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Alternatives to animal disposal – epilogue: what the future holds

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Summary

The quest for alternatives to mass animal destruction and disposal represent the findings and advancement of an international initiative that was originated by Canada. Slaughter will remain an important disease management tool for zoonotic and highly infectious diseases. When animal diseases do not constitute a public health risk, however, mass slaughter will continue to be questioned. Solving broad issues of economic, political and social forces is equally as important as addressing technical needs. These issues influence gaining, maintaining or losing consumer confidence during disease events. Therefore, effective, meaningful and inclusive communication with the public is necessary. Furthermore, strategic investments to develop new technical tools collaboratively will be required on a global scale. In addition, other positive contributing factors include capacity building in veterinary services, the use of disease modelling, trends analysis, anticipation and agricultural intelligence, and the vision and enthusiasm of young scientists. The challenges which lie ahead are threefold, namely: to find acceptable alternatives, to develop new international standards to provide confidence and to communicate future approaches more effectively. The concluding result is a re-emphasised statement of the urgent need for legitimate, alternative strategies, the challenges which make this difficult and the exciting opportunities ahead. There is a need for renewed creativity, innovation and support to further advance the concept and vision of the four international workshops on animal disposal alternatives for the betterment of global society.

Keywords

Agri-intelligence, Alternative approaches, Animal disposal, Australia, Canada, Foresight technology, Mass animal destruction, New Zealand, United States of America.

Alternative all'eliminazione degli animali – epilogo: quel che riserva il futuro

Riassunto

Un'iniziativa internazionale, partita dal Canada, ha portato a nuove prospettive per quanto riguarda la ricerca di alternative alla distruzione di massa di animali e loro eliminazione. La soppressione degli animali rimane uno strumento importante in caso di zoonosi e malattie altamente contagiose. Tuttavia, se le malattie non rappresentano un rischio per la salute pubblica, la soppressione di massa continuerà

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a creare dubbi. La risoluzione di problemi ad ampio raggio coinvolgenti forze economiche, politiche e sociali riveste la stessa importanza della gestione delle esigenze tecniche. Questi problemi hanno un peso sulla possibilità di ottenere, mantenere o perdere la fiducia dei consumatori nel corso di eventi epidemici. Di conseguenza è necessaria una comunicazione con il pubblico che sia efficace, completa e significativa. Saranno inoltre necessari investimenti mirati e su scala globale al fine di sviluppare strumenti tecnici da usare in collaborazione. Altri fattori positivi che possono contribuire alla soluzione del problema includono l'organizzazione dei servizi veterinari, l'utilizzo di modelli di malattia e analisi del trend del loro sviluppo, previsioni accurate per quanto riguarda l'agricoltura, agri-intelligence, e l'intuito e l'entusiasmo di giovani ricercatori. Restano tre sfide da affrontare in futuro: trovare alternative accettabili, sviluppare nuovi standard internazionali per ottenere la fiducia dei consumatori e comunicare loro in modo più efficace gli approcci futuri al problema. Il risultato conclusivo enfatizza ancora l'urgente necessità di strategie alternative legittime, sottolinea i problemi che ne rendono difficile l'attuazione e anche le interessanti opportunità per il futuro. Servono una nuova creatività, innovazioni e sostegno per portare ulteriormente avanti le idee e le prospettive dei quattro workshop internazionali sulle misure alternative all'eliminazione degli animali, in un'ottica di miglioramento sociale globale.

Parole chiave
Agri-intelligence, Approcci alternativi, Australia, Canada, Distruzione di massa di animali, Eliminazione degli animali, Nuova Zelanda, Stati Uniti d'America, Tecnologie predittive.

Introduction

The quest for alternatives to mass animal destruction and disposal, as put forward in the papers of this monograph, represent the findings and advancement of an international initiative that was originally conceived in Canada (1). The study, as explored by an international working group, evolved over a five-year period as a series of international workshops. Although involving participants from a number of countries, the prime driving force that sustained the study came from Australia, Canada, New Zealand and the United States of America who generously provided expertise and financial support for the study.

The objective of the study and the question behind it were simple, clear and widely endorsed:
'What alternative approaches to mass animal destruction and disposal could effectively control animal disease yet minimise the waste and adverse consequences of the stamping-out approach?'

However simple the question, alternative approaches were neither obvious nor readily achievable. The dilemma is universal but as the occurrence of major animal diseases increases, so does the urgency (5). This monograph, while displaying a range of innovative initiatives that have been undertaken, also demonstrates the difficulty and the challenge.

The quest, though firmly undertaken, is incomplete and continues to demand resolution. The cost of present approaches to animal disease control could conceivably become unacceptable and unaffordable. With limited alternative options, decision-makers will face a difficult to impossible choice, yet a choice will have to be made. Options should be available before a major animal disease crisis demands them.

Sooner or later this dilemma must be resolved and the urgency is increasing. Already in certain areas, the use of mass animal destruction would be in question. International cooperation is essential and should be promoted.

This study represents a model of a process which now rightfully should be expanded. By broadening the geographic scope of the study, the possibility of evolving this thinking into implementable guidelines could become a reality. The ideal goal would be for such guidelines to be accepted as international standards. In this way, these standards could serve as guidance to decision-makers around the globe as they face major animal disease

crises. Their decisions will contribute positively to global society in many ways from ensuring a safe food supply, to lessening financial impacts, to improving environmental sustainability, to reducing the psychological distress of producers, to enhancing animal welfare.

It is the desire of the authors of these papers and the sponsors of the study, that this monograph stimulate renewed creativity and innovation in addressing this global challenge.

Future views from Canada

Although it may not be possible to predict the future with any degree of absolute certainty, there can be little doubt that the convergence of factors which have precipitated the current unprecedented globalisation of animal disease, will persist with consequences for animal production both anticipated and perhaps as yet unimagined.

Society's relationship with the animal population, with which it shares the planet, will be challenged by dynamics associated with a number of both intrinsic and extrinsic factors.

Challenges ahead

If, as some profess, a global pandemic is a matter of 'when' and not 'if', and if the origin of such a reality is a zoonotic pathogen, then society's views of the animal kingdom could change. It may well be dictated by how effective risk communication has been in proactively informing, conditioning and obtaining citizenship acceptance of the interventions necessary to address an outbreak.

If, as others believe, the evolution of new diagnostic methods, vaccination approaches or of biotechnological and genomic-based tools will serve to mitigate disease occurrences, then once again societal acceptance of such measures or tools will be required and soon.

If, as many have forecast, the availability of water and water quality or the competition between human and animal directed land use will ultimately determine whether animal production systems are sustainable in the longer term, then efficiency in producing and salvaging animal protein will be necessary and will create new economic models.

If, as has been debated in various fora, the negative consequences of globalised trade on the environment and society, commerce and human activities, outweigh the economic and political benefits, then a shift to local specialised and less intensive production systems may be envisaged.

The list is endless.

How to move forward

Nevertheless, irrespective of the 'ifs', 'ands' or 'buts', any successful outcome relative to a commitment to alternatives to animal destruction and disposal, is predicated on achieving a meaningful dialogue between the veterinary community and the broader health community, as well as with the general public which both are called to serve.

A fundamental step in the dialogue must be a commitment to capacity building in veterinary services in all countries. This is critical to the timely detection, reporting and response to disease occurrences at their source. Such an investment should be part of every country's prevention strategy, recognising that in a global context, every country is vulnerable to the capacity in the jurisdictions of other countries. Basic to any viable approach to finding alternatives to animal disposal is the inherent desire to minimise exposure to disease threats and the need for animal depopulation in the first place. There is also increasing recognition that any 'borders and inward' strategy is incapable of effectively managing all possible risk pathways. In addition, it is critically important to salvage the biodiversity and genetic diversity of the remaining animal populations globally.

To achieve a meaningful and inclusive dialogue it is therefore foreseen that veterinary infrastructure and needs assessments must be adopted as a vital preliminary step in capacity building and as a collective priority. The leadership demonstrated by the World Organisation for Animal Health (OIE: Office International des Épizooties) in adapting the performance, vision and strategy (PVS) tool,

originally developed by the Inter-American Institute for Cooperation on Agriculture (IICA) as a means to objectively review the quality of veterinary services in a country, is a critically important advancement. Equally important is the training of professionals in the use of the tool, and the tool's competency. Assessments of all interested countries, supported by contributions of time and money by donors and other countries, are necessary to ensure that any investments are directed to those areas that will return maximum benefit.

There is also an urgent need for expanded investment in foresight activities, such as that already initiated in several countries, as part of the dialogue with both decision-makers and the public. Such an investment should be directed at analysing the disparate activities, conducted to date, for commonality and challenge. A broader range of disciplines should be included as part of the continuous refinement of the processes and plausible scenarios developed, that would truly reflect the best possible thinking.

If success can be achieved in veterinary capacity building at the global level, and if a coordinated and integrated undertaking of foresight activities can be established, then a meaningful dialogue can ensue. This dialogue would lead to contingencies and activities that would prepare the veterinary community for the successful management of the anticipated events and outcomes, including the alternatives to animal disposal, that would respond to society's needs and expectations.

In parallel with the above, however, developed countries must continue to pursue research on a collaborative basis, in a wide number of activities through the use of global networks. Such activities include the alternate use of biomass derived from animals to achieve true animal optimisation and utilisation, biosensors and early detection tools, antivirals, vaccine delivery systems and other immune system enhancers.

Canada has been encouraged by the progress made to date but we fully recognise that greater challenges remain ahead.

Proposed approaches

To this end, it is proposed that in addition to those areas referred to above, the next iteration of initiatives in support of achieving a consensus on viable alternatives to animal disposal should place emphasis on further investments and support in advancing the development of three primary tools.

The first is the emerging development of practical and appropriate uses of disease modelling and trends analysis systems which should also include the emerging components of anticipation and agricultural intelligence. The second is research into the decision-making framework to be used in emergency disease control situations. This framework must identify the critical control points that would allow for flexibility in decision-making and would also provide the critical information necessary to support such decision points in order to maximise the scope and number of options available. The third, and perhaps most important, is the recognition of the vision and enthusiasm that has been established in a core group of forward-thinking young scientists and their ability to make a difference.

Epidemiological modelling offers the potential to critically evaluate the effectiveness and efficiency of various control measures. It provides the ability to understand or estimate the future magnitude, duration and geographic extent of a disease event in response to the application of specific control efforts. However, in order to be effective, such a tool must take full account of disease transmission models, meteorological data, resource evaluation models, economic models, risk models and surveillance models. Consequently, not all countries may be in a position to use such a tool as the basic data requirements may not be available. Nevertheless, the development of such an important tool to facilitate decision-making, and its availability through an established international collaborating centre, would have significant potential in reducing the indiscriminate loss of animal protein or unwarranted depopulation of animals in

disease control programmes. In parallel with this, the capacity building efforts already underway can provide the relevant information that will enable this development.

Similarly, a structured undertaking to research and critically evaluate the decision-making framework within emergency management approaches would be of enormous value. Current approaches have, with merit, been largely driven by conservative or precautionary drivers which aspire to maximise biological containment of an outbreak, often in the absence of full knowledge of the scope or extent of the outbreak.

However, a more defined and defensible basis for informed decision-making will be provided by investments in the evolution of international standards, traceability, real-time active surveillance and data capture to supplement monitoring, biosecurity and the baseline information that could be determined in advance of a disease occurrence.

Furthermore, effective decision-making and policy determinations in times of crisis or emergency management, while informed by good science, must also consider other factors including social, environmental, political, economic and capacity considerations.

It is therefore incumbent on research into the level of risk tolerance in each of these factors beyond the biological science, to improve the decision-making process and to provide greater flexibility for decision-makers. This research should yield guidance on when certain decisions are appropriate, the consequences of timing, the nature of the approaches instituted and the opportunity to revisit approaches as new information becomes available, with a view to optimising animal health and minimising animal destruction and disposal.

The priority

While all the above tools are required and will benefit from sustained attention and support by national veterinary services, the most critical asset common to many of the countries that have been actively engaged in the development of the concept of alternatives to animal disposal, is the cadre of professionals who have taken up the concept and vision.

If there is a single action that can be undertaken as a priority, it should be the continued support of the group of individuals who have emerged over the past few years as contributors to the workshops and who have demonstrated the commitment, energy and passion necessary to move the initiative of alternatives to animal disposal forward.

The challenge is a simple one. We must collectively find the means to commit their time and the necessary financial resources to permit them to continue in their purpose-driven efforts. The seeds have been planted and nurtured. Perhaps it is time to provide them the means to grow and develop the potential they have demonstrated. I have no doubt in their ability to make a difference and to make the concept of alternatives to animal disposal a reality for the good of the profession, the good of veterinary services and the good of society at the global level.

Future views from the United States of America

The future of course will hold many challenges both large and small. Foremost among them, there will remain the need to further develop effective disease control options that minimise mass animal destruction. This ongoing and critical challenge requires not only that specific technical needs be addressed but also that other influential forces – such as broad economic, political and social forces – be considered and addressed as well. These forces were highlighted during the numerous International Working Group on Animal Disposal Alternatives (IWADA) workshops first held in 2000 and again throughout the Animal Health Foresight Project (AHFP) (1, 2, 3, 4). Satisfying these broad forces presents as much of a challenge as does solving the technical issues surrounding disease management alternatives.

The scenario tools used in the AHFP in particular, helped to encourage participants to see the development of disease management

alternatives as more than strictly a technical challenge. By using both public anxiety and the level of animal utilisation as focal points for the AHFP scenarios, participants were forced to confront how 'non-technical' issues influence the ways in which government agencies and industry gain, maintain and lose consumer confidence during disease events.

Of particular note, it was interesting to see how easy it was for participants to envisage a failure scenario, which was characterised by high public anxiety and limited animal utilisation. In contrast and equally as interesting, participants found that envisaging the ideal scenario – a world characterised by low public anxiety and high animal utilisation – was much more difficult. The difficulty shared by AHFP participants in envisaging the ideal scenario is a strong indicator of the steep challenges inherent in the new thinking and emphasis upon effective communications that surfaced during the AHFP sessions. Communications and engaging effectively with the media are ongoing challenges for all organisations and even more so for more reserved government organisations.

With respect to making progress on technical disease issues, it will take strategic investments to develop the new tools needed for achieving effective disease control while minimising mass animal destruction. Numerous effective technologies have been identified, such as early disease detection devices, models that can predict disease spread, antivirals that treat infected animals and vaccines that protect uninfected animals. However, the questions of where to direct and how to optimise limited available resources remain a challenge.

To help address these questions, various strategic road mapping projects have been initiated in the United States to identify priorities. Investments in new technologies are also being made; however, the opportunities to further leverage these investments on a global scale need to be thoroughly explored. In addition, the public will need to be actively engaged to ensure the acceptability of those tools chosen for disease control. Making these connections between research and the public is important, and it is an area of growing interest and activity.

Within the United States, the results of the IWADA and AHFP have been shared and discussed with industry and other stakeholders. The response has been positive and stakeholders agree that the key issues/ challenges have been raised. Additionally, stakeholders recognise the substantial effort it will take to develop the much needed disease control alternatives.

Although sustaining and building upon the momentum achieved by IWADA and AHFP will be challenging, the United States is committed to continuing these efforts. We are currently providing leadership to a team that also includes representatives from Australia, Canada and New Zealand. The team has been charged with developing an implementation plan that will move all four countries towards the goal of managing animal disease outbreaks with minimum loss of animals.

Future views from New Zealand

One thing that is sure in life is that change is constant and those who are able to anticipate and adapt to meet the changing environment are usually those who will position themselves for future success.

In the livestock production and animal health area, there are many current or anticipated challenges that will require significant change to current approaches if we are to maintain effective, viable and sustainable livestock production systems. Absolutely critical for success in addressing these challenges, is the need for effective risk communications.

Over the last decade, there has been a continuing trend for consumers and retailers in the developed world to demand 'quality' food assurances over and above what regulators both at the national and international levels have considered necessary.

While at times these additional assurances involve animal health or food safety assurances of livestock products, by far the majority have involved aspects of the production systems. Key amongst these are

assurances relating to animal welfare of livestock, with more recent issues about the environmental footprints of various production and transportation systems that have been utilised up until the animal products are purchased by the consumer.

Concerns about how animals are bred, housed, fed, treated, transported and slaughtered, including how disease events in animals are dealt with, have increasingly become areas of debate and concern to large parts of our societies. Future demands placed on livestock production systems by changing climates will increasingly highlight situations whether from drought or newly emerged pests and diseases. If traditional approaches are used to regain the animal health status, we will see increased public and consumer concerns as to why such actions are still being taken.

Added to this, large parts of our societies have become increasingly distanced from the realities of existing animal production systems and therefore are lacking any detailed understanding or acceptance as to what is integral to 'normal' production situations. This makes it even more difficult for our societies to understand what may be required in 'abnormal' production situations, such as what is required when an animal health emergency develops.

In addition, younger generations having often grown up in modern affluent urban environments, have developed different cultures and value sets and find many concepts of current animal production systems unacceptable and even distasteful.

Historically, while large-scale slaughter of livestock (so called 'stamping out') has been used to control and eradicate serious animal diseases, this is now coming under increasing scrutiny and challenge. Even veterinary experts within our animal health systems are seeing as totally unnecessary the large-scale destruction of animals and the corresponding waste of animal protein and genetic resources.

Such historic approaches are often used as the approach of choice, as a result of pressure from the domestic industries, concerned as to whether there will be a rejection by their consumers and markets, who are calling for zero risk for food safety, when of course in reality no such thing exists. This, along with over-reactions from importing countries, reinforces the need for the over-reaction taken in exporting countries, so that in reality a type of 'vicious circle' has been created and sustained.

In today's technologically advanced world, we have substantial knowledge of animal disease epidemiology, along with a far greater scientific certainty in determining when animal products do or do not present a food safety or animal health risk. We are also able to more effectively apply diagnostics, vaccines and even changed production systems to rapidly and effectively eliminate pathogens, or to control them to a point whereby they no longer constitute an animal health or food safety risk.

However, we still have situations in which importing countries, along with consumers and retailers, are reluctant to accept these alternatives, resulting in situations where even those countries that have the ability to utilise acceptable alternatives to stamping out, do not pursue such capacity due to the fear of them not being able to retain the full confidence of consumers and regulators in regard to the safety of their products.

We therefore collectively have a significant challenge ahead of us as animal health experts. Firstly, we need to find acceptable alternatives to the historic approaches of controlling animal diseases that do not require the large-scale slaughter of animals when this is not necessary. This will require a significant and concerted effort and needs to involve the combined efforts of our research scientists, livestock producers and processors, regulators and consumers, to find acceptable alternatives.

Secondly, once alternatives are identified, we need to develop new international standards that give industries, regulators and politicians the confidence to apply these alternative approaches, without fear of consumer or regulator over-reaction. The OIE is the organisation that must take the lead role in driving the development and adoption of such standards.

And last but by no means least, we will need to communicate the future approaches more effectively than what we have been able to in the past, to livestock producers and the related processing industries, retailers, consumers, regulators and the public as to why they can have confidence in the future actions taken to control animal diseases, without having recourse to the large-scale destruction of animals and their products.

These three challenges are not going to be addressed overnight, but the start made by the IWADA project means we now have a platform on which to build. Not to do so will mean that we will fail to place our livestock producers in a sustainable position for future success, in the farm to fork continuum.

An Australian viewpoint: what the future holds

Introduction

Animals and animal products have been destroyed and disposed of for many hundreds of years. This was because of public health fears and to prevent the spread of infectious diseases although the cause and overall nature of diseases were not fully understood and preventive or curative treatments had not yet been established. Observation and experience led societies to destroy animals for diseases such as rabies, sheep pox, anthrax, glanders, rinderpest and the like. Dead stock and fomites were often buried or burned. Dead and dying stock could also be salvaged for food.

Decisions were based on the socio-economic or cultural considerations and varied between populations. Have circumstances changed in the 21st century that will see new approaches in the short to medium term?

Some observations on contemporary disease issues

A significant number of novel zoonotic and emerging or re-emerging diseases have occurred throughout the world in recent years. Approximately 75% of emerging diseases are zoonotic and have resulted in significant adverse health and socio-economic impacts. Factors contributing to the development and establishment of emerging and re-emerging diseases include demographic changes, intensive production methods, trade, tourism and war. Probably the most important predisposing factors are climate changes and human interventions that have led to modified ecological conditions and an adaptation of infectious agents and carrier species to the new situation. It can safely be assumed that, given these circumstances, the risks of emerging and re-emerging diseases will increase and, given the importance of zoonotic diseases, highly developed cross-disciplinary approaches will be essential to improve the understanding of human, wildlife, companion and production animal infectious diseases.

Public concerns about diseases will, to a large extent, determine animal disease management policies. It is difficult to imagine the public at large in developed countries not supporting the slaughter of animals when major zoonotic diseases, such as highly pathogenic avian influenza or Nipah virus or diseases of unknown aetiology occur or are insufficiently understood. The public will expect authorities to ensure the safe disposal of livestock, products and fomites in such situations to protect not only human and animal health but also the environment. In poor countries and particularly in village situations, salvage for food is likely to be practised, irrespective of the inherent risks due to a lack of knowledge and adverse economic circumstances.

Mass slaughter for animal diseases that do not constitute a public health risk will continue to be questioned, particularly if preventive treatments are available and environmental problems associated with destruction occur. A useful example is the 2001 outbreak of foot and mouth disease (FMD) in the United Kingdom, where livestock slaughter may have been disproportionate to eradication and control needs, and atmospheric pollution, for example polychlorinated biphenyls (PCBs) resulting from burning, was reported to be a problem. Strong welfare criticisms were raised with the holding of livestock and humane slaughter.

Nevertheless, the importance of slaughter as a disease management tool for control and eradication of new outbreaks of highly

infectious diseases, such as FMD, must be recognised. This is because almost invariably it is impossible to combine disease control elements, such as quarantine, control, vaccination and laboratory systems, rapidly enough. The cost benefits of such approaches need to be made clear. Governments and industry must be able to justify such approaches on socio-economic grounds and be prepared to make decisions to change direction quickly if it is apparent this policy is failing. Failure to be open and transparent with the public or to conduct slaughter and disposal in accordance with the highest standards of welfare and disposal, will lead to deserved criticism and questions as to the validity of slaughter as a *bona fide* management tool.

In many countries, prevention techniques utilising effective vaccines can obviate the need for slaughter unless new strains emerge, incorrect vaccines are used or there are failures in animal health services. Many countries simply cannot afford to establish and maintain effective veterinary services, fund vaccines or provide financial incentives to report and manage disease. Under such circumstances, countries have to live with problems which, in doing so, may hinder their own development and pose disease threats to other countries.

Countries free of infectious diseases that have a high impact on animal production and/or international trade will continue to apply strong import quarantine measures for imports to minimise risks and cost consequences to their agricultural economies. Such measures will be conservative and must meet their 'appropriate level of protection', as well as be consistent with the World Trade Organization Sanitary and Phytosanitary Agreement (6). Slaughter policies will often be implemented upon the introduction of these diseases as an eradication tool. It is important that international standards, under the auspices of the OIE, continue to be developed to allow safe trade and that countries support such standards. However, it is critical that animal health systems that form the basis of export certification be effective, have integrity and are subject to independent audit. In this way, the use of slaughter as a management tool in the medium term will be minimised.

There have been a number of significant technological developments in recent years. These have included new vaccine technologies, therapeutics, diagnostic systems and information management approaches to support disease prevention and management. It is difficult to foresee a situation where broad-based vaccines and highly sophisticated therapeutics will be available for a number of years and at a price affordable to developing countries in particular. However, improved training and communication have led to a fairly universal understanding, amongst veterinarians at least, of the basic requirements of effective animal disease control systems. The ability to introduce such systems is the key problem, but if this can be done progressively, social and economic benefits to countries will accrue and the use of slaughter as a management technique will diminish.

The animal health sector of the 'quadrilateral' countries (Australia, Canada, New Zealand and the United States of America) has recognised the importance of new approaches to animal disposal to underpin disease response. Collaborative approaches, including information sharing and research prioritisation, are intended to contribute to more rapid acceptance of innovative approaches to such matters as vaccination for disease containment and eradication, and to effective and environmentally sound systems for composting animal carcasses.

Concluding remarks

In the short to medium term, social, economic and cultural norms will determine approaches to slaughter and disposal. Developing medium-sized, rich and trading economies have different drivers. No one size fits all. Technological developments have a long way to go before sophisticated prevention techniques, treatments and diagnostics are sufficiently advanced that will enable widespread cost-effective application of such technologies. Therefore, animal destruction and disposal, if conducted properly, will remain key components of the animal health armamentarium in the short to medium term.

However, trends would indicate general improvements in animal health services throughout the world, particularly given the increasing incidence of zoonoses. Top quality animal health services are absolutely critical to disease prevention, eradication and control, and will become more effective if they can work closely with a range of other disciplines and adopt new technologies and proportionate approaches. These, together with the adoption of agreed science-based standards for disease management and animal and product movements, will likely lead to a progressive reduction, but not elimination, of mass slaughter in the longer term.

Although animal health services are a key to progress, they must seek to be part of and, therefore, guide and influence the overall social and economic agendas of the countries to which they belong, otherwise others not so well equipped to do so will drive the animal health agendas. A similar approach must be followed with international organisations, particularly those which fund animal health programmes in developing countries.

The future is complex and somewhat confusing but the prospects for the progressive introduction of alternatives to animal disposal are real in the longer term. The quadrilateral countries have made a good start in considering the range of issues associated with this subject and should be complimented for their efforts and vision. Other countries should join them by taking this issue forward.

Conclusion

The papers of this monograph have explored, from many perspectives, the concept of alternatives to the use of mass animal destruction for animal disease control. They have analysed and discussed the many complex questions and dilemmas that are embedded in this subject. What has been brought forth are the needs and desires, often conflicting, of the many aspects of society, including consumers, the general public, producers, global traders, veterinary services, and the veterinary profession.

The concluding result is a re-emphasised statement of the urgent need for legitimate, alternative strategies, the challenges which make this difficult, and the exciting opportunities which may lie ahead. It has been demonstrated and is abundantly clear that further study of this subject is required and is fully justified. Visionary support has already been provided by the four quadrilateral countries, Australia, Canada, New Zealand and the United States of America. This must serve as the stimulus to create the much needed broader geographical base of support to finally and collaboratively realise the original objectives of the IWADA concept, for the betterment of global society.

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