Economic Assessment of Selected Investments by the Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease

Summary of the key findings

An independent economic analysis of selected AB-CRC projects was undertaken to determine the AB-CRC's contribution to Australia's industrial, commercial and economic growth.

The analysis concludes that AB-CRC investment of $13 million in three areas of research has realised $228 million in benefits, with a Net Present Value (NPV) of $215 million and Benefit Cost (B/C) Ratio of 17.5 to 1. The Internal Rate of Return (IRR) is 12.8%. The benefit cost analyses (BCAs), when assessed against total CRC resources, produce a B/C Ratio of 2.7 to 1, and an IRR of 9.2%.

In other words, the $13 million investment in research and development (R&D) has paid for total AB-CRC costs almost three times over. This does not take into account any benefits from other AB-CRC projects not included in this analysis.

The analysis, performed by Agtrans Research, was undertaken to identify the actual and likely outcomes and benefits from current investment in three areas of R&D:

1. Preparedness and response to avian and equine influenza (3 analyses covering 9 CRC projects)
2. Preparedness and response to foot-and-mouth disease (2 analyses covering 6 projects)
3. Early warning systems for detecting outbreaks of exotic diseases other than for avian influenza and foot-and-mouth disease (4 analyses covering 11 projects targeting SARS, Surra, Nipah virus and Bluetongue virus).

A comparison with 192 BCAs from the agriculture and natural resource management sectors indicates that the coverage of benefits of AB-CRC research has been above average. The aggregated results for the three areas showed that avian and equine influenza had the highest B/C Ratio of 139.6 to 1, due mainly to the contribution of AB-CRC research to eradicating equine influenza in Australia following the 2007 outbreak.

Results are provided for the three areas of investment in Table 1, and in more detail in Table 2. The projects included in the BCAs and associated conclusions are summarised under the disease-specific headings which follow.

Table 1: Aggregate investment criteria for three areas of investment at a 5% discount rate

Investment Criteria	Avian Influenza and Equine Influenza	Foot-and-Mouth Disease	Other Diseases
PVB ($m)	150.02	31.92	46.40
PVC ($m)	1.07	4.90	7.10
NPV ($m)	148.94	27.02	32.30
B/C Ratio	139.56	6.51	6.54
IRR	11.15	27.16	26.62

Table 2: Aggregate investment criteria for avian and equine influenza (5% discount rate)

Investment area	PVB ($m)	PVC ($m)	NPV ($m)	B/C Ratio	IRR (%)
Avian influenza – Preparedness	7.04	0.76	6.28	9.30	49.7
Avian influenza – Response	8.30	0.32	7.98	26.09	91.6
Equine influenza - Response	134.67	0.30	134.38	456.1	10.6
FMD – Preparedness	20.17	1.30	18.87	15.51	39.9
FMD – Response	11.76	3.60	8.15	3.26	19.1
SARS	22.14	2.31	19.83	9.58	32.8
Surra	15.91	2.44	13.46	6.51	24.6
Nipah Virus	7.32	2.05	5.27	3.57	21.4
Bluetongue Virus	1.03	0.29	0.74	3.52	17.8

Avian Influenza

R&D Objective 1 (Preparedness): For Australia to be better prepared for an outbreak of avian influenza by improving understanding of the role of ducks and wild birds in virus transmission, and associated implications for disease eradication and control measures.

Projects included in the BCA

- Epidemiology of avian influenza in aquatic birds in northern QLD.
- Spatio-temporal analysis of avian influenza viruses in migratory shorebirds and nomadic waterfowl in north-west WA for use in risk analysis of incursion and spread of exotic strains of avian influenza to Australia.
- Investigation of H5N1 transmission pathways between wild water birds, other wild birds and poultry in Thailand and Bali to optimise risk assessment for incursion of H5N1 to Australia.
- Studies on the epidemiology, pathogenesis and control of H5N1 in ducks in Vietnam.
- Risk assessment of transmission of H5N1 by wild birds to domestic animals in Thailand.
- A risk-based approach to avian influenza research priorities.

Conclusions

- A wide range of research is being conducted in Australia and throughout Asia through the CRC to improve our understanding of the role of wild birds and ducks in transmitting avian influenza.
- The CRC projects as a whole provide the basis for a semi-quantitative risk analysis for the introduction of highly pathogenic avian influenza into Australia.
- The knowledge generated by the CRC will lead to the design of better control strategies which could reduce the length, severity and consequent economic costs of an outbreak.
- Australian poultry producers would suffer the most severe economic costs in the event of an outbreak.
- The BCA does not consider any positive impact of the CRC's research on an human influenza pandemic.
- Given the high costs of an avian influenza outbreak, research designed to reduce this impact has high economic benefits.

R&D Objective 2 (Response): To improve the available diagnostic technologies and have nation wide capacity for testing.

Projects included in the BCA

- Development of diagnostic capabilities for influenza A and H5N1 isolates.
- Technology transfer of new technology to State/NT and New Zealand laboratories.
- Evaluation of new generation rapid antigen tests for avian influenza virus detection.

Conclusions

- Avian and human pandemic influenza would inflict substantial economic costs on Australia regardless of the size of the outbreak.
- Even at very low probability of an outbreak occurring, research designed to minimise impact yields positive economic benefits.
- The projects provide Australia with tools to better detect the presence of avian influenza.
- The PCR test has improved test confidence and can process specimens at greater speed, therefore improving targeted vaccination and stamping out programs.
- The evaluation of the antigen tests provides capacity for field or small district laboratories in remote locations to more rapidly raise the alert if an outbreak occurs.
- The enhanced pathogen detection capability will reduce the length, severity and economic costs of an outbreak.
- Coupled with the relatively low cost of the research, the B/C ratio and IRR are very attractive.

Equine Influenza

R&D Objective 1 (Response): To improve the available diagnostic technologies and have nation-wide capacity for testing.

Projects included in the BCA

- Development of diagnostic capabilities for influenza H5N1 isolates.
- Technology transfer of new technology to State/NT and New Zealand laboratories.
- Evaluation of new generation rapid molecular tests for avian (and equine) influenza virus detection.

Conclusions

- The influenza PCR test, which can be used for detecting both avian and equine influenza, has improved test confidence and the speed at which specimens can be processed.
- The extension of the assay to the state and territory laboratories was a critical step in the project.
- The assay was used in all Australian states and territories to control and ultimately eradicate equine influenza following the outbreak in August 2007.
- The assay may not have been developed in time after the outbreak for state laboratories to use if the earlier extension project had not occurred.
- The assay was important in influencing the decision to contain the equine influenza outbreak with a view to eradication rather let the disease become endemic or try to contain it to NSW and QLD only.
- The costs of eradication to the industry due to the control of horse movements was becoming extremely high, and therefore a high degree of confidence was required to adhere to the eradication strategy. This confidence would not have been possible without the assay.
- The primary benefit from the assay is the speed with which infection could be detected, allowing rapid implementation of intervention strategies.
- The assay provides for proof-of-freedom being recognised earlier with reduced industry costs via earlier zone changes and freeing up of conditions with easier horse movements between zones.
- BCA was based on an eradication and endemic scenario. It focuses on comparing a high cost in the first year (eradication scenario) with a lower but continuous annual cost thereafter due to the required vaccination program (endemic scenario).
- The cost of producing the assay was relatively small but the PVB generated was very high, given the very significant contribution of the assay to equine influenza eradication.

Foot-and-Mouth Disease

R&D Objective 1 (Preparedness): For Australia to be better prepared for an outbreak of foot-and-mouth disease (FMD) by improving understanding of the risk factors of the disease, and associated implications for disease eradication and control measures.

Projects included in the BCA

- Peri-urban regional surveillance for biosecurity for the pig industry in eastern Australia.
- Spatial predictive modelling for feral pigs in northern Australia.

Conclusions

- The major benefit from the research will be a risk assessment for the introduction and spread of FMD among smallholder pig producers in Australia. It is intended that this new knowledge will support change to legislation and policies governing issues such as producer locality registration, post-farm-gate pig identification and swill feeding.
- The CRC research has the potential to identify and control an FMD outbreak more rapidly.
- The economic benefits stem from eradicating the disease more quickly and having accelerated access into FMD-free markets over a shorter period of time.
- The social and environmental impacts of an FMD outbreak are also substantial.
- For the research investment to break even, an annual probability of a FMD outbreak occurring needs to exceed 0.1%.
- Given the large economic benefits and modest costs of the projects, only small probabilities of an outbreak and cost reducing impact of research assumptions are required for the investment to yield attractive dividends.

R&D Objective 2 (Response): For Australia to have better tools for eradicating or controlling FMD in the event of an incursion.

Projects included in the BCA

- Application of new platform technologies for the development of protein based rapid multi-analyte detection tests.
- Quantification of confidence in disease freedom.
- Molecular detection systems for emergency diseases.
- Adding value to livestock movement data.

Conclusions

- Rapid DNA-based tests have been developed to identify an outbreak of FMD more quickly.
- A disease confidence and cattle movement tracking methodology has been developed that could be used to better trace infected animals and persuade international markets that Australia was disease-free more quickly in the event of an outbreak.
- There is considerable uncertainty surrounding the magnitudes of economic costs associated with possible FMD outbreaks. However even at low probabilities of FMD occurring, sensitivity analysis demonstrated that the benefits from impact reducing CRC-developed technology are likely to outweigh the investment costs.

Other Diseases

R&D Objective: To improve preparedness and response capability for other significant exotic disease threats

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SARS

Projects included in the BCA

- Development of a serological test to detect SARS coronavirus antibody in different animal species.
- Investigations of SARS-like coronaviruses in bats.
- Molecular and immunological investigations of bat-virus interactions

Conclusions

- The research increases understanding of SARS and SARS-like coronaviruses, particularly as it relates to its interaction with animal populations and particularly those in which it is endemic.
- This will improve the ability to monitor and quickly react to an outbreak or potential outbreak of SARS.
- Increased understanding of virus genetics may eventually contribute to vaccines or treatments.
- Increased understanding of infection and immune dynamics in bats and their ability to support emerging zoonoses may assist in minimising the emergence of infectious diseases from bats.
- The majority of benefits are due to reducing the probability of an international outbreak of SARS. These benefits are due to economic impacts on Australia, as opposed to the mortality impact.

Surra

Projects included in the BCA

- Molecular detection systems for emergency diseases.
- Development of tools to improve the surveillance for surra.
- *Trypanosoma evansi* in Agile wallabies (*Macropus agilis*).

Conclusions

- A surra DNA assay (TaqMan) has been developed and validated at the CSIRO's Australian Animal Health Laboratory. Test validation is being undertaken in Bali and the Philippines.
- The likelihood of being able to detect potential incursions of surra into Australia, based on the available diagnostic capabilities, will be assessed.
- A geographic information system (GIS)-based model has been developed to predict abundance and distribution of tabanids (the disease vector) in north Queensland to inform risk assessment. A GIS-based model will be developed to predict the likely spread and impact of surra in Australia.
- The economic impact of the research is significant even when assuming the research has a limited impact in reducing the likelihood of the disease becoming endemic, or the length of time until an outbreak is eradicated.
- Economic returns are positive at all discount rates used.
- Assuming the disease enters northern Australia through an infected animal from a neighbouring country, over half the PVB is from the impact on the Queensland horse industry. Benefits to live cattle exports, cattle enterprises and wildlife have also been estimated.

Other Diseases cont.

Nipah Virus

Projects included in the BCA

- Assessment of the risk of introduction of Nipah virus to Australia via flying foxes.
- Application of new platform technologies for the development of protein-based rapid multi-analyte detection tests.

Conclusions

- CRC research has provided knowledge about the presence of the virus and its likelihood of advancing to Australia, as well as improved testing methods.
- The research has had implications for risk assessments and surveillance, and for a higher level of preparedness should flying foxes carry the virus into Australia.
- BCAs were based on two scenarios – an outbreak in feral pigs and in a commercial pig herd.
- The research is likely to provide significant benefits to Australia using both scenarios. It is likely that the expected benefits are underestimated.
- The sources of benefits overall are dominated by the human lives lost (69%), with trade losses contributing 30% and slaughtering pigs just 1%. The research investment provides a positive return irrespective of whether it contributes to reducing human deaths.
- There may be some added costs of surveillance emanating from the research findings that have not been accounted for in the analysis.

Bluetongue Virus

Projects included in the BCA

- Improving bluetongue virus surveillance in remote areas.
- Quantification of confidence in disease freedom.
- Promoting the adoption of stochastic scenario tree modelling as an international standard through the further development of practical web-based modelling tools.

Conclusions

- The research is likely to provide some benefits to Australia, although the benefits are not overly large.
- The main reason for this is the low probability assumed for bluetongue entry to sheep areas in Australia. If it does enter sheep areas then infection is likely to be self limiting due to the current Australian midge distribution.
- CRC research has led to a potentially higher level of effectiveness for surveillance in remote areas. However there is uncertainty as to whether this potential will be exploited. The associated increase in surveillance costs is important and has been accounted for in the analysis.