The World Organisation for Animal Health (OIE)

Prevention and control of animal diseases worldwide

Economic analysis – Prevention versus outbreak costs

Final Report
Part I

Submitted by:
Civic Consulting - Agra CEAS Consulting

Part I prepared by Agra CEAS Consulting

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September 2007

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List of acronyms

ACIAR:	Australian Centre for International Agricultural Research
ADB:	Asian Development Bank
AH:	Animal Health
AHI:	Avian and Human Pandemic Influenza
AHIF:	Avian and Human Influenza Facility
AI:	Avian Influenza
ALIVE:	ALive Platform, Partnership for Livestock Development, Poverty Alleviation & Sustainable Growth in Africa
ANSVA:	National Sanitary Veterinary and Food Safety Authority (Romania)
APL:	Adaptable Program Loan
ASEAN:	Association of Southeast Asian Nations
ASF:	African Swine Fever
AUIBAR:	African Union Inter-African Bureau of Animal Resources
AusAID:	Australian Government's overseas aid program
AUSVETPLAN:	Australian Veterinary plan
BIPs:	Border Inspection Posts
BSE:	Bovine Spongiform Encephalopathy
CAECC:	Central Anti-Epizootic Command Centre (Romania)
CBA:	Cost-Benefit Analysis
CBPP:	Contagious Bovine Pleuropneumonia
COHEFA:	Hemispheric Committee for the Eradication of Foot-and-Mouth Disease
CS:	Current Situation
CSF:	Classical Swine Fever
DALYs:	Disability Adjusted Life Years
DEFRA:	Department for Environment, Food and Rural Affairs (UK)
EC:	European Commission
ECTAD:	Emergency Centre for Transboundary Animal Disease Operations
EFSA:	European Food Safety Authority
EIU:	Economist Intelligence Unit
EMPRES:	(FAO) Emergency Prevention System
EU MS:	European Union Member States
EU:	European Union
EUR:	Euro (currency)
FAO:	Food and Agriculture Organisation of the United Nations
FAOSTAT:	Statistical Databases from the Food and Agriculture Organization
FDL&PCS:	Nigeria Federal Department of Livestock and Pest Control Services
FMD:	Foot-and-Mouth disease
FVO:	European Commission Food and Veterinary Office
GDLN:	Global Development Learning Network
GDP:	Gross Domestic Product
GEIFA:	Inter-American group for FMD eradication
GF-TADs:	(OIE/FAO) Global Framework for Transboundary Animal Diseases
GLEWS:	(FAO/OIE/WHO) Global Early Warning System
GPAI:	Global Program for Avian Influenza Control and Human Pandemic Preparedness and Response
GREP:	Global Plan for the Eradication of Rinderpest

H5N1	Haemagglutinin type 5; Neuraminidase subtype 1 (Influenza Virus)
HCMC:	Ho Chi Min City
HDI:	Human Development Index
HPAI:	Highly Pathogenic Avian Influenza
IAEA:	International Atomic Energy Agency
IDAH:	Institute for Diagnosis and Animal Health (Romania)
IFPRI:	International Food Policy Research Institute
IMF:	International Monetary Fund
IS:	Improved Situation
IVHPH:	Institute for Veterinary Hygiene and Public Health (Romania)
LDCs:	Least Developed Countries
MAFRD:	Ministry of Agriculture, Forestry and Rural Development
MAP:	Multi-country Adaptable Program Loan
MARD:	Ministry of Agriculture and Rural Development
MDGs:	Millennium Development Goals
MTM:	Malaysia-Thailand-Myanmar
N:	Nigerian Naria (currency)
NADIS:	National Animal Disease Surveillance System (Nigeria)
NEEDs:	National Economic Empowerment and Development Strategy
NLPD:	National Livestock Project Division
NPV:	Net Present Value
NRL:	National Reference Laboratory
NSCAI:	National Steering Committee for the Prevention and Control of Avian Influenza (Vietnam)
NVRI:	National Veterinary Research Institute (Nigeria)
OAS:	Organization of American States
OAU:	Organisation of African Unity
OECD:	Organisation for Economic Co-operation and Development
OFFLU:	OIE/FAO Network on Avian Influenza
OIE:	World Organisation for Animal Health
OPI:	Integrated Operational Program for Avian and Human Influenza
PACE:	Pan African Programme for the Control of Epizootics
PAHO:	Pan American Health Organisation
PAN:	Nigerian Poultry Association
PANAFTOSA:	Pan American Foot-and-Mouth Disease Centre
PARC:	Pan African Rinderpest Campaign
PCR:	Polymerase Chain Reaction
PHEFA:	Hemispheric Program for FMD eradication
PPLPI:	Pro-Poor Livestock Policy Initiatives
PPR:	Peste de Petits Ruminants
PVS:	(OIE) Performance, Vision and Strategy: A Tool for Veterinary Services
RCU:	Regional Coordination Unit for FMD in South-East Asia
RON:	Romanian currency
SANCO:	European Commission Health and Consumer Protection
SARS:	Severe Acute Respiratory Syndrome
SE Asia:	South East Asia
SEAFMD:	Sub-commission for FMD control in South-East Asia
SENASA:	National service of livestock, plant health and food security (Argentina)

SOPs:	Standard Operating Procedures
SPS:	Sanitary and Phytosanitary
STDF:	Standards and Trade Development Facility of the WTO
STM:	(FAO/OECD) Short Term commodity Model
TADs:	Transboundary Animal Diseases
TCP:	FAO Technical Cooperation Programme
TRYM:	Treasury macro econometric model
UK:	United Kingdom
UN:	United Nations
UNDP:	United Nations Development Programme
UNSIC:	United Nations System Influenza Co-ordinator
URAA:	Uruguay Round Agreement on Agriculture
US:	United States of America
USD:	United States Dollar (currency)
USDA	United States Department of Agriculture
VLUs:	Veterinary Livestock Units
VND:	Vietnam currency
VS:	Veterinary Services
VSF:	Vétérinaires Sans Frontières
VTHs:	Veterinary Teaching Hospitals (Nigeria)
WAHID:	(OIE) World Animal Health Information Database
WANSCA:	West African Network for the promotion of Short Cycle Animals in rural areas
WB:	World Bank
WHO:	World Health Organization
WTO:	World Trade Organisation
YLDs:	Years of life lived with disability
YLLs:	Years of life lost

Acknowledgements

This analysis would not have been possible without the support of a number of organisations and information sources, including the World Organisation for Animal Health (OIE), the Food and Agriculture Organization (FAO), AU-IBAR, the UNDP, and competent national authorities in the case study countries. We also would like to thank organisations, such as *Agronomes et Vétérinaires Sans Frontières*, the European Commission (EC), the French National Institute of Agriculture Research (INRA), the Organisation for Economic Co-operation and Development (OECD) and the World Bank, which have authorized several of their experts to review the draft reports in depth. We would like to express our gratitude to these experts that provided very helpful written comments.[1] We also would like to thank Alain Dehove of the OIE and François Le Gall of the World Bank for the support and guidance provided throughout the study.

[1] Participants in the peer-review process were asked to provide their expert opinion, without necessarily expressing the view of their organisation.

Executive Summary

Timing and methodology used

This study was conducted by Agra CEAS Consulting Ltd in the period November 2006 to March 2007 with some further updating in September 2007. The work was undertaken using desk research, literature review and construction of a detailed and extensive literature database. It also involved consultations with key relevant institutions/authorities and experts and case studies in 4 countries: Argentina, Vietnam, Nigeria and Romania. Finally a model to provide detailed estimates of the costs of outbreaks (by types of direct and indirect impact) with application to the particular case of HPAI was developed. This enabled the comparison of prevention versus outbreaks costs, so as to derive conclusions on the relative costs and benefits of improving the prevention and control systems in the animal health field.

Study focus

The focus of this project has been on Transboundary Animal Diseases (TADs), particularly those with high zoonotic potential. Transboundary animal diseases, in the context of this project, are defined as those that are of significant economic, trade and/or food security importance for a considerable number of countries, which can easily spread to other countries and reach epidemic proportions and where control/management, including exclusion, requires co-operation between several countries. The occurrence of such diseases and their control and eradication poses significant challenges for the world's Veterinary Services (VS) and entails substantial socio-economic costs, especially in the context of developing countries' poverty alleviation and development objectives. In addition, many of these diseases have high public health relevance and have become virtually endemic in many parts of the developing world. Due to both its high public health relevance and its significant socio-economic implications, the particular focus of this work has been on Highly Pathogenic Avian Influenza (HPAI). Foot and Mouth Disease (FMD) which has had extensive socio-economic impacts wherever it has occurred and has attracted significant control and eradication efforts and resources is also particularly addressed. The study covers the 132 developing country members of the OIE.

The definition of prevention and control costs, outbreak costs and what would be the benefits of improved prevention and control systems is based on a review of literature, taking the examples of prevention and control strategies currently in place (in particular for HPAI and FMD). The costs of prevention and control include emergency preparedness, human resources, surveillance systems and vaccination. Disease outbreak costs are broken down into direct cost and losses in the form of direct production costs of various kinds as well as control costs and indirect impacts in terms of ripple and spill-over effects as well as impacts on wider society. The review and assessment of the various costs involved in prevention and in the event of disease outbreak are outlined in detail by type of costs.

Conclusions and model results

The review of the literature indicates clearly that when a comparison of prevention versus outbreak costs is made, the majority of the reviewed studies conclude that the significant benefits that accrue from improved prevention and control measures outweigh the cost of investment. Thus, for example, in Latin America investment in improvements to animal health of some additional US$ 157 million per year over

15 years generates a Net Present Value of US$ 1.9 billion. In Africa it has been estimated that an investment of Euro 14.7 to control CBPP could save Euro 30 million in losses from morbidity/mortality, leading to a net benefit of Euro 15.4 million and in Asia eradication programmes for FMD have been assessed to provide benefits in terms of improved trade and market access that are worth several times the investment. While specific results need to be treated with caution and clearly depend on what underlying assumptions are made and the methodological tools used (it is noted that the analysis which can be defined as a full classical cost benefit analysis is relatively limited in this field), the nature of the relationship between outbreak costs compared to the costs of prevention is indisputable and is validated by the four case studies on this issue which were undertaken for Argentina, Vietnam, Nigeria and Romania.

Drawing on this analysis the report provides a global overview of prevention costs versus outbreak costs for HPAI using a specific analytical tool incorporating a baseline, scenarios and assumptions on key parameters from which to estimate the detailed direct and indirect costs of a disease outbreak.

At a country level the "most likely", "low impact" and "high impact" scenarios vary in terms of the duration of the impact of the epidemic and the intensity of disease spread within countries. At a global level the three scenarios used are formulated on the basis of the geographical coverage of the disease worldwide, with scenario A including only H5N1 infected countries, scenario B infected and 'non infected at immediate risk' countries, and scenario C all developing/transition countries that are members of the OIE.

The range of outcomes in relation to **direct costs and losses** under the different scenarios are as follows:

The results for scenarios A and B tend to be very similar, reflecting the relatively small number of countries added under scenario B, given the current state of HPAI outbreaks worldwide. If this position changes, with a more substantial geographical spread of the disease, then the impact would start moving closer to the substantially higher figures of scenario C. Thus, total direct costs and losses (excluding consequential on-farm losses) in scenarios A and B are estimated at US$ 5.3 billion and US$ 6.1 billion respectively (on an annual basis), but would rise up to US$ 9.7 billion if the disease were to spread throughout the developing world. Including consequential on-farm losses, the total direct impact would be US$ 11.7 billion and US$ 13.5 billion respectively in the case of scenarios A and B, but could rise up to US$ 21.3 billion if the disease was to spread more worldwide along the lines suggested by scenario C. It is noted that in all cases, the impact is not proportionate to the number of countries added under each scenario, because the countries of scenarios A and B account for 55% and 63% respectively of the poultry stock of all developing OIE country members.

The various **indirect costs** in the event of an HPAI outbreak have been estimated as a range between 3 possible outcomes from the 3 main scenarios ('most likely', 'low impact' and 'high impact'). Global estimates of the indirect impact under the 'most likely scenario' are presented on an annual basis and in total terms (i.e. depending on the duration of the impact of the epidemic). Under the 'most likely' scenario, ripple costs are estimated at US$ 5.3 billion in terms of domestic market losses in the poultry sector and a further US$ 3.8 billion in terms of export market losses on an annual basis. Assuming a 2 year duration of impact, as is currently the case under the 'most likely' scenario based on real market baseline trends, the total ripple impact in terms of domestic and export market losses in the poultry sector would be double the above amounts (i.e. to US$ 10.6 billion and US$ 7.5 billion respectively).

The considerable extent to which the relative value of spill-over (tourism) and wider society (human pandemic) costs outweigh the ripple effects is also highlighted. In the case of spill-over effects in the tourism sector alone, these are estimated to amount to US$ 72 billion on an annual basis under the 'most likely' scenario and double that amount assuming a 2-year duration of the impact (i.e. US$ 144 billion). Wider society costs, in the event of a human pandemic, are several multiples of all costs, and depending on the severity of the outbreak these are estimated at US$ 311.2 billion (at 15% attack rate), and at US$ 711.2 billion (at a 35% attack rate) on an annual basis alone. It should be noted that these costs exclude certain types of indirect impacts for which it has not been possible to provide estimates on a global scale. Such impacts include ripple effects on upstream/downstream industries (raw material suppliers, catering and distribution, wholesale markets, employment in the sector etc.), spill-over effects (e.g. on the services industry) and other wider society costs (e.g. environmental effects).

In conclusion it is important to note that the aim here has been to develop a flexible tool, rather than solely providing estimates as such. This means that the baseline, the assumptions and the scenarios can be improved/refined at any point in time, as further research and evidence on a disease impact becomes available. This tool allows a flexible approach, which highlights the relative importance of the various direct and indirect impacts, so as to provide direction to policy-making in this field.

It should also be noted that in this study this tool has been developed specifically for the case of HPAI, but it has the potential to be adapted for application in the case of other TADs such as FMD.

The report in brief

Timing and methodology used

The work on Part I of this project was conducted by Agra CEAS Consulting Ltd in the period November 2006 to March 2007 with some further updating in September 2007. The work was undertaken using desk research, a literature review and construction of a detailed and extensive literature database. It also involved consultations with key relevant institutions/authorities and experts and case studies in 4 countries: Argentina, Vietnam, Nigeria and Romania. Finally a modelling tool to provide detailed estimates of the costs of outbreaks (by types of direct and indirect impact) with application to the particular case of HPAI was developed. This enabled the comparison of prevention versus outbreaks costs, so as to derive conclusions on the relative costs and benefits of improving the prevention and control systems in the animal health field.

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The focus of this project has been on Transboundary Animal Diseases (TADs), particularly those with high zoonotic potential. Transboundary animal diseases, in the context of this project, are defined as those that are of significant economic, trade and/or food security importance for a considerable number of countries, which can easily spread to other countries and reach epidemic proportions and where control/management, including exclusion, requires co-operation between several countries. The occurrence of such diseases and their control and eradication poses significant challenges for the world's Veterinary Services (VS) and entails substantial socio-economic costs, especially in the context of developing countries' poverty alleviation and development objectives. In addition, many of these diseases have high public health relevance and have become virtually endemic in many parts of the developing world. As it has high public health relevance and significant socio-economic implications the particular focus of this work is on Highly Pathogenic Avian Influenza (HPAI**).** Foot and Mouth Disease (FMD) which has had extensive socio-economic impacts wherever it has occurred and has attracted significant control and eradication efforts and resources is also particularly addressed. The study covers the 132 developing country members of the OIE.

Analysis steps

Classification and definitions

The study starts with a classification of the countries (by GDP, trade status) and the nature of the farming systems in place (commercial, back yard), to highlight the importance of these factors in defining the appropriate prevention and control strategies and in establishing the impact of animal diseases.

A review of the current prevention and control strategies in place, in particular for HPAI and FMD, provides the basis for the definition of prevention and control costs, outbreak costs and what would be the benefits of improved prevention and control systems.

For the purposes of the analysis, **prevention and control costs** have been defined as the costs incurred by governments during 'normal' times, i.e. in advance of outbreaks. In particular, these include:

- Emergency preparedness, in terms in particular of the existence of emergency preparedness plans and the state of VS more generally,
- Surveillance networks, in terms in particular of diagnostic capacity and border controls.

For the definition of **outbreak costs** a differentiation was made between direct costs and losses, and the various indirect costs and indirect losses as follows:

A. Direct impact

The total direct cost of a disease is the sum of the production losses (direct and consequential) and the costs of disease control, as follows:

- **Direct losses:** These stem either from the disease itself, or from sanitary control measures (stamping-out policies). In addition to the loss from the value of animals culled as such, there are culling and disposal costs.
- **Control costs: S**uch costs during and after the outbreak typically include equipment, facilities, disinfectants, protective clothing, staff in quarantine stations etc. They may also include (ring) vaccination where this is considered appropriate and is available.
- **Other direct production losses**: Consequential on-farm losses include losses due to the fall in stock, to restrictions of movement when zoning restrictions are put in place, and due to the loss in animal value.

B. Indirect impact

The indirect impact of livestock diseases includes ripple effects, spill-over effects and costs to the wider society including longer term macro-economic effects. These costs are defined as follows:

- **Ripple effects:** Ripple effects include impacts on livestock and livestock product prices and on upstream and downstream activities along the livestock value chain upstream and the producer: breeding, feed production, input supply, production, collection and trade (of eggs or live birds), slaughter, processing, final sale and consumption.
- **Spill-over effects:** Apart from agriculture as such and the impact of diseases along the affected livestock sector's value chain, tourism and services are the two other sectors most likely to be severely affected. The macro-economic impact can consequently be severe if these two sectors are important in the economy. In addition, as already indicated, animal diseases can have major effects on food availability and quality for poor communities and therefore raise issues of food security, as well as having negative effects on poverty alleviation.
- **Wider society:** Developing or transition countries, which tend to have inadequate/inefficient public health systems, are particularly exposed to the risk of zoonoses on public health. In the particular case of a pandemic, a large proportion of the economic losses are caused by higher morbidity and mortality rates in the human population and by its repercussions on the world economy.

On the other hand, three main **benefits** of improved prevention are most widely explored in the available literature. These are as follows:

1. **Enhanced food security / poverty alleviation.** This includes the benefits accrued from productivity improvements and generally improved production systems.
2. **Improved market access**
3. **Savings in potential outbreak costs**

In terms of the first objective, it is important to note that an estimated 600 million poor people worldwide rely directly on livestock production for their livelihoods. Several parts of the developing world, most notably sub-Saharan Africa, are still below the recommended protein diet levels and only get a fraction of the daily livestock protein intake of industrialised countries. In addition, each year the population of developing countries grows by an estimated 72 million, with the highest growth rates in Africa and in Asia, adding to the demand for food products. Average annual per capita consumption of all meats in the developed world is thus projected to increase to 30 kg, which represents an increase by about a third on 1993 levels. Improved animal health not only guarantees food supplies but is also considered to be a major factor for productivity gains in the livestock sector.

In terms of the second objective, trade in livestock and livestock products makes up approximately one sixth of global agricultural trade. Most of these exports (nearly 80%) currently come from the developed world. For example, the least developed countries are estimated to account for only less than 5% of total world meat exports by value. Within this overall picture only a few countries account for the bulk of exports: 90 % of exports of beef and poultry (70% for pork) come from 5 countries. This having been said, it is widely acknowledged in the available literature that big gains are possible for the developing countries from the removal of sanitary barriers now that post URAA tariff barriers have been reduced and that these opportunities are likely to expand if tariff barriers are further reduced in the ongoing WTO and bilateral negotiations. Within this evolving policy outlook, the improvement in SPS conditions for developing country exporters or potential exporters has become an issue of utmost importance (as well as being an obligation under the WTO SPS Agreement).

Literature review

This definitional work was followed by an extensive review of the literature on the costs of prevention and control including emergency preparedness, human resources, surveillance systems and vaccination. In this context the study comes to the following conclusions on the relevance of country preparedness to prevention and control costs:

- The costs of improved prevention and control for the major TADs will depend *inter alia* on the current level of preparedness in the various countries;

- Existing data from international surveys (OIE, UNSIC) and other literature suggest that there are considerable differences in approach and status quo between developing/transition countries, notably in terms of the overall state of Veterinary Services, preparation of prevention and control plans for specific diseases (e.g. HPAI), available and well-trained veterinary staff, epidemio-surveillance networks, border controls, diagnostic capacity, and vaccination;

- In the context of countries' international obligations within the overall framework for the prevention and control of major TADs, as defined by the OIE, the varying levels of preparedness and prevention systems between countries indicate the need to define priorities and assess gaps on a country by country basis. In the case of vaccination the policy debate on the appropriateness and conditions for application of this method is currently on-going;

- This has implications in terms of the budget required in each country to enable it to arrive to an optimal surveillance system.

The literature review also indicates clearly that when a comparison of prevention versus outbreak costs is made, and it must be said that there is relatively little analysis which can be defined as a full classical cost benefit analysis, the majority of the studies reviewed studies conclude that the significant benefits that accrue from improved prevention and control measures outweigh the cost of investment. Thus for example, in Latin America investment in improvements to animal health of some additional US$ 157 million per year over 15 years generates a Net Present Value of US$ 1.9 billion. In Africa it has been estimated that an investment of Euro 14.7 to control CBPP could save Euro 30 million in losses from morbidity/mortality, leading to a net benefit of Euro 15.4 million and in Asia eradication programmes for FMD have been assessed to provide benefits in terms of improved trade and market access that are worth several times the investment. While specific results need to be treated with caution and clearly depend on what underlying assumptions are used the nature of the relationship between outbreak costs compared to the costs of prevention is indisputable and is validated by the four case studies which were undertaken.

Case study results[2]

Argentina:

The FMD campaign undertaken in South America during 1999-2004 has demonstrated the value of regional action when the control of TADs of major economic importance to the region is being sought. It also demonstrates the significance of maintaining the investment when pockets of resistance remain which risk to erupt to full blown outbreaks in countries of the region. Some US$ 3.5 billion have been committed on the fight against FMD by South American countries during 1990-2004, which is considered to have contributed to an effective control of the disease during this period. Against this, in the space of only a year, the 2000/01 FMD outbreak in Argentina has resulted to losses in beef export revenue alone of US$ 439 million.

Preliminary results of on-going cost-benefit analysis of improvements in Argentina's and wider Latin American VS (OIE Regional Representation/CEMA) suggest that there are significant benefits in terms of both productivity gains and potential trade gains from investing in such improvements, and that the final outcome in terms of NPV and welfare gains justifies the investment. For example, increased expenditure

[2] *The benefits highlighted in the case studies assume that a certain investment will result in productivity gains and exports. The scale of the benefit is conditional on the effective design and implementation of the investment to be undertaken, leading to an effective control of the disease (eradication is questionable as there is a significant risk factor that the disease would re-appear, as has been the general experience. The above calculations do not take into account the incremental operational costs involved, which can be a significant part of the cost of strengthening VS. On the other hand, the investment in strengthening the control of a particular disease, e.g. HPAI, can have important spill-over benefits on the entire VS.*

of some US$ 18 million in Argentina's VS would result in productivity gains of US$ 20 million per year, and additional annual exports of 260.000 tonnes.

Vietnam:

The country suffers from a number of high risk factors with respect to HPAI. Consequently the government has committed significant national resources (including donor support) to the fight against avian influenza and for the prevention of a human pandemic. This has included extensive restructuring in the VS since the 2004-05 AI outbreaks, although there is little information to date on whether this has resulted in improvements that can effectively prevent/control future outbreaks (a recently concluded PVS evaluation is bound to shed more light on this). Our analysis and comparisons of data on the committed national budgets for 2006-10 under the Operational Programme for avian influenza (animal health component) against real and projected costs of the outbreaks reveal the relative scale of the costs and benefits involved. These conclusions are supported by other work reviewed from available literature. For example:

- The total commitment on animal health under the 2006-10 OPI (excluding control costs in the event of an outbreak) comes to some US$ 70 million for the 5 year period, while the total direct and indirect costs from the outbreak in 2004 alone is (conservatively) estimated at US$ 300 million.

- Investing in disease investigation and strengthening VS over the same period would cost public coffers a total US$ 30 million, compared to total direct production costs and losses during the 2004-05 outbreak of US$ 62 million a year and excluding consequential on-farm losses.

- Adding consequential losses, our projections of the total direct impact under the most likely scenario (which is milder than the 2004-05 epidemics) come to US$ 115 million a year.

In a country where two thirds of the production is run by small holder systems and over two thirds of farms keep poultry, this analysis also demonstrates the potential benefits of improved prevention in terms of social equity and poverty alleviation (and even food security). Relatively the largest direct losses were felt by small scale, often indebted, commercial chicken producers, while Vietnam's millions of farm households with small numbers of poultry were also affected. Against this, investment in bio-security is estimated to require at least US$ 500 million for minimum improvements in the next 10 years, a cost prohibitive to small rural farmers.

Nigeria

The experience of Nigeria in this area is relatively more recent and more limited compared to Vietnam. However, both the government and international community are concerned of the potential risks and ramifications of these outbreaks in the context of the extensive presence of rural/urban backyard farming, relatively weak biosecurity, and the socio-economic importance of the sector.

Our analysis and comparisons of data on the planned commitments for 2006-10 under the WB integrated plan for the control and eradication of avian influenza as well as under the ALIVE needs assessment for Nigeria, against real and projected costs of the outbreaks, reveal the relative scale of the costs and benefits involved. For example:

- The total commitment on animal health under the 2006-10 WB plan (excluding control costs in the event of an outbreak) comes to some US$ 22.6 million for the 5 year period (or an average US$ 4.5 million per year), while the direct costs from the outbreak in part of last year alone is (conservatively) estimated at US$ 8.4 million and excluding consequential on-farm losses.

- Investing in strengthening disease surveillance and veterinary quarantine would cost a total US$ 10 million over the same period, or US$ 2 million a year which is less than 25% of the above conservative estimate.

- The relative scale of this investment is even more evident when adding consequential losses, with our projections of the total direct impact under the most likely scenario (which is milder than the 2006 epidemic) reaching US$ 113 million a year.

In a country where two thirds of the official (registered) production is run by small holder systems and poultry rearing is central to the survival of poor rural and urban communities, this analysis also demonstrates the potential benefits of improved prevention in terms of poverty alleviation and food security.

Romania

The country's VS have undergone significant restructuring and upgrading in the run up to EU accession (Romania became an EU member on 1 January 2007). Having suffered a large number of outbreaks since 2004, this country was relatively recently declared HPAI-free.

Our analysis and comparisons of data on the planned commitments for 2006-09 under the WB integrated plan for the control and eradication of avian influenza, against real and projected costs of the outbreaks, reveal the relative scale of the costs and benefits involved, and the interest in investing further in improved structures and surveillance systems. For example:

- The total commitment on animal health under the 2006-09 WB plan (excluding control costs in the event of an outbreak) comes to some US$ 12.6 million for the 3 year period (or an average US$ 4.2 million per year), while the direct costs from the outbreak in the six months of 2005-06 outbreak alone were estimated at US$ 67.6 million, excluding consequential on-farm losses (Figure 15).

- Investing in strengthening disease surveillance and diagnostics would cost a total US$ 11 million over the same period, or US$ 3.6 million a year which is less than 0.5% of the above conservative estimate.

- The relative scale of this investment is even more evident when adding some ripple and spill-over effects, bringing the total impact at some US$ 211.6 million, as a consequence of the effects of the October 2005 to May 2006 outbreak.

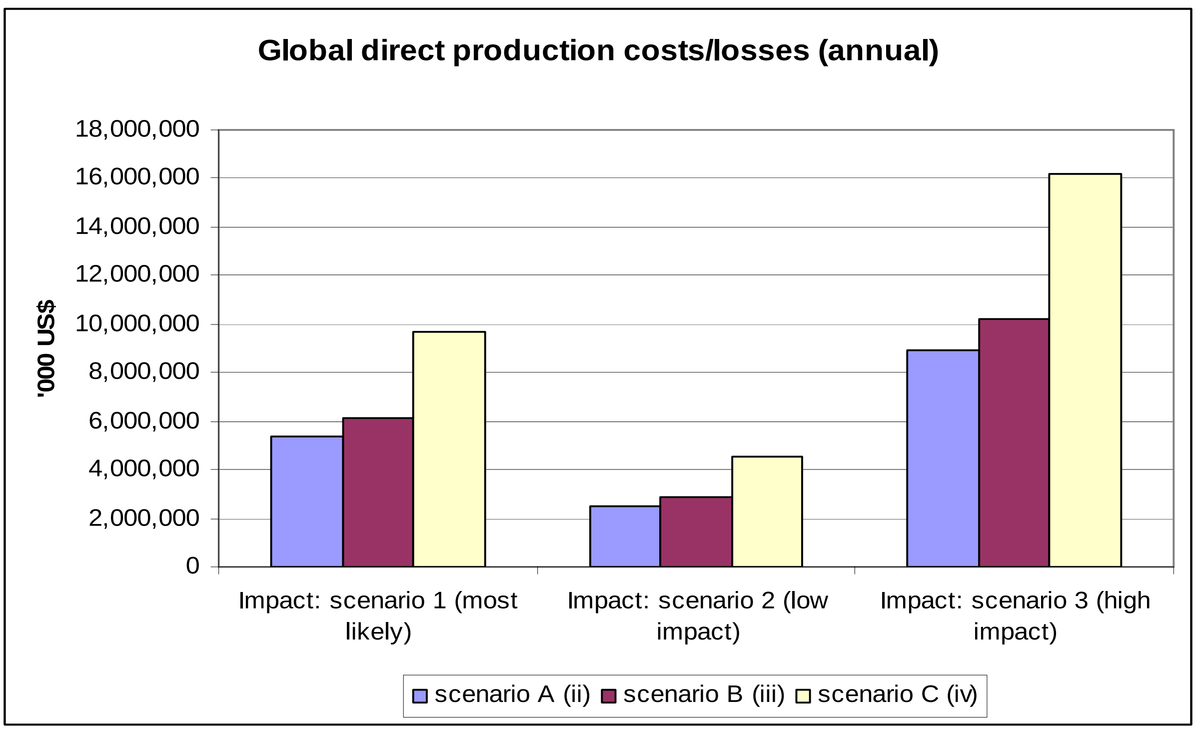
Modelling of prevention costs versus outbreak costs

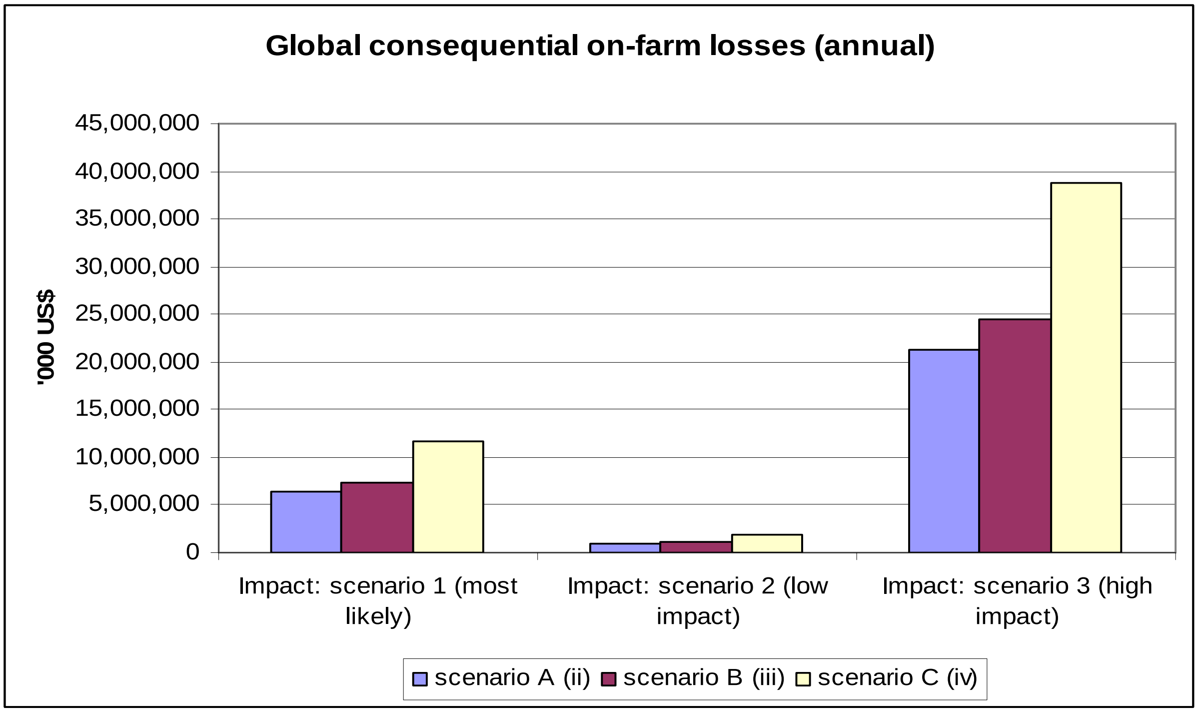
Drawing on the analysis undertaken in the previous steps, the study provides a global overview of prevention costs versus outbreak costs for HPAI by developing a specific analytical tool incorporating a baseline, scenarios and assumptions on key parameters from which to estimate the detailed direct and indirect costs of a disease outbreak.

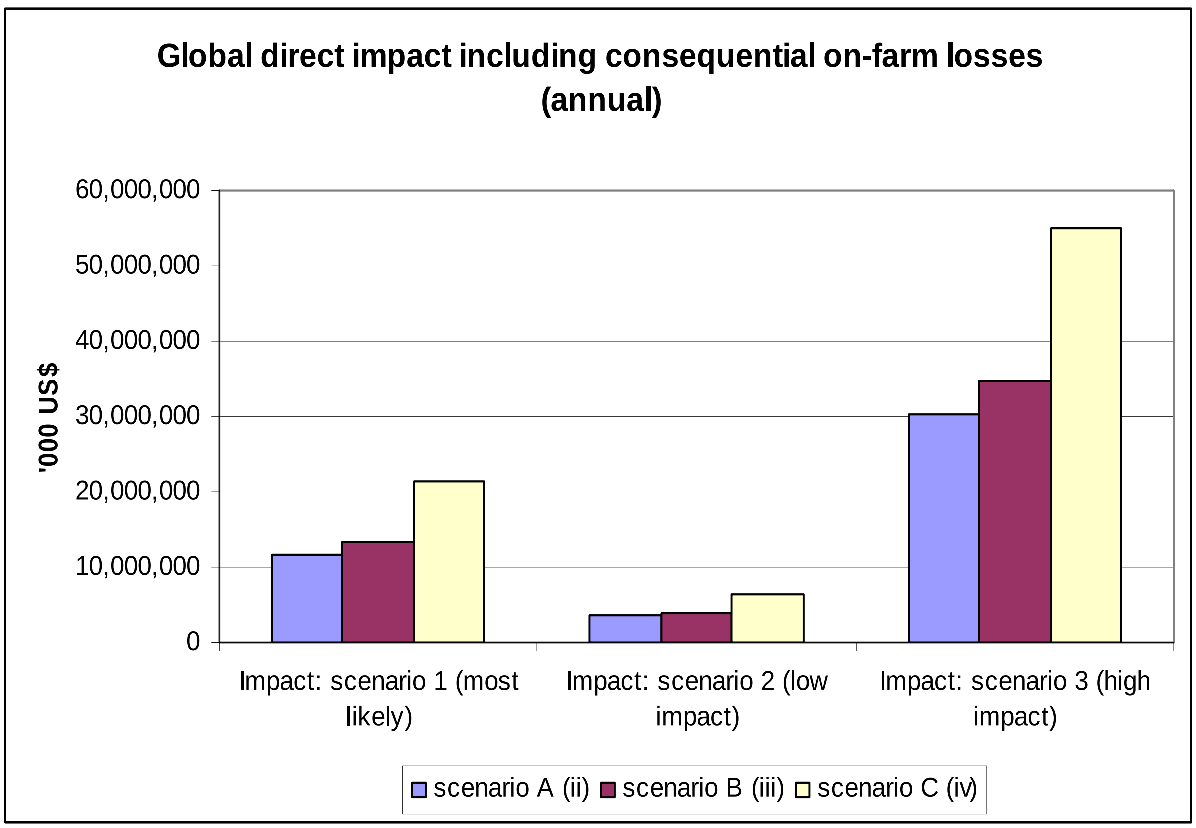
At a country level the "most likely", "low impact" and "high impact" scenarios vary in terms of the duration of the impact of the epidemic and the intensity of disease spread within countries. At a global level the three scenarios used are formulated on the basis of the geographical coverage of the disease worldwide, with scenario A including only H5N1 infected countries, scenario B infected and 'non infected at immediate risk' countries, and scenario C all developing/transition countries that are members of the OIE.

The range of outcomes in relation to **direct costs and losses** under the different scenarios are indicated in **Figure A**. The results for scenarios A and B tend to be very similar, reflecting the relatively small number of countries added under scenario B, given the current state of HPAI outbreaks worldwide. If this position changes, with a more substantial geographical spread of the disease, the impact would start moving closer to the substantially higher figures of scenario C. Thus, total direct costs and losses (excluding consequential on-farm losses) in scenarios A and B are estimated at US$ 5.3 billion and US$ 6.1 billion respectively (on an annual basis), but would rise up to US$ 9.7 billion if the disease were to spread throughout the developing world. Including consequential on-farm losses, the total direct impact would be US$ 11.7 billion and US$ 13.5 billion respectively in the case of scenarios A and B, but could rise up to US$ 21.3 billion if the disease was to spread more worldwide along the lines suggested by scenario C.

Figure A: Overview of estimated direct impacts under the different scenarios, HPAI (i)




Global consequential on-farm losses (annual)
'000 US$
45,000,000
40,000,000
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
Impact: scenario 1 (most likely)
Impact: scenario 2 (low impact)
Impact: scenario 3 (high impact)
scenario A (ii)
scenario B (iii)
scenario C (iv)


Global direct impact including consequential on-farm losses (annual)
'000 US$
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
Impact: scenario 1 (most likely)
Impact: scenario 2 (low impact)
Impact: scenario 3 (high impact)
scenario A (ii)
scenario B (iii)
scenario C (iv)

<u>*Notes:*</u>
(i) Includes animal value losses, culling/disposal and control costs
(ii) Scenario A includes the following countries: Cambodia, China, Indonesia, Laos, Thailand, Vietnam, S. Korea; Mongolia, Kazakhstan, Russia, Turkey, Romania; Nigeria, Niger, Sudan
(iii) Scenario B includes the countries of scenario A plus: N Korea, Malaysia, Brunei, Myanmar, Singapore, Philippines; Bangladesh, Bhutan, India, Nepal, Sri Lanka
(iv) Scenario C includes all developing/transition countries, members of the OIE (132 countries in total)

Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

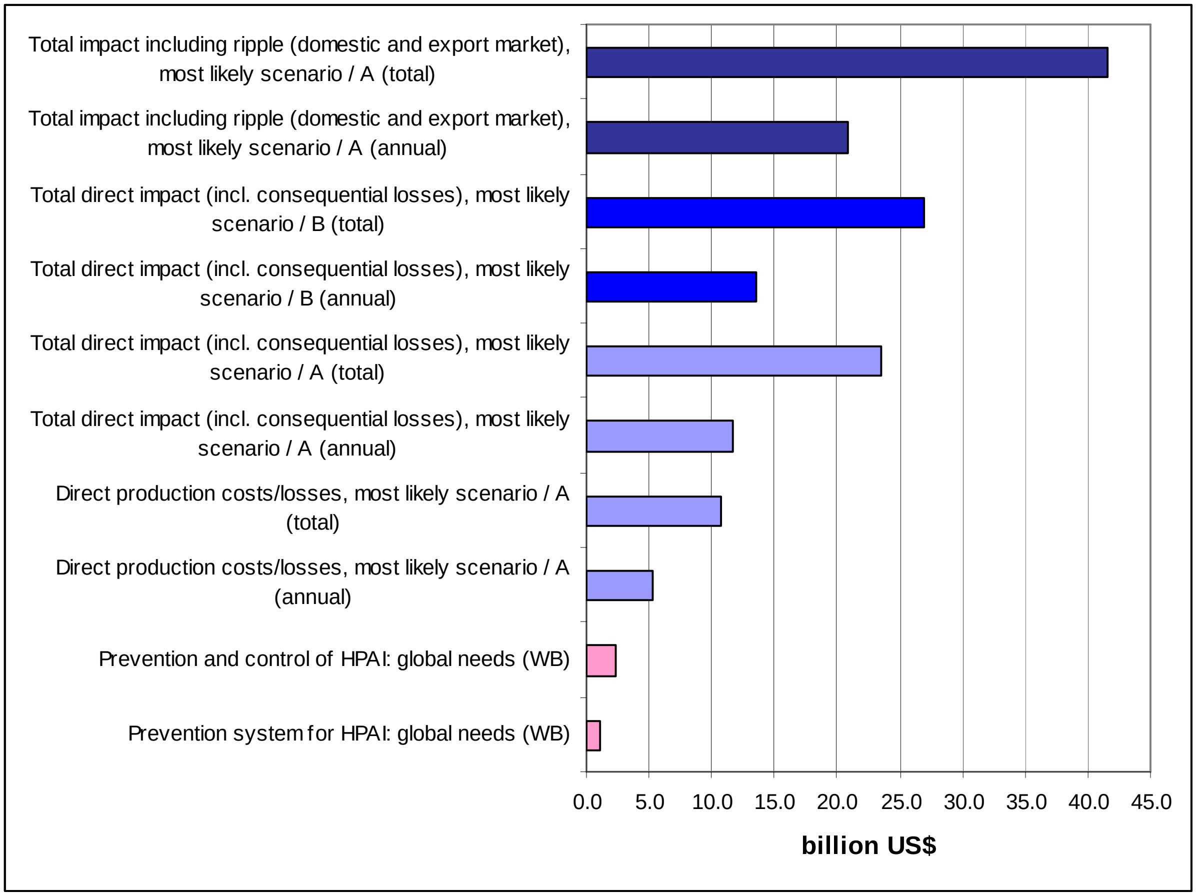
The various **indirect costs** in the event of an HPAI outbreak have been estimated as a range between 3 possible outcomes from the 3 main scenarios ('most likely', 'low impact' and 'high impact'). Global estimates of the indirect impact under the 'most likely scenario' are presented on an annual basis and in total terms (i.e. depending on the duration of the impact of the epidemic). Under the 'most likely' scenario, ripple costs are estimated at US$ 5.3 billion in terms of domestic market losses in the poultry sector and a further US$ 3.8 billion in terms of export market losses on an annual basis. Assuming a 2 year duration of impact, as is currently the case under the 'most likely' scenario based on real market baseline trends, the total ripple impact in terms of domestic and export market losses in the poultry sector would be double the above amounts (i.e. to US$ 10.6 billion and US$ 7.5 billion respectively).

The considerable extent to which the relative value of **spill-over** (tourism) and **wider society (human pandemic) costs** outweigh the ripple effects is also highlighted. In the case of spill-over effects in the tourism sector alone, these are estimated to amount to US$ 72 billion on an annual basis under the 'most likely' scenario and double that amount assuming a 2 year duration of the impact (i.e. US$ 144 billion). Wider society costs, in the event of a human pandemic, are several multiples of all costs, and depending on the severity of the outbreak these are estimated at US$ 311.2 billion (at a 15% attack rate), and at US$ 711.2 billion (at a 35% attack rate) on an annual basis alone. It should be noted that these costs are the minimum expected outcomes, as they exclude certain types of indirect impacts for which it has not been possible to provide estimates on a global scale. Such impacts include ripple effects on upstream/downstream industries (raw material suppliers, catering and distribution, wholesale markets, employment in the sector etc.), spill-over effects (e.g. on the services industry) and other wider society costs (e.g. environmental effects).

In this context it is noted that the aim of this study has been to develop a flexible tool, rather than solely providing estimates. This means that the baseline, the assumptions and the scenarios can be improved/refined at any point in time, as further research and evidence on a disease impact becomes available. This tool allows a flexible approach, which highlights the relative importance of the various direct and indirect impacts, so as to provide direction to policy-making in this field. It should also be noted that in this report this tool has been developed specifically for the case of HPAI, but it has the potential to be adapted for application in the case of other TADs such as FMD.

Comparing the global cost of prevention and preparedness with that of an outbreak in the case of HPAI, the most recent global needs assessments of prevention and response to HPAI suggest that some US$ 2.27 billion would be required over a 3-year period. Of this amount, prevention and preparedness costs as such account for just over US$ 1 billion. Against this assessment, outbreak costs under the 'most likely' scenario and for H5N1 countries only are estimated at US$ 5.34 billion per year for the direct production costs and losses alone (excluding consequential losses) (**Figure B**). Adding consequential on-farm losses, the total direct impact comes to US$ 11.75 billion per year. Assuming the impact of an outbreak spread over a period of 2 years ('most likely scenario') the total direct impacts would be US$ 10.7 billion excluding consequential on-farm losses and US$ 23.5 billion if these losses are included. Moving towards scenarios B and C these costs increase further to US$ 12.3 billion and US$ 26.9 billion respectively (in the case of scenario B) and to US$ 19.4 billion and US$ 42.7 billion respectively (in the case of scenario C). Before even considering the indirect impacts the benefits of improved prevention therefore by far outweigh the potential outbreak costs and losses.

Figure B: Prevention versus outbreak costs: comparison under various scenarios, HPAI



<u>Notes</u>:
HPAI global needs figures are totals over a 3 year period;
Incremental operational costs (a significant part of the total costs of strengthening VS) are excluded from these calculations, due to lack of data;
Outbreak costs are quoted in annual and total amounts (total here refers to the duration of the impact, which is assumed to last for 2 years in the most likely scenario).

Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

The report concludes by noting that it is difficult to predict the severity of the threats posed by Transboundary Animal Diseases (TADs). Moreover, different issues arise depending on the nature of the disease. A disease such as HPAI, with its high public health relevance, poses a different set of challenges than a disease such as FMD which has purely commercial and socio-economic implications. Both diseases, however, have the potential to lead to substantial and even devastating consequences in terms of increased poverty, decreases in food security and social equity/stability in developing/transition countries.

At the same time, the current state of Veterinary Services (VS) and preparedness levels in developing/transition countries pose a real and present threat to the prevention and control of TADs. As is demonstrated in the case studies and from the literature review, the various identified weaknesses essentially revolve around the key issue of the lack of funds and/or poor governance. Within a weaker economic environment and while these countries are struggling to catch up with the rest of the world, it is evident that VS have not been – more importantly have not consistently been – a priority in the use of relatively constrained public funds. Today more than ever, with increasing globalisation, the world's 'developed' and 'developing/transition' countries are so interconnected that both the effects of TADs and the measures to prevent them cannot be viewed in isolation. This calls for a global approach in the fight against animal diseases and it is clear that the veterinary services have a crucial role to play here as the providers of Global Public Goods.

1. Introduction

1.1. Aim of the study

This is **Part I** of a series of economic studies on the financing of animal epizootics and zoonoses losses in developing and transition countries, commissioned by the OIE with support of the World Bank.

Part I deals with the economic impact of diseases and cost-benefit analysis of improved disease prevention and rapid control. The objectives of this study, as laid down in the ToR, are as follows:

"To clarify the relative direct and indirect impacts and the economic cost of different types of animal diseases and assess the costs and benefits of global and national animal disease prevention and control, in particular through appropriate governance allowing early detection and notification and rapid response within all parts of a country. The cost of the appropriate governance (in compliance with OIE international standards) will be compared with the potential cost of sanitary crisis resulting from diseases such as BSE, FMD and avian influenza".

This Report details the work undertaken in Part I, which was carried out by Agra CEAS Consulting. It describes the methodology followed, the scope of the analysis, and our key findings and conclusions.

1.2. Structure of the Report

The structure of this Report is as follows: Section 2 outlines the key methodological tools employed for the study. Section 3 outlines the scope of the study in terms of disease focus, developing country and farming system coverage, the description of prevention and control systems, and the definition of prevention and outbreak costs and of the potential benefits of improved prevention. Section 3 provides a synthesis of the main findings from the literature review. In particular, this includes an assessment and conclusions of existing information and applied research on the costs of prevention and control systems, on the costs of outbreaks, and of relevant cost-benefit analysis of improved prevention. Section 5 covers the four country case studies that were undertaken, in each case outlining the context (animal health problems, and veterinary services structures), and then the costs of prevention versus the costs of outbreaks. Section 5 provides a global (worldwide) overview of prevention costs versus outbreak costs (the latter based on a specific model developed explicitly for the purposes of this study, as presented in Annex 5). Section 6 outlines the overall study conclusions and recommendations (more detailed conclusions and recommendations are also provided per section within the study).

2. Methodology

The main methodological tools employed in Part I have included:

- Desk research: identification of relevant literature and data from key sources in the animal health field (including all the major competent international, regional and national bodies). This has included the construction of a detailed and extensive literature database, which is provided as a **separate deliverable under Part I**;

- Literature review: analysis of the available literature. The analysis has focused on extracting the key information and conclusions of relevance to our study. This has covered nearly 300 references of relevance. This analysis is also provided as a **separate deliverable under Part I**;

- Consultations with key relevant institutions/authorities and experts. This has included both relevant information/data gathering and advice on the methodology and direction of the study;

- Case studies in 4 countries: Argentina, Vietnam, Nigeria and Romania. The criteria used for the selection of these particular countries have included regional representativeness (so as to cover the key world developing regions), the extent/threat and relevance of disease outbreaks (in connection with HPAI and FMD in particular), level of economic development and trade orientation (so as to cover a range of socio-economic profiles);

- Development of a model to provide detailed estimates of the costs of outbreaks (detailed types of direct and indirect impact), with application to the particular case of HPAI. This model is presented in full (baseline, scenarios, assumptions, and results) in **Annex 5**.

- Analysis and synthesis of costs and benefits. This has focused on the comparison of prevention versus outbreaks costs, so as to derive conclusions on the cost and benefit of improving the prevention and control systems in the animal health field.

3. Scope

3.1. Disease focus: TADs

The focus of this project has been on Transboundary Animal Diseases (TADs), particularly of high zoonotic potential. Transboundary animal diseases are defined as those that are of significant economic, trade and/or food security importance for a considerable number of countries, which can easily spread to other countries and reach epidemic proportions and where control/management, including exclusion, requires co-operation between several countries.

The occurrence of such diseases and their control and eradication poses significant challenges for the world's **Veterinary Services** (VS)[3] and entails substantial socio-economic costs, especially in the context of developing countries' poverty alleviation and development objectives. In addition, many of these diseases have high public health relevance and have become virtually endemic in many parts of the developing world, as demonstrated in **Annex 1**.

Amongst TADs, the project has focused in particular on two diseases of potentially high socio-economic impact, which today present some of the most significant challenges for VS world wide:

- **Highly Pathogenic Avian Influenza (HPAI):** The start of the current 'H5N1' subtype of HPAI epizootic occurred at the end of 2003 in parts of SE Asia[4]. By the end of 2005, the disease had spread to parts of Central Asia, Siberia, the Balkans, the Middle East and Eastern Europe, while at the beginning of 2006 it spread to parts of Western Europe and Africa. The latest situation of the HPAI occurrence since 2003 (number of outbreaks and geographical occurrence) is shown in **Annex 2** (source: OIE WAHID). According to the OIE (A279), the rate and pattern of the spread suggests that the reaction of the international community has not been timely enough. This disease has high public health relevance and significant socio-economic implications.

- **Foot and Mouth Disease (FMD):** Although of limited public health importance as such, FMD has had extensive socio-economic impacts[5] wherever it has occurred (whether in the developed or in the developing world), while its control and eradication has attracted significant efforts and

[3] This term encompasses the full range of public and private components of national, regional and international veterinary systems. The World Organisation for Animal Health (OIE) *Terrestrial Animal Health Code* defines the Veterinary Services (VS) of a country or group of countries as 'the national Veterinary Administration, the Veterinary Authorities and all persons authorised, registered or licensed by the Veterinary Statutory Body', and both the public and private components of national mechanisms for the control and prevention of animal diseases (*Terrestrial Code* 16th edition, OIE, 2007).

[4] The HPAI virus has been present in China since at least 1996 and probably disseminated to Southeast Asian countries at least some months before it developed into the epidemic beginning in 2003.

[5] FMD was chosen amongst a range of diseases that affect the poor in developing countries. The impact of FMD is exerted mainly through its implications on trade and market access (see for example A129).

resources in most parts of the world. The latest situation of the FMD occurrence is shown in **Annex 2** (source: OIE WAHID).

3.2. Classification of developing countries

The analysis covers all developing and transition countries which are members of the OIE[6]. For the purposes of this analysis, countries have been classified according to certain parameters, which include the region, economic criteria such as the level of economic development (per capita GDP), and trade interest (export or import orientation) (**Annex 3)**. This classification is used to determine categories of countries with common parameters, to facilitate the global overview.

There are wide differences in the socio-economic situation (ranging from very poor to relatively wealthy) of developing/transition countries which are members of the OIE (A40).

For example, in Asia, the countries currently infected with HPAI H5N1 (such as Cambodia, Indonesia, Lao PDR, Thailand, Vietnam, China) have significant differences in living standards, economic prospects, per capita income and population size and density. Lao PDR and Cambodia have the lowest per capita incomes in the region, whereas Thailand belongs to the group of newly industrialising countries. The vast majority of the poor in all these countries lives in rural areas and depends on mixed farming systems that include some level of livestock production.

These differences have implications in terms both of the impact of diseases on the macro and micro-economy and the incentive/available means to invest in prevention. Countries where poverty alleviation is the main concern have different problems and goals than large exporters whose main motivation is to improve their competitive position in export markets. Indeed, with respect to the most cited benefits of improving prevention – enhanced food security, poverty alleviation and improved market access – country positions can differ significantly as a function of their general level of development.

Improvements in animal health and more generally the livestock sector can contribute to the micro and macro economy of a country for the attainment of the following goals:

- To ensure both national and household food security;
- To reduce poverty through generation of employment, income and savings;
- To contribute to economic growth though trade in livestock and livestock products and supplying raw materials to industry.

[6] This includes some 132 country members at the time of the analysis. The current full membership of the OIE (all countries) includes 170 countries.

These objectives fall within the broad framework of the Millennium Development Goals adopted by the UN General Assembly in 2000[7].

Certain indicators can be used to measure the extent of the difference in the importance of these goals between countries. In particular, the following key socio-economic variables and indicators have been included in our country classification:

- GDP per capita and the Human Development Index (HDI[8]) as indicators of relative wealth.
- Share of agricultural sector in total GDP, and LSUs (livestock units) per person, as indicators of the contribution of agriculture and livestock to the economy. These indicators provide measures of the relative importance of the sector in the macro-economy. Used in conjunction with poverty measures (such as the UNDP HDI), they can indicate the socio-economic dimensions of the sector, from which conclusions can be drawn for the sector's importance both in macro-economic and in micro-economic terms. In countries with a high incidence of rural poverty / poor ranking on the HDI the sector is expected to play a greater role in poverty alleviation, particularly when combined with high rates of LUs per person;
- Share of agricultural exports in total value of exports, and net trade position (exports minus imports of livestock products) as an indicator of trade orientation. This indicates the relative importance of the sector in trade terms. Countries have been consequently classified as (net) exporters or (net) importers.

This has allowed us to classify countries in clusters, from which conclusions can be drawn with respect to the different interests and position of each cluster in terms of animal health prevention and the relative impact of animal disease outbreaks. The complete analysis and classification of each country can be found in **Annex 3**.

3.3. Farming systems

It is important to differentiate between farming systems because the impact and hence cost of a particular disease can vary significantly depending on the production system. FMD, for instance, will cause higher production losses in dairy herds than in beef herds. Similarly, HPAI, affects smallholder poultry systems differently than commercial large-scale poultry based systems: in medium to small holder poultry farms, which tend to have a medium to low level of biosecurity, animal mortality is higher than in intensive production systems (where biosecurity tends to be higher), but the latter inevitably suffer from a higher rate of financial risk due to the higher poultry concentration levels (A14)[9]. Fast transmission of diseases

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[7] At the millennium summit of the United Nations in September 2000, all the 189 member nations joined in a formal commitment to reduce global deprivation, including poverty, hunger, poor health and abuses of human rights. This commitment was taken into a series of Millennium Development Goals (MDGs) to be achieved by 2015.

[8] A composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent standard of living. For details on how the index is calculated, see UNDP statistics.

[9] E.g. the FAO recommendations on AI prevention in Asia state that the probability of infection is higher in backyard and village farms (production sectors 3 and 4) than in commercial/semi-commercial ones (sectors 1 and 2), however,

within areas of high livestock density (brought about by the intensification of production over the last 30 years) has led to large economic losses in the developed world (e.g. UK FMD), and this danger is now believed to be more acute in the developing world where veterinary and human health services generally tend to be weaker (A58).

The livestock sector in developing countries has experienced phenomenal growth in the last decade, to the extent that the literature widely refers to this as the '*livestock revolution*'. This has been fuelled mainly by economic growth, population growth, urbanisation and the resulting global expansion in demand for food of animal origin (A58, A96, A111c). Nonetheless, substantial differences remain in the livestock structures and farming systems between the developing countries examined here, due to differential extent and nature of livestock sector growth in each country/region. These mirror the general levels and patterns of economic growth in the various countries, but also reflect more historical factors such as the fact that livestock fulfils different goals from region to region, between countries and even within different regions of a country. Thus, at international level, there has been considerable variation in terms of the livestock sector's contribution to economic development and the achievement of Millennium Development Goals[7]. For example some parts of the developing world, in particular sub-Saharan Africa have lagged behind in the phenomenon of the livestock revolution which has characterised other developing regions[10]; even between African countries, the livestock sector has experienced differential patterns of development, whether supply or demand induced (A187). Thus, the resulting structures of the livestock sector can vary considerably between the developing countries under review.

The FAO have established a typology of poultry production systems, which has been followed in the 2004 FAO recommendations on AI prevention in Asia (A14). This typology has been used in a number of studies on the impact of HPAI and compensation issues (FAO: A91, A159), for the analysis of the type of impacts the disease has caused to the various farming systems and implications for effective compensation as a control measure. The FAO typology distinguishes between 4 'sectors': in sectors 1 and 2 production tends to be large-scale, highly integrated, with well-organised bio-security systems and quality control processes in sectors which usually tend to be more export-oriented; sector 3 farms are commercially oriented and can be fairly medium scale but tend to be less bio-secure; sector 4 is what the literature widely refers to as 'backyard' farming or minimum input – minimum output systems with low bio-security levels but high importance for the survival of poor rural populations (i.e. central to food security and poverty alleviation).

This typology has been applied in a number of country studies including Vietnam (A16, A159) and Nigeria (A293), which are two of the case studies presented here. The majority of developing countries have predominantly sector 3 and sector 4 poultry systems, but in newly industrialised and key livestock product exporting developing countries - such as Brazil, Malaysia and Thailand - poultry systems are closer to sectors 1 and 2 as is the case in the developed world (A159). An illustration of the differential impact a disease can have in the various production systems is the fact that in emerging countries that have experienced HPAI, such as Indonesia and Vietnam, sector 3 which was previously expanding and

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if the virus enters the latter, infection may have a greater impact due to the concentration of susceptible poultry in these farms.

[10] Mwangi D M and Omore A 2004 The Livestock Revolution - a view on implications for Africa. British Society of Animal Science, Penicuik, UK.

increasingly prevalent appears to have shrunk dramatically. The evidence therefore strongly suggests that the HPAI crisis has accelerated the sector's restructuring.

It is stressed that the situation is very dynamic, as the livestock sector in the developing/transition countries is evolving rapidly within some of the fastest growing economies and populations in the world (e.g. China). Globalisation, the changing focus of agricultural development, and the changing production and consumption patterns all have implications for the provisions of animal health services (A66). Population growth, increasing income and urbanisation are causing a marked increase in demand for livestock products in the developing/transition world. According to IFPRI projections, the number of people in the world is projected to be 7.7 billion by 2020, with the largest increase coming from the developing world. If current trends continue, there will be a significant percentage of people in developing/transition countries whose diets will be modified from plant-based to meat- and dairy-based. To supply these needs, it is estimated that global livestock production in 2020 will have to be at least double the 2000 levels (A96).

3.4. Description of prevention and control systems

3.4.1. Overview

The prevention and control of animal diseases[11] involves a series of measures taken ex ante and ex post in response to an anticipated disease outbreak, moving from short term control and containment (in the event of first occurrence of an outbreak) to medium term (activities followed after short term control measures), to longer term (following eradication or return to a 'normal' situation).

The WTO SPS Agreement recognises the OIE as the relevant international organisation responsible for the development and promotion of international animal health standards, guidelines, and recommendations affecting trade in live animals and animal products. An overview of the OIE provisions, as outlined in the OIE Terrestrial Animal Health Code, is provided in **Table 1**.

[11] This section deals only with the animal health aspects of prevention strategies. The human health aspects are covered by WHO material, including the results of the 2005 Lyon conference on strengthening national capacities for epidemic preparedness and response in support to national implementation of international regulations (A214), and the WHO contribution to the Geneva 2005 meeting on Avian Influenza (AI) Emergency Preparedness and Response (A223).

Table 1 Overview of OIE international standards, guidelines and recommendations (a)

Components of prevention and control systems	OIE provisions
General provisions	
Disease notification	Member Countries obliged to notify within 24 hours epidemiological information with regards to occurrence/ reoccurrence of listed notifiable diseases, the occurrence of a new strain of a listed disease, a significant change in the epidemiology of a listed disease or the detection of an emerging disease. Reports within specific time limits should be sent on the presence or the evolution of the listed diseases
International trade	Importing and exporting Member Countries responsibilities in exchanging up-to-date health information, setting import regulations and providing accurate health certification.
Disease risk analysis	Guidelines and principles for conducting risk analysis associated with the importation of animals and animals products. The Terrestrial Code provides the descriptions of the components of import risk analysis: hazard identification, risk assessment, risk management and risk communication.
Zoning/ compartmentalisation	Recommendations for establishing and maintaining a free zone or compartment for a particular disease within a Member Country.
Equivalence of sanitary measures	Guidelines to assist OIE Member Countries to determine whether sanitary measures arising from different animal health and production systems may provide the same level of animal and human health protection
Veterinary Services	The Veterinary Services of the Member Countries should comply with fundamental ethical, organisational and technical principles established by the OIE to demonstrate the integrity of its international veterinary certificate. Guidelines are provided for the evaluation of the quality of the Veterinary Services, which should be applied using the OIE Performance, Vision and Strategy (PVS) instrument.
Specific diseases	
e.g. HPAI, FMD	Measures that exporting Member Countries need to undertake in order to export, including requirements, which should be met by

Components of prevention and control systems	OIE provisions
	a country/ zone/ compartment in order to achieve a specified disease status e.g. free country, free zone with vaccination, etc. The measures incorporate the latest scientific information, and diagnostic and vaccination techniques. For certain important diseases, appendices describe surveillance methods to be implemented for the determination of the status of the country or zone.

(a) For animal health and zoonoses, the SPS Agreement refers to the 'standards, guidelines and recommendations developed under the auspices of the OIE'.

Source: OIE Terrestrial Animal Health Code

The measures involved can vary by disease, as described in the OIE Terrestrial Animal Health Code and in the OIE Technical Disease Cards (**Annex 1**). A more detailed description of the international strategy and measures for the control and prevention of the two main TADs discussed here, HPAI and FMD, is provided below. Our objective has been to establish the main cost components involved in implementing these measures (as discussed in section 3.4.3). Control measures in the event of a disease outbreak as such and their costs are discussed in more detail separately under section 3.6.

Veterinary Services[12] (VS) are at the very core of the prevention, control and eradication of animal diseases. As such, their ability to effectively safeguard the livestock sector from such diseases will be crucial for the protection both of public health and of rural livelihoods (in terms of food security and poverty alleviation, as discussed in section 3.2). These objectives are commonly classified in literature as '*public goods*' (A35)[13]. The provision of VS could be defined as an intermediate public good, the final public good being to guarantee the above objectives.

A public good provides benefits to a large number of people (potentially everyone), without reducing the benefits that each individual may derive from it[14]. The control and eradication of communicable diseases

[12] The OIE *Terrestrial Animal Health Code* defines the Veterinary Services (VS) of a country or group of countries as 'the national Veterinary Administration, the Veterinary Authorities and all persons authorised, registered or licensed by the Veterinary Statutory Body', including both the public and private components of national mechanisms for the control and prevention of animal diseases.

[13] See, for example, the various contributions on this subject included in A35.

[14] Conventional economic theory defines public goods as being non-rival in consumption and having non-excludable benefits, i.e. having the opposite characteristics of private goods (A35b). According to this standard definition the market cannot price these goods efficiently, which justifies government intervention. A more expanded definition, which is not anchored necessarily on non-rivalry and non-excludability, takes into account deliberate policy choices that affect the nature and benefits of goods (A35c).

is classified as a de facto public good on both grounds; the broad objectives of economic stability and growth and development potential are also listed under the same heading (A35c).

Furthermore, the publicness of the response is an important factor for classifying a public good (A35a). This concept has been applied in the case of communicable diseases (A35c, A35d[15]). Actions to address international health challenges are seen as efforts to enhance the publicness of responses. Indeed, looking at international cooperation on public health since the 1950s, it can be concluded that problems tend to persist when the publicness of the response is limited (A35d).

Given the transboundary nature of some of the most challenging animal diseases, the OIE, along with key donor organisations including the World Bank (WB) and other international/national donors[16], have advocated that the objectives which the core functions of Veterinary Services seek to achieve are a "**Global Public Good**''[17]. The control and eradication of communicable diseases is classified as a global public good on the grounds that, with increasing globalisation and cross-border economic activity resulting in the increase in global systemic risks, this good has become indivisible across borders or transnational (A35, A39, A59, A35d, A94). Some of the other objectives sought by improvements in animal health in developing/transition countries, notably poverty alleviation and promoting food security, are also classified under the same heading.

The main argument followed by the literature is that, given that they are serving Global Public Goods, the available key prevention and control tools to respond to global animal diseases (good governance of Veterinary Services, animal health legislation and policies, disease information, the implementation of international standards, research and development) should be provided and funded in all countries. For reasons of negative externality[18], a special effort should be made by the international community to boost the capacities of developing countries and countries in transition. This takes into account both the interdependence of countries in combating global diseases and the disparities that exist in the capacities,

[15] Three inputs are considered crucial for controlling disease: available and accessible medical knowledge, a national public health infrastructure, and private spending on complementary goods and services (A35d).

[16] See for example, UK Joint Industry position (DEFRA, A22).

[17] Global public goods are public goods whose benefits extend to all countries, people and generations. A less strict but more meaningful definition would be when the good benefits more than one group of countries and does not discriminate against any population group or generation (A35). This definition is applicable in the case of some regional communicable diseases such as AI, i.e. in cases where a worldwide epidemic may occur actions to monitor and isolate a regional outbreak clearly constitute global public goods (A39, A59, A94). Even in the case of regional non-communicable diseases, inadequate healthcare responses in any region can have global spill-overs (A59, A35d). Moreover, the public goods associated with communicable diseases provide intergenerational spill-overs of benefits. Once a disease is cured or a virus is isolated, benefits are conferred on the present and future generations (A59).

[18] An externality exists where an action – or inaction – by an individual or country imposes a cost (negative externality) or creates a benefit (positive externality) for others, without this being taken into consideration by the individual or country responsible). This argument has often been used in the case of infectious diseases (e.g. A22, A68).

or willingness, of countries to participate in combating them. This logical framework has been followed *inter alia* by the WB in its international activities in this area[19].

A global framework for the progressive control of transboundary animal diseases (GF-TADs) was developed by the OIE and the FAO in May 2004, to serve as a facilitating mechanism to provide for capacity building and to assist in establishing programmes for the specific control of certain TADs based on regional priorities (A41). One of the OIE's main objectives, in its Fourth Strategic Plan, is to strengthen the capacity building of the national Veterinary Services, encouraging the improvement of legislation and resources, in order to assist member countries to comply with the (OIE) international standards and guidelines for animal health (including zoonoses) and for safe international trade in animals and animal products. The necessity to strengthen Veterinary Services was also been reaffirmed at the G8 Summit held in St. Petersburg on July 16, 2006[20].

In recent years, the need to ensure a greater transparency and preparedness to deal with emerging and re-emerging diseases, in accordance with the rules and obligations of the WTO SPS Agreement provisions, has been a primary driver in the reorganisation of the role of VS in the developing world[21]. This has involved, at the top level, the clearer delineation of responsibilities between those parts of government concerned with public health and consumer protection and those dealing with the economic issues of meat production and trade. At a lower level, it has necessitated improved surveillance mechanisms, enhanced research and a better prioritisation in the use of the available resources. Recommendations to this effect have been made by the OIE (**Table 1**). However, it is recognised that developing countries may lack the necessary financial and human resources to implement these recommendations and this being a global public good, international organisations and donors need to step in to help promote the required reforms (A139, A134).

Thus a global good governance programme for the improvement of VS in developing countries involving cooperation of the main international organisations and donors (A57) has been set. The programme centres on the concepts of improved transparency, early detection and rapid response to animal disease outbreaks.

Early detection of animal diseases in particular relies on good cooperation between the main actors involved in the system: livestock owners, private veterinarians and animal health services, the public veterinary administration, and the wider food chain[22]. This systemic approach is inherent in the definition of the VS according to the OIE Terrestrial Code[3]. The effective collaboration of these private and public components is in fact a key criterion in evaluating a country's VS using the OIE PVS instrument (A79). In

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[19] For example the WB Development Grant Facility (DGF). The DGF was established in 1997 to integrate the overall strategy, allocations, and management of Bank grant-making activities funded from the Administrative Budget under a single umbrella mechanism.

[20] http://en.g8russia.ru/docs/10.html: Conclusion 13. in "Fight against infectious diseases"

[21] It is noted that, under the WTO SPS, developing countries were given a longer deadline, to the vear 2000, to conform to the Agreement.

[22] Further discussion on the respective contribution of the different sectors can be found in section 3.5. For a more extended reading on this see, for example, A57, A66 and A82.

designing future strategies, the chain approach is also emphasised in the SAFFE initiative launched by the OIE in April 2006. This emphasises the partnership between the public and private sectors within the mandate of the VS in order to strengthen the global food safety system[23].

3.4.2. HPAI prevention and control strategy

A Global Strategy for the Progressive Control of Highly Pathogenic Avian Influenza (HPAI) was first developed by the OIE and the FAO in collaboration with the WHO, and presented in November 2005 at a global meeting in Geneva co-sponsored by these organisations and the World Bank. This was subsequently revised, most recently in March 2007 (A40). It is a long term strategy that aims to minimise the global threat and risk of influenza at source in domestic poultry and to prevent exposure of humans, through progressive control of HPAI. The key components of the strategy include control at source in birds, surveillance, rapid containment, pandemic preparedness, integrated Animal and Human Health (AHI) plans involving also other sectors, and communication (**Box 1**). Implementation was designed over three time frames (immediate to short (1-3 years), short to medium (4-6 years) and medium to long term (7-10 years)) and at three levels (national, regional and international).

[23] The SSAFE initiative is hosted by the University of Minnesota (USA). It intends to provide input from the entire food supply chain, to facilitate and enable progress in strengthening the global food safety system as well as animal disease prevention and control worldwide, and to leverage resources through public-private partnerships for collective action. It counts with partners of the private sector from the global and regional food and feed systems (production, processing and distribution), NGOs, and intergovernmental agencies worldwide. The initiative effectively responds to a widely accepted need: governments in developing and in–transition countries are not capable of raising their animal health and public health infrastructures to the required standards to address avian influenza and other emerging animal diseases without cooperation with the private sector, including farmers and private veterinarians.

Box 1 Key components of a global action plan to control avian influenza in animals and limit the threat of a human influenza pandemic

- ***Control at Source in Birds***. Improving veterinary services, emergency preparedness plans and control campaigns (including culling, compensation, quarantine and movement restrictions and vaccination).
- ***Surveillance***. Strengthening early warning, detection and rapid response systems for animal and human influenza; building and strengthening laboratory capacity rapid confirmation; rapid and transparent notification.
- ***Rapid Containment***. Support and training for the investigation of animal and human cases and clusters, and planning and testing rapid containment activities.
- ***Pandemic Preparedness***. Building and testing national and global pandemic preparedness plans; strengthening health system capacity, training clinicians and health managers.
- ***Integrated Country Plans***. Developing integrated national plans across all sectors to provide the basis for coordinated technical and financial support.
- ***Communications***. Factual and transparent communications, in particular risk communication, is vital.

Source: Global Strategy for the Progressive Control of Highly Pathogenic Avian Influenza, OIE/ FAO/WHO, March 2007 (A40).

This strategy was drawn up before the Africa HPAI outbreaks, so the objective at that time was to progressively control the spread of HPAI, mainly of the H5N1 strain, in domestic poultry of all affected countries of Asia and Eastern Europe, and to prevent the disease from reaching those other regions and countries not until then infected, but at high risk[24]. Thus, the global strategy was adapted by AUIBAR in collaboration with the OIE/FAO to suit African specificities (A258). A vision and an outline of a strategy for the prevention and control of HPAI in Africa was also proposed by the FAO in July 2006 (A285), which is consistent with the initial OIE/FAO Global Strategy of November 2005 and supplements the AU IBAR strategy document.

Specific provisions that exporting Member Countries need to comply with in order to export are laid down in the OIE Terrestrial Animal Health Code (**Table 1**). In addition, since September 2004, the FAO had developed specific recommendations[25] on the prevention, control and eradication of HPAI in Asia[26], as

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[24] Africa was at the time classified as a 'new region at risk' and action was foreseen at a regional level. Only for infected countries (with HPAI: Cambodia, Lao, Vietnam, Indonesia; with H7/H9: Pakistan) and for non-infected countries 'at immediate risk', action was foreseen at both country and regional levels.

[25] A distinction is made here between OIE international standards, guidelines and recommendations (**Table 1**) and FAO recommendations, which are not international standards.

[26] This is a position paper that presents the main scientific and technical issues and recommendations on prevention, control and eradication of HPAI, with a tabulated summary of FAO conclusions and recommendations in annex. They have been prepared with the contribution of several experts and government officials, including from the OIE,

well as detailed guidelines for the surveillance and diagnosis of HPAI in Asia[27] (A14 and A268 respectively). More generally, the FAO developed in 2006 a manual intended to assist national animal health authorities and other stakeholders throughout the world consider the needs for preparing for HPAI, focussing on the necessary measures for the early detection and rapid response to contain the disease (A38).

Following these strategies, the World Bank in consultation with the OIE, FAO, WHO and the UN System Influenza Co-ordinator (UNSIC) jointly developed a model that defines key components of the response to avian and human influenza (AHI) at the country, regional, and global levels. This model has been used for the assessment of financing needs and gaps to fight avian flu (Annex A of A89).

At a country level, apart from the rapid outbreak containment measures which are discussed separately here in the context of outbreak costs (including culling, compensation, disposal, post-culling disinfection, and vaccination), key components of the response on the animal health side are as follows:

- **Integrated country plans**. All countries, regardless of their level of risk, should prepare integrated country plans for human and animal health. Country plans should identify clear and common objectives across sectors, with associated results, outcomes, and costs, to which all sectors can contribute. They may also need to provide for the development of policy, legislation, and related strategy work to support the interventions identified.

- **Surveillance and early warning systems (animal health).** Systems for surveillance and early warning involve the enhancement of laboratory and diagnostic capacity; operational support to active and passive surveillance, including routine serological survey, and related information system support; training; and technical assistance and support to research.

- **Communication and coordination.** The most immediate economic impacts of a pandemic may arise not from death or sickness but from private individuals' uncoordinated efforts to avoid infection. Effective communication and coordination is key for governments to minimise panic and disruption and to engage the active involvement of all stakeholders.

These components are part of a medium term strategy (up to 3 years). In addition, longer term objectives would include:

- **Strengthening the capacity of the veterinary system** to deal with animal health outbreaks, especially zoonotic diseases.

- **Restructuring the poultry industry.**

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and the recommendations of the OIE Terrestrial Animal Health Code (13th edition, 2004). These Guidelines reflect the knowledge of HPAI in Asia at the time, and were therefore to under continuous review as epidemiology evolved and scientific knowledge and management tools became more comprehensive.

[27] The purpose of this document is to provide guiding principles and minimum requirements for surveillance and diagnosis of H5N1 highly pathogenic avian influenza (HPAI) that can be applied by countries and regional networks in Asia. OIE recommendations are to be read in conjunction with this document.

In all these activities there are roles for both the public and private sectors.

At the regional level, important cross-country activities provide support to countries facing similar sets of challenges. Regional activities should not duplicate country-level activities. They could include: support for reference laboratories (when these are set up to serve a region rather than an individual country); coordination of activities undertaken across countries on implementation policies, surveillance methods, and control measures, given the transboundary nature of the disease; assistance to capacity building, in response to demands made to regional organisations by countries; direct support for regional bodies (including animal health organisations, regional organisations, and technical organisations[28]), building on existing infrastructure and mechanisms such as the Global Framework for the Control of Transboundary Diseases (GFTADs, developed by OIE/FAO) and the Global Early Warnings System (GLEWS, sponsored by OIE/FAO/WHO); support to communication activities (e.g. meetings, workshops and data exchange provided by regional/international organisations; r*esearch on regional issues.*

At a global level, various support activities can complement those at the country and regional levels, including support to the following: standard setting and global strategy development (OIE and FAO); support to laboratory networks development of materials and new technologies (e.g. vaccines and antiviral treatments); coordination of the response to avoid duplication and waste; and communication.

3.4.3. FMD prevention and control strategy

The OIE has been particularly active in promoting effective FMD control and surveillance strategies in its Member Countries, especially those where the disease is endemic.

Due to its highly contagious nature and economic importance for many countries, FMD was the first disease for which the OIE established an official list of free countries and zones and prepared guidelines on harmonised methods of FMD surveillance to assist Member Countries in their eradication or control programmes.

The OIE has established categories of freedom from FMD that can be allocated to an exporting Member Country, which have different implications for trade (**Table 1**). These categories are: FMD free country or zone where vaccination is not practised; FMD free country or zone where vaccination is practised; and, infected country or zone (OIE Terrestrial Animal Health Code 2006). The Terrestrial Code provides also Guidelines for the surveillance of FMD. According to these guidelines, an FMD surveillance Programme should include:

- An early warning system and processing chain for reporting suspicious cases. Farmers and workers who have contact with livestock should be trained and report promptly any suspicion of FMD. Samples should be submitted to an approved laboratory. Sampling kits and other equipment should be available and personnel responsible for surveillance should be able to call for assistance from a team with expertise in FMD diagnosis and control.

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[28] E.g., Asia-Pacific Economic Cooperation, Association of South East Asian Nations, FAO, OIE, and WHO regional representations.

- Regular and frequent clinical inspection and serological testing of high-risk group of animals, such as those adjacent to an FMD infected country or zone should be carried out.

The target population of a surveillance strategy should cover all susceptible species. The strategy may be based on randomised sampling or targeted surveillance (e.g. based on the increased likelihood of infection in particular localities or species) depending on the epidemiological situation. The sensibility and specificity of the tests used should be ideally validated for the vaccination/infection history and production class of animals in the target population and an effective procedure for following up positive samples should be in place to increase the level of confidence of the diagnostic tests. Surveillance can be carried out at three levels: clinical surveillance, followed by laboratory testing, virological surveillance and serological surveillance. The strategy and design of the surveillance programme is dependent on the prevailing epidemiological circumstances.

Four strategies are recognised by the OIE in a programme to eradicate FMDV infection following an outbreak. These involve a combination of culling and vaccination (**Annex 1**).

Since 1996 the FAO, through EMPRES[29] and in collaboration with the OIE and PHAO, has supported activities in the context of regional programmes for FMD control and eradication. For this purpose, the FAO developed a manual for the preparation of FMD contingency plans to provide guidelines for the countries threatened by FMD, as outlined in **Box 2**.

[29] The Emergency Prevention System (EMPRES) against transboundary animal and plant pests and diseases was developed by the FAO in 1996. EMPRES has two components: plant pests and animal diseases. The livestock component focuses primarily on rinderpest but also on 5 other epidemic diseases including FMD. The aim is to promote effective containment and control of the most serious epidemic livestock diseases as well as newly emerging diseases by progressive elimination on a regional and global basis through international co-operation involving early warning, early/rapid reaction, enabling research and coordination.

Box 2 Key components of FMD contingency plans

Nature of the disease: this includes aetiology, evolution and distribution, epidemiological features, clinical signs, pathology, immunology and diagnosis.

Risk analysis for FMD: this process includes hazard identification (i.e. identifying the pathogenic agents which could potentially be introduced in the country), risk assessment (i.e. evaluating the likelihood and the biological and economic consequences of entry, establishment, or spread of a pathogenic agent), risk management (i.e. identifying, selecting and implementing measures that can be applied to reduce the level of risk) and risk communication (the interactive exchange of information on risk among risk assessors, risk managers and the stakeholders).

Prevention strategies: includes import quarantine legislation in line with the OIE International animal Health Code, control movement across national borders, ban of swill feeding from international aircraft or ships, containment of herds to avoid the contact with animals at risk

Early warning contingency plan for FMD: a contingency plan should include training programmes for veterinarians and animal health staff (including stakeholders and traders), strengthening laboratory capacity for a rapid and certain diagnosis, establishing contact with Reference Laboratories and surveillance.

Strategies for control and eradication: This includes *a) Constraining access of the virus to susceptible host animals* through import controls and quarantine; good hygiene and sanitary practices including cleaning, disinfection and safe destruction of potentially contaminated materials; preventing the feeding of contaminated materials to livestock; *b) avoiding contact between infected and susceptible animals* through zoning[30] and quarantine of infected farms or areas and movement controls; *c) reducing the number of infected or potentially infected animals in livestock populations,* through slaughter of infected or potentially infected animals and safe disposal of carcasses; *d) reducing the number of susceptible animals* through destocking or vaccination programmes.

Source: FAO Preparation of FMD contingency plans (A1); adapted for risk analysis with the OIE guidelines from the OIE Terrestrial Animal Health Code.

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[30] Zoning is the proclamation of geographic areas in which specific disease control actions are to be carried out. These areas are usually in the form of concentric “circles” around suspected foci of infection, with the most intensive disease control activities. The **infected zone** is a zone generally of the size of 10 km radius around the disease foci in areas with intensive livestock or 50 km radius in areas with extensive livestock in which actions like quarantine, movement control, slaughter safe disposal of carcasses and decontamination procedures should be taken to limit the spread of the disease. The **surveillance zone** is larger than the infected zone and is subject to control measures to monitor the spread of the disease such as active disease surveillance, movement control and restriction for abattoirs, sale of animals and animal products**.** The **disease free zone** includes the rest of the country, in which strict quarantine measures should be applied to prevent the entry of the disease for the infected zones and continuing surveillance (A1).

Regional campaigns for FMD control and eradication include the South East Asia campaign (SEAFMD) and the PANAFTOSA campaign in the Americas[31]. These campaigns are discussed further in section 4.2.2.1.

3.5. Definition of prevention and control costs

For the purposes of our analysis, prevention and control costs have been defined as the costs incurred by governments during 'normal' times, i.e. in advance of outbreaks. In particular, as outlined in **Table 2**, these include:

- Emergency preparedness, in terms in particular of the existence of emergency preparedness plans and the state of VS more generally,

- Surveillance networks, in terms in particular of diagnostic capacity and border controls.

At a disease-specific level, in the case of HPAI, it follows the main components of the FAO/OIE/WHO Global Strategy for the Progressive Control of HPAI (A40). A more complete as well as more detailed list of the various costs involved in the prevention of HPAI – at country, regional and international level – is provided by the World Bank in its assessment of financing needs and gaps for a global response to the disease (A89), and this has been taken into account here.

The costs of prevention will depend on a range of factors, including the nature of the disease and its prevalence in a country (first occurrence, endemic, high risk or low risk etc.) (**Annex 1**), the structure of the livestock sector, and the current situation of the VS and preparedness levels in each country.

For instance, the costs of comprehensive surveillance for HPAI depend *inter alia* on specific conditions in each country in terms of the structure of the poultry sector. In countries where poultry are predominantly kept in smallholder and scavenging systems, i.e. with a geographically/spatially dispersed and difficult to access sector, costs are expected to be high. This applies to Vietnam where 8 million households rear poultry, and Nigeria, but also most of SE Asia and Africa, as will be seen in the case studies.

An overview of the current status quo around the world for the key components of an effective prevention for HPAI is provided in section 4.2.

[31] There are currently also calls for a regional approach to the eradication and control of FMD in the Middle East and North Africa, according to which a common strategic programme should be adopted, based on risk evaluation, appropriate strategies for control and the establishment of a surveillance network for an early warning system (A180). This is one the regions of the world most heavily affected by FMD, and the situation poses a continuous threat to other regions, especially Europe. In the Middle East, preventive vaccination is used (targeting cattle), albeit as a tool for preventing economic losses caused by the disease rather than as a means of preventing the spread of infection. The diagnostic capacity is limited and the samples are sent to the WRL. In North Africa the management of the outbreaks has recently been focused on emergency preparedness and control measures based on quarantine and mass vaccination to limit the spread of the disease.

Table 2 Overview of definitions: prevention costs versus outbreak costs

			Mainly affected by the costs (1)				
	Type of costs	**Examples**	**Govern ment**	**Livestock holders**	**Agrifood chain**	**Other industry sectors**	**Wider society**
Prevention costs	*Veterinary system*	▪ Surveillance (including diagnostic capacity/laboratories) ▪ Veterinary border inspection / customs ▪ Human resources ▪ Training and simulation exercises	**X** (public VS)	**X** (private VS)			
	Preventive vaccination	▪ Vaccine stocks / storage (cold chain) ▪ Human resources	**X**	**X**			
	Bio-security measures	▪ Animal identification ▪ Isolation of newly arrived animals ▪ Isolation of sick animals ▪ Movement rules (animals, people, equipment) ▪ Cleaning/disinfection procedures		**X**	**X**		

			Mainly affected by the costs (1)				
	Type of costs	**Examples**	**Govern ment**	**Livestock holders**	**Agrifood chain**	**Other industry sectors**	**Wider society**
A. Outbreak costs: direct impact	*<u>Direct disease losses and control costs</u>*	▪ Value of culled animals (including pre-emptive and welfare slaughter) ▪ Culling ▪ Disposal ▪ Cleansing and disinfection etc. ▪ Veterinary inputs ▪ Administration of control measures ▪ Serology ▪ (Ring) vaccination / buffer zone	**X** (2)	**X** (2)			
	Other <u>direct production losses</u> of directly caused by veterinary restrictions	▪ Business interruption losses directly caused by veterinary movement restrictions ▪ Partial loss of animal value (e.g. through vaccination etc.)		**X**			

			Mainly affected by the costs (1)				
	Type of costs	**Examples**	**Govern ment**	**Livestock holders**	**Agrifood chain**	**Other industry sectors**	**Wider society**
B. Outbreak costs: indirect impact	*Losses caused by <u>ripple effects</u> (impact on prices and on upstream and downstream activities)*	▪ Price effects regarding livestock/ livestock products ▪ Loss of access/ opportunity to access, regional and international markets ▪ Impact on inputs (feed, chicks, vet medicines)	**X** (3)	**X**	**X**		
	Losses caused by <u>spill-over effects</u> (impact on other economic sectors)	▪ Drop in demand in the services sector (tourism, public transport, retail trade, hospitality and food services)				**X**	

<u>Notes:</u>
(1) This Table refers to the economic agents *mainly* affected by the costs/losses
(2) Includes transfer costs of government for public compensation for culled animals etc.
(3) In terms of loss in fees / taxes

A more precise definition of the various costs is provided below.

3.6. Definition of outbreak costs

Outbreak costs differentiate between direct costs and losses, and the various indirect costs and indirect losses, in accordance with the typology of costs presented in **Table 2**.

A. Direct impact

The total direct cost of a disease is the sum of the production losses (direct and consequential) and the costs of disease control, as follows:

- **Direct losses:** Direct losses can stem either from the disease itself (which at its worst potentially result in the complete loss of all livestock of a particular species), or from sanitary control measures (stamping-out policies) (A292). In addition to the loss from the value of animals culled as such, there are culling and disposal costs.

- **Control costs:** Control costs during and after the outbreak typically include equipment, facilities, disinfectants, protective clothing, staff in quarantine stations etc. They may also include (ring) vaccination where this is considered appropriate and is available (more comment on vaccination can be found in section 3.4.3).

- **Other direct production losses**: Consequential on-farm losses include losses due to the fall in stock, to restrictions of movement when zoning restrictions are put in place, and due to the loss in animal value.

B. Indirect impact

The indirect impact of livestock diseases includes ripple effects, spill-over effects and costs to the wider society including longer term macro-economic effects. These costs are defined as follows:

- **Ripple effects:** Ripple effects include impacts on livestock and livestock product prices and on upstream and downstream activities along the livestock value chain. For example, the value chain for poultry is complex and involves several activities upstream and downstream: breeding, feed production, input supply (notably feed, breeding chicks, veterinary medicines), production, collection and trade (of eggs or live birds), slaughter, processing, final sale and consumption. Moreover, with globalisation markets have become increasingly interlinked, so that it becomes increasingly difficult to isolate the impact of an animal disease on a specific country or group of countries.

  Due to the methodological difficulties and constraints of this type of analysis and its extensive data requirements, such costs are rarely explored in depth in the available literature. The only costs that are more systematically covered by literature are the business disruption costs suffered by the poultry farmers and the poultry/egg production industry in terms of the fall in domestic demand and prices and the loss of export markets, and to a lesser extent the impact on the feed industry.

- **Spill-over effects:** Apart from agriculture as such and the impact of diseases along the affected livestock sector's value chain, tourism and services are the two other sectors most severely affected. The macro-economic impact can consequently be severe if these two sectors are important in the economy. In addition, as already indicated, animal diseases can have major effects on food availability and quality for poor communities and therefore raise issues of food security, as well as having negative effects on poverty alleviation.

- **Wider society:** Developing or transition countries, which tend to have inadequate/inefficient public health systems, are particularly exposed to the risk of zoonoses on public health. In the particular case of a pandemic, a large proportion of the economic losses are caused by higher morbidity and mortality rates in the human population and by its repercussions on the world economy (A185).

3.7. Definition of benefits of improved prevention and control systems

Investing in measures to improve the prevention and control of animal diseases is costly, and the priorities for each country need to be established on a case by case basis depending on their current status, capacity and level of development[32]. This necessitates cost-benefit analysis, preferably in advance of the measures/programmes. This type of analysis is cumbersome (both in the applied methodology and in data requirements), and results depend highly on the assumptions made, as will be discussed in sections 4 and 4.4 respectively.

Three main benefits of improved prevention are most widely explored in the available literature. These are as follows:

4. **enhanced food security / poverty alleviation.** This includes the benefits accrued from productivity improvements and generally improved production systems.

5. **improved market access**

6. **savings in potential outbreak costs**

In terms of the first objective, it is important to note that an estimated 600 million poor people worldwide rely directly on livestock production for their livelihoods. Several parts of the developing world, most notably sub-Saharan Africa, are still below the recommended protein diet levels and only get a fraction of the daily livestock protein intake of industrialised countries[33]. In addition, each year the population of developing countries grows by an estimated 72 million, with the highest growth rates in Africa and in Asia, adding to the demand for food products[34]. Average annual per capita consumption of all meats in the developed world is thus projected to increase to 30 kgs, which represents an increase by about a third on 1993 levels[35] (A96). Improved animal health not only guarantees food supplies but is also considered to be a major factor for productivity gains in the livestock sector.

In terms of the second objective, trade in livestock and livestock products makes up approximately one sixth of global agricultural trade. Most of these exports (nearly 80%) currently come from the developed world (**Figure 1**). For example, the least developed countries are estimated to account for only less than 5% of total world meat exports by value. Within this overall picture only a few countries account for the bulk of exports: 90 % of exports of beef and poultry (70% for pork) come from 5 countries.

The only OIE developing/transition countries with a substantial export presence in the world today are Brazil and Thailand. Three countries account for 26.3% of trade in chicken meat (by value): Brazil 17.3%, Thailand with 4.7% and China with 4.3% (including Hong Kong then China accounts for 8.5% of trade).

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[32] This approach is generally advocated in the area of food safety, see for example A134.

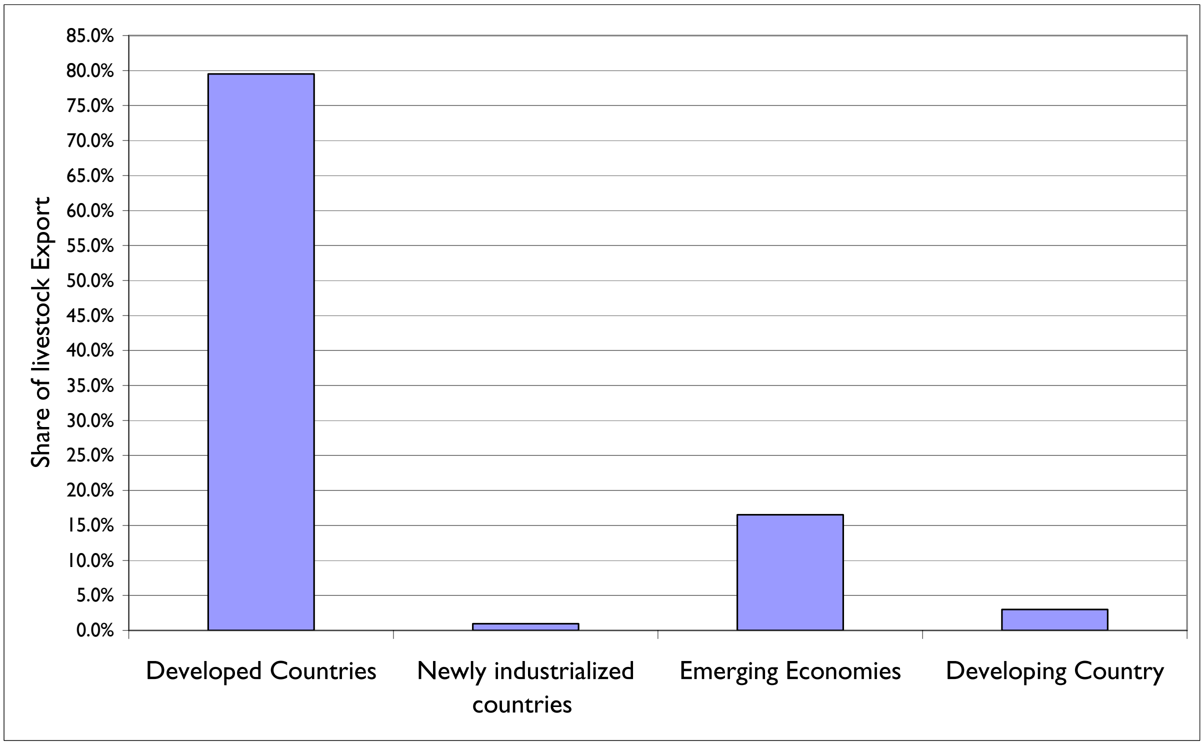
[33] Average daily per capita livestock protein intake in Sub-Saharan Africa in 2002 was 9.3 grams (representing actually a drop on 1980 levels), compared to 16.2 grams in developing Asia (an increase of 131% on 1980 levels), 34.1 in Latin America (24% increase from 1980), and 56.1 grams in industrialised countries.

[34] Source: world Bank, based on growth rates during 1991-2001. The highest growth rate is in sub-Saharan Africa (2.8%), followed by rest of Africa (2.6%), South Asia (2.1%) and Latin America/Caribbean (2.0%).

[35] IFPRI projections on the basis of a global food model (IMPACT).

Two emerging economies account for 9.6% of trade in beef (by value): Brazil with 6.7% and Argentina with 2.9% (Uruguay, a developing country, accounts for 2.3% of trade). Finally, four developing or emerging economies countries account for 8.7% of trade in pigmeat (by value): Brazil with 3.8%, China with 2%, Hungary with 1.7% and Mexico with 1.4%.

Figure 1 Share of global livestock product exports by key world regions (by value)



Source: UN COMTRADE data

It is widely acknowledged in the available literature that big gains are possible for the developing countries from removal of sanitary barriers now that post URAA tariff barriers have been reduced (e.g. A141); these opportunities are likely to expand if tariff barriers are further reduced in the ongoing WTO and bilateral negotiations. Within this evolving policy outlook, the improvement in SPS conditions for developing country exporters or potential exporters has become an issue of utmost importance (as well as being an obligation under the WTO SPS Agreement).

Furthermore, benefits are expected to accrue in terms of the potential savings to be made in outbreak costs from the fact that with improved prevention and veterinary services such outbreaks can be avoided altogether or their frequency reduced or at the very least their costs can be minimised. However, it is important to note that currently the cost-benefit of any investment aiming to improve early detection/diagnosis would tend to be unreliable as at present there are no accurate epidemiological modelling studies in the developing world of the rate of disease spread with late diagnosis versus early diagnosis (see for e.g. A7). Similarly, there is limited data and information on certain suspected risk factors, such as breaches in cross-border activity, which would provide the economic rationale in terms of the benefits of increased border controls for example[36].

In cases where data is available some cost-benefit analysis of the adopted/envisaged prevention and control measures has been carried out (outlined in section 4.4). The available studies focus at either of the above 3 main types of benefits or a combination. It is noted that estimating the potential benefit in export gains of improved export focused measures (such as establishing disease-free zones; developing laboratory capacity; regulation and training; strengthening capacity for slaughterhouse inspection and certification on exports, vaccination programmes) is a relatively more straightforward task. This analysis, however, is considerably more difficult and scarce in the case of sanitary measures that are aimed to improve domestic conditions and public health.

[36] Such analysis is difficult to perform even in the context of developed countries where data availability is usually higher. See for example, EFSA report on the risk of introduction of FMD in the European Union.

4. Literature review: synthesis of main findings

4.1. The economics of animal health: state of the art

To date, the economic dimension of animal health has been relatively under-explored within the analytical framework of production economics. The reasons why this has been the case have been extensively covered by literature (see, for example A17 and A115) and include:

- The complex impact of animal diseases: while direct impacts are more straightforward to quantify, the more subtle implications of these diseases (indirect impacts, spill-over and ripple effects) have been more difficult to approach.

- The complexity of livestock systems compared to crop systems, due *inter alia* to longer cycles (generally over a year full cycle compared to most annual crop systems).

- The fact that many livestock systems are an integral component of mixed farm systems, particularly in developing countries. This often constrains analysis to examining impacts at farm or household level only.

The economic impact assessment of animal diseases and disease control is generally carried out at two levels:

1. The micro-economic level of the herd or farm household;

2. The macro-economic levels of the sector, the country or internationally.

Our review has focused mostly on the macro-economic analysis (A17, A28, A68, A81, A82, A232).

A range of tools and methods are available under this heading, including economic surplus methods, mathematical programming, and simulation and systems analysis. The over-arching framework which all these methods and tools appear to feed into is an analysis of costs and benefits (although not always in the strict sense of a cost-benefit analysis, or CBA, as applied in project appraisal as such[37]). It is argued that, if the subject of the analysis is long-term disease control programmes at the national or regional levels, CBA is the analytical structure of choice[38]. CBA is typically carried out to evaluate and compare between

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[37] It is not possible here to provide a full description of the techniques of Cost Benefit Analysis (CBA). The reader is referred to suitable texts such as those by Gittinger (1982), Irwin (1978), and Dasgupta and Pearce (1978). Gittinger J.P. (1982). Economic Analysis of Agricultural Projects. Baltimore: John Hopkins University Press. Irwin, G. (1978). Modern Cost-Benefit methods. Basingstoke, UK: Macmillan Publishers Ltd. Dasgupta and Pearce (1978): Cost-benefit analysis: theory and practice. Macmillan, London.

[38] See for example, Dijkhuizen, Huirne and Jalvingh (1995): Economic analysis of animal diseases and their control. Prev. Vet. Med., 25, 135-149.

different strategies to inform policy-makers. It is used mostly to evaluate disease control programmes for a particular disease in a particular country or region within a country.

The various tools available for economic impact assessment differ greatly in complexity and in terms of the analytical skills required for their application, but are all limited by the requirements for appropriate data. Thus, generally, CBA in the AH field has been applied flexibly rather than in the strict project appraisal context. This is dictated largely by data limitations, as some of the costs and benefits are extremely difficult and contentious to quantify.

To overcome these constraints, CBA in the context of animal health strategies has often been based on relatively straight forward computation of key parameters such as the systems affected by the disease, livestock population at risk, disease incidence and possible control measures, leading to estimates of financial costs and losses and/or prevention/control costs[39]. Also, often the comparisons refer to different time periods for the respective costs and benefits, but due to the methodological difficulties a calculation of Net Present Values (NPVs) is not always undertaken. Although not as rigorous or comprehensive and despite these shortcomings, the advantages of this framework are that it can be applied and understood relatively easily (A115).

4.2. Costs of prevention and control systems

The sections that follow present data and key findings from a number of sources, including academic literature, project information, and national, regional and international programmes. With reference to the latter, the purpose has not been to address operational aspects or to evaluate the performance and positive/negative experiences of past investment, although where relevant a more critical assessment has been made.

4.2.1. The relevance of country preparedness to prevention and control costs

As already indicated, the costs of prevention will *inter alia* depend on the current state of the VS and preparedness levels in each country. For example, the most common key constraints to HPAI control and prevention, as identified by international organisations and experts[40] in the reviewed literature, include the following:

- Weak national veterinary services (VS);
- Poor surveillance;
- Lack of appropriate legislation in place in some cases;

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[39] An example of such a type of study (also involving simulation analysis under different scenarios) is A4

[40] Including the FAO, the OIE, the WB, AU-IBAR, Alive etc.

- Difficulties in implementing stamping out, vaccination, and movement restrictions, due either to inherent difficulties in the application of these control measure and/or to the inability of the VS to apply correctly;

- Disincentives for reporting the disease (in particular where compensation for culling has not been applied or has been applied incorrectly);

- Issues relating to lack of biosecurity.

An overview of the current status quo around the world for key components of an effective prevention policy (as discussed in section 3.4.3) is presented below.

It is noted that the OIE is currently in the process of assessing the level of preparedness and compliance with international standards of Veterinary Services in individual OIE Member Countries using the PVS tool. This work has started relatively recently, and the information that has emerged so far is in draft form and remains confidential. As more country analyses and information emerge from this process, the international community will be in a better position to assess the state of key components of prevention and control systems in countries around the world.

4.2.1.1. Emergency preparedness

A survey of OIE Member Countries around the world carried out in 2004/05[41] indicated that the main weaknesses in the chain of controls concern the logistical and financial resources of Veterinary Services, and insufficient involvement of livestock producers and even of field veterinarians. Furthermore, 25% of the African countries that responded to the survey have no program for control of transboundary animal diseases despite the high incidence of zoonotic and non-zoonotic epizootic diseases; this percentage is as high as 50% of the countries that responded from the Middle East[42] (A111e). It is important to note that only around 10% of these programmes/projects are targeted not at controlling one or more diseases but at improving overall animal health, by building the capacity of Veterinary Services. Against this, 65% of the countries perceive their capacity to comply with OIE standards on the quality of VS to be satisfactory on the whole[43]. Africa in particular suffers from a dire lack of capacities, as do Asia and the Americas to a lesser extent. An analysis of the survey results by country development level confirms that the developing countries have low capacities in all areas.

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[41] Survey based on a standard questionnaire sent to all OIE member countries in 2004 and 2005. The organisation and functioning of national Veterinary Services were analysed based on the responses from 85 of these countries.

[42] Percentages quoted are based on responses from the surveyed countries. In total 86 of the Member Countries of the OIE replied to the questionnaire (a 51% response rate), of which from Africa 20, Asia 21, the Americas 13, Europe 28 and Oceania 4. The low response rate of the Middle East may explain here why they appear to be worse-off than Africa.

[43] This question of the survey covered the following capacities of VS: staffing levels; training level; regulatory framework; budgetary resources; laboratory facilities; epidemiological surveillance; early detection/rapid response; risk analysis; information management; communication; collaboration between VS and public health services; participation in setting international standards; involvement of farmer organisations.; involvement of trade organisations; and the role of consumers.

To cope with the current disease situation, programmes and projects for the prevention and control of avian influenza have mushroomed since 2004, particularly in Asia and Europe, and more recently in Africa. According to another survey of some 200 countries[44] around the world carried out in 2006 by the UN System Influenza Coordinator (UNSIC), the majority of countries have made significant progress in the last two years in establishing Avian Influenza Task Forces and in developing integrated avian and human influenza preparedness plans[45] (A236).

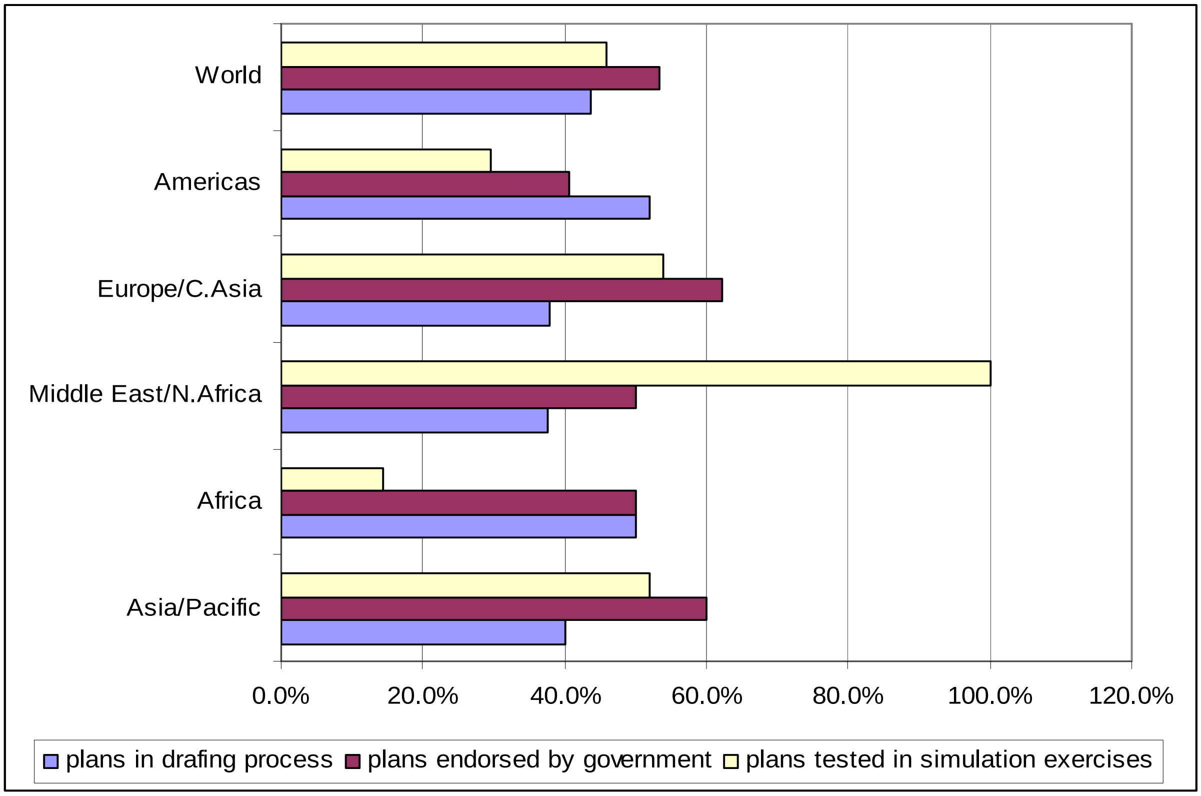
Despite continuing progress and the strong engagement of national governments, a number of shortfalls remain. Some 55% of these plans have been endorsed by governments, while 45% are still in drafting process (**Figure 2**). Also, plans remain largely untested. The percentage of national plans tested through simulation exercises is particularly low in Africa (20%) and the Americas (29%), followed by the Middle East/N. Africa (40%), Asia/Pacific (48%), and Europe/Central Asia (58%)[46].

[44] The countries covered by the UNSIC survey include all developing/transition countries that are members of the OIE, i.e. all the countries covered by our analysis.

[45] The UNSIC baseline survey was carried out in May 2006 with results reported in June. The objective is to update on progress every 6 months. Thus, a first update on this was prepared in November 2006 (in draft, latest update available). Systematic comparison with the evidence obtained in June already indicates progress in a number of respects. Globally, in the animal health sector, there have been some significant enhancements in avian influenza detection capacity, surveillance and reporting systems, trans-boundary disease controls, poultry vaccination policies, and poultry compensation arrangements. It should be noted, however, that a smaller number of countries responded to the November update than to the May baseline. Therefore, the data quoted here use mainly the results of the baseline survey when the response rate was higher.

[46] The UNSIC survey covers simulation exercises for integrated preparedness, i.e. no distinction is made between the animal disease outbreak part and the human pandemic part of the plan.

Figure 2 Overview of country national emergency plans for HPAI (a)



(a) On the basis of the number of countries that responded to the survey (133 countries)

Source: UN System Influenza Coordinator, June 2006

Another key point is that although plans tend to focus on common key intervention areas (such as pursuing animal health through improved bio-security and veterinary services and integrating the animal health and human health approaches[47]), there appears to be significant variation in the contents and quality of the plans. This observation has been made by the 2006 UNSIC survey and was confirmed by our analysis of the national plans (discussed in section 4.2.3). Although the World Bank, the EC and the OIE endeavour to carry out uniform, independent expert assessments or appraisals of the quality of these plans, as far as we are aware these are not publicly available on a systematic basis to allow an informed comment on this in the context of the current analysis.

[47] The WB inter-regional knowledge sharing seminar on avian and human influenza of July 2006 focused on the integrated country plans as the basis for coordinated and effective national response to avian and human pandemic influenza (AHI) and on the need for close linkages between health and agriculture services to facilitate the integration of national planning. Organised under the Global Development Learning Network (GDLN), a global partnership of more than 100 Distance Learning Centres.

4.2.1.2. Human resources

The availability of competent and well-trained human resources is an important dimension of the countries' preparedness to deal with animal diseases. Adequate expertise is essential to disease prevention and control. According to the 2006 UNSIC survey (A236), the number of trained veterinarians derived from existing official sources (as reported to the OIE Handistatus II database) varies considerably across all countries in the various world regions, and disparities between country/regions remain even after allowing for the size of the sector (in terms of the quantity of meat produced) per region/country (**Figure 3**).

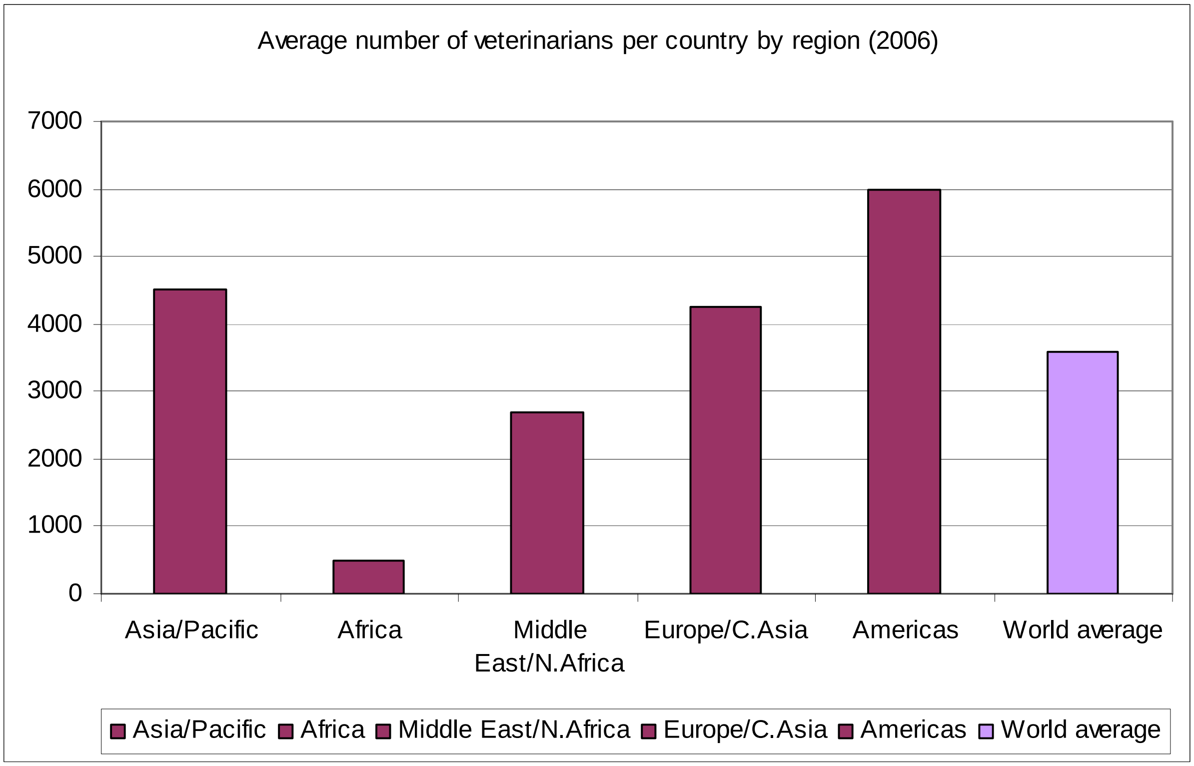
These data and disparities between regions should be interpreted with caution. Firstly, there are significant limitations in the data available on veterinary expertise. Secondly, it is difficult to make an objective comparison of the different veterinary personnel situations in different countries because veterinary systems and livestock structures / production systems (whether intensive or extensive, backyard or industrial etc.) vary enormously between countries and these factors influence the optimal number of required veterinary staff in each case (A80, A81, A92)[48].

Generally, however, there should be some proportionality between the size of the sector and the number of veterinarians[49]. In practice, this does not seem to be the case (**Figure 3)**. For example, in the Americas, the number of veterinarians per country in relation to the size of the sector (expressed in 100,000 tonnes of meat produced) is 30-35% higher than in Europe, Asia and the Pacific (data for Europe include C. Asia), over double than in Middle East and North Africa, and 12 times higher than in Africa.

[48] There does not appear to be an optimal number of veterinarians as such. Every country has different veterinary personnel conditions and needs, is at a different stage of development in its Veterinary Services, and employs a different structure of veterinary staff categories (often mutually overlapping). Therefore, the impracticability of setting a fixed and uniform international quantitative standard for Veterinary Services is recognised (A80).

[49] Literature from the early 1990s (A81), quotes 20,000 Veterinary Livestock Units (VLUs) per veterinarian as the appropriate ratio for curative and preventative work in the extensive and low-input livestock production systems in Africa and the Middle East, compared to 2,500 VLUs in the high density and capital intensive production systems found in Europe. For regions characterised by a combination of extensive and intensive production systems (North and South America, Asia, Oceania) the average of the two above figures (i.e. 12,500 VLUs) is taken as a standard. An analysis of 1989 data shows that the Middle east at the time has a surplus of veterinary personnel, while Africa had a substantial deficit in veterinarians but a surplus in veterinary auxiliaries. (VLU: equivalent to 1 cow or 2 pigs or 10 small ruminants or 100 fowl).

Figure 3 Availability of veterinarians per region



Source: UNSIC 2006, based on FAOSTAT and OIE Handistatus II data for 2004

It is not just the number of veterinarians per se that is important, but also their **training**. From the results of the UNSIC survey, the number of veterinarians specifically trained in AI detection is unclear but it seems that significant gaps exist. Also, few countries[50] appear to have any village veterinary workers, and those which do generally have already been affected by AI. A survey conducted in 2003 to assess the current undergraduate curricula[51] in the veterinary faculties of sub-Saharan Africa demonstrated that most of these faculties faced serious shortages, both in budgets and qualified personnel (A153).

Beyond the availability of sufficient, competent and well-trained resources, major gains in the efficiency of human resources can be achieved by eliminating the overlap of functions between the public and private sector, through better organisation, streamlining of operations and a clear chain of command.

[50] Only 17 amongst the countries that responded to the survey.

[51] The survey examined the extent to which such curricula are adjusted for crucial developments in the veterinary field and the increasing risk of transboundary diseases.

4.2.1.3. Animal disease surveillance systems

Building and maintaining good (epidemio-)surveillance networks covering the entire national territory potentially for all animals and for all animal diseases, including zoonoses, is an international obligation of all OIE member countries (**Table 1**).

Nonetheless, as demonstrated by the large animal health crises of the last decade including those related to FMD and HPAI, many countries especially in the developing world fall short of meeting this requirement. This is due to the lack of significant human resources, as well as of the necessary technical and financial resources that accompany both the initial investment and its operational maintenance.

The 2006 UNSIC survey (A236) provides a global perspective of the overall surveillance capacity for animal health. This indicates that overall capacity is perceived to be strong with nearly 84% of the surveyed countries reporting a strengthened AI surveillance and reporting in birds. Surveillance capacity appears to be equally strong across all regions.

Delays in reporting the outbreak of a disease to the OIE, the official body for mandatory reporting of listed animal diseases, can be an indicator of a country's preparedness to manage outbreaks (A236). A recent FAO investigation of reporting times for outbreaks of AI in animals, which covered some 2298 disease outbreak events from 31 countries since 2003, concluded that the average time from outbreak observation to reporting to the OIE was 12.7 days with a median of 10.8 days (range: 1.2 – 44.5 days). The required reporting interval from observation of an outbreak to notification of the OIE is immediate or 24 hours. This disparity may well suggest that significant gaps continue to exist in country-level preparedness[52].

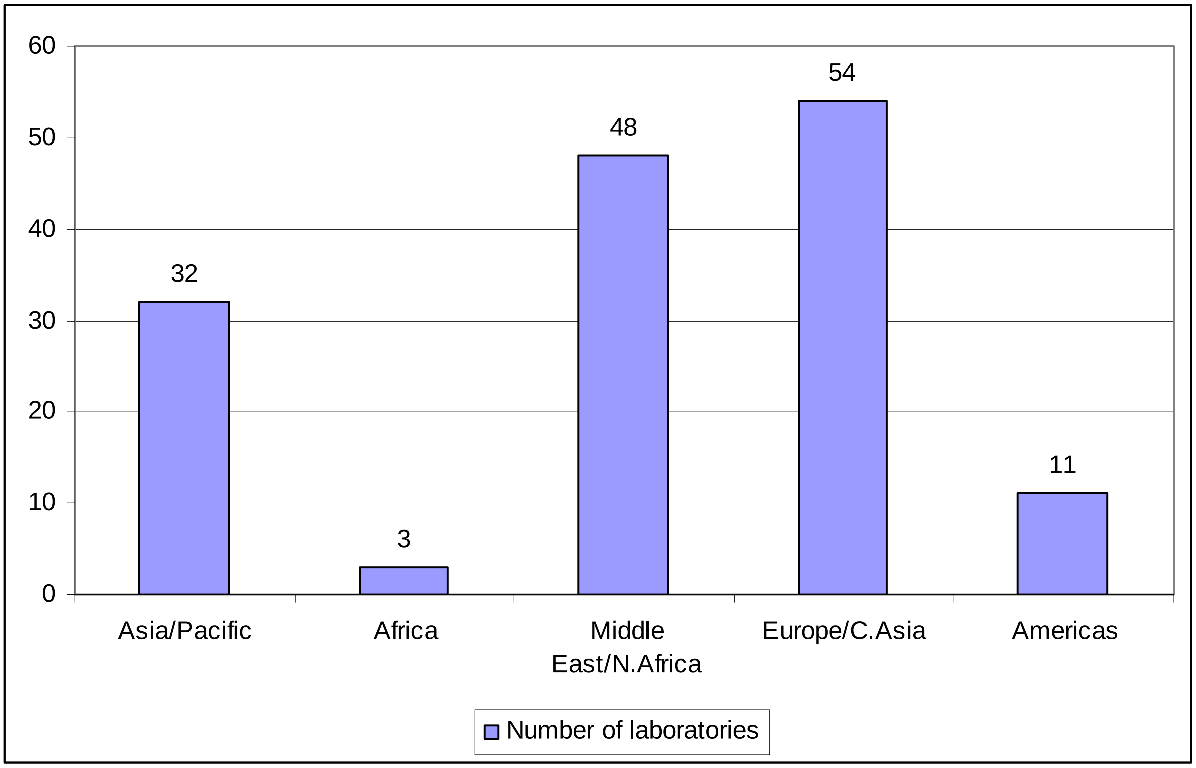
Looking in more detail at two major components of the animal disease surveillance system, border controls and diagnostic capacity, according to the 2006 UNSIC survey:

Border controls for AI are also fairly strong, with 80-90% of countries across all regions planning or implementing such controls. It should be noted, however, that limited information is available on border control breaches (fraud/illegal imports) which makes it impossible to define the current level of risk from cross-border activity.

By contrast, **laboratory capacity** for AI detection is apparently in place for only some 65% of the countries that responded to the survey. Laboratory detection capacity is particularly low in Africa (reported in only 6 of the countries), the Middle East/N. Africa (7 countries) and the Americas (7 countries). Although the picture is better in the rest of the world it is still fairly modest in comparison to the key importance of this component (Asia/Pacific: 11 countries; and Europe/C. Asia: 19 countries). From the survey results, it seems that around 148 laboratories in the world today have the capacity to detect AI.

[52] This may not necessarily always be the case. Political pressures to under-report exerted by the industry and/or other interest groups can not be excluded.

Figure 4 Number of AI detection laboratories per region



Source: UNSIC survey, October 2006 (A236)

Furthermore, only 50% of the countries surveyed in Africa, Asia/Pacific and the Americas are planning or implementing **controls on cross-species contact of birds and other animals**, compared to around 80% in Europe/C. Asia and the Middle East/N. Africa.

According to the Alive partnership[53] as well as the PACE programme[54], capacities for disease reporting with epidemiological investigation and differential diagnostic follow-up actions as well as data analysis are generally deficient in Africa (A258 and A163). This is despite the significant progress made in developing national surveillance systems by programs aimed at controlling epizootic diseases (in

[53] ALIVE: Partnership for Livestock Development, Poverty Alleviation, and Sustainable Growth.

[54] The Pan African Programme for the Control of Epizootics (PACE) replaces the Pan African Rinderpest Campaign (PARC) which concluded in 1999. The main aim of PACE is a surveillance of epizootic diseases in Africa to accurately determine their prevalence and impact on livestock production. It is the first continental epidemiology programme. The five-year PACE programme covers 32 sub-Saharan countries, has a 72 million EURO budget, and is co-ordinated by the Inter-African Bureau of Animal Resources (IBAR) of the Organisation of African Unity (OAU).

particular PARC and PACE[55]) over the last 20 years, which have received sustained funding and technical support[56]. More recently, in January 2006, the FAO launched a series of Regional Technical Cooperation Projects in West/Central, East/Southern and North Africa, which are intended to establish HPAI disease and epidemiological surveillance networks.

4.2.1.4. Vaccination

Vaccination is another control and/or prevention measure applied in selected cases, where this is available and considered appropriate. At present, there is significant literature and policy debate on the suitability of this control method and the conditions that need to be fulfilled for its effective application. For example, vaccination for HPAI has been applied in Vietnam (apparently with successful results) but not other parts of Asia[57], and is currently being considered in Nigeria although there is a strong debate on its potential effectiveness in the Nigerian context (A293). In the countries where a vaccination strategy was adopted, this was mainly because the disease had spread widely throughout the smallholder poultry sector, particularly in production systems 2, 3 and 4 (medium to low level of biosecurity), accompanied by very high animal mortality (A40). The trade situation of a country and its concern to have its products accepted in export markets is another key parameter affecting decisions to adopt vaccination (e.g. Vietnam has no exports versus Thailand which is a key export country). The debate is compounded by the lack / limited access to data on the efficacy of this policy option and of the current vaccines used[58].

The 2006 UNSIC survey (A236) indicates that country attitudes and vaccination strategies differ substantially between regions and the implementation of such programmes remains relatively infrequent. The percentage of countries planning/implementing poultry vaccination is particularly low in the Americas (16%), Europe/C. Asia (23%), and the Middle East/N. Africa (28%), and relatively modest in the rest of the world (Africa: 52%; Asia/Pacific: 45%) Although in the last 6 months of 2006 countries stepped up their preparation of vaccination plans, it is unclear whether this was triggered by a growing acceptance of this policy option or simply reflects the response to the rapid spread of H5N1.

The OIE/FAO are currently in the process of developing guidelines on vaccination for HPAI, which cover *inter alia* the epidemiological situation of the disease, the type of poultry production systems, logistical

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[55] It was in fact the PACE surveillance programme that first alerted Africa to HPAI infection (in Nigeria).

[56] Despite the progress achieved by these programmes, new challenges have emerged in terms of prevention and control, such as those more recently posed by HPAI. Also, few donors have allocated funds so far to finance projects that would ensure the sustainable and long-term reinforcement of VS.

[57] Currently (Nov 2005), China, Vietnam, Indonesia and Pakistan are the only countries using vaccination as part of their HPAI control strategy.

[58] Modelling studies suggest that where 90% of birds in a flock are adequately protected by vaccine, the probability of flock infection is reduced by 50%. However, despite such vaccination protection at the individual level, 'silent spread' of H5N1 can still occur within the flock, with risk for transmission between flocks, particularly at the end of production cycle when biological security is compromised during bird transportation and cleaning of housing units. This highlights the need for a highly effective vaccine, an equally effective vaccination delivery mechanism, adequate bio-security measures, and potentially, the use of unvaccinated sentinel birds placed within vaccinated flocks (A236).

factors (veterinary services, cold chain requirements), diagnostic capacity, the objective of the vaccination campaign (whether emergency, preventive or routine), the strategy (mass, targeted or ring), and monitoring and financial issues. A world conference on vaccination for avian influenza has taken place in March 2007[59]. The conference's recommendations state that "*vaccination plans should be an integral part of a country's contingency and emergency preparedness plans*", and that "*vaccination should be considered on the basis of a comprehensive analysis including risk assessment of the country situation and context*", "*when relevant as an additional tool to classical methods such as stamping out and increase of biosecurity, but always in combination with these classical methods*". Furthermore it is recommended "*that importing countries respect the OIE standards to avoid unjustified trade barriers related to vaccination against avian influenza*".

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Our analysis in this section leads us to the following conclusions:

<u>Relevance of country preparedness to prevention and control costs:</u>

The costs of improved prevention and control for the major TADs will depend *inter alia* on the current level of preparedness in the various countries.

Existing data from international surveys (OIE, UNSIC) and other literature suggest that there are considerable differences in approach and status quo between developing/transition countries, notably in terms of the overall state of Veterinary Services, preparation of prevention and control plans for specific diseases (e.g. HPAI), available and well-trained veterinary staff, epidemio-surveillance networks, border controls, diagnostic capacity, and vaccination.

In the context of countries' international obligations within the overall framework for the prevention and control of major TADs, as defined by the OIE, the varying levels of preparedness and prevention systems between countries indicate the need to define priorities and assess gaps on a country by country basis. In the case of vaccination the policy debate on the appropriateness and conditions for application of this method is currently on-going.

This has implications in terms of the budget required in each country to enable it to arrive to an optimal surveillance system.

[59] Vaccination: a tool for the control of avian influenza. An OIE/FAO/IZSVe scientific conference co-organised and supported by the EC (http://www.oie.int/verone/index.htm).

4.2.2. Assessment of costs at international (global/regional) level

A number of international initiatives are in place today, whether global, regional or disease specific, which range from detailed programmes for the control of specific TADs (HPAI, FMD, rinderpest etc.), to more general international initiatives in the field of prevention and control of TADs, and activities dealing with the enforcement of SPS rules and standards. These provide assessments of the relevant costs, either at global/regional level, and/or at country level[60]. They include the following (listed in order of relevance to the study, moving from those that are disease specific to the more general)[61].

4.2.2.1. Disease specific programmes

a) Global fight against avian influenza

The global financing framework for the fight against avian influenza has been flexible and dependent on systematic monitoring of the prevailing and anticipated needs. Thus, a number of need assessments of the required budget have been prepared in the last 2 years by the various competent international organisations and presented to donors with requests for funding. These assessments include components that relate to the control of the disease in the short term and components that relate to the medium-long term objectives of improving prevention and the capacity of national VS to respond more effectively to outbreaks. Pledges have consequently been made for funding action at three levels: country responses which attract the bulk of the budget, and - given the need for countries to cooperate on cross-border issues - involvement of key regional organisations and global activities (WHO, OIE, FAO, and others).

The international stakeholders' meeting on Avian Influenza and Human Pandemic Influenza (AHI), which was held in Geneva in November 2005, concluded with a strong consensus on the need to address AHI by supporting integrated country programs, covering both animal health and human pandemic preparedness, complemented by regional and global coordination. As a result, a total US$ 1.87 billion was pledged in January 2006 at a donor pledging conference in Beijing, including both grants and loans/credit, of which a total US$ 1.4 billion had been committed as at 31 October 2006[62] (A147 and A282).

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[60] It is noted that where needs assessments are performed by the countries themselves, their demands may not necessarily reflect real needs. The data that are available in this context should always be used with caution. The OIE PVS evaluations can play an important role in this respect in providing an objective picture of the real situation, moreover as they follow a uniform approach between countries.

[61] This section does not aim to provide an exhaustive list of all the programmes in place today, but to highlight some of key relevance to this study.

[62] The largest international sources of support have been the World Bank (14%), the European Commission (13.2%) and the Asian Development Bank (5.6%). The largest country donors have been the United States (26.9%), Japan (13.3%) and Australia (7.9%), followed by several EU MS (Germany, UK, France, Netherlands, Sweden, Finland) which together account for 11.4%.

The pledge was based on a World Bank assessment of the financing needs and gaps at the time (A89 and A176)[63]. This included mainly country level support (accounting for US$ 1.2 billion), and relatively smaller shares to support the role of international organisations in assisting regional and global initiatives on animal health (US$ 75 million, for organisations including the WHO, FAO, and the OIE) and on human health (US$ 157.6 million for the WHO).

The activities foreseen included assistance to ‘infected’, ‘at risk’ and ‘newly infected’ countries for: emergency preparedness (development of functional disease control plans and simulation exercises; development of contingency plans for human pandemic of influenza of avian origin), active surveillance and monitoring, and communication and public awareness; laboratory support (including provision of equipment and consumables, assistance with diagnostic procedures), and assistance with analysis and studies (including of epidemiological data); and disease control (including provision of equipment, vaccines and consumables), capacity building, poultry industry restructuring, and various coordination activities.

When first presented at the Geneva stakeholders’ conference and to the Beijing donor pledging conference, the global programme for avian influenza control (developed jointly by the OIE, FAO and the World Bank), had estimated costs for the animal health component only to US$ 494.3 million over a period of 3 years (of which some US$ 60 million were sought for the first 6 months as emergency action).

Due to the rapid expansion of the disease, this budget was substantially revised in March 2006 to a total estimate of US$ 882.1 million over the 3-year period (FAO’s perspective for a global programme for avian influenza control and eradication A42). Of this, some US$ 308.5 million were proposed to serve as a contingency mechanism, to be managed by the FAO, for rapid response to infections in new countries not identified as yet (of which funds for 6 months only, at US$ 21.6 million, were sought at this stage). The important budget increase provided for the unexpected spread of the disease to Europe and Africa (two continents that were not affected in November 2005 when the previous estimates were made) but also in Asia itself. The budget included an international coordination component of US$ 132 million[64].

The emphasis was mainly on infected countries for which nearly a third of the total budget (some US$ 304.5 million) was proposed. Two countries (Indonesia and Vietnam) accounted for nearly a third of this total (US$ 75.3 million and US$ 20.4 million, or 25% and 7%, respectively), whereas India and Nigeria were estimated to need around US$ 45 million each (i.e. 15% each of the total)[65]. A further US$ 157.6 million was proposed for countries ‘at risk’ which included all world regions.

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[63] The Technical Note (Annex C) to document A89 (“AHI: Financing Needs and Gaps”) provides details of the costing for individual countries, the assumptions made and the tools used for extrapolation to the world. This procedure was undertaken in consultation with the OIE, the FAO and the WHO

[64] This was drafted on the basis of supporting coordination activities to be undertaken by the FAO as such and did not include activities related to the OIE notably coordination of the international effort for the strengthening of VS for mid to long-term capacity improvements, which was part of the original Geneva budget (for a proposed $22.5 million).

[65] The proposed budget for Indonesia, Vietnam, Lao and Cambodia was based on detailed need assessments in the countries, whereas for a second set of countries (15 countries, including India, Nigeria, Egypt, Iran, Cameroon, Romania, Turkey, Malaysia etc.) detailed need assessments were still to be provided.

In December 2006, at a major three-day international donor conference on avian flu in Bamako[66], the World Bank provided revised estimates of the global financing needs and gaps for combating avian flu during the 2006-08 period, with total needs for country-level support estimated at US$ 2.27 billion[67] (A147 and A282).

The revised estimates were justified as follows. Firstly, it was already evident that due to the high disbursement rates of the previous pledges (as of end of October 2006, some 75% of the Beijing pledges had been committed and 51% had been disbursed) grants were already exhausted and not available for programs going forward[68]. Secondly, the focus of the previous pledges had been mainly East Asia and East Europe with Africa receiving little support; consequently, the revised estimates placed an increased emphasis on support to newly infected countries in sub-Saharan Africa while maintaining the level of effort required for fighting the disease in SE Asia (**Table 3**). Thirdly, since the Beijing pledge, there had been a dramatic increase in the number of countries reporting infection (55 in total since January 2006), and in the number of human deaths (154 in total).

The World Bank estimated that, under two different scenarios, the financing gaps as in December 2006 were US$ 880 million to US$ 1.15 billion. As of today, it appears that following the Bamako donor conference, a further US$ 475 million has been pledged by international donors[69].

As part of the overall financing framework for avian influenza control, the World Bank proposed in December 2005 a $500 million multi-country facility (a horizontal APL) designed along the lines of a multi-country Adaptable Program Loan (MAP) for a global program for avian influenza control and human pandemic preparedness and response (A43). A total 30 projects have been approved to date under this programme for a total US$330 million. The total and individual detailed components under each project are summarised in **Annex 4**, and more details of the projects that are currently in progress in Nigeria and Romania are contained in the case studies on these countries (sections 5.3 and 5.4 respectively).

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[66] The objectives of the Bamako Conference were: (1) To take stock of international mobilisation within the framework of a world wide partnership in the fight against the avian influenza epizootic and the prevention of a global pandemic; (2) To provide the necessary technical elements and draw lessons from the initial experiences with a view to improving the global combat strategy; (3) To develop a specific advocacy strategy that targets African governments and the donor community for increased financial support to combat the disease on the continent. For more information see: www.avianinfluenzaconference4.org

[67] In addition, estimates were given of need to support UN agencies ($300 million for 1 year) and the OIE ($25 million for 1 year only).

[68] The only source of funding with substantial uncommitted amounts were the multilateral development banks (WB and ADB). As of end of October 2006, they had committed $281m to specific AHI programs, against Beijing pledges of $974m. **However, these uncommitted funds were mostly loans and concessional credits, rather than grants**. Disbursement rates of multilateral development banks were low because the country programs that they finance are multi-year (strengthening of animal and human health services and other capacity-building typically requires 3-5 year programs). To circumvent this problem, and facilitate speedy implementation, the World Bank applies its emergency lending procedures to avian flu projects under its Global Programme for Avian Influenza Control (GPAI/APLs) (A43).

[69] In addition to the $513 million committed as at end of October 2006.

The global financing framework for HPAI is summarised in **Table 3**. Of the estimated financial needs in the original estimates in January 2006, infected and newly infected countries account for the majority (60%). A relatively high amount was also estimated for countries at 'high risk' (38% of the total), which reflected the large number of countries falling in this category. In terms of geographical distribution of the country needs, a comparison of the January 2006 and December 2006 estimates reflects clearly the change in focus following the emergence of HPAI/H5N1 in Africa. In the original estimates of January 2006, East Asia accounted for over half of the total (52.8%), followed by Europe/Central Asia (18.7%), sub-Saharan Africa (12.2%), and Middle East/North Africa (9.15%). In the revised estimates of December 2006, East Asia maintained the largest share (41.1%), while the share of Sub-Saharan Africa increased substantially (25.9%). In fact, between the two estimates, the financing needs for Africa have increased fourfold, the needs for East Asia and South Asia increased by about 50%, and the needs of the Middle east/North Africa more than doubled. The largest need increases were for Egypt and Nigeria. Indonesia accounted for a large part of the increase in the financing gap in East Asia.

Given that the above framework covers the next 2-3 years (3 years from January 2006, 2 years from January 2007), it could be deducted that – as it currently stands - the global estimates of the required investment in improved prevention and control for an integrated (animal and human health) HPAI project, including country needs and regional needs, come to an **average US$ 860 million per year**.

Table 3 Prevention and control of HPAI: global financing framework and country needs

	Needs (a) (million US$)
WB: Financing needs and gaps, January 2006 (Beijing pledging conference)	
• Country needs (b), of which:	1,202.3
Infected countries	*565.9*
Newly infected	*150.5*
High risk	*461.1*
Low/moderate risk	*24.8*
TOTAL (c)	***1,809.7***
WB: Financing needs and gaps, December 2006 (Bamako pledging conference)	
• Country needs (b), of which:	2,273.9
Sub-Saharan Africa	*588.9*
East Asia & Pacific	*935.2*
Europe & Central Asia	*247.0*
Latin America & Caribbean	*21.0*
Middle East & North Africa	*233.0*
South Asia	*148.7*
TOTAL	***2,273.9***

(a) Estimates of needs for the next 2-3 years

(b) Excluding contingencies at 20%
(c) Including contingencies at 20%; including needs at regional level

Source: WB, January 2006 and November 2006 (A89 and A147)

According to the methodology underlying these estimates (A89), a significant proportion of identified needs in fact address rapid emergency containment in the event of an outbreak (including culling, compensation, control and vaccination costs). Projected at the latest WB estimates presented in Bamako (A147), this amounts to just under US$ 1 billion (**Table 4**). On the other hand, prevention and preparedness costs as such (i.e. including preparation of preparedness plans, coordination, surveillance and early warning, development of animal health strategies) accounts for 45% of the country needs, or just over US$ 1 billion. On a 3 year basis, this amounts to **an average US$ 340 million per year.** It is noted that this includes both the animal and the human health components of prevention and preparedness for AI.

Table 4 Prevention and control of HPAI: estimates of global needs by type of intervention

	In million US$ (a)	**Share of total (%)**
1. Cross cutting issues (preparedness plans and coordination) (b)	181.9	8%
2. Surveillance and early warning (animal and human)	636.7	28%
3. Rapid outbreak containment plan and operations (animal and human) (c)	977.8	43%
4. Health system response to deal with AI	27.3	12%
5. Preparing a medium-term agenda for animal and human health	204.7	9%
TOTAL (a)	***2,273.9***	***100%***

(a) Excluding contingencies at 20%. Source A89
(b) For which a standard package of technical assistance and studies of US$ 250,000 was taken as the baseline for an average size country, adjusted for country size.
(c) This includes culling and compensation costs, and vaccination costs.

Source: World Bank (A89 and A147)

The Africa estimates included in this framework were established in the context of the ALIVE project. A preliminary assessment of the financing needs and gaps for avian and human influenza control and prevention in Africa was made in June 2006 (Vienna meeting). This was revised in December 2006 for the Bamako conference (A 258). The global budget needs were estimated at US$ 722 million for immediate and short term needs for 3 years; and another US$ 1.1 billion for year 4-10 (**Table 5**). The animal health component as such accounted for over half of the estimated needs in each case.

The ALIVE needs assessment for Africa prepared a detailed breakdown of the various costs involved, including for the animal health component (as a total for the 54 countries covered by the assessment). Of the total national funding estimated to be required for the animal health component, prevention activities and the strengthening of VS as such accounted for only a fifth of the budget in the short term 3-year period (US$ 44.4 million and US$ 32 million, respectively) (**Table 5**). However, in the medium to long term period, these activities were estimated to amount to 66% of the total needs, largely because of the increased investment in strengthening VS (US$ 74.5 million and US$ 269.3 million, respectively). On the other hand, the bulk of the costs in the short term were taken by the estimated response needs, in view of the urgent upsurge of AI, but the relative share of these costs diminished in the medium-long term time frame (from 80% down to 34%).

Table 5 Prevention and control of HPAI: Africa needs estimates by type of intervention

	in '000 US$		
	Immediate	**short term (3 years)**	**Medium & long term (4-10 years)**
Animal Health Component (national funding)			
1. Prevention			
Preparation of emergency preparedness plans	2,000	2,000	
Strengthening disease surveillance for early detection, diagnosis and reporting	700	19,000	42,000
Improving biosecurity		8,000	17,500
Training & continuing education of veterinary staff	2,000	5,000	15,000
Poultry census and mapping of farming systems		1,000	
Sub-total	*4,700*	*35,000*	*74,500*
2. *Response (a)*			
Sub-total	*9,550*	*252,500*	*178,200*
3. Strengthening VS			
Governance and legislation activities in line with international standards		520	480
Development of priority infrastructure		24,000	224,000
Strengthening the capabilities of public and private national actors		2,300	19,600
Support for the organisation of producers and processors		2,900	25,200
Sub-total		*31,970*	*269,280*
Total Animal Health (national funding)	***14,250***	***333,720***	***521,980***
Total Animal Health (regional funding)		***58,410***	***94,850***

			in '000 US$
	Immediate	**short term (3 years)**	**Medium & long term (4-10 years)**
Total Animal Health (national & regional)	***14,250***	***392,130***	***616,830***
Global budget (b)	***22,603***	***722,055.5***	***1,095,598***
Total AH share of global budget (b)	***63.1%***	***54.3%***	***56.3%***

(a) This includes culling, compensation, and control costs (including vaccination).
(b) Global budget includes human health and communication activities

Source: ALIVE (A258)

b) South East Asia campaign for the control and eradication of FMD (SEAFMD)

In 1994 the OIE launched a campaign to control and eradicate FMD in Southeast Asia. For this purpose it established a sub-commission for FMD control in South-East Asia (SEAFMD)[70] and in 1997 established a Regional Coordination Unit for FMD in South-East Asia (RCU) in Bangkok to harmonise the control actions against FMD between the countries of the region (A 234). At that time in fact the Veterinary Services of the seven countries concerned were at different stages of development and most of them lacked veterinary staff with good training and adequate resources. The sub-commission developed a regional plan for FMD control as a guideline for control activities in the region (SEAFMD campaign). The RCU operated a regional coordination role by assisting countries to develop harmonised plans and to implement the FMD control measures in line with the SEAFMD campaign. The annual budget of the Regional Coordinating Unit (RCU) is estimated at US$ 600,000 per year to operate the coordinating and monitoring agency and to supply the necessary skills, training and information throughout the campaign.

The project was developed in three phases. The first phase (1997-2000) (*Preparatory Phase*) focused on the reinforcement of the animal health services in the countries concerned and in achieving uniformity in the disease control activities to reach a minimum standard before starting phase 2 of the program. The second phase (2001-2004) (*Control Phase*) was focuses on extensive epidemiological monitoring, strategic vaccination, animal movement control and step-by-step creation of disease free areas. The third phase (2006-2008) (*Eradication and Consolidation Phase*) has the objective to establish a well protected and internationally verified FMD free zone within the region (13th meeting of the OIE SEAFMD Sub-Commission for FMD in Southeast Asia, Cambodia, March 2007).

All these activities have involved collaboration with the FAO and the joint FAO/IAEA division, the International Livestock Research Institute, the World Reference Laboratory for FMD (Pirbright, UK), and agencies such as ACIAR. National donors from countries in the region have also significantly contributed to the campaign.

[70] Initially SEAFMD involved seven member countries of the ASEAN (Association of Southeast Asian Nations) countries with endemic FMD. They were: Cambodia, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam. Indonesia joined the Sub-Commission in 2000 (A181).

Only two countries of the region at the start of the campaign, namely Myanmar and Thailand, had a capacity to produce vaccines. Due to the high budgets required for the purchase and application of massive vaccination, vaccination has only been used to protect high-risk enterprises, to undertake strategic vaccination and to control outbreaks at a local level (ring vaccination). (Regional Coordination, OIE SEAFMD programme).

This campaign was successful in the Philippines where two thirds of the country have achieved the FMD free zone status and in Indonesia which is free of FMD. In 2003, a new step in the SEAFMD strategic plan started through the Malaysia-Thailand-Myanmar (MTM) Peninsular Campaign for FMD Freedom. The MTM Campaign involves Malaysia, Thailand and Myanmar, and aims to establish a FMD free zone on the MTM peninsular according to the OIE standards.

In 2003, the Asian Development Bank (ADB) presented a regional programme aiming to achieve an FMD-free zone in the Greater Mekong region over a 6-year timeframe, with a proposed budget of US$ 5 million over the 2003-07 period.

c) Pan American campaign for the control and eradication of FMD (PANAFTOSA)

To fight against FMD in the Americas, the Pan American Foot and Mouth Disease Centre (PANAFTOSA) was created in 1951 in Rio de Janeiro as a special program within the Organisation of American States (OAS), and later transferred as a specialised centre of the PAHO (WHO). The centre was created to improve the control and eradication of FMD through research on new vaccines and diagnostic procedures, and trained government and private sector workers throughout the Americas to set up strategies for the control and eradication of FMD. (A191)

The Centre developed reference techniques for virological and serological diagnosis for FMD as well as for vaccines and in 1973 developed the Continental System for Information and Surveillance of Vesicular Diseases, to collect epidemiological information in all countries of South America.

In 1987 PANAFTOSA under the guidance of the Hemispheric Committee for the Eradication of Foot and Mouth Disease (COHEFA) developed the Hemispheric Program for FMD eradication (PHEFA) as a regional programme to be foreseen by the single countries.

The objectives of the PHEFA were to eradicate FMD of the America by 2009 through the control and elimination of the disease in endemic areas and the prevention of reintroduction of the disease in free areas.

Based on the knowledge of the production forms, the identification and evaluation of the risks of introduction of FMD in different areas according to a macro regionalisation of South America in endemic and free areas, the programme set up the guidelines for national programmes for the control and eradication of FMD. The main principles of the program include: epidemiological surveillance; prevention system; sanitary control at airports, ports and borders; laboratory diagnosis and vaccine control; vaccine production; massive and systematic vaccination; control of outbreaks; information systems; border controls; and community participation (Source PANAFTOSA- PAHO/WHO).

These principles were adopted at national level by each country, and the outbreaks were largely successfully controlled through massive vaccination or stamping out according to their own national control and eradication policies for FMD, quarantine measures and control of movement at border areas and between areas with different FMD health status.

In consequence of new outbreaks in 2001 which affected Argentina as well as Uruguay, and parts of southern Brazil (A191) on March 2004 GEIFA (Inter-American group for FMD eradication) was created as the competent body for the preparation, supervision and execution of the regional project for the final phase of the eradication of FMD in the Americas, as part of the PHEFA and in support of the national programmes for FMD prevention and eradication. GIEFA developed an Action Plan for 2005-2010. The Basic Strategies of PHEFA and GIEFA are the knowledge of livestock production forms; the characterisation of risk of introduction and diffusion of FMD; strengthening of National Veterinary Services; improvement of coordination between National services on a regional basis; stimulate livestock sector participation in programmes; allocation of international resources for the poor or in need areas.

In the wake of the FMD outbreaks which occurred in 2001, especially in Europe and South America, the OIE and FAO convened an international conference on FMD in Brazilia, Brazil. One of the key recommendations was a call for international action against major animal diseases, especially FMD, rinderpest and classical swine fever. This was further emphasised by the special ministerial meeting on FMD during the 31st Session of the FAO Conference, which urged the FAO, OIE and World Health Organisation (WHO) to continue their joint efforts to seek an international solution to the problem of FMD and other transboundary animal diseases.

The FMD campaign has attracted significant funds over the years. During the 1990-2004 period, some US$ 3.5 billion have been committed to the fight against FMD by South American countries, and these efforts are continuing. While a regional approach is increasingly being advocated to addressing FMD, the extent of the financial commitment on GIEFA is not clear as yet. A review of the cost-benefit of improvements in Latin American veterinarian systems was recently undertaken by the OIE Regional Representation/CEMA (A141) [71]. These issues are explored further under the Argentina case study (section 5.1).

d) Pan-African Programme for the Control of Epizootics (PACE)

PACE is a five years (2002-2007) regional programme coordinated by the African Union Inter-African Bureau of Animal Resources (AU-IBAR) with the aim to improve surveillance of epizootic diseases in Africa to accurately determine their prevalence and impact on livestock production. 32 Sub Saharan African countries were involved in the project, which has represented the first continental epidemiology programme. PACE has been funded by the European Union through the European Development Fund and its total cost **over the 5 year period has been estimated at 72 million EURO**.

The programme is a successor to the Pan African Rinderpest Control Programme (PARC) in force from 1986 until 1999, which virtually eradicated Rinderpest in Africa. PARC has been a key element of the Global Plan for the Eradication of Rinderpest (GREP), a programme coordinated by FAO that aims at the eradication of the disease from the world by 2010. (Source: FAO EMPRESS)

According to an assessment made by the Epidemiological Unit of PACE, CBPP is endemic in many parts of Africa and it is identified as the second most important transboundary disease in Africa after rinderpest. The reasons for the persistence of CBPP are attributed to animal movement within and between countries and to the absence of adequate diagnostic tests, the lack of use of diagnostic tests because of diminished financial support and a downturn in the use and quality of CBPP vaccine.

[71] This research is currently in progress – results are preliminary. Further findings are presented in **Table 10**.

Animal losses in Africa due to this disease are estimated to be about US$ 2 billion. Several projects have been undertaken from 1990-2003 to assist the member countries in the control of CBPP through FAO TCP[72] for a total amount of US$ 3,322,633. (Source Towards sustainable CBPP control programmes for Africa, FAO, 2004).

4.2.2.2. General programmes

a) Standards and Trade Development Facility (STDF)

The STDF was formally established in mid-2002 by the FAO, the OIE, the World Bank, the WHO and the WTO, as a financing and coordinating mechanism. The World Bank estimates that annual expenditure by donor agencies on trade-related SPS programmes has been running at an **annual budget of US$ 65-70 million** (although some under-reporting of technical cooperation activities is possible). However, based on data from the STDF database, it would appear that only a small minority of the projects reported deal with the strengthening of hard infrastructure such as laboratory facilities (the bulk dealing with knowledge transfer projects) and that in terms of the overall number and value of projects, animal health lags behind the food safety sector and other SPS issues[73] (A111f).

b) Global framework for the progressive control of transboundary animal diseases (GF-TADs)

This joint initiative was developed by the FAO and the OIE in May 2004, to serve as a facilitating mechanism to provide for capacity building and to assist in establishing programmes for the specific control of certain TADs based on regional priorities. The six-year programme (2004-2009) envisages *inter alia* supporting country-based surveillance and enhanced disease reporting through capacity building of epidemiology units and of laboratory personnel; concerted animal disease control programmes developed through the establishment of regional support units within ongoing regional specialised organisations and/or Regional Commissions; and, the development of Regional and Global Early Warning Systems for TADs (GLEWS) established with the collaboration of FAO, OIE and WHO, connected to regional epidemiological systems.

One of the main objective of GF-TADs has been the design of national programmes on disease control, which would be prepared with national authorities and submitted by the GF-TADs Steering Committee to donors.

The entire programme foresees a budget of **US $79.4 million for the six-year period**[74].

c) OIE plan to support the VS of developing countries to meet OIE international quality standards

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[72] FAO Technical Cooperation Programme (TCP)

[73] For example, in 2005 some US$ 1 million was spent on animal health and feed quality, US$ 1.5 million on general SPS and the rest for food safety and plant health.

[74] Of which: Global Early Warning System (GLEWS) US$ 4.1 million, Research US$ 3.8 million, Emergency Contingency Fund US$ 6.4 million, Networks of Diagnostic Laboratories and Epidemiology Units US$ 11.7 million, FAO/OIE Regional Support Units US$ 46.8 million.

In August 2006, the OIE proposed a three-year plan to improve Veterinary Services (VS) in developing countries (A57). Although the objectives of the plan are applicable to all TADs, especially zoonoses, due to the urgency of the current situation with HPAI, the programme is focused mainly on developing countries that are AI infected or at immediate risk. It aims helping those countries to have an effective VS, capable of detecting animal disease outbreaks as soon as they occur and responding rapidly to bring the diseases immediately under control. The plan is designed to bring the VS in the countries concerned into line with OIE international standards in terms of governance, organisation and functioning, and encourage an active partnership with the private sector. In therefore includes an evaluation of the national VS in the various countries[75] to determine their normative deficiencies, on the basis of which detailed projects to improve the VS are to be drawn and implemented during a preliminary pilot phase. This programme will be implemented in strong collaboration with the FAO, the WHO, and OIE regional representations.

Key priority actions and investments envisaged by the programme include *inter alia* the preparation of emergency plans and systems for early detection, rapid response and surveillance for priority diseases, strengthening the capability of public and private stakeholders (including through training), creation of a compensation fund for livestock producers, bringing diagnostic capability into line with international standards, and support for the creation of the relevant vaccines and antigens national stocks.

[75] Including the currently under way evaluations of the VS with the use of the PVS tool.

4.2.3. Assessments of costs at national (country) level

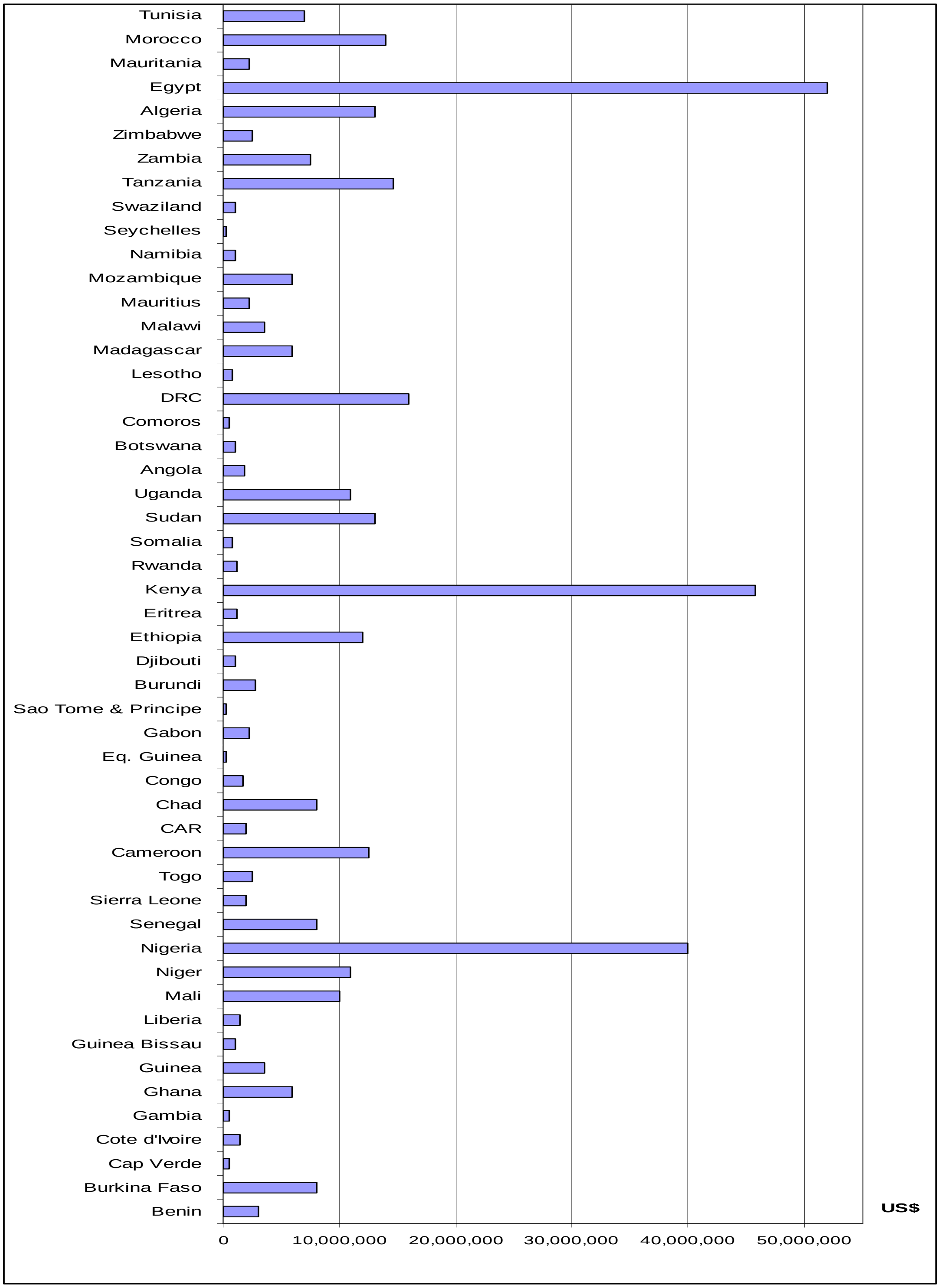
As indicated in the previous sections, the costs of prevention and control systems depend on the specific conditions of each county, including the nature of the disease and its prevalence (**Annex 1**), the current situation of the VS and preparedness levels (section 4.2.1), and the structure of the sector. All these factors affect the costs of establishing comprehensive surveillance, implementing controls, and developing biosecurity. Consequently, these costs need to be defined as much as possible on a country by country basis.

In the case of HPAI, more detailed assessments of the costs involved at country level are available.

The data on total country needs from the ALIVE needs assessment for Africa indicated in the previous section (**Table 4** and **Table 5**), are based on estimates of the costs of the animal health component of the national plans for the prevention and control of HPAI for each of the 54 African countries covered by the project[76] (A258). These estimates are derived from an analysis of national AHI emergency preparedness plans, as drafted by most African countries themselves and are therefore derived from the countries' own assessment of the situation. It is also noted that the analysis and synthesis of the data by ALIVE has involved significant work, as the original plans are presented in a different way between countries in most cases. As indicated in **Figure 5**, the highest needs at country level were identified by Egypt, Kenya and Nigeria (accounting respectively for 14%, 12% and 11% of the total needs). This reflects the high risk perception and the importance attributed by the national governments of these countries to HPAI. The situation in Nigeria is further assessed in the case study on this country presented in this Report (section 5.3.).

[76] Except South Africa and Libya, for which no detailed estimates of the animal health component are available.

Figure 5 Africa needs assessment for HPAI: animal health component by country



Source: ALIVE , as presented in Bamako, December 2006 (A258)

Other main sources of country data, for countries in Africa and in the other regions, have been the World Bank APL projects under the Global Program for Avian Influenza (GPAI)[77] and the national plans. As at present, a total 13 countries have received financing under the APL facility for integrated AHI preparedness and response projects, the majority of which are currently implemented. In terms of the national plans, as discussed in section 3.4.3, most countries currently have plans in drafting process. From a recent review of the countries that responded to the 2006 UNSIC survey (including some 125 developing/transition countries which are members of the OIE) in the majority of cases such plans are in drafting process (A236b).

Thus, APLs and national plans were obtained for 47 countries in total (in some cases, including Romania and Vietnam, both documents were available). Overall budgets, main components and budget breakdown per component are presented in **Annex 4**.

The following conclusions can be drawn from the analysis of these documents:

- In accordance with the recommendations of the competent organisations (OIE, FAO, WHO, WB), an increasing number of plans integrate the animal and human health components into a single strategy and approach. Nonetheless, in a number of cases, plans only deal with the animal health component. Conversely, some countries have pandemic influenza plans but no animal health plans as such. The preparation of an integrated plan is an objective of the assistance provided to countries under the WB APL facility.

- Comparisons between countries are difficult, as national plans tend to differ significantly in terms of lay out, contents, components, duration (in years) and the level of detail. As indicated above, this problem was also encountered by the ALIVE analysis of the African country plans. Furthermore, there is no systematic and uniform independent expert appraisal of the plans at present, which could be used as a guide to the quality of these documents[78].

[77] The World Bank has two main mechanisms to help countries deal with avian influenza in animals and to prepare for a possible human flu pandemic. The first of these is a global funding program, formally known as the Global Program for Avian Influenza (GPAI). A description of the GPAI and an overview of its implementation to July 2006 are provided respectively in A43 and A135. The second mechanism are trust funds, notably the new multidonor Avian and Human Influenza Facility (AHIF) – which will channel approximately $75 million of the funds committed by donors at the Beijing Conference on avian flu in January 2006.

[78] Some plans have been reviewed/assessed by various bodies (e.g. the FAO, UN Technical Agencies, the WHO, the WB etc.), these reviews are not done in a systematic or uniform manner. Furthermore, results of these reviews are in most cases confidential or not readily available. The closest uniform analysis at present is provided in the November 2006 UNSIC survey which provided individual country profiles for the 155 countries that were covered by the survey (including some 125 developing/transition countries that are members of the OIE). The profiles were done in a standardised format, following the 6 success factors for AHI plans outlined by UNSIC (strong political commitment, clear procedures and systems for rapid implementation, attention to improved functioning of VS, incentives/compensation schemes provided, mobilisation of civil society and private sector, mass communication campaign), on the basis of information submitted by the countries and additional information collected by UNSIC agencies.

- For the same reasons, it is extremely difficult to draw overall conclusions on the detail of the plans across countries. Despite our efforts to obtain aggregate figures across countries of the costs of some of the plans' key components (e.g. surveillance, laboratory costs/diagnostic capacity etc.), this has not been possible due to the very different composition of these plans.

- The majority of countries have sought to strengthen veterinary services, in accordance with OIE standards focused primarily on animal disease surveillance, reporting of suspected outbreaks to national authorities, confirmation of diagnosis (through laboratory tests) and international reporting when the disease is detected (**Annex 4**).

In addition, a third source of information for our analysis have been the on-going country assessments undertaken by OIE trained experts using the PVS evaluation tool. Although this has so far been applied in a limited number of developing countries[79], while results are only available in draft and/or remain confidential at this stage, some early indications can be drawn from the assessments. It appears that the main areas where improvements are needed are the increase in veterinary personnel, training, improving epidemio-surveillance and laboratory capacity. These results are in line with the needs identified by most countries in their national plans but also the needs of developing countries in general, as identified by the international community.

Our analysis in this section leads us to the following conclusions and recommendations:

[79] The PVS evaluations started in November 2006. Initially a pilot project, this has now become a fully-fledged instrument. As at end of August 2007, 50 formal requests from OIE Member Countries had been received, and some 36 PVS evaluation missions had been carried out. Of these 18 missions were in Africa (24 requests in total), 6 missions in the Americas (8 requests), 5 missions in Asia/Pacific and 5 in Europe (6 requests respectively each) and 2 missions in the Middle East (6 requests). The OIE intends to carry out some 105 evaluations over 3 years (i.e. approximately 35 evaluations each year, or 3 a month).

<u>Literature review: assessment of prevention costs:</u>

The difficulties encountered in comparing plans reflect the varying nature of the problems and concerns of each country, including in terms of disease occurrence, farming structures, and existing veterinary systems and infrastructure. These factors affect each country's objectives, needs and priorities. These specificities highlight the risks of extrapolating from ad hoc country cases to a regional and global level.

To overcome these constraints, the present analysis has been based on the global estimates provided by the World Bank, and on the Africa estimates by ALIVE (the latter based on individual countries' own assessments), as follows:

WB: global estimates of costs of improved prevention and preparedness (integrated animal health and human health) = US$ 1 billion for 2006-08 (average US$ 340 million per year);

ALIVE: Africa estimates of country needs (animal health only). Prevention and preparedness = US$ 44.4 million for 3 years (average US$ 15 million per year). Strengthening VS = US$ 32 million for 3 years (average US$ 10.6 million per year).

Our analysis highlights the importance of a systematic assessment of every country's needs, based on objective criteria. In this context, the recently started country reviews (using the OIE PVS tool) provide a substantial first step to this direction.

⇒ ***A recommendation here could be that the results of the PVS evaluations are followed up by detailed economic assessments of the costs involved in carrying out the recommended modifications to bring the assessed countries' VS in line with the OIE standards and their international obligations.***

4.3. Disease outbreak costs and losses

4.3.1. Overall impact

Given the complexity of issues and the relatively early stages in the advancement of the economic analysis of AH systems, the economic implications of animal diseases and animal disease control are largely under-studied.

In the case of developed countries, the direct and indirect costs of crises have generally been more extensively covered than is the case in developing countries[80]. Only more recently, HPAI induced losses in the developing/emerging economies of SE Asia have been studied in depth.

[80] A notable exception is rinderpest, the economic implications of which have been extensively studied in the context of the Pan African Rinderpest Campaign (e.g. by VEERU, University of Reading).

A selection of examples of the overall impact of animal diseases is provided in **Table 6**. The relative scale of the overall impacts per country in the case of HPAI is illustrated in **Figure 6**.

Indirect or longer-term impacts (such as loss of consumer confidence, and repercussions on trade and tourism) are generally seen to be far greater than the direct or shorter-term impacts. There is wide consensus in the literature on this point, not only in respect of animal disease outbreaks (e.g. UK FMD, Asia and Africa HPAI) but more generally for public health crises (e.g. 2003 SARS experience in Asia). One factor that generally appears to contribute to relatively lower direct costs in developed countries is the fairly rapid response and reaction to crises. This factor is generally less present in developing/emerging countries although there is wide variation between countries.

In global macro-economic terms, the direct impact may be relatively modest, depending on the contribution of livestock to the national GDP. However, in the context of the rural economy as such, or in micro-economic terms looking at individual farmers, the impact can be devastating given that the affected farmers in most developing countries have few other sources of income and the sector is of fundamental importance for rural livelihoods and their survival (as discussed in section 3.2). In this case, serious poverty alleviation and food security concerns enter into the equation.

For example, in Vietnam - one of the countries hardest hit by HPAI - the total direct loss of the poultry sector has been estimated at less than 1 % of the national GDP (**Table 7**). Nonetheless, the relatively largest losses were felt by small-scale, often indebted, commercial chicken producers with limited other livestock activity. In addition, the number of rural households directly involved in poultry production has fallen by 50%. Although these smallest producers are the ones who have lost the least in absolute terms, in relative terms they have lost the most, when compared to their daily income (of 2 US$ per day or less, a financial position in which some 64% of households are found in Vietnam) (see section 5.2). In Nigeria, the situation for the rural and urban poor was even worse as these poor households often have few other sources of protein food or income (see section 5.3).

The total number of poor people dependent[81] on poultry in five of the currently most affected countries of Asia (Cambodia, Indonesia, Lao PDR, Thailand, and Vietnam), where some 60-80% of the rural population is assumed to keep poultry, is estimated at between 136-210 million (A40, A91). These figures exclude China's rural population likely to keep poultry, which could be as high as 450-600 million[82]. The FAO and the OIE estimate that between a third and half of the population in the most affected areas of South East Asia earn at least part of their income from poultry farming. In Nigeria, 60-70% of the population lives in rural areas and it is estimated that 80-95% of them keep poultry – in addition urban households frequently keep poultry (UNDP Nigeria data); this picture is representative of most sub-Saharan Africa.

[81] This includes people that are partially dependent on poultry, although even in this case dependence can be crucial for rural livelihoods.

[82] According to China's latest nationwide census the Chinese population in 2001 stood at 1.26 billion, including people living on the island of Taiwan. Some 60% of this is estimated to be rural population (their relative share has fallen by an estimated 25 percentage points in the last decade due to massive urbanisation).

The macro-economic impact will be considerably more severe when the indirect effects of an epidemic on trade, tourism and services are added to the direct effects on the livestock sector as such, given that these sectors make a relatively large contribution to the national GDP in most economies. If potential (and extremely difficult to estimate) human pandemic costs are added, and when dynamic multiplier effects are considered (i.e. the domino effects that the decline in one sector in one country may have on all areas of economic activity and on other countries, including as remote sectors as the stock markets[83]) the global impact on the economy may be comparable to a severe recession[84].

Table 6 Overall impact of animal disease outbreaks: selected examples

Country	Impact
Asia	The total losses in GDP accruing from the damaged poultry sector in Asia amounted to US$10 billion. (This is calculated on the basis of over 150 million poultry destroyed as the result of the 2003 and 2004 Asian **HPAI** outbreaks. It includes direct and indirect economic impact and trade losses for the region as a whole). (A40)
Asia Thailand Vietnam (a)	According to Oxford Economic Forecasting the total GDP losses accruing from **HPAI** in 2004 are estimated at US$ 10–15 billion for Asia, of which US$ 1.2 billion are accounted for by losses in Thailand, and US$ 0.3 billion in Vietnam. These estimates are based on an assumed quarter-year loss of income for poultry farms, and include Asia-wide multiplier effects from the farm losses. The scaling up of health-risk impacts, e.g. from AI in birds to a more generalised problem for livestock and a drop in tourism, could create annual economic losses of as much as US$ 50–60 billion, even if human cases of disease were to remain limited. Escalation of the latter would have yet more serious implications.
Thailand	Significant trade losses for a country that used to be the world's fifth largest poultry exporter before the **HPAI** outbreak, the cost of animal disease surveillance and control, and livelihood losses to poultry keeping households are estimated to have resulted in 1.5% national GDP loss (A76). In April 2005, the Thai PM stated that avian flu had cost his country some US$1.1 billion.
Indonesia	In Indonesia, the value of birds lost as such to **HPAI** is estimated at US$16-32 million, the total direct loss to the broiler and layer breeders and producers at US$ 171 million and, when indirect losses are added, the total loss goes up to US$ 387 million or a factor of two. (Data source: Indonesian Poultry Information Centre). These estimates do not account for the loss incurred by village/ backyard farmers, estimated at 30 million households keeping 200 million chickens. (A76, A91)
Nigeria (a)	On the whole, the total economic cost due to the **HPAI** crisis including direct and indirect losses is

[83] See for example IMF analysis on the global impact of avian flu on financial markets (A77).

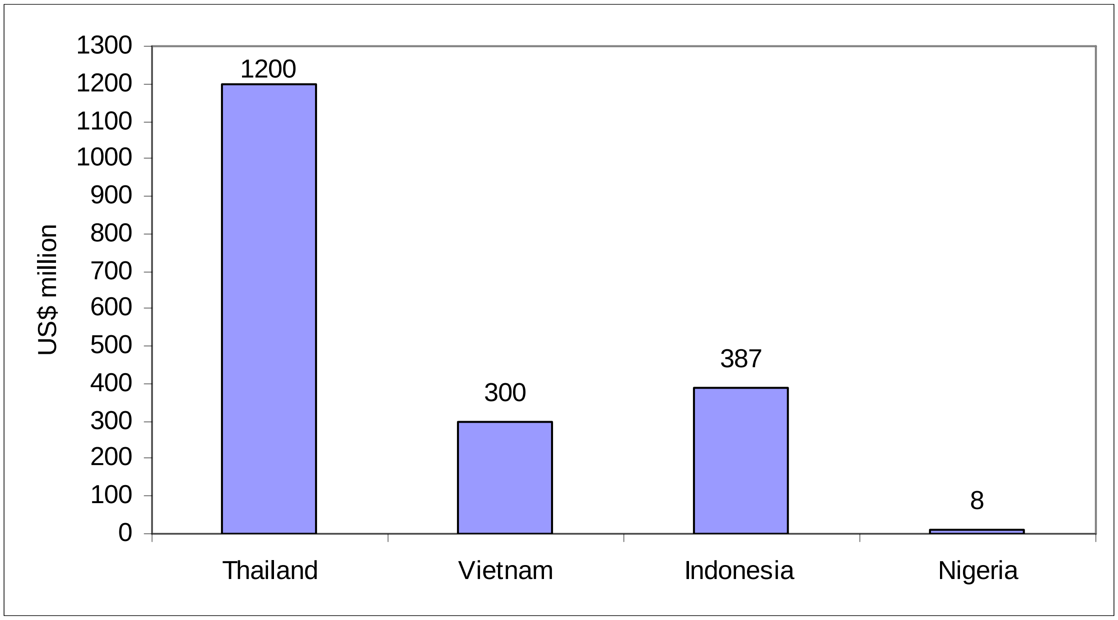
[84] See for example, the estimated macro-economic effects on the Australian economy, based on the Treasury macro econometric model (TRYM). The model incorporates 6 steps and accumulates the impact in each step (in order: global demand shocks, deaths, labour market, effects on consumption, business climate and investment). When all steps are added, the total effect to the economy is a 5% fall of the GDP. This is about half the level of the recession in the Australian economy caused by the Great Depression. As discussed elsewhere, these results should be treated with caution as they are very dependent on the underlying assumptions and scenarios. (A179)

Country	Impact
	estimated by the UNDP Nigeria at about N1 billion (US$7.9 million). (A293)
UK	In Britain, as a result of the 2001 **FMD** epidemic, four million susceptible animals on 10,157 premises were slaughtered (of which only 2,026 premises were actually declared infected) and a further 2.5 million animals were slaughtered for reasons of welfare, such as overcrowding and compromised nutrition; when the total number of still-suckling lambs, calves and pigs that were slaughtered is included, the total could be as high as ten million. The financial cost of the FMD epidemic, based on the slaughter of the four million susceptible animals only, was estimated at over £5.8-6.3 billion (depending on the assumption made for the spill-over impact). This includes £3.1 billion losses for the agriculture and food chain and £2.7-3.2 billion in losses sustained by the leisure and tourist industry. The social cost – evidenced in the loss of public confidence by the many newspaper reports and submissions to the various inquiries conducted after the epidemic – can not be quantified. Despite the magnitude of the losses, in relative terms, the effect of the outbreak was estimated to be less than 0.2% of the national GDP for 2001, which appears to be modest in comparison to normal economic fluctuations. (A228, A166).
Italy	In 1999–2000, the outbreak of **H7N1 HPAI** in Italy resulted in US$122 million in compensation for destroyed birds, and it was estimated that indirect costs exceeded US$400 million, bringing the total cost to over US$512 million. (A144)
Ireland	The 2001 **FMD** outbreak in Ireland cost around US$ 5 billion in the space of 4 months, with indirect costs representing more than 95% of the total cost. (A253)
NL	A model applied to the 1997/1998 **CSF** outbreak in the Netherlands (in which over ten million pigs were slaughtered), estimates the total financial consequences of the outbreak at US $2.3 billion. Consequential losses for farmers are US $423 million (18% of the total) and losses for related industries are US $596 million (26% of the total). Budgetary consequences for the government include less than 50% of the total losses calculated by the model. (A143)
Canada	In a 2002 study of the economic impact of a potential outbreak of **FMD** in Canada, the total Net Economic Impact (NEI) was found to vary from a low of $13.7 billion, assuming optimistic conditions under a small-scale outbreak, to $45.9 billion for a large-scale outbreak. Impacts associated with the large-scale outbreak included: trade loss of approximately $19.6 billion (or 5% of Canada's total export sales from all sectors in 2001); $26.4 billion cost to the industry, representing 80% of the 2001 Canadian primary agriculture sectors' market cash receipts; significant loss in the tourism and other non agricultural sectors of the economy ($6-$7 billion), an amount exceeding the direct costs of the outbreak to the primary sector. (A112)

(a) More extensive information on these countries can be found in the case studies

Source: compiled by Agra CEAS Consulting

Figure 6 Overall impact of HPAI outbreaks: selected examples



Source: Table 6

The sections below provide an overview of how disease outbreak costs and losses are covered by the available literature, and discuss some of the key findings of the available research to date. Our analysis follows the typology of outbreak costs presented in **Table 2**, distinguishing between direct and indirect costs and losses.

4.3.2. Direct costs and losses

A selection of examples of direct production costs and losses is presented in **Table 7** and **Figure 7**. More detailed comments are provided by type of impact below.

4.3.2.1. Direct production losses

On a global scale, it is estimated that within the past two years more than 250 million poultry have died or been culled as a result of avian influenza (FAO estimate, as at end of October 2006). In Africa, based on the experience of the outbreaks so far, it is estimated that 5% (around 66,000,000 poultry) of the total poultry population (South Africa not included) would be culled within 3 years (Alive estimates) (**Table 7**).

Even though these figures are substantial, seen from the perspective of the global size of the sector the global poultry population dead/culled only accounts for less than 1% of the 52 billion birds slaughtered annually in the world.

However, given the dependence on the poultry sector of poverty stricken households in the developing world and especially the least developed countries, the culling and high mortality of birds has a significant impact on their livelihoods[85]. This impact is compounded by the consequential on-farm losses and the broader indirect effects discussed below.

It is noted that in a given production system, an inverse relationship appears to exist between production losses and control costs, in that the higher the treatment and control expenditure the lower the losses and vice versa. Moreover, this relationship between losses and expenditure is non-linear reflecting the non-linear nature of the classical production function (A115).

4.3.2.2. Control costs

This type of cost is rarely documented with data. Only in the case of FMD outbreaks in developed countries (e.g. UK), and the more recent HPAI outbreaks in both developed and developing countries, these costs were explored in depth.

Given the data scarcity, any global estimates of the control costs available by literature usually draw on the above cases. For example, the African assessment of needs and gaps in the context of HPAI (A258) evaluates the operational cost of the culling team activities, disinfection of premises and disposal of dead birds taking into consideration the experience of two of the most documented cases: Vietnam and Nigeria (**Table 7**).

4.3.2.3. Other direct production losses

Widely referred to as consequential on-farm losses, these depend on the period that the farmers stay out of production during and after the crisis is over. These types of losses are generally not well documented in the literature and therefore difficult to assess and quantify.

In the case of HPAI, given that poultry restocking should normally take place only a minimum of 3-4 weeks after the premises have been cleaned and disinfected (following OIE and FAO recommendations but also as demonstrated in practice in the countries affected by HPAI – see for example A91), a month can be considered as the minimum disruption period.

A distinction should be made between restocking in the village and backyard farming system, which appears to be an autonomous process, and restocking in commercial and industrial systems. Generally, the main problems that farms in the latter sector encounter in continuing with poultry raising are related to the high prices of inputs, difficulties in procuring day-old chicks and fear of resurgence of Avian Influenza. Evidence has shown that even without these problems, it takes a long time to re-stock to pre-outbreak levels. For example, with no constraints to restocking (i.e. assuming day-old chicks and other inputs are readily available) the time taken to complete restocking in Vietnam was estimated to be 12 months for the backyard system and 5 to 8 months for the industrial and commercial systems (A91). These losses can be mitigated if farmers can switch to alternative production, as was the case for example with certain farmers

[85] It is noted that the impact of HPAI on small holders of poultry is not new, as these holders are accustomed to large losses through NCD.

in some SE Asian countries who moved into pig farming. In general, however, such losses have a longer term impact on the sector's restructuring as discussed in section 4.3.3 below.

There is also an effect on employment, which appears to be determined by the degree of commercialisation and industrialisation in the sector and therefore the level of employment it generates. For example, following the Asian HPAI crisis, countries whose poultry sectors are less industrialised like Lao PDR and Cambodia had a small loss of jobs, compared to Indonesia which has a considerable share of farms in commercial systems 1 and 2.

Another way of looking at the global direct costs and losses is through the poultry sector's contribution to the GDP. The WB has undertaken such analysis in the case of SE Asian countries, demonstrating that the direct impact on the region could be 0.1-0.2% of the GDP depending on the importance of the poultry sector in the economy (**Table 7**).

Table 7 Direct production costs and losses: selected examples

Country	Impact
Direct losses	
Vietnam (a)	In the first **HPAI** outbreak in 2004, 58 out of 64 Provinces were affected, and 17% of the total national poultry flock of 262 million birds (about 44 million) lost. The loss in terms of the value of birds was estimated at VND 800 billion (assuming an average farm gate price for chicken of VND 20,000 before AI) or US$ 53 million. According to other sources the value of the birds lost is even higher. In the second wave of outbreaks, the costs were smaller due to a less drastic approach to culling in which clinically infected birds only were slaughtered, and because the disease spread less. (A9, A16, A91, A204, A292) The central government budget allocated to AI compensation up to June 2005 amounted to VND 268 billion (US$ 17.2 million) (A3).
Thailand	After Vietnam, direct losses from **HPAI** were highest in Thailand: 29 million birds or 14.5% of the poultry population (A76). In spring 2005, the government reported it had paid some $55.8 million to farmers as compensation for the mass chicken culling (25.9 million birds were culled, A16)
Indonesia	In Indonesia, 15 out of 30 provinces were infected with **HPAI** and 17 million birds (15 million layers and 2 million parent stock) died or were stamped out. The value of birds lost was between US$16.2 and 32.4 million (A16). These estimates are based on a price range of typically US$ 1-2 per bird, subject to weight and type (broiler or layer). The Indonesian Poultry Information Centre estimates the total direct losses of the broiler and layer breeders and producers at US$ 170.9 million. These figures do not account for the loss incurred by village and backyard farmers for which no accurate estimates of total losses are available. It is believed that the greatest loss was among backyard village farmers, estimated at 30 million households keeping 200 million native chickens or 63% of total poultry population. (A16, A40, A91, A292)
Nigeria (a)	The **HPAI** outbreak caused a loss of approximately 890,000 birds through deaths and stamping out as at mid-June 2006 At an average farm gate price of about N700 per bird, the farm gate value of the birds lost was about N 617 million (or US$ 4.8 million). These figures are based on official estimates, and are believed to under-estimate reality, because the actual poultry population wiped out in rural areas remains unknown (A293).
Uruguay	Following the 2001 **FMD** outbreak, the direct costs involved in the implementation of the initial

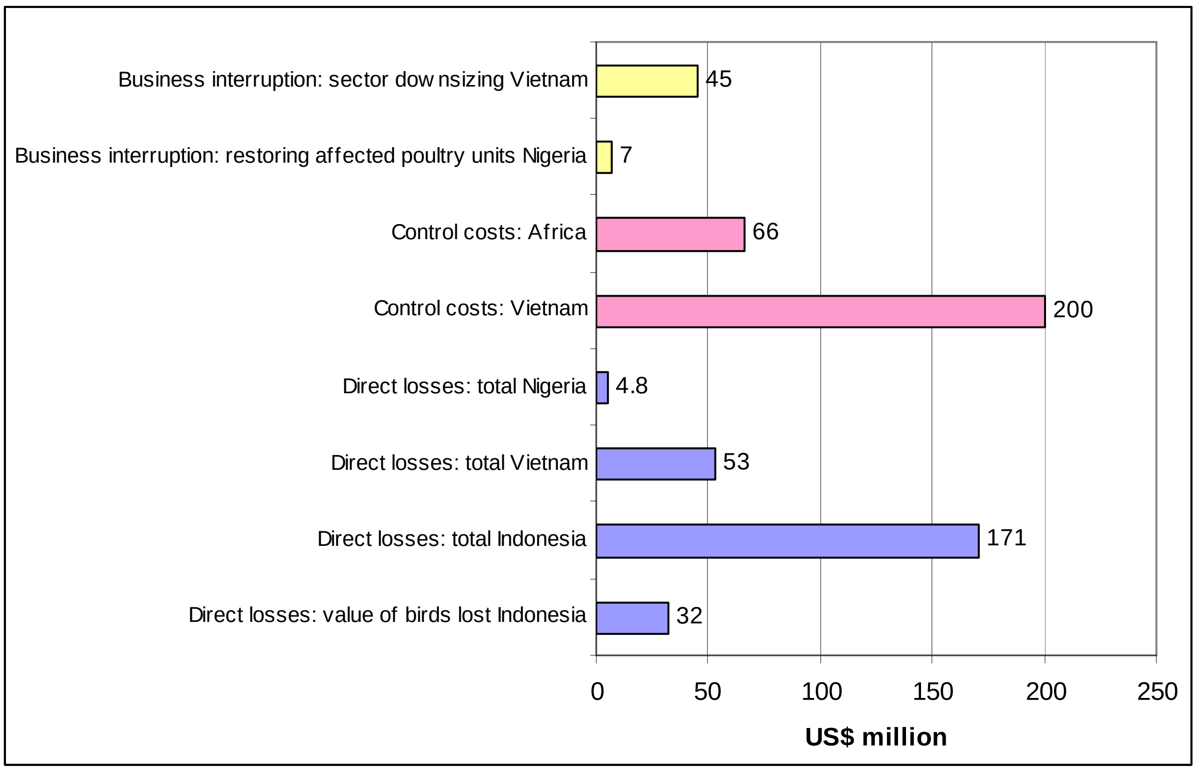
Country	Impact
	sanitary containment measures, which included the disposal of 5,424 cattle, 1,511 sheep and 333 pigs, amounted to over US$2 million. The costs involved in the secondary round of containment measures, which included the costs of vaccinating cattle in the immediate vicinity of the affected areas and the costs of the nation-wide vaccination campaign covering the entire cattle herd that will follow, were estimated at US$18.2 million. (A259)
Control costs	
Africa	Given that in Africa, some 5% (around 66,000,000 poultry) of the total poultry population could be culled within three years if **HPAI** continues to spread at current rates, and estimated to cost about US$ 1 per bird (Alive estimates, A258), the total control costs of a pan-African outbreak could reach at least US$ 66 million (e.g. above figures exclude South Africa).
Vietnam (a)	In the case of the Vietnam **HPAI** outbreaks, it was estimated to cost about US$ 0.25 per bird to cull and dispose approximately 200 chickens per farm. Direct losses (value of birds plus culling costs) from the first wave of the outbreak in 2004 (when the culling operations were more extensive) were estimated to be over $200 million. (A7, A9, A91)
Nigeria (a)	In the case of the Nigeria **HPAI** outbreaks, culling teams were organised on an ad hoc basis and the costs were estimated to reach about US$ 1.00 per bird, if the team culled 1,000 birds within a day. (A7, A258).
Consequential on-farm losses	
• **Business interruption**	
Vietnam (a)	Vétérinaires Sans Frontières (VSF) conducted a case study of a village in the highlands of North Vietnam which estimated that a smallholder lost between US$ 69 and US$ 108 from the **HPAI** outbreaks, including the value of lost birds, loss of an average 2.3 months with no activities, and loss of no income and consumption during the period of no activities. In Vietnam about 18% of the households earn less than US$1 per capita a day and 64% of the households less than US$2. (A76)
Nigeria (a)	The cost of restoring the affected poultry units back to their original level (i.e. before the **HPAI** outbreak) is estimated at about N889 million (or $6.95 million). In addition, there was a 45% drop in the flock size of the non-affected farms, mainly because of lack of funds to feed the birds (due to the drop in poultry sales) which forced many farmers to reduce flocks, and it is unclear whether these farms will recover. (A293)
Asia	The size of the poultry sector in the national economies of the Asian region before the **HPAI** epidemic ranged from around 0.6% of GDP at the low end in countries like Vietnam and Thailand, to a high of a little over 2% in the Philippines, with most countries averaging a little over 1% of GDP. In an economy like Vietnam, where poultry output is down by around 15%, this part of economic loss is worth about 0.1% of GDP or about $45 million. If similar declines in poultry numbers were to occur in an economy like Indonesia where the poultry sector plays a somewhat larger part in the economy, these direct costs could amount to 0.2% of GDP. (A140, A140a)
• **On-farm employment**	
Lao PDR	Lao PDR and Cambodia poultry sectors resulted in a small loss of jobs (as low as 52 jobs in Lao

Country	Impact
Cambodia Indonesia	PDR), where a total stamping out of all poultry was undertaken on 42 intensive commercial enterprises following **HPAI** outbreaks. By comparison, in Indonesia, a survey reports that 23% of permanent workers on industrial and commercial farms lost their jobs and more than 40% of family members were unable to continue to work with poultry as farms closed. (A91)
Indonesia	In Indonesia, an estimated 23% of industrial and commercial farm workers lost their jobs following the **HPAI** outbreaks and 40% of these were unable to find alternative employment. (A8)
Nigeria (a)	The UNDP rapid assessment survey revealed that 80% of workers in the affected farms and 45% of those working in non-affected farms have lost their jobs as a result of the **HPA**I outbreak. (A293)

(a) More extensive information on these countries can be found in the case studies

Source: compiled by Agra CEAS Consulting

Figure 7 Direct production costs and losses of HPAI outbreaks: selected examples



Source: Table 7

4.3.3. Indirect impact

Generally, the available research points out that indirect costs are typically significant multiples of direct plus consequential on-farm costs and losses, although it should be noted that at the same time the literature also uniformly stresses the difficulties of measuring the precise extent of these costs (A228, A159, A258, A292).

Such costs are rarely explored in depth in the available literature, largely due to the methodological difficulties and constraints of this type of analysis and its extensive data requirements. Assessing the overall impact of an animal disease on both global meat markets and other sectors along the supply chain necessitates the use of a framework which links markets, both spatially and cross-commodity. Moreover, the resulting impact assessment is dependent on the various assumptions underpinning the analysis and constrained by data limitations. Broadly, a distinction can be made in the available literature between ex-post assessments of the actual impact of a disease outbreak that has occurred and ex-ante simulations of the potential impact of a disease outbreak in the event this occurs. The latter are particularly difficult to perform, and results are inevitably shaped by the underlying assumptions and scenarios. Great caution should therefore be paid in the interpretation of the results.

From the experience of developed countries (where literature on the indirect costs of a disease is generally more advanced), the direct costs – although significant – are usually relatively lower than the considerable indirect costs caused by the loss of consumer confidence and the impact on export trade. The overwhelming evidence of the available research suggests that where the response to a disease outbreak has been rapid and strict control measures have been applied, coupled with an effective communication campaign towards the wider public, the indirect impacts tend to be more contained.

It is important to note that economic analysis to date has focused on the impacts of ad hoc outbreaks rather than the long term effects of endemic diseases, in other words of smaller but repeated outbreaks over a number of years. It has also mostly focused on the domestic impact (within a country or economic zone e.g. the EU) of an outbreak rather than the global market impact.

However, the international community is increasingly concerned about the global social and economic impacts of endemic diseases as such. This is partly due to changing times. While many animal diseases, particularly FMD and most types of AI, have long shown signs of becoming endemic in many parts of the developing world, only since 2001 has the severity of outbreaks of FMD (in Europe and Latin America) and more recently AI outbreaks in Asia (and moving westward into Europe and Africa) demonstrated that such events can have a significant impact on international meat markets.

The relative importance of these impacts can be highlighted in the context of the global growth in meat production and trade of the last 15 years. World meat production has grown from 100 million tonnes in 1990 to nearly 280 million tonnes in 2006. Nearly three quarters of this growth is concentrated in developing countries, and is accounted for by the pigmeat and poultry sectors. Global meat trade has grown in similar rates from 8 million tonnes in 1990 to nearly 20 million tonnes by 2006. The value of meat trade has also increased, but at a lower rate than the volume, indicating the declining trend of meat prices and the changing meat product composition of trade (much of the growth has been driven by growing demand for poultry cuts, due to health and economic factors notably the lower prices of poultry meat relative to other meats). The most significant contributor to the growth in trade has been the poultry industry (followed by pigmeat), so that the poultry sector’s share of world meat trade has risen from 22% in 1990 to over 40% in 2005. Consequently, a severe transboundary disease outbreak such as HPAI can have potentially destabilising effects on international poultry markets and can disrupt the sector's growth prospects (at least in the short to medium term) in the developing world.

4.3.3.1. Ripple effects

In terms of the costs that are more systematically covered by literature (price effects, trade impact and impact on upstream/downstream activities), from a review of the available research the following conclusions can be drawn:

a) Price / demand shocks

On the basis of economic theory, the effect on prices will depend on the balance of supply and demand shifts caused by the outbreak, and whether the affected country is a closed (limited net trade) or an open (trade oriented) economy. In a closed economy, the anticipated impact would be price falls in the affected areas and for the affected products if there is a consumption shock, but higher prices if supply falls and there is no change in demand. In open economies (importing or exporting), prices will be more affected by instability in world markets (and may also contribute to it). In the latter case, prices even in disease-free countries will be affected (e.g. an importing or exporting country facing higher prices in the world market, or where consumer demand is affected by the international crisis). With increasing trade and globalisation, the effects on disease-free countries have become more pronounced. Some examples of such effects can be found in **Table 8**.

At a global level, the net effect on prices of an animal disease outbreak is less clear. Certainly, meat markets affected by animal disease outbreaks are characterised by considerable instability as governments are forced to adopt policies to protect their livestock sectors, including import bans, tighter sanitary border control measures, and stronger domestic regulations including movement controls and quarantine, which result in increased price volatility both in domestic markets and worldwide. Some countries will loose, but other countries will gain due to the higher prices offered to products from disease-free markets (not necessarily countries, but even regions/compartments if such policies are applied). But the compounded net effect could be in either direction.

The global impact depends mainly on 3 factors: a) the supply and demand balance worldwide for the affected products (this is strongly dependent on the extent of consumer health concerns, which tends to vary between countries and cultures as is evident from the examples quoted in **Table 8**) , b) the level of concentration in global meat markets and the position held by the disease-affected as well as the disease-free countries within this (i.e. whether they are a major exporter/importer), and c) the world supply and demand in substitute products.

For example, in 2004, the HPAI outbreaks led to a more than 30% increase in international poultry prices, which is attributed not just to HPAI-induced pressures in the world poultry market but also to the simultaneous BSE-related pressures on the international beef market (A111d). By contrast, since late 2005, AI outbreaks in approximately 40 previously unaffected countries (many of which are the major poultry consuming and importing countries of Europe, the Middle East, and Africa) may have prompted the sharp decline in the FAO poultry price index during the same period. In 2001, as a consequence of the severe FMD pandemic that prompted countries around the globe to close their borders to imports, international prices for beef and pigmeat fell, while poultry prices rose.

Generally, supply volumes tend to remain below pre-AI levels at least in the short to medium term (6 months to 1 year), and only recover in the longer term (beyond the first year). Within this general pattern, evidence suggests that stakeholders associated with more industrial production (i.e. production system 1) are capturing higher prices than before, while the other stakeholders still face collapsed demand and prices that are significantly lower than before (A9). This is largely due to the fact that a) they can more rapidly recover from the crisis due to access to credit and inputs, and b) can move to more bio-secure production methods with certified products typically attracting a price premium.

It is unclear what the longer-term impact of disease outbreaks on demand would be. Recent international surveys conducted following the various outbreaks of HPAI around the world, but also country surveys and evidence, indicate that the short term impact is very significant and that the change in consumer behaviour may persist for considerable time (e.g. 2006 Eurobarometer and IPSOS surveys, **Table 8**).

b) Trade impact

The loss of access – or opportunities for access – to regional and international markets tends to have much more important economic implications than production losses alone. The extent of the damage will depend on a country's export orientation and can be quite severe for countries that had an important and established export market pre-outbreak. Thailand, for example, lost its position from being the world's fourth largest poultrymeat exporter prior to the HPAI outbreak (**Table 8**). To some extent, in the short to medium term, the loss can be mitigated if a country can switch to alternative exports (for example, in the case of Thailand, by switching to processed poultry meat it regained most of its export value), but the longer term sustainability and outlook of these new markets is uncertain.

Conversely, the eradication of certain major diseases to gain access to "high value" export markets can bring considerable benefits, as has been the case in parts of SE Asia and Latin American countries (e.g. Uruguay, **Table 8**). Also, it appears that the introduction of "derogation" measures (zoning, compartmentalisation[86]) by the OIE can mitigate some of the losses in disease-affected countries (A283), but also temporarily offset certain countries' lack of export capacity while they acquire national capacities to prevent and manage crises (A292), as discussed further below.

As already discussed, even where sophisticated economic modelling has been applied, it is extremely difficult to capture the impact of an animal disease on exports and international trade (both to estimate the impact of an actual outbreak and to forecast the potential impact of an outbreak under different scenarios). Exports take place within a dynamic economic, commercial and policy environment, where a range of factors interplay and affect competition between countries and between sectors. The incidence of a disease, however, can add to other factors (such as increased competition from a new exporter, or increased demand for substitute meats / protein sources in international markets, or depressed prices in competing sectors), to amplify the global impact. Thus, where such models have been applied, this has taken place within a precise scenario framework and results depend heavily on the underlying assumptions (see for example the application of the FAO STM model below).

[86] The OIE recently included the concept of compartmentalisation in its guidelines on avian influenza control (OIE, 2005). It has been stressed that this strategy needs to be adopted with particular attention to country level production characteristics, and that it should be agreed bilaterally between trading partner countries as has always been the case in the context of bilateral trade agreements (A53).

In terms of the global impact on trade from outbreaks of transboundary diseases, the size of the impact will depend on whether the outbreak occurs in significant world exporting countries, in which case a ban on exports from that country can send significant shocks to other major exporting as well as importing countries. For example, in 1997, the EU classical swine fever outbreak significantly affected intra-EU trade, as the Netherlands was a major exporter of pork and live pigs within the EU, but global pork trade was largely unaffected since the Netherlands, as well as Germany, Belgium, France, Italy and Spain, were not major exporters of pork outside the EU. By contrast, in 1996/97 the global pigmeat market was affected by the FMD outbreak in Taipei China, a major world exporter whose pork exports fell to 15% of the previous year's value (**Table 8**). Furthermore, the net trade position of a major trading country can determine how localised the impact of an animal disease will be, and the impact is likely to be different when an affected country is both a major world exporter and a major importer, compared to a situation where an affected country is a significant exporter only.

While it is possible to identify the resulting diversion in trade flows, as one country's loss can be another country's gain, the resulting net effect in terms of total loss in world trade revenues is difficult to establish. Available evidence suggests it is rather substantial. For example, restrictions on trade as a consequence of BSE notifications may have resulted to an estimated net loss of US$4.1 billion in world trade (**Table 9**). According to some analysts, the various world-wide import bans on meat from disease-infected areas, combined with heightened border inspections and testing, have limited global meat trade growth, from the 7% annual gains witnessed during the late 1990s to only 2% annually over the past few years (to 2006) (A111d). Given a global volume in meat trade of about 18 million tonnes and a global value estimated at US$72 billion (2004 estimates, FAO), this represents a potential annual loss in trade of some 0.9 million tonnes (or US$3.6 billion). In 2001 the severity and visibility of the FMD pandemic that affected major meat markets (EU, Mercosur) led to countries around the globe closing their borders to at least 25% of world beef trade and nearly 40% of global pork exports. In 2004 and 2005, the impact of the AI outbreak in Asia led to an unprecedented 8% decline in global poultry trade, and a loss of approximately US$ 1 billion in export earnings for the Asian region alone. With the continuing menace of AI, it is estimated that global poultry trade value is down nearly US$2 billion in 2006 (A295).

Due to the complexity of the factors involved and the methodological difficulties, very few studies have tried to forecast such global aspects of the potential trade impact. A notable exception is the FAO/OECD short term commodity model (STM)[87], which has been used to evaluate the short term global impact of a potential outbreak of Avian Influenza (as well as FMD and BSE) in different parts of the world. The model attempts to measure the impact of exogenously imposed export shocks to baseline projections. The potential impact is evaluated under difference scenarios of consumption shocks that the crisis may provoke to the EU-25 and/or the rest of the world, with implications on export volumes and

[87] Developed in the context of Aglink-Cosimo, a collaborative modelling project between the OECD and the FAO. This is presently one of the most comprehensive partial equilibrium models for global agriculture and it is one of the tools used in the generation of baseline projections underlying the OECD-FAO Agricultural Outlook. It is a dynamic, multi-commodity, partial-equilibrium, global trade model, which provides one-year-ahead projections for demand, imports, exports, stocks and prices, given predetermined supply for 18 basic agricultural products, covering 50 countries /regions. Four meat categories, sub-divided into disease-affected and disease-free markets, are included in the model alongside a comprehensive coverage of the feed sector. Changes in real income, population and exchange rates are the principal exogenous variables driving global agricultural commodity markets. This model has also been used to evaluate the impact of FMD and BSE.

domestic/international prices. The model scenarios and assumptions are constantly revised in view of new developments in animal disease occurrence (preliminary model results in A76, A111d and A283).

The latest results (December 2006, A283) indicate that in the event of a global consumption shock due to AI (assuming this results in a 10% shift in global consumption away from poultry to other meats) international poultry prices would fall by 7% while pigmeat and beef prices would increase substantially (11-16% for beef and 15-19% for pigmeat). The net effect on world trade would be a fall in exports by 13% (while exports of developing countries would fall by 19% and imports by 12%). If the outbreak only occurred in the EU-25 (and assuming a 10% shift in EU consumption away from poultry) the effect on prices and global trade would be minimal but developing countries would expand their exports by 6% and drop their imports by 9%. A hypothetical outbreak in Brazil would result in a 3% increase in poultry prices and a 6% fall in world trade, although developing countries would increase their exports by 17%[88].

The same model demonstrates the importance of regionalisation policies in mitigating the trade losses caused by outbreaks not just in the disease-affected countries but for the world. Model results indicate that in the event of an FMD outbreak in Brazil, Brazilian exports of beef would fall by 9% and 60% respectively if regionalisation was applied, compared to a total ban on exports if regionalisation was not applied. Given that Brazil is the world's largest beef exporter, the application of regionalisation has dramatic effects on world trade (reducing the impact to virtually zero) compared to a scenario where the policy is not applied (in which case the global decline in exports is 9%). These effects are reflected in world prices, with a significant containment in the decline of Brazil beef prices when regionalisation is applied (from 56% drop in the policy-off scenario down to a 7% in the policy-on) as well as significantly halting world price increases for beef.

A selection of examples of the various ripple effects in terms of demand and trade impacts, caused by disease outbreaks in different parts of the world and at a global level, as identified from the reviewed literature, can be found in **Table 8** below.

Table 8 Ripple effects: selected examples of demand/price shocks and trade impact

Country	Impact
Demand/price shocks	
global	An international survey of 19 countries (including Argentina, Brazil, Chile and Thailand) conducted in May 2006 shows that in most countries, about a fifth of the respondents reduced their consumption because of concern over AI. The impact was higher (30%) in **HPAI**-affected countries like Thailand and Italy, but even in HPAI-free countries such as Argentina and Brazil some 15% of respondents were affected. (A255)
Vietnam	A 2004 FAO survey found that in Vietnam and Cambodia, prices of non-poultry meats rose up to 30% when live-bird markets were disrupted by **HPAI** and remained high even after the poultry

[88] As already discussed, results depend on the scenarios and assumptions made, for example on consumer response. With potential outbreaks and consumption shocks uncertain, the above scenarios are only some of the possible impact assessments that can be made. Indeed, the results differ substantially from previous runs of the model using different assumptions (A76, A111d). These results should therefore be interpreted with caution.

Country	Impact
Cambodia	markets recovered, taking the purchase of meat out of reach for low income consumers. (A40)
Vietnam (a)	At the lowest point of the **HPAI** crisis (Oct/Nov 2005), prices were 50-60% below normal, and one observer reported that the volume of poultry sales had fallen by half, from about 40 million poultry per month to 20 million. When prices started recovering in December they were 30-60% lower than pre-outbreak levels, but supermarket prices were 25-35% higher. The volumes sold daily (poultry and eggs) were lower than pre-outbreak levels. (All unofficial data.) (A9)
Vietnam (a)	In HCMC, there was a sharp decline in the number of poultry and egg markets. Although the net effect on producers depends on market volume rather than the number of outlets as such, given that these new markets are entrusted with selling certified produce only this suggests a significant shrinking of the market for non-commercial farmers. In addition, these farmers and markets that sold certified products were able to capture higher prices. (A9)
Cambodia	Although the impact of HPAI in terms of direct deaths and control measures (stamping out) was relatively minor, according to data by Veterinaires Sans Frontieres (VSF), a significant drop in the prices of poultry products was seen during the first 2 months of 2004 (followed by complete recovery) (A76). Combining the fall in prices with the fall in quantities sold and comparing this with the recovery rates in the markets, it appears that broiler traders took up to 3 years to recoup their losses and egg traders nearly a year. (A16)
Indonesia	According to data from the Indonesian Poultry information Centre, the price of a live broiler fell from around Rupia 8000 per kg in January 2004 to as low as Rupia 4000 in some locations at the end of February, and only recovered to the pre-outbreak level by May. (A91) According to other reports, the price fell to Rupia 1200 per kg after the outbreak, but by April it reached Rupia 10000 per kg. (A16)
Nigeria (a)	Egg and chicken sales declined by 80% within 2 weeks following the announcement of **HPAI** outbreaks in Nigeria in February 2006 (UNDP data and Nigerian Poultry Association – PAN). Up to 4 months after, the recovery rate was still below 50%. (A293)
Ghana	A survey of consumers/stakeholders in Ghana showed that the eating habits of almost half the respondents changed after **HPAI** media announcements. Interestingly the public health and the animal health workers were the categories of respondents whose eating habits changed the most in that 75% of them stopped eating completely poultrymeat. (A291)
Turkey	In Turkey, the combined effect of the two **HPAI** outbreaks of October 2005 and January 2006, led to both broiler and egg prices falling by about 30%. The market has taken almost a year to recover. In the first outbreak alone, poultry sales dropped by 50% and prices by 40%, while the market took 2 months to recover. (A295)
Egypt	In Egypt, prices for poultry fell by almost 30% in 2 months after the announcement of Turkey's **HPAI** outbreak in September 2005 and continued falling to February 2006 when Egypt's outbreak was announced. Following mass culling there was a sharp price increase in the next 4 months. Overall, prices have taken almost a year to recover to pre-outbreak levels. Egg prices fell following the outbreak but recovered quickly at considerably higher than pre-outbreak levels. (A295)
EU27+	A special Eurobarometer survey conducted in March/April 2006 on consumer response in the EU-27 following the world **HPAI** outbreaks revealed that nearly a fifth of citizens had reduced their

Country	Impact
	consumption of poultry meat (18% on average, with large country differences). Although three quarters of this group did so only on a temporary basis, some 13% intended to cut down on consumption permanently. (A190) Sales of poultry and eggs were reported in early 2006 to have fallen by 70% in Italy and by 20% in France, following announcements of AI outbreaks in other parts of Europe/the world (A144). The Italian farmers' association estimated that the industry was losing €6m a day, and that it had lost a total of about €650m thus far.
Trade impacts	
Global (Argentina Uruguay)	In 2001, the severity and visibility of the **FMD** pandemic, combined with **BSE** concerns, led to countries around the globe closing their borders to at least one-quarter of world beef trade. Trade losses for Argentina and Uruguay were estimated at US$ 400 million and US$ 150 million respectively. (A111d)
Global	The results of a 2000 study quantifying the impact of **BSE** on world trade suggest that economies affected by BSE notifications saw a decline of US$5.6 billion while unaffected economies saw an increase of US$1.5 billion (in both cases, from hypothetical projections in designated products). Thus, it may be concluded that import restrictions to control the spread of emergent BSE infection had a significant effect on trade flows. The study also shows that economies unaffected by BSE may have benefited from an increase in trade hence the loss to affected countries is not an actual net loss to the global economy but a shift in trading patterns. (A6)
East Africa	Following an outbreak of **Rift Valley Fever** in East Africa which led to an export ban by Saudi Arabia and other Gulf countries on livestock products from Ethiopia, the costs of the ban on Ethiopia's main exporting region (Somali) and their distribution among different types of households, producers and traders are assessed using a CGE model. Results show that Somali's GDP is reduced by 36% as a consequence of the ban. In addition, poor and better off producers experience total losses in value added of around 50% of their respective levels in a normal year.
Brazil	Due to the **FMD** outbreak in October 2005, Brazilian beef exports in 2005 grew at only 16%, half of the trade gains registered over the past five years. (A111d). According to latest data from the Brazilian Ministry of Agriculture on exports of beef meat in relation to the number of FMD cases during the 1990-2006 period, after the dramatic reduction in cases post 1998, exports increased from US$ 0.5 billion (the average annual value of exports during the 1990-1998 period) to US$ 3.5 billion in 2006. During the same period (particularly in more recent years), investment in the fight against diseases (both public and private funds) has increased significantly.
Uruguay	Uruguay beef exports more than doubled in volume (representing a 52% increase in value) after the OIE declared Uruguay officially **FMD**-free without vaccination in 1996. Access to the US market (which pays more than double the prices paid on the domestic market) provides Uruguay with additional income of around US$ 20 million per year. According to analysts, access to "Pacific Rim" markets would generate supplementary revenue of US$ 90 million per year. (A283)
Asia (Thailand, China)	Limitations on fresh/chilled/frozen products from **HPAI**-affected Asian exporters (in particular Thailand and the People's Republic of China) caused a decline in Asian exports from 1.8 million tonnes in 2003 to less than 1 million tonnes in 2004, a loss of approximately US$ 1 billion of export earnings for the region. (A111d)

Country	**Impact**
Thailand	Prior to the **HPAI** outbreaks in late 2003, Thailand was the world's fourth largest poultry exporter. With approximately 40% of Thailand's estimated production of 1.5 million tonnes destined for export markets, market closures resulted in a 40% decline in export earnings in 2004, from an estimated US$ 1.1 billion to US$ 674 million. (A76)
Taipei China	The global pig meat market was affected by the **FMD** outbreak in Taipei China, when its pork exports, valued in 1996 at US$ 1.6 billion, fell to US$ 234 million in 1997. The result was a gain in access for some of its major competitors into Taipei China's previous export markets. (A111d)

(a) More extensive information on these countries can be found in the case studies

Source: compiled by Agra CEAS Consulting

Although there is no uniform pattern of the rate at which demand for the affected products and prices / trade at world level recover, it appears that zoonotic diseases such HPAI and BSE have longer lasting effects than diseases of less public health concern (such as FMD). From the experience of previous outbreaks, it appears that changing consumption and trade patterns related to zoonotic animal diseases tend to recover within two years.

c) Impact on sector's restructuring

As already discussed, animal diseases can have profound effects on a country's livestock industry structure and outlook.

Evidence suggests than in many cases the HPAI crisis has tended to accelerate the sectoral restructuring trend already under way in SE Asia. For example, in the case of Vietnam, while all poultry stakeholders have suffered in the short term from AI and the ensuing collapse in demand for poultry meat and eggs, the longer-term restructuring of the industry already under way – especially in and around big urban centres – has created a divergence in their future prospects. Farmers in Sectors 4 and 3 continue facing weaker demand in rural areas and an urban market that prohibits their produce (this would affect particularly the more commercially oriented sector 3), while commercial producers in Sectors 1 and 2 face better growth prospects as the market for "certified" poultry grows and consumers become more accustomed to processed products (A9).

d) Impact on upstream/downstream sectors

In addition to the above, a range of negative impacts prevail in the sectors upstream/downstream from livestock production as such. Amongst these, we distinguish the impact on the feed sector which is most documented by literature. The various HPAI crises, for example, have caused demand for feed to drop substantially in the EU-25, in Asia and in Africa, affecting the feed sector even in all countries that were important suppliers of feed inputs (**Table 9**). The latest simulations of the FAO model indicate that, with lower meat production pushing down grain and protein feed consumption, this may result in price drops[89]

[89] However, this should be compensated by the increase in cereal prices because of the increasing demand for this raw material from the growth of the bio-fuel sector.

of 3% in the event of a global consumption shock due to AI (assuming a 10% shift in global consumption away from poultry) (A283).

In the case of HPAI outbreaks, the available evidence also indicates that demand for chicks has fallen substantially suggesting longer-term dramatic effects on the sector's productive capacity and restructuring (as discussed above). As the experience of these outbreaks is relatively recent, it is not clear whether and how long the sector would take to recover to pre-outbreak production volumes.

There is also an effect on employment, which appears to be determined by the degree of commercialisation and industrialisation in the sector. For example, following the Asian HPAI crisis, countries whose poultry sectors are less industrialised like Lao PDR and Cambodia had a small loss of jobs, compared to Indonesia which has a considerable share of commercial systems 1 and 2.

Table 9 Ripple effects: selected examples of the impact on upstream/downstream industries

Country	Impact
Feed sector	
global	Since 2003, the global decrease in the demand for poultry products following **HPAI** appears to have affected the demand and prices for feed grains and oilseeds on world markets, although these markets are now thought to be recovering (source: Feedinfo 2006). (A295)
Vietnam (a)	The **AI** outbreaks have had a sharp effect on feed manufacturers, particularly those selling to semi-commercial producers. For instance, one major manufacturer reported a drop of 90% in feed production while another reported a drop of 60-70%. The cost of commercial feed accounts for up to 70% of the cost of raising industrial chicken, and Vietnam's poultry sector normally consumes an estimated 8-10 mt/year of complete feed, nearly all of which is directed toward semi-commercial and industrial farms. (A9)
Indonesia	In Indonesia, where half the provinces were infected with **AI** and 16.2 million birds died/were culled (excluding backyard farming), the demand for poultry feed was estimated to be reduced by 45%. (A91, A76)
Nigeria (a)	Following the **HPAI** outbreaks in Nigeria in early 2006, poultry feed sales dropped by 82%, and only 43% recovery (to pre-outbreak levels) had been attained by May 2006. Even in non-affected farms, following a 45% drop in the flock size (as farmers were cutting down flocks due to lack if funds to feed the birds), the level of feed usage declined by 55%. The loss to feed mills is estimated at about N 60.5 million ($0.5 million), on the basis of average feed consumption per bird (0.135 kg per day) and assuming it takes about seven months for the feed mills to fully recover from the shock at a constant rate; this translates to a 3.5 month volume of feeds (the average price per ton of feed is about N 48,000). (A293)
Benin	Maize prices are reported to have gone down because the demand from large-scale Nigerian poultry producers for maize feeds has been drastically reduced, following the **HPAI** outbreaks in neighbouring Nigeria. (A291)
EU-25	The European poultry feed industry, which has a turnover of about US$ 42 billion, has been hit by the **AI** crisis, with a 40% reduction in demand for poultry feed in some EU countries (A292).

Country	**Impact**
US	In the US, where 62% of oilseed and cereal production is destined for animal feed, an **epizootic** that would reduce livestock production by 10% would immediately result in the loss of 418,000 jobs, a surplus of 18.4 million tonnes of cereal and oilseed crops, a 10% drop in global market prices, and crises in other producer countries. (A292)
Other inputs: demand for chicks	
Indonesia	The drastic fall in demand and prices which was caused by the **HPAI** outbreaks in early 2004 had consequences for the producers of hatching eggs and day-old chicken. The demand for day-old chicks in the infected areas decreased by 58% for broilers and 40% for layers. Overall, the weekly supply of day-old chicks fell by 17.5% for broilers and 25% for layers. According to data from the Indonesian Poultry information Centre, within 1-2 months from the outbreak, sales of broilers fell from around 21 million per week to 14 million, while prices fell from Rupia 2200 per day-old chick to as low as Rupia 200. (A16, A76, A91)
Brazil	In Brazil, where 30% of poultry production is for export, the price of a day-old chick – an early indicator of a possible change in production – is reported to have fallen by 50% following global reports on **HPAI**. Even through the country is not infected, market uncertainties and price drops have prompted larger producers to cut their production by 15% this year (2006), thus affecting the country's export outlook (A292).
Wholesale markets/traders	
Vietnam (a)	The reorganisation of HCMC's chicken and egg production following the **HPAI** outbreaks (and the need to ensure product safety) led to a decline in the number of wholesale egg markets from 134 to 75, while the number of poultry markets fell from 1,550 to 7 (excluding supermarkets). (A9)
Nigeria (a)	Associated businesses such as those trading in poultry products are estimated to have lost close to N 61.7 million ($0.5 million): this is estimated as the 10% of the farm gate price of the number of birds that were either culled or dead as a result of the **HPAI**. One live chicken sellers' association (Abubakar Rimi Market in Kano, reputed to be the largest local chicken market in Nigeria), claimed that their sales dropped from 10,000 birds to only 1,000 birds per day in February/March 2006. The price also crashed from N350 to N150 per bird during the crisis. Similar experiences were reported in other markets. (A293)
Catering sector	
Nigeria (a)	A sharp drop by 81% was reported in sales in restaurants, fast food business outlets, roadside roasted chicken sellers and egg sellers within 2 weeks following the announcement of **HPAI** outbreaks (February 2006), which by May 2006 had only recovered to 67.7% of the pre-outbreak sales. (A293)

(a) More extensive information on the costs in these countries can be found in the case studies

Source: compiled by Agra CEAS Consulting

4.3.3.2. Spill-over effects

Tourism and services appear to be the two other sectors that are most severely affected by disease outbreaks. The extent to which this will have a significant macro-economic impact will depend on the contribution of these sectors to the national economy. In countries where these two sectors make a major contribution, as was the case for example with HPAI in parts of SE Asia, the impact can be devastating. (A12).

In the United Kingdom, the adverse impact of FMD on tourism and leisure totalled US$49 billion because of bans on access to rural areas, representing more than half the total cost of the disease (based on FAO, 2002 data). Similarly, indirect costs in Ireland, including spill-over effects, are estimated at 95% of the total US$5 billion loss incurred in 4 months only (**Table 6**). Significant impacts for the tourism and services sectors were also found in a 2002 Canadian simulation of the impact of a potential FMD outbreak (A112).

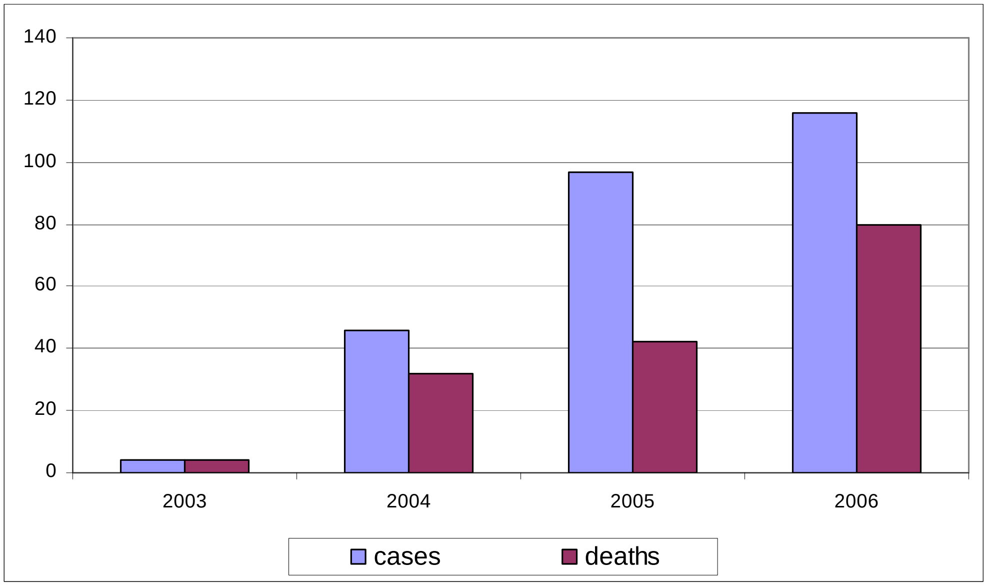
It is noted that similar diversion effects to those evident in trade may take place in the case of tourism and services. From studies looking at the effects on tourism in the UK during the 2001 FMD epidemic, there appears to be significant transfer of lost regional tourism revenue to other regions' tourism (certain studies argue that up to 75% transfers may have occurred, e.g. A249). It is plausible that such impacts may have occurred between countries or even between regions.

4.3.3.3. Wider society

The most obvious economic losses of a potential human pandemic are a shrinking and less productive workforce. Experts concede that, in the event of a pandemic, the losses could be as severe as ten times greater than all the other losses combined.

According to the latest data by the WHO, by 3 February 2007 a total 271 human cases of H5N1 had been reported, causing a total 165 deaths. This represents a case-fatality rate of 61%. Of concern to experts has been the persistence of the disease and the growing number of cases/deaths since the first outbreak in 2003 (**Figure 8**).

Figure 8 Cumulative global number of AI/H5N1 human cases and deaths, 2003-2006



Source: WHO (includes only laboratory-confirmed cases)

All of the confirmed human cases and deaths were in developing countries (**Figure 9** and **Figure 10**). Vietnam and Indonesia account for two thirds of the fatalities. The countries with the highest incidence tend to have the highest concentration of human and poultry population in the developing world, pointing to the increased risk posed by this factor. For example, in Lao PDR and Cambodia the total number of poultry losses and human fatalities was low. Apart from the smaller population of the two countries, a factor believed to have contributed to the lower losses are the low human/poultry population densities which provide less favourable conditions for the H5N1 virus to establish itself and spread (A91).

Figure 9 Cumulative number of AI/H5N1 human cases by country, 2003-to date

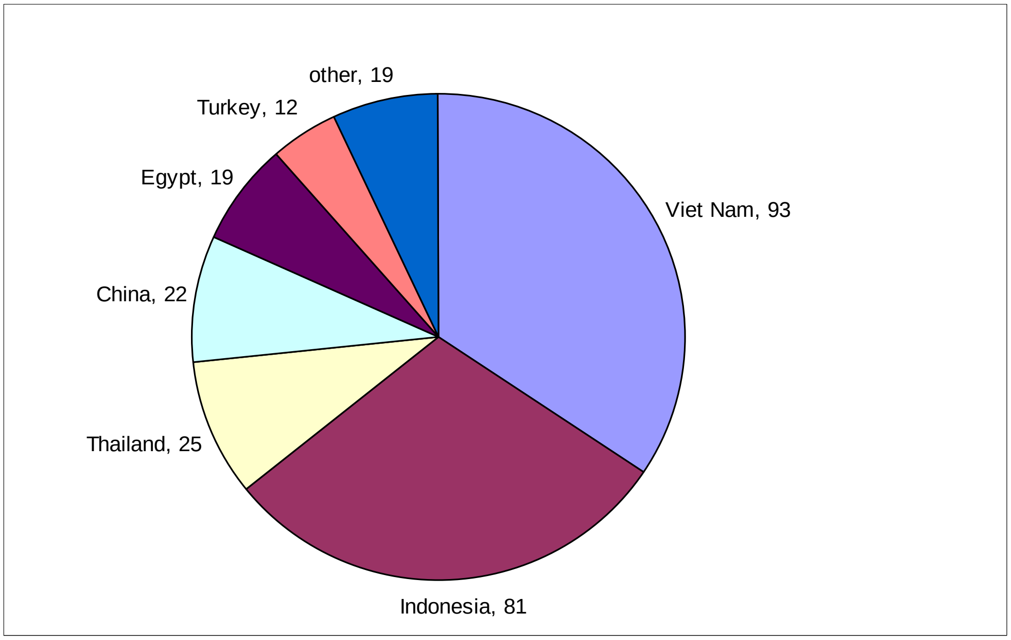
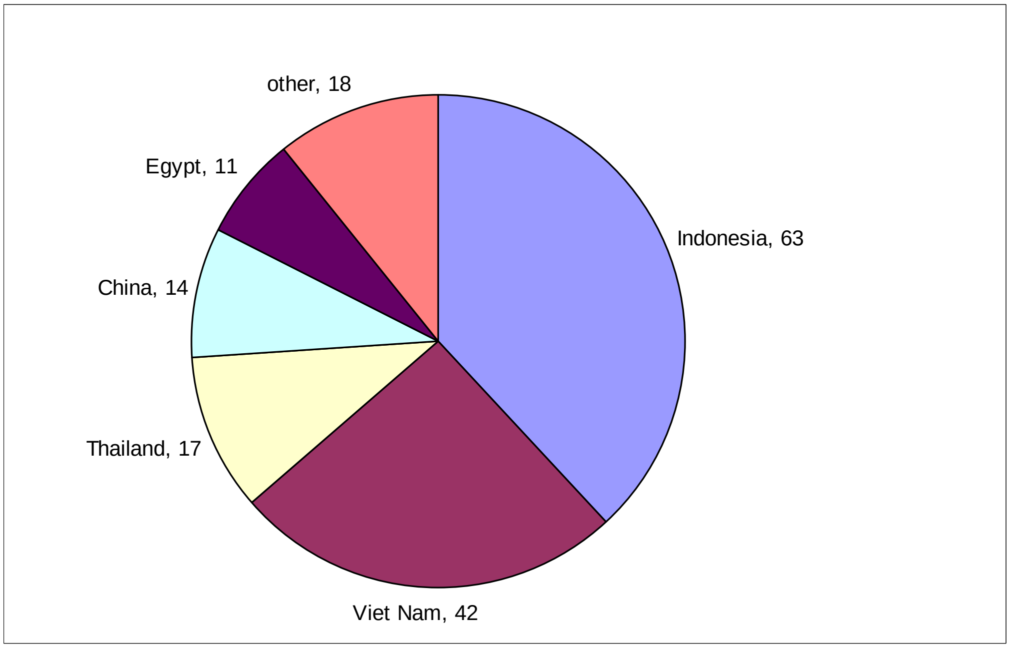


Figure 10 Cumulative number of AI/H5N1 human deaths by country, 2003-to date



'other' includes: Cambodia, Azerbaijan, Turkey, Iraq, Nigeria

Source: WHO, 3 February 2007

To assess the potential impact of a human pandemic caused by a likely mutation of the HPAI H5N1 virus to humans, the literature draws extensively on the three most documented cases of human flu in the 20th century as well as the most recent experience of a human pandemic scare -- the SE Asian severe acute respiratory syndrome (SARS). Latest estimates indicate that the "Spanish" flu outbreak of 1918 could have been responsible for the deaths of 50 million people, or 2.5% of the population of the time (A292). SARS revealed the scale and speed of the consumer/tourist response to even a limited outbreak: Asia's loss in regional GDP was US$18 billion in 2003 or 0.6 percentage points of the GDP growth rate in a region otherwise described as a booming economy[90] (ADB estimates, A198).

A problem with this analysis is that pandemics behave highly unpredictably, which explains why during previous pandemics great variations were seen in mortality, severity of illness, and patterns of spread. The mortality of the previous century's three pandemics varied enormously, from less than 1 million to some 50 million deaths. One consistent feature reported in all cases, nonetheless, has been the rapid surge in the number of fatalities and their exponential increase over a very brief time, often measured in weeks.

Best-case scenarios (WHO), modelled on the mild pandemic of 1968, project global excess deaths in the range 2 million to 7.4 million. Other estimates that factor in a more virulent virus, similar to that responsible for the deadly 1918 pandemic, estimate much higher numbers of deaths. Both scenarios are scientifically valid (A261). The differences arise from assumptions about the inherent virulence of the virus, which past experience has shown to vary greatly. In the final analysis, it is impossible to predict with any accuracy the impact that the next pandemic will have. However, all estimates, from the best-case to the worst-case scenario, suggest that losses would be very extensive.

Recent econometric modelling based mainly on demographic data from countries of the Asia Pacific region[91] suggests that a global influenza pandemic will have potentially large and disparate macro-economic consequences. Depending on the severity and duration of the pandemic, it may cost the world 1.4 to 142.2 million lives, causing global GDP to fall - at least temporarily - by 0.8% to 12.6% which represents a loss of some US$330 billion to $US 4.4 trillion (A10).

Based on the SARS experience in Southeast Asia, the World Bank estimates that an avian influenza pandemic could lead to a 2% drop in world GDP and cost the world economy US$ 800 billion in one year (all losses including wider society morbidity and mortality) (A292)[92].

Recent ADB-ERD simulations (A90, A290) estimate the potential economic impact of an avian flu pandemic on 9 Asian countries at $113 billion (or 2.6% of their 2006 GDP), under a scenario of a mild

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[90] Much of the loss was linked to a rapid decline in travel and tourism, a fast growing sector now worth some US$ 1.5 trillion per year, nearly 4% of global GDP. Losses also rose sharply in leisure industries and retailing.

[91] Based on an Asia Pacific model consisting of 20 countries and 6 economic sectors.

[92] Earlier (1999) estimates for the US alone, put the cost of a flu pandemic at US$100 to US$200 million (in present value) depending on the assumptions (A5). The World Bank extrapolates from these figures to other developed countries coming to a global loss of US$ 500 million in present value (A185). It is emphasised, however, that these costs do not include losses in the developing countries and that it would be inappropriate to make a simple extrapolation from studies of rich developed countries to relatively poor developing countries where health systems are less developed and mortality could be much higher.

outbreak (infection rate: 20%; population mortality rate: 0.1%; equivalent to 3 million people dead) with limited demand shocks (serious impact for 2 quarters of the year). Exporting economies such as Singapore, Thailand, Malaysia and Chine would be particularly affected. In the second scenario, when the impact is of longer duration (4 quarters) and demand shocks spread to the rest of the world, the estimated loss to the region could be $283 billion (or 6.5% of GDP), resulting in cutback in Asia's GDP growth to 0.1% (global GDP could also contract by 0.6%).

According to analysis by Oxford Economic Forecasting, a flu outbreak would almost inevitably be global and this not only multiplies the losses around the world but would add a large “trade multiplier effect” as well, so that the costs would be more than a simple multiple of SARS. A likely minimum economic cost of a serious global pandemic flu outbreak is estimated at 1% of world GDP or about $400billion. Under reasonable assumptions over the duration, attack rates and mortality rates of a flu pandemic, the annual cost could easily rise to more than 5% of world GDP, representing losses of about $2 trillion per annum. (A210)

It is possible to quantify the impact of zoonotic diseases on human health in terms of disability adjusted life years (DALYs[93]), as is currently done by the WHO for a range of diseases of zoonotic potential. From such an analysis useful conclusions can be drawn with regard to the cost-effectiveness of using different control strategies to avert the burden of diseases. However, the paucity of basic epidemiological information on zoonotic diseases is a major constraint to making quantitative assessments of their relative importance, in public health terms, in different areas of the developing world (A19).

Our analysis in this section leads us to the following conclusions:

[93] The DALY takes into account both premature death and morbidity/disability and it considers the years of life lost (YLLs) and the years of life lived with disability (YLDs). It is extensively used to evaluate the cost-effectiveness of medical interventions to improve health so as to determine the priority of the different actions and the use of public health budgets (A49).

Literature review: economic impact of animal diseases

The economic costs of major TADs have been hitherto largely under-studied, particularly in developing/transition countries (with the notable exception of some studies of CBPP, RVF and rinderpest in African countries). In recent years, following major outbreaks (FMD, HPAI) and mounting concern worldwide on the potential repercussions of such diseases on farmers, the rural community and the wider economy, more examples of such analysis have started to emerge also in other regions of the world.

Existing literature on this subject is relatively scattered, and concentrates mostly on particular diseases, countries, and types of impact, within a certain time period. There are hardly any examples of systematic analysis undertaken at a regional level and across the broad spectrum of types of impact followed by our study.

While there is wide consensus in the available literature that indirect or longer term impacts (such as loss of consumer confidence or the effects on trade and tourism) are far greater than the direct or shorter term impacts (loss of poultry value, consequential on-farm losses), as proven to be the case in the particular case of the studies examined here, there is a need for determining on a global worldwide level the extent and relative importance of the various impacts. We have sought to address this gap by estimating these impacts for individual countries and on a world scale (section 6).

Determining the relative scale of the range of impacts, and therefore of the potential benefits involved, is essential for policy-making. It enables policy-makers to identify the potential benefits of improved prevention and control policies in order to define the relative cost-benefit of alternative options, so as to concentrate on appropriate and proportionate policy measures and investment decisions in each case (disease, country, region).

4.4. Comparison of prevention versus outbreak costs: cost-benefit analysis

The shortcomings of a CBA (cost-benefit analysis) approach, notably in terms of data requirements and the dependence on the underlying scenarios/assumptions, have been discussed elsewhere in this report (sections 3.7 and 4). This is hardly surprising, given that even in the broader field of disaster management there are very few examples of CBA analysis at present (A138).

Due to these constraints, there are relatively few examples of thorough cost-benefit analysis in the reviewed literature. Selected examples are presented in **Table 10**.

The majority of the studies reviewed deal with a more tangible and measurable type of benefit, the trade impact. Overwhelmingly, the available research supports the thesis that improved prevention and control (including through the improvement in VS) contribute to significant gains in trade, which justify the investment. This is particularly so in the case of FMD, but there are important such benefits also in the case of HPAI. In some cases (e.g. A141) the benefit in terms of productivity gains, although significant, is not a sufficient argument on its own in macro-economic terms to justify the investment.

It is noted that a number of other studies (discussed elsewhere in this Report) explore the various potential benefits of improved prevention in a less rigid methodological framework. Such analysis can be based on surveys, case studies, and official or anecdotal evidence. The explored benefits include *inter alia* trade effects, productivity gains, poverty alleviation and social welfare implications. In the vast majority of cases, the findings suggest there are significant benefits.

Table 10 Cost-benefit of improved prevention and control: selected examples

Country	Impact
Latin America (a)	An **analysis of the benefit of improvements to animal health** in Latin America. *This research is currently in progress.* (A141): Scenarios: Compares the 'Current Situation' (CS) with an 'Improved Situation' (IS). The CS is described in terms of expenditure per animal equivalent (AE) which ranges from US $ 1.5 in Argentina, to US $ 0.7 in Brazil and US $ 0.4 –0.50 in Paraguay and Peru. Scenario 1 envisages an increase in expenditure per animal equivalent to 50 % of the difference between average expenditure in Brazil/Argentina compared to Paraguay /Peru, which equates to an increase of US $0.32 per animal; this would result in increased expenditure of some $ 18 million in Argentina and $ 3.5 million per year in Bolivia. Scenario 2 is based on the number of vets and average 'salary'; the IS here refers to moving upwards in terms of costs to a range between US $ 75-146 million. Results: Preliminary estimates are presented in terms of Net Present Value (NPV) and economic surplus (producer and consumer surplus). The conclusion is that trade impacts are a very important benefit: for every single unit of expenditure welfare gain ranges from 11 to 22 units. Given assumptions on removal of trade barriers, continued world economic and meat demand growth, growth in productivity in other regions etc., 100% of impact would only be achieved by year 15. **An injection over 15 years of some additional US $157 million per year, which has an internal rate of return of 50%, generates a NPV of US $1.9 billion** or US$ 3 per head of population or US $4.2 per animal equivalent. On the other hand, productivity gains alone, although significant, are not considered a sufficient economic justification for investment.
Philippines	Scenarios: Maintaining **FMD** control at current levels with continued presence of the disease, compared to a publicly funded programme achieving eradication by 2005 (policy objective at the time of the study), 2007 and 2010. Baseline is 1997, the beginning of the national FMD control programme when the annual economic cost was highest, peaking at over US$14 million, due primarily to extensive vaccination. This is projected to rise gradually from year 2000 levels. Approximately a third of the total each year, or an average US$1.1 million, represents public control costs for prevention, mostly related to surveillance and monitoring activities. An additional US$0.3 million (9%) is spent to contain the persistent FMD outbreaks. Commercial pig producers support the largest share of the cost, US$1.7 million (54%), for preventive vaccination. The value of production losses suffered by producers due to FMD is limited to an estimated US$0.1 million. Results: Under varying assumptions regarding the development of exports of livestock products following eradication, **estimated benefit-cost ratios for the investment in eradication range from 1.6 (2010, no exports) to 12 (2005, export gain of 10,000 tonnes of low-value and high-value livestock products)**. This indicates eradication is the most economically viable public investment. The commercial pig sector is estimated to capture 84% of the benefits generated by the investment, versus 4% by backyard farmers. (A233)

Country	**Impact**
Thailand	Scenarios: Improved vaccination coverage for **FMD** (to reduce productivity losses), compared to eventual eradication of FMD. Results: the economic return to the high expenditure incurred in FMD control could be achieved in the short term if greater international trade in pork products was made possible and higher export prices than those in the domestic market could be attained. **If FMD were to be eradicated from Thailand by 2010, the eradication would be economically viable, even without exports, with a benefit-cost ratio of 3.7**. **If eradication is achieved by 2015 without additional exports, the benefit-cost ratio becomes 2 and by 2020 it would be 1.2. If additional exports are achieved, the justification for eradication becomes stronger with a benefit-cost ratio of up to 15:1.** (A124)
UK	Scenarios: Four broad control strategies for **FMD** are examined. a) Culling of infected premises and epidemiologically linked holdings; b) Strategy (a) plus contiguous cull; c) Strategy (a) plus vaccination of cattle only; d) Strategy (a) plus vaccination of cattle and sheep. Results: The findings suggest that there are a large number of parameters that influence the size and total cost of an outbreak and hence there is no generally applicable lowest cost control strategy. The predicted mean total outbreak cost (net of inter-sectoral transfers, e.g. from the affected regions' tourism industry to other regions) varies between approximately £20 million and £440 million. This compares with the estimated cost of the 2001 outbreak of approximately £3,800 million on a comparable basis (£3,100 million for the livestock industry, food chain and central Government costs; and £700 million for the estimated lost tourism sector "value added" not transferred elsewhere in the economy). (A249)
Africa	Cost and benefit analysis of the **CBPP** control program in twelve sub-Saharan African countries (Burkina Faso, Chad, Cote d'Ivoire, Ethiopia, Ghana, Guinea, Kenya, Mali, Mauritania, Niger, Tanzania and Uganda): Scenarios: Compares the economic cost of CBPP without control' program for CBPP and the benefits of its control. The value of the losses of CBPP due to morbidity and mortality in all the twelve sub-Saharan African countries concerned was estimated at 30.1 million Euros (an average of 2.5 million Euros per country), which represents the 66.7% of the total economic cost of CBPP estimated at 44.8 million Euros (an average cost of 3.7 million Euros per country). The cost of the disease control (estimated at 14,7 million Euros) includes the cost of vaccination (78%) and the cost of treatment (22%). Results: these estimates suggest that **by investing 14.7 million Euros to control CBPP in the countries concerned, a loss of 30 million Euros will be avoided. This will lead to a net benefit of 15.4 million Euros; equivalent to a net benefit of 1.3 million Euros per country** Benefit-cost analysis revealed that CBPP control using vaccination and antibiotic treatment is economically beneficial as an overall benefit-cot ratio of 1.94 (ranged from 1.61 in Chad to 2.56 in Kenya). (A186)
Mali	Preliminary simulations from a cost-benefit analysis of the strengthening of VS and in particular of epidemiological surveillance in Mali demonstrated that a reduction by 1% of the mortality rate of bovines and by 2% of the mortality rate of small ruminants would allow an increase in annual production of 14,000 tonnes of meat, which represents a retail value of about US$ 28.9 million a year. (Analysis quoted in A110)

(a) More extensive information on the costs/benefits for Argentina can be found in the case study

Source: compiled by Agra CEAS Consulting

Certain observations can be made on the results of the available studies.

1. Firstly, as discussed elsewhere, these results should be interpreted with caution due to the specificities of the methodology, coverage and scenarios/assumptions on which these studies are based. It is therefore important that results are always analysed in the context covered by the specific study. In all cases (including the present study, as outlined in section 6), the estimates provided should best be seen in relative terms, as orders of magnitude.

   When, for example, estimating the benefits in terms of market access that can be achieved with increased funding on veterinary services and control measures, it should be noted that results will always depend not only on the volume of funds provided but also on the efficiency with which these are applied.

2. Secondly, caution should be taken in extrapolating from the findings of a specific case study country/ies to the regional/global level. This is not only because the various studies use specific scenarios and assumptions, as discussed in the previous point, but also because they cover situations (at an economic, policy, institutional, epidemiological level) which may be specific to the country/ies under review.

   This is the case both for FMD and HPAI, which both as diseases and in terms of potential economic impacts present strong regional specificities.

   For example, in the case of FMD in SE Asian countries, a number of factors influence the capacity of each country to achieve control and eradication (A124, A182, A233). First, the feasibility of effectively controlling and eradicating the disease varies considerably depending on whether the disease is endemic (as is the case for most of SE Asia); the type of farming systems primarily affected (village systems in Thailand/Laos, commercial system accounts for 2/3 of pig farmers in the Philippines); and the risk of re-introduction (important movement corridors in Thailand/Laos, islands in the Philippines). Secondly, the presence of a significant commercial livestock sector is a key differentiating factor: the constant threat of FMD requires commercial producers to incur high costs for preventive measures and likewise influences governments to invest in publicly funded FMD control programmes in the small-scale and village sectors, while a strong commercial sector also contributes pressure to develop export trade which becomes an important driving force for eradication. These findings have clear implications for regional FMD control efforts: given the diversity in the economic impacts of FMD and in national capacities for control of the disease, regional freedom in South-East Asia is considered highly unlikely in the short to medium term[94] (A233). By contrast, in the case of the South American region, FMD eradication is pursued as a regional objective, given the strong regional relevance of the disease and the significant global export potential of the region as a whole (discussed further in the case study on Argentina below).

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[94] According to the latest OIE Resolution No. XXVI of 26 May 2006, the only SE Asian countries recognised as "FMD-free without vaccination" are Indonesia and Singapore, and zones of Malaysia and the Philippines.

In the case of HPAI, similar factors enter into play in the fight against the disease. In particular, the nature of the disease (for example, now acknowledged endemic in many parts of SE Asia), the state of VS preparedness in each country, and the existing farming structures (e.g. geographically highly dispersed poultry population) affect the needs and costs of establishing effective surveillance, biosecurity and improving prevention and control in each country.

Our analysis in this section leads us to the following conclusions:

<u>Literature review: comparison of prevention to outbreak costs</u>

From the reviewed literature, in relatively few cases the analysis on the benefits of improved animal disease prevention and control can be defined as a full classical CBA. The majority of the reviewed studies consider the most measurable types of benefit, notably trade impacts. They also tend to focus on specific components of prevention and control systems, specific diseases, countries (or even regions within countries), specific epidemiological conditions in which prevention and control measures may be applied, specific types of benefit and specific scenarios and assumptions under which the benefits may be derived.

In all the cases reviewed here (Table 10), such studies conclude that the significant benefits that accrue from improved prevention and control measures outweigh the cost of investment. For example:

- **In Latin America, an investment on improvements to animal health of some additional US$ 157 million per year over 15 years generates a Net Present Value of US$ 1.9 billion. In Africa, an investment of Euro 14.7 to control CBPP could save Euro 30 million in losses from morbidity/mortality, leading to a net benefit of Euro 15.4 million.**

- **In Asia (Philippines, Thailand), eradication programmes for FMD have been assessed to provide benefits in terms of improved trade and market access that are several times worth the investment (the extent of the benefit depending on the underlying assumptions).**

Results of this type of analysis depend heavily on the underlying scenarios/assumptions, and the implication of this is that a) they need to be interpreted within the context in which they have been generated; and b) comparison and extrapolations from individual case studies are constrained and should be treated with caution.

5. Case studies

5.1. Argentina (South America)

5.1.1. Background

5.1.1.1. Importance of livestock sector to the economy

Argentina's stock of cattle, sheep, goats and pigs totals over 68 million, which represents 1.6% of world stocks (cattle: 1.6%, sheep: 1.2%). Beef production accounts for 5% world volume. In 2004, the livestock sector accounted for 2.8% of the country's GDP and 31% of the agricultural GDP.

The livestock sector is an important generator of export income; agriculture has led the export-driven recovery of the Argentinean economy following the crisis of 2001. Argentina is one of the world's top beef exporters (6.6% of world exports by volume and 5% by value in 2004), and a significant dairy exporter (0.5% and 1% respectively). In 2004, beef exports brought over US$1 billion and dairy another US$0.5 billion, together accounting for 11.5% of Argentina's total export earnings that year. By quantity and value the EU (Germany) is the biggest importer of Argentinean fresh beef (and Russia of frozen). Processed meat and dairy products account for the largest share of North American (US and Canadian) agricultural imports from Argentina.

An estimated 45% of Argentina's population lives in rural areas (above the average for Latin America), and a significant proportion of these rely on livestock for income. Nearly 40% of rural households are in extreme poverty (compared to just over 30% in urban areas): this is estimated to affect more than 200,000 rural households, most of them in dispersed areas.

Despite its significance, the beef sector has experienced long-term stagnation in production, exports, and by all available productivity measures, although there has been some recovery in recent years. Between 1961 and 2002, land productivity in livestock grew only 50% in Argentina (compared to 150% in Chile and 300% in Brazil).

Another key weakness of the Argentinean livestock sector is the poor slaughtering and meat processing facilities. According to the WB, equipment complying with international standards can serve at present only 25% of output, estimated at 13.5 million tons per year. Uniformity and quality is a requisite to improve beef production and increase exports and has an effect on prices. Poor meat processing is estimated to result in price losses in processed products of approximately 15%. In an industry whose output is valued at US$18.5 billion, lack of quality can result in losses of over US$2.7 billion per year (A260).

A classification of Argentina's socio-economic position in the world, as carried out for the purposes of this study, can be found in **Annex 3**.

5.1.1.2. Key AH problem areas

Argentina was selected as a representative case study in the Americas because of the FMD relevance. Due to the fact that FMD, particularly in South America, has proven to be a challenge not facing any one country alone, a regional approach is very important for addressing this animal health problem. Such an approach is increasingly being taken by the various countries in the region as will be discussed in the following sections. Therefore, Argentina is being presented here not only on its own merit but also in the context of its role in the South American region.

FMD is a recurrent disease in South America and appears to be endemic in Bolivia, Ecuador and Venezuela. The disease occurs sporadically in Argentina, Paraguay, Uruguay, Peru, Colombia and Brazil. In particular, FMD serotypes O, A, and C are known to occur in the affected regions. The general FMD situation in South America significantly improved during the 1990s, due both to regional initiatives[95] and efforts made by individual countries (**Figure 12**).

Since 2000, however, a number of countries have reported new and significant outbreaks including Argentina, Brazil, Paraguay and Uruguay. The evolution of FMD outbreaks in Argentina during 1990-2005 closely mirrors the general trend in South America as depicted in **Figure 11**. This situation has resulted in major trading setbacks for the region.

A significant part of Central and South America are currently recognised as FMD-free without or with vaccination, but some of the countries that are not recognised have significant export potential, including Argentina and Brazil for which only certain zones are recognised FMD-free[96]. The impact of FMD, particularly in Brazil and Argentina, has global implications since these are major world exporters of meat. In the case of Argentina, when the first outbreak occurred in 2000, the country had only recently gained recognition from the OIE as being FMD-free without vaccination[97].

The OIE currently recognises two exporting zones in Argentina with respect to FMD status. The zone situated south of the 42° parallel (South Patagonia) is recognised as "FMD-free without vaccination", while the zone situated north of the 42° parallel is recognised as "FMD-free with vaccination"[98]. The

[95] Since 1987, an Hemispheric Plan for the Eradication of FMD (PHEFA) has been put in place by the countries of South America. Clinical cases of FMD decreased considerably throughout the continent: during the early 1990s national laboratories diagnosed an average of 766 cases per year in South America, but by the late 1990s the continent-wide average had fallen to 130. In 1999, clinical signs of FMD were absent in 60% of all cattle on the continent (which represented 41% of all South American herds and covered 60% of the continent's geographical area) (A160).

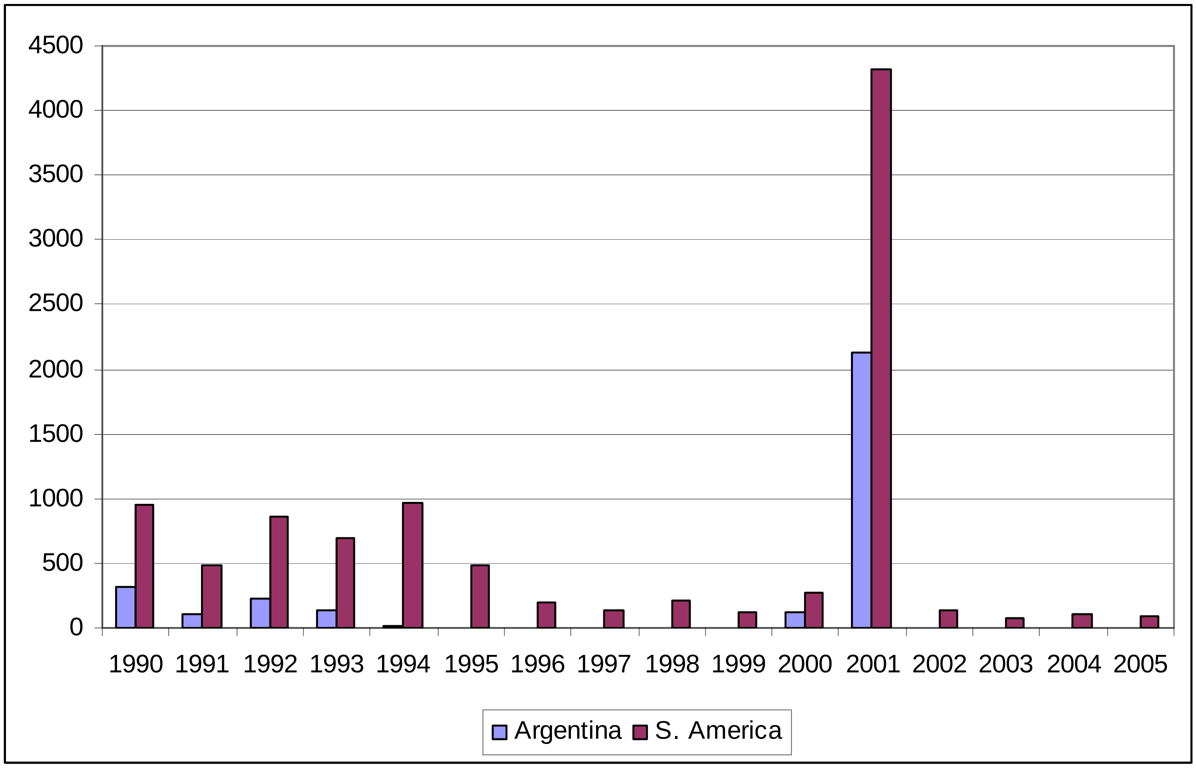
[96] According to data from PANAFTOSA/PAHO-WHO, OIE FMD zoning in South America covered as at the end of 2005 78% of the total cattle population (which represented 60% of all South American herds and covered 53% of the continent's geographical area). [PANAFTOSA: Pan American FMD Centre]

[97] In May 1997, Argentina achieved the classification of FMD free with vaccination, in accordance with Chapter 2.1.1 of the OIE Code. In May 2000, the status of FMD free without vaccination was achieved.

[98] For the various implications of vaccination see section 4.2.1.4.

latest outbreak in Argentina occurred in early February 2006 in the province of Corrientes, following which Argentina temporarily lost its status, but the impact appears to have been minimal[99].

Figure 11 FMD outbreaks: Argentina and South America (1990-2005) (a) (b)



(a) On the basis of reported outbreaks – FMD prevalence may be higher than the reported figures
(b) South America includes: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Uruguay and Venezuela

Source: Country reports to PANAFTOSA/PAHO-WHO

As already discussed, FMD is a regional problem in South America, therefore maintaining the recognised FMD free status (without or with vaccination) remains a constant challenge for Argentina, as well as some of the other countries in the region, while the disease remains present in neighbouring countries or areas. FMD-free areas of countries which border infected areas/countries are at greater risk than before

[99] 'FMD free zone with vaccination' status for Argentina, as recognised by the International Committee of the OIE in terms of Resolution XX of 24 May 2005, was suspended with effect from 8 February 2006 (adopted by the International Committee of the OIE on 23 May 2006). Argentina reported it had eradicated the outbreak on 3 April 2006. The country responded to the outbreak through the stamping out of around 5,000 animals (mainly cattle). The trade impact has been minimal because most major markets (with the exception of Chile) only banned imports from Corrientes, a province which accounts for only 2% of Argentine beef exports.

achieving disease-free status, especially if freedom is achieved without vaccination. This appears to be a persistent problem for Argentina as has been shown in previous outbreaks[100], emphasising the importance of strict and harmonised controls at source in all the countries of the region as well as of tight border controls and cross-border trade (A160, A172, A191). Both the re-emergence of the disease in 2000 and the more recent outbreak in Argentina's approved export zone in 2006 have been seen as warning signs that movement controls may not be adequately implemented (e.g. EU/SANCO-FVO Mission Report, A172; UK DEFRA analysis, 2006).

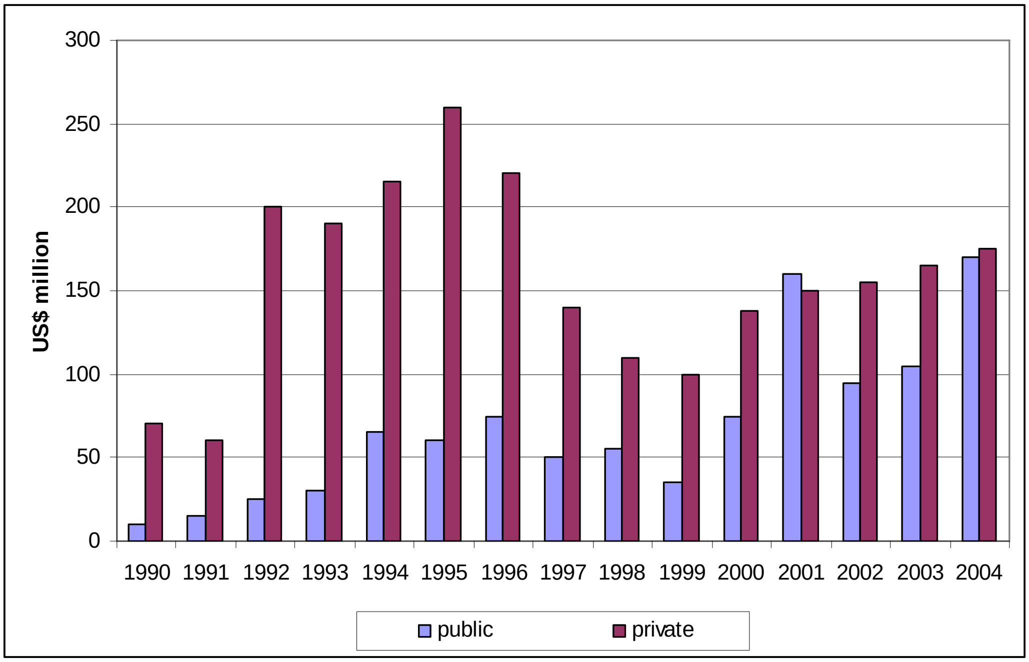
More generally, it is argued that the continuous re-introduction of FMD into the Southern Cone countries of South America is the result of failure to sustain the continuing high levels of prevention and surveillance required to maintain FMD free status (A160, A260). For example, it appears that during the 2000-2001 FMD outbreaks in Argentina, few of the local committees previously established were still in operation[101] (A196). This is attributed both to the general economic and financial instability in the region (scarcity of funds puts pressure on governments to prioritise), and lack of institutional experience in the management of these programmes.

The funds committed by both the public and private sector in South America indicate that the significant commitment during the mid 1990s was somewhat relaxed by the late 1990s, when the FMD situation was considered largely resolved and governments therefore moved funds to other high-priority areas (**Figure 12**). Following the extent and the spread of the outbreaks in 2000 in a large area previously considered free of FMD (**Figure 11**), expenditure on FMD programmes picked up again in 2001, with a significantly increased contribution by the public sector.

[100] The first reported incident in 2000 by Argentina was of the virus type A in a province on the northern border with Paraguay. Further investigations linked outbreaks in two other provinces to this initial report. By the time culling and carcass disposal had been completed, the veterinary services had detected 124 infected premises, 113 of which were type A virus. In 2001, all of the 2126 officially reported outbreaks were of the type A virus. A special control zone on the northern limit of the Patagonia area prevented the disease from spreading to the south of the country. The types and prevailing strains show that the Argentine problem is the problem of the region, thus, an isolated strategy will not produce long term results (SENASA, A259)

[101] These committees were established in previous outbreaks and played an important role in co-ordinating the response at national level.

Figure 12 Public and private funds committed to FMD programmes in South America, 1990-2004



Source: Country plans; PANAFTOSA/PAHO-WHO

5.1.1.3. AH services and institutional structures

During 1990-2004, the changes initiated under the national programmes appear to have contributed significantly to the strengthening of the veterinary services in Argentina (in common with most of the other South American countries) (A160). A review of the development of Argentina's competent authorities and structures, at national and regional level, during that period is contained in **Annex 2**. The relevant competent authority in Argentina is SENASA, the national service of livestock, plant health and food security, which operates under the Ministry of Agriculture and Food. Since the re-emergence of the disease in 2000-2001 SENASA has been restructured, and further restructuring plans are envisaged for the near future[102].

The EU's FVO reports that significant improvements were made in the structure and resources (trained staff and equipment) of SENASA and the other relevant bodies during 2000-2005, in successive missions

[102] An EU-financed (EuropeAid) programme to support the institutional strengthening of SENASA, of an estimated value of Euro 2.9 million, was launched in late 2006. The 3 year project has 3 components: a) support for the institutional redesign of SENASA; b) strengthening the control, surveillance and certification systems for the agri-food chain as a whole; and c) improving the data processing systems particularly for the traceability, prevention and control of health risks.

which were undertaken by the FVO expert teams during that period to evaluate the controls in place over FMD (A172). Despite some shortcomings, the overall set-up of the FMD controls and institutional structures is described fairly positively, and the Argentinean authorities are seen as being responsive and taking measures to follow up on the recommendations made. Overall, the latest FVO report (2005) concludes that the control system in place guarantees that provisions of Community legislation on imports of meat of all species are generally complied with, although further improvements can be made in FMD control. The points on which emphasis is always placed are active/passive surveillance and border/movement controls, which by definition are the most sensitive links in the system given the regional epidemiological relevance of FMD.

In its latest report on Argentina's agricultural sector, the World Bank also concludes that SENASA has a good technical capacity and has been able over the years to establish sound regulatory systems and processes, and that it is aware of its own deficiencies and striving to correct them (A260).

Eradication plans have been enacted since 1990 in Argentina, the most recent following the large outbreak in 2000-01[103]. The goal has always been the eradication of FMD from the national territory, allowing for international recognition of the country as FMD-free. The plans have included the strengthening of the national and regional structure with broad participation of all sectors; the limitation of viral circulation by means of systematic or strategic vaccination; control of livestock movement; stamping out or sanitary slaughtering under special circumstances; and epidemiological surveillance. The national FMD contingency plan has recently been under review, following *inter alia* FVO recommendations.

Mass vaccination during the 1990s has been an important component of Argentina's eradication plan. This was suspended in 1999, which led to part of the country gaining 'FMD-free without vaccination' status since 2000. However, systematic and strategic vaccination campaigns have been maintained to keep the country free of FMD (A172).

To address concerns over cross border transmission of the virus, a buffer zone programme started officially in 2001 (Resolutions 403/04, 446/04 and 748/04) with the objective of maintaining the country status achieved for FMD. It establishes a buffer zone along the border with Bolivia and Paraguay. This appears to provide efficient additional protection in this high risk area (A172c).

The only laboratory entitled to perform analyses related to field investigation of FMD in Argentina is the SENASA national reference laboratory in Martinez. This gained accreditation in 2006.

Animal registration/identification and animal health management systems are in operation (the latter was introduced in 2004), and these appear to have reinforced the traceability and control of animal movements (A172c).

At a regional level, during the last 20 years, Argentina has been part of the regional initiatives for the fight against FMD, including the Hemispheric Plan for the Eradication of FMD (PHEFA) established in 1987,

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[103] In 1990, Argentina started a two-phase eradication plan. The first phase lasted from 1990 until 1992 (control plan); the second phase ran from 1993 to 1997 (eradication plan). Following the 2000 re-emergence of the disease, Argentina's plan for FMD eradication was unveiled and implemented in April 2001 (SENASA Resolution No. 5, dated April 15, 2001).

and the new Hemispheric Plan for FMD (GIEFA) created in March 2004. GIEFA was created in the inter-American context[104] to deal with the few pockets of resisting FMD on the continent. The objective of GIEFA is to eradicate FMD from the Americas by 2010 through control and elimination of the disease from endemic areas and by protecting FMD free areas. To this end, in 2005 the GIEFA developed an Action Plan, which is to be complemented by national plans.

One of the basic strategies of the new plan is to strengthen the infrastructure of national veterinary services. It appears that the previous programme (the PHEFA) contributed significantly to the improvements of veterinary services in almost all countries of the region, including Argentina.

5.1.2. Cost of prevention and control systems

As discussed above, significant public and private funds have been committed in the South American region in the context of the national plans. In total, some US$ 3.5 billion have been committed on the fight against FMD by South American countries during 1990-2004, of which the public sector has contributed roughly 30% and the private sector 70% (**Figure 12**). Over 75% of the mass vaccination undertaken by Argentina and other countries in the region was funded by the private sector (A196).

In 2001, although in the midst of extensive financial difficulties, Argentina's government assigned a budget close to US$ 60,000,000 in its latest plan to control FMD (SENASA Resolution 5/2001).

While a regional approach is increasingly being advocated to address FMD, the extent of the financial commitment on GIEFA is not clear as yet.

5.1.3. Costs of outbreaks

Argentina's FMD outbreaks have caused significant ripple effects in terms of trade losses in important export markets. As soon as the "FMD-free with vaccination" status was granted in May 2007, US and Canadian markets were opened to Argentine fresh beef (further gains were envisaged in Asian countries in anticipation of a sustained "FMD-free without vaccination" status). Following the FMD outbreak in 2000-01, the closure of foreign markets reduced export volume by 53% and export value by 65% within the first eight months of 2001 compared to the previous year. Beef exports fell from US$706 million in 2000 to US$267 million in 2001 (A260).

Additional losses were reported from lower livestock prices. The dairy industry was also affected because of reduced productivity per cow and restricted market access.

[104] Created by PAHO-WHO (Pan American Health Organisation) and USDA in Houston Conference, with an initial 12 members (6 private and 6 public) and later expanded to include 4 new members (Paraguay, Bolivia, Ecuador and Venezuela).

5.1.4. Comparison of prevention versus outbreak costs

A review of the cost-benefit of improvements in Argentina's and other Latin American veterinarian systems was recently undertaken by the OIE Regional Representation/CEMA (A141) [105]. The review indicates that the cost of provision of veterinary services in Latin America is approximately US $ 300 million per year. This means each dollar spent on veterinary services covers a stock value of between US $280-300 per animal, in other words expenditure per year on official veterinary services equates to 0.3% of the value of the stock. Starting from the current situation as a baseline, the potential economic benefits from reduced animal disease incidence resulting from different scenarios of increased investment in veterinary services are explored. The current situation is described in terms of expenditure per animal equivalent, which ranges from US $ 1.5 in Argentina to US $ 0.4 – 0.50 in Paraguay and Peru and US $ 0.7 in Brazil. One scenario envisages an increase in the expenditure of US$ 0.32/animal equivalent. This would result in increased expenditure of US$ 18 million in Argentina.

Preliminary results, in the case of Argentina, indicate that productivity increases from a reduction in animal disease incidence would range from 5% to 15%, which (taking a value of US$ 0.8 per animal equivalent and attributing this to the increase in meat output) could generate revenue in Argentina of US$ 20 million. In terms of the potential trade impact, assuming a 20% price improvement (earlier research suggests that there could be up to 40% increase in Argentinean prices resulting from removal of FMD), Argentina could gain an additional 260,000 tonnes of exports. It is noted that the region as a whole could achieve total exports of 1.9 million tonnes (compared to present exports from these countries of 1.2 million tonnes) i.e. 60 % increase. It is concluded that the final outcome in terms of NPV and welfare gains justifies the investment.

Trade benefits in return to this type of investment are also expected by other experts, including the WB. It is noted that Uruguay, a country that has followed a very similar path to Argentina in improving animal health conditions during the 1990s and was declared "FMD-free without vaccination" by the OIE in May 1996, was able to gradually open up selective export markets in Europe, Asia, and North America, reaching a total of US$412 million in 2000 (A230).

In addition, there are poverty alleviation arguments in support of such investment. In its latest report on Argentina's agricultural sector, the WB recommends investing *inter alia* in SPS systems, as an effective way to help improving poverty conditions (A260).

More generally, the WB notes that Argentina's experience with FMD control demonstrates how a program based on a regionally concerted effort and strongly supported over a number of years with adequate legal, technical and financial means finds success, but reversal is still possible if support weakens. The same conclusion can be drawn also from the experience of other countries in the region such as Uruguay (A230) and Brazil (A175).

Our analysis in this section leads us to the following conclusions:

[105] This research is currently in progress – results are preliminary. Further findings are presented in **Table 10**.

Case study: Argentina

The FMD campaign undertaken in South America during 1999-2004 has demonstrated the value of regional action when the control of TADs of major economic importance to the region is being sought. It also demonstrates the significance of maintaining the investment when pockets of resistance remain which risk to erupt to full blown outbreaks in countries of the region.

Some US$ 3.5 billion have been committed on the fight against FMD by South American countries during 1990-2004 (Figure 12), which is considered to have contributed to an effective control of the disease during this period (Figure 11).

Against this, in the space of only a year, the 2000/01 FMD outbreak in Argentina has resulted to losses in beef export revenue alone of US$ 439 million.

Preliminary results of on-going cost-benefit analysis of improvements in Argentina's and wider Latin American VS (OIE Regional Representation/CEMA) suggest that there are significant benefits in terms of both productivity gains and potential trade gains from investing in such improvements, and that the final outcome in terms of NPV and welfare gains justifies the investment.

For example, an increased expenditure of some US$ 18 million in Argentina's VS would result in productivity gains of US$ 20 million per year, and additional annual exports of 260.000 tonnes..

5.2. Vietnam (Asia)

5.2.1. Background

5.2.1.1. Importance of livestock sector to the economy

Vietnam's total poultry population is estimated at around 250 million birds, including 20-60 million ducks and geese. The livestock sector accounts for about 20% of the agricultural GDP or about 5% of the country's total GDP (A97). Poultry is the country's second most important meat category after pork, accounting for an estimated 13% of the total in 2004 (though it averaged about 16% prior to the onset of AI) (A9). Of this share, 70% is made up of chicken, and the remainder is mostly duck and geese. According to FAOSTA data, the sector has experienced strong growth during the 1990s and until the AI outbreaks (1990-2000: 5.8% average annual growth rate; 2000-03: 8.3%), but in 2004 the sector has dramatically recessed (-11.8%).

The bulk of the production is for domestic use: Vietnam is a net importer of livestock products, and their share of total agricultural trade value is very small.

Three basic systems of poultry production are identified in Vietnam: family, semi-commercial and commercial/industrial (A9, A16). An estimated 60-70% of poultry is raised in 'backyard' family farms (sectors 3 and 4) in close proximity to other birds. In fact, some 94% of the poultry keeping households are reported to fall in the category of a village and scavenging backyard system (A91). Few systems could be classified as being in sector 1 (industrial farms), and these account for 20-25% of the national production. The remainder 10-15% of poultry production is carried out by semi-industrial/commercial farms (sector 2). Poultry is generally sold live in local markets and slaughtered at home, while only a small number of birds are processed through slaughterhouses.

The relatively low costs of raising poultry relative to cattle or pigs make it the most popular livestock enterprise in Vietnamese rural households, constituting an important source of cash income – particularly for women – thus contributing significantly to poverty alleviation. It is estimated that some 70% of Vietnam's 12 million rural households keep poultry. Poultry is the most important livestock-based income source for the poorest quintile, providing about 7% of cash income for these households, as well as being a relatively inexpensive protein source for their own consumption.

A classification of Vietnam's socio-economic position in the world, as carried out for the purposes of this study, can be found in **Annex 3**.

5.2.1.2. Key AH problem areas

Vietnam was selected as a representative case study in Asia because of the HPAI relevance, both in terms of the significance of the outbreaks and in terms of the approach followed and the mobilisation of the international community.

The country suffers from a number of high risk factors with respect to AI. Apart from having a relatively high share of sector 3 and 4 poultry systems as discussed above, Vietnam is one of the most densely populated countries in the region and has one of the highest concentration ratios of poultry (501 chicken per sq. km, 716 domestic birds per sq. km) particularly in the areas affected by AI (A16). Further risks arise from farm management practices (close contact with animals and between domestic birds and wild birds) and along the value chain (particularly live bird markets) (A9). A final set of risks, particularly in the first wave of AI in early 2004, emerged from poor knowledge of the disease and how it spread (though this is less prevalent now), and from stakeholders' efforts to circumvent the control measures imposed (this was not helped by the compensation policy that was first adopted, as will be discussed below) (A3, A9, A258).

Since the outbreak of the HPAI H5N1 strain in December 2003, in the three waves of the epidemic[106], Vietnam has accumulated by far the largest number of outbreaks in the world (2,368) or 52% of the total

[106] According to WHO, the spread of HPAI can be categorised into three waves. The first wave of the disease lasted from December 2003 until March 2004, when disease spread to 57 of Vietnam's 64 provinces resulting to 44 million birds dead/culled (including affected and non-affected birds) and the death of 16 people. The second wave, which was mainly confined to 17 provinces, began in April 2004 and lasted through November, resulting in the culling of 84,000 poultry (all of which were clinically affected), and claimed four people. A third wave of the disease began in December 2004, and until mid 2006 about 1.9 million birds had been slaughtered and twenty two people had died.

(followed by Thailand, which accounts for 24% of the total) (**Annex 2**). The response to the disease has included mass culling (with compensation) and an extensive national poultry vaccination program.

Despite improvements in the situation since late 2005, the disease is still uncomfortably present. Since December 2006 only, Vietnam has had 52 outbreaks of HPAI with 10,314 poultry deaths and 15,485 poultry destroyed[107]. This has led experts to conclude that HPAI has become endemic to Vietnam. WHO recently signalled that the outbreaks could take years to end definitely.

According to veterinary experts, including the OIE, the main challenges currently posed by the HPAI epidemic in the wider Asian region are set to continue for the foreseeable future (**Box 3**).

Box 3 Current challenges posed by the AI situation in Asia

1. Unprecedented cases and socio-economic impacts (increase of poverty, impediment to trade)
2. Repeated outbreaks since the end of 2003
3. Viruses holding a foothold and circulating
4. Threatening risks to human and animal health
5. No immediate eradication foreseen
6. Spread to new countries and re-emerging (including role of migratory birds)
7. Poor biosecurity – animal production systems
8. Gaps between legislation and its enforcement

Source: OIE Regional Representation for Asia and the Pacific, February 2006 (A100)

At the same time, Vietnam has reported the highest number of human HPAI infections in any country by a substantial margin. From December 2003, when the first human case was detected, to date there have been 93 confirmed cases (**Figure 9**). With 42 deaths, this gives a very high case fatality rate (45%) (**Figure 10**). Concern amongst experts, including the WHO, has arisen over the fact that the virus might mutate in a way that facilitates its transmission, both within and also between species, which would make it progressively more harmful.

[107] Vietnam's latest report to the OIE on HPAI, 17 January 2007. A further 30 outbreaks are still recorded as unresolved.

5.2.1.3. AH services and institutional structures

Vietnam has committed significant national resources to the fight against avian influenza and for the prevention of a human pandemic. A National Steering Committee for the Prevention and Control of Avian Influenza (NSCAI) has been established in January 2004 as the national coordination mechanism for HPAI planning and supervision[108], while a National Steering Committee for H5N1 Avian Influenza among humans evolved from the National SARS Steering Committee (established in 2003) to deal with human health aspects. This is supplemented by Steering Committees at provincial and sometimes district level, established under the People's committees.

In September 2005 the NSCAI prepared a National Preparedness Plan in response to Avian Flu Epidemic H5N1 and Human influenza Pandemic (A326), which was approved by the Prime Minister in November 2005. This integrated plan designed responsive measures under WHO's pandemic phases and scenarios, and allocated responsibilities and actions for ministries, People's Committees at all levels and other organisations. In February 2006, the government established a National Task Force under the NSCAI, whose main task has been to develop the *Integrated Operational Program for Avian and Human Influenza* (OPI) covering the period 2006-10. These plans an their budgets are discussed in section 5.2.2).

Vietnam's animal health system as such is structured as follows. The Department of Animal Health (under the Ministry of Agriculture and Rural Development - MARD) co-ordinates national policy, while six Regional Veterinary Centres manage their particular territories. Each province has a sub-Department of Animal Health, which supervise more than 600 District Veterinary Services (A9).

Regarding the provision of animal health professionals, in 2004 a French mission to Vietnam[109] reports that, in contrast to many developing countries, geographical coverage in Vietnam is quite good. However, there is a lack of specialist knowledge, and their services are not used often, particularly for preventive care/vaccination. Back in 1998 IFPRI (1998) found that less than 1% of producers asked veterinary services for regular examination of their stock. Although the situation has improved since then, the proportion of birds per veterinarian, estimated at 145,200 birds, is considered to be rather low in comparison to the needs (A16). The public veterinary workers are supplemented by a network of private para-veterinary practitioners. Vétérinaires Sans Frontiers (VSF) in 2004[110] report that the cost of a visit of a para-veterinarian to treat a few birds is too high in relation to the value of the animals.

Moreover, according to the VSF, there is a lack of coordination between central and provincial levels resulting in difficulty applying national decrees, and a general lack of staff to keep up with inspection needs is also reported. AI outbreaks appear to have made all these problems more acute. Although extension services are prevalent throughout Vietnam, the VSF (2004) study reported no organisation in

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[108] The Committee which is composed of members of the various competent Ministries meets weekly to brief the government of the latest developments.

[109] D'Andlau, Georges et al (2004): "Avian Influenza Support Mission to Vietnam: Diagnosis and Short-term and Long-term Proposals". Paris: Agence Française de Développement.

[110] Delquigny, Thomas et al. (2004), Evolution and impact of avian influenza epidemic and description of the avian production in Vietnam, Final Report. Hanoi: Vétérinaires sans Frontières.

30% of districts and 70% of villages, suggesting a serious lack of capacity. State extension services have not traditionally focused on poultry production because for most producers, it is an activity involving little outlay of capital or time. Also, there is a major constraint in the transmission of information between the provinces and the central government, as the People's Committee has to endorse any outbreak and contribute to the compensation payment; consequently, poor province tend to under-report[111].

There is little evidence in the current literature on the evolution of Vietnam's animal health sector over time. The particular questions of interest would be: a) whether the resources committed to the animal health sector's restructuring since the AI outbreaks (as discussed in section 5.2.2) have paid off in improvements and b) whether the VS and the systems in place are currently prepared to prevent and/or control future outbreaks (not only of HPAI but also of other diseases).

Vietnam's VS were recently subject to an independent audit following the OIE PVS evaluation methodology. Although detailed results to date remain confidential, the general conclusion is that the country's VS can be considered to be in transition. This means that there has been a notable improvement in the last 3 years towards a generally good structure, particularly at national and regional levels, which would suggest that the effort undertaken so far is paying off. The structures that have now emerged can be used as a basis for further improvements. Some of the priority areas where further investment is needed include the establishment of strategic and operational plans for the VS (in particular to reinforce communication between regions and the centre, and restore the chain of command), building a national database for central data collection at national level (as part of the national animal health information system), maintenance and training of laboratory diagnostic capacity (including standard operating procedures for sampling and collection), improving quarantine and movement controls (equipment and training), reinforcing the food inspection system, and increasing/improving staff resources (inter alia through training and better pay)[112].

5.2.2. Cost of prevention and control systems

Vietnam's efforts to control HPAI were supported and co-ordinated from the outset by a platform of donor assistance which complemented multilateral assistance provided mainly by the World Bank and the EC, as well as direct bilateral financing and technical assistance. Up to December 2005, Vietnam had received some US$ 45.9 million in donor support to control HPAI (**Table 11**).

Table 11 Vietnam: donor support to HPAI control, 2003-05 (a)

	US$ million
Grants from country donors	17.8
Grants from international organisations	2.4

[111] WB (2006): Vietnam Action Plan for Food Safety and Agricultural Health.

[112] The key priorities identified during the Vietnam PVS mission also reflect the concerns of the government. These priorities have been embedded in a road map which has just been approved by the Ministry of Agriculture and Rural development (MARD, April 2007): *Strengthening the national management framework in veterinary services, 2007 to 2010.*

	US$ million
- of which EC:	*1.9*
Grants supported through UNDP	7.7
WB AI Emergency Recovery Project, 2004 (A204)	5
WB National Health Support project	13
TOTAL	**45.9**

(a) does not include some support provided by NGOs and private companies

Source: Vietnam Ministry of Agriculture (MARD) and Ministry of Health (A271)

Due to these efforts, as discussed elsewhere in this Report, Vietnam's national integrated plan is one of the strongest not only in the region but also in the world (section 4.2.3). Indeed, the response and mobilisation of the international community and the cooperation of the national VS can be considered exemplary.

Currently, Vietnam's HPAI prevention and control operations are carried out in the framework of the Integrated National Strategy and Pandemic Response Plan (Red Book), and the Integrated Operational Plan (Green Book). The background to the development of these plans is discussed briefly below.

Following the National Preparedness Plan[113] of September 2005, specific action plans were approved for the human and animal health sectors: the National plan of Action on Human Influenza Pandemic Prevention and Control[114] (November 2005), and the Emergency Disease Contingency Plan for Control of HPAI (December 2005).

Built upon the National Preparedness Plan, the Integrated National Plan for Avian Influenza Control and Human Pandemic Influenza Prevention and Response 2006-2008 (A271), also known as **Red Book**, was completed in January 2006. The Red Book laid out the actions and the costs to undertake during 2006-2008 for the animal health and human health sectors. The plan supports the improvement of co-ordinated prevention and national preparedness, strengthening surveillance and early warning systems, strengthening HPAI control and outbreak containment and sets out the key areas to be addressed towards a medium term agenda. The estimated total budget required by the Red Book was US$266 million, of which US$ 137,5 million (52%) for the agricultural sector to control HPAI in domestic poultry and US$ 128,5 million (48%) for the health sector for preparedness and response to a human influenza pandemic[115].

[113] The estimated required budget under this Plan was VND 8,877 billion, of which 45% for animal health, and 55% for human health. The budget for the human health was further sub-divided into: costs of treatment (accounting for 75% of the total); the costs of prevention; Tamiflu stocks; and other costs.

[114] The National plan of Action on Human Influenza Pandemic Prevention and Control estimated a cost of VND 17,000 billion for health activities in case of an outbreak of human influenza pandemic.

[115] A more detailed budget is provided in Table 1 of the Plan (A271)

Based on this Plan, a detailed Integrated National Operational Programme for Avian and Human Influenza 2006-2010 (OPI) (A270), also known as **Green Book**, was prepared by a Government Taskforce established by the Steering Committee with support from the UN Country Team, the World Bank and other donors participating in a Joint Assessment Mission from 18-28 April 2006 and finally endorsed by the international community. The plan is focused on the national preparedness, the improvement of the policy framework, public awareness and information activities as well as strengthening the disease control in the agricultural sector and the surveillance in both human and animal sectors. It constitutes the basis for the national VS to develop their own strategy to control HPAI. The total cost of the OPI was estimated at US$ 250 million, including US$31.2 million for the enhanced coordination activities (12% of the total), US$116.4 million for HPAI control and eradication activities in the agricultural sector (47%) and US$102.4 million for influenza prevention and pandemic preparedness in the human population (41%)[116].

The priorities proposed in the OPI have been discussed in a number of fora, while a number of international organisations (including the WB, the FAO, and the WHO) have been involved in a joint assessment mission during the plan's preparation, which assessed the country needs and financial requirements for the implementation of the Plan over the 2006-10 period.

In the animal health sector (HPAI Control and Eradication Strategy), the OPI's key components include the strengthening of VS, a control and eradication strategy, support to surveillance and epidemiological investigation, and support for poultry sector restructuring. The strategy foresees a stepwise approach in three phases:

(a) control phase (short term), in which the incidence of outbreaks is reduced by stamping out of outbreaks, mass vaccination and the start of improvements in bio-security (poultry production and changes to marketing practices). This phase is expected to continue in 2007, with some reduction of the national mass vaccination program occurring in 2006;

(b) consolidation phase (medium term), in which gains are maintained, further restructuring of the industry is undertaken, farms in the industrial sector demonstrate freedom from HPAI, and disease free compartments are expanded. This phase is to continue to the end of the OPI planning horizon, from 2008 to 2010; and

(c) eradication phase (long term) which will start in 2010 and will continue beyond the OPI period.

The bulk of the costs (**Table 12**) are foreseen for the control of the disease (65.9%) and, in accordance with the strategy, nearly half of the costs of this component are expected to be incurred in the short term (2006-07). The most significant expenditure of disease control is on targeted vaccination (US$ 25.6 million or 46.6%), followed by compensation to livestock owners and disease investigation (appr. US$ 12.5 million each or 22.6%). The strengthening of the VS comes second in the Plan (18.9%) and is expected to be undertaken in year 2 (2007); in addition, the bulk of the (epidemio) surveillance investment is envisaged for 2007. Most of the VS component is devoted to the development of laboratory capacity and equipment (US$ 12.2 or 92% of the total component).

[116] All costs including contingencies. A more detailed budget is provided in Table 1, Annex 2 of the Plan (A109)

Table 12 Vietnam: HPAI Control & Eradication (AH component of Integrated Plan, 2006-10)

	US$ million (a)					
	2006	**2007**	**2008**	**2009**	**2010**	**Total (a)**
A. Strengthening VS, of which	0.96	11.37	1.14	1.14	1.14	15.75
• *Laboratory development*	-	*7.35*	*0.85*	*0.85*	*0.85*	*9.90*
• *Additional equipment labs*	-	*2.30*	-	-	-	*2.30*
• *Training of laboratory staff and specialist*	*0.22*	*0.53*	*0.20*	*0.20*	*0.20*	*1.35*
B. HPAI Control, of which	13.89	13.18	9.69	9.19	9.21	55.17
• *Disease Investigation*	2.85	2.56	2.25	2.25	2.27	12.29
• ***Outbreak control (crisis)***	***3.12***	***3.12***	***2.62***	***2.62***	***2.62***	***14.00***
• *Vaccination*	*7.04*	*6.81*	*4.27*	*3.80*	*3.80*	*25.72*
• *Border controls*	*0.66*	*0.47*	*0.43*	*0.40*	*0.40*	*2.36*
• *Quarantine and movement control*	*0.22*	*0.22*	*0.12*	*0.12*	*0.12*	*0.80*
C. Epidemio-Surveillance, of which	0.52	2.08	1.21	0.42	0.22	4.45
• *Epidemiological research*	-	*1.65*	*0.99*	*0.20*	-	*2.84*
D. Poultry Sector Restructuring	0.26	2.64	2.58	2.38	0.51	8.37
TOTAL	**15.63**	**29.27**	**14.62**	**13.13**	**11.08**	**83.74**

(a) excludes contingencies – if contingencies are included total cost comes to US$ 91.9 million

Source: Vietnam OPI (A109)

Vaccination has been and continues to be a key component of Vietnam's control and eradication strategy. Since September 2005, three rounds of vaccination for smallholder and village poultry have been conducted and the number of outbreaks and culled poultry decreased significantly. Although the precise contribution of vaccination to the control of the disease can not be determined due to implementation of a number of measures simultaneously, this is considered to have reduced the size of the susceptible population (A7). Originally, some US$ 17.3 million were allocated to the vaccination program for the planned vaccination of 160 million poultry over a two-year period (MARD and FAO data), but the OPI envisages some US$25.6 million on targeted vaccination. By the end of January, 246 million doses had been administered, at an approximate cost of $10 million. This cost will reduce over time as the vaccination is targeted to high-risk production sectors and areas based on surveillance data and epidemiological studies. In addition to the costs for vaccines and the logistical costs of injecting into birds, a vaccination campaign for HPAI also includes costs for pre and post vaccination surveillance. The cost of this for the first two initial years of the campaign was estimated at US$ 1.13 million. The majority of this cost is spent on laboratory tests for active surveillance to detect circulating viruses.

Some examples of prevention and control costs, for the different components of a comprehensive surveillance system, vaccination and biosecurity, are provided in **Table 13** below.

Table 13 Vietnam: selected examples of prevention and control costs

Component	Costs
Comprehensive surveillance	Estimates of a 10 year strategy for Vietnam which includes heightened surveillance, improved biosecurity of markets, preventive vaccination and improved biosecurity on all types of farms (sectors 1 to 4) put the cost of the investment at between 4 and 6 times the benefit, depending on the assumptions made about the incidence of disease. (A76)
Early warning	Investment in early warning typically includes staff training, laboratory upgrades and information system upgrade from the field to the centre. For Vietnam the total cost would be approximately US$2.4 million, including setting up community animal health worker networks. In addition, there are recurrent costs, including field observation, sample taking and testing, reporting. In Vietnam, the cost would be around US$ 4.1 million a year, or US$ 41 million over ten years. (A76)
Laboratories	Upgrading of info systems: depending on the number of provinces and labs connected to the system this investment is estimated in Vietnam at some US$ 340,000 (if information systems for laboratories in two thirds of the provinces are upgraded and linked). (A7)
Vaccination	In Vietnam the budget allocation for the vaccination program was originally US$ 17.3 million for the planned vaccination of 160 million poultry over a 2 year period. By end of Jan 2006, 246 million doses had been administered at a cost of US$ 10 million. (A7) The estimated cost of mass vaccination – including pre- and post-vaccination serological surveillance (over a period of two years), followed by strategic serological surveillance (over five years) is US$ 39 million (operating costs), with an initial investment of US$ 2.7 million. A thorough post-vaccination surveillance (such as that performed in Europe or Hong Kong) in countries with dispersed poultry sectors (such as Vietnam) is estimated to be prohibitive. (A76).
Communication	A mass media campaign over a year to raise farmer awareness how to recognise AI and how to report it to the authorities costs US$1 million. The cost is relatively high due to the extensive production systems / backyard farming in the country. (A7)
Biosecurity (on-farm)	In Vietnam, due to the large number of smallholders, the costs of training for just 10% of the 7 million farms at a cost of US$50 per farm would amount to US$ 35 million. These costs would be faced by the government. In addition, there would be costs of investing in biosecurity (normally borne by farmers). Assuming a minimum investment of US$ 75-100 on average per farm (in fence areas for grazing and building a small shelter which are the minimum biosecurity measures), the cost is expected to be over US$500-700 million for investment costs alone and twice that for recurrent costs. This scale of investment is out of reach for most farmers (A7, A76). This raises questions on the usefulness of the Plan, if such a key component is in practice difficult to implement.
Biosecurity (in markets)	The total cost of upgrading markets in Vietnam to improve biosecurity would be between $5 and $10 million. (A76)

Source: compiled by Agra CEAS Consulting

5.2.3. Costs of outbreaks

Vietnam's losses from the AI epidemic have been extensively covered by literature, making this one of the best-documented countries on the subject. **Table 14** provides a picture of the direct and indirect impacts based on a selection from the available literature[117]. A more detailed calculation of the direct production costs and losses (including culling and control costs), based on the available literature and certain assumptions, is provided in **Table 15**.

A total 44 million birds were culled/died after the first HPAI outbreak in 2004. Although compensation was applied, this was judged to be at low level and reportedly acted as a disincentive for farmers to report the disease on time (A3, A258).

Table 14 Vietnam: selected direct and indirect impacts of AI outbreaks (a)

Direct costs and losses	
Production losses Compensation	In the first outbreak in 2004, 58 out of 64 Provinces were affected, and 17% of the total national poultry flock of 262 million birds (about 44 million) lost. The loss in terms of the value of birds was estimated at VND 800 billion (assuming an average farm gate price for chicken of VND 20,000 before AI) or US$ 53 million. According to other sources the value of the birds lost is even higher. In the second wave of outbreaks, the costs were smaller due to a less drastic approach to culling in which clinically infected birds only were slaughtered, and because the disease spread less. (A9, A16, A91, A204, A292) The central government budget allocated to AI compensation up to June 2005 amounted to VND 268 billion (US$ 17.2 million) (A3).
Culling & control costs	It was estimated to cost about US$ 0.25 per bird to cull and dispose approximately 200 chickens per farm (A7, A9, A91). Containing the first epidemic in 2004 is estimated to have costs the government about VND 400 billion (US$ 27 million) including the temporary labour for culling and disinfection, hiring of equipment etc. (A204)
Consequential on-farm losses	The loss of income, assuming poultry production fell to zero for a period of 3 months (during the moratorium on re-stocking), would amount to around VND 1.6 trillion (US$107 million), which is considered a realistic estimate of the actual losses caused by the 2004 crisis. (A204). The number of rural households directly involved in poultry production, predominantly carried out by women, is reported to have fallen by 50% (A40, A91).
Total direct impact	The WB has estimated the total direct impact in terms of the poultry sector's contribution to GDP (0.6% Vietnam before the HPAI epidemic). With poultry output down by around 15%, this part of economic loss is worth about 0.1% of GDP or about $45 million. On the other hand there have also been important substitution effects, especially towards production of pork. Combining these effects, the direct cost in Vietnam may be around 0.12% of GDP.

[117] It is noted that the literature available on this subject in some cases may provide conflicting information due to the assumptions and base data used, e.g. on the bird value. The various results have therefore been calibrated and updated with latest evidence to provide a more accurate picture of the impact.

	(A140, A140a)
Indirect impact: ripple effects	
Prices of substitute products	A 2004 FAO survey found that in Vietnam, prices of non-poultry meats rose up to 30% when live-bird markets were disrupted by the AI outbreaks and remained high even after the poultry markets recovered, taking the purchase of meat out of reach for low income consumers. (A40)
Poultry prices and sales	At the lowest point of the HPAI crisis (Oct/Nov 2005), prices were 50-60% below normal, and the volume of poultry sales reported to have fallen by half, from about 40 million poultry per month to 20 million. When prices started recovering in December they were 30-60% lower than pre-outbreak levels, but supermarket prices were 25-35% higher (in fact these farmers and markets that sold certified products were able to capture higher prices). The volumes sold daily (poultry and eggs) were lower than pre-outbreak levels. (All unofficial data.) (A9)
Feed industry	The AI outbreaks have had a sharp effect on feed manufacturers, particularly those selling to semi-commercial producers. For instance, one major manufacturer reported a drop of 90% in feed production while another reported a drop of 60-70%. The cost of commercial feed accounts for up to 70% of the cost of raising industrial chicken, and Vietnam's poultry sector normally consumes an estimated 8-10 mt/year of complete feed, nearly all of which is directed toward semi-commercial and industrial farms. (A9)
Wholesale markets	The reorganisation of HCMC's chicken and egg production following the **HPAI** outbreaks (and the need to ensure product safety) led to a decline in the number of wholesale egg markets from 134 to 75, while the number of poultry markets fell from 1,550 to 7 (excluding supermarkets). (A9)

(a) The literature available on this subject may in some cases provide conflicting information due to the assumptions and base data used, e.g. on the bird value. The various results have therefore been calibrated and updated with latest evidence to provide a more accurate picture of the impact.

Source: compiled by Agra CEAS Consulting

Table 15 Vietnam: calculation of total direct costs of HPAI outbreaks (2004-05)

	VND	**USD (b)**
Total costs (2005) (a)	797,300,000,000	51,108,974
Total costs (2004-5) (a)	1,936,970,000,000	124,164,744
Total compensation provided (1)	267,991,000,000	17,178,910
Value of culled animals per head (2)	40,000	2.56
Compensation provided per head (3)	5,000	0.32
Restocking subsidy per head (4)	2,000	0.13
Culling and disposal costs per head (5)	3,900	0.25

	VND	USD (b)
Control costs per head (6)	3,000	0.19
Number of birds culled (2005)	*17,000,000*	
Total compensation (2005)	85,000,000,000	5,448,718
Total value of culled animals (2005)	680,000,000,000	43,589,744
Total restocking subsidy (2005)	34,000,000,000	2,179,487
Total culling and disposal costs (2005)	66,300,000,000	4,250,000
Total control costs (2005)	51,000,000,000	3,269,231
Number of birds culled (2004-5)	*41,300,000*	
Total compensation (2004-5)	206,500,000,000	13,237,179
Total value of culled animals (2004-5)	1,652,000,000,000	105,897,436
Total restocking subsidy (2004-5)	82,600,000,000	5,294,872
Total culling and disposal costs (2004-5)	161,070,000,000	10,325,000
Total control costs (2004-5)	123,900,000,000	7,942,308
Laying hen market value (7)	100,000	6.41
Poultry farming income (8)		
Normal' (pre-outbreak)	400,000,000,000	25,641,026
Crisis (average during crisis)	100,000,000,000	6,410,256
Total income loss during crisis	1,800,000,000,000	115,384,615

(a) includes culling (value of culled animals and culling/disposal) and control costs
(b) Exchange rate: 1USD = VND 15600
(1) To date central government funds allocated for AI amounts to VND 268 billion, from the budget of the National Prevention/Emergency Fund (around 15% of the budget) (source: A3)
(2) Assuming that the provided compensation from the Fund (at 5,000 VND per head) only represents 10-15% of the real market value. This is the real 'lost income per head' (source: A3)
(3) Compensation for culling only, at 5,000 VND per head
(4) On the basis of the provided compensation from the Fund for restocking (at 2,000 VND per head)
(5) Cost estimates per bird on the basis of destruction and disposal of 200 chickens per farm (source: A7)
(6) On the basis of the provided compensation from the Fund. Includes control costs during and after the outbreak (i.e. equipment, facilities, disinfectants, protective clothing, staff in quarantine stations etc.)
(7) The market value of a layer is considered to be 100,000 VND/head (source: A3)
(8) Monthly volume sales by price. Income during 'normal' and 'crisis' periods calculated as follows: At the lowest point of the crisis (Oct/Nov 2005), prices were 50 to 60% below normal, and volume of poultry sales had fallen from about 40 million poultry per month to 20 million (unofficial data, source: A9). Crisis period

assumed to be an average over 6 months (in the beginning crisis has a higher impact on sales/prices, with return to normal the impact progressively diminishes).

Source: Agra CEAS Consulting, based on data from literature (including A3, A7 and A9)

It is generally estimated that the economic impact of the AI epidemics has amounted to less than 1% of Vietnam's GDP. UN agencies have estimated that, in the first outbreak alone (when the impact has been more extensive) the total economic impact (including direct costs and losses and indirect impacts in upstream and downstream activities) have amounted to over US$ 200 million which was about 0.6% of the GDP that year (A204). Both the WB and the IMF have concluded that, in macroeconomic terms, the impact of avian flu on the country's economy has been very modest, and that despite the outbreaks the national GDP continued to post strong growth (rising by 8.4% in 2005) contributing the targets set within the Vietnam's poverty reduction strategy (A266, A266b).

The picture is, however, very different when the micro-economic impact of the disease is assessed. In Vietnam, relatively the largest losses were felt by small scale, often indebted, commercial chicken producers with limited numbers of other livestock[118] (A76). The social and economic costs were also particularly felt by Vietnam's millions of farm households with small numbers of poultry. Around 8 million of Vietnam's 12 million households were estimated to be engaged in poultry production prior to 2003, and this number is estimated to have fallen by 50% following the outbreak, suggesting a significant impact on the sector's restructuring (A9, A16)[119]. Moreover, the impacts are unevenly distributed, as income from poultry and eggs is relatively more significant for the poorest part of the population[120]. Simulation models (FAO PPLPI) show that a backyard poultry sales ban would result in up to 25% loss of income for the poorer households (losses could be reduced to 10% if there was some diversification towards alternative production); if households were also banned from raising poultry for their own consumption the loss could be double for the poorer households (A30).

If the outbreaks escalated into a human pandemic, this would have devastating economic and social consequences, including large-scale loss of livelihoods as well as lives. Vietnam, like other countries affected countries, confronts choices in balancing preparation versus action since both imply economic costs. At least three impacts should be considered under a human pandemic scenario: (a) effects of sickness and mortality on potential output; (b) private preventive responses to an epidemic; and (c) public sector responses.

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[118] Despite the fact that compensation was paid, this was at a lower rate than initially announced, was only paid to farmers that registered with the authorities, and there were delays.

[119] Although some of this restructuring was partly induced by government policies and not just the economic forces at play following the HPAI outbreaks.

[120] Vétérinaires Sans Frontières (VSF) in a case study of a village in the highlands of North Vietnam estimated that a smallholder lost US$ 69-108 from the **HPAI** outbreaks, including the value of lost birds and loss of an average 2.3 months with no activities (no income and consumption). In Vietnam about 18% of the households earn less than US$1 per capita a day and 64% of the households less than US$2. (A76)

5.2.4. Comparison of prevention versus outbreak costs

The animal health component of Vietnam's national Operational Programme for Avian Influenza and Human Influenza (OPI) for the 2006-2010 period comes to US$ 83.74 million. Of this total, the most significant amount (US$ 55.17 million) is earmarked for control activities (**Table 12**). Excluding the provision for control costs in the event of an outbreak (culling and compensation), total prevention and control activities as such (during 'normal times') come down to US$ 70.14 million. Other key components include the strengthening of VS as such, which accounts for US$ 15.8 million over the 5-year period, and vaccination (US$ 25.7 million). Estimates of the various components of surveillance, vaccination and biosecurity are also provided in some literature (**Table 13**).

Against these figures, the analysis of existing data suggests that direct costs of the 2004-05 HPAI outbreaks (including culling and control costs, excluding consequential on-farm losses) amounted to US$ 124.2 (**Table 15**). Our own estimates of a potential HPAI outbreak occurring in future suggest that, under the scenarios and assumptions presented in section 6, Vietnam could face total direct costs and losses (including consequential on-farm losses) of US$ 115.4 million a year.

These direct impacts are compounded by multiple indirect effects as described in **Table 14**. According to one source, the outbreak in 2004 is estimated to have resulted to total GDP losses in Vietnam of US$ 0.3 billion for that year alone (**Table 6**).

The comparison of the relative scale of the required investment for the next 5-10 years (as provided in the OPI budgets and estimates from literature) against the actual and potential outbreak costs involved is depicted in **Figure 13**. It is noted that the national OPI prevention and control figures are totals over a 5 year period, and the estimates of the various prevention and control components from the literature are totals over a 10 year period, while the outbreak costs are quoted as annual amounts. It is also noted that comparisons have been made only between the public investment components and the total costs. Components of an effective prevention and control system covered by the private sector, notably investment on biosecurity which is normally covered by farmers, have not been taken into consideration here. The scale of this investment (min US$500-700 in Vietnam) is considered prohibitive for the smallholder sector (**Table 13**).

The comparison clearly points to the fact that the potential benefits that can accrue from improving prevention and control are worth several times the investment. It is noted, however, that this relies on the assumption that a certain investment would result in gains in productivity and export earnings. The extent to which this will occur will depend on the effective design and implementation of the investment, to ensure the effective control of the disease. A risk factor will be the re-appearance of the disease, as is often the case in practice.

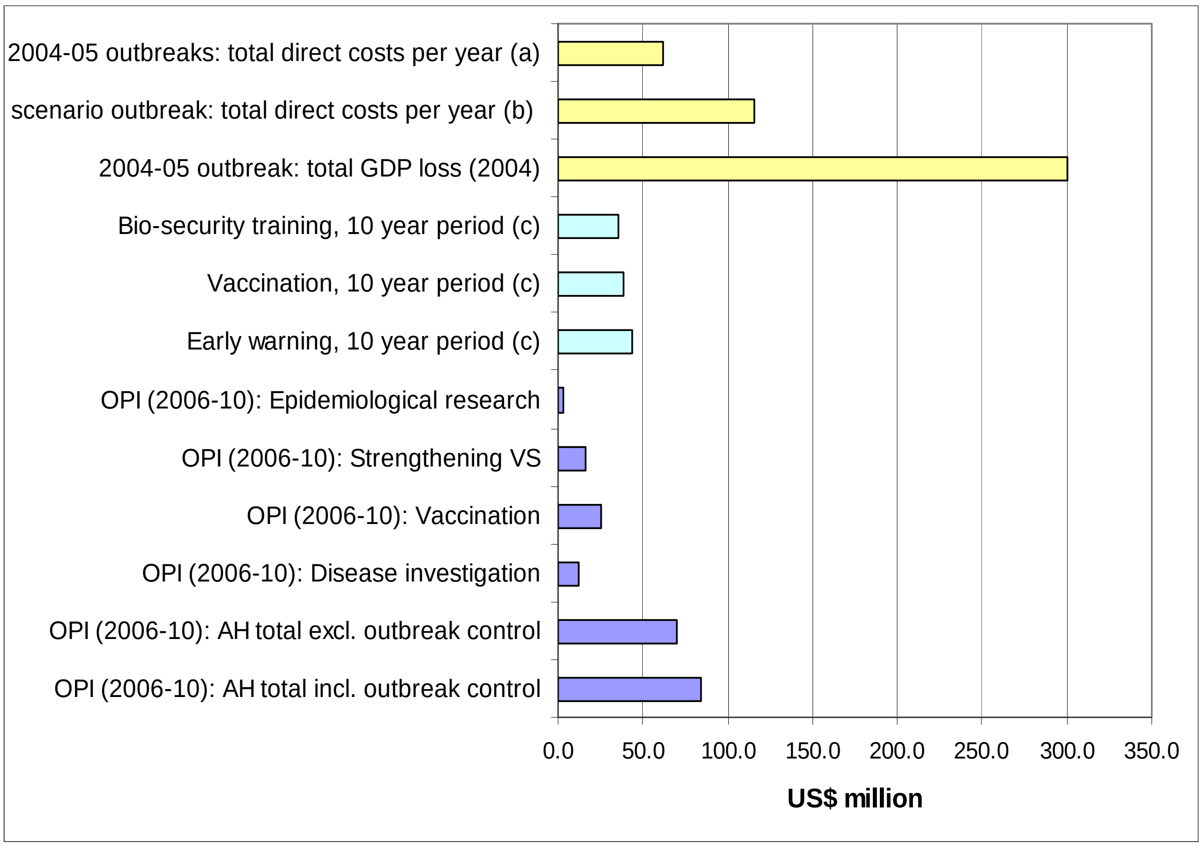
The above calculations do not take into account the incremental operational costs involved, which can be a significant part of the cost of strengthening VS.

On the other hand, the investment in strengthening the control of a particular disease, e.g. HPAI, can have important spill-over benefits on the entire VS.

Although these conclusions are made at macro-economic level, they have important implications at micro-level for individual farmers and other business relying on the poultry sector, particularly in the poorer rural parts of the Vietnamese population.

The OIE and the FAO estimate that between one third and one half of the population in the most affected areas of South East Asia earn at least part of their income from poultry farming. In Vietnam, 60% of the poorest section of the population, for whom poultry farming accounts for 6% to 7% of household incomes, is relatively more exposed to revenue losses caused by avian influenza. The number of rural households directly involved in poultry production, predominantly carried out by women, is reported to have fallen by 50% (**Table 14**). Although the smallest producers are the ones who have lost the least in absolute terms, in relative terms they have lost the most, with losses due to an outbreak costing several times their daily income (A292).

Figure 13 Vietnam: comparison of prevention versus outbreak costs



(a) annual; including consequential on-farm losses (source: Agra CEAS projection, **Annex 5**)
(b) annual average over 2004-05; excluding consequential on-farm losses (source: **Table 15**)
(c) estimates for a 10 year period (source: **Table 13**)

Notes:
OPI figures are totals over a 5 year period;
Bio-security training, vaccination and early warning estimates are totals over a 10 year period;
Outbreak costs are quoted as annual amounts;
Incremental operational costs (a significant part of the total costs of strengthening VS) are excluded from these calculations, due to lack of data.

Source: Agra CEAS Consulting, based on literature and own analysis

Our analysis in this section leads us to the following conclusions:

Case study: Vietnam

Vietnam suffers from a number of high risk factors with respect to HPAI. Consequently the government has committed significant national resources (including donor support) to the fight against avian influenza and for the prevention of a human pandemic. This has included extensive restructuring in the VS since the 2004-05 AI outbreaks, although there is little information to date on whether this has resulted in improvements that can effectively prevent/control future outbreaks (a recently concluded PVS evaluation is bound to shed more light on this).

Our analysis and comparisons of data on the committed national budgets for 2006-10 under the Operational Programme for avian influenza (animal health component) against real and projected costs of the outbreaks reveal the relative scale of the costs and benefits involved (see Notes*). These conclusions are supported by other work reviewed from available literature. For example:

- **The total commitment on animal health under the 2006-10 OPI (excluding control costs in the event of an outbreak) comes to some US$ 70 million for the 5 year period, while the total direct and indirect costs from the outbreak in 2004 alone is (conservatively) estimated at US$ 300 million (Figure 13).**

- **Investing in disease investigation and strengthening VS over the same period would cost public coffers a total US$ 30 million, compared to total direct production costs and losses during the 2004-05 outbreak of US$ 62 million a year and excluding consequential on-farm losses.**

- **Adding consequential losses, our projections of the total direct impact under the most likely scenario (which is milder than the 2004-05 epidemics) come to US$ 115 million a year.**

In a country where two thirds of the production is run by small holder systems and over two thirds of farms keep poultry, this analysis also demonstrates the potential benefits of improved prevention in terms of social equity and poverty alleviation (and even food security). Relatively the largest direct losses were felt by small scale, often indebted, commercial chicken producers, while Vietnam's millions of farm households with small numbers of poultry were also affected. Against this, investment in bio-security is estimated to require at least US$ 500 million for minimum improvements in the next 10 years, a cost prohibitive to small rural farmers.

* *Notes: These benefits assume that a certain investment will result in productivity gains and exports. The scale of the benefit is conditional on the effective design and implementation of the investment to be undertaken, leading to an effective control of the disease (eradication is questionable as there is a significant risk factor that the disease would re-appear, as has been the general experience. The above calculations do not take into account the*

incremental operational costs involved, which can be a significant part of the cost of strengthening VS. On the other hand, the investment in strengthening the control of a particular disease, e.g. HPAI, can have important spill-over benefits on the entire VS.

5.3. Nigeria (Africa)

5.3.1. Background

5.3.1.1. Importance of livestock sector to the economy

According to official figures[121], Nigeria has a total poultry population of 140 million, of which the sectoral distribution is 20% commercial integrated systems (sector 1 of the FAO classification), 10% semi-commercial (sector 2) and 70% backyard intensive and village farming (sectors 3 and 4) (A273, A293). Flock sizes vary from 5-49 birds in sector 4, up to a 1,000 birds in sector 3, 1,000-5,000 in sector 2 (mainly for egg production) and over 5,000 in sector 1. The types of domestic poultry found in Nigeria are chicken, pigeons, ducks, guinea fowls, and turkeys, but chicken are by far the most important species constituting over 90% of the total poultry stock.

The poultry sector is worth some US$230-250 million (about N30 billion) and contributes 9-10% to the country's agricultural GDP (which in its turn accounts for 35% of the national GDP). It also attracts a significant share of the investment on agriculture. Although Nigeria is a net importer both in terms of livestock products and poultry in particular, it is believed to have potential for export.

The sector's importance in socio-economic terms is crucial. Poverty alleviation is the central issue of the Nigerian economy, with about 60% of the population living below the poverty line[122]. The majority of the poor reside in rural areas and are engaged in some form of agricultural activity, including poultry. Apart from providing an important source of income, poultry is a major source of protein for the entire population (with protein intake still below the FAO recommended levels). Thus, a virulent disease outbreak such as the HPAI has major implications for both the income and food security of the country's rural and urban poor (A291).

A classification of Nigeria's socio-economic position in the world, as carried out for the purposes of this study, can be found in **Annex 3**.

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[121] These figures are reported to underestimate reality, due to the large numbers of unregistered poultry kept in poor rural and urban households.

[122] The Nigerian government is currently implementing a Poverty Reduction Strategy along World Bank and IMF recommendations (NEEDs: the 2004 National Economic Empowerment and Development Strategy), which focuses on Nigeria's commitment to rapid and sustainable growth and poverty reduction (A267). The strategy envisages an agricultural export target for 2007 of US$ 3 billion.

5.3.1.2. Key AH problem areas

Nigeria was selected as a representative case study in Africa because of the HPAI relevance. The country's HPAI problems are more recent, consequently an relatively limited number of outbreaks have been confirmed so far[123] (compared, for example, to Vietnam, **Annex 2**). However, the international community is concerned of the potential risks and ramifications of these outbreaks in the context of the extensive presence of rural/urban backyard farming, relatively weak biosecurity, and the socio-economic importance of the sector for the world's most poverty struck continent.

To date, the origins of the HPAI epizootic in Nigeria remain unknown, and neither introduction through poultry trade nor through migratory wild fowl can be ruled out (A169). A risk analysis previously undertaken in the context of Nigeria's HPAI Emergency Preparedness Plan (A286) identified three main risk factors: the high presence of wetlands (24 in total), 2 major migratory routes, and the relatively poor situation of the veterinary services.

Nigeria was the first country in West Africa to report HPAI amongst its poultry stock, as confirmed in February 2006[124]. Despite control measures having been taken, including culling and quarantine, the spread of the disease has been rather quick. Starting from three states in January 2006, it spread to 11 states in March 2006, to 13 states and the Federal Capital Territory as at May 2006, and to a total 36 states by the end of the year[123]. HPAI continues to be present with more suspected cases and culling activity announced in January this year (EMPRES-ECTAD, 24 January 2007).

5.3.1.3. AH services and institutional structures

The Nigerian Veterinary Services are headed at the federal level by the Director of the Federal Department of Livestock and Pest Control Services (FDL&PCS), which operates under the Ministry of Agriculture and Natural Resources, and at state level by the Director of State Veterinary Services. The FDL&PCS is divided into eight Divisions, namely: the Animal Health, Quarantine Services, the Veterinary Public Health, Livestock Development, the Planning and Research, Pastoral resources, NLPD as well as the Pest Control Division. The FDL&PCS has field offices at the various state capitals while each state veterinary service has area offices at the local government headquarters. According to the Nigerian VS, this setup is designed to enable efficient and early collection of information on TADs including HPAI. Although by law the state Directors of Veterinary Services are in-charge of animal disease control, emergencies arising from major transboundary animal diseases such as HPAI should be under the overall command of the DFDL&PCS.

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[123] An Inter-Agency (FAO/OIE/AU-IBAR) mission to Nigeria reported that as at mid October 2006, 43 Local Government Areas in 15 states (including the Federal Capital Territory) had been recorded as suffering outbreaks at some point. In total, some 500 outbreaks had been reported, of which approximately one quarter had been confirmed as caused by H5N1 HPAI.

[124] Case first suspected on 16 January (Sambawa Farm), sample sent for testing to Padova, Italy on 3 February, confirmation (H5N1) received on 7 February, announcement made public 8 February.

The FDL&PCS had begun to work on a response to the global threat of HPAI already in 2003. In anticipation of an eventual HPAI outbreak, in December 2005 a Technical Committee of Experts for the prevention and control of HPAI was set up. This was actively involved in the development of an HPAI emergency preparedness plan (for animal health), which was circulated in January 2006 and reviewed/extended in February 2006[125] (A286). The Plan was drawn following FAO recommendations for preparing National Animal Disease Emergency Preparedness and Contingency Plans for major TADs and the Australian Veterinary plan (AUSVETPLAN). It was later to be fine-tuned with Annexes containing the resource plans, both material and human, as well as Standard Operating Procedures (SOPs). The Plan was supplemented by an action plan for communication and public awareness (social mobilisation). All these plans were later integrated into a national strategy document. The national policy envisaged control by stamping-out of infected farms with payment of compensation for birds culled, but excluded vaccination. Following the February 2006 confirmed outbreaks, an i*nter-ministerial* Steering Committee of Experts on avian influenza[126] was also set up, and a National Technical Committee on Avian Influenza for the coordination and implementation of the plan.

Several experts have pointed to the inadequacy of current VS structures (A169, A203, A293, A291). The available literature and information from sources contacted in Nigeria point to certain deficiencies that may have aggravated the initial impact of the disease. A major impediment in the early days that the disease was suspected in Nigeria was considered to be the lack of local/regional testing capability to test for the disease. This was seen as adding to the delays in confirming and reporting the disease which may have contributed to the escalation of the spread (A293). Furthermore, although a preparedness plan was in place this was not considered to be adequate (*inter alia* due to lack of funding) when the emergency arose (A169).

International agencies and organisations (including the FAO, OIE, AU-IBAR and the WB) have in various instances indicated that the overall capacity of the federal as well as of the state VS in handling disease emergencies to be relatively weak (e.g. A203, A169). Years of under-funding were considered to have led to a weakening of the system, and a generally dysfunctional chain of command between the central VS and the field services. An exception appears to be the National Animal Disease Surveillance System (NADIS), which by adopting a supra-state zonal approach had established good working relationships with the state veterinary services. For example, the system had been re-oriented to increase surveillance of suspect mortalities in both domestic and wild fowl.

The country's capacity in veterinary human resources is considered by the national authorities to be adequate to detect and control most TADs[127]; however it is acknowledged that most of the veterinarians do not have first hand experience with AI this being an emerging disease and that therefore specialised

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[125] "*Strategies for prevention of introduction, disease surveillance networking and the contingency plan for prevention and control of the HPAI in Nigeria*" (A286)

[126] The Committee united amongst others, the Federal Ministers of Agriculture and Rural Development (MARD), Health, Information and National Orientation, several State Commissioners for agriculture and health and stakeholders within the international community (including the WB and WHO).

[127] Nigeria has five University veterinary faculties that produce graduate veterinarians; at the time of the HPAI first outbreaks there were about 4,586 registered veterinarians in addition to 7,810 livestock scientists, laboratory technologists and animal health auxiliaries in the country.

training to the detection, diagnosis and control of the disease would be required (A286). More than 600 Nigerian animal health officials have been trained under a scheme funded by the European Union and the FAO to undertake a nationwide surveillance to track bird flu. These experts would be deployed in January 2007 across the country, to provide the much needed local resource for testing any suspected cases[128].

Despite these shortcomings, an inter-Agency mission (FAO/OIE/AU-IBAR) conducted in October 2006 concluded that the first phase of HPAI control in Nigeria has been reasonably successful and that the elimination of the infection could possibly be contemplated within the short to medium term depending on the control measures to be taken (A169). Recommendations for further action include: a) enhancing surveillance (*inter alia* through: support to the National Veterinary Research Institute – NVRI; enhancing active surveillance in smallholder village poultry, and the active engagement of private veterinarians); and b) enhancing control measures (*inter alia* through improved conditions for timely and adequate compensation; reviewing vaccination policy, particularly on targeted and/or ring vaccination; improving and consolidating the national emergency preparedness plan; and developing a clearly defined national strategic plan for the progressive control and elimination of HPAI).

In March 2006, the Federal government of Nigeria and the World Bank signed a US$ 50,000,000 special credit agreement, in the context of the GPAI/APL programme, for a project targeting both AI control and human pandemic preparedness (A203). The animal health component of this plan was based on a review of the key institutions and their readiness to perform the required/intended tasks. It deals with four main themes, namely surveillance, early detection and rapid containment, control at source in birds, and risk communication. As such, the project deals with many of the above issues and recommendations identified by the inter-Agency mission and the Nigerian authorities. Further budgetary details of this project are given in **Table 17**.

An independent OIE mission to assess the state of Nigeria's VS on the basis of the PVS tool has just taken place[129].

5.3.2. Cost of prevention and control systems

The total estimated budget under the Nigerian preparedness plan (A286) was N (Nigerian Naria) 880 million (or US$ 6.9 million). Of this, N 400 million (44%) was envisaged for strengthening diagnostic laboratories, N 200 million (22%) for stamping out including compensation, N 100 million (11%) for strengthening the veterinary quarantine infrastructure, N 100 million (11%) for research (including on vaccine development), and N 80 million (9%) for targeting the disease and sero-surveillance (**Table 16**). An additional US$400,000 was foreseen for vaccine procurement (for 20,000 doses/annum). Despite the detailed technical components of this plan it is understood that, at the time of the February 2006 outbreak, funding had not yet been mobilised for the plan's prompt execution.

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[128] More information on this service can be found at the OIE database.

[129] 20 August to 5 September 2007

Table 16 Nigeria: Budget for HPAI emergency preparedness and response (2006-07)

Activity	**N million**	**US$ million, (a)**
Strengthening the diagnostic laboratory	400	3.12
Stamping out and compensation	200	1.56
Strengthening the veterinary quarantine infrastructure	100	0.78
Research	100	0.78
Targeting the disease and sero-surveillance	80	0.62
TOTAL	**880**	**6.87**

(a) 1 Nigerian Naira = US$0.0078 (current exchange rate)

Source: National strategies for prevention of introduction, disease surveillance networking and contingency plan for a disease emergency (A 286)

The largest component of this plan was the strengthening of laboratory diagnostic capabilities. This envisaged upgrading the diagnostic capacity of the six designated laboratories for carrying out HPAI diagnosis in Nigeria (NVRI, VTHs at Zaria, Ibadan, Maiduguri, Nsukka and Sokoto. Each of these laboratories was expected to have the capacity to carry out screening direct antigen detection tests, immunoflourescence test and serological tests for antibody detection, while the NVRI would carry out virus isolation and identification. Regional laboratory networking was also foreseen. The plan also envisaged exploring (with the FAO, WHO, IAEA and OIE) the prospects for a Technical Cooperation Project (TCP) to enhance Nigeria's HPAI diagnostic capacity[130].

The importance of focussing the effort on the NVRI services so as to enable it to provide the full range of diagnostic services was also confirmed by the interagency mission of October 2006 (A169). It should be noted that, to improve diagnostic capacity for the Africa region as a whole, the possibility of establishing a regional AI reference laboratory within one of the West African countries has been suggested by stakeholders as one option to explore[131] (A293).

The WB APL credit facility of March 2006 (A203) has a total budget of US$ 58.4 million (excluding contingencies), of which US$ 29.2 million for animal health, US$ 18.3 million for human health, US$ 4.1

[130] A TCP project for an Active Avian Influenza Surveillance study in Nigeria is currently under way (2006/07) with a total budget of US$653,000. Nigeria also benefits from other regional/global TCP projects including the emergency assistance for the control and prevention of avian influenza in sub-Saharan Africa 2006/07 (global budget: US$3.4 million), and the global emergency assistance for the control and prevention of avian influenza (US$ 3.5 plus US$ 5.9 million for 2005-07).

[131] Workshop on AI organised by WANSCA, Ghana, September 2006 (A291). WANSCA: West African Network for the promotion of Short Cycle Animals in rural areas.

million for Social Mobilisation and Strategic Communication and US$ 6.9 million Implementation Support and Monitoring & Evaluation. The animal health component covers 6 areas and a detailed budget breakdown is presented in **Table 17**.

Table 17 Nigeria: HPAI Control & Eradication (AH component of Integrated Plan, 2006-10)

	US$ million (a)			
	2006	**2007**	**2008**	**Total**
A. Strengthening HPAI control programmes	2.69	2.89	1.01	6.59
B. Strengthening disease surveillance, diagnostic capacity and applied research	2.84	1.59	0.52	4.95
C. Strengthening veterinary quarantine services	1.78	2.33	1.03	5.14
D. Enhancing HPAI prevention and preparedness	0.77	0.86	0.08	1.72
E. Improving bio-security in poultry production	0.49	0.29	0.20	0.98
F. Compensation & economic recovery	6.67	2.06	1.08	9.82
TOTAL	**15.25**	**10.03**	**3.92**	**29.20**

(a) excludes contingencies

Source: Nigeria WB GPAI/APL (A203)

The 2006 ALIVE Africa needs assessment presented in Bamako in December (A258) provides estimates of the total animal health component for fighting AI in Nigeria at US$ 40 million over a 10 year period (global budget for Nigeria including all other components of AI prevention and control is US$ 84.3 over the same period). These estimates are largely in line with the current Nigerian WB APL project. Nigeria needs are some of the highest identified by the ALIVE assessment (**Figure 5**).

5.3.3. Costs of outbreaks

According to data from the FDLPCS, as at mid October 2006, some 400,000 poultry died and 900,000 were culled (A169). Culling continues this year, with already some 20,000 poultry culled in week 3 in the NW of the country where fresh cases were detected in January EMPRES-ECTAD.

The main control measures used were stamping out with compensation (vaccination was excluded). A government-funded (US$ 847,558 since 2003) compensation scheme was put in place in March 2006 compensating farmers at 30-50% of the market value (A236b) (further details on this scheme can be found in Deliverable 2).

Some of the costs resulting from the AI outbreaks in Nigeria is provided in **Table 18**. On the whole, the total economic impact for Nigeria from the HPAI crisis, including direct and indirect losses, is estimated by the UNDP Nigeria to have been at least N1 billion (US$7.9 million) (A293). Although a significant figure as such, this corresponds to 0.01% of the latest GDP estimates for 2006 ($115.6 billion[132]).

A recent IFPRI study uses a spatial equilibrium model that makes use of the latest spatial distribution data sets for poultry and human populations to analyse the potential impact of AI in West Africa, using Nigeria as an example. The study finds that, depending on the size of the affected areas, the direct impact of the spread of AI along the two major migratory bird flyways would be the loss of about 4% of national chicken production. The indirect (ripple) effects of consumers' reluctance to consume poultry if AI is detected, causing a decline in chicken prices, are generally found to be larger than the direct effect. It is estimated that, if the worst-case scenario occurred (AI spreads >20km along the two major flyways), Nigerian chicken production would fall by 21%, prices by 12% and the combined result could mean that poultry farmers would lose up to US$250 million of revenue (A98). In the best case scenario (AI confined in a narrow zone within the flyway), the total loss to farmers would be US$ 48-52 million.

Table 18 Nigeria: selected direct and indirect impacts of AI outbreaks (a)

Direct costs and losses	
Production losses	As at mid-June 2006, the HPAI outbreak caused a loss of approximately 890,000 birds through deaths and stamping out. At an average farm gate price of about N700 per bird, the farm gate value of the birds lost was about N 617 million (or US$ 4.8 million). These figures are based on official estimates, and are believed to under-estimate reality, because the actual poultry population wiped out in rural areas remains unknown (A293).
Culling costs	Culling teams were organised on an ad hoc basis and the costs were estimated to reach about US$ 1.00 per bird, if the team culled 1,000 birds within a day (culling and disposal costs). (A7, A258).
Re-stocking costs	The cost of restoring the affected poultry units back to pre-outbreak levels is estimated at about N889 million (or $6.95 million). In addition, there was a 45% drop in the flock size of the non-affected farms, mainly because of lack of funds to feed the birds which forced many farmers to reduce flocks, and it is unclear whether these farms will recover. (A293)
Consequential on-farm losses	The UNDP rapid assessment survey revealed that 80% of workers in the affected farms and 45% of those working in non-affected farms have lost their jobs as a result of the HPAI outbreak. (A293)
Indirect impact: ripple effects	
Poultry sales	Egg and chicken sales declined by 80% within 2 weeks following the announcement of HPAI outbreaks in Nigeria in February 2006 (UNDP data and Nigerian Poultry Association – PAN). Up to 4 months after, the recovery rate was still below 50%. (A293)
Feed industry	Following the HPAI outbreaks in Nigeria in early 2006, poultry feed sales dropped by 82%, and only 43% recovery (to pre-outbreak levels) had been attained by May 2006. Even in non-

[132] Source: Economist Intelligence Unit (EIU) estimate for 2006 at market exchange rate. Exchange rate (av) N:US$: 127.4

	affected farms, following a 45% drop in the flock size (as farmers were cutting down flocks due to lack if funds to feed the birds), the level of feed usage declined by 55%. The loss to feed mills is estimated at about N 60.5 million ($0.5 million), on the basis of average feed consumption per bird (0.135 kg per day) and assuming it takes about seven months for the feed mills to fully recover from the shock at a constant rate; this translates to a 3.5 month volume of feeds (the average price per ton of feed is about N 48,000). (A293)
Traders/ markets	Associated businesses such as those trading in poultry products are estimated to have lost close to N 61.7 million ($0.5 million): this is estimated as the 10% of the farm gate price of the number of birds that were either culled or dead as a result of the HPAI. One live chicken sellers' association (Abubakar Rimi Market in Kano, reputed to be the largest local chicken market in Nigeria), claimed that their sales dropped from 10,000 birds to only 1,000 birds per day in February/March 2006. The price per bird also crashed during the crisis. Similar experiences were reported in other markets. (A293)
Catering industry	A sharp drop by 81% was reported in sales in restaurants, fast food business outlets, roadside roasted chicken sellers and egg sellers within 2 weeks following the announcement of HPAI outbreaks (February 2006), which by May 2006 had only recovered to 67.7% of the pre-outbreak sales. (A293)

Source: compiled by Agra CEAS Consulting

A more detailed calculation of the direct production costs and losses based on the available literature and certain assumptions is provided in **Table 15**.

Table 19 Nigeria: calculation of total direct costs of HPAI outbreaks (2006)

	Nigerian Naria (N)	**USD**
Total costs (Oct. 2006) (a)	1,068,760,000	8,389,011
Total costs (est.) (a) (c)	2,313,696,000	18,160,879
Total compensation (2006 est.) (c)(d)	655,855,200	5,148,000
Value of culled animals per head	700	5.49
Compensation rate per head (d)	248	1.95
Culling and disposal costs per head (e)	127	1.00
Control costs per head (f)	49	0.38
Number of birds culled (Oct. 2006) (b)	*900,000*	*900,000*
Number of birds died (Oct. 2006) (b)	*400,000*	*400,000*
Number of birds culled (est) (c)	*2,640,000*	*2,640,000*
Total value of culled/dead animals (Oct. 2006)	910,000,000	7,142,857
Total culling and disposal costs (Oct. 2006)	114,660,000	900,000
Total control costs (Oct. 2006)	44,100,000	346,154
Total value of culled/dead animals (est.) (c)	1,848,000,000	14,505,495
Total culling and disposal costs (est.) (c)	336,336,000	2,640,000
Total control costs (est.) (c)	129,360,000	1,015,385

	Nigerian Naria (N)	USD
Market price (layer) (g)	700	5.49
Market price (broiler) (g)	1,000	7.85

(a) includes culling (value of culled animals and culling/disposal) and control costs
(b) FDLPCS official data (A169)
(c) assuming disease continues on same course (as in the first 2 months) - the total number of poultry losses in the first 2 months after outbreak first occurred (Feb 2006) was 440,000 (A258)
(d) on the basis of government announcement, compensation for culling only
(e) cost estimates per bird on the basis of destroying and disposing of 1000 birds per day by ad hoc organised teams (A7)
(f) assumed to the double that of Vietnam as more costly to organise (for culling/disposal costs per bird ratio of Vietnam to Nigeria was 4:1)
(g) range of current chicken market price (source: UNDP Nigeria, A293)
Exchange rate: 1USD = 127.4 Nigerian Naria (source: EIU)

Source: Agra CEAS Consulting, based on data from literature (including A7, A169, A258 and A293)

5.3.4. Comparison of prevention versus outbreak costs

Although no cost-benefit analysis as such of Nigeria's prevention and control strategies currently exists in the reviewed literature, from a comparison of prevention to outbreaks costs significant conclusions can be drawn.

The total budget of Nigeria's national preparedness plan came to a total US$ 5.31 million excluding stamping our and compensation in the event of an outbreak (**Table 16**). The animal health component of the WB Integrated plan for HPAI control and eradication for 2006-10 comes to a total US$ 29.2 million over the 5 year period (**Table 17**). Of this total, some US$ 6.59 million is earmarked for control (culling and compensation activities) in the event of an outbreak. Excluding this provision, total prevention and control activities as such (during 'normal times') come down to US$ 22.6 million. Other key components include the strengthening of veterinary quarantine, which accounts for US$ 5.1 million over the 5 year period, strengthening disease surveillance (US$ 4.95 million), and the establishment of a compensation fund and economic recovery schemes for vulnerable farmers (US$ 9.8 million). Finally, the ALIVE assessment (A258) gave estimates of the total animal health component for fighting AI in Nigeria at US$ 40 million over a 10 year period.

Against these figures, the analysis of existing data suggests that direct costs of the 2004-05 HPAI outbreaks (including culling and control costs, excluding consequential on-farm losses) amounted to US$ 8.4 as at October 2006 (**Table 19**). It is noted that, unlike in the case of Vietnam, in Nigeria the economic impact was not as high due to the relatively short timeline of these calculations. However, if projected on a yearly basis, assuming the disease continued on the same course as in the first 2 months, then direct costs could reach US$ 18.2 million. Our own estimates of a potential HPAI outbreak occurring in future suggest that, under the scenarios and assumptions presented in section 6, Nigeria could face total direct costs and losses (including consequential on-farm losses) of US$ 113 million a year (i.e. of a scale similar to Vietnam). To these direct impacts are added the various indirect effects described in **Table 18**.

The comparison of the relative scale of the various prevention plans and needs assessments against the actual and potential outbreak costs involved is depicted in **Figure 14**. It is noted that the WB control and eradication plan's figures are totals over a 5 year period, and the ALIVE estimates are totals over a 10 year period, while the outbreak costs are quoted as annual amounts. It is also noted that comparisons have been made only between the public investment components and the total costs. Components of an effective prevention and control system covered by the private sector, notably investment on biosecurity which is normally covered by farmers, have not been taken into consideration here. The scale of this investment is considered to be similar to other smallholder countries with similar poultry farming and developing country features such as Vietnam, where these were estimated at min US$500-700. This type of investment is considered prohibitive for the smallholder sector.

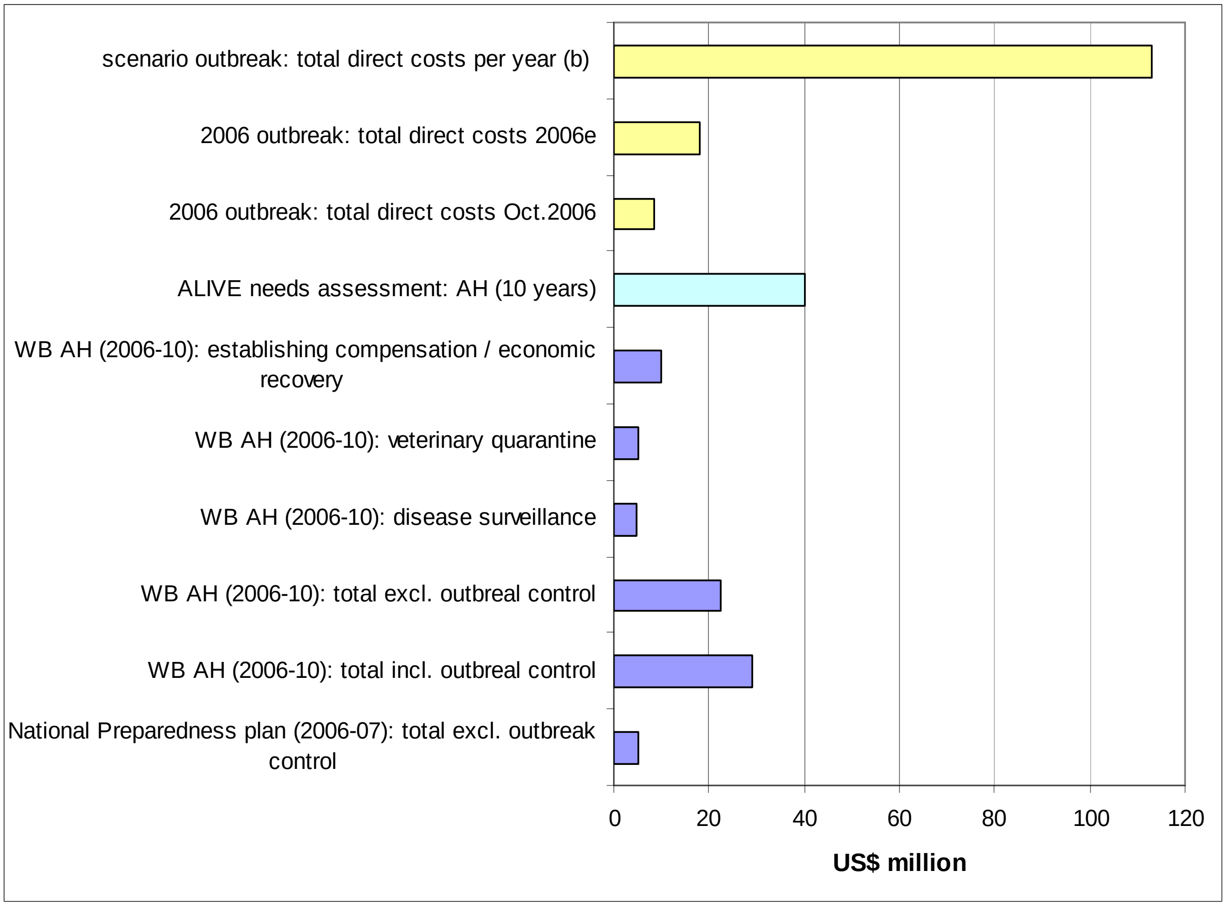
The comparison clearly points to the fact that the potential benefits that can accrue from improving prevention and control are worth several times the investment. It is noted, however, that this relies on the assumption that a certain investment would result in gains in productivity and export earnings. The extent to which this will occur will depend on the effective design and implementation of the investment, to ensure the effective control of the disease. A risk factor will be the re-appearance of the disease, as is often the case in practice.

The above calculations do not take into account the incremental operational costs involved, which can be a significant part of the cost of strengthening VS.

On the other hand, the investment in strengthening the control of a particular disease, e.g. HPAI, can have important spill-over benefits on the entire VS.

As in the case of Vietnam, the conclusions drawn at macro-economic level have important implications at micro-level, for individual farmers and other business relying on the poultry sector, particularly in the poorer urban and rural parts of Nigeria. It is estimates that some 70% of poultry is kept in backyard and village farming.

Figure 14 Nigeria: comparison of prevention versus outbreak costs



Notes:
WB control and eradication plan's figures are totals over a 5 year period;
ALIVE estimates are totals over a 10 year period;
Outbreak costs are quoted as annual amounts;
Incremental operational costs (a significant part of the total costs of strengthening VS) are excluded from these calculations, due to lack of data.

Source: Agra CEAS Consulting, based on literature and own analysis

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Our analysis in this section leads us to the following conclusions:

Case study: Nigeria

Nigeria's experience in this area is relatively more recent and more limited compared to Vietnam. However, both the government and international community are concerned of the potential risks and ramifications of these outbreaks in the context of the extensive presence of rural/urban backyard farming, relatively weak biosecurity, and the socio-economic importance of the sector.

Our analysis and comparisons of data on the planned commitments for 2006-10 under the WB integrated plan for the control and eradication of avian influenza as well as under the ALIVE needs assessment for Nigeria, against real and projected costs of the outbreaks, reveal the relative scale of the costs and benefits involved (see Notes). For example:

- **The total commitment on animal health under the 2006-10 WB plan (excluding control costs in the event of an outbreak) comes to some US$ 22.6 million for the 5 year period (or an average US$ 4.5 million per year), while the direct costs from the outbreak in part of last year alone is (conservatively) estimated at US$ 8.4 million and excluding consequential on-farm losses (Figure 14).**
- **Investing in strengthening disease surveillance and veterinary quarantine would cost a total US$ 10 million over the same period, or US$ 2 million a year which is less than 25% of the above conservative estimate.**
- **The relative scale of this investment is even more evident when adding consequential losses, with our projections of the total direct impact under the most likely scenario (which is milder than the 2006 epidemic) reaching US$ 113 million a year.**

In a country where two thirds of the official (registered) production is run by small holder systems and poultry rearing is central to the survival of poor rural and urban communities, this analysis also demonstrates the potential benefits of improved prevention in terms of poverty alleviation and food security.

Notes: These benefits assume that a certain investment will result in productivity gains and exports. The scale of the benefit is conditional on the effective design and implementation of the investment to be undertaken, leading to an effective control of the disease (eradication is questionable as there is a significant risk factor that the disease would re-appear, as has been the general experience. The above calculations do not take into account the incremental operational costs involved, which can be a significant part of the cost of strengthening VS. On the other hand, the investment in strengthening the control of a particular disease, e.g. HPAI, can have important spill-over benefits on the entire VS.

5.4. Romania (East Europe)

5.4.1. Background

5.4.1.1. Importance of livestock sector to the economy

Despite the ongoing economic reform process which have affected the size of the Romanian agricultural sector, this still plays a critical role in the national economy, contributing 11.9% to GDP and occupying 35% o f the total labour force in 2003.

Within this context, the size of the Romanian poultry sector has nearly doubled (in terms of production volumes) since 2000. In 2005, domestic consumption of poultry meat increased by 19% compared to the previous year to a total o f around 375,000 tons, o f which 59% or 220,000 tons were produced domestically. This excludes subsistence farming which is very prevalent in the country. Including production for own consumption, Romania's total annual domestic output of poultry is estimated at around 360,000 tons.

It is estimated that nearly 70% o f the country's poultry population (of 70 million birds) is kept in small-holder ("backyard") systems. A typical small-holder farm in Romania keeps 20 chickens, 10 ducks, 5 turkeys, 3 geese, 3 swine, 10 sheep and goats, a cow and a horse living in immediate proximity. Most of the backyard poultry is produced for own consumption or for sale at local (live bird) markets. This sector if generally characterised by low bio-security.

On the other hand, Romania's commercial poultry production is highly concentrated, with 15 large scale producers holding about 60% of the total commercial production. In this sector too, bio-security concerns have been raised, particularly from the more recent AI outbreaks (A93a).

A classification of Romania’s socio-economic position in the world, as carried out for the purposes of this study, can be found in **Annex 3**.

5.4.1.2. Key AH problem areas

Romania was selected as a representative case study in Europe because of the HPAI relevance, but also the fact that the country’s VS have undergone significant restructuring and upgrading in the run up to EU accession (Romania became an EU member on 1 January 2007). The country has had 168 outbreaks since 2004 (**Annex 2**), and only recently was declared HPAI-free (1 October 2006)[133].

[133] According to Article 2.7.12.4. of the OIE *Terrestrial Animal Health Code* states a country may regain its status as avian influenza-free 90 days after *“a stamping-out policy (including disinfection of all affected establishments) is applied, providing that surveillance in accordance with Appendix 3.8.9. has been carried out during that three-month period”*. The last culling and disinfection were completed on 1 July 2006. Since then, clinical and virological surveillance nation-wide have found no positive cases of HPAI. The event is therefore considered resolved. Romania therefore declares having regained its status as a highly pathogenic avian influenza-free country on 1 October 2006. (OIE Final Report No 4, 21 December 2006).

5.4.1.3. AH services and institutional structures

The Central Competent Authority for veterinary services in Romania is the National Sanitary Veterinary and Food Safety Authority (ANSVA). The ANSVA is organised in four directorates: 1- Veterinary, 2- General Food Safety, 3- Inspection, Control, BIPs and Co-ordination of Veterinary Institutes and 4- Economical-administrative, Juridical and International Relations, ANSVA is responsible for supervision, prevention, risk analysis, control, inspection and authorisation in the fields of animal health and welfare, food safety and border inspection posts (BIPs). The Authority is an independent body with its own budget and it is managed by a President (ranked as State Secretary) reporting directly to the Prime Minister (EC DG SANCO/FVO mission reports).

ANSVSA employs about 3000 regular staff and some 400 area veterinarians in it s 42 County Sanitary Veterinary and Food Safety Directorates (Bucharest included). At the local level ANSVSA has contractual arrangements with about 2800 private veterinarians. Three public institutions are affiliated to ANSVSA: (1) the Institute for Diagnosis and Animal Health (IDAH), (2) the Institute for the Control o f Biological Products and Veterinary Drugs, and (3) the Institute for Veterinary Hygiene and Public Health (IVHPH). In addition, ANSVSA also controls the border inspection posts (BIPs). (A93a).

Since the first outbreaks in 2005, several measures have been taken by the Romanian Government to prevent, control and eradicate Avian Influenza in the country. A chain of command was promptly set up to manage the crisis at central, county, and local level based on the indications of the Contingency plan (CP). A permanent National Disease Command Centre (the "Central Anti-Epizootic Command Centre") (CAECC) and local disease command centres made of the deputy director of the County Sanitary, Veterinary and Food Safety Unit and several AI experts have been established through Order No. 146/2005 (A275, A93a). On May 26 2006, the Prime Minister established a National Centre for the Coordination of the Fight against AI, chaired by the president of ANSVSA (National Sanitary Veterinary and Food Safety Authority), comprising representatives of 6 ministries and technical experts, and functioning as an advisory body to the CAECC (A93a). In addition, the Command Centre was assisted by a Crisis Cell which remained operational until the quarantine was lifted and the poultry farms were repopulated. (A93a). Together with the National Commission for Defence against Disasters, responsible for the definition of the overall policy framework for disaster prevention and response, the AECC was created to direct the intervention policy (A275, A93a).

At central level the Veterinary service of the ANSVSA is the CA (Competent Authority) directing the technical measures being taken against the epidemic of avian influenza and is the only authorised institution to make international notifications on animal diseases. At the time of the outbreak an epidemiological cell was temporarily based at the National Reference Laboratory (NRL) to coordinate the technical activities. (A275).

5.4.2. Cost of prevention and control systems

A national plan of intervention in case of a flu pandemic and a contingency plan for avian influenza, approved by the European Commission in December 2006 (Commission Decision, No 2007/24/EC, approving contingency plans for the control of avian influenza and New Castle disease; 22 December 2006), are in place in Romania but the extension and the cost of the overall projects are unclear.

After the first confirmed outbreak, immediate support was provided by international organisations and programs are currently in place to strengthen AI surveillance and reporting systems (A236b). Through a FAO/German Trust Fund project, Germany allocated US$ 141,000, for a 6-month project which ended in May 2006, to provide emergency assistance to control Avian Influenza in Romania (A 42), while in November 2006 the EU allocated 105,000 Euro to improve the surveillance for avian influenza in the country[134].

In August 2006 the World Bank approved a loan to Romania over the 11/2006-8/2009 period in the amount of Euro 29.6 million (US$ 37.7 million) under the GPAI programme to support a national program to increase Romania's avian and human influenza preparedness. The project allocated Euro 14.3 million (39%) for Animal Health, Euro 19.80 million (54%) for Human Health; Euro 1.641 million (4%) for Public Awareness and Communications and Euro 1.824 million (5%) for support, monitoring and evaluation (A93a). The Animal health component includes 4 components whose budget details are provided in **Table 20**.

Table 20 Romania: Animal Health component of the avian influenza control and human pandemic preparedness and response project

	Amount (EURO million)
Strengthening the Institutional Framework	1.503
Strengthening Disease Surveillance, Diagnostic Capacity and Research	10.878
Strengthening HPAI Control Programs	1.578
Improving Bio-security in poultry production trade	293
TOTAL	**14.252**

Source: Romania WB GPAI/APL

Some 57% of the Animal Heath budget has been allocated to support the improvement of diagnostic capacity. Romania's laboratory capacity has been substantially improved over the past years and is equipped to diagnose all notifiable diseases, including HPAI, at the national reference laboratory (NRL) located at the Institute for Diagnosis and Animal Health (IDAH), but on the other hand the IDAH laboratory is the only BSL-3 facility on the animal health side. (A93a)

The National Reference Laboratory (NRL) has been in charge since the beginning of the outbreaks to confirm through virus isolation the presence of HPAI. It has also been involved in the training of staff especially for the setting up of Polymerase Chain Reaction (PCR) diagnostic units in the county laboratories that have been provided with such technology. Three teams (virology, molecular biology and animal health & traceability) were set up to respond to the emergency and the number of people involved

[134]According to this Commission Decision, Romania was allocated Euro 9.72 million in maximum co-funding (50% in most cases) for 2007 for the monitoring, eradication and control of animal diseases. The bulk of this budget has been committed to CSF (5.25 million Euro) and TSE monitoring (2.37 million Euro, for both of which the Commission co-funding rate is up to 100%.

with AI increased from two to forty five. The NRL has also established and reviewed the diagnostic protocols for HPAI. (A275).

Local laboratories have in general good structures and are well equipped. Since the start of the epidemic, six county laboratories have been provided with PCR facilities. A total of eight laboratories are now equipped with the necessary equipment to carry out PCR or real time PCR testing but training still needed for the staff to improve the use of these facilities. (A93a)

However, given the large number of laboratories spread throughout the country and the abundance of equipment, Romania's veterinary system would benefit from laboratory consolidation and more strategic location. (A93a)

Romania's surveillance system is primarily passive, reacting to reports of disease suspicions and testing dead or sick birds. Active surveillance would be needed to ensure that the disease is detected early enough which would substantially increase the number of samples tested for which the capacity not always exists, especially with respect to consumables such as reagents. Within the GPAI/APL project, Euro 0.188 million has been established to that end.

In case of an AI outbreak, Romania pursues a policy of virus eradication through the immediate destruction of poultry in the infected zone, the establishment of surveillance zones, epidemiological surveys, the complete disinfection of affected areas and the use of sentinel birds before restocking. Culling is performed with plastic garbage containers filled with carbon dioxide but more appropriate containers for asphyxiation purposes in an animal welfare-acceptable manner would be needed for the culling operations as well as mobile incineration units for safe disposal of carcasses (A93a).

Financial compensation for culling is paid within 60 days through the provisions of a national fund "Compensation for Animal Diseases" allocated in the Ministry of Agriculture (MAFRD) budget. The amount of compensation payments are based on the replacement value equalling the market price of the destroyed animals or by estimating the total losses incurred by the holder. Initial budgetary allocations for payments compensating farmers for culling/slaughtering in order to prevent animal diseases (such as avian influenza, swine fever, foot and mouth disease, etc.) amounted to about EUR 2.0 million in MAFRD's 2005 budget and EUR 5.5 million in the 2006 budget. Since the first outbreak of HPAI in Romania in October 2005, total compensation payments for culled poultry have added up to EUR 3.9 million out of which EUR 3.2 million were paid in 2006. Average compensation payments amounted to RON 20 (EUR 5.7) per each hen culled (hens representing 80% of the total poultry culled) to about RON 60 (EUR 17) per each turkey culled. Speedy payment of compensation appears to have substantially contributed to the acceptance of culling activities by the rural population. (A93a).

Despite the effectively control of HPAI outbreaks, weaknesses still remain. The WB assessment has identified those to lie particularly in the areas of quarantining, culling of infected and at risk poultry and the safe disposal of poultry carcasses. In order to support the disease control measures, the GPAI/APL programme allocated EUR 1.475 million for targeting virus eradication at the source which includes the above mentioned measures, EUR 0.103 million to implement poultry vaccination campaigns and EUR 0.29 million for improving bio-security especially in small holders farms. In the context of a shift from passive to active surveillance, the project will also support with EUR 2.23 million the development of an animal disease information system to collect the epidemiological information to set up a properly disease control strategy and sharing the information with the international agencies.

5.4.3. Costs of outbreaks

Official conservative estimates have put the total economic losses due to HPAI since the beginning of the outbreaks at an amount of EUR 192 million. This figure excludes costs, for which official quantitative estimates (in the form o f official statistics or formal reports and claims) are not available. Actual losses are therefore likely to be under-estimated by this figure.

The public expenditures incurred as a consequence of HPAI outbreaks in the period October 2005 to May 2006 alone are summarised in **Table 21**.

Table 21 Romania: some direct costs of HPAI outbreaks (a)

	Government expenditure (Euro million)
Outbreak operations (disinfection, culling, incineration)	5.7
Compensation to poultry producers	3.9
Vaccination of civil population and security forces	1.0
Preventive medication, anti-viral drugs (Tamiflu)	0.2
Sanitary and protection equipment, information campaign	0.3
Road and railway disinfection	45.2
TOTAL	**56.3**

(a) Includes public expenditure incurred during the October 2005 to May 2006 period. Excludes certain expenditures for which no official data available.

Source: official statistics (A93a)

In addition, the private sector suffered important economic losses. For the poultry sector, these are estimated at around EUR 70 million, coming from depressed prices (down by 41%), drop in demand (down by 22%), extra-storage costs (up by 18%), lost export opportunities (down by 14%), extra-disinfection costs (up by 14%), and delays in the production flows. The Federation o f the Employers in the Romanian Tourism estimates that the tourism sector losses caused by the outbreaks could be up to EUR 50 million in the period from October 2005 to March 2006 alone. In addition, poultry holders suffered losses from lost production during an average period of 6 weeks after infection, culling, and disinfection. These losses have been estimated at about EUR 1.5 million since October 2005. More generally, the AI outbreaks in Romania have demonstrated the extreme susceptibility o f the sector to the market collapse caused by loss of consumer confidence.

The WB GPAI/APL project has thus concluded that there are clear cost benefits in improving prevention and control of HPAI.

5.4.4. Comparison of prevention versus outbreak costs

In the case of Romania, no cost-benefit analysis as such of Romania's prevention and control strategies appears to exist currently in the reviewed literature. Nonetheless, important conclusions can be drawn in this direction from a comparison of prevention to outbreak costs.

The animal health component of the WB Integrated plan for HPAI control for 2006-9 comes to a total US$ 14.3 million over a 3 year period (**Table 20**). Of this total, some US$ 1.6 million is earmarked for control (culling and compensation activities) in the event of an outbreak. Excluding this provision, total prevention and control activities as such (during 'normal times') come down to US$ 12.6 million. The largest component of this plan is strengthening disease surveillance, diagnostic capacity and research which accounts for US$ 10.9 million over the 3 year period. Strengthening the institutional framework attracts some US$ 1.5 million, and finally biosecurity US$ 0.3 million.

Against these figures, the analysis of existing data suggests that direct costs of the 2004-05 HPAI outbreaks (including culling and control costs, excluding consequential on-farm losses) amounted to Euro 56.3 million during the 6 month period between October 2005 and May 2006, or roughly US$ 67.6 million [135] (**Table 21**). Official conservative estimates have put the total economic losses (direct and indirect) due to HPAI since the beginning of the outbreaks at an amount of EUR 192 million (or US$ 230.4 million). These losses the various indirect effects described above, such as ripple effects in terms of fall in demand/prices and loss of export (official estimates put this at Euro 70 million, or US$ 84 million), and the spill-over effects on tourism (estimated by the tourism industry at Euro 50 million, or US$ 60 million).

Our own estimates of a potential HPAI outbreak occurring in future suggest that, under the scenarios and assumptions presented in section 6, Romania could face total direct costs and losses (including consequential on-farm losses) of US$ 65.3 million a year.

The comparison of the relative scale of the WB prevention plan against the actual and potential outbreak costs involved is depicted in **Figure 15**. It is noted that the WB control and eradication plan's figures are totals over a 3 year period, while the outbreak costs are quoted as amounts during the outbreak time (i.e. covering a six-month period) or, in our projections, annual estimates.

The comparison clearly points to the fact that the potential benefits that can accrue from improving prevention and control are worth several times the investment.

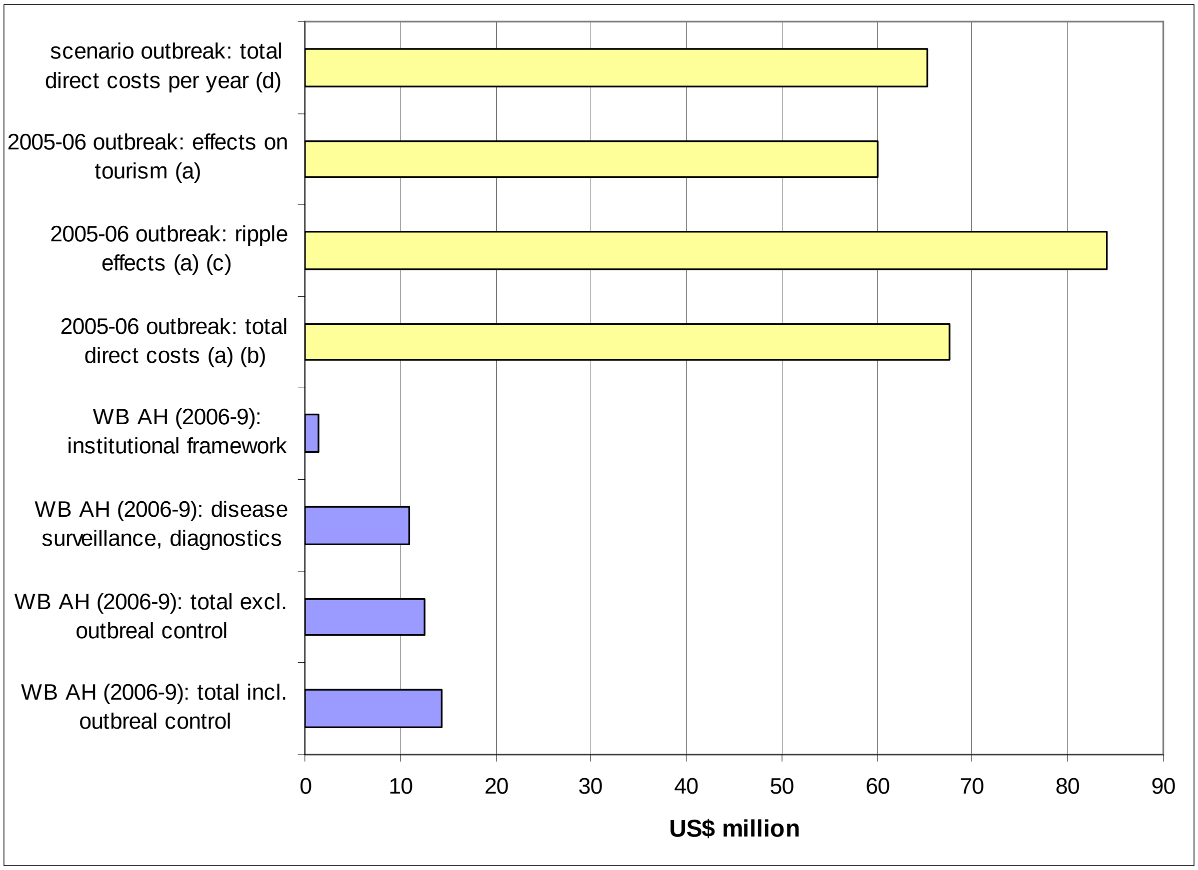
It is noted, however, that this relies on the assumption that a certain investment would result in gains in productivity and export earnings. The extent to which this will occur will depend on the effective design and implementation of the investment, to ensure the effective control of the disease. A risk factor will be the re-appearance of the disease, as is often the case in practice.

The above calculations do not take into account the incremental operational costs involved, which can be a significant part of the cost of strengthening VS.

[135] Euro to US$ average exchange rate during October to May 2006

On the other hand, the investment in strengthening the control of a particular disease, e.g. HPAI, can have important spill-over benefits on the entire VS.

Figure 15 Romania: comparison of prevention versus outbreak costs



(a) during the six month period of the outbreaks
(b) excluding consequential on-farm losses
(c) includes price/demand changes and impact on exports
(b) annual; including consequential on-farm losses (source: Agra CEAS projection, Annex 5)

Notes:
WB AH plan's figures are totals over a 3 year period;
Total direct costs (scenario outbreak) are quoted as annual amounts;
Incremental operational costs (a significant part of the total costs of strengthening VS) are excluded from these calculations, due to lack of data.

Source: Agra CEAS Consulting, based on literature and own analysis

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Our analysis in this section leads us to the following conclusions:

Case study: Romania

Romania's VS have undergone significant restructuring and upgrading in the run up to EU accession (Romania became an EU member on 1 January 2007). Having suffered a large number of outbreaks since 2004, this country was relatively recently declared HPAI-free.

Our analysis and comparisons of data on the planned commitments for 2006-09 under the WB integrated plan for the control and eradication of avian influenza, against real and projected costs of the outbreaks, reveal the relative scale of the costs and benefits involved, and the interest in investing further in improved structures and surveillance systems (see Notes*). For example:

- **The total commitment on animal health under the 2006-09 WB plan (excluding control costs in the event of an outbreak) comes to some US$ 12.6 million for the 3 year period (or an average US$ 4.2 million per year), while the direct costs from the outbreak in the six months of 2005-06 outbreak alone were estimated at US$ 67.6 million, excluding consequential on-farm losses (Figure 15).**

- **Investing in strengthening disease surveillance and diagnostics would cost a total US$ 11 million over the same period, or US$ 3.6 million a year which is less than 0.5% of the above conservative estimate.**

- **The relative scale of this investment is even more evident when adding some ripple and spill-over effects, bringing the total impact at some US$ 211.6 million, as a consequence of the effects of the October 2005 to May 2006 outbreak.**

* *Notes: These benefits assume that a certain investment will result in productivity gains and exports. The scale of the benefit is conditional on the effective design and implementation of the investment to be undertaken, leading to an effective control of the disease (eradication is questionable as there is a significant risk factor that the disease would re-appear, as has been the general experience. The above calculations do not take into account the incremental operational costs involved, which can be a significant part of the cost of strengthening VS. On the other hand, the investment in strengthening the control of a particular disease, e.g. HPAI, can have important spill-over benefits on the entire VS.*

6. Global overview

6.1. Overall approach and objectives

We have structured the overview as a global analysis of prevention costs versus outbreak costs. While the costs of prevention are relatively well documented in the estimates provided, for example in the case of HPAI by the competent international bodies on their worldwide needs assessments (section 4.2), the world wide direct and indirect impact of an animal disease has not yet been analysed as such. Estimating these costs would allow drawing conclusions on the expected potential benefits of investing in improved prevention, as well as on the anticipated scale of the direct production control costs and losses which is of use to part II of the analysis.

To fill this gap, we have developed a specific analytical tool incorporating a baseline, scenarios and assumptions on key parameters from which to estimate the detailed direct and indirect costs of a disease outbreak.

It is important to note that the aim here has been to develop a flexible tool, rather than solely providing estimates as such. This means that the baseline, the assumptions and the scenarios can be improved/refined at any point in time, as further research and evidence on a disease impact becomes available. This tool allows a flexible approach, which highlights the relative importance of the various direct and indirect impacts, so as to provide direction to policy-making in this field.

In this report this tool has been developed specifically for the case of HPAI, but it has the potential to be adapted for application in the case of other TADs. In the case of HPAI, the available research to date as well as the nature of the disease and its economic impacts allows a more detailed approach for the calculation of worldwide direct and indirect impacts. In the case of FMD, the available evidence is largely sporadic, in that it is based on specific measures and countries/regions, and is therefore heavily dependent on specificities which do not allow sensible extrapolations to be made at a world level (as discussed in section 4.4). However, this tool could be easily adapted to derive estimates of the worldwide effects of FMD when such research and evidence becomes available. In the meantime we have used the experience of Argentina and the wider Latin America region from our case study, to draw some conclusions on prevention versus outbreak costs.

6.2. Economic analysis of outbreak costs

The analytical tool, as developed and applied in the case of HPAI, is attached as a separate spreadsheet file (**Annex 5)**. The following sections describe the parameters used, the applied baseline, scenarios and assumptions, and the derived estimates[136].

[136] The layout of the spreadsheet is detailed in the “READ ME FIRST” worksheet.

6.2.1. Key parameters

For the analysis of outbreak costs we differentiate between direct and indirect, further broken down by cost sub-category, according to the typology presented in **Table 2**.

Direct costs and losses are calculated in detail per country – member of the OIE[137] and then these are added to obtain the estimate of global direct costs and losses. These costs are also summarised according to country income levels, which is important in the context of the analysis carried out in Deliverable 2[138].

Indirect costs are calculated at a global level (including all developing/transition countries which are members of the OIE). In this case, the available data and the applied methodology do not allow a more detailed breakdown per country.

A range of parameters is used to calculate each type of cost, as follows (**Table 22**):

Table 22 Parameters used in global economic analysis of outbreak costs

Direct production costs and losses:	
Direct losses	e) Number of poultry lost (died from the disease or culled) f) Average market value per head of poultry (pre-outbreak) g) Culling and disposal costs per head of poultry h) Control costs per head of poultry
Consequential on-farm losses	i) Farm income from activity per head of poultry j) Duration of farm business disruption
Indirect costs:	
Ripple (a)	• Fall in domestic poultry prices • Fall in domestic sales • Fall in world poultry prices • Fall in world poultry trade (exports) • Duration of the above impacts
Spill-over (b)	• Loss in world tourism income value • Duration of the above impact
Wider society (c)	• Loss in global GDP in the event of a human pandemic.

(a) Total net impact on domestic and international markets: depends on impact of outbreak on consumer demand and price levels and proportion of producers/production affected; unaffected producers/countries may actually gain from higher prices. Excludes other potential ripple effects, notably the impact on agricultural input sectors, due to lack of evidence/data.
(b) Costs to the economic sectors of tourism/travel only covered here. Other potentially affected economic sectors (e.g. services) excluded, due to lack of evidence/data.
(c) Economic impact based on the public health effects of a pandemic influenza. Excludes other potential impacts, such as environmental effects, due to lack of evidence/data.

[137] Within the scope of the ToR for this study, as outlined in section 3.2.

[138] As direct costs and losses are calculated per country, it is possible to summarise costs according to any of the clusters presented in section 3.2.

These parameters are outlined in more detail the "*Assumptions outbreak costs*" worksheet of **Annex 5**.

6.2.2. Scenarios and assumptions

Our estimations start from a baseline which contains data derived from the combined analysis of literature review and the case studies. In particular, the baseline on direct outbreak costs includes data from the case studies on Vietnam and Nigeria but also developments in other parts of the world and global developments as documented in the literature. The baseline on indirect outbreak costs is largely based on the available evidence of world developments from the existing literature. The baseline is summarised in the "*Assumptions outbreak costs*" worksheet, and further detailed in the "*Vietnam HPAI*", "*Nigeria HPAI*", "*global HPAI*" and "*pandemic effects*" worksheets (**Annex 5**).

Assumptions are made in order to extrapolate from the baseline to the country 'clusters'. At a general level, these assumptions include duration of the impact (which depends on the duration and re-occurrence of the epidemic), the rate of disease spread and the coverage (in terms of countries). At a cost-specific level, assumptions are made on the key parameters that define each type of cost. In the case of direct production costs and losses, these include the extent of poultry population loss, market value, culling/disposal costs, and control costs per head of poultry, and loss of income from business disruption (as indicated above).

A total of six scenarios have been formulated, as indicated in **Annex 5**:

- At a country level, **scenario 1 ("most likely")**, **scenario 2 ("low impact")** and **scenario 3 ("high impact")** vary in terms of the duration of the impact of the epidemic and the intensity of disease spread within countries.

- At a global level, **scenario A**, **scenario B** and **scenario C** are formulated on the basis of the geographical coverage of the disease worldwide, with scenario A including only H5N1 infected countries, scenario B infected and 'non infected at immediate risk' countries, and scenario C all developing/transition countries that are members of the OIE[139].

The following comments can be made concerning the assumptions made on the various parameters.

Markets (prices and trade):

We have taken developments in world poultry markets since the 2003/04 outbreaks as the baseline on which the assumptions have been built. The most likely scenario closely follows the real market developments depicted by the baseline. It is important to note that all assumptions are made in terms of the overall net impact, as price falls and sales decline for the affected producers/countries have generally resulted in gains in price and sales increases for producers/countries that have managed to stay free from the disease (as discussed in section 4.3.).

[139] This classification has been adjusted from reference A40, the Global Strategy for Progressive Control of HPAI (November 2005) and A42, Avian Influenza Control and Eradication: FAO proposal (March 2006), with an update of the current situation from OIE WAHID database (February 2007).

We differentiate between prices in local/internal markets, and prices in international markets (world market price). The former is used for the calculation of the loss in poultry value and for the lost income per head of poultry; the latter is used for the calculation of the export market loss.

The world market price for poultry has experienced significant swings in the last 2 years, following the AI outbreaks (FAO poultry meat outlook). At the onset of the outbreaks in 2004, lagging consumption in Asia and the loss of export markets for regional supplies led to an 8% decline in international trade. Over two years, as countries free from the disease moved to fill the gap in supplies, poultry prices in international markets rose by over 30%. Market developments since late 2005, however, have dramatically changed price developments in international meat markets. In particular, AI outbreaks in approximately 40 previously unaffected countries, many of which are the major poultry consuming and importing countries of Europe, the Middle East, and Africa, have prompted a decline in the FAO world poultry price index by 22% (A111d). Plummeting consumer demand in a context of adequate supplies has continued to put poultry prices under considerable downward pressure in the short term. The duration and overall extent of the market impact of the more recent AI outbreaks will heavily depend on currently erratic consumer perceptions about human health risks.

In view of these real market developments[140], in our analysis we have taken a baseline world price that is the average of the 2006 level for the US, Brazil and Europe (i.e. the main world poultry exporters accounting for over 80% of global trade). Our assumption is that, in the most likely scenario, an AI outbreak would cause shocks in world markets lasting 2 years. We have therefore assumed that prices would fall by an average 20% over a 2 year period (thereafter recovering to pre-outbreak levels), and world exports would fall by an average 10% over the same period before recovering to pre-outbreak levels. In the low impact scenario, the duration of the impact is shorter (1 year) and the extent of the fall smaller.

These scenarios and assumptions are summarised in the "*Assumptions outbreak costs*" worksheet of **Annex 5**.

6.3. Estimates of outbreak costs

6.3.1. Direct impact

Cost estimates in the event of an HPAI outbreak are presented as a range between nine possible outcomes from a combination of the 6 scenarios outlined above ('most likely', 'low impact' and 'high impact', and A, B and C on the geographical country coverage).

Global estimates of the direct production costs and losses (excluding consequential on-farm losses), under the 'most likely scenario' for each of the 3 scenarios of geographical country coverage (A, B, and C), are presented in **Table 23**. Similarly, global estimates of total direct costs including consequential on-farm losses under the 'most likely scenario' are presented in **Table 24**.

[140] This was based on information and data available at the time of the analysis.

The estimates allow us to draw some general conclusions on the structure of these costs, as depicted in **Figure 16**. The importance of poultry value losses (80% of total direct production costs and losses) and of consequential on-farm losses (55% of the total direct impact) is in particular highlighted.

The range of outcomes under the different scenarios ('most likely', 'low impact' and 'high impact', and A, B and C on the geographical country coverage) are summarised in **Figure 17**. As can be seen, the results for scenarios A and B tend to be very similar, reflecting the relatively small number of countries added in scenario B, given the current state of HPAI outbreaks worldwide. If this position changes, with a more substantial geographical spread of the disease, then the impact would start moving closer to the substantially higher figures of scenario C. Thus, total direct costs and losses (excluding consequential on-farm losses) in scenarios A and B are estimated at US$ 5.3 billion and US$ 6.1 billion respectively (on an annual basis), but would rise up to US$ 9.7 billion if the disease were to spread throughout the developing world. Including consequential on-farm losses, the total direct impact would be US$ 11.7 billion and US$ 13.5 billion respectively in the case of scenarios A and B, but could rise up to US$ 21.3 billion if the disease was to spread more worldwide along the lines suggested by scenario C. It is noted that in all cases, the impact is not proportionate to the number of countries added under subsequent each scenario, because the countries of scenarios A and B account for 55% and 63% respectively of the poultry stock of all developing OIE country members.

Similarly, the most likely scenario depends on the assumptions made on the various parameters as the situation currently stands (markets/prices, duration of impact, size of poultry sector affected etc.), in other words it represents the most realistic potential outcome with the information currently available. If this situation changes, this would affect the assumptions made on the key parameters such as the duration of the impact, the size of the poultry sector affected, the effect on consumption, markets and prices and so on. Thus, if the situation becomes less critical, then the potential outcome would start moving towards the 'low impact' scenario; conversely if the situation becomes more severe, then the potential outcome would start to approximate to that of the 'high impact' scenario (**Figure 17** and **Figure 18**). For example, taking scenario A, total direct costs and losses (excluding consequential on-farm losses) in the 'low impact' scenario come down to US$2.5 billion and the 'high impact scenario rise to US$ 8.9 billion (all figures on an annual basis), compared to US$ 5.3 billion in the 'most likely' scenario. Including consequential on-farm losses, the total direct impact would be US$ 3.5 billion in the 'low impact' scenario and US$ 30.3 billion the 'high impact scenario (compared to US$ 11.7 billion in the 'most likely' scenario).

Table 23 Estimated global impact: direct costs and losses (a) (in '000 US$), HPAI

	Impact: scenario 1 (most likely)			
	Poultry value losses	**Culling/ Disposal costs**	**Control costs**	***Total impact (a)***
Direct production costs/losses: Global impact, annual (i)				
scenario A (ii)	***4,271,540***	***747,519***	***320,365***	***5,339,425***
scenario B (iii)	***4,898,934***	***857,313***	***367,420***	***6,123,668***
scenario C (iv)	***7,763,260***	***1,358,571***	***582,245***	***9,704,075***
Direct production costs/losses: Global impact, total (i)				
scenario A (ii)	***8,543,080***	***1,495,039***	***640,731***	***10,678,850***
scenario B (iii)	***9,797,868***	***1,714,627***	***734,840***	***12,247,335***
scenario C (iv)	***15,526,520***	***2,717,141***	***1,164,489***	***19,408,151***

(a) Includes animal value losses, culling/disposal and control costs
(i) The 'global' impact is given in a range, depending on 3 scenarios in terms of country coverage (scenarios A to C). Furthermore, it is indicated per year and in total, depending on the assumptions for duration of the epidemic
(ii) Scenario A includes the following countries: Cambodia, China, Indonesia, Laos, Thailand, Vietnam, S. Korea; Mongolia, Kazakshtan, Russia, Turkey, Romania; Nigeria, Niger, Sudan
(iii) Scenario B includes the countries of scenario A plus: N Korea, Malaysia, Brunei, Myanmar, Singapore, Philippines; Bangladesh, Bhutan, India, Nepal, Sri Lanka
(iv) Scenario C includes all developing/transition countries which are members of the OIE (132 countries in total)

Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

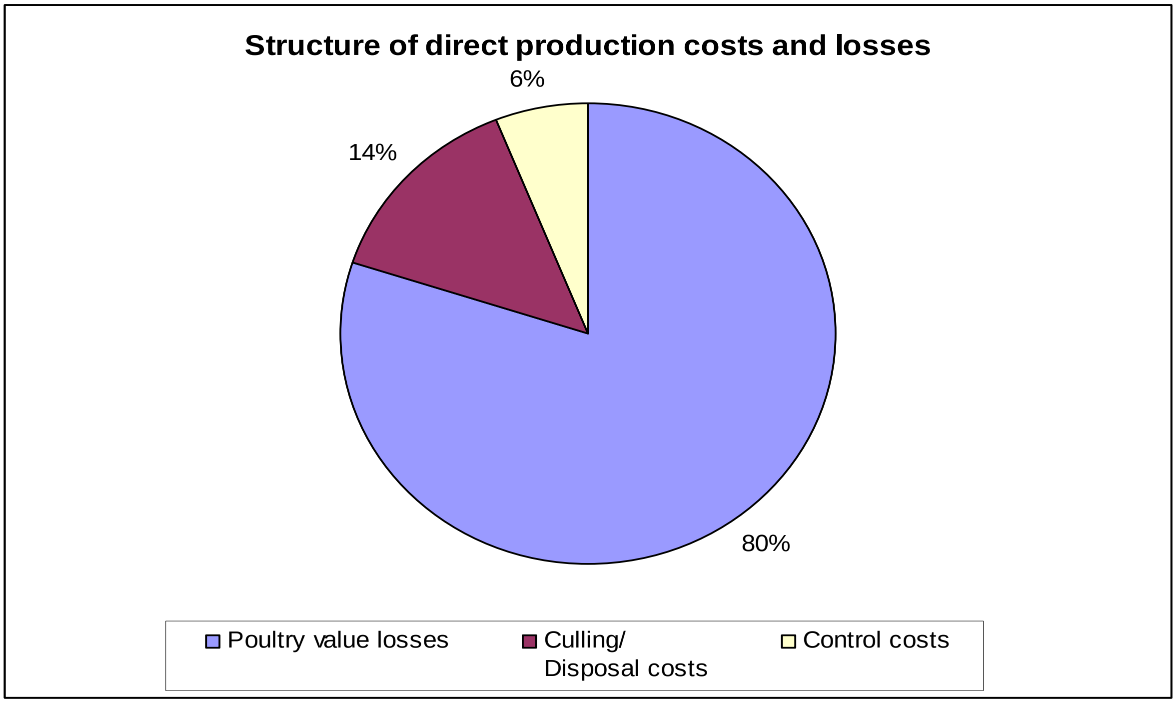
Table 24 Estimated global impact: total direct costs including consequential on-farm losses (in '000 US$), HPAI

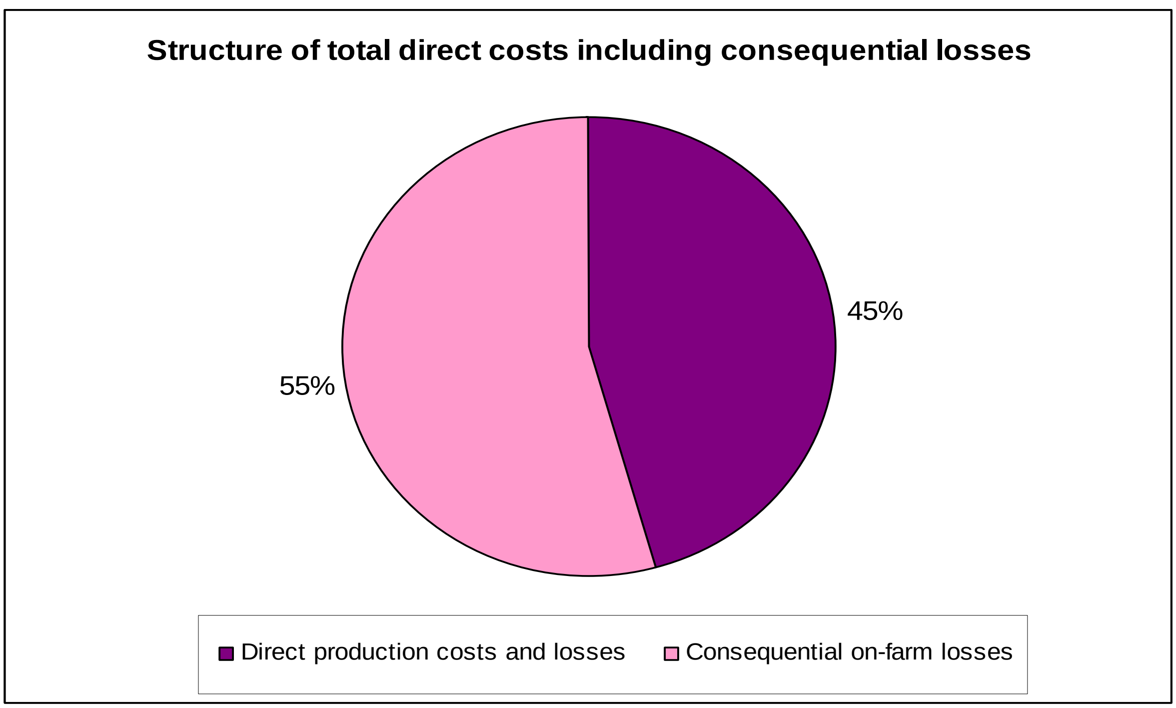
	Impact: scenario 1 (most likely)		
	Direct production costs/losses, total impact (a)	**Consequential on-farm losses**	**Total direct impact, including consequential on-farm losses**
Global impact, annual (i)			
scenario A (ii)	***5,339,425***	***6,407,310***	***11,746,734***
scenario B (iii)	***6,123,668***	***7,348,401***	***13,472,069***
scenario C (iv)	***9,704,075***	***11,644,890***	***21,348,966***
Global impact, total (i)			
scenario A (ii)	***10,678,850***	***12,814,619***	***23,493,469***
scenario B (iii)	***12,247,335***	***14,696,802***	***26,944,137***
scenario C (iv)	***19,408,151***	***23,289,781***	***42,697,931***

(a) Includes animal value losses, culling/disposal and control costs
(i) The 'global' impact is given in a range, depending on 3 scenarios in terms of country coverage (scenarios A to C). Furthermore, it is indicated per year and in total, depending on the assumptions for duration of the epidemic
(ii) Scenario A includes the following countries: Cambodia, China, Indonesia, Laos, Thailand, Vietnam, S. Korea; Mongolia, Kazakshtan, Russia, Turkey, Romania; Nigeria, Niger, Sudan
(iii) Scenario B includes the countries of scenario A plus : N Korea, Malaysia, Brunei, Myanmar, Singapore, Philippines; Bangladesh, Bhutan, India, Nepal, Sri Lanka
(iv) Scenario C includes all developing/transition countries which are members of the OIE (132 countries in total)

Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

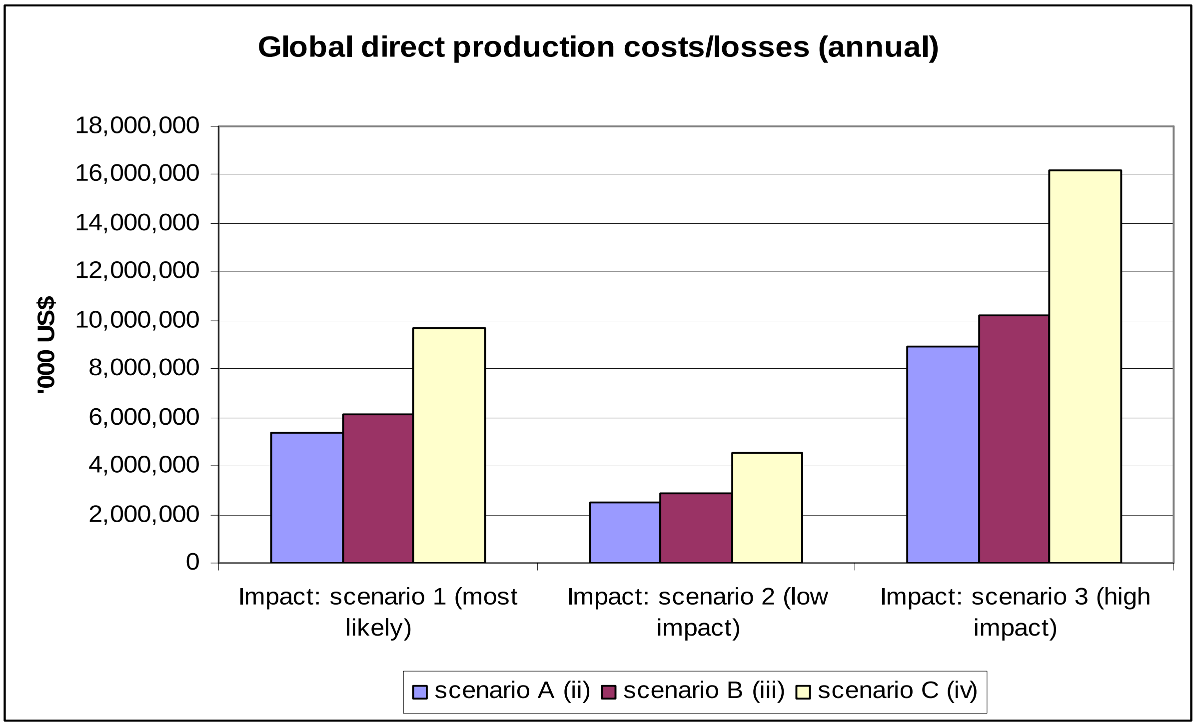
Figure 16 General pattern of estimated direct impacts, HPAI



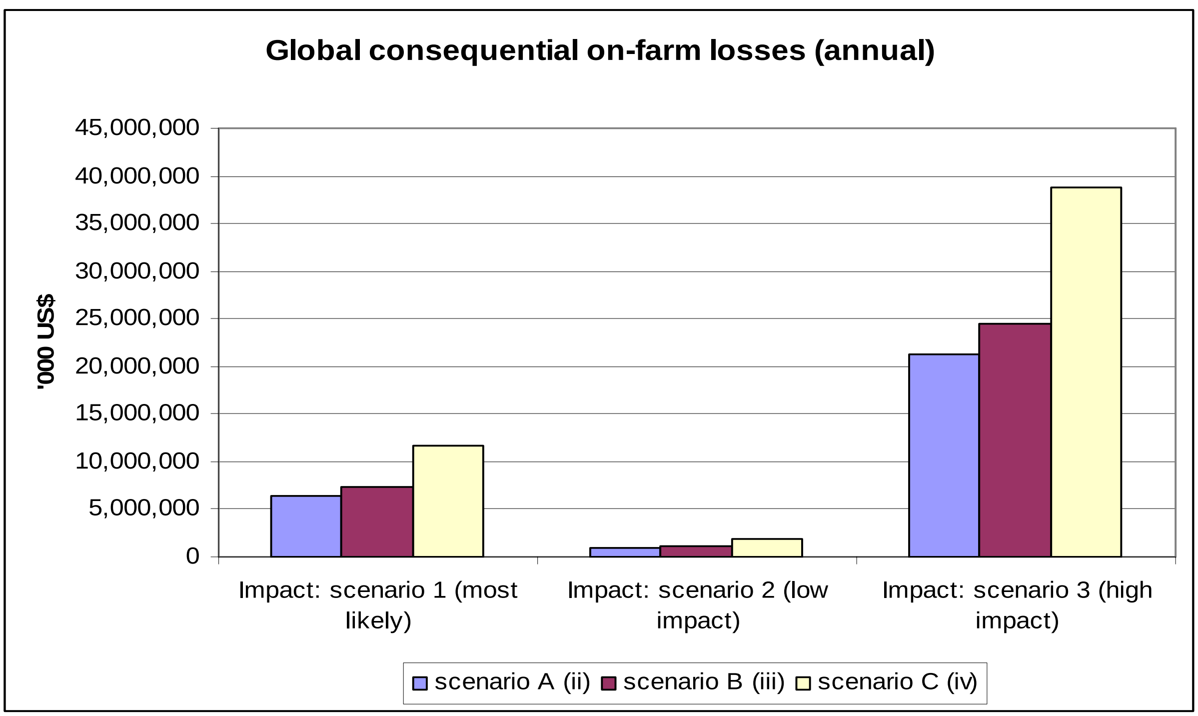


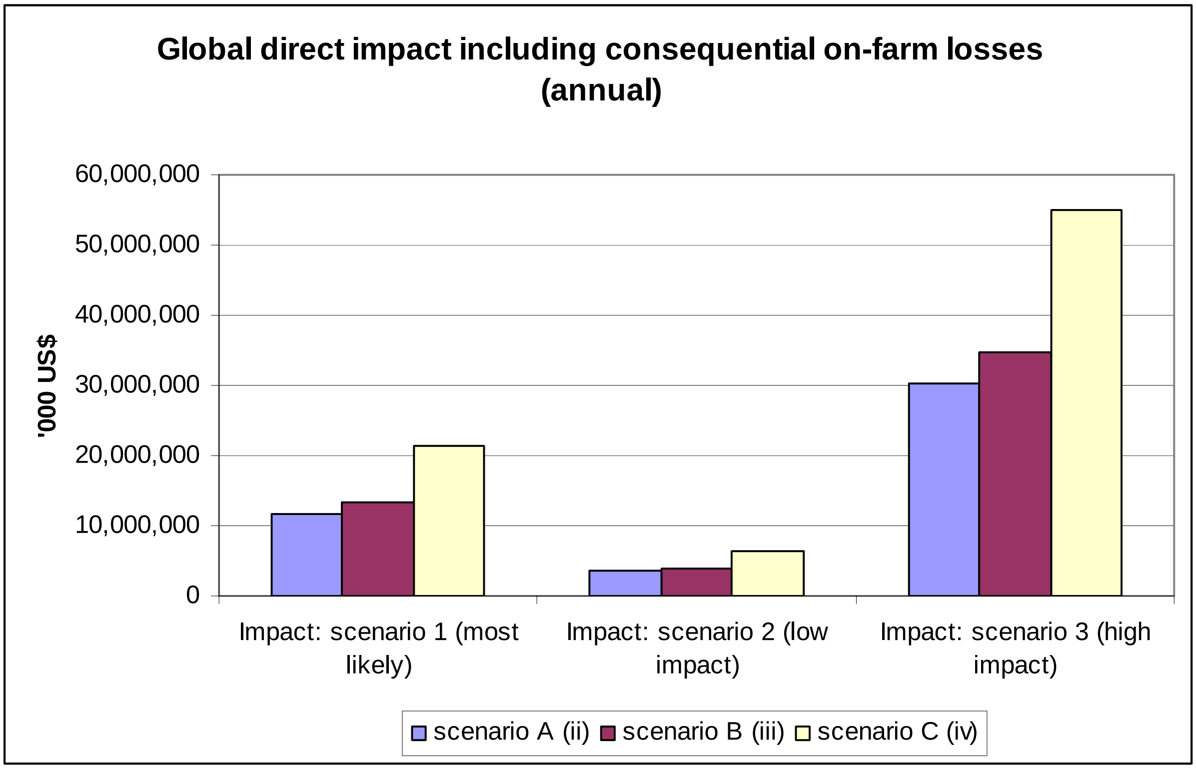
Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

Figure 17 Overview of estimated direct impacts under the different scenarios, HPAI (i)



Note: Includes animal value losses, culling/disposal and control costs



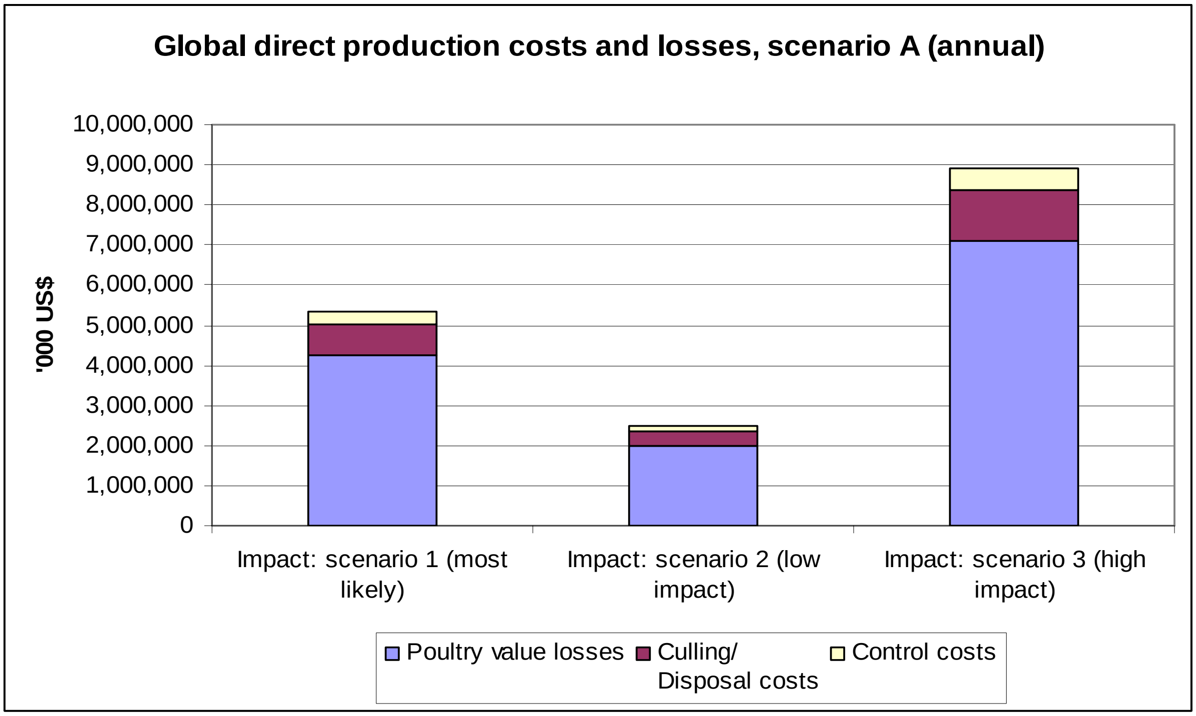


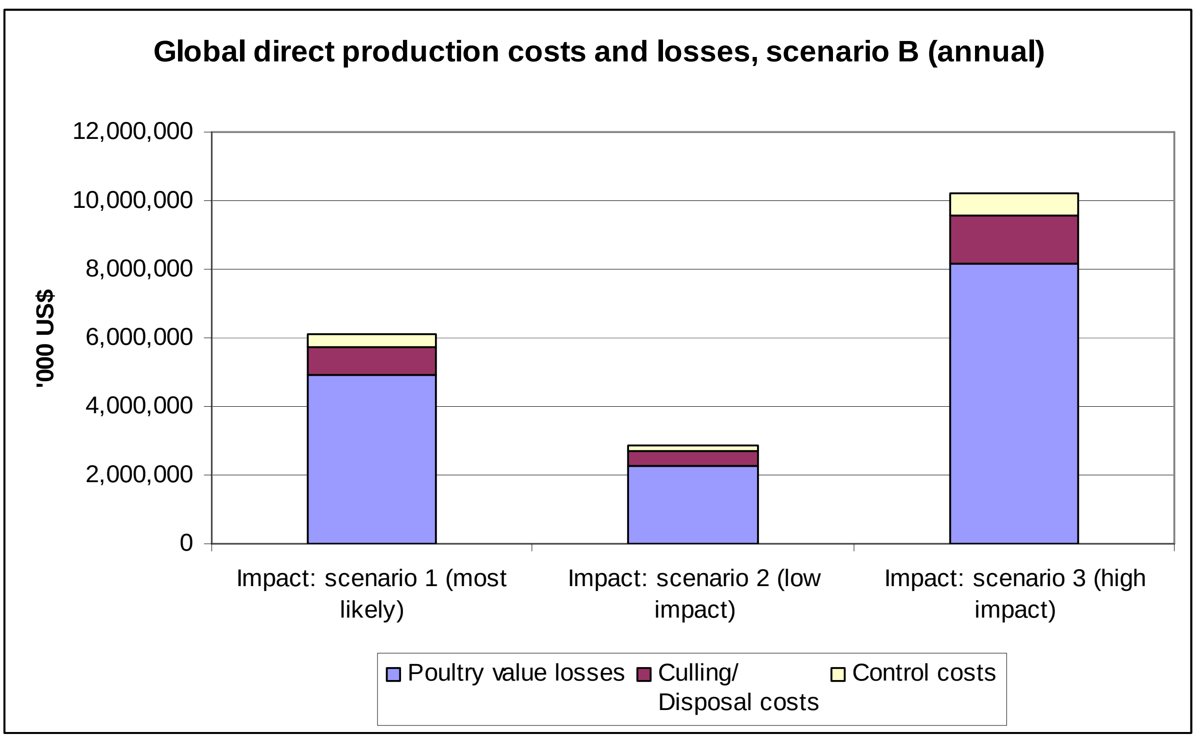
Note: impact presented on an annual basis. For full results see **Annex 5**

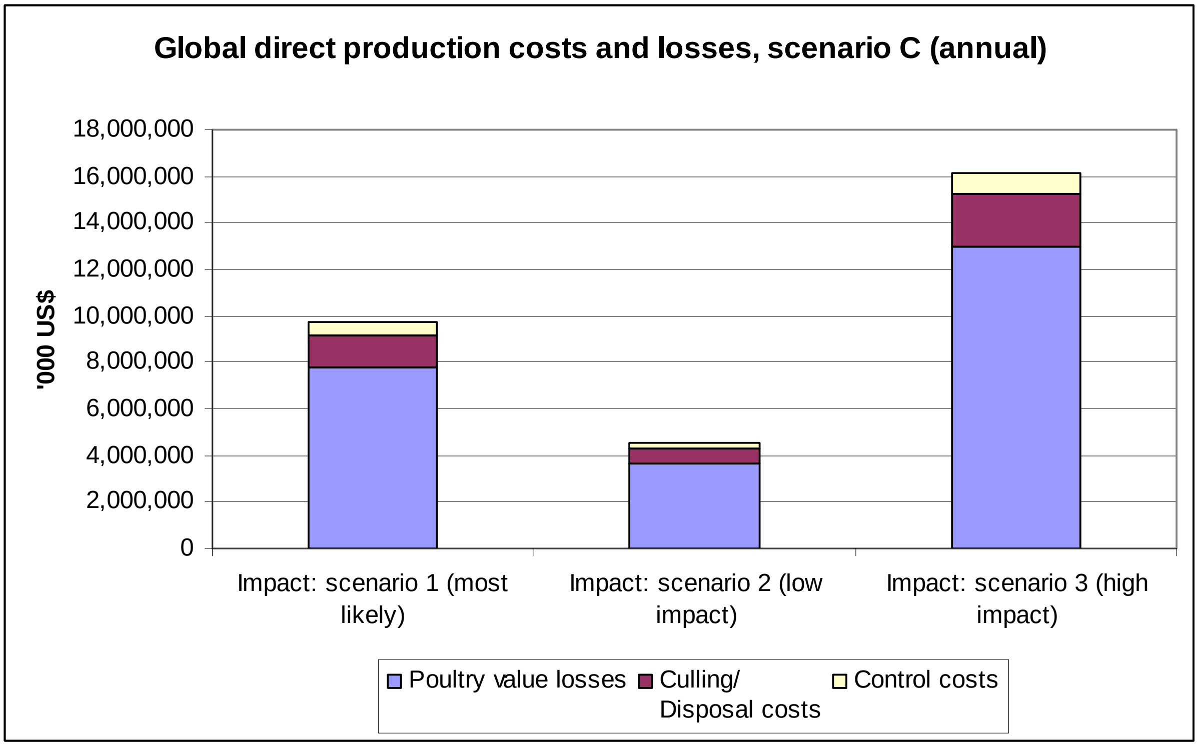
(i) Includes animal value losses, culling/disposal and control costs
(ii) Scenario A includes the following countries: Cambodia, China, Indonesia, Laos, Thailand, Vietnam, S. Korea; Mongolia, Kazakhstan, Russia, Turkey, Romania; Nigeria, Niger, Sudan
(iii) Scenario B includes the countries of scenario A plus: N Korea, Malaysia, Brunei, Myanmar, Singapore, Philippines; Bangladesh, Bhutan, India, Nepal, Sri Lanka
(iv) Scenario C includes all developing/transition countries, members of the OIE (132 countries in total)

Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

Figure 18 Overview of estimated direct production costs and losses under the different scenarios, HPAI







Note: Impact presented on an annual basis. For full results see **Annex 5**

Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

6.3.2. Indirect impact

The various indirect costs in the event of an HPAI outbreak have been estimated as a range between 3 possible outcomes from the 3 main scenarios ('most likely', 'low impact' and 'high impact'). Unlike direct costs, it has not been possible to estimate costs per country, therefore it has not been possible to examine scenarios A, B and C on the geographical country coverage. As discussed above, this is due to the complexity of interactions, whereby a loss in one sector may be a gain in another. Thus, the effects given here are an estimated net impact which accommodates for such interactions, based on assumptions taken from the baseline i.e. the experience we have now gained from the global impact on world markets following the AI outbreaks of the last few years.

Global estimates of the indirect impact under the 'most likely scenario' are presented in **Table 25**, on an annual basis and in total terms (i.e. depending on the duration of the impact of the epidemic). Under the 'most likely' scenario, ripple costs are estimated at US$ 5.3 billion in terms of domestic market losses in the poultry sector and a further US$ 3.8 billion in terms of export market losses on an annual basis. Assuming a 2 year duration of impact, as is currently the case under the 'most likely' scenario based on real market baseline trends, the total ripple impact in terms of domestic and export market losses in the poultry sector would be double the above amounts (i.e. US$ 10.6 billion and US$ 7.5 billion respectively).

The considerable extent to which the relative value of spill-over (tourism) and wider society (human pandemic) costs outweigh the ripple effects is highlighted under the different scenarios in **Figure 19**. In the case of spill-over effects in the tourism sector alone, these are estimated to amount to US$ 72 billion on an annual basis under the 'most likely' scenario and double that amount assuming a 2-year duration of the impact (i.e. US$ 144 billion). Wider society costs, in the event of a human pandemic, are several multiples of all costs, and depending on the severity of the outbreak these are estimated at US$ 311.2 billion (at 15% attack rate), and at US$ 711.2 billion (at a 35% attack rate) on an annual basis alone. This is consistent with the approach taken in much of the literature on indirect impacts, where the animal health and human pandemic scenarios of HPAI have been looked at separately (e.g. A43, A90, A210, A261). There is also wide consensus that, the further we move towards spill-over and wider society impacts, the more the picture becomes uncertain and heavily dependent on the underlying assumptions.

It should be noted that these costs are the minimum expected outcome, as they exclude certain types of indirect impacts for which it has not been possible to provide estimates on a global scale. Such impacts include ripple effects on upstream/downstream industries (raw material suppliers, catering and distribution, wholesale markets, employment in the sector etc.), spill-over effects (e.g. on the services industry) and other wider society costs (e.g. environmental effects). Where available, some evidence of these effects on an ad hoc basis has been provided in section 4.3.3, and this suggests that such costs can be fairly substantial. For example, it is estimated that the European poultry feed industry following the AI crisis has seen up to 40% reductions in demand for poultry feed in EU countries (**Table 9**).

In this context, the estimates of total indirect impact provided here should be considered as the minimum potential outcome.

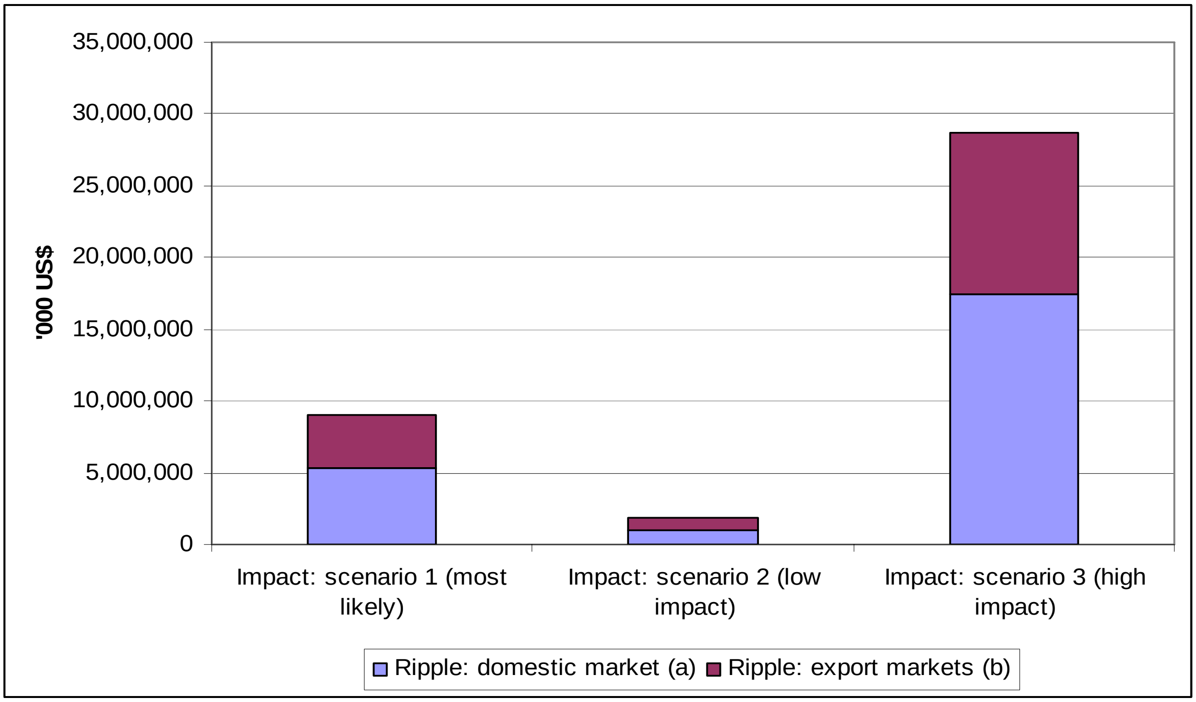
Table 25 Estimated global impact: indirect costs, HPAI

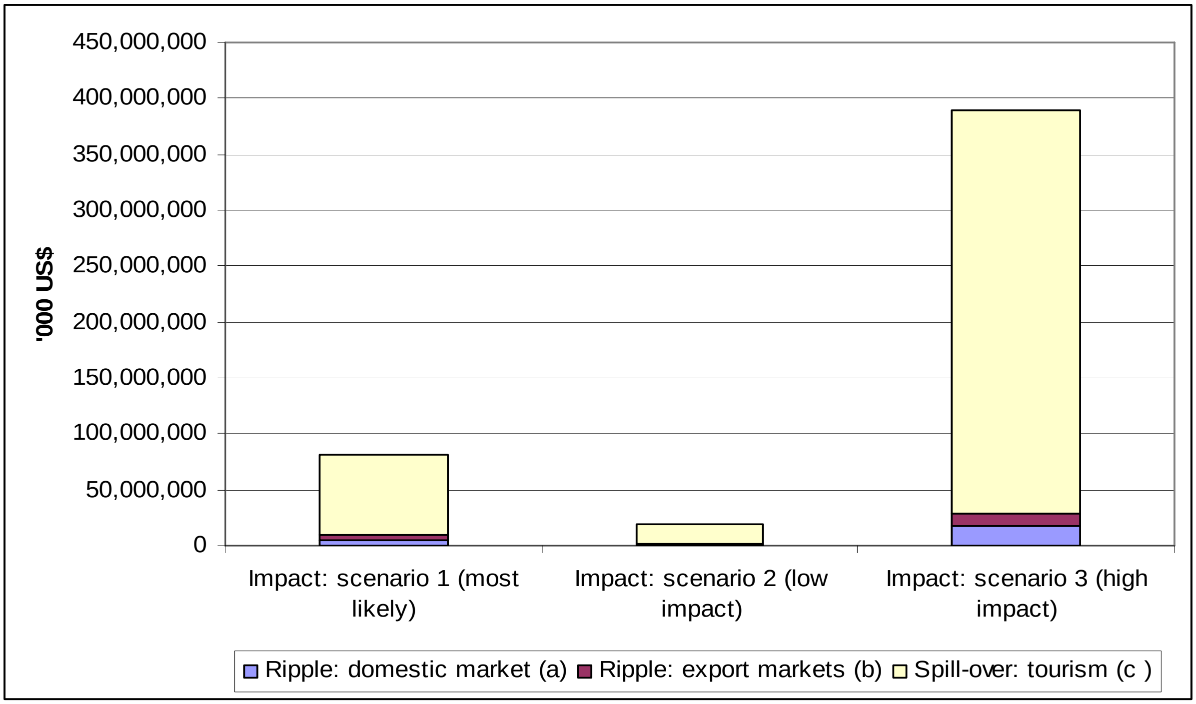
	Impact: scenario 1 (most likely)				
	Ripple: domestic market (a)	**Ripple: export markets (a)**	**Spill-over: tourism (b)**	**Wider society (c)**	***Total impact***
Indirect costs/losses: Global impact, annual (i)	5,279,017	3,774,984	72,000,000	311,150,000	***392,204,001***
				711,200,000	***792,254,001***
Indirect costs/losses: Global impact, total (i)	10,558,034	7,549,968	144,000,000	622,300,000	***784,408,002***
				1,422,400,000	***1,584,508,002***

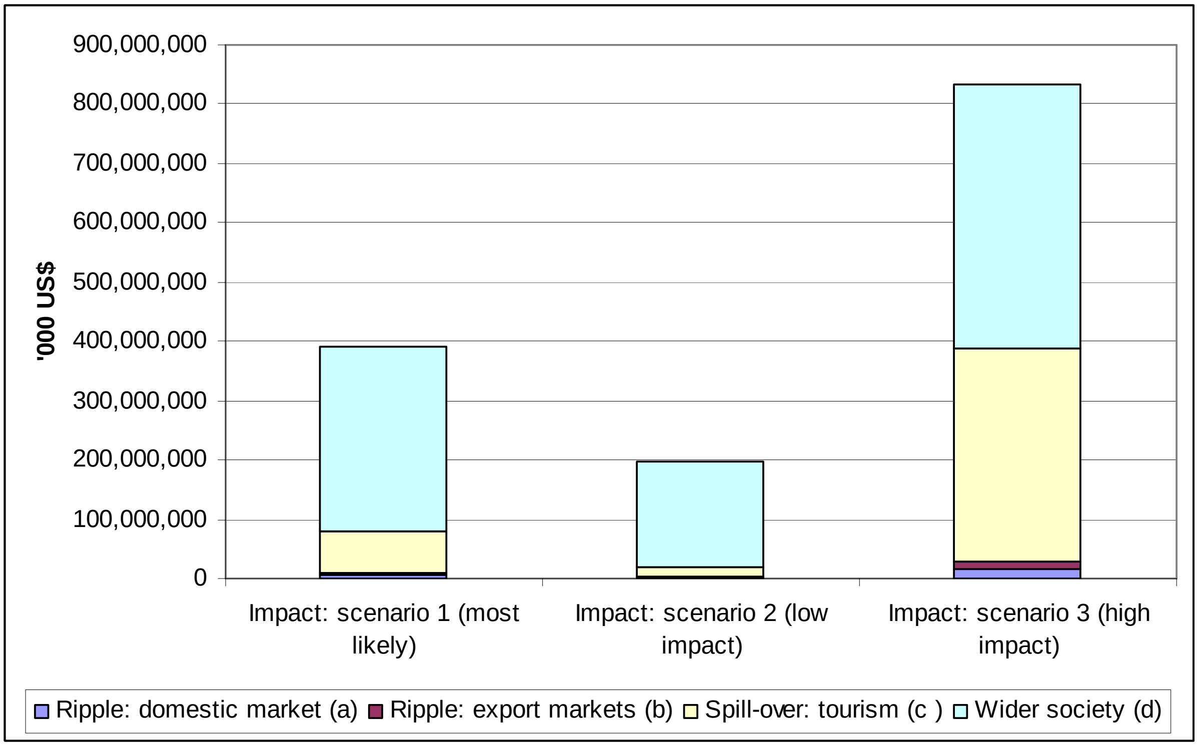
(a) Total net impact on domestic and international markets: depends on impact of outbreak on consumer demand and price levels and proportion of producers/production affected; unaffected producers/countries may actually gain from higher prices. Excludes other potential ripple effects, notably the impact on agricultural input sectors, due to lack of evidence/data.
(b) Costs to the economic sectors of tourism/travel only covered here. Other potentially affected economic sectors (e.g. services) excluded, due to lack of evidence/data.
(c) Economic impact based on the public health effects of a pandemic influenza. Excludes other potential impacts, such as environmental effects, due to lack of evidence/data. Low value assumes 15% attack rate; high value assumes 35% attack rate.
(i) The 'global' impact is indicated per year and in total, depending on the assumptions for duration of the epidemic.

Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

Figure 19 Overview of estimated indirect impacts under the different scenarios, HPAI







Note: Impact presented on an annual basis. For full results see **Annex 5**

(a) Total net impact on domestic and international markets: depends on impact of outbreak on consumer demand and price levels and proportion of producers/production affected; unaffected producers/countries may actually gain from higher prices.
(b) Excludes other potential ripple effects, notably the impact on agricultural input sectors, due to lack of evidence/data.
(c) Costs to the economic sectors of tourism/travel only covered here. Other potentially affected economic sectors (e.g. services) excluded, due to lack of evidence/data.
(d) Economic impact based on the public health effects of a pandemic influenza. Excludes other potential impacts, such as environmental effects, due to lack of evidence/data. Low value assumes 15% attack rate; high value assumes 35% attack rate.

Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

6.4. Comparison of prevention costs to outbreak costs

In the case of HPAI, the most recent global needs assessments of prevention and response to HPAI suggest that some US$ 2.27 billion would be required over a 3-year period (as discussed in section 4.2). Of this amount, prevention and preparedness costs as such account for just over US$ 1 billion (**Table 4**). It is noted that these calculations do not take into account the incremental operational costs involved, which can be a significant part of the cost of strengthening VS.

Against this assessment, outbreak costs under the 'most likely' scenario and for H5N1 countries only are estimated at US$ 5.34 billion per year for the direct production costs and losses alone (excluding consequential losses) (**Figure 20**).

Adding consequential on-farm losses, the total direct impact comes to US$ 11.75 billion per year. Assuming the impact of an outbreak spread over a period of 2 years ('most likely scenario') the total direct impacts would be US$ 10.7 billion excluding consequential on-farm losses and US$ 23.5 billion if these losses are included.

Moving towards scenarios B and C these costs increase further to US$ 12.3 billion and US$ 26.9 billion respectively (in the case of scenario B) and to US$ 19.4 billion and US$ 42.7 billion respectively (in the case of scenario C).

Before even considering the indirect impacts, the benefits of improved prevention by far outweigh the potential outbreak costs and losses.

Adding potential ripple effects (only in terms of the potential losses in domestic and export markets) to the above scenarios would bring the total impact to US$ 41.6 billion over a 2 year period.

The 'benefit' of improved prevention in this case is defined as the potential savings that could/should be made on outbreak costs if an effective prevention and emergency preparedness structure is in place. It is noted, however, that this relies on the assumption that a certain investment would result in gains in productivity and export earnings. The extent to which this will occur will depend on the effective design and implementation of the investment, to ensure the effective control of the disease. A risk factor will be the re-appearance of the disease, as is often the case in practice. It is also noted that as several countries start embarking on improving their prevention and control systems and strengthening their VS, some of these losses would be mitigated; however, the timeframe of the calculations here (2-3 years) is relatively short for such effects to be felt through.

In addition, other benefits include the potential contribution to poverty alleviation, as discussed in section 3.7, given that a significant number of the countries included in these estimates are defined as LDCs or low income countries (**Annex 3**). Under the most likely scenario, in the event of an HPAI outbreak the estimated direct impact (excluding consequential losses) for the LDCs as agroup ranges from US$ 72.6 million in scenario A (only 4 LDCs affected) to US$ 258 million in scenario B (8 LDCs affected) and nearly US$ 600 million if all LDCs were to be affected (scenario C).

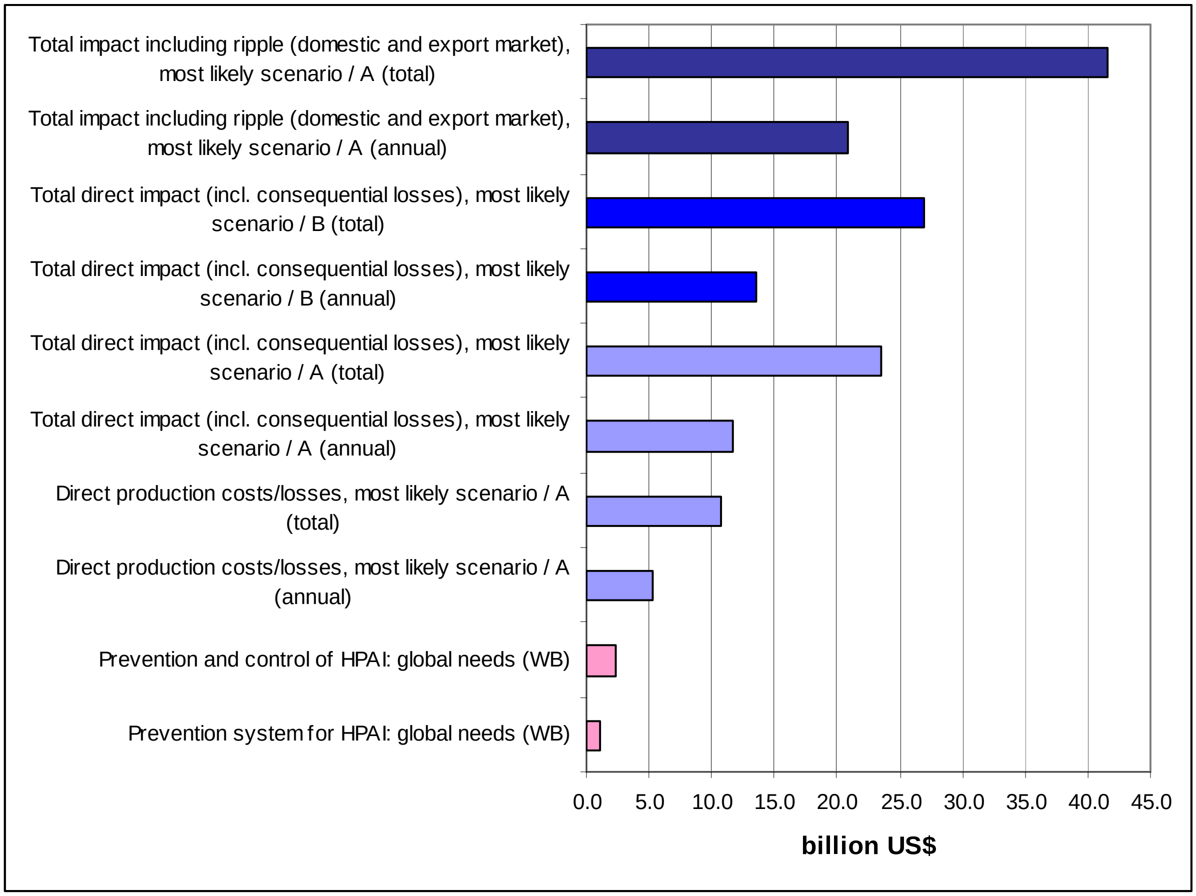
Furthermore, the investment in strengthening the control of a particular disease, e.g. HPAI, can have important spill-over benefits on the entire VS.

In the case of FMD, although a complete estimation of outbreak costs and an extrapolation to a world level has not been possible from the ad hoc evidence available, as discussed in section 4.4, existing studies overwhelmingly support the thesis that improved prevention and control (including through the improvement in VS) contributes to significant gains in terms of trade, which justify the investment[141]. This is particularly the case for FMD, but there are also important benefits of this kind in the case of HPAI, as demonstrated by the ripple export markets impacts in the above calculations.

Similar conclusions can be drawn from the analysis of the CBPP and rinderpest campaigns in Africa (section 4.4).

[141] This may not be the case for all developing/transition countries as quality issues and poor marketing channels often act as additional factors to animal health problems, that prohibit some countries from untapping their export potential, where such a potential is available.

Figure 20 Prevention versus outbreak costs: comparison under various scenarios, HPAI



<u>Notes</u>:
HPAI global needs figures are totals over a 3 year period;
Incremental operational costs (a significant part of the total costs of strengthening VS) are excluded from these calculations, due to lack of data;
Outbreak costs are quoted in annual and total amounts (total here refers to the duration of the impact, which is assumed to last for 2 years in the most likely scenario).

Source: *"OIE Del1 global costs analysis.xls"*, Agra CEAS Consulting.

7. Conclusions

It is difficult to predict the severity of the threats posed by Transboundary Animal Diseases (TADs). Moreover, different issues arise depending on the nature of the disease. A disease such as HPAI, with its high public health relevance, poses a different set of challenges than a disease such as FMD which has purely commercial and socio-economic implications. Both diseases, however, have the potential to lead to substantial and even devastating consequences in terms of increased poverty, decreases in food security and social equity/stability in developing/transition countries.

At the same time, the current state of Veterinary Services (VS) and preparedness levels in developing/transition countries pose a real and present threat to the prevention and control of TADs. As is demonstrated in the case studies and from the literature review, the various identified weaknesses essentially revolve around the key issue of the lack of funds and/or poor governance. Within a weaker economic environment and while these countries are struggling to catch up with the rest of the world, it is evident that VS have not been – more importantly have <u>not consistently</u> been – a priority in the use of relatively constrained public funds. Today more than ever, with increasing globalisation, the world's 'developed' and 'developing/transition' countries are so interconnected that both the effects of TADs and the measures to prevent them can not be viewed in isolation. This call for a global approach in the fight against animal diseases, for which there is wide consensus in the reviewed literature that the VS have a crucial role to play as the providers of Global Public Goods.

In the case of HPAI, while significant risk remains that the virus mutates to infect humans, as yet adaptation for human-to-human transmission has not occurred. However, the WHO considers it a probable (rather than a possible) scenario, and the key competent agencies for animal health (OIE/FAO) warn that the greater the shedding of virus from infected poultry the greater the risk of adaptation leading to a human pandemic. It is therefore clear that the disease must be contained efficiently and within a reasonable time frame. This being a transboundary disease, efficient containment can not take place unless all countries in the world are prepared to face a possible outbreak. The worldwide system for the prevention and control of HPAI can only be as strong as its weakest link. To date, the H5N1 has been most prevalent in SE Asia but it has spread relatively quickly to Africa and has made its appearance in the developed world (more recently with the February 2007 UK outbreak).

This raises important strategic questions for policy-makers around the world. A key issue is the extent of the investment that needs to be undertaken to improve current systems to prevent TADs, not only in the specific context of the two diseases examined here (HPAI and FMD) but also more generally.

To determine the appropriate level of investment, in purely economic terms, demands an analysis of the costs of the investment versus the benefits. As discussed in the Report, such an analysis in the strict sense of a CBA methodology has a number of limitations:

- Firstly, this theme requires both detailed epidemiological and economic modelling, for which neither the methodology has been adequately developed nor the necessary data exists.
- Second, in most cases, both the costs and the benefits extend beyond the boundaries of a specific disease. The interrelationships may be too complex to allow clear modelling. For example, general improvements in VS have implications for all diseases, in which case the resulting

benefits (e.g. in terms of potential improvements in market access) can not clearly be defined because they can not be attributed to a specific livestock sector that may benefit from these improvements.

- Third, these being transboundary diseases, the potential costs and benefits transcend national borders. In this case too, interrelationships are too complex to readily allow modelling. For example, the improvement of preventive capability in Nigeria should have major implications for neighbouring countries and the region, however relevant policies undertaken in the other countries also impact on the region.

- Fourth, even where the costs and benefits can be examined in the context of a specific measure affecting a specific livestock sector (e.g. improved diagnostic laboratory capacity for HPAI), the resulting benefits are not always tangible or readily quantifiable. For example, in examining the potential benefits that may accrue from the avoidance of a human pandemic, only approximate estimates can be provided.

- Fifth, it is difficult to isolate the potential benefits of the examined investment from other conjectural trends that may influence the outcome. For example, building a new diagnostic laboratory may improve detection of a disease but the likely benefit in terms of – say - the improved trade potential may be undermined by factors such as high production costs, poor marketing/distribution channels, poor infrastructure, trade policies, or the emergence of a new competitor in potential export markets.

- Sixth, even where such analysis has been attempted, results depend heavily on the underlying assumptions and scenarios, and should therefore be interpreted within that context.

The current project has examined the costs of specific measures, recognised by the competent agencies in this field as the minimum requirements for effective prevention and control, and has compared them to the costs of outbreaks in the particular case of HPAI. For the latter, it has developed a detailed model, which estimated the costs per country and extrapolating at global level, under different scenarios and assumptions. The extent of the investment on prevention will depend on preparedness levels in each country, which, as demonstrated in the case studies and the literature review can be extremely variable. Similarly, the extent of the benefit will depend on a range of factors including the duration, severity and geographical scale of the epidemic, economic factors and the potential consequences and scale of a human pandemic.

It is therefore important to view the estimates of prevention costs and outbreak costs in terms of relative scale rather than as absolute figures, and within the context in which they have been produced. For this reason, a range of estimates is provided under a range of scenarios and assumptions, while our most likely scenario is modelled closely on past experience and data from the costs of actual outbreaks (this has been used as our baseline).

It is noted that direct costs and losses, although extensive in themselves, are in fact the smallest element of the overall impact of an outbreak and therefore produce the smallest element of benefit accruing from improved prevention. While direct impacts are relatively easier to determine, indirect impacts are more cumbersome, especially as we move down the list from ripple to spill-over and wider society effects. Results should therefore be interpreted with caution the further we move away from the estimation of direct impacts.

Overall the results clearly demonstrate that the potential costs of an HPAI outbreak are a multiple of the investment required for effective prevention. This suggests that the potential benefit of improved prevention is very substantially higher than the cost of the investment, depending on the underlying scenarios and assumptions. If the effects of a human pandemic are added to the equation, then the economic benefits – beyond avoiding the loss of human lives as such – by far outweigh the costs. Beyond these benefits, there are clear implications in terms of poverty alleviation and food security as the producer costs and losses of an outbreak are disproportionately felt by those most in need: the poorer rural communities of the developing world.

These results have implications for policy-making. An important element of animal health prevention policies is the control of risks at source, hence the advantages of improved prevention in exporting developing countries accrue not just to them but also to importing developed countries. Apart from providing solidarity as such in facing crises and assisting the developing world to come out of the poverty deadlock, the potential benefits that can accrue to developed countries from improved disease prevention and preparedness at source in developing countries is a major argument for the mobilisation of funding from the international community. The nature of the potential costs and benefits also determines the rationale and potential extent of involvement of public and private initiatives in mitigating the effects of an outbreak. These issues are explored in Deliverables II and III.

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Annexes

Annex 1: Transboundary Animal Diseases (TADs): overview of occurrence and prevention/control strategies for major TADs

Disease	Host	Virulence	Prevention and Control	Occurrence of the disease in World (from 01/01/05 to 10/02/07)
Highly pathogenic avian influenza (HPAI)	Probably all domestic and wild avian species are susceptible to infection. Other species can be affected but the infection remains generally unapparent (pig, horse, cats). Humans can become infected from contact with the birds, and death has occurred in some cases (HPAI). However, no human to human transmission yet.	HP viruses cause severe, systemic disease with high mortality in chickens, turkeys, and other gallinaceous birds.	**Generally:** Effective disease surveillance and early reporting of outbreaks Enhance Bio-security at poultry farms Avoidance of contact between poultry and wild birds Border animal movement controls **In the affected outbreak area:** Stamping-out of infected and at risk poultry in the infected area Disposal of carcasses and of their products in a bio-secure manner Quarantine (prohibition to move any animal, animal product, material or equipment) Restriction and control of movements of persons and vehicles Cleaning and disinfection buildings, equipment/materials and premises Allow at least 21 days before restocking (sanitary void) Epidemiological investigation **Around the affected outbreak area:** Stamping out of all poultry (within an area of 3 or 5 km radius), and/or, Vaccination Control of movements of poultry , poultry products and limit the movements of person **In the remaining part of the territory:** Prohibit poultry markets and other gatherings of birds Strengthen the surveillance of poultry farms Strengthen bio-security in poultry farms Strengthen movements controls inside the country and at the borders	Outbreaks have occurred in the following countries: **Sub- Saharan Africa (AFR):** Burkina Faso, Cote D'Ivoire, Niger, Nigeria, South Africa, Sudan, Zimbabwe Middle East and North Africa (MNA): Egypt, Iran, Iraq, Israel **Eastern Europe and Central Asia (ECA):** Albania, Bosnia and Herzegovina, Bulgaria, Czech Republic, Georgia, Hungary, Romania, Serbia and Montenegro, Turkey, Ukraine, United Kingdom **Europe:** Austria, Denmark, Germany, Greece, Italy, Spain, Sweden **South Asia (SAS):** Afghanistan, India **East Asia and Pacific (EAP):** Cambodia, Hong Kong (P.R. China) Indonesia, Japan, Korea (Rep. of), Myanmar, Thailand, Viet Nam
Foot and mouth disease (FMD)	Bovidae, swine, sheep, goats, buffalo, and all wild ruminants and suidae. Camelidae	In a susceptible population, morbidity approaches 100%. The disease is rarely fatal except in young animals.	**Generally:** • Effective surveillance and early reporting of outbreaks • Border animal movement controls • Quarantine measures	Outbreaks have occurred in the following countries: **Sub- Saharan Africa (AFR):** Benin, Botswana, Burkina, Cameroon, Congo

Disease	Host	Virulence	Prevention and Control	Occurrence of the disease in World (from 01/01/05 to 10/02/07)
	have low susceptibility.		**In the affected area:** • Four strategies are recognised by the OIE in a programme to eradicate FMD infection following an outbreak: 1. slaughter of all clinically affected and in-contact susceptible animals; 2. slaughter of all clinically affected and in-contact susceptible animals and vaccination of at-risk animals, with subsequent slaughter of vaccinated animals; 3. slaughter of all clinically affected and in-contact susceptible animals and vaccination of at-risk animals, without subsequent slaughter of vaccinated animals; 4. vaccination used without slaughter of affected animals or subsequent slaughter of vaccinated animals. • Destruction of cadavers, litter, and susceptible animal products in the infected area • Disinfection of premises and all infected material • Restriction and control of movement of susceptible animals • Zoning • Epidemiological investigation • Efficient surveillance • Quarantine measures	(Dem. Rep. of the), Cote D'Ivoire, Eritrea, Ethiopia, Faso, Ghana, Guinea, Kenya, Malawi, Mali, Niger, South Africa, Sudan, Tanzania, Togo, Zimbabwe **Middle East and North Africa (MNA):** Israel, Jordan, Saudi Arabia Eastern Europe and Central Asia (ECA): Turkey **Europe:** South Asia (SAS): Afghanistan, Bhutan, Sri Lanka, Nepal **East Asia and Pacific (EAP):** China (People's Rep. of), Myanmar, Thailand, Viet Nam **Latin America and Caribbean (LAC):** Brazil, Ecuador, Bolivia
Swine vesicular disease	Pigs Humans: laboratory personnel may seroconvert.	Morbidity rate in herds may be low but high in groups of pigs (in pens). No mortality	• No treatment • No vaccination • Control of movement of pigs and vehicles used for transporting pigs • Prohibition of feeding with ship or aircraft garbage • Thorough cooking of garbage • Strict quarantine • Elimination of infected and contact pigs • Thorough disinfection of premises, transport vehicles, and equipment	The disease has been recorded in Hong Kong, Japan and several European countries in the past. During 2005 the disease was clinically demonstrated in Italy

Disease	Host	Virulence	Prevention and Control	Occurrence of the disease in World (from 01/01/05 to 10/02/07)
Vesicular stomatitis	Human (minor zoonosis). Domestic hosts: equidae, bovidae, suidae. Wild hosts: white-tailed deer and numerous species of small mammals in the tropics.	Morbidity rate variable, up to 90% in a herd. Low mortality rate	• No treatment • No vaccine • Restriction and control of animal movement from the affected premises • Disinfection of trucks and fomites • Surveillance	The disease is limited to the Americas.
Peste de petits Ruminants	Goats and sheep Cattle and pigs develop inapparent infections.	Morbidity (90%) and mortality (50-80%) rates are higher in young animals than in adults.	• No specific treatment • Movement control and quarantine • Rinderpest vaccine is commonly used. Recently, a homologous PPR vaccine has been developed • Slaughter of infected animals • Destruction of carcasses • Disinfection	PPR occurs in Africa, the Arabian Peninsula, the Middle East and Turkey
Contagious Bovine Pleuropneu monia (CBPP)	Cattle, zebu and buffalo. Wild bovids and camels are resistant.	Mortality rates can reach 50% in early stages. During an outbreak only 33% of animals present symptoms (hyperacute or acute forms), 46% are infected but have no symptoms (sub-clinical forms) and 21% seem to be resistant.	• No efficient treatment **In disease-free areas**: • Quarantine, • Surveillance (blood testing) • Slaughtering of all animals of the herd in which positive animals have been found • Control of cattle movements **In infected areas:** • Vaccination	CBPP is widespread in Africa. The disease was suspected (not confirmed) in 2005 in Mongolia
Lumpy skin disease	Cattle Oryx, giraffe and impala are susceptible to experimental infection. LSD virus replies in	Morbidity rate 5-85% Mortality rate very variable (usually low).	• No specific treatment • Vaccination **Free countries**: • Survey of importation of livestock, carcases, hides, skins and semen **Infected countries:** • Quarantine to avoid introduction of infected animals in to	The disease is present in Africa and reoccurs in Israel. It has also been recorded in Vietnam

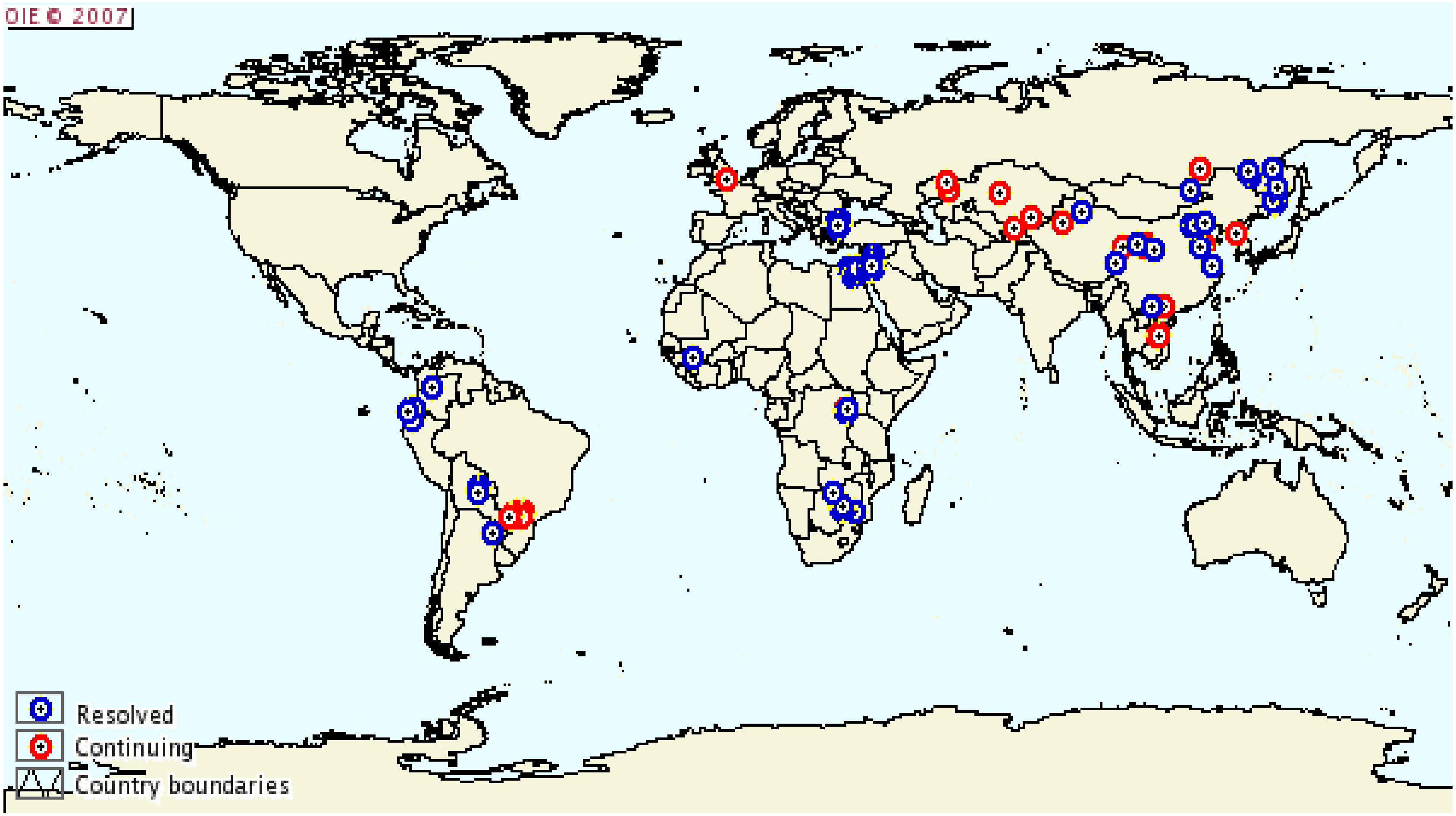
Disease	Host	Virulence	Prevention and Control	Occurrence of the disease in World (from 01/01/05 to 10/02/07)
	Sheep and goats after inoculation		safe herds • In case of outbreaks, isolation and prohibition of animal movements • Slaughtering of all sick and infected animals • Destruction of carcasses • Disinfection of premises and implements • Vector control in premises and on animals • Vaccination	
Rift Valley Fever	Cattle, sheep, goats, dromedaries, several rodents wild ruminants, humans, African monkeys and domestic carnivores	High mortality rate in young animals High abortion rate in ruminants	• No specific treatment • Hygiene and vector control • Vaccination	RVF is present and recurrent in African countries
Bluetongue	Sheep Cattle, goats, dromedaries, wild ruminants: generally inapparent infection	Mortality rate normally low in sheep but up to 10% in some epizooties (OIE)	• No efficient treatment **Disease free areas:** • Quarantine • Serological survey • Vector control **Infected areas:** • Vector control • Prophylactic vaccination	During 2006 the disease has occurred in North Africa, Europe and Middle East (Israel). It has also been reported in Saudi Arabia, Latin America and Caribbean
Sheep and goat pox	Sheep and goat	Morbidity rate: endemic areas 70-90%. mortality rate: Endemic areas 5-10%, although can approach 100% in imported animals.	• No treatment • Vaccination for prevention and control • Quarantine of infected herds and sick animals for at least 45 days after recovery • Slaughtering of infected herd • Proper disposal of cadavers and products • Disinfection • Quarantine before introduction into herds • Animal and vehicle movement controls within infected areas	Sheep pox and goat pox are present in Africa, in the Middle East and Asia. During January 2007 it was also reported in Greece and Mongolia
African horse sickness	Usual hosts: horses, mules, donkeys, zebra. Occasional hosts: elephants, onager,	Mortality rate in horses is 70-95%, in mules it is around 50%, and in donkeys it is around 10%.	• No efficient treatment • Slaughtering of affected horses and destruction of cadavers • Vector control (insecticides, repellents, screens) • Vaccination of non-infected horses with polyvalent	It is endemic in Africa

Disease	Host	Virulence	Prevention and Control	Occurrence of the disease in World (from 01/01/05 to 10/02/07)
	camels, and dogs (after eating infected blood or horsemeat).		vaccine. After virus identification, animals that received polyvalent vaccine should be revaccinated with the homologous vaccine	
African swine fever	All breeds and types of domestic pigs and European wild boars.	Mortality rates vary from 0 to 100%, depending on the virulence of the virus with which pigs are infected.	• No treatment • No vaccine **In free country:** • Careful import policy for animals and animal products • Proper disposal of waste food from aircraft or ships coming from infected countries • Efficient sterilisation of garbage **In outbreaks** • Rapid slaughtering of all pigs and proper disposal of cadavers and litter is essential • Thorough cleaning and disinfection • Designation of infected zone, with control of pig movements • Detailed epidemiological investigation, with tracing of possible sources (up-stream) and possible spread (down-stream) of infection • Surveillance of infected zone, and surrounding area **Infected countries** • Avoid contact between pigs and soft tick vectors (Africa)	It is endemic in many African countries and in Italy is restricted to Sardinia.
Classical swine fever	Pigs and wild boars	Virulence varies from severe, with high mortality, to mild or even subclinical. Fatal to young, cronich for adults.	• No treatment • Strict import policy for live pigs, and fresh and cured pig meat • Quarantine of pigs before admission into herd • Efficient sterilisation (or prohibition) of waste food fed to pigs • Serological surveillance targeted to breeding sows and boars • Prophylactic vaccination where classical swine fever is enzootic **Response to outbreaks** • slaughter of all pigs on affected premises • Proper disposal of carcases	CFS occurs in Latin and Central America, in parts of Europe, Asia and Africa (Madagascar)

Disease	Host	Virulence	Prevention and Control	Occurrence of the disease in World (from 01/01/05 to 10/02/07)
			• Disinfection • Designation of infected zone, with control of pig movements • Detailed epidemiological investigation • Surveillance of infected zone, and surrounding area	
Newcastle Disease	Birds, both domestic and wild A carrier state may exist in some wild birds.	The mortality and morbidity rates vary among species, and with the strain of virus.	• No treatment • Vaccination for permanent immunity • Avoidance of contact with birds of unknown health status • One age group per farm ('all in-all out') breeding is recommended • Strict isolation of outbreaks • Destruction of all infected and exposed birds • Proper disposal of carcasses • Disinfection • 21 days before restocking • Control of human traffic	Newcastle Disease have been reported in Asia, Africa (most sub- Saharan), Middle East and Europe

Annex 2: Occurrence of HPAI/H5N1 and FMD: current status worldwide

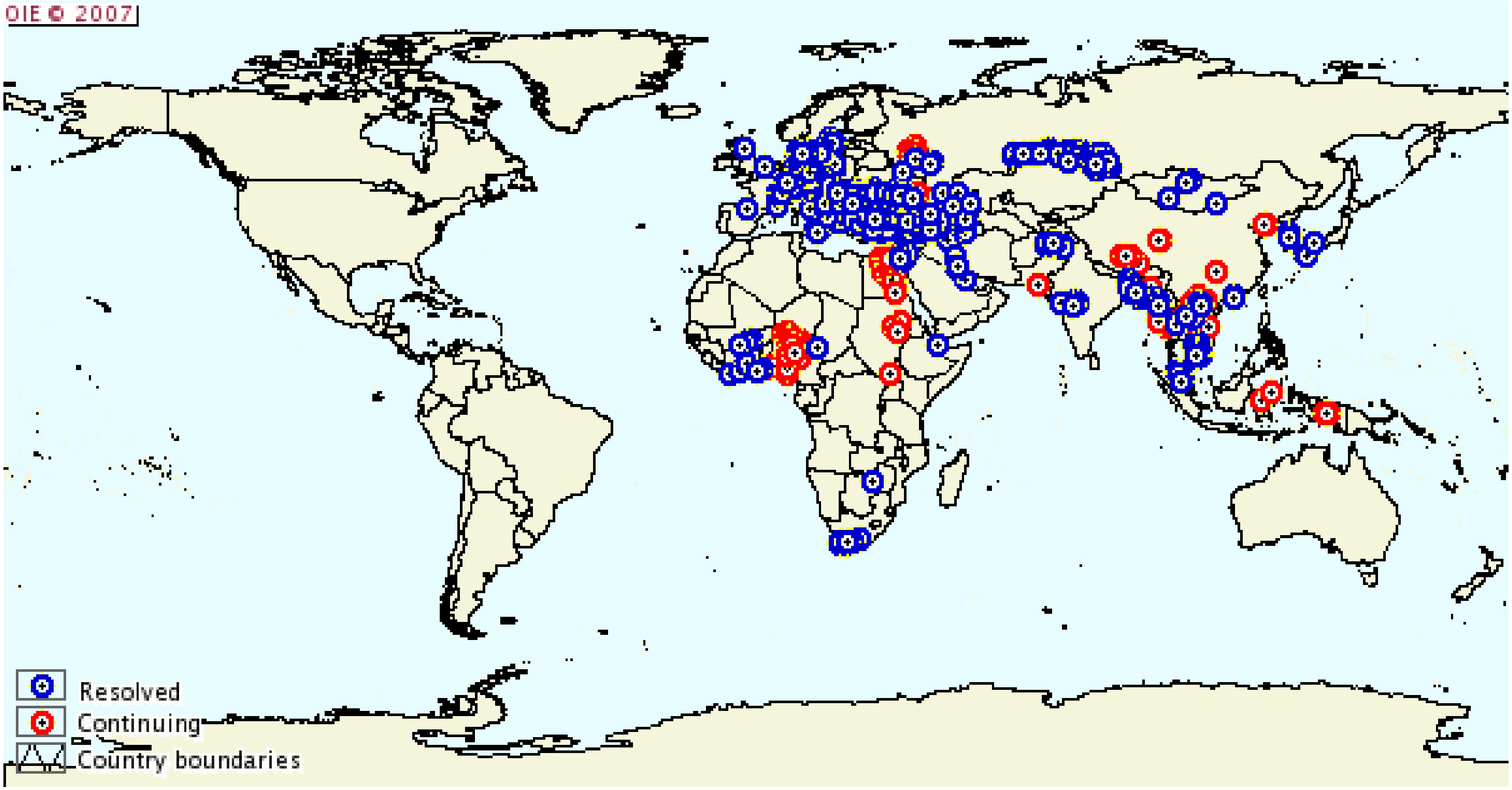
FMD outbreaks



Note: covers period 1 Jan 2006 to end of August 2007. (Reports received in paper form in early 2006, before the launching of WAHID, are being processed in the new World Animal Health Database and may not be shown).

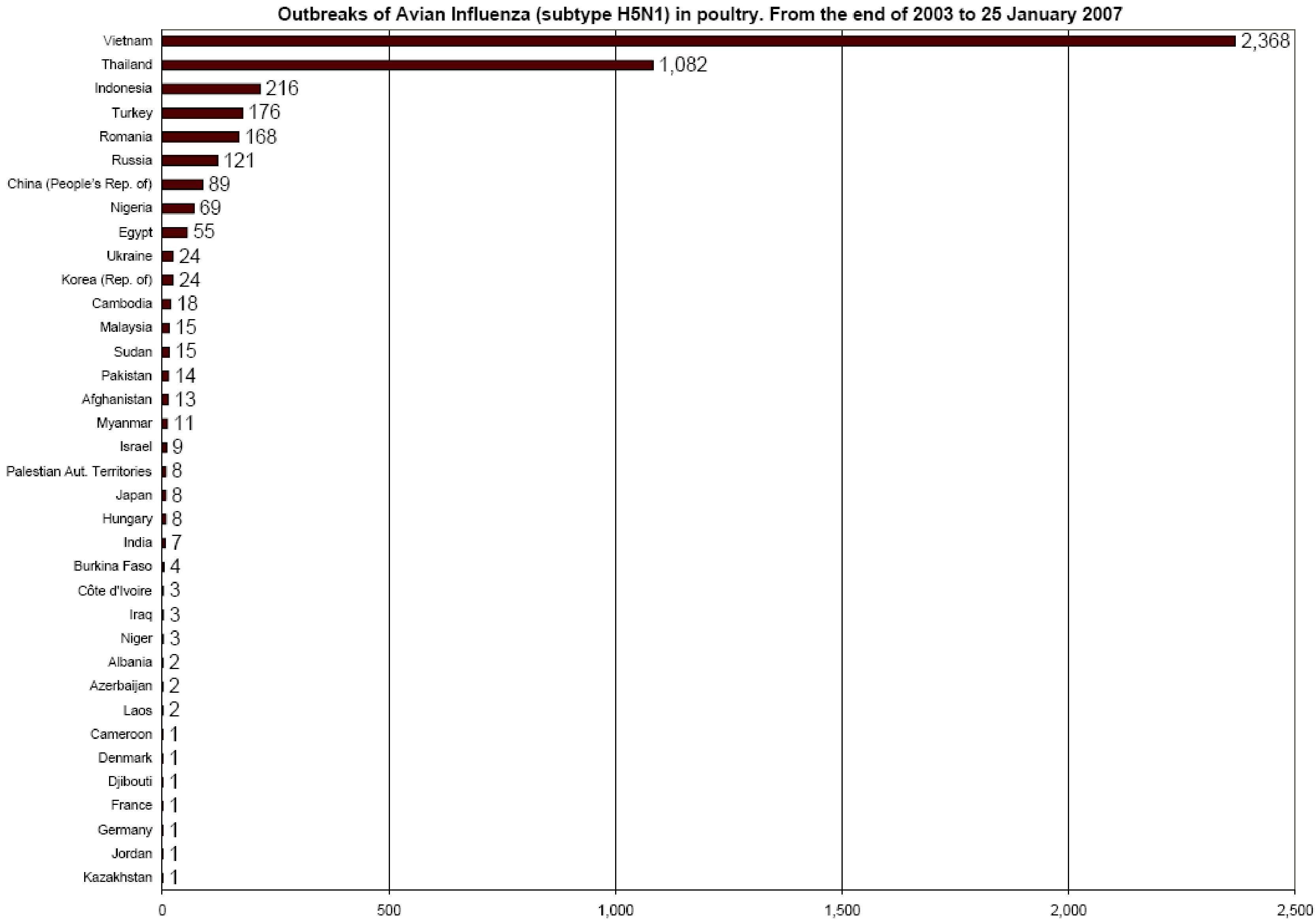
Source: OIE, World Animal Health Information Database (WAHID)

HPAI outbreaks



Note: covers period 1 Jan 2006 to end of August 2007. (Reports received in paper form in early 2006, before the launching of WAHID, are being processed in the new World Animal Health Database and may not be shown).

Source: OIE, World Animal Health Information Database (WAHID)


Outbreaks of Avian Influenza (subtype H5N1) in poultry. From the end of 2003 to 25 January 2007
Vietnam 2,368
Thailand 1,082
Indonesia 216
Turkey 176
Romania 168
Russia 121
China (People's Rep. of) 89
Nigeria 69
Egypt 55
Ukraine 24
Korea (Rep. of) 24
Cambodia 18
Malaysia 15
Sudan 15
Pakistan 14
Afghanistan 13
Myanmar 11
Israel 9
Palestian Aut. Territories 8
Japan 8
Hungary 8
India 7
Burkina Faso 4
Côte d'Ivoire 3
Iraq 3
Niger 3
Albania 2
Azerbaijan 2
Laos 2
Cameroon 1
Denmark 1
Djibouti 1
France 1
Germany 1
Jordan 1
Kazakhstan 1
0
500
1,000
1,500
2,000
2,500

Annex 3: OIE country analysis

	OIE member	Region	Income group	World Bank Income Group	Poverty (HDI index)	Trade interest (livestock sector)	Trade interest (poultry sector)	Agriculture income (as % of GDP)	Total LSU per Capita (All Livestock)	LSUs per capita for Poultry
1	Afghanistan	CIS	bottom low	Low income				0.0%	0.20	0.002
2	Albania	rest of Europe	middle	Lower middle income	..	Importer	Importer	24.6%	0.14	0.010
3	Algeria	North Africa	middle	Lower middle income	21.5	Importer	Importer	8.7%	0.15	0.027
4	Angola	sub-sah Africa; SADC	bottom low	Lower middle income	40.9			5.9%	0.21	0.003
5	**Argentina**	**South America; Latin America**	**high**	Upper middle income	**4.3**	Exporter	"Imp/Exp"	10.5%	1.03	0.017
6	Armenia	CIS	low	Lower middle income	..	Importer	Importer	22.6%	0.01	0.011
7	Azerbaijan	CIS	low	Lower middle income	..	Importer	Importer	12.1%	0.01	0.015
8	Bahrain	Middle East	upper high	High income: nonOECD	..	Importer	Importer	0.5%	0.03	0.005
9	Bangladesh	SE Asia	bottom low	Low income	44.2	Importer	Importer	21.9%	0.18	0.007
10	Barbados	Latin America	upper high	Upper middle income	4.5	Importer	Importer	6.0%	0.15	0.088
11	Belarus	CIS	middle	Lower middle income	..	"Imp/Exp"	"Imp/Exp"	9.0%	0.02	0.018
12	Belize	Latin America	middle	Upper middle income	..	Importer	Importer	18.4%	0.23	0.041
13	Benin	sub-sah Africa	bottom low	Low income	47.8	Importer	Importer	34.1%	0.22	0.011
14	Bhutan	SE Asia	low	Low income	39				0.19	0.001
15	Bolivia	South America; Latin America	bottom low	Lower middle income	13.9	"Imp/Exp"	Importer	13.5%	0.78	0.057
16	Bosnia-Herz	rest of Europe	middle	Lower middle income	..	Importer	Importer	13.5%	0.02	0.016
17	Botswana	sub-sah Africa; SADC	high	Upper middle income	48.3	Exporter	Importer	2.3%	1.52	0.016
18	Brazil	South America; Latin America	middle	Lower middle income	10.1	Exporter	Exporter	7.6%	0.98	0.041
19	Brunei	SE Asia	upper high	High income: nonOECD	..	Importer	Importer	0.0%	0.25	0.243
20	Bulgaria	rest of Europe	middle	Lower middle income	..	"Imp/Exp"	"Imp/Exp"	9.9%	0.02	0.016
21	Burkina Faso	sub-sah Africa	bottom low	Low income	58.3	Exporter	Importer	38.9%	0.72	0.014
22	Burundi	sub-sah Africa	bottom low	Low income	40.7	Importer	Importer	42.2%	0.06	0.004
23	Cambodia	SE Asia	bottom low	Low income	39.3	Importer	Importer	26.0%	0.21	0.007
24	Cameroon	sub-sah Africa	bottom low	Lower middle income	35.6			41.9%	0.36	0.013
25	Central Afr. Rep.	sub-sah Africa	bottom low	Low income	47.8	Importer	Importer	58.5%	0.79	0.008
26	Chad	sub-sah Africa	bottom low	Low income	57.9			20.0%	0.62	0.004
27	Chile	South America; Latin America	high	Upper middle income	3.7	"Imp/Exp"	Exporter	5.2%	0.40	0.041
28	China	SE Asia	low	Lower middle income	11.7	"Imp/Exp"	"Imp/Exp"	11.8%	0.02	0.023
29	Colombia	South America; Latin America	middle	Lower middle income	7.6	"Imp/Exp"	Importer	10.3%	0.55	0.023
30	Comoros	sub-sah Africa	bottom low	Low income	31.6			43.4%	0.07	0.004
31	Congo	sub-sah Africa; SADC	bottom low	Lower middle income	27.9			5.4%	0.04	0.004
32	Congo Dem. Rep	sub-sah Africa	bottom low	Low income	40.9			58.5%	0.02	0.002
33	Costa Rica	Latin America	high	Upper middle income	4.4	Exporter	"Imp/Exp"	8.5%	0.34	0.032
34	Cote d'Ivoire	sub-sah Africa	bottom low	Low income	41.5			27.4%	0.10	0.013
35	Croatia	rest of Europe	high	Upper middle income	..	Importer	"Imp/Exp"	7.5%	0.02	0.016
36	Cuba	Latin America	bottom low	Lower middle income	4.7	Importer	Importer		0.32	0.017
37	Djibouti	sub-sah Africa	bottom low	Lower middle income	30					
38	Dominican Rep	Latin America	middle	Lower middle income	11.9	Importer	Importer	6.5%	0.28	0.037
39	Ecuador	South America; Latin America	low	Lower middle income	8.9	"Imp/Exp"	"Imp/Exp"	6.4%	0.46	0.055
40	Egypt	North Africa	low	Lower middle income	20			13.7%	0.08	0.009
41	El Salvador	Latin America	low	Lower middle income	15.7	Importer	"Imp/Exp"	9.5%	0.18	0.014
42	Eq. Guinea	sub-sah Africa	high	Upper middle income	38.1			2.6%	0.02	0.004
43	Eritrea	sub-sah Africa	bottom low	Low income	38.1	Importer	Importer	11.1%	0.44	0.002
44	Ethiopia	sub-sah Africa	bottom low	Low income	55.3	Exporter	"Imp/Exp"	32.4%	0.47	0.004

45	FYR Macedonia	rest of Europe	*middle*	Lower middle income	*..*			*11.0%*	*0.01*	*0.009*
46	Gabon	sub-sah Africa	*middle*	Upper middle income	*27.3*	*Importer*	*Importer*	*5.0%*	*0.10*	*0.016*
47	Gambia	sub-sah Africa	*bottom low*	Low income	*44.7*	*Importer*	*Importer*	*34.1%*	*0.21*	*0.003*
48	Georgia	CIS	*low*	Lower middle income	*..*	*Importer*	*Importer*	*12.8%*	*0.01*	*0.014*
49	Ghana	sub-sah Africa	*bottom low*	Low income	*33.1*	*Importer*	*Importer*	*31.4%*	*0.10*	*0.009*
50	Guatemala	Latin America	*low*	Lower middle income	*22.9*	*Importer*	*Importer*	*23.6%*	*0.19*	*0.015*
51	Guinea	sub-sah Africa	*low*	Low income	*52*	*Importer*	*Importer*	*27.2%*	*0.34*	*0.012*
52	Guinea Bissau	sub-sah Africa	*bottom low*	Low income	*48.2*			*58.9%*	*0.39*	*0.007*
53	Guyana	South America	*low*	Lower middle income	*..*	*Importer*	*Importer*	*38.4%*	*0.36*	*0.186*
54	Haiti	Latin America	*bottom low*	Low income	*39.4*			*39.0%*	*0.20*	*0.005*
55	Honduras	Latin America	*low*	Lower middle income	*17.2*	*Importer*	*Importer*	*12.3%*	*0.34*	*0.018*
56	India	SE Asia	*bottom low*	Low income	*31.3*	*Exporter*	*Exporter*	*19.6%*	*0.17*	*0.003*
57	Indonesia	SE Asia	*low*	Lower middle income	*18.5*	*Importer*	*"Imp/Exp"*	*13.2%*	*0.09*	*0.039*
58	Iran	Middle East	*middle*	Lower middle income	*16.4*	*Importer*	*"Imp/Exp"*	*11.2%*		
59	Iraq	Middle East	*bottom low*	Lower middle income					*0.09*	*0.008*
60	Jamaica	Latin America	*middle*	Lower middle income	*14.8*	*Importer*	*Importer*	*4.4%*	*0.18*	*0.033*
61	Jordan	Middle East	*middle*	Lower middle income	*7.6*	*Importer*	*Importer*	*3.3%*	*0.08*	*0.031*
62	Kazakhstan	CIS	*middle*	Lower middle income	*..*	*Importer*	*Importer*	*6.1%*	*0.01*	*0.012*
63	Kenya	sub-sah Africa	*bottom low*	Low income	*35.5*	*Exporter*	*Exporter*	*14.5%*	*0.46*	*0.006*
64	Korea North	other Asia	*bottom low*	Low income					*0.07*	*0.007*
65	Korea South	other Asia	*upper high*	High income: OECD	*..*	*Importer*	*Importer*	*0.0%*	*0.02*	*0.016*
66	Kuwait	Middle East	*upper high*	High income: nonOECD	*..*	*Importer*	*Importer*	*0.4%*	*0.13*	*0.085*
67	Kyrgyzstan	CIS	*low*	Low income	*..*	*Importer*	*Importer*	*32.9%*	*0.01*	*0.005*
68	Laos	SE Asia	*bottom low*	Low income	*36*			*43.9%*	*0.26*	*0.023*
69	Lebanon	Middle East	*middle*	Upper middle income	*9.6*	*Importer*	*"Imp/Exp"*	*11.3%*	*0.12*	*0.068*
70	Lesotho	sub-sah Africa; SADC	*bottom low*	Lower middle income	*47.5*			*14.7%*	*0.36*	*0.007*
71	Libya	North Africa	*high*	Upper middle income	*..*			*6.7%*	*0.15*	*0.030*
72	Madagascar	sub-sah Africa; SADC	*bottom low*	Low income	*36.3*	*Importer*	*Exporter*	*26.8%*	*0.53*	*0.009*
73	Malawi	sub-sah Africa; SADC	*bottom low*	Low income	*43*	*Importer*	*Importer*	*33.8%*	*0.08*	*0.008*
74	Malaysia	SE Asia	*high*	Upper middle income	*8.3*	*Importer*	*Importer*	*6.8%*	*0.10*	*0.051*
75	Mali	sub-sah Africa	*bottom low*	Low income	*60.2*	*Importer*	*Importer*	*46.0%*	*0.62*	*0.016*
76	Mauritania	sub-sah Africa	*bottom low*	Low income	*41*			*18.5%*	*0.95*	*0.010*
77	Mauritius	sub-sah Africa; SADC	*high*	Upper middle income	*11.3*	*Importer*	*Importer*	*6.3%*	*0.08*	*0.055*
78	Mexico	Latin America	*high*	Upper middle income	*7.2*	*Importer*	*Importer*	*3.7%*	*0.34*	*0.028*
79	Moldova	CIS	*low*	Lower middle income	*..*		*Importer*	*17.9%*	*0.13*	*0.029*
80	Mongolia	other Asia	*bottom low*	Low income	*18.5*	*Exporter*	*Importer*	*15.6%*	*1.69*	*0.000*
81	Morocco	North Africa	*low*	Lower middle income	*33.4*	*Importer*	*Importer*	*22.2%*	*0.20*	*0.030*
82	Mozambique	sub-sah Africa; SADC	*bottom low*	Low income	*48.9*	*Importer*	*Importer*	*22.1%*	*0.08*	*0.010*
83	Myanmar	SE Asia	*bottom low*	Low income	*21.6*	*Importer*	*Importer*		*0.23*	*0.011*
84	Namibia	sub-sah Africa; SADC	*middle*	Lower middle income	*32.5*	*"Imp/Exp"*	*Importer*	*7.7%*	*1.44*	*0.012*
85	Nepal	SE Asia	*bottom low*	Low income	*38.1*	*Importer*	*Importer*	*36.1%*	*0.25*	*0.006*
86	New Caledonia	SE Asia	*high*	High income: nonOECD		*Importer*	*Importer*		*0.40*	*0.018*
87	Nicaragua	Latin America	*low*	Lower middle income	*18*	*Exporter*	*"Imp/Exp"*	*17.2%*	*0.62*	*0.023*
88	Niger	sub-sah Africa	*bottom low*	Low income	*56.4*	*Importer*	*Importer*	*39.8%*	*0.24*	*0.013*
89	**Nigeria**	**sub-sah Africa**	***bottom low***	Low income	***40.6***	*Importer*	*Importer*	*21.1%*	*0.15*	*0.008*
90	Oman	Middle East	*upper high*	Upper middle income	*..*	*Importer*	*Importer*	*2.4%*	*0.17*	*0.011*
91	Pakistan	SE Asia	*bottom low*	Low income	*36.3*	*Exporter*	*Importer*	*17.9%*	*0.21*	*0.007*

92	Panama	South America; Latin America	middle	Upper middle income	7.9	"Imp/Exp"	Importer	7.6%	0.44	0.030
93	Paraguay	South America; Latin America	low	Lower middle income	8.3	Exporter	"Imp/Exp"	27.9%	1.21	0.019
94	Peru	South America; Latin America	middle	Lower middle income	11.6	Importer	Importer	7.4%	0.26	0.025
95	Philippines	SE Asia	low	Lower middle income	15.3	Importer	Importer	13.6%	0.08	0.011
96	Qatar	Middle East	upper high	High income: nonOECD	7.9	Importer	Importer	0.2%	0.05	0.039
97	**Romania**	**rest of Europe**	**middle**	Upper middle income	**..**	Importer	Importer	9.8%	0.03	0.028
98	Russia	CIS	high	Upper middle income	..	Importer	Importer	4.9%	0.02	0.016
99	Rwanda	sub-sah Africa	bottom low	Low income	37.3	Importer	Importer	33.3%	0.13	0.002
100	Sao Tome	sub-sah Africa	bottom low	Low income	..				0.02	0.016
101	Saudi Arabia	Middle East	upper high	High income: nonOECD	..	Importer	Importer	3.0%	0.04	0.040
102	Senegal	sub-sah Africa	bottom low	Low income	44	Importer	Importer	15.5%	0.30	0.016
103	Serbia-Mont	rest of Europe	middle	Lower middle income		Importer	Importer	18.0%	0.01	0.011
104	Sierra Leone	sub-sah Africa	bottom low	Low income	51.9			45.8%	0.08	0.010
105	Singapore	SE Asia	upper high	High income: nonOECD	6.3	Importer	Importer	0.0%	0.00	0.003
106	Somalia	sub-sah Africa	bottom low	Low income					0.90	0.003
107	South Africa	sub-sah Africa; SADC	high	Upper middle income	30.9	Importer	Importer	2.7%	0.31	0.018
108	Sri Lanka	SE Asia	low	Lower middle income	17.7	Importer	Importer	16.5%	0.06	0.004
109	Sudan	sub-sah Africa	bottom low	Low income	31.3	Exporter	Importer	32.3%	1.16	0.007
110	Suriname	South America	middle	Lower middle income	10.3	Importer	Importer	13.4%	0.30	0.059
111	Swaziland	sub-sah Africa; SADC	middle	Lower middle income	52.5	"Imp/Exp"	Importer	12.4%	0.56	0.022
112	Syria	Middle East	middle	Lower middle income	14.4	Exporter	Exporter	23.5%	0.15	0.009
113	Taipei China (Taiwan)	SE Asia	upper high					2.0%		
114	Tajikistan	CIS	bottom low	Low income	..	Importer	Importer	20.6%	0.00	0.002
115	Tanzania	sub-sah Africa; SADC	bottom low	Low income	36.3			40.5%	0.49	0.005
116	Thailand	SE Asia	middle	Lower middle income	9.3	Exporter	Exporter	9.7%	0.12	0.028
117	Togo	sub-sah Africa	bottom low	Low income	39.2	Importer	Importer	38.9%	0.12	0.010
118	Trinidad-Tobago	Latin America	upper high	Upper middle income	8.8	Importer	Importer	0.6%	0.19	0.151
119	Tunisia	North Africa	middle	Lower middle income	17.9	Importer	"Imp/Exp"	15.3%	0.23	0.044
120	Turkey	rest of Europe	middle	Upper middle income	9.8	Exporter	Exporter	11.1%	0.23	0.028
121	Turkmenistan	CIS	middle	Lower middle income	..	Importer	Importer	22.0%	0.62	0.010
122	Uganda	sub-sah Africa	bottom low	Low income	36	"Imp/Exp"	Importer	30.2%	0.26	0.008
123	Ukraine	CIS	low	Lower middle income	..	"Imp/Exp"	Importer	15.1%	0.02	0.020
124	UAE	Middle East	upper high	High income: nonOECD	15.9	Importer	Importer	3.2%	0.05	0.023
125	Uruguay	South America; Latin America	high	Upper middle income	3.3	Exporter	Exporter	7.2%	2.98	0.028
126	Uzbekistan	CIS	bottom low	Low income	..			33.4%	0.01	0.005
127	Vanuatu	SE Asia	low	Lower middle income	24.7				0.66	0.011
128	Venezuela	South America; Latin America	middle	Upper middle income	8.8	Importer	Importer	4.1%	0.53	0.029
129	**Vietnam**	**SE Asia**	**bottom low**	Low income	**15.7**			18.6%	0.14	0.013
130	Yemen	Middle East	bottom low	Low income	40.6	Importer	Importer	12.3%	0.14	0.012
131	Zambia	sub-sah Africa; SADC	bottom low	Low income	45.6	Exporter	Exporter	17.0%	0.21	0.018
132	Zimbabwe	sub-sah Africa; SADC	bottom low	Low income	46	Exporter	Exporter	23.2%	0.40	0.012

Notes
***Region**: some countries have been assumed to belong to a certain grouping to facilitate aggregation (e.g. Vanuatu and New Caledonia to SE Asia*
***Income group**: defined on basis of per capita income, as follows:*
upper high: >10000 US$ both in nominal and in relative (ppp) terms
high: 8-10000 US$ in nominal or 4.5-10000 US$ in nominal and >10000 US$ in relative (ppp) terms
middle: 3-8000 US$ nominal or 2-4500 US$ nominal and 5-10000 US$ in relative (ppp) terms
low: 1-3000 US$ in nominal and 3-5000 US$ in relative (ppp) terms
bottom low: <1000 US$ in nominal and <3000 US$ in relative (ppp) terms
***Trade interest**: defined on the basis of a livestock trade specialisation index (methodology described in A129)*

Annex 4: Prevention and response to AI: national emergency plans and WB-GPAI/APL projects

<u>Note:</u> This list contains only the WB-GPAI/APL projects that had been approved at the time of this analysis, i.e. by end of March 2007.

	Country	Title	Date	Programme duration	Plan/Project	Budget info	Total budget	Size of poultry sector (2005)
	Sub-Saharan Africa							
2	***Benin***	PLAN D'INTERVENTION D'URGENCE CONTRE LA GRIPPE AVIAIRE (A 297)	Feb-06	6 months	National Contingency Plan for Avian Influenza	**Emergency plan** **Intervention in Animal Health:** FCFA 2,658 million (US$ 5.33 million) • Preparation: FCFA 587.6 million (US$ 1.178 million) • Investigation: FCFA 0.790 million (US$ 0.002 million) • Alert: FCFA 4 million (US$ 0.008 million) • Operations: FCFA 2,059.345 million (US$ 4.128 million) • End of restriction: FCFA 6 million (US$ 0.012 million) **Intervention in Human Health:** FCFA 468 million (US$ 0.938 million)	**FCFA 3,126 million (US$6.226 million) without contingency**	**Poultry population: 13 million**
3	***Burkina Faso***	PLAN STRATÉGIQUE POUR LA PRÉPARATION ET LA RIPOSTE À D'ÉVENTUELS CAS DE GRIPPE AVIAIRE AU BURKINA FASO EN 2005-2006 (draft) (A298)	Oct-05	2005-2006	National Contingency Plan for Human Pandemic Inluenza (DRAFT)	**Epidemiological surveillance :** FCFA 52.5 million (US$ 0.097 million) **Laboratory:** FCFA 38.5 million (US$ 0.071 million) **Early and adeguate case treatment:** FCFA 76 million (US$ 0.140 million) **Social Mobilization:** FCFA 33.5 million (US$ 0.062 million) **Disinfection and biosecurity:** FCFA 45 million (US$ 0.083 million) **Research:** FCFA 37 million (US$ 0.068 million) **Epidemic management:** FCFA 34 (US$ 0.063 million)	**FCFA 316.5 million (US$ 0.584 million)**	**Poultry population: 25.7 million**
4	***Cameroon***	PLAN STRATEGIQUE DE LUTTE CONTRE L'EPIDEMIE DE GRIPPE HUMAINE DE SOUCHE AVIAIRE AU CAMEROUN (A299)	Jan-06	2006	National Contingency Plan for Human Pandemic Inluenza	**• Strengthening of surveillance systems in Human and Animal sector:** FCFA 190 million (0. 349 million US$) **• Prevention of Human infection:** FCFA 1,720 million (3.162 million US$) **• Information, Education and Communication:** FCFA 250 million (0.460 million US$) **• AI Human cases management:** FCFA 2,720 million (5 million US$) **• Epidemiological and Therapeutical Research:** FCFA 150 million (0.276 million US$)	**FCFA 5,030 million (9.247 million US$)**	**Poultry populationt: 31 million**
5	***Cap Vert***	PLAN NATIONAL DE LUTTE CONTRE LA GRIPPE AVIAIRE H5N1(A300)	Feb-06	2006-2008	National Contingency Plan for Avian Influenza	**Budget details not available**	**Escudos Capverdien 9,039,137 (US$1.067million)**	**Poultry population: 0.46 million**
6	***Central African Republic***	PLAN DE PREPARATION ET DE RIPOSTE A LA GRIPPE AVIAIRE (A301)	Mar-06	Not specified	National Contingency Plan for Avian Influenza	· **Level 1:** No infection in-country but in the region or in economic partner countrie (including training, surveys, surveillance, communication for Human and Animal sector): FCFA 1,179 million (US$ 2.184 million) · **Level 2:** Avian flu declaration in neighboring countries (including training, import restrictions, border control for Animal sector): FCFA 85.680 million (US$ 0.159 million) · **Level 3:** Avian flu declaration in poultry (including culling, quarantine, vaccination, training for Human and Animal sector): FCFA 515 million (US$ 0.954 million) · **Level 4:** Human case suspicion (medicine stockpiling, human case managment fro Human sector): FCFA 489 million (US$ 0.906 million) · **Level 5:** Flu pandemic, human-human infection(vaccination, case treatment for Human sector): FCFA 2,840 million (US$ 5.259 million) · **Follow up/evaluation:** FCFA 24 million (US$ 0.044 million)	**FCFA 5,133.180 million (US$ 9.506 million)**	**Poultry population: 4.8 million**
7	***Gambia***	EMERGENCY PREPAREDNESS AND RESPONSE PLAN FOR AVIAN INFLUENZA (A303)	Feb-06	Not specified	National Contigency Plan for Avian Influenza	**Strengthening Surveillancein Animal and Human sector:** GDM 41.621 million (US$ 1.497 million) **Prevention and control in Animal and Human sector:** GDM 20.605 million (US$ 0. 723 million) **Communication:** GDM 1.522 million (US$ 0,055 million)	**GDM 63.748 million (US$ 2.275 million)**	**Poultry population: 0.65 million**
8	***Ghana***	PREPAREDNESS AND RESPONSE PLAN FOR AVIAN AND HUMAN PANDEMIC INFLUENZA 2005-2006 (REVISED ON FEBRUARY 2006) (A304)	Feb-06	2006	National Contingency Plan for Avian Influenza	**Planning and Coordination:** US$ 0.293 million **Surveillance, Situation Monitoring and Assessment in Human and Animal sector:** US$ 2.036 million • Surveillance of migratory bird Populations: US$ 234,957 • Surveillance of Domestic animal Populations: US$ 307,100 • Surveillance of Human Populations:US$ 1,949,370 **Prevention and Containment:** US$ 2.822 million • in Domestic Animal Populations: US$ 1,218,878 • in Human Populations: US$ 1,602,708 **Health System Response:** US$ 0.710 million **Communications:** US$ 0.421 million	**US$ 6.281 million**	**Poultry population: 30 million**

9	***Guinea***	PLAN NATIONAL MULTI-SECTORIEL DE PREPARATION ET DE RIPOSTE A LA GRIPPE AVIAIRE (A305)	Feb-06	2006	National Contingency Plan for Avian Influenza	· **Epidemiological surveillance reinforcement in Human and Animal sector :** FG (Francs Guinéens) 677.250 million (US$ 0,152 million) · **Reinforcement of laboratory capacity in Human and Animal sector:** FG 490 million (US$ 0,11 million) · **AI case treatment and management in Human and Animal sector:** FG 1,398.8 million (US$ 0.314 million) · **Management/coordination:** FG 152.750 million (US$ 0.034 million) · **Social mobilization:** FG 64.710 million (US$ 0.014 million) · **Research in Human and Animal sector:** FG 75 million (US$ 0.016 million)	**FG 2,859 million (US$0.766 million)**	**Poultry population: 15.87 million**
10	***Guiné-Bissau***	PLANO ESTRATÉGICO NACIONAL DE PREVENÇÃO E DE LUTA CONTRA A GRIPE DAS AVES (A306)	Mar-06	2006-2007	National Contingency Plan for Avian Influenza	**Surveillance and Epidemiological Surveys in Animal sector:** FCFA 380 million (US$ 0.691 million US$) **Training and communication:** FCFA 36.376 million (US$ 0.066 million US$) **Emergency programme in Human and Animal sector:** FCFA 328.5 million (US$ 0.597 million US$)	**FCFA 744.876.000 (US$ 1.354 million)**	**Poultry population: 1.6 million**
12	***Kenya***	AVIAN INFLUENZA EMERGENCY PREPAREDNESS AND RESPONSE (A264)	Nov-05	Not specified	National Contingency Plan for Avian Influenza	**Epidemiological surveillance in Human and Animal sector:** US$ 3,7 million **Infection Prevention and Contro in Human and Animal sectorl:** US$ 3.5 million **IEC and Social Mobilization in Human and Animal sector:** US$ 1.5 million **Case Managemen in Human and Animal sectort:** US$ 4.6 million **Laboratory and Research in Human and Animal sector:** US$ 1.1 million **Co-ordination and Resource Mobilization in Human and Animal sector:** US$ 2.1 million **Training in Human and Animal sector:** US$ 1.2 million **Additional H.Workers:** US$ 2.3 million	**US$ 20.00 million**	**Poultry population: 28.66 million**
13	***Lesotho***	NATIONAL PREPAREDNESS AND RESPONSE PLAN FOR AVIAN INFLUENZA PANDEMIC (A315)	Nov-05	Not specified	National Contingency Plan for Human Pandemic Inluenza	**Phase 1 Inter-pandemic** (to reduce opportunity for human infection): M 1,860,103 (US$ 0.26 million) **Phase 2 Pandemic alert** (to contain or delay the spread of the disease at the source): M 14,121,254 (US$ 1.974 million) **Phase 3 Pandemic** (to reduce morbidity, mortality and social disruption): M 45,000 (US$ 0.06 million)	**M 17,841,460 (US$2.491 million)**	**Poulry population: 1.8 million**
14	***Malawi***	AVIAN INFLUENZA EMERGENCY PREPAREDNESS PLAN FOR MALAWI (A313)	Dec-05	Dec 2005-Jun 2006	National Contingency Plan for Avian Influenza	National preparedeness and response plan to prevent and control the pandemic influenza. The plan includes the following draft of the budget: • **Animal Helath:** MK 85,364,605 (US$ 682,916.8) • **National Parks and Wild life:** MK 200,104,250 (US$1,330,964) • **Human Health:** MK 12,358,852,391 (US$95,068,095)	**MK 12,644,321,246 (US$ 97.082 million)**	**Poultry population: 15.2 million**
14	***Malawi***	AVIAN INFLUENZA IMPLEMENTATION PLAN FOR 2006 (A314)	2006	2006	Implementation Plan	• **Public Awareness:** MK 18,280,155 (US$ 0. 131 million) • **Strengthening of surveillance:** MK 108,945,925 (US$ 0.781 million) • **Migratory birds movement pattern established and mapped:** MK 8,409,300 MK (US$ 0.06 million) • **Capacity for managing the disease strengthened:** MK 59,721,150 (US$ 0.428 million) • **Monitoring and Evaluation strengthened:** MK 8,407,900 (US$ 0.06 million)	**MK 203,755,430 (US$1.461 million)**	**Poultry population: 15.2 million**
18	***Mauritania***	PLAN STRATEGIQUE NATIONAL DE PREVENTION ET DE LUTTE CONTRE LA GRIPPE AVIAIRE 2006-2007 (A308)	Feb-06	2006-2007	National Contingency Plan for Avian Influenza	**Coordination of intervention:** UM 459.64 million (US$ 1.721 million) **Epidemiological Surveillance:** UM 942.6 million (US$ 3.531 million) **Strengthen of laboratory:** UM 525.4 million (US$ 1.967 million) **Information, Education, Communication, Social mobilisation:** UM 192.3 million (US$ 0.720 million) **Medicament (antiviral):** UM 100 million (US$ 0.374 million) **Equipping of structure of isolation:** UM 100 million (US$ 0.374 million) **Compensation:** UM 120 million (US$ 0.449 million)	**UM 2 439 940 000 (US$9.1 million)**	**Poultry population: 4.2 million**
19	***Namibia***	CONTINGENCY PLAN FOR CONTOL AND ERADICATION OF AVIAN INFLUENZA (A317A)	Not reported	Not specified	National Contingency Plan for Avian Influenza	Guidelines for the prevention, control and eventual eradication of Highly Pathogenic Avian Influenza (HPAI) in case of an outbreak of the disease in Namibia.	**No budget estimation**	**Poultry population: 3.5 million**
19	***Namibia***	CONTINGENCY PLAN FOR AVIAN INFLUENZA TO COMPLIMENT THE CONTINGENCY PLAN OF MINISTRY OF AGRICULTURE, WATER AND FORESTRY (A317)	Not reported	Not specified	National Contingency Plan for Human Pandemic Inluenza	Guidelines for the prevention, control and eventual eradication of Highly Pathogenic Avian Influenza (HPAI) in case of an outbreak in Namibia in Human Beings.	**No budget estimation**	**Poultry population: 3.5 million**

20	***Niger***	PLAN NATIONAL D'URGENCE DE PRÉVENTION ET LUTTE CONTRE LA GRIPPE AVIAIRE (A327)	Apr-06	Feb 2006-Feb 2007	National Contingency Plan for Avian Influenza	· **All-level emergency units:** FCFA 498 409 000 (US$ 0,983 million) · **Restrictions of poultry and wild bird product importation:** FCFA 6 145 000 (US$ 0.012 million) · **Elaboration of a communication plan:** FCFA 218 000 000 (US$ 0.430 million) · **Active surveillance:** FCFA 4 764 064 506 (US$ 9.398 million) · **Trade ban and poultry (+derived product) seizing :** FCFA 5 099 800 000 (US$ 10.058 million) · **Slaughter, incineration of contaminated poultry + birds:** FCFA 36 480 000 (US$ 0.072 million) · **Surveillance of population and animal movements in affected areas:** FCFA 77 000 000 (US$ 0.152 million) · **Total ban on hunting:** FCFA 89 288 700 (US$ 0.176 million) · **Surveillance and intervention staff protection:** FCFA 108 000 000 (US$ 0.213 million) · **Medication, vaccination stock:** FCFA 1 543 750 000 (US$ 3.045 million) · **Quarantine and disinfection of infected bird sites:** FCFA 65 000 000 (US$ 0.128 million) · **Quarantine and disinfection of suspect farms:** FCFA 3 600 000 (US$ 0.007 million) · **Quarantine and care of suspected or confirmed infected humans:** FCFA 190 000 000 (US$ 0.375 million) · **Simulation exercise with all actors:** FCFA 20 000 000 (US$ 0.039 million) · **Research/action:** FCFA 50 000 000 (US$ 0.099 million) · **Follow up/evaluation:** FCFA 50 000 000 (US$ 0.099 million)	**FCFA12,819,537,206 (US$ 25.15 million)**	**Poultry population: 25 million**
21	***Nigeria***	STRATEGIES FOR PREVENTION OF INTRODUCTION, DISEASE SURVEILLANCE NETWORKING AND CONTINGENCY PLAN FOR A DISEASE EMERGENCY (A286)	Dec-05	2006-2007	National Strategies for prevention of Avian Influenza	• **International and regional initiatives, travels and technical exchange programmes**: NN (Nigerian Naira) 10.0 million (US$ 0.078 million) • **Establishment and meetings of inter- ministerial committee and intersectoral linkages**: NN 1.5 million (US$ 0.12 million) • **Establishment and meetings of Livestock sector expert committee on HPAI, and Coordination meetings with stakeholders**: NN 5.0 million (US$ 0.039 million) • **Development of technical guidelines**: NN 7.0 million (US$ 0.055 million) • **Training for AH staff, Poultry farmers and public awareness programmes on HPAI**: NN20.0 million (US$ 0.156 million) • **Targeted disease, virus and sero-surveillance livestock/poultry**: NN 80 million (US$ 0.624 million) • **Strengthening of designated diagnostic laboratories**: NN 400.0 million (US$ 3.121 million) • **Research on HPAI virus and disease including vaccine development:** NN 100.0 million (US$ 0.780 million) • **Strengthening of Veterinary quarantine infrastructure including manpower**: NN 100.0 million (US$ 0.780 million) • **Vaccine procurement (20,000 doses/annum)**: US$ 400,000.0 • **Simulation exercises and drills**: NN 2.0 million (US$ 0.016 million) • **Stamping out of affected poultry population with compensation**: NN200.0 million (US$ 1.561 million)	**NN 955,5 million plus US$ 400,000 (US$7.065million)**	**Poultry population: 150.7 million**
21	***Nigeria***	AVIAN INFLUENZA CONTROL AND HUMAN PANDEMIC PREPAREDNESS AND RESPONSE PROJECT (A203)	Mar-06	2006-2008	WB-APL/GPAI	**Component 1 Animal Health (H5N1 containment, control, prevention, and eradication activities in the livestock sector):** US$ 29.20 million **Component2 Human Health (HPAI prevention, preparedness and planning, response and containment activities in the human health sector):** US$ 18.25 million **Component3 Social Mobilization and Strategic Communication (promotion of community education, public awareness,):** US$ 4.08 million **Component 4 Implementation Support and Monitoring & Evaluation (support, monitoring and evaluation):** US$ 6.89 million	**US$ 58.42 million (without contingencies)**	**Poultry population: 150.7 million**
22	***Senegal***	PLAN NATIONAL DE PRÉVENTION ET DE LUTTE CONTRE LA GRIPPE AVIAIRE (A309)	Oct-05	2 years	National Contingency Plan for Avian Influenza	• **Epidemiological surveillance:** FCFA 501.5 million (US$ 921,875) • **Communication Programme:** FCFA 240.5 million (US$ 442,096) • **Emergency intervention plan:** FCFA 655 million (US$ 1,204,045) • **Training Programme:** FCFA 105.506 million (US$ 193,945) • **Coordination Unit:** FCFA 240 million (US$ 441,177)	**FCFA 1,742.506 million (US$ 3.203 million)**	**Poultry population: 26.96 million**
23	***Sierra Leone***	PLAN OF ACTION FOR THE PREVENTION AND CONTROL OF AVIAN INFLUENZA ("BIRD FLU") (draft) (A310)	Nov-05	Not specified	Action Plan (DRAFT)	· **National response (technical committee setup, equipment secretariat):** Le (Leone) 46,750,000 (US$ 0.016 million) · **Public awareness, prevention and control:** Le 205,290,000 (US$ 0.068 million) · **Epidemiological surveillance**: Le 328,750,000 (US$ 0.110 million) · **Entry and spread prevention:** Le 678,000,000 (US$ 0.226 million) · **Human case management:** Le 305,000,000 (US$ 0.102 million)	**Le 1,563.790 million (US$0.522 million)**	**Poultry population: 7.5 million**
24	***Tchad***	PLAN D'ACTION D'URGENCE POUR LA PRÉVENTION ET LA LUTTE CONTRE LA GRIPPE AVIAIRE (A311)	Feb-06	Not specified	Action Plan	**Animal Health:** CFA 796.26 million (US$ 1.595 million) **Human Health:** CFA 110.962 million (US$ 0.222 million) **Environment:** CFA 70.5 million (US$ 0.141 million)	**CFA 975.722 million (US$ 1.955 million)**	**Poultry population: 24 million**

25	***Togo***	PLAN STRATEGIQUE NATIONAL DE PREVENTION ET DE LUTTE CONTRE LA GRIPPE AVIAIRE (A312)	Feb-06	2006-2007	National Contingency Plan for Avian Influenza	· **Community sensitization on AI and behavior:** FCFA 118,235 million (US$ 0.233 million) · **training and diagnostic capacity :** FCFA 160,35 million (US$ 0.316 million) · **Surveillance and early warning system:** FCFA 247,705 million (US$ 0.489 million) · **Bio-security, disinfection, compensation, medicines and vaccines :** FCFA 1,299.5 million (US$ 2.564 million) · **Control measures and human case management:** FCFA 308 million (US$ 0.608 million) · **Follow up and coordination:** FCFA 134 million (US$ 0.264 million)	**FCFA 2 267 790 000 (US$ 4.475 million)**	**Poultry population: 10 million**
26	***Zambia***	AVIAN INFLUENZA AND PANDEMIC INFLUENZA PREPAREDNESS: NATIONAL RESPONSE PLAN (DRAFT) (A316)	Nov-05	Not specified	National Contingency Plan for Avian Influenza (DRAFT)	**Pre-pandemic Phase 3.978 million ZMK (US$ 0.934 million)** • Reduce the opportunity for Human Infection, including multi-sectoral collaboration: ZMK 45 million • Strengthen risk communication to Communities-awareness campaigns: ZMK 311.7 million • Capacity building: ZMK 186 million • Data collection and mapping of migratory birds: ZMK 275 million • Census and mapping of domestic birds: ZMK 1,245.01 million • Strengthen the early warning system-active surveillance of humans and birds: ZMK 1,076.75 • Control of poultry and birds movement: ZMK 688.5 million • Identify and equip place for managing patients: ZMK 150 million **Emergence of Pandemic Virus: ZMK 1,289.92 million (US$ 0.303 million)** • Targeting the virus at the source, bio security equipment and medicines: ZMK 1,289.920 **Pandemic declared and spreading internationally: ZMK 1,415 million (US$ 0.332 million)** • Reduce morbidity, mortality and social disruption: ZMK 1,340 million • Research: ZMK 75 million	**ZMK 6,682.88 million (US$ 1.569 million)**	**Poultry population: 30 million**

TOTAL: 26 countries

Rate of exchange: January-February 2007

	Country	Title	Date	Programme duration	Plan/Project	Budget info	Total budget	Size of poultry sector (2005)
	Middle East							
1	***Yemen***	EMERGENCY PLAN OF ACTION: BIRD FLU PRECAUTIONARY MEASURES (A 318)	Oct-05	Not specified	National Contingency Plan for Avian Influenza	• **Component 1. Jointly Implemented Activities (Ministry of Agriculture and Ministry of Health)**: Y.R.(Yemeni Riyals) 7,000,000 (US$ 0.036 million) The budget includes the following activities:1) Establishment of coordination among the overseen operational structure (Public, Private, Local Authorities, International Organisations and Organisations of the Civil Society; 2)Information and communication; 3)Monitoring of the epidemiological situation; 4) Regular meeting of technical committees • **Component 2. Activities to be implemented by the Ministry of Agriculture and Irrigation** (MoA&I): Y.R.109,923,240 (US$ 0.561 million) The budget includes the following activities: 1) Ban of importation of live birds and poultry and their products from affected countries; 2) Strengthening the surveillance; 3) Conducting a field survey to assess the current health situation of the poultry; 4) Control and monitoring the entry points; 5) Prohibiting entry of personal birds for affected countries 6) Applying the approved health requirements according to the recommendations of the OIE 7) Low implementation 8) Raising the awareness among Veterinarians, tech. staff and the poultry breeders 9) Communication with international organisations 10) Providing the needs for surveillance activities 11) Strengthening the Central Veterinary Laboratory 12) Intensified monitoring of the migratory birds 13) Preparing an urgent plan to contain the disease • **Component 3. Activities to be implemented by the Ministry of Public Health and Population** (MoPH&P): Y.R. 47 (US$ 2.41 million) The budget includes the following activities: 1) Strengthening general prevention; 2) Raising the preparedness of the country entry points; 3) Raising the awareness among the health workers; 4) Strengthening the surveillance; 5) Strengthening the diagnostic capacities of the Central Public Health Laboratory (CPHL and its branches in the govern 6) Surveillance of the international labours and students 7) Raising awareness among the public and travellers; 8) Preparing a Medical Emergency Preparedness Procedure (MEPP) to contain the disease	**Y.R. 589 million (US$3.007 million)**	**Poultry population: 37 million**

	Country	Title	Date	Programme duration	Source	Budget info	Total budget	Size of poultry sector (2005)
	South Asia							
1	***Afghanistan***	AVIAN INFLUENZA CONTROL PROJECT (A206a)	Apr-06	Oct 2006- Dec 2007	WB-APL/GPAI	**Animal Health Component** (US$5.2 million) **Human Health Component** (US$ 4.3 million) **Management, Communication and Public Awareness** (US$2.6 million)	**US$ 12.1 million**	**Poultry population: 8.4 million**
2	***India***	INFLUENZA PANDEMIC PREPAREDNESS AND RESPONSE PLAN (DRAFT) (A319)	No date	Not specified	National Contingency Plan for Human Pandemic Inluenza (DRAFT)	**No budget estimation.** Plan for the prevention and control of Human Pandemic	**No budget estimation**	**Poultry population: 430 million**
3	***Nepal***	AVIAN INFLUENZA CONTROL PROJECT (A320)	Dec-06	Oct 2006- July 2011	WB-APL/GPAI	**1.Animal Health** (US$ 6.12 million) 1.1, Surveillance (US$ 0.74 million) 1.2. Prevention and Containment (US$ 0.76 million) 1.3. Laboratory Capacity (US$ 3.37 million) 1.4. Vetennary Services (US$ 1.15 million) 1.5. Compensation Fund (US$ 0.10 million) **2. HumanHealth** (US$ 6.34 million) 2.1. Surveillance and Laboratory (US$ 3.30 million) 2.2. Prevention and Containment (US$ 0.98 million) 2.3. Health Care Delivery System (US$ 2.06 million) **3. Communications** (US$ 1.65 million) 3.1. Animal Health Communications (US$ 0.62 million) 3.2. HumanHealth Communications (US$ 0.67 million) 3.3 Cross-cutting Issues (US$ 0.36 million) **4. Project Management** (US$ 1.72 million) 4.1. Animal Health Support (US$ 1.21 million) 4.2. HumanHealth Support (US$ 0.5 1 million)	**US$ 15.83 million (without contigencies)**	**Poultry population: 22.79 million**
	East Asia & Pacific							
4	***China***					**Project not available**	**Project not available**	**Poultry population: 4,360.24 million**
5	***Indonesia***	NATIONAL STRATEGIC PLAN FOR AVIAN INFLUENZA CONTROL AND PANDEMIC INFLUENZA PREPAREDNESS 2006-2008 (A328)	Jan-06	2006-2008	National Contingency Plan for Avian Influenza	**National Avian Influenza control strategy** • **Highly Pathogenic Avian Influenza (HPAI) Control in Animals:** Rp (rupiah) 3,334.7 million (US$ 75.462 million) • **Management of Human Cases of AI:** Rp 824.41 million (US$ 18.656 million) • **Protection of High-Risk Groups:** Rp 73.4 million (US$ 1.661 million) • **Epidemiological Surveillance on Animals and Humans:** Rp 705.52 million (US$ 15.966 million) • **Restructuring the Poultry Industry System:** Rp 3.7 million (US$ 0.084 million) • **Risk Communication, Information and Public Awareness:** Rp 390.92 million (US$ 8.846 million) • **Strengthening Supporting Laws:** Rp 11.5 million (US$ 0.260 million) • **Capacity Building:** Rp 672.27 million (US$ 15.213 million) • **Action Research:** Rp 154.5 million (US$ 3.496 million) • **Monitoring and Evaluation:** Rp 21.9 million (US$ 0.496 million) **Subtototal: Rp 6,192.82 million (US$ 140.141 million)** **National Human Pandemic Influenza preparedness policy** • **Strengthening Sustainable Management:** Rp 68.9 million (US$ 1.56 million) • **Strengthening Surveillance on Animals and Humans:** Rp 348.9 million (US$ 7.899 million) • **Prevention and Control:** Rp 923.9 million (US$ 20.917 million) • **Strengthening Health Service Response Capacity:** Rp 822.3 million (US$ 18.617 million) • **Risk Communication, Information and Public Awareness:** Rp 273 million (US$ 6.181 million) **Subtotal: Rp 2437 million (US$ 55.174 million)**	**Rp 8,629.82 million (US$195.314 million)**	**Poultry population: 1,249. 42 million**

6	***Lao PDR***	AVIAN AND HUMAN INFLUENZA CONTROL AND PREPAREDNESS PROJECT (A207)	Jun-06	Sep 2006-Apr 2010	WB-APL/GPAI	**Animal Health** (US$ 5.35 million). **Human Health - Surveillance and Response** (US$ 1.10 million). **Human Health - Curative Services** (US$ 2.54 million). **Information, Education and Communication** (US$1.87 million). **Program Coordination and Regulatory Framework** (US$ 2.69 million).	**13.56 million US$**	**Poultry population: 19.8 million**
7	***Malaysia***	NATIONAL INFLUENZA PANDEMIC PREPAREDNESS PLAN (A321)	Jan-06	Not specified	National Contingency Plan for Human Pandemic Inluenza	**No budget estimation.** Guidelines for preparedness and response plan for Human Pandemic Influenza .	**No budget estimation**	**Poultry population: 185 million**
8	***Philippines (Republic of)***	PREPAREDNESS AND RESPONSE PLAN FOR AVIAN AND PANDEMIC INFLUENZA (A322a)	Oct-05	Not specified	National Contingency Plan for Human Pandemic Inluenza	**No budget estimation.** Guidelines for preparedness and response plan for Human Pandemic Influenza .	**No budget estimation**	**Poultry population: 136 million**
9	***Thailand***	NATIONAL STRATEGIC PLAN FOR AVIAN INFLUENZA CONTROL AND INFLUENZA PANDEMIC PREPAREDNESS, 2005 - 2007 (A323)	Jan-05	2005-2007	National Contingency Plan for Avian Influenza	**Development of a disease free poultry management system:** Baths 700 million (US$ 19.5 million) **Disease surveillance and response during outbreaks:** Baths 1,560 million (US$ 43.5 million) **Knowledge generation and management and Develop integrated management system and mechanism:** Baths325million (US$ 9.1million) **Capacity building of organisations and manpower:** Baths 1,201 million (US$ 33.5 million) **Create understanding and participation of the civil society and private sectors:** Baths 240 million (US$6.7million)	**Baths 4,026 million (US$112.3 million)**	**Poultry population: 260 million**
10	***Vietnam (Socialist Republic of)***	NATIONAL PREPAREDNESS PLAN IN RESPONSE TO AVIAN FLU EPIDEMIC H5N1 AND HUMAN INFLUENZA PANDEMIC (A326)	Sep-05	2005-2006	National Contingency Plan for Human Pandemic Inluenza	**Prevention sector:** VND 603 billion (US$ 37.746 million) **Treatment sector:** VND 3,600 billion (US$ 225.352 million) **Taminflu:** VND 310 billion (US$ 19.405 million) **Other:** VND 386 billion (US$ 24.163 million)	**VND 4,916 billion (US$307.731 million)**	**Poultry population: 153.93 million**
10	***Vietnam (Socialist Republic of)***	INTEGRATED NATIONAL PLAN FOR AI CONTROL AND HUMAN INFLUENZA PANDEMIC PREPAREDNESS AND RESPONSE,2006-2008 (A271)	Jan-06	2006-2008	National Contingency Plan for Avian Influenza	**I. Enhancing Coordinated Prevention and Preparedness Capability: US$** 35 million **II. Strengthening Surveillance and Early Warning System: US$** 61.5 million **III. Strengthening HPAI Control and Outbreak Containment: US$** 169 million	**US$ 266 million**	**Poultry population: 153.93million**
10	***Vietnam (Socialist Republic of)***	INTEGRATED NATIONAL OPERATIONAL PROGRAM FOR AVIAN AND HUMAN INFLUENZA (OPI): 2006-2010 (A270)	May-06	2006-2010	Integrated Operational Program for Avian Influenza	**I. Enhanced Coordination Activities: US$ 26,612** • National preparedness: US$ 590 • Policy and strategy development: US$ 134 • Program Coordination: US$ 5,406 • Public awareness and information, education and communication: US$ 4,200 • Program monitoring and evaluation: US$ 1,800 • Support for regional activities and international agencies: US$ 17,482 **II .HAPI Control and Eradication in the Agricultural Sector: US$ 83,737.1** • Strengthening Veterinary Services (capacity building): US$ 15,763 • Disease Control: US$ 55,160 • Surveillance and Epidemiological Investigation: US$ 4,443.8 • Poultry sector restructuring: US$ 8,370 **III. Influenza Prevention and Pandemic Preparedness in the Health Sector: US$ 96,230** • Strengthening Surveillance and Response: US$ 37,925 • Strengthening Diagnostic Capacity: US$ 14,442 • Strengthening Curative Care System: US$ 34,253 • Improving Research: US$ 9,610	**US$ 209 million**	**Poultry population: 153.93 million**
10	***Vietnam (Socialist Republic of)***	AVIAN INFLUENZA EMERGENCY RECOVERY PROJECT (A204)	Jul-04	2004-2006	WB-APL/GPAI	**Strengthening Diagnostic Capacity, Disease Surveillance, and HPAI Research:** US$ 2.760 million **Poultry Sector Rehabilitation:** US$ 2.13 million US$ **Public Awareness and Information:** US$ 0.95 million US$ **Project Management:** US$ 0.360 million	**US$ 6.2 million**	**Poultry population: 153.93 million**

10 countries

Note: West bank and Gaza: project approved but not available at the moment

Rate of exchange: January-February 2007

	Country	Title	Date	Programme duration	Source	Budget info	Total budget	Size of poultry sector (2005)
	Europe & Central Asia							
1	***Albania***	AVIAN INFLUENZA CONTROL AND HUMAN PANDEMIC PREPAREDNESS AND RESPONSE PROJECT (A201)	Jun-06	Jul 2006- Jun 2009	WB-APL/GPAI	**Component 1: Public Awareness and Information Campaign** (US$ 0.461 million) **Component 2: Animal Health** (US$ 3.698 million) **Component 3: Human Health Component** (US$ 1.6 million) **Component 4: Support to Avian Influenza Task Force** (US$ 341.2 million)	**US$ 6.10 million**	**Poultry population: 4.67 million**
2	***Armenia***	AVIAN INFLUENZA PREPAREDNESS (AIP) PROJECT (A209)	May-06	Jun 2006-May 2009	WB-APL/GPAI	**1. Animal Health Component:** US$ 5.55 million **2. Human Health Component:** US$ 2.745 million **3. Public Awareness and Communication Support:** US$ 0.932 million	**US$ 9.229 million (without contingencies)**	**Poultry population: 4.59 million**
3	***Georgia***	AVIAN INFLUENZA CONTROL AND HUMAN PANDEMIC PREPAREDNESS AND RESPONSE PROJECT (A208)	May-06	May 2006-Aug 2009	WB-APL/GPAI	**Animal Health Component** (US$ 5.183 million) **Human Health Component** (US$ 4.317 million) **Public Awareness and Information Component** (US$ 0.9 million)	**US$ 10.4 million**	**Poultry population: 9.1 million**
4	***Kyrgyz Republic***	AVIAN INFLUENZA CONTROL AND HUMAN PANDEMIC PREPAREDNESS AND RESPONSE PROJECT (A205)	Jan-06	Mar 2006-Dec 2009	WB-APL/GPAI	**1. Animal Health** (US$ 2.88 million) **2. Human Health** (US$ 2.30 million) **3. Public Awareness and Information** (US$ 0.44 million) **4. Implementation Support and Monitoring & Evaluation** (US$ 0.38 million)	**US$ 6 million (without contingencies)**	**Poulrty population: 4.12 million**
5	***Moldova***	AVIAN INFLUENZA CONTROL AND HUMAN PANDEMIC PREPAREDNESS AND RESPONSE (AIHP) PROJECT (A199)	May-06	Sept 2006-Dec 2008	WB-APL/GPAI	**Component 1: Animal Health** (US$ 3.6 million) **Component 2: Human Health** (US$ 3.7 million) **Component 3: Public Information and Awareness** (US$ 1.3 million) **Component 4: Implementation support and monitoring & evaluation** (US$ 0.55 million) **Unallocated fund** (US$ 1.45 million)	**US$ 10.6 million**	**Poultry population: 17.44 million heads**
6	***Romania***	AVIAN INFLUENZA CONTROL AND HUMAN PANDEMIC PREPAREDNESS AND RESPONSE PROJECT (A93a)	Sep-06	Nov 2006-Aug 2009	WB-APL/GPAI	**Animal Health: EUR 14.3 million** (US$ 18.781million) **Human Health:EUR 19.80 million** (US$ 26.003 million) **Public Awareness and Communications: EUR 1.641 million** (US$ 21.554 million) **Implementation Support, Monitoring and Evaluation: EUR 1.824 million** (US$ 2.395 million)	**Euro 37.5 million (US$47.7 million)**	**Poultry population: 87.01 million**
7	***Tajikistan (Republic of)***	AVIAN INFLUENZA CONTROL AND HUMAN PANDEMIC PREPAREDNESS AND RESPONSE PROJECT (A206)	Jun-06	Sep 2006-Dec 2009	WB-APL/GPAI	**Component 1 - Public Awareness and Information** (US$ 1.2 million) **Component 2 - Animal Health** (US$ 3 million) **Component 3 - Human Health** (US$ 2.3 million) **Component 4 - Implementation Support and Monitoring Evaluation Contingency** (US$ 0.3 million)	**US$ 6.8 million**	**Poultry population: 2.3 million**
8	***Turkey***	AVIAN INFLUENZA AND HUMAN PANDEMIC PREPAREDNESS AND RESPONSE PROJECT (A200)	Mar-06	Jun 2006-Jul 2010	WB-APL/GPAI	**ANIMAL HEALTH COMPONENT:** US$ 30.86 million **HUMAN HEALTH COMPONENT:** US$ 20.84 million **PUBLIC AWARENESS AND COORDINATION SUPPORT COMPONENT:** US$ 2,78 million	**US$ 54.5 million (without contigencies)**	**Poultry population: 296.88 million**

8 countries

Rate of exchange: January-February 2007

	Country	Title	Date	Programme duration	Source	Budget info	Total budget	Size of poultry sector (2005)
	Latin America							
1	***Bolivia***	PLAN NACIONAL PARA PANDEMIA DE INFLUENZA Y GRIPE AVIAR (A325)	Oct-05	2005-2008	National Contingency Plan for Human Pandemic Inluenza	**No budget estimation.** Guidelines for preparedness and response plan for Human Pandemic Influenza.	**No budget estimation**	**Poultry population: 75 million**
2	***Uruguay***	PLAN DE CONTINGENTIA EN INFLUENZA AVIAR (A324)	2004	Not specified	National Contingency Plan for Avian Influenza	**No budget estimation.** Guideline for prevention and control of AI in animals	**No budget estimation**	**Poultry population: 14 million**

2 countries

Annex 5: Global outbreak costs: scenarios, assumptions and results

Instructions to users

Objective:

This spreadsheet has been developed to serve as a working tool for the estimation of the costs of HPAI outbreaks at a global, regional and individual country level under different scenarios and assumptions.
The idea is that, as the epidemic occurence of HPAI is constantly changing, the scenarios and assumptions can ve varied to reflect more accurately the evolving reality.
Similarly, the data on which the current spreadsheet is based can be adjusted as new data and evidence from other research comes to light.

Scenarios and assumptions:

The current scenarios are as follows:
Scenario 1 (most likely scenario): assumes that, in the event of a disaese outbreak, the resulting impact will be between the low impact and high impact scenarios
Scenario 2 (low impact)
Scenario 3 (high impact)

In addition, there are 3 scenarios on the geographical scale of the outbreak: Scenario A; Scenario B; Scenario C.
These are based on the country classification of the "Global Strategy for Progressive Control of HPAI" (A40), and on the "AI Control and Eradication: FAO proposal for a global programme" (A42).
Current country coverage has been adjusted to reflect the current status of the geographical presence of the disease (based on OIE/WAHID data).

The variables on which the above scenarios depend are illustrated in the '**Assumptions outbreak costs**' worksheet.

Results:

A differentiation is made between direct impacts and losses and indirect impacts.
Results on the former are presented in the '**Direct outbreak costs**' worksheet, for the latter in the '**Indirect outbreak costs**' worksheet.

The direct outbreak costs are given for OIE developing/transition countries only (scope of this project).
The indirect impact is given for the world.
The underlying assumption is that, this being a transboundary disease, the wider economic effects (in terms of trade loss, loss in other sectors such as travel/tourism and the wider costs of a pandemic) transcend throughout the world.

Data sources/notes:

All sources of data are indicated in the notes under each worksheet.
The worksheets 'Vietnam HPAI' and 'Nigeria HPAI' contain more detailed data and calculations for the direct production costs and losses in these countries, based on our case studies.
The worksheet 'global HPAI' contains more detailed data and calculations for the indirect costs and losses at a global level, based on our literature review.
The worksheet 'pandemic effects' contains more detailed data and calculations for the pandemic effects.

Disease: HPAI	ACTUAL				ASSUMPTIONS		
	Baseline (Vietnam)	**Baseline (Nigeria)**	**Baseline (global)**		**Impact: scenario 1 (most likely)**	**Impact: scenario 2 (low impact)**	**Impact: scenario 3 (high impact)**
Duration of impact (years)	2+	1+			2	1	3
Rate of disease spread (a)					moderate	slow	rapid
Coverage (countries) (b)					scenario A	scenario A	scenario A
					scenario B	scenario B	scenario B
					scenario C	scenario C	scenario C
Direct production costs/losses:							
● Direct losses (c)							
% of birds culled	7-17%	2%	2%		15%	7%	25%
average market value per head (US$)	2.56	5.49		global	4	4	4
				Asia	2.5	2.5	2.5
				rest of world	6	6	6
culling/disposal costs per head (US$)	0.25	1.00		global	0.7	0.7	0.7
				Asia	0.3	0.3	0.3
				rest of world	1	1	1
control costs per head (US$)	0.19	0.38		global	0.3	0.3	0.3
				Asia	0.2	0.2	0.2
				rest of world	0.4	0.4	0.4
● Consequential on-farm losses (d)							
% of birds culled	7-17%				15%	7%	25%
monthly income from activity (per head) (US$)	0.96				2.00	2.00	2.00
duration (number of months)	3				3	1	6
Indirect costs							
Ripple (e)							
● Fall in domestic prices / demand (e)							
% rate of sales volume loss (per month)	up to 50%				20%	10%	40%
% rate of price fall (per month)	up to 50%				20%	10%	40%
duration (months)	3				3	1	6
● Loss of exports / market access (f)							
% rate of trade volume loss (per month)			0.4%		0.5%	0.2%	1.0%
% rate of price fall (per month)			0.8%		1.0%	0.5%	2.0%
duration (months)			12		24	12	36
Spill-over (g)							
● Fall in tourism / travel							
% rate of tourism income loss (per month)			0.4%		0.4%	0.2%	1.0%
duration (months)			12		12	6	24
Wider society (h)							
● Economic impact (% fall in GDP)							
15% attack rate			0.7%		0.7%	0.4%	1.0%
35% attach rate			1.6%		1.6%	1.0%	3.0%

Notes:

(a) Dependent on density of poultry popuplation, production system (intensive or extensive), weather conditions, presence of wild reservoirs and other natural risk factors.
Also, veterinary preparedness (surveillance levels, early detection, application of movement controls and other control measures etc.)
(b) Country classification based on A40 (Global Strategy for Progressive Control of HPAI), A42 (AI Control and Eradication: FAO proposal for a global programme) and current status (OIE, WAHID).
As at Nov 2005, the strategy was focussed on 3 groups of countries:
1) H5N1 infected countries (SE Asia: Cambodia, China, Indonesia, Laos, Thailand, Vietnam; Mongolia, Kazakshtan, Russia, Turkey and Romania)
2) Non-infected at immediate risk countries - includes those free of infection after having stamped out HPAI (DPR Korea, Malaysia, and Rep of Korea)
and those never infected (SE Asia: Brunei, Myanmar, Singapore and Philippines; S. Asia: Bangladesh, Bhutan, India, Maldives, Nepal, Sri Lanka)
3) Non-infected new countries at risk: includes the other regions of the world
(c) Includes culling (value of culled animals and culling/disposal) and control costs - excludes 'other direct production' or 'consequential' losses.
(d) Depends on period of non-activity during a moratorium on re-stocking
Excludes upstream/downstream sectors (poultry feed, processors, vet medicines etc.)
(e) Total net impact. Depends on impact of outbreak on consumer demand and price levels and proprotion of producers/production affected; some unaffected producers may actually gain from higher prices.
Also, depends on the point of return to pre-outbreak levels after the end of the crisis - duration is therefore the total number of months with no/reduced activity.
It is possible that some business will exit from the sector while others will expand (as has been the case in practice).
Assumes, however, than in net macro-economic terms supply will resume at pre-outbreak levels.
(f) Total net impact. Same assumptions apply as for domestic trade. Some countries may gain from increased exports (of poultry or substitute meats) and/or higher prices.
(g) Costs to the economic sectors of tourism/travel only covered here. Other economic sectors (e.g. services) excluded.
(h) Economic impact based on public health effects of a pandemic influenza. Source of baseline (global): US economic impact (A5). Range assumes a 15% to 35% attack rate.

Disease: HPAI			in '000 US$					in '000 US$			
			Baseline				Impact: scenario 1 (most likely)				
	Poultry stock ('000 head)	Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*	Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*
	2005	*2004-05 avg*	*2004-05 avg*	*2004-05 avg*	*2004-05 avg*	*2004-05 avg*					
case study 1 (Asia)	243,000	13.50%	84,103	8,200	6,308	***98,610***	15%	91,125	10,935	7,290	***109,350***
avg cost per head			*2.56*	*0.25*	*0.19*			*2.5*	*0.3*	*0.2*	
	2006 est.	*2006 est.*	*2006 est.*	*2006 est.*	*2006 est.*	*2006 est.*					
case study 2 (Africa)	140,000	2%	14,505	2,640	1,015	***18,161***	15%	126,000	21,000	8,400	***155,400***
avg cost per head			*5.49*	*1.00*	*0.38*			*6*	*1*	*0.4*	
Direct production costs/losses: Global impact, annual (i)											
avg cost per head								*4*	*0.7*	*0.3*	
scenario A (ii)							15%	***4,271,540***	***747,519***	***320,365***	***5,339,425***
scenario B (iii)							15%	***4,898,934***	***857,313***	***367,420***	***6,123,668***
scenario C (iv)							15%	***7,763,260***	***1,358,571***	***582,245***	***9,704,075***
Direct production costs/losses: Global impact, total (i)											
scenario A (ii)								***8,543,080***	***1,495,039***	***640,731***	***10,678,850***
scenario B (iii)								***9,797,868***	***1,714,627***	***734,840***	***12,247,335***
scenario C (iv)								***15,526,520***	***2,717,141***	***1,164,489***	***19,408,151***
Consequential on-farm losses: Global impact, annual (i)											
avg income loss per head											*6*
scenario A (ii)							15%				***6,407,310***
scenario B (iii)							15%				***7,348,401***
scenario C (iv)							15%				***11,644,890***
Consequential on-farm losses: Global impact, total (i)											
scenario A (ii)											***12,814,619***
scenario B (iii)											***14,696,802***
scenario C (iv)											***23,289,781***
Total direct impact including consequential on-farm losses, annual (i)											
scenario A (ii)											***11,746,734***
scenario B (iii)											***13,472,069***
scenario C (iv)											***21,348,966***
Total direct impact including consequential on-farm losses, total (i)											
scenario A (ii)											***23,493,469***
scenario B (iii)											***26,944,137***
scenario C (iv)											***42,697,931***

	Individual countries:									**in '000 US$**			
				Total poultry stock , 2005 (v)						**Impact: scenario 1 (most likely)**			
			Poultry stock ('000 head) (v)		*Scenario A countries*	*Scenario B countries*	*Scenario C countries*		**Poultry stock losses (%)**	**Poultry value losses**	**Culling/ Disposal costs**	**Control costs**	***Total impact***
				('000 head)	*7,119,233*	*8,164,890*	*12,938,767*						
				(% of total)	*55.0%*	*63.1%*	*100.0%*						
1	Afghanistan		8,400						15%	5,040	882	378	***6,300***
2	Albania		4,670						15%	2,802	490	210	***3,503***
3	Algeria		125,000						15%	75,000	13,125	5,625	***93,750***
4	Angola		6,800						15%	4,080	714	306	***5,100***
5	**Argentina**		95,000						15%	57,000	9,975	4,275	***71,250***
6	Armenia		4,590						15%	2,754	482	207	***3,443***
7	Azerbaijan		17,553						15%	10,532	1,843	790	***13,165***
8	Bahrain		470						15%	282	49	21	***353***
9	Bangladesh		142,000						15%	85,200	14,910	6,390	***106,500***
10	Barbados		3,400						15%	2,040	357	153	***2,550***
11	Belarus		24,600						15%	14,760	2,583	1,107	***18,450***
12	Belize		1,600						15%	960	168	72	***1,200***
13	Benin		13,000						15%	7,800	1,365	585	***9,750***
14	Bhutan		230						15%	138	24	10	***173***
15	Bolivia		75,000						15%	45,000	7,875	3,375	***56,250***
16	Bosnia-Herz		9,000						15%	5,400	945	405	***6,750***
17	Botswana		4,000						15%	2,400	420	180	***3,000***
18	Brazil		1,100,000						15%	660,000	115,500	49,500	***825,000***
19	Brunei		13,000						15%	7,800	1,365	585	***9,750***
20	Bulgaria		17,159						15%	10,295	1,802	772	***12,869***
21	Burkina Faso		25,739						15%	15,443	2,703	1,158	***19,304***
22	Burundi		4,300						15%	2,580	452	194	***3,225***
23	Cambodia		15,000						15%	9,000	1,575	675	***11,250***
24	Cameroon		31,000						15%	18,600	3,255	1,395	***23,250***
25	Central Afr. Rep.		4,769						15%	2,861	501	215	***3,577***
26	Chad		5,200						15%	3,120	546	234	***3,900***
27	Chile		95,000						15%	57,000	9,975	4,275	***71,250***
28	China		4,360,243						15%	2,616,146	457,826	196,211	***3,270,182***
29	Colombia		150,000						15%	90,000	15,750	6,750	***112,500***
30	Comoros		510						15%	306	54	23	***383***
31	Congo		2,400						15%	1,440	252	108	***1,800***
32	Congo Dem. Rep		19,769						15%	11,861	2,076	890	***14,827***
33	Costa Rica		19,500						15%	11,700	2,048	878	***14,625***
34	Cote d'Ivoire		33,000						15%	19,800	3,465	1,485	***24,750***
35	Croatia		10,640						15%	6,384	1,117	479	***7,980***
36	Cuba		27,440						15%	16,464	2,881	1,235	***20,580***
37	Djibouti								15%	0	0	0	***0***
38	Dominican Rep		47,500						15%	28,500	4,988	2,138	***35,625***
39	Ecuador		104,217						15%	62,530	10,943	4,690	***78,163***
40	Egypt		95,000						15%	57,000	9,975	4,275	***71,250***
41	El Salvador		13,437						15%	8,062	1,411	605	***10,078***
42	Eq. Guinea		320						15%	192	34	14	***240***
43	Eritrea		1,370						15%	822	144	62	***1,028***
44	Ethiopia		39,000						15%	23,400	4,095	1,755	***29,250***
45	FYR Macedonia		2,617						15%	1,570	275	118	***1,963***
46	Gabon		3,100						15%	1,860	326	140	***2,325***
47	Gambia		650						15%	390	68	29	***488***
48	Georgia		9,100						15%	5,460	956	410	***6,825***
49	Ghana		30,000						15%	18,000	3,150	1,350	***22,500***
50	Guatemala		27,000						15%	16,200	2,835	1,215	***20,250***
51	Guinea		15,865						15%	9,519	1,666	714	***11,899***
52	Guinea Bissau		1,600						15%	960	168	72	***1,200***
53	Guyana		20,000						15%	12,000	2,100	900	***15,000***
54	Haiti		5,500						15%	3,300	578	248	***4,125***
55	Honduras		18,700						15%	11,220	1,964	842	***14,025***
56	India		430,000						15%	258,000	45,150	19,350	***322,500***
57	Indonesia		1,249,426						15%	749,656	131,190	56,224	***937,070***
58	Iran		280,000						15%	168,000	29,400	12,600	***210,000***
59	Iraq		33,000						15%	19,800	3,465	1,485	***24,750***
60	Jamaica		12,500						15%	7,500	1,313	563	***9,375***
61	Jordan		25,000						15%	15,000	2,625	1,125	***18,750***
62	Kazakhstan		25,500						15%	15,300	2,678	1,148	***19,125***
63	Kenya		28,657						15%	17,194	3,009	1,290	***21,493***
64	Korea North		21,000						15%	12,600	2,205	945	***15,750***
65	Korea South		110,000						15%	66,000	11,550	4,950	***82,500***
66	Kuwait		32,500						15%	19,500	3,413	1,463	***24,375***
67	Kyrgyzstan		4,121						15%	2,473	433	185	***3,091***
68	Laos		19,800						15%	11,880	2,079	891	***14,850***
69	Lebanon		35,000						15%	21,000	3,675	1,575	***26,250***
70	Lesotho		1,800						15%	1,080	189	81	***1,350***

71	Libya		25,000						15%	15,000	2,625	1,125	***18,750***
72	Madagascar		24,000						15%	14,400	2,520	1,080	***18,000***
73	Malawi		15,200						15%	9,120	1,596	684	***11,400***
74	Malaysia		185,000						15%	111,000	19,425	8,325	***138,750***
75	Mali		31,000						15%	18,600	3,255	1,395	***23,250***
76	Mauritania		4,200						15%	2,520	441	189	***3,150***
77	Mauritius		9,800						15%	5,880	1,029	441	***7,350***
78	Mexico		425,000						15%	255,000	44,625	19,125	***318,750***
79	Moldova		17,442						15%	10,465	1,831	785	***13,082***
80	Mongolia		30						15%	18	3	1	***23***
81	Morocco		137,000						15%	82,200	14,385	6,165	***102,750***
82	Mozambique		28,000						15%	16,800	2,940	1,260	***21,000***
83	Myanmar		82,000						15%	49,200	8,610	3,690	***61,500***
84	Namibia		3,500						15%	2,100	368	158	***2,625***
85	Nepal		22,790						15%	13,674	2,393	1,026	***17,093***
86	New Caledonia		600						15%	360	63	27	***450***
87	Nicaragua		18,000						15%	10,800	1,890	810	***13,500***
88	Niger		25,000						15%	15,000	2,625	1,125	***18,750***
89	**Nigeria**		150,700						15%	90,420	15,824	6,782	***113,025***
90	Oman		4,200						15%	2,520	441	189	***3,150***
91	Pakistan		166,000						15%	99,600	17,430	7,470	***124,500***
92	Panama		14,000						15%	8,400	1,470	630	***10,500***
93	Paraguay		17,000						15%	10,200	1,785	765	***12,750***
94	Peru		99,255						15%	59,553	10,422	4,466	***74,441***
95	Philippines		136,001						15%	81,601	14,280	6,120	***102,001***
96	Qatar		4,500						15%	2,700	473	203	***3,375***
97	**Romania**		87,014						15%	52,208	9,136	3,916	***65,261***
98	Russia		328,707						15%	197,224	34,514	14,792	***246,530***
99	Rwanda		2,000						15%	1,200	210	90	***1,500***
100	Sao Tome		290						15%	174	30	13	***218***
101	Saudi Arabia		141,000						15%	84,600	14,805	6,345	***105,750***
102	Senegal		26,959						15%	16,175	2,831	1,213	***20,219***
103	Serbia-Mont		15,221						15%	9,133	1,598	685	***11,416***
104	Sierra Leone		7,500						15%	4,500	788	338	***5,625***
105	Singapore		2,000						15%	1,200	210	90	***1,500***
106	Somalia		3,400						15%	2,040	357	153	***2,550***
107	South Africa		121,000						15%	72,600	12,705	5,445	***90,750***
108	Sri Lanka		11,636						15%	6,982	1,222	524	***8,727***
109	Sudan		37,000						15%	22,200	3,885	1,665	***27,750***
110	Suriname		3,800						15%	2,280	399	171	***2,850***
111	Swaziland		3,200						15%	1,920	336	144	***2,400***
112	Syria		23,795						15%	14,277	2,498	1,071	***17,846***
113	Taipei China (Taiwan)								15%	0	0	0	***0***
114	Tajikistan		2,296						15%	1,378	241	103	***1,722***
115	Tanzania		30,000						15%	18,000	3,150	1,350	***22,500***
116	Thailand		260,000						15%	156,000	27,300	11,700	***195,000***
117	Togo		9,000						15%	5,400	945	405	***6,750***
118	Trinidad-Tobago		28,200						15%	16,920	2,961	1,269	***21,150***
119	Tunisia		64,000						15%	38,400	6,720	2,880	***48,000***
120	Turkey		296,876						15%	178,126	31,172	13,359	***222,657***
121	Turkmenistan		7,000						15%	4,200	735	315	***5,250***
122	Uganda		32,600						15%	19,560	3,423	1,467	***24,450***
123	Ukraine		131,976						15%	79,186	13,857	5,939	***98,982***
124	UAE		15,000						15%	9,000	1,575	675	***11,250***
125	Uruguay		14,000						15%	8,400	1,470	630	***10,500***
126	Uzbekistan		20,540						15%	12,324	2,157	924	***15,405***
127	Vanuatu		340						15%	204	36	15	***255***
128	Venezuela		110,000						15%	66,000	11,550	4,950	***82,500***
129	**Vietnam**		153,937						15%	92,362	16,163	6,927	***115,453***
130	Yemen		37,000						15%	22,200	3,885	1,665	***27,750***
131	Zambia		30,000						15%	18,000	3,150	1,350	***22,500***
132	Zimbabwe		23,000						15%	13,800	2,415	1,035	***17,250***
	TOTAL		**12,938,767**							**7,763,260**	**1,358,571**	**582,245**	***9,704,075***

Notes:

(i) The 'global' impact is given in a range, depending on 3 scenarios in terms of country coverage (scenarios A to C).
Furthermore, it is indicated per year and in total, depending on the assumptions for duration of the epidemic - see 'assumptions outbreak costs'
Includes animal value losses, culling/disposal and control costs
(ii) Scenario A Includes the following countries: Cambodia, China, Indonesia, Laos, Thailand, Vietnam, S. Korea; Mongolia, Kazakhstan, Russia, Turkey, Romania; Nigeria, Niger, Sudan
(iii) Scenario B includes the countries of Note (b) above plus : N korea, Malyasia, Brunei, Myanmar, Singapore, Philippines; Bangladesh, Bhutan, India, Nepal, Sri Lanka
(iv) Scenario C includes all OIE developing country members (132 countries in total)
(v) Latest data available, source FAOSTAT. Chicken numbers: since 2005 FAOSTAT does not differentiate any more between broilers and layers (double counting between the 2 categories was possible in earlier years).

	in '000 US$					in '000 US$			
	Impact: scenario 2 (low impact)					Impact: scenario 3 (high impact)			
Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*	Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*
7%	42,525	5,103	3,402	***51,030***	25%	151,875	18,225	12,150	***182,250***
	2.5	*0.3*	*0.2*			*2.5*	*0.3*	*0.2*	
7%	58,800	9,800	3,920	***72,520***	25%	210,000	35,000	14,000	***259,000***
	6	*1*	*0.4*			*6*	*1*	*0.4*	
	4	*0.7*	*0.3*			*4*	*0.7*	*0.3*	
7%	***1,993,385***	***348,842***	***149,504***	***2,491,732***	25%	***7,119,233***	***1,245,866***	***533,942***	***8,899,041***
7%	***2,286,169***	***400,080***	***171,463***	***2,857,712***	25%	***8,164,890***	***1,428,856***	***612,367***	***10,206,113***
7%	***3,622,855***	***634,000***	***271,714***	***4,528,568***	25%	***12,938,767***	***2,264,284***	***970,408***	***16,173,459***
	1,993,385	***348,842***	***149,504***	***2,491,732***		***21,357,699***	***3,737,597***	***1,601,827***	***26,697,124***
	2,286,169	***400,080***	***171,463***	***2,857,712***		***24,494,670***	***4,286,567***	***1,837,100***	***30,618,338***
	3,622,855	***634,000***	***271,714***	***4,528,568***		***38,816,301***	***6,792,853***	***2,911,223***	***48,520,376***
				2					***12***
7%				***996,693***	25%				***21,357,699***
7%				***1,143,085***	25%				***24,494,670***
7%				***1,811,427***	25%				***38,816,301***
				996,693					***64,073,097***
				1,143,085					***73,484,010***
				1,811,427					***116,448,903***
				3,488,424					***30,256,740***
				4,000,796					***34,700,783***
				6,339,996					***54,989,760***
				3,488,424					***90,770,221***
				4,000,796					***104,102,348***
				6,339,996					***164,969,279***

	in '000 US$					in '000 US$			
Impact: scenario 2 (low impact)					Impact: scenario 3 (high impact)				
Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*	Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*
7%	2,352	412	176	***2,940***	25%	8,400	1,470	630	***10,500***
7%	1,308	229	98	***1,635***	25%	4,670	817	350	***5,838***
7%	35,000	6,125	2,625	***43,750***	25%	125,000	21,875	9,375	***156,250***
7%	1,904	333	143	***2,380***	25%	6,800	1,190	510	***8,500***
7%	26,600	4,655	1,995	***33,250***	25%	95,000	16,625	7,125	***118,750***
7%	1,285	225	96	***1,607***	25%	4,590	803	344	***5,738***
7%	4,915	860	369	***6,144***	25%	17,553	3,072	1,316	***21,941***
7%	132	23	10	***165***	25%	470	82	35	***588***
7%	39,760	6,958	2,982	***49,700***	25%	142,000	24,850	10,650	***177,500***
7%	952	167	71	***1,190***	25%	3,400	595	255	***4,250***
7%	6,888	1,205	517	***8,610***	25%	24,600	4,305	1,845	***30,750***
7%	448	78	34	***560***	25%	1,600	280	120	***2,000***
7%	3,640	637	273	***4,550***	25%	13,000	2,275	975	***16,250***
7%	64	11	5	***81***	25%	230	40	17	***288***
7%	21,000	3,675	1,575	***26,250***	25%	75,000	13,125	5,625	***93,750***
7%	2,520	441	189	***3,150***	25%	9,000	1,575	675	***11,250***
7%	1,120	196	84	***1,400***	25%	4,000	700	300	***5,000***
7%	308,000	53,900	23,100	***385,000***	25%	1,100,000	192,500	82,500	***1,375,000***
7%	3,640	637	273	***4,550***	25%	13,000	2,275	975	***16,250***
7%	4,805	841	360	***6,006***	25%	17,159	3,003	1,287	***21,449***
7%	7,207	1,261	541	***9,009***	25%	25,739	4,504	1,930	***32,174***
7%	1,204	211	90	***1,505***	25%	4,300	753	323	***5,375***
7%	4,200	735	315	***5,250***	25%	15,000	2,625	1,125	***18,750***
7%	8,680	1,519	651	***10,850***	25%	31,000	5,425	2,325	***38,750***
7%	1,335	234	100	***1,669***	25%	4,769	835	358	***5,961***
7%	1,456	255	109	***1,820***	25%	5,200	910	390	***6,500***
7%	26,600	4,655	1,995	***33,250***	25%	95,000	16,625	7,125	***118,750***
7%	1,220,868	213,652	91,565	***1,526,085***	25%	4,360,243	763,043	327,018	***5,450,304***
7%	42,000	7,350	3,150	***52,500***	25%	150,000	26,250	11,250	***187,500***
7%	143	25	11	***179***	25%	510	89	38	***638***
7%	672	118	50	***840***	25%	2,400	420	180	***3,000***
7%	5,535	969	415	***6,919***	25%	19,769	3,460	1,483	***24,711***
7%	5,460	956	410	***6,825***	25%	19,500	3,413	1,463	***24,375***
7%	9,240	1,617	693	***11,550***	25%	33,000	5,775	2,475	***41,250***
7%	2,979	521	223	***3,724***	25%	10,640	1,862	798	***13,300***
7%	7,683	1,345	576	***9,604***	25%	27,440	4,802	2,058	***34,300***
7%	0	0	0	***0***	25%	0	0	0	***0***
7%	13,300	2,328	998	***16,625***	25%	47,500	8,313	3,563	***59,375***
7%	29,181	5,107	2,189	***36,476***	25%	104,217	18,238	7,816	***130,271***
7%	26,600	4,655	1,995	***33,250***	25%	95,000	16,625	7,125	***118,750***
7%	3,762	658	282	***4,703***	25%	13,437	2,351	1,008	***16,796***
7%	90	16	7	***112***	25%	320	56	24	***400***
7%	384	67	29	***480***	25%	1,370	240	103	***1,713***
7%	10,920	1,911	819	***13,650***	25%	39,000	6,825	2,925	***48,750***
7%	733	128	55	***916***	25%	2,617	458	196	***3,271***
7%	868	152	65	***1,085***	25%	3,100	543	233	***3,875***
7%	182	32	14	***228***	25%	650	114	49	***813***
7%	2,548	446	191	***3,185***	25%	9,100	1,593	683	***11,375***
7%	8,400	1,470	630	***10,500***	25%	30,000	5,250	2,250	***37,500***
7%	7,560	1,323	567	***9,450***	25%	27,000	4,725	2,025	***33,750***
7%	4,442	777	333	***5,553***	25%	15,865	2,776	1,190	***19,831***
7%	448	78	34	***560***	25%	1,600	280	120	***2,000***
7%	5,600	980	420	***7,000***	25%	20,000	3,500	1,500	***25,000***
7%	1,540	270	116	***1,925***	25%	5,500	963	413	***6,875***
7%	5,236	916	393	***6,545***	25%	18,700	3,273	1,403	***23,375***
7%	120,400	21,070	9,030	***150,500***	25%	430,000	75,250	32,250	***537,500***
7%	349,839	61,222	26,238	***437,299***	25%	1,249,426	218,650	93,707	***1,561,783***
7%	78,400	13,720	5,880	***98,000***	25%	280,000	49,000	21,000	***350,000***
7%	9,240	1,617	693	***11,550***	25%	33,000	5,775	2,475	***41,250***
7%	3,500	613	263	***4,375***	25%	12,500	2,188	938	***15,625***
7%	7,000	1,225	525	***8,750***	25%	25,000	4,375	1,875	***31,250***
7%	7,140	1,250	536	***8,925***	25%	25,500	4,463	1,913	***31,875***
7%	8,024	1,404	602	***10,030***	25%	28,657	5,015	2,149	***35,821***
7%	5,880	1,029	441	***7,350***	25%	21,000	3,675	1,575	***26,250***
7%	30,800	5,390	2,310	***38,500***	25%	110,000	19,250	8,250	***137,500***
7%	9,100	1,593	683	***11,375***	25%	32,500	5,688	2,438	***40,625***
7%	1,154	202	87	***1,442***	25%	4,121	721	309	***5,151***
7%	5,544	970	416	***6,930***	25%	19,800	3,465	1,485	***24,750***
7%	9,800	1,715	735	***12,250***	25%	35,000	6,125	2,625	***43,750***
7%	504	88	38	***630***	25%	1,800	315	135	***2,250***

7%	7,000	1,225	525	***8,750***	25%	25,000	4,375	1,875	***31,250***
7%	6,720	1,176	504	***8,400***	25%	24,000	4,200	1,800	***30,000***
7%	4,256	745	319	***5,320***	25%	15,200	2,660	1,140	***19,000***
7%	51,800	9,065	3,885	***64,750***	25%	185,000	32,375	13,875	***231,250***
7%	8,680	1,519	651	***10,850***	25%	31,000	5,425	2,325	***38,750***
7%	1,176	206	88	***1,470***	25%	4,200	735	315	***5,250***
7%	2,744	480	206	***3,430***	25%	9,800	1,715	735	***12,250***
7%	119,000	20,825	8,925	***148,750***	25%	425,000	74,375	31,875	***531,250***
7%	4,884	855	366	***6,105***	25%	17,442	3,052	1,308	***21,803***
7%	8	1	1	***11***	25%	30	5	2	***38***
7%	38,360	6,713	2,877	***47,950***	25%	137,000	23,975	10,275	***171,250***
7%	7,840	1,372	588	***9,800***	25%	28,000	4,900	2,100	***35,000***
7%	22,960	4,018	1,722	***28,700***	25%	82,000	14,350	6,150	***102,500***
7%	980	172	74	***1,225***	25%	3,500	613	263	***4,375***
7%	6,381	1,117	479	***7,977***	25%	22,790	3,988	1,709	***28,488***
7%	168	29	13	***210***	25%	600	105	45	***750***
7%	5,040	882	378	***6,300***	25%	18,000	3,150	1,350	***22,500***
7%	7,000	1,225	525	***8,750***	25%	25,000	4,375	1,875	***31,250***
7%	42,196	7,384	3,165	***52,745***	25%	150,700	26,373	11,303	***188,375***
7%	1,176	206	88	***1,470***	25%	4,200	735	315	***5,250***
7%	46,480	8,134	3,486	***58,100***	25%	166,000	29,050	12,450	***207,500***
7%	3,920	686	294	***4,900***	25%	14,000	2,450	1,050	***17,500***
7%	4,760	833	357	***5,950***	25%	17,000	2,975	1,275	***21,250***
7%	27,791	4,863	2,084	***34,739***	25%	99,255	17,370	7,444	***124,069***
7%	38,080	6,664	2,856	***47,600***	25%	136,001	23,800	10,200	***170,001***
7%	1,260	221	95	***1,575***	25%	4,500	788	338	***5,625***
7%	24,364	4,264	1,827	***30,455***	25%	87,014	15,227	6,526	***108,768***
7%	92,038	16,107	6,903	***115,047***	25%	328,707	57,524	24,653	***410,884***
7%	560	98	42	***700***	25%	2,000	350	150	***2,500***
7%	81	14	6	***102***	25%	290	51	22	***363***
7%	39,480	6,909	2,961	***49,350***	25%	141,000	24,675	10,575	***176,250***
7%	7,549	1,321	566	***9,436***	25%	26,959	4,718	2,022	***33,699***
7%	4,262	746	320	***5,327***	25%	15,221	2,664	1,142	***19,026***
7%	2,100	368	158	***2,625***	25%	7,500	1,313	563	***9,375***
7%	560	98	42	***700***	25%	2,000	350	150	***2,500***
7%	952	167	71	***1,190***	25%	3,400	595	255	***4,250***
7%	33,880	5,929	2,541	***42,350***	25%	121,000	21,175	9,075	***151,250***
7%	3,258	570	244	***4,073***	25%	11,636	2,036	873	***14,545***
7%	10,360	1,813	777	***12,950***	25%	37,000	6,475	2,775	***46,250***
7%	1,064	186	80	***1,330***	25%	3,800	665	285	***4,750***
7%	896	157	67	***1,120***	25%	3,200	560	240	***4,000***
7%	6,663	1,166	500	***8,328***	25%	23,795	4,164	1,785	***29,744***
7%	0	0	0	***0***	25%	0	0	0	***0***
7%	643	113	48	***804***	25%	2,296	402	172	***2,870***
7%	8,400	1,470	630	***10,500***	25%	30,000	5,250	2,250	***37,500***
7%	72,800	12,740	5,460	***91,000***	25%	260,000	45,500	19,500	***325,000***
7%	2,520	441	189	***3,150***	25%	9,000	1,575	675	***11,250***
7%	7,896	1,382	592	***9,870***	25%	28,200	4,935	2,115	***35,250***
7%	17,920	3,136	1,344	***22,400***	25%	64,000	11,200	4,800	***80,000***
7%	83,125	14,547	6,234	***103,907***	25%	296,876	51,953	22,266	***371,095***
7%	1,960	343	147	***2,450***	25%	7,000	1,225	525	***8,750***
7%	9,128	1,597	685	***11,410***	25%	32,600	5,705	2,445	***40,750***
7%	36,953	6,467	2,771	***46,192***	25%	131,976	23,096	9,898	***164,970***
7%	4,200	735	315	***5,250***	25%	15,000	2,625	1,125	***18,750***
7%	3,920	686	294	***4,900***	25%	14,000	2,450	1,050	***17,500***
7%	5,751	1,006	431	***7,189***	25%	20,540	3,595	1,541	***25,675***
7%	95	17	7	***119***	25%	340	60	26	***425***
7%	30,800	5,390	2,310	***38,500***	25%	110,000	19,250	8,250	***137,500***
7%	43,102	7,543	3,233	***53,878***	25%	153,937	26,939	11,545	***192,421***
7%	10,360	1,813	777	***12,950***	25%	37,000	6,475	2,775	***46,250***
7%	8,400	1,470	630	***10,500***	25%	30,000	5,250	2,250	***37,500***
7%	6,440	1,127	483	***8,050***	25%	23,000	4,025	1,725	***28,750***
	3,622,855	**634,000**	**271,714**	***4,528,568***		**12,938,767**	**2,264,284**	**970,408**	***16,173,459***

Disease: HPAI				in '000 US$					in '000 US$		
			Baseline					**Impact: scenario 1 (most likely)**			
	Poultry stock ('000 head)	**Poultry stock losses (%)**	**Poultry value losses**	**Culling/ Disposal costs**	**Control costs**	***Total impact***	**Poultry stock losses (%)**	**Poultry value losses**	**Culling/ Disposal costs**	**Control costs**	***Total impact***
	2005	*2004-05 avg*	*2004-05 avg*	*2004-05 avg*	*2004-05 avg*	*2004-05 avg*					
case study 1 (Asia)	243,000	13.50%	84,103	8,200	6,308	***98,610***	15%	91,125	10,935	7,290	***109,350***
avg cost per head			*2.56*	*0.25*	*0.19*			*2.5*	*0.3*	*0.2*	
	2006 est.	*2006 est.*	*2006 est.*	*2006 est.*	*2006 est.*	*2006 est.*					
case study 2 (Africa)	140,000	2%	14,505	2,640	1,015	***18,161***	15%	126,000	21,000	8,400	***155,400***
avg cost per head			*5.49*	*1.00*	*0.38*			*6*	*1*	*0.4*	
Direct production costs/losses: Global impact, annual (i)											
avg cost per head								*4*	*0.7*	*0.3*	
scenario A (ii)							15%	***4,271,540***	***747,519***	***320,365***	***5,339,425***
scenario B (iii)							15%	***4,898,934***	***857,313***	***367,420***	***6,123,668***
scenario C (iv)							15%	***7,763,260***	***1,358,571***	***582,245***	***9,704,075***
Direct production costs/losses: Global impact, total (i)											
scenario A (ii)								***8,543,080***	***1,495,039***	***640,731***	***10,678,850***
scenario B (iii)								***9,797,868***	***1,714,627***	***734,840***	***12,247,335***
scenario C (iv)								***15,526,520***	***2,717,141***	***1,164,489***	***19,408,151***
Consequential on-farm losses: Global impact, annual (i)											
avg income loss per head											*6*
scenario A (ii)							15%				***6,407,310***
scenario B (iii)							15%				***7,348,401***
scenario C (iv)							15%				***11,644,890***
Consequential on-farm losses: Global impact, total (i)											
scenario A (ii)											***12,814,619***
scenario B (iii)											***14,696,802***
scenario C (iv)											***23,289,781***
Total direct impact including consequential on-farm losses, annual (i)											
scenario A (ii)											***11,746,734***
scenario B (iii)											***13,472,069***
scenario C (iv)											***21,348,966***
Total direct impact including consequential on-farm losses, total (i)											
scenario A (ii)											***23,493,469***
scenario B (iii)											***26,944,137***
scenario C (iv)											***42,697,931***

	Individual countries:										in '000 US$			
					Total poultry stock , 2005 (v)						Impact: scenario 1 (most likely)			
			Poultry stock ('000 head) (v)		*Scenario A countries*	*Scenario B countries*	*Scenario C countries*		Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*
				('000 head)	*7,119,233*	*8,164,890*	*12,938,767*						
		LDC State		*(% of total)*	*55.0%*	*63.1%*	*100.0%*						
1	Afghanistan	LDC	8,400		***5040***	***882***	***378***	***6300***	15%	5,040	882	378	***6,300***
2	Albania		4,670						15%	2,802	490	210	***3,503***
3	Algeria		125,000						15%	75,000	13,125	5,625	***93,750***
4	Angola	LDC	6,800		***4080***	***714***	***306***	***5100***	15%	4,080	714	306	***5,100***
5	**Argentina**		95,000						15%	57,000	9,975	4,275	***71,250***
6	Armenia		4,590						15%	2,754	482	207	***3,443***
7	Azerbaijan		17,553						15%	10,532	1,843	790	***13,165***
8	Bahrain		470						15%	282	49	21	***353***
9	Bangladesh	LDC	142,000		***85200***	***14910***	***6390***	***106500***	15%	85,200	14,910	6,390	***106,500***
10	Barbados		3,400						15%	2,040	357	153	***2,550***
11	Belarus		24,600						15%	14,760	2,583	1,107	***18,450***
12	Belize		1,600						15%	960	168	72	***1,200***
13	Benin	LDC	13,000		***7800***	***1365***	***585***	***9750***	15%	7,800	1,365	585	***9,750***
14	Bhutan	LDC	230		***138***	***24.15***	***10.35***	***172.5***	15%	138	24	10	***173***
15	Bolivia		75,000						15%	45,000	7,875	3,375	***56,250***
16	Bosnia-Herz		9,000						15%	5,400	945	405	***6,750***
17	Botswana		4,000						15%	2,400	420	180	***3,000***
18	Brazil		1,100,000						15%	660,000	115,500	49,500	***825,000***
19	Brunei		13,000						15%	7,800	1,365	585	***9,750***
20	Bulgaria		17,159						15%	10,295	1,802	772	***12,869***
21	Burkina Faso	LDC	25,739		***15443.4***	***2702.595***	***1158.255***	***19304.25***	15%	15,443	2,703	1,158	***19,304***
22	Burundi	LDC	4,300		***2580***	***451.5***	***193.5***	***3225***	15%	2,580	452	194	***3,225***
23	Cambodia	LDC	15,000		***9000***	***1575***	***675***	***11250***	15%	9,000	1,575	675	***11,250***
24	Cameroon		31,000						15%	18,600	3,255	1,395	***23,250***
25	Central Afr. Rep.	LDC	4,769		***2861.4***	***500.745***	***214.605***	***3576.75***	15%	2,861	501	215	***3,577***
26	Chad	LDC	5,200		***3120***	***546***	***234***	***3900***	15%	3,120	546	234	***3,900***
27	Chile		95,000						15%	57,000	9,975	4,275	***71,250***
28	China		4,360,243						15%	2,616,146	457,826	196,211	***3,270,182***
29	Colombia		150,000						15%	90,000	15,750	6,750	***112,500***
30	Comoros	LDC	510		***306***	***53.55***	***22.95***	***382.5***	15%	306	54	23	***383***
31	Congo		2,400						15%	1,440	252	108	***1,800***
32	Congo Dem. Rep	LDC	19,769		***11861.4***	***2075.745***	***889.605***	***14826.75***	15%	11,861	2,076	890	***14,827***
33	Costa Rica		19,500						15%	11,700	2,048	878	***14,625***
34	Cote d'Ivoire		33,000						15%	19,800	3,465	1,485	***24,750***
35	Croatia		10,640						15%	6,384	1,117	479	***7,980***
36	Cuba		27,440						15%	16,464	2,881	1,235	***20,580***
37	Djibouti	LDC			***0***	***0***	***0***	***0***	15%	0	0	0	***0***
38	Dominican Rep		47,500						15%	28,500	4,988	2,138	***35,625***
39	Ecuador		104,217						15%	62,530	10,943	4,690	***78,163***
40	Egypt		95,000						15%	57,000	9,975	4,275	***71,250***
41	El Salvador		13,437						15%	8,062	1,411	605	***10,078***
42	Eq. Guinea		320						15%	192	34	14	***240***
43	Eritrea	LDC	1,370		***822***	***143.85***	***61.65***	***1027.5***	15%	822	144	62	***1,028***
44	Ethiopia	LDC	39,000		***23400***	***4095***	***1755***	***29250***	15%	23,400	4,095	1,755	***29,250***
45	FYR Macedonia		2,617						15%	1,570	275	118	***1,963***
46	Gabon		3,100						15%	1,860	326	140	***2,325***
47	Gambia	LDC	650		***390***	***68.25***	***29.25***	***487.5***	15%	390	68	29	***488***
48	Georgia		9,100						15%	5,460	956	410	***6,825***
49	Ghana		30,000						15%	18,000	3,150	1,350	***22,500***
50	Guatemala		27,000						15%	16,200	2,835	1,215	***20,250***
51	Guinea	LDC	15,865		***9519***	***1665.825***	***713.925***	***11898.75***	15%	9,519	1,666	714	***11,899***
52	Guinea Bissau	LDC	1,600		***960***	***168***	***72***	***1200***	15%	960	168	72	***1,200***
53	Guyana		20,000						15%	12,000	2,100	900	***15,000***
54	Haiti	LDC	5,500		***3300***	***577.5***	***247.5***	***4125***	15%	3,300	578	248	***4,125***
55	Honduras		18,700						15%	11,220	1,964	842	***14,025***
56	India		430,000						15%	258,000	45,150	19,350	***322,500***
57	Indonesia		1,249,426						15%	749,656	131,190	56,224	***937,070***
58	Iran		280,000						15%	168,000	29,400	12,600	***210,000***
59	Iraq		33,000						15%	19,800	3,465	1,485	***24,750***
60	Jamaica		12,500						15%	7,500	1,313	563	***9,375***
61	Jordan		25,000						15%	15,000	2,625	1,125	***18,750***
62	Kazakhstan		25,500						15%	15,300	2,678	1,148	***19,125***
63	Kenya		28,657						15%	17,194	3,009	1,290	***21,493***
64	Korea North		21,000						15%	12,600	2,205	945	***15,750***
65	Korea South		110,000						15%	66,000	11,550	4,950	***82,500***
66	Kuwait		32,500						15%	19,500	3,413	1,463	***24,375***
67	Kyrgyzstan		4,121						15%	2,473	433	185	***3,091***
68	Laos	LDC	19,800		***11880***	***2079***	***891***	***14850***	15%	11,880	2,079	891	***14,850***
69	Lebanon		35,000						15%	21,000	3,675	1,575	***26,250***
70	Lesotho	LDC	1,800		***1080***	***189***	***81***	***1350***	15%	1,080	189	81	***1,350***
71	Libya		25,000						15%	15,000	2,625	1,125	***18,750***
72	Madagascar	LDC	24,000		***14400***	***2520***	***1080***	***18000***	15%	14,400	2,520	1,080	***18,000***
73	Malawi	LDC	15,200		***9120***	***1596***	***684***	***11400***	15%	9,120	1,596	684	***11,400***

74	Malaysia		185,000						15%	111,000	19,425	8,325	***138,750***
75	Mali	LDC	31,000		***18600***	***3255***	***1395***	***23250***	15%	18,600	3,255	1,395	***23,250***
76	Mauritania	LDC	4,200		***2520***	***441***	***189***	***3150***	15%	2,520	441	189	***3,150***
77	Mauritius		9,800						15%	5,880	1,029	441	***7,350***
78	Mexico		425,000						15%	255,000	44,625	19,125	***318,750***
79	Moldova		17,442						15%	10,465	1,831	785	***13,082***
80	Mongolia		30						15%	18	3	1	***23***
81	Morocco		137,000						15%	82,200	14,385	6,165	***102,750***
82	Mozambique	LDC	28,000		***16800***	***2940***	***1260***	***21000***	15%	16,800	2,940	1,260	***21,000***
83	Myanmar	LDC	82,000		***49200***	***8610***	***3690***	***61500***	15%	49,200	8,610	3,690	***61,500***
84	Namibia		3,500						15%	2,100	368	158	***2,625***
85	Nepal	LDC	22,790		***13674***	***2392.95***	***1025.55***	***17092.5***	15%	13,674	2,393	1,026	***17,093***
86	New Caledonia		600						15%	360	63	27	***450***
87	Nicaragua		18,000						15%	10,800	1,890	810	***13,500***
88	Niger	LDC	25,000		***15000***	***2625***	***1125***	***18750***	15%	15,000	2,625	1,125	***18,750***
89	**Nigeria**		150,700						15%	90,420	15,824	6,782	***113,025***
90	Oman		4,200						15%	2,520	441	189	***3,150***
91	Pakistan		166,000						15%	99,600	17,430	7,470	***124,500***
92	Panama		14,000						15%	8,400	1,470	630	***10,500***
93	Paraguay		17,000						15%	10,200	1,785	765	***12,750***
94	Peru		99,255						15%	59,553	10,422	4,466	***74,441***
95	Philippines		136,001						15%	81,601	14,280	6,120	***102,001***
96	Qatar		4,500						15%	2,700	473	203	***3,375***
97	**Romania**		87,014						15%	52,208	9,136	3,916	***65,261***
98	Russia		328,707						15%	197,224	34,514	14,792	***246,530***
99	Rwanda	LDC	2,000		***1200***	***210***	***90***	***1500***	15%	1,200	210	90	***1,500***
100	Sao Tome	LDC	290		***174***	***30.45***	***13.05***	***217.5***	15%	174	30	13	***218***
101	Saudi Arabia		141,000						15%	84,600	14,805	6,345	***105,750***
102	Senegal	LDC	26,959		***16175.4***	***2830.695***	***1213.155***	***20219.25***	15%	16,175	2,831	1,213	***20,219***
103	Serbia-Mont		15,221						15%	9,133	1,598	685	***11,416***
104	Sierra Leone	LDC	7,500		***4500***	***787.5***	***337.5***	***5625***	15%	4,500	788	338	***5,625***
105	Singapore		2,000						15%	1,200	210	90	***1,500***
106	Somalia	LDC	3,400		***2040***	***357***	***153***	***2550***	15%	2,040	357	153	***2,550***
107	South Africa		121,000						15%	72,600	12,705	5,445	***90,750***
108	Sri Lanka		11,636						15%	6,982	1,222	524	***8,727***
109	Sudan	LDC	37,000		***22200***	***3885***	***1665***	***27750***	15%	22,200	3,885	1,665	***27,750***
110	Suriname		3,800						15%	2,280	399	171	***2,850***
111	Swaziland		3,200						15%	1,920	336	144	***2,400***
112	Syria		23,795						15%	14,277	2,498	1,071	***17,846***
113	Taipei China (Taiwan)								15%	0	0	0	***0***
114	Tajikistan		2,296						15%	1,378	241	103	***1,722***
115	Tanzania	LDC	30,000		***18000***	***3150***	***1350***	***22500***	15%	18,000	3,150	1,350	***22,500***
116	Thailand		260,000						15%	156,000	27,300	11,700	***195,000***
117	Togo	LDC	9,000		***5400***	***945***	***405***	***6750***	15%	5,400	945	405	***6,750***
118	Trinidad-Tobago		28,200						15%	16,920	2,961	1,269	***21,150***
119	Tunisia		64,000						15%	38,400	6,720	2,880	***48,000***
120	Turkey		296,876						15%	178,126	31,172	13,359	***222,657***
121	Turkmenistan		7,000						15%	4,200	735	315	***5,250***
122	Uganda	LDC	32,600		***19560***	***3423***	***1467***	***24450***	15%	19,560	3,423	1,467	***24,450***
123	Ukraine		131,976						15%	79,186	13,857	5,939	***98,982***
124	UAE		15,000						15%	9,000	1,575	675	***11,250***
125	Uruguay		14,000						15%	8,400	1,470	630	***10,500***
126	Uzbekistan		20,540						15%	12,324	2,157	924	***15,405***
127	Vanuatu	LDC	340		***204***	***35.7***	***15.3***	***255***	15%	204	36	15	***255***
128	Venezuela		110,000						15%	66,000	11,550	4,950	***82,500***
129	**Vietnam**		153,937						15%	92,362	16,163	6,927	***115,453***
130	Yemen	LDC	37,000		***22200***	***3885***	***1665***	***27750***	15%	22,200	3,885	1,665	***27,750***
131	Zambia	LDC	30,000		***18000***	***3150***	***1350***	***22500***	15%	18,000	3,150	1,350	***22,500***
132	Zimbabwe		23,000						15%	13,800	2,415	1,035	***17,250***
				Annual impact on LDCs	**Poultry value losses for LDCs**	**Culling/ Disposal costs for LDCs**	**Control costs for LDCs**	***Total impact for LDCs***					
	TOTAL		**12,938,767**	**scenario A**	**58,080**	**10,164**	**4,356**	**72,600**		**7,763,260**	**1,358,571**	**582,245**	***9,704,075***
				scenario B	**206,292**	**36,101**	**15,472**	**257,865**					
				scenario C	**467,749**	**81,856**	**35,081**	**584,686**					
				Total impact on LDCs									
				scenario A	**116,160**	**20,328**	**8,712**	**145,200**					
				scenario B	**412,584**	**72,202**	**30,944**	**515,730**					
Notes:				**scenario C**	**935,497**	**163,712**	**70,162**	**1,169,372**					

(i) The 'global' impact is given in a range, depending on 3 scenarios in terms of country coverage (scenarios A to C).
Furthermore, it is indicated per year and in total, depending on the assumptions for duration of the epidemic - see 'assumptions outbreak costs'
Includes animal value losses, culling/disposal and control costs
(ii) Scenario A Includes the following countries: Cambodia, China, Indonesia, Laos, Thailand, Vietnam, S. Korea; Mongolia, Kazakhstan, Russia, Turkey, Romania; Nigeria, Niger, Sudan
(iii) Scenario B includes the countries of Note (b) above plus : N korea, Malaysia, Brunei, Myanmar, Singapore, Philippines; Bangladesh, Bhutan, India, Nepal, Sri Lanka
(iv) Scenario C includes all OIE developing country members (132 countries in total)
(v) Latest data available, source FAOSTAT. Chicken numbers: since 2005 FAOSTAT does not differentiate any more between broilers and layers (double counting between the 2 categories was possible in earlier years).

	in '000 US$					in '000 US$			
	Impact: scenario 2 (low impact)					Impact: scenario 3 (high impact)			
Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*	Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*
7%	42,525	5,103	3,402	***51,030***	25%	151,875	18,225	12,150	***182,250***
	2.5	*0.3*	*0.2*			*2.5*	*0.3*	*0.2*	
7%	58,800	9,800	3,920	***72,520***	25%	210,000	35,000	14,000	***259,000***
	6	*1*	*0.4*			*6*	*1*	*0.4*	
	4	*0.7*	*0.3*			*4*	*0.7*	*0.3*	
7%	***1,993,385***	***348,842***	***149,504***	***2,491,732***	25%	***7,119,233***	***1,245,866***	***533,942***	***8,899,041***
7%	***2,286,169***	***400,080***	***171,463***	***2,857,712***	25%	***8,164,890***	***1,428,856***	***612,367***	***10,206,113***
7%	***3,622,855***	***634,000***	***271,714***	***4,528,568***	25%	***12,938,767***	***2,264,284***	***970,408***	***16,173,459***
	1,993,385	***348,842***	***149,504***	***2,491,732***		***21,357,699***	***3,737,597***	***1,601,827***	***26,697,124***
	2,286,169	***400,080***	***171,463***	***2,857,712***		***24,494,670***	***4,286,567***	***1,837,100***	***30,618,338***
	3,622,855	***634,000***	***271,714***	***4,528,568***		***38,816,301***	***6,792,853***	***2,911,223***	***48,520,376***
				2					*12*
7%				***996,693***	25%				***21,357,699***
7%				***1,143,085***	25%				***24,494,670***
7%				***1,811,427***	25%				***38,816,301***
				996,693					***64,073,097***
				1,143,085					***73,484,010***
				1,811,427					***116,448,903***
				3,488,424					***30,256,740***
				4,000,796					***34,700,783***
				6,339,996					***54,989,760***
				3,488,424					***90,770,221***
				4,000,796					***104,102,348***
				6,339,996					***164,969,279***

	in '000 US$					in '000 US$			
	Impact: scenario 2 (low impact)					Impact: scenario 3 (high impact)			
Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*	Poultry stock losses (%)	Poultry value losses	Culling/ Disposal costs	Control costs	*Total impact*
7%	2,352	412	176	***2,940***	25%	8,400	1,470	630	***10,500***
7%	1,308	229	98	***1,635***	25%	4,670	817	350	***5,838***
7%	35,000	6,125	2,625	***43,750***	25%	125,000	21,875	9,375	***156,250***
7%	1,904	333	143	***2,380***	25%	6,800	1,190	510	***8,500***
7%	26,600	4,655	1,995	***33,250***	25%	95,000	16,625	7,125	***118,750***
7%	1,285	225	96	***1,607***	25%	4,590	803	344	***5,738***
7%	4,915	860	369	***6,144***	25%	17,553	3,072	1,316	***21,941***
7%	132	23	10	***165***	25%	470	82	35	***588***
7%	39,760	6,958	2,982	***49,700***	25%	142,000	24,850	10,650	***177,500***
7%	952	167	71	***1,190***	25%	3,400	595	255	***4,250***
7%	6,888	1,205	517	***8,610***	25%	24,600	4,305	1,845	***30,750***
7%	448	78	34	***560***	25%	1,600	280	120	***2,000***
7%	3,640	637	273	***4,550***	25%	13,000	2,275	975	***16,250***
7%	64	11	5	***81***	25%	230	40	17	***288***
7%	21,000	3,675	1,575	***26,250***	25%	75,000	13,125	5,625	***93,750***
7%	2,520	441	189	***3,150***	25%	9,000	1,575	675	***11,250***
7%	1,120	196	84	***1,400***	25%	4,000	700	300	***5,000***
7%	308,000	53,900	23,100	***385,000***	25%	1,100,000	192,500	82,500	***1,375,000***
7%	3,640	637	273	***4,550***	25%	13,000	2,275	975	***16,250***
7%	4,805	841	360	***6,006***	25%	17,159	3,003	1,287	***21,449***
7%	7,207	1,261	541	***9,009***	25%	25,739	4,504	1,930	***32,174***
7%	1,204	211	90	***1,505***	25%	4,300	753	323	***5,375***
7%	4,200	735	315	***5,250***	25%	15,000	2,625	1,125	***18,750***
7%	8,680	1,519	651	***10,850***	25%	31,000	5,425	2,325	***38,750***
7%	1,335	234	100	***1,669***	25%	4,769	835	358	***5,961***
7%	1,456	255	109	***1,820***	25%	5,200	910	390	***6,500***
7%	26,600	4,655	1,995	***33,250***	25%	95,000	16,625	7,125	***118,750***
7%	1,220,868	213,652	91,565	***1,526,085***	25%	4,360,243	763,043	327,018	***5,450,304***
7%	42,000	7,350	3,150	***52,500***	25%	150,000	26,250	11,250	***187,500***
7%	143	25	11	***179***	25%	510	89	38	***638***
7%	672	118	50	***840***	25%	2,400	420	180	***3,000***
7%	5,535	969	415	***6,919***	25%	19,769	3,460	1,483	***24,711***
7%	5,460	956	410	***6,825***	25%	19,500	3,413	1,463	***24,375***
7%	9,240	1,617	693	***11,550***	25%	33,000	5,775	2,475	***41,250***
7%	2,979	521	223	***3,724***	25%	10,640	1,862	798	***13,300***
7%	7,683	1,345	576	***9,604***	25%	27,440	4,802	2,058	***34,300***
7%	0	0	0	***0***	25%	0	0	0	***0***
7%	13,300	2,328	998	***16,625***	25%	47,500	8,313	3,563	***59,375***
7%	29,181	5,107	2,189	***36,476***	25%	104,217	18,238	7,816	***130,271***
7%	26,600	4,655	1,995	***33,250***	25%	95,000	16,625	7,125	***118,750***
7%	3,762	658	282	***4,703***	25%	13,437	2,351	1,008	***16,796***
7%	90	16	7	***112***	25%	320	56	24	***400***
7%	384	67	29	***480***	25%	1,370	240	103	***1,713***
7%	10,920	1,911	819	***13,650***	25%	39,000	6,825	2,925	***48,750***
7%	733	128	55	***916***	25%	2,617	458	196	***3,271***
7%	868	152	65	***1,085***	25%	3,100	543	233	***3,875***
7%	182	32	14	***228***	25%	650	114	49	***813***
7%	2,548	446	191	***3,185***	25%	9,100	1,593	683	***11,375***
7%	8,400	1,470	630	***10,500***	25%	30,000	5,250	2,250	***37,500***
7%	7,560	1,323	567	***9,450***	25%	27,000	4,725	2,025	***33,750***
7%	4,442	777	333	***5,553***	25%	15,865	2,776	1,190	***19,831***
7%	448	78	34	***560***	25%	1,600	280	120	***2,000***
7%	5,600	980	420	***7,000***	25%	20,000	3,500	1,500	***25,000***
7%	1,540	270	116	***1,925***	25%	5,500	963	413	***6,875***
7%	5,236	916	393	***6,545***	25%	18,700	3,273	1,403	***23,375***
7%	120,400	21,070	9,030	***150,500***	25%	430,000	75,250	32,250	***537,500***
7%	349,839	61,222	26,238	***437,299***	25%	1,249,426	218,650	93,707	***1,561,783***
7%	78,400	13,720	5,880	***98,000***	25%	280,000	49,000	21,000	***350,000***
7%	9,240	1,617	693	***11,550***	25%	33,000	5,775	2,475	***41,250***
7%	3,500	613	263	***4,375***	25%	12,500	2,188	938	***15,625***
7%	7,000	1,225	525	***8,750***	25%	25,000	4,375	1,875	***31,250***
7%	7,140	1,250	536	***8,925***	25%	25,500	4,463	1,913	***31,875***
7%	8,024	1,404	602	***10,030***	25%	28,657	5,015	2,149	***35,821***
7%	5,880	1,029	441	***7,350***	25%	21,000	3,675	1,575	***26,250***
7%	30,800	5,390	2,310	***38,500***	25%	110,000	19,250	8,250	***137,500***
7%	9,100	1,593	683	***11,375***	25%	32,500	5,688	2,438	***40,625***
7%	1,154	202	87	***1,442***	25%	4,121	721	309	***5,151***
7%	5,544	970	416	***6,930***	25%	19,800	3,465	1,485	***24,750***
7%	9,800	1,715	735	***12,250***	25%	35,000	6,125	2,625	***43,750***
7%	504	88	38	***630***	25%	1,800	315	135	***2,250***
7%	7,000	1,225	525	***8,750***	25%	25,000	4,375	1,875	***31,250***
7%	6,720	1,176	504	***8,400***	25%	24,000	4,200	1,800	***30,000***
7%	4,256	745	319	***5,320***	25%	15,200	2,660	1,140	***19,000***

7%	51,800	9,065	3,885	*64,750*	25%	185,000	32,375	13,875	*231,250*
7%	8,680	1,519	651	*10,850*	25%	31,000	5,425	2,325	*38,750*
7%	1,176	206	88	*1,470*	25%	4,200	735	315	*5,250*
7%	2,744	480	206	*3,430*	25%	9,800	1,715	735	*12,250*
7%	119,000	20,825	8,925	*148,750*	25%	425,000	74,375	31,875	*531,250*
7%	4,884	855	366	*6,105*	25%	17,442	3,052	1,308	*21,803*
7%	8	1	1	*11*	25%	30	5	2	*38*
7%	38,360	6,713	2,877	*47,950*	25%	137,000	23,975	10,275	*171,250*
7%	7,840	1,372	588	*9,800*	25%	28,000	4,900	2,100	*35,000*
7%	22,960	4,018	1,722	*28,700*	25%	82,000	14,350	6,150	*102,500*
7%	980	172	74	*1,225*	25%	3,500	613	263	*4,375*
7%	6,381	1,117	479	*7,977*	25%	22,790	3,988	1,709	*28,488*
7%	168	29	13	*210*	25%	600	105	45	*750*
7%	5,040	882	378	*6,300*	25%	18,000	3,150	1,350	*22,500*
7%	7,000	1,225	525	*8,750*	25%	25,000	4,375	1,875	*31,250*
7%	42,196	7,384	3,165	*52,745*	25%	150,700	26,373	11,303	*188,375*
7%	1,176	206	88	*1,470*	25%	4,200	735	315	*5,250*
7%	46,480	8,134	3,486	*58,100*	25%	166,000	29,050	12,450	*207,500*
7%	3,920	686	294	*4,900*	25%	14,000	2,450	1,050	*17,500*
7%	4,760	833	357	*5,950*	25%	17,000	2,975	1,275	*21,250*
7%	27,791	4,863	2,084	*34,739*	25%	99,255	17,370	7,444	*124,069*
7%	38,080	6,664	2,856	*47,600*	25%	136,001	23,800	10,200	*170,001*
7%	1,260	221	95	*1,575*	25%	4,500	788	338	*5,625*
7%	24,364	4,264	1,827	*30,455*	25%	87,014	15,227	6,526	*108,768*
7%	92,038	16,107	6,903	*115,047*	25%	328,707	57,524	24,653	*410,884*
7%	560	98	42	*700*	25%	2,000	350	150	*2,500*
7%	81	14	6	*102*	25%	290	51	22	*363*
7%	39,480	6,909	2,961	*49,350*	25%	141,000	24,675	10,575	*176,250*
7%	7,549	1,321	566	*9,436*	25%	26,959	4,718	2,022	*33,699*
7%	4,262	746	320	*5,327*	25%	15,221	2,664	1,142	*19,026*
7%	2,100	368	158	*2,625*	25%	7,500	1,313	563	*9,375*
7%	560	98	42	*700*	25%	2,000	350	150	*2,500*
7%	952	167	71	*1,190*	25%	3,400	595	255	*4,250*
7%	33,880	5,929	2,541	*42,350*	25%	121,000	21,175	9,075	*151,250*
7%	3,258	570	244	*4,073*	25%	11,636	2,036	873	*14,545*
7%	10,360	1,813	777	*12,950*	25%	37,000	6,475	2,775	*46,250*
7%	1,064	186	80	*1,330*	25%	3,800	665	285	*4,750*
7%	896	157	67	*1,120*	25%	3,200	560	240	*4,000*
7%	6,663	1,166	500	*8,328*	25%	23,795	4,164	1,785	*29,744*
7%	0	0	0	*0*	25%	0	0	0	*0*
7%	643	113	48	*804*	25%	2,296	402	172	*2,870*
7%	8,400	1,470	630	*10,500*	25%	30,000	5,250	2,250	*37,500*
7%	72,800	12,740	5,460	*91,000*	25%	260,000	45,500	19,500	*325,000*
7%	2,520	441	189	*3,150*	25%	9,000	1,575	675	*11,250*
7%	7,896	1,382	592	*9,870*	25%	28,200	4,935	2,115	*35,250*
7%	17,920	3,136	1,344	*22,400*	25%	64,000	11,200	4,800	*80,000*
7%	83,125	14,547	6,234	*103,907*	25%	296,876	51,953	22,266	*371,095*
7%	1,960	343	147	*2,450*	25%	7,000	1,225	525	*8,750*
7%	9,128	1,597	685	*11,410*	25%	32,600	5,705	2,445	*40,750*
7%	36,953	6,467	2,771	*46,192*	25%	131,976	23,096	9,898	*164,970*
7%	4,200	735	315	*5,250*	25%	15,000	2,625	1,125	*18,750*
7%	3,920	686	294	*4,900*	25%	14,000	2,450	1,050	*17,500*
7%	5,751	1,006	431	*7,189*	25%	20,540	3,595	1,541	*25,675*
7%	95	17	7	*119*	25%	340	60	26	*425*
7%	30,800	5,390	2,310	*38,500*	25%	110,000	19,250	8,250	*137,500*
7%	43,102	7,543	3,233	*53,878*	25%	153,937	26,939	11,545	*192,421*
7%	10,360	1,813	777	*12,950*	25%	37,000	6,475	2,775	*46,250*
7%	8,400	1,470	630	*10,500*	25%	30,000	5,250	2,250	*37,500*
7%	6,440	1,127	483	*8,050*	25%	23,000	4,025	1,725	*28,750*
	3,622,855	**634,000**	**271,714**	***4,528,568***		**12,938,767**	**2,264,284**	**970,408**	***16,173,459***

Disease: HPAI							**in '000 US$**		
			Baseline				**Impact: scenario 1 (most likely)**		
	Poultry stock ('000 head)	**GDP ('000 US$)**	**Trade volume (tonnes)**	**Tourism/travel value ('000 US$)**	**Ripple: domestic market (a)**	**Ripple: export markets (b)**	**Spill-over: tourism (c)**	**Wider society (d)**	***Total impact***
	2005	*2004-05 avg*	*2003-04 avg.*	*2004 est.*					
	12,938,767	44,450,000,000	8,630,000	1,500,000,000					
Indirect costs/losses: Global impact, annual (i)									
					5,279,017	3,774,984	72,000,000	311,150,000	***392,204,001***
								711,200,000	***792,254,001***
Indirect costs/losses: Global impact, total (i)									
					10,558,034	7,549,968	144,000,000	622,300,000	***784,408,002***
								1,422,400,000	***1,584,508,002***
Notes:									
(a) Domestic sales loss = loss in monthly sales volume (% of poultry stock affected by crisis x lower price) + loss in monthly sales value (% of poultry stock not affected by crisis x price drop) x duration (months):									
					Ripple (domestic market): detailed calculations				
	poultry sold in dometic markets ('000 head):				2,587,753				
	poultry sales loss ('000 head):				517,551				
	poultry sales loss (volume loss x lower price) ('000 US$):				931,591				
	rest of poultry sold in domestic markets ('000 head):				2,070,203				
	poultry sales loss (lower volume x price drop) ('000 US$)				828,081				
	Total poultry sales loss (monthly, '000 US$):				1,759,672				
	Total poultry sales loss ('000 US$):				5,279,017				
(b) Exports loss = loss in monthly exports volume (% of exports affected by crisis x lower price) + loss in monthly sales value (% of exports not affected by crisis x price drop) x duration (months) :									
					Ripple (export markets): detailed calculations				
	poultry exports (tonnes):				8,630,000				
	poultry exports loss (tonnes):				43,150				
	poultry exports loss (volume loss x lower price) ('000 US$):				52,319				
	rest of poultry exports (tonnes):				8,586,850				
	poultry sales loss (lower volume x price drop) ('000 US$)				104,973				
	Total poultry sales loss (monthly, '000 US$):				157,291				
	Total poultry sales loss ('000 US$):				3,774,984				
(c) tourism value loss x duration (months)									
(d) low value assumes 15% attack rate; high value assumes 35% attack rate									
(i) Indicated per year and in total, depending on the assumptions for duration of the epidemic - see 'assumptions outbreak costs'									
FOR ASSUMPTIONS SEE WORKSHEET 'Assumptions outbreak costs'									

	in '000 US$					in '000 US$			
		Impact: scenario 2 (low impact)					Impact: scenario 3 (high impact)		
Ripple: domestic market (a)	**Ripple: export markets (b)**	**Spill-over: tourism (c)**	**Wider society (d)**	***Total impact***	**Ripple: domestic market (a)**	**Ripple: export markets (b)**	**Spill-over: tourism (c)**	**Wider society (d)**	***Total impact***
957,469	883,898	18,000,000	177,800,000	***197,641,367***	17,389,703	11,255,904	360,000,000	444,500,000	***833,145,607***
			711,200,000	***731,041,367***				1,333,500,000	***1,722,145,607***
957,469	883,898	18,000,000	177,800,000	***197,641,367***	52,169,109	33,767,712	1,080,000,000	1,333,500,000	***2,499,436,821***
			711,200,000	***731,041,367***				4,000,500,000	***5,166,436,821***
Ripple (domestic market): detailed calculations					**Ripple (domestic market): detailed calculations**				
poultry sold in dometic markets ('000 head):			2,587,753		poultry sold in dometic markets ('000 head):			2,587,753	
poultry sales loss ('000 head):			258,775		poultry sales loss ('000 head):			1,035,101	
poultry sales loss (volume loss x lower price) ('000 US$):			491,673		poultry sales loss (volume loss x lower price) ('000 US$):			1,656,162	
rest of poultry sold in domestic markets ('000 head):			2,328,978		rest of poultry sold in domestic markets ('000 head):			1,552,652	
poultry sales loss (lower volume x price drop) ('000 US$)			465,796		poultry sales loss (lower volume x price drop) ('000 US$)			1,242,122	
Total poultry sales loss (monthly, '000 US$):			957,469		Total poultry sales loss (monthly, '000 US$):			2,898,284	
Total poultry sales loss ('000 US$):			957,469		Total poultry sales loss ('000 US$):			17,389,703	
Ripple (export markets): detailed calculations					**Ripple (export markets): detailed calculations**				
poultry exports (tonnes):			8,630,000		poultry exports (tonnes):			8,630,000	
poultry exports loss (tonnes):			17,260		poultry exports loss (tonnes):			86,300	
poultry exports loss (volume loss x lower price) ('000 US$):			21,014		poultry exports loss (volume loss x lower price) ('000 US$):			103,774	
rest of poultry exports (tonnes):			8,612,740		rest of poultry exports (tonnes):			8,543,700	
poultry sales loss (lower volume x price drop) ('000 US$)			52,645		poultry sales loss (lower volume x price drop) ('000 US$)			208,890	
Total poultry sales loss (monthly, '000 US$):			73,658		Total poultry sales loss (monthly, '000 US$):			312,664	
Total poultry sales loss ('000 US$):			883,898		Total poultry sales loss ('000 US$):			11,255,904	

		Global HPAI	
	Period	**Total**	**Year avg**
Global number of poultry culled/dead ('000 head) (a)	*2005-06*	250,000	125,000
Global poultry population ('000 head) (b)	*2005*		12,938,767
Share of global poultry population (%)	*2005-06*	1.9%	1.0%
Global value of poultry trade loss ('000 US$) (c)	*2006*		2,000,000
Trade loss as % of global value of poultry exports (c) (d)	*2006/2003-04 avg*		19.0%
Global volume of poultry trade loss (tonnes) (d)	*2004-05/2003-04 a*	863,000	431,500
Trade loss as % of global volume of poultry exports (c) (d)	*2004-05*	10.0%	5.0%
World poultry price drop (%) (c)	*2004-05*	20.0%	10.0%
Loss in travel and tourism sector (% of global value) (e)	*estimate*		5.0%
Human infections: cases (f)	*2003-Feb 2007*	271	90
Human infections: dead (f)	*2003-Feb 2007*	165	55
Human infections: fatality rate (%) (f)	*2003-Feb 2007*	60.9%	60.9%
AI pandemic impact (GDP loss, '000 US$) (g)	*simulation*		400,000,000
AI pandemic impact (% fall in GDP) (g)	*simulation*		1%
AI pandemic impact (GDP loss, '000 US$) (h)	*simulation*		800,000,000
AI pandemic impact (% fall in GDP) (h)	*simulation*		2%
AI pandemic impact (GDP loss, '000 US$) (i)	*simulation*		2,000,000,000
AI pandemic impact (% fall in GDP) (i)	*simulation*		5%
Global GDP ('000 US$, nominal) (k)	*2005*		44,450,000,000
Global value of poultry trade ('000 US$) (d)	*2003-04 average*		10,550,000
Global volume of poultry trade (tonnes) (d)	*2003-04 average*		8,630,000
World poultry price (US$ per kg) (l)	*2003-04 average*		1.2
Global value of travel/tourism ('000 US$) (m)	*2004 est.*		1,500,000,000

Notes:

(a) FAO data, as at end of October 2006
(b) FAOSTAT, total chicken numbers
(c) FAO poultry meat outlook; FAO symposium, November 2006
(d) FAOSTAT, value and volume of global exports
(e) OEF analysis of a human pandemic assumes total halt in travel/tourism (A210) - here a milder impact is assumed following an AI in animals only.
(f) WHO (3 February 2007)
(g) Oxford Economic Forecasting, based on SARS, minimum cost
(h) World Bank estimates, based on SARS
(i) Oxford Economic Forecasting, based on SARS, adding 'trade multiplier effects'
(k) World Bank, IMF
(l) On average the value of trade divided by volume. In 2006, this was also the average export price for the US, Brazil and Europe, which together account for over 80% of world poultry exports.
(m) Global annual value of travel/tourism estimated by World Tourism Organisation (UN/WTO)

	Vietnam: HPAI	
	VND	**USD**
Total costs (2005) (a)	797,300,000,000	51,108,974
Total costs (2004-5) (a)	1,936,970,000,000	124,164,744
Total compensation provided (1)	267,991,000,000	17,178,910
Value of culled animals per head (2)	40,000	2.56
Compensation provided per head (3)	5,000	0.32
Restocking subsidy per head (4)	2,000	0.13
Culling and disposal costs per head (5)	3,900	0.25
Control costs per head (6)	3,000	0.19
Number of birds culled (2005)	*17,000,000*	
Total compensation (2005)	85,000,000,000	5,448,718
Total value of culled animals (2005)	680,000,000,000	43,589,744
Total restocking subsidy (2005)	34,000,000,000	2,179,487
Total culling and disposal costs (2005)	66,300,000,000	4,250,000
Total control costs (2005)	51,000,000,000	3,269,231
Number of birds culled (2004-5)	*41,300,000*	
Total compensation (2004-5)	206,500,000,000	13,237,179
Total value of culled animals (2004-5)	1,652,000,000,000	105,897,436
Total restocking subsidy (2004-5)	82,600,000,000	5,294,872
Total culling and disposal costs (2004-5)	161,070,000,000	10,325,000
Total control costs (2004-5)	123,900,000,000	7,942,308
Laying hen market value (7)	100,000	6.41
Poultry farming income (8)		
'Normal' (pre-outbreak)	600,000,000,000	38,461,538
'Normal' number of broilers sold	40,000,000	
'Normal' income per broiler	15,000	0.96
Crisis (average during crisis)	150,000,000,000	9,615,385
Total income loss during crisis	2,700,000,000,000	173,076,923

Notes:

(a) includes culling (value of culled animals and culling/disposal) and control costs

(1) To date central government budget allocated for AI amounts to 268 billion VND, which comes from the budget of the National Prevention/Emergency Fund and corresponds to some 15% of this budget (source: A3)

(2) Assuming that the provided compensation from the Fund (at 5,000 VND per head) only represents 10-15% of the real market value. This is the real 'lost income per head' (source: A3)

(3) Compensation for culling only, at 5,000 VND per head

(4) On the basis of the provided compensation from the Fund for restocking (at 2,000 VND per head)

(5) Cost estimates per bird on the basis of destruction and disposal of 200 chickens per farm (source: A7)

(6) On the basis of the provided compensation from the Fund. Includes control costs during and after the outbreak (i.e. equipment, facilities, disinfectants, protective clothing, staff in quarantine stations etc.)

(7) The market value of a layer is considered to be 100,000 VND/head (source: A3)

(8) Monthly sales by price. Income during 'normal' and 'crisis' periods calculated as follows:

At the lowest point of the crisis (Oct/Nov 2005), prices were 50 to 60% below normal, and volume of poultry sales had fallen from about 40 million poultry per month to 20 million (unofficial data, source: A9)

Price pre-crisis = VND 15,000/poultry. This is based on VND 10,000 /kg (semi-commercial farmer, source: A9), for an average 1.5 kg/broiler (productivity in Vietnam is relatively low, source: FAO).

Crisis period assumed to be an average over 6 months (in the beginning crisis has a higher impact on sales/prices, with return to normal the impact progressively diminishes).

Exchange rate: 1USD = VND	*15600*

Vietnam: Country data

Broiler chicken (no of heads), 2005	195,000,000
Laying hens (no of heads), 2005	48,000,000
Total (2005)	243,000,000
Number of birds culled (2005) % of total	7%
Number of birds culled (2004) % of total	10%
Number of birds culled (2004-5) % of total	17%
Number of birds culled (2004-5 average) %	13%

source: FAOSTAT

Notes:

(a) It is estimated that 65-70% of the total poultry population is kept in backyard farms.

Large commercial systems represent 20-25% of the total poultry population and about 10-15% is kept in small commercial farms. (A16)

	Nigeria: HPAI				**Africa: HPAI**	
	Nigerian Naria (N)	**USD**			**USD**	**USD**
Total costs (Oct. 2006) (a)	1,068,760,000	8,389,011		Total costs (1 yr est)	151,340,659	
Total costs (est.) (a) (c)	2,313,696,000	18,160,879		Total costs (3 yrs est)		454,021,978
Total compensation (2006 est.) (c)(d)	655,855,200	5,148,000				
Value of culled animals per head	700	5.49		Value of culled animals per head		5.49
Compensation rate per head (d)	248	1.95				
Culling and disposal costs per head (e)	127	1.00		Culling and disposal costs per head (2)		1.00
Control costs per head (f)	49	0.38		Control costs per head (f)		0.38
Number of birds culled (Oct. 2006) (b)	*900,000*	*900,000*				
Number of birds died (Oct. 2006) (b)	*400,000*	*400,000*				
Number of birds culled (est) (c)	*2,640,000*	*2,640,000*		*Number of birds culled (3 yrs est) (1)*	*22,000,000*	*66,000,000*
Total value of culled/dead animals (Oct. 2006)	910,000,000	7,142,857		Total value of culled/dead animals (3 yrs est.)	120,879,121	362,637,363
Total culling and disposal costs (Oct. 2006)	114,660,000	900,000		Total culling and disposal costs (3 yrs est.)	22,000,000	66,000,000
Total control costs (Oct. 2006)	44,100,000	346,154		Total control costs (3 yrs est.)	8,461,538	25,384,615
Total value of culled/dead animals (est.) (c)	1,848,000,000	14,505,495				
Total culling and disposal costs (est.) (c)	336,336,000	2,640,000				
Total control costs (est.) (c)	129,360,000	1,015,385				
Market price (layer) (g)	700	5.49				
Market price (broiler) (g)	1,000	7.85				
Notes:						
(a) includes culling (value of culled animals and culling/disposal) and control costs						
(b) source: FDLPCS official data (A169)						
(c) assuming disease continues on same course (as in the first 2 months) - the total number of poultry losses in the first 2 months after outbreak first occurred (Feb 2006) was 440,000 (A258)						
(d) on the basis of gvmt announcement, compensation for culling only						
(e) cost estimates per bird on the basis of destroying and disposing of 1000 birds per day by ad hoc organised teams (source: A7)						
(f) assumted to the double that of Vietnam as more costly to organise (for culling/disposal costs per bird ratio of Vietnam to Nigeria was 4:1)						
(g) range of current chicken market price (source: UNDP Nigeria, A293)						
(1) In Africa, it is estimated that 5 % (around 66,000,000 poultry) of the total poultry population (1.320 billion poultry - poultry population of South Africa not included) would be culled within 3 years (A258)						
(2) It is estimated to cost about US$ 1.00 per bird (A258, A7)						
Exchange rate: 1USD = Nigerian Naria (source: EIU)	*127.4*					

Nigeria: Country data				**Africa**		
Broiler chicken (no of heads), 2005 (b)	140,000,000					
Laying hens (no of heads), 2005 (b)	119,000,000					
Number of birds culled (2006 est.) % (a)	2%			Number of birds culled (3 yrs est.) % (c)	5%	
source: FAOSTAT						
Notes						

(a) FAOSTAT reports an overlap between the two categories hence the total number is not the addition of the two.
Other sources (e.g. WB, A203) give a total number of 175 million poultry, of which 143 million are free ranging.
Nigerian official sources give a 140 million poultry total stock and this is the figure used in this calculation
(b) It is estimated that 60% of the total poultry population is scavenging or backyard poultry.
The highly industrialised and integrated poultry production systems represent 25% of the total poultry population and about 15% is kept in semi-commercial sector III farms.
(c) In Africa, it is estimated that 5 % (around 66,000,000 poultry) of the total poultry population (1.320 billion poultry - poultry population of South Africa not included) would be culled within 3 years (A258)

Public health effects of a pandemic influenza (1)

	Attack rate	Number of people (2)	Cost (million US$, 1995) (4)	Share of each category	Cost (million US$, 2005) (4) (5)	Cost as % of GDP (2005) (5) (6)
Hospitalisations	15%	314,000	1,928	2.7%	2,352	0.02%
	35%	734,000	4,499	2.7%	5,489	0.04%
Outpatient visits	15%	18,000,000	5,708	8.0%	6,964	0.06%
	35%	42,000,000	13,318	8.0%	16,248	0.13%
Clinically ill (3)	15%	20,000,000	4,422	6.2%	5,395	0.04%
	35%	47,000,000	10,317	6.2%	12,587	0.10%
Deaths	15%	89,000	59,288	83.1%	72,331	0.58%
	35%	207,000	138,340	83.1%	168,775	1.35%
Total economic impact (4)	15%		71,346	2.7%	87,042	0.70%
	35%		166,474	1.2%	203,098	1.63%

Notes:

(1) Mean estimates of the possible effects of an influenza pandemic in the US. (source: A5)
(2) The distribution of cases was based on lower and upper estimates of age-specific attack rates from the 1918, 1928-29, and 1957 epidemics and pandemics
(3) Mean number of clinically ill not seeking medical care but still sustaining economic loss
(4) Estimated costs, on the basis of medical costs and value of lost work days. Excludes other disruptions to commerce and society.
(5) Cost (in 1995 million US$) adjusted to 2005 $ value. In 2005, $1.00 from 1995 is worth: $1.22 using the GDP deflator
(6) 2005 GDP: 12,456 billion US $ (source: IMF)

Assumptions made

Category of PH impact	***Age group (yrs)***	***Mean Total cases at high risk (%)***
Death	*0-19*	*9.0*
	20-64	*40.9*
	65 +	*34.4*
	Total	*84.3*
Hospitalizations	*0-19*	*4.6*
	20-64	*14.7*
	65 +	*18.3*
	Total	*37.6*
Outpatients	*0-19*	*5.0*
	20-64	*10.4*
	65 +	*4.0*
	Total	*19.5*

Assumptions made						
Costs per case	***Age group***	***Costs ($)***				
Death (Present Value of earnings lost)	*0-19*	*1,016,101*				
	20-64	*1,037,673*				
	65 +	*65,837*				
Hospitalizations (total costs)	*0-19*	*3,366*				
	20-64	*6,842*				
	65 +	*7,653*				
Costs days lost (indirect)	*0-19*	*325*				
	20-64	*800*				
	65 +	*650*				
Medical costs (direct)	*0-19*	*3,041*				
	20-64	*6,042*				
	65 +	*7,003*				
Outpatient visits (total costs)	*0-19*	300				
	20-64	330				
	65 +	458				
Costs days lost (indirect)	*0-19*	*195*				
	20-64	*200*				
	65 +	*325*				
Medical costs (direct)	*0-19*	*105*				
	20-64	*130*				
	65 +	*133*				
Clinically ill (total costs)	*0-19*	*197*				
	20-64	*202*				
	65 +	*327*				
Costs days lost (indirect)	*0-19*	*195*				
	20-64	*200*				
	65 +	*325*				
Medical costs (direct)	*0-19*	*2*				
	20-64	*2*				
	65 +	*2*				