# Veterinary research in the UK: a snapshot

**A REPORT BY THE RCVS RESEARCH SUBCOMMITTEE**

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RCVS SETTING VETERINARY STANDARDS

# Contents

# Executive summary

- The veterinary profession is, at its core, a science-based profession.
- Veterinary research has been responsible for remarkable scientific achievements, of which the global eradication of rinderpest and the production of the first vaccine for a retrovirus (Feline Leukaemia Virus) are but two examples.
- The health and welfare of the 20 million companion animals in the UK is dependent on solid research, as is the health and productivity of the more than 36 million of its food animals.
- Veterinary research has a part to play in the major challenges that the world is facing at present:
  - **It can contribute to address inefficiencies in the food-chain**. With the world population predicted to reach 9 billion in 2050, it has been projected that the global poultry production will have to quadruple, the cattle population will increase to about 2.6 billion (from 1.5 billion in 2000), and the global goat and sheep population from 1.7 billion to about 2.7 billion over the same period. This places an unprecedented pressure on maintaining the health and sustainability of the flock which should be addressed by sound veterinary research.
  - **It can help address national food security**, ensuring that indigenous food industries are competitive and maintained even (or especially) in periods of crisis.
  - **It can prevent or minimize the devastating financial losses brought about by animal disease, zoonotic or otherwise**, not to mention the losses of animal and human lives. Recurring foodbourne diseases such as ***Campylobacteriosis*** and ***Salmonelliosis*** cost the UK respectively £538m and £14m per annum. In one year alone, at the height of the BSE crisis, more than £3.5 billion were spent in the UK to control and deal with the disease, whilst the Foot and Mouth epidemic cost the UK £8 billion in just 7.5 months. Whereas financial losses associated with zoonotic outbreaks are measured in billions of pounds, research investment is limited to the low millions. Even so, UK veterinary teams have been performing remarkably well – it is estimated that the Bluetongue vaccination programme in 2008 has saved £460 million and 10,000 jobs in the UK, not to mention countless animal lives.
  - **It can improve food animal welfare and help tackle climate change,** since food-producing animals are one of the great contributors to global warming and veterinary research addresses, among many things, methods to reduce animal emissions.
  - **It can contribute to the conservation of wildlife** and inform the conflicts of interest between humans and their neighbouring animal populations.
  - **It can improve companion animal and equine health and welfare** and consequently improve the quality of life of the British public known world-wide as a nation of animal lovers whilst, for example, it secures the growth of the pet food industry (responsible for 8,000 direct jobs and a £2.05 billion market in the UK) and equine industry (70,000 direct jobs, £4.20 billion annual turnover in the UK).

# Key findings

- The UK has a highly efficient research base in the veterinary sciences, which is competitive nationally with other research areas of similar size (dentistry) and internationally with both established scientific powers (USA) and emerging competitors (China, Brazil). This is evidenced by the indicators below:
  - The rate of publication for veterinary science in the UK is on par with dentistry and oral medicine, its usual comparator, reaching 1,080 citable papers for 2011 alone, distributed evenly between small animal, food animal and equine science.
  - Yearly growth in veterinary publication output in the UK (6%) is slightly higher than for the USA (3%) but much lower than for China or Brazil (34% and 31% respectively), confirming the status of the latter countries as emerging scientific competitors.
  - Even though UK veterinary science publishes fewer papers than its American, Chinese and Brazilian counterparts, it is definitely the most efficient research base, with higher quality papers (consistently cited more often) and with higher impact.
  - UK veterinary science ranks worldwide at number two (using the ***h***-index rank), which is a remarkable position, considering the size and investment held by other international research powers.
- The task of evaluating the trends in investment in veterinary research is extremely challenging due to a number of factors, chief among which is the lack of a common definition for veterinary research. This should be addressed very quickly so that the field can be monitored appropriately.
- The total amount invested in veterinary research in 2009/2010 was very roughly estimated to be around £127-£128 million. The lion share of this investment has been provided by Department for Environment, Food and Rural Affairs (Defra), the Biotechnology and Biological Sciences Research Council (BBSRC) and the Wellcome Trust, with the universities securing about 44% of the overall sum.
- Comparisons with the value of investment in 1996/97 (at the time of publishing of the Selborne report) are not appropriate because the individual value were not published at the time and because the BBSRC has considerably expanded its definition of “veterinary research” since then, inadvertently creating an artificial boost of the values between the two different periods.
- Considering all the major funders except BBSRC (Defra, Wellcome Trust and the industrial funding bodies) there is an apparent reduction of 5.5% in investment on veterinary research over the last 14 years. If BBSRC values are included, this value artificially changes to an increase in investment of 32%, mostly due to the administrative changes.
- Veterinary academic research has seen an increase of 67% in funding between 1996/97 and 2009/2010. Whilst the overall financial balance is apparently positive for academia it is unclear if this is also due to administrative changes. For example, contributions to the research infrastructure which were previously not included in grant-making totals have started to be included in funding values. Furthermore, it should be said that this apparent investment has been made with sudden increases and cuts between the years. Whilst any growth in investment is certainly welcomed by academic research, having such a large variation in income can place a big strain on resources, hinder the establishment of a solid research infrastructure and compromise the long term sustainability of the UK’s veterinary research environment.
- There is evidence to believe that veterinary research funding tends to have a reactive approach, peaking after a zoonotic disease outbreak, rather than a proactive strategic outlook.

# Message from the RCVS Research Subcommittee

Veterinary research has possibly never been so important to society.

In the context of "One Health" and as the world is facing collective challenges relating to climate change and to feeding the nine billion people who are predicted to populate the globe by 2050, veterinary surgeons have a remarkable role to play.

They are being called forward to perform the vital surveillance that ensures a safe food-chain and to manage the productivity and welfare of food animals with regards to their health and to their contribution to global warming, but have also a fundamental role in preserving animal wildlife and protecting companion animals who are increasingly a part of family life and a growing market in a recession economy.

If veterinary surgeons are to respond to these challenges, they need to do so in the context of proper academic research underpinnings and the UK needs to ensure that its veterinary research base is equipped and dynamic enough to carry out its important mission.

In 1996-1997, the Wellcome Trust and the RCVS funded an exercise to assess the state of veterinary research which came to be known as the "Selborne Report". In it, important considerations were made such as the need to increase the exposure of veterinary undergraduates to research environments and a need to establish more collaborative ventures between the various bodies involved with animal health and welfare research.

In the time since, significant progress has been made regarding undergraduate veterinary research but there is a distinct lack of evidence that forbids comparisons to be made and progress to be assessed. The Research Subcommittee felt that it was important to establish some base indicators against which to monitor veterinary research for the future, but also that a case should clearly be made for veterinary research as the biggest foundation for the activity of veterinary surgeons and nurses.

A clear definition of veterinary research still does not exist and because of that the level of investment in veterinary research cannot truly be compared. On the other hand, veterinary research is not solely carried out by veterinary surgeons as there are a number of interdisciplinary teams working on translational research. These issues make the task of monitoring the veterinary research environment especially challenging.

The following document discusses the case for veterinary research in terms of its global importance and then moves on to investigate its strengths in the UK. We were pleased to confirm that the UK veterinary research base is one of the most efficient in the world, and second only to the USA in terms of *h*-index ranking, despite of its much smaller size. However, we were concerned to verify that research budgets have been steadily declining at Defra over the past 14 years and that priorities tend to be set reactively – peaking after zoonotic outbreaks – and do not reflect the proactiveness expected of a country that has in its agricultural base 7% of its GDP.

With this document we hope to help increase the justified pride that UK veterinary surgeons should have in their research base but also to raise our concerns with regards to assuring adequate levels of funding that fully reflect the sizeable risks that are involved with animal health, which go far beyond food-producing animals and zoonotic threats.

***The RCVS Research Subcommittee exists to promote research as the principal element of evidence-based veterinary practice, to support the veterinary profession and the public in relation to animal (and human) health and welfare, and to ensure that veterinary research takes its place as a valued contributor within the broad spectrum of biomedical research by, among other actions, ensuring that veterinary research achievements are publicised widely and prominently.***

# Introduction

Periods of economic recession, like the one that assailed several world-leading economies in 2008 and 2010, often prompt re-distributions of government funding and force institutions to re-think their strategies and priorities. In such challenging moments, science should be seen as the ideal tool with which to "out-innovate, out-educate and out-build" a country's economic competitors.[3] Scientific research generates wealth and can "help drive [a country] to a strong [economic] re-growth through knowledge based economies".[4] Science can also inspire and inform society, as it can provide means to respond to environmental and sociological demands.

Against the backdrop of a growing population and the threats posed by climate change, agricultural and veterinary research are being relied upon to provide answers and solutions capable of feeding the world's population in safer and more sustainable ways.[5] The ability to do so will undoubtedly shape the future in ways we can only imagine now.

The economical growth of a nation and the health of both its animal and human populations are therefore strongly dependent on how effectively science – namely veterinary science – can anticipate and respond to the challenges in animal welfare, public health, food safety and bio-security. In many ways, the advance of veterinary science is not only scientifically interesting, it is vital to secure our future.

# 1. Global importance of veterinary science

## 1.1 Impact on the sustainability of the food-chain

In the UK, the demand for food is relatively static, as would be expected of a reasonably affluent and growing economy. Globally, the picture is quite different.

World population is expected to grow by 2.3 billion over the next decades, reaching over nine billion in 2050.[5] Most of this growth will be happening in developing countries[i] but the impact of that population growth will undoubtedly be felt far and wide.[6] If production losses (eg from disease, pests, storage) and food waste (eg during processing, transportation and consumption) are not appropriately dealt with, global food production will have to increase by 70% between 2005-07 and 2050 to face the growing population trend.

According to the OECD,[6] "the challenge [now] is to feed a growing, more urban and, on average, richer population whilst adopting more efficient and sustainable production methods and adapting to climate change."

Feeding the world's population will bring – in fact it is already bringing – incredible challenges in terms of sustainably balancing demand and supply, and adequately managing the contribution of the food system to the mitigation of climate change, for example. In the next 50 years, the production of food will most likely involve a strong competition for land, water and energy. Precautionary strategic measures will therefore need to be taken to ensure that the world's capacity to produce food is not jeopardised.

In its ***Foresight Report on the Future of Food and Farming***,[5] the Government Office for Science warns that "***This is a unique time in history – humanity is facing a future that is very different from the past. Decisions made now and over the next few decades will disproportionately influence the future."***

Quality of food, not only the quantity of it, will also suffer a dramatic shift. As incomes rise in developing countries, diets are expected to slowly diversify away from staple foods towards meat and processed foods that will favour livestock and dairy products.[6] An analysis of the food consumption in countries like China and Brazil shows that the country's development is generally accompanied by a sharp increase in meat consumption.

Overall, the global cattle population has been predicted to increase from 1.5 billion in 2000 to about 2.6 billion by 2050, and the global goat and sheep population from 1.7 billion to about 2.7 billion over the same period.[5, 7-8] This places an unprecedented pressure on maintaining the health and sustainability of the herd. Similarly, it is estimated that global poultry production will have to quadruple to satisfy demand.

These numbers also highlight the pressures to which the UK livestock sector is currently subjected. Not only is international competition rising but also heavy regulation has resulted in increased production costs for UK farmers, consequently reducing profit margins in a way that, according to Defra, can "[jeopardise] the sustainability of the superior UK production system".[9]

An appropriate response to both the challenge of sustainably feeding the growing population, and that of improving the quality of production of the national livestock sector ***"depends in large part on technology and innovation"***.[6]

In the production of meat for consumption, for example, efficiency gains could be achieved if the genetic markers associated with traits of economic value were known. For example, "***the nutritive value of meat and milk could be enhanced by providing the livestock industry with information that would allow farmers to produce animals with a fatty acid composition closer to that recommended by government***."[10]

On the other hand, research and innovation can also help to address major inefficiencies in the reproductive performance of ruminants, pigs and poultry which result in breeding percentages well below the potential of the herd/flock. Either by improving the fertility (cattle and sheep), or developing scientifically-informed diets for the animals that avoid overfeeding them crude protein or performing genetic selection (pigs, poultry), a great deal could potentially be achieved in enhancing the UK's response to the above mentioned challenges. Additionally, the overall reproductive performance of the herd (effectively meaning the number of offspring reared to slaughter) can be further increased by not only increasing pre-natal performance but also by increasing post-natal survival.

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i Sub-Saharan Africa, for example, is expected to grow the fastest, by some 114%.

## 1.2 Impact on food security

The UK produces 60% of the food that it consumes (overall) and is 74% self-sufficient in indigenous-type foods[i], which is within usual values by modern historical standards. It should be noted, however, that self-sufficiency values have markedly declined over the last 200 years (from 100% self-sufficiency around 1750 to 60% in the 2000s).[11-12] Traditionally, the UK imports more food than it exports, but the decline in self-sufficiency, combined with other economic factors has widened the gap between imports and exports in the last decades.

Even though the Cabinet Office admits that "attempting to pursue national food security in isolation from the global context is unlikely to be practicable, sustainable or financially rational", it also recognises that "improving competitiveness in food production and raising sustainable output"[13] are important objectives to achieve, which will markedly increase food security.

Agricultural output can be hit by factors such as poor weather and animal disease. An analysis of the UK food self-sufficiency ratios by commodity shows that the biggest variation (in the last 20 years) has occurred for cattle and calves, beef and veal (Figure 1).[13] It is highly likely that the marked drop in self-sufficiency that occurred in the mid-90s is directly related to the Bovine Spongiform Encephalopathy (BSE) crisis. This illustrates the larger economic risks associated with animal health.

**UK self-sufficiency varies greatly from commodity to commodity**

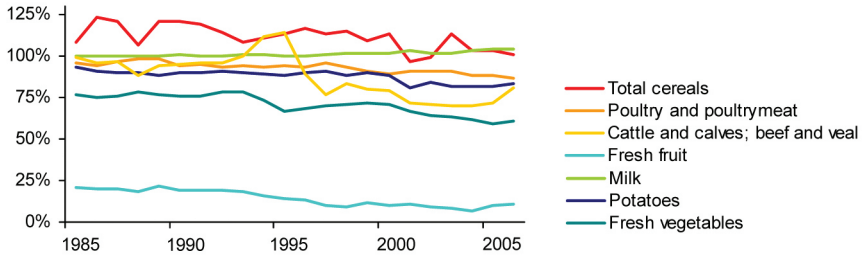


**Figure 1** - Variation in UK self-sufficiency according to commodity. Source: [13]

Veterinary research enhances the welfare of animals and the protection of the human population from zoonotic infections, and therefore plays a fundamental role in shielding the markets and protecting the economy against disease outbreaks and drops in feed production/rises in feed price. In the same way that indigenous industries cannot be recreated overnight, vaccines take time to be developed.

For example, the longer we wait to learn about animal diseases, the longer it takes to develop an effective vaccine. As was shown, this can have serious impact on the security of the food supply, not to mention the effects on human and animal health.

## 1.3 Impact on food safety

***"There is no room for complacency about food safety. Smarter approaches are needed to ensure that interventions focus on the points of highest risk in the food-chain" Cabinet Office, 2008.***

As more developing countries are driven to expand their agricultural capacity, the challenge of maintaining the security of the food-chain becomes even greater. Artificial economic barriers and geography have but a small role to play in preventing the spread of disease, as disease knows no borders, especially in an increasingly connected world.

In 2006, 21 billion food animals were produced and transported worldwide.[14] Every year, more than 300 million pigs, sheep and cattle are sent to EU-27 slaughterhouses for meat production along with an estimated 6,000 million birds.[15] Securing that each one of these animals is fit for human consumption is an enormous task.

Data from the World Health Organisation states that up to "30% of the population in high-income countries may suffer from foodborne diseases each year, while the picture in low-income countries is less clear, but likely to be worse".[5] Alarmingly, about 75% of all new diseases emerging during the last two decades have been zoonoses.[14]

i In this context, "indigenous foods" refers to the type of foods that can be produced in the country.

Both domestic and wildlife reservoirs are involved in the transmission of diseases and therefore the risk of zoonotic infection is not predicted to diminish in the future. Trade and markets can create pathways for disease transfer and evolution, and the wildlife trade may also provide a source of zoonoses.

The real scale of this threat becomes clearer in light of the fact that 270 tonnes of potentially contaminated bush meat can pass unchecked through one single European airport a year.[5] This not only poses a public health threat, but it can also have devastating consequences for animal health, as the recent Foot and Mouth disease outbreak illustrates.

Ensuring the safety of our food through the prevention, monitoring and treatment of foodborne diseases is a pivotal responsibility of the veterinary profession.

In the EU, "there were a small number of diseases which had a high incidence rate, most notably Giardiasis, Campylobacteriosis and Salmonellosis, a range of less common diseases such as Listeriosis and a further range of much less common diseases such as cholera or variant Creutzfeld-Jakob disease" (Table 1).[15]

**Table 1 - Number and case rate of several zoonotic diseases in the UK and in the EU27 for 2009[16]**

| **Disease** | **UK** (nr of confirmed cases) | **EU-27** (nr of confirmed cases) | **EU-27 Case rate** (per 100,000 inhabitants) |
|---|---|---|---|
| Anthrax | 10 | 55 (21 deaths) | **0.004** |
| Botulism | 13 | 132 | **0.03** |
| Brucellosis | 17 | 401 | **0.08** |
| Campylobacteriosis | 65,043 | 198,683 | **53.07** |
| Cholera | 16 | 19 | **0.06** |
| Cryptosporidiosis | 5,587 | 8,016 | **2.74** |
| Echinoccoccosis | 7 | 789 | **0.18** |
| *E.Coli* | 1,339 | 3,573 | **0.86** |
| Giardiasis | 3,719 | 16,239 | **5.6** |
| Leptosirosis | 53 | 544 | **0.14** |
| Listeriosis | 235 | 1,654 | **No data** |
| Salmonelliosis | 10,479 | 108,615 | **No data** |
| Toxoplasmosis[i] | 10 | 26 | **No data** |
| Trichinellosis | 0 | 750 | **0.15** |
| Tularaemia | 0 | 825 | **No data** |
| Variant Creutzfeld-Jakob disease[ii] | 3 | 8 | **0.01 per 1,000,000** |
| Yersiniosis | 61 | 7,626 | **2.02** |

Campylobacteriosis is undoubtedly the most common zoonotic disease in the EU. Britain has been seeing a steady increase in the incidence of serious gastrointestinal complications related to ***Campylobacter*** (8% increase from 2009 to 2010)[17], with an associated annual cost of at least £538m to the country.[18] Investment in research for this area, however, has not exceeded £4m combined between the three major public funders (Defra, BBSRC and Food Standards Agency (FSA) – data from 2008).

Salmonelliosis costs the UK an excess of £14m per annum (£1,225 per reported case)[19] and it is interesting to notice that whereas financial losses associated with zoonotic disease outbreaks in the food-chain are normally measured in the tens of millions or even billion pounds, research investment is limited to the low millions. For example, at the height of the BSE crisis, in the financial year of 1995/1996 alone, more than £3.5 billion were spent in the UK to control and deal with the disease,[1, 20] yet public funding for research in the area that same year was limited to less than £10m. In fact, the combined public investment in research in Transmissible spongiform encephalopathies (TSE) in the last 19 years (£312m) is less than 9% of the costs associated with tackling the disease in 1995 alone.[1] (Figure 2)

i Due to the change in the EU case definition for toxoplasmosis in 2008, only congenital cases are required to be reported from 2009 onwards. These numbers therefore, report data <1year of age.

ii Number of deaths.

**Government expenditure on spongiform encephalopathy-related research**

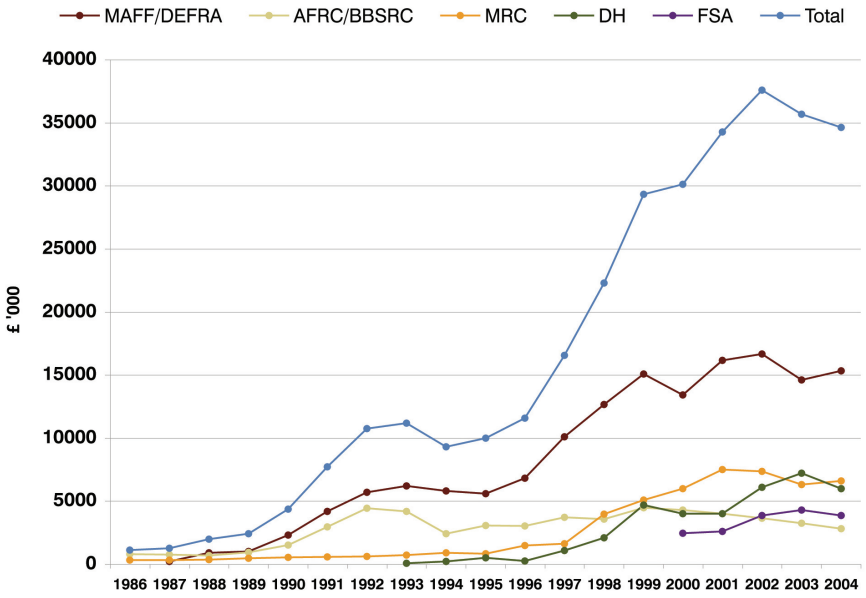


**Figure 2** - UK Government expenditure on spongiform encephalopathy-related research 1986/87-2002/03 (in £'000)[1-2]

Other major losses associated with food animals are known. For example, the Foot and Mouth epidemic in 2001 cost the UK £8bn in just 7.5 months and resulted in the slaughter of 6.7 million animals.[21]

Additionally, the economic consequences of food safety scares can be disproportionately large compared to actual risks to consumers,[5] as exemplified by the egg salmonella crisis of the late 1980s and the E coli outbreak in 2011. With the BSE outbreak, for example, the meat trade and the farming industry were affected for several years after the epidemic was controlled, as the international markets struggled to regain their confidence in British produce. It is also important to remember the number of animal lives lost, which, admittedly, should not only be measured in financial terms.

Through veterinary research and surveillance, a reduction of 99.9% in the number of reported BSE cases was achieved in a period of less than 15 years, but care should be taken in declaring the disease eradicated. In fact, important questions – such as the origin of the disease – remain unanswered and if recrudescence of BSE is to be avoided, research priorities will need to consider tackling the uncertainties.

As one epidemic seems to come closer to an end, others emerge. In 2010, 31,679 animals were slaughtered due to Bovine Tuberculosis (bTB) and it's worth noting that numbers keep increasing (7.5% over a year) despite the fact that the number of cattle in Great Britain has been falling (13% in the last 13 years). One of the key challenges in controlling bTB lies in detecting infection in individual live animals, as infectious animals are asymptomatic for long periods of time. Current methods of testing rely on the immunological response[i] from the animal but there is reason to believe that detecting the causative bacteria directly might improve detection rates, avoid false negatives from animals which have developed immunological resistance and consequently help tackle infection in other animals. Such tests are not yet available for widespread application, but as one of the countries most interested in finding a solution, Britain should lead on this technology.

The Bluetongue virus is yet another example of an animal disease with potential disastrous consequences to the economy, the welfare of animals and the safety of the food-chain. It is estimated that the success of the Bluetongue vaccination programme in 2008 has saved £460m and 10,000 jobs in the UK, not to mention the lives of many animals.[22]

In order to address the major challenges involved in keeping the food-chain safe for human consumption, the food system needs to be at the forefront of technological development. At this point, and according to the Government Office for Science "***the potential costs of NOT utilising new technology must be taken into account***".[5] Mechanisms need to be put in place to ensure that the potential dangers are known and that sufficient data can support the response to disease outbreaks. These mechanisms need to be concerted and cross-disciplinary.

i ie measuring its response when it is infected with small doses of the bacterium.

## 1.4 Impact on human and animal welfare

### 1.4.1 Farm animal welfare

Whilst most European citizens list the presence of residues in crops as their top food-related concern, UK citizens are most worried about the welfare of farm animals.[23]

Despite making the headlines less often than zoonotic disease outbreaks, issues regarding animal welfare have a profound impact on the productivity and sustainability of animal farming and are strongly dependent on veterinary research.

In a world where several billion people are striving to move up the food-chain by adopting diets with higher animal protein content, land and water productivity need to be significantly raised if animals are to be reared more efficiently.

Emerging economies like India and China are now taking the lead worldwide in the production of animal-derived products, but concerns regarding standards of animal welfare in these countries still persist.

India's dairy herd, the largest milk producing herd in the world, is also highly inefficient. Each animal is estimated to produce four to five litres a day – which is around a quarter of the values for an average western herd.[24] China is the largest pig producing country in the world, but its welfare practices are quite far from UK standards, which implies that a large part of the pig meat consumed worldwide derives from animals that have been reared in less than ideal conditions.[25]

Welfare management has direct consequences on animal behaviour, welfare, health and productivity, and on the profitability of animal-derived produce. However, the issue should also be framed in the wider context of public health, environmental protection and food security.

On the food security perspective, intensive farming systems which disregard animal welfare can also obstruct equitable access to food, fail to detect public health threats (or indeed enhance them) and contribute to regional pollution by inadequate management of animal waste, for example.

There is also a large body of evidence confirming that chronic stress makes animals more prone to disease, which might ultimately result in higher levels of anti-microbial resistance by leading to more antibiotic treatments being prescribed.

Welfare management can also have direct impact on addressing climate change issues. Methane emissions from cattle are responsible for about 80 million metric tonnes of greenhouse emissions (GHE), which accounts for about 28% of global methane emissions from all human-related activities. [i]

It is widely accepted that welfare management can help reduce this number. Several practices have already been identified to have a positive impact in improving production efficiency and reducing greenhouse gas emissions, such as improving grazing management, adding certain nutrients to the diets of the animals, providing appropriate water sources and protecting water quality and improving genetics and reproductive efficiency, just to name a few.[26]

Careful consideration of these issues by health professionals, veterinary researchers and informed consumers is now contributing to a re-definition of "quality of animal products" to include factors such as hygiene/safety, nutrition, traceability and quality of the production environment. "Meat quality" is therefore much more than a mere checklist of physicochemical/organoleptic characteristics.

Failure to address welfare issues will significantly affect the competitiveness and economical viability of the food industry and the balance of ecosystems.

Veterinary research treads a fine line between productivity and welfare, by first identifying the issues that need to be tackled in order to produce (and protect) healthy, productive animals which exhibit normal behaviour, and to then develop infrastructures and technology that can assist that production in economically efficient terms. Its impact is so deeply embedded in the food-chain that it becomes extremely hard to quantify.

i http://www.epa.gov/rlep/faq.html#1

### 1.4.2 Companion animals and their owners

Other welfare issues arise beyond those related to food-producing animals. Companion animals and also laboratory animals are increasingly dependent on our ability to understand and promote their wellbeing.

Ethical debates regarding the use of animals for food and research can be enlightened by developing better assessment and management of pain and distress. Social issues related to irresponsible dog ownership, for example, can be enlightened with research on canine behaviour and appropriate education of owners.

Research funding often does not reflect the vital impact that companion animals have in the physical and mental health of their owners and of the social framework around them.

In England alone, there were over 5,000 hospital admissions and a £3.3 million spend by the NHS resulting from dog-related injuries in one single year (2009/2010). Beyond this cost, it is estimated that 2.8 million livestock are attacked each year by dogs.[27]

In order to achieve a necessary level of understanding, research needs to be conducted on the nutrition needs, metabolism, and safety of food and feeds and on behaviour/environmental conditions that might improve their wellbeing.

On another level, research into the behavioural and training needs of companion animals and service animals will increase their quality of life and enhance their performance as assistants, protectors and life savers.

Animals are essential in areas as diverse as herding, search and rescue, drug and chemical detection, police and military assistance and support for people with special needs.[28] There is also sufficient evidence to suggest that companion animals have a direct impact on the life expectancy and psychological wellbeing of the human population, positively affecting the wider social framework of their caregivers.[29-30]

## 1.5 Impact on wildlife

The notion that man is responsible for the extinction of many wildlife species (ie non-domestic species) is now widespread and several high profile public awareness campaigns have been trying to address wildlife conservation issues, warning that simple and quick solutions are not easy to find.

It is accepted that multidisciplinary teams are best placed to tackle the challenges in conservation, and that these must include veterinary surgeons, equipped with sound scientific knowledge.

The variety of species that veterinary surgeons are called upon to study, protect and care for is vast and only professionals with access to the best research can truly fulfil their role.

From treating animals that have been injured as a consequence of their interactions with humans, to assisting reproduction of endangered species, the role of a veterinary surgeon in this area is varied and challenging. It also involves studying, surveying and controlling infectious diseases in wildlife.

Of the estimated 800 species that have become extinct over the last five centuries, circa 4% have been lost to infectious disease, but this number is expected to increase as contact between wildlife and domesticated species increases.

Currently, 16,928 species are threatened with extinction, including nearly one-third of amphibians, more than one in eight birds and nearly a quarter of mammals.[31] Failure to intervene swiftly and to identify the best (science-based) interventions can result in disastrous consequences.

Besides disease, wildlife is also threatened by interaction with populations.

The cohabitation of humans and wildlife is mostly peaceful but can occasionally result in conflicting interests. As the dominant species, human interests have historically taken precedence over wildlife preservation but the last decades have seen a shift of attitude towards a more responsible sharing of natural resources and the protection of ecosystems.

In the UK, individuals are free to manage wildlife within the law, which includes putting in place avoidance measures when minor conflict occurs, and lethal or non-lethal measures when the conflict is intolerable and unavoidable, in which cases special licences are necessary.

The conservation of vulnerable or rare species and habitats, exploitation of wildlife resources and the control of species to address impacts on the economy, public health and safety are the main drivers in wildlife management, an area which heavily relies on the input of veterinary surgeons. At government level, research on the issue is managed by Defra, with a nominal baseline of £530,000 (for 2010/2011).[32]

Recent discussions on the role that badgers play in spreading bTB illustrate capably the importance of having a solid body of evidence coming from good quality research on wildlife. Similar issues exist with foxes and the spread of rabies and Echinococcus Multiloccularis.

Expanding human populations may result in unsustainable demands for food and water supplies, whereas habitat destruction places humans and animals in greater proximity and increases the risk of infectious disease within and between species.

The impact that these factors may have on our quality of life is clear and, irrespective of the concerns we should have for other plant and animal species, it is time to accept that the healthy biodiversity of the planet is also essential for our health.

# 2. Veterinary research in the UK: facts and figures

## 2.1 The quality of the UK's veterinary research base

***"Although many innovations that we champion arose from garages or university dorms (the home computer and Facebook), in this age the ones we really need (…) require huge sums of money and resources. How can we encourage the innovations we need to happen?" (Tim Harford, 2011)***

The UK is well known for producing high quality research and for having highly efficient researchers.[33] For example, it is the country that spends the lowest percentage of GDP on R&D in the G7, but it still manages to be the most productive in terms of scientific publication (papers per GDP and papers per researcher). Worldwide, it ranks second in terms of scientific impact (citations per paper), which is a remarkable position.[33]

Studies have shown that "the literature of science is a reasonably good indicator of a country's level of the participation in the worldwide enterprise of scientific research".[34] This means that the quantification of the research output (as indexed by databases such as the Web of Knowledge™ and Scimago) can give an idea of the UK research capacity in veterinary sciences.

Previous bibliometric studies have found that veterinary sciences in the UK perform remarkably well when benchmarked against other countries.[35]

Globally, papers in the veterinary sciences[i] tend to be published in specialised journals with impact factors (IF) mostly between 0.2 and 1.5 (with the highest IF reaching 4). For the category "Dentistry, Oral Surgery and Oral Medicine"[ii], which is often taken as the best comparative subject area, this value is slightly higher ([1-2] with the highest IF reaching 4) suggesting that dentistry tends to be slightly more regarded scientifically or simply that it reaches a wider audience. For the category "Medicine - Research and Experimental", journal IFs can reach up to 13, with the majority of publications sitting in the [2-4] interval, which is, expectedly, higher than both the disciplines mentioned before.

The number of citable papers in the category "veterinary sciences" published by researchers with a UK address was evaluated from the period 1996-2010 (Figure 3). The data show that there is a somewhat cyclical variation in publication rates with a large increase of paper publication (20-30% growth) being followed by two or three declining years. This cyclical pattern can be a statistical artifice derived from the data or changes in classification of papers by the Web of Knowledge and the Scopus database. Nonetheless, over the last third of the data, the rate of growth is clearly positive reaching 1,080 citable documents in 2011, equally distributed between small animals, food animals and equine (food animals gaining the highest number of cites).

A similar trend occurs for "Dentistry, Oral Surgery and Oral Medicine". In particular from 2003, the rate of growth for both subject areas shows a very similar pattern, suggesting that in terms of productivity and volume of research output, the veterinary sciences are at least on par with other national research areas of similar size. This is further confirmed by the data in Table 2, which shows both subjects have comparable values in terms of ***h***-index, citations per document and relative contribution to regional and world publication output (% region and % world, respectively). The degree of international collaboration is also similar across both disciplines (% of documents with more than one country listed in the authors' addresses).

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i "Veterinary sciences covers resources concerning both the research and clinical aspects of animal health, diseases, injuries, nutrition, reproduction, and public health. This category includes materials on companion, farm, zoo, laboratory, wild, and aquatic animals."***(Web of Knowledge).***

ii "Dentistry, Oral Surgery & Medicine covers resources on the anatomy, physiology, biochemistry, and pathology of the teeth and oral cavity. This category includes specific resources on periodontal disease, dental implants, oral and maxillofacial surgery, oral pathology, and oral surgery. Coverage also includes resources on community dentistry, public health dentistry, and pediatric dentistry."(***Web of Knowledge***).

## Publication output

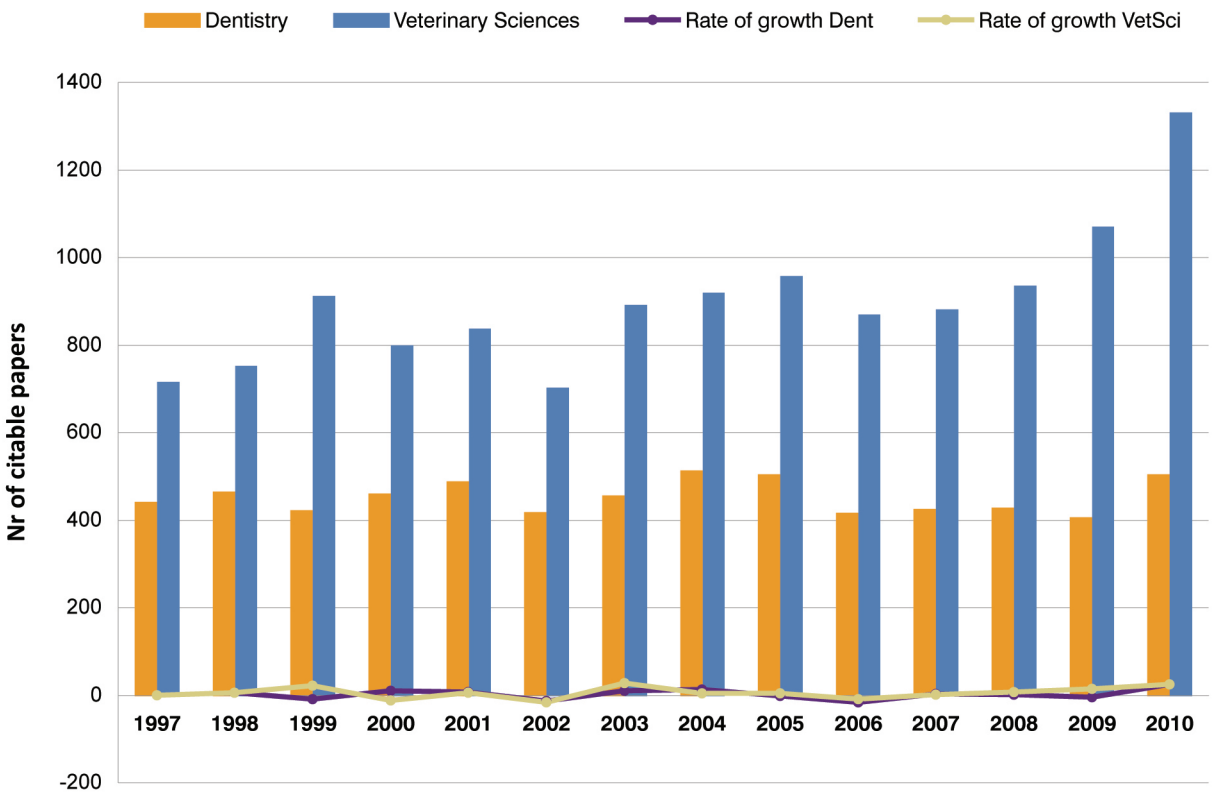


**Figure 3** – Comparative distribution of publication output during 1997-2010, and respective % growth in publication between UK veterinary sciences and dentistry (data from the Scopus database, Scopus SJR - SCImago Journal & Country Rank). www.scimagojr.com

**Table 2 – Analysis of UK bibliometric parameters for dentistry and Veterinary Sciences.**
Source: ScopusSJR - SCImago Journal & Country Rank. www.scimagojr.com

| Parameters (1996-2011) | Dentistry | Veterinary sciences |
|---|---|---|
| *H*-index | 92 | 90 |
| Documents | 8,069 | 17,734 |
| Citable documents (excludes letters, corrections, etc) | 7,539 (93%) | 14,370 (81%) |
| Citations | 101,790 | 154,310 |
| Self-citations | 21,946 (22%) | 44,246 (29%) |
| Citations per document | 12.6 | 8.7 |
| Uncited documents (% average) | 16% | 32% |
| International collaboration (% average) | 34% | 33% |
| Region (% average) | 28 | 27 |
| World (% average) | 8 | 8 |

Internationally, a comparison was made with the US, Brazil and China which constitute respectively a highly regarded scientific power and two emerging competitors. These are large countries, and sample size is therefore not comparable with the UK, making the number of papers a less valid parameter to measure statistically. The average growth of publication output per year between countries of different size can then be used as an indicator.

Data mined from the Web Of Knowledge and the Scopus database showed that the average yearly growth in publication numbers for the UK and the USA (with an average growth 6 and 3%, respectively) is quite modest when compared to China and Brazil (average growth 34 and 31%, respectively), which confirms the status of the latter countries as emerging scientific nations in the veterinary field.

Another way to analyse the research output is to focus on "efficiency". The number of times a scientific paper is cited by a subsequent publication can give a measure of its impact and influence. Therefore, measuring the citations per produced paper (minus the number of self-cites) can be a useful marker when measuring a large with a small sample.[36]

In Figure 4, where the result of such analysis is plotted, it can be seen that the UK is the most efficient country of the sample in terms of citations per paper. It follows that, even though British veterinary researchers publish fewer papers than their counterparts in the USA and Brazil, the number of citations per paper continues to be higher for British veterinary research than for any other country. This indicates that, whilst the number of papers published by UK researchers is considerably smaller, their quality is higher (eg in 2008 for 866 citable papers from the UK there were 2,530 US and 1,264 Brazilian papers).

**Research impact by citations**

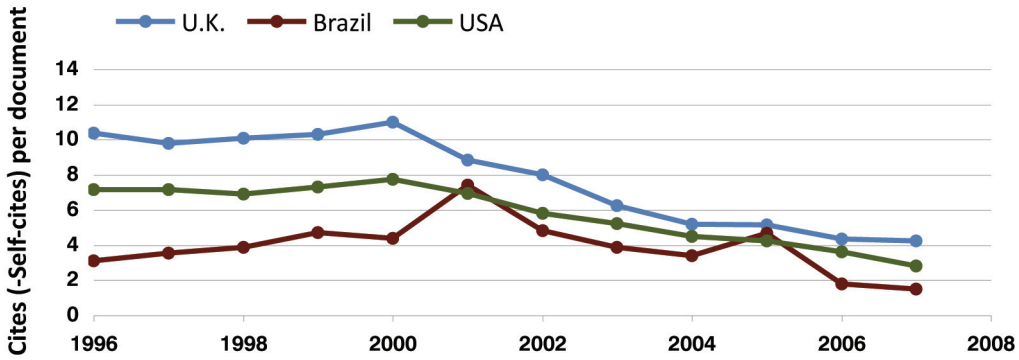


**Figure 4 –** Average citation per paper for publications in the "Veterinary sciences category, originating from the UK, Brazil and the USA (data mined from the Web of Knowledge™ and Scimago – Scopus)

Worldwide, the quality of veterinary research can be compared with other countries using the ***h***-index ranking system. Originally, the concept of the ***h***-index was developed to measure the scholarly publishing productivity and impact of individual researchers through a single indicator. It became widely popular for the simplicity of the concept, and its use was extended to research groups, institutions and journals and countries.[37]

From Table 3 it can be seen that the UK is remarkably well positioned in the country ranking for veterinary research. So far, the most highly cited papers in the subject-area of veterinary science in the UK[38-39] are related to TSEs, in particular research on the variant of Creutzfeldt-Jakob disease.

**Table 3 – Country ranking for the subject area of veterinary sciences**, for the period 1996-2011, ranked by *h*-index. (Source: SCImago. (2007). SJR — SCImago Journal & Country Rank www.scimagojr.com)

| Ranking | Country | Citable documents | Citations per document | *h*-index |
|---|---|---|---|---|
| 1 | United States | 38,831 | 9.35 | 105 |
| **2** | **United Kingdom** | **14,370** | **9.54** | **90** |
| 3 | Canada | 6,701 | 9.76 | 71 |
| 4 | France | 7,275 | 7.36 | 70 |
| 5 | Netherlands | 4,479 | 10.89 | 67 |
| 6 | Australia | 5,359 | 9.77 | 63 |
| 7 | Germany | 11,653 | 5.61 | 63 |
| 8 | Denmark | 2,486 | 13.31 | 60 |
| 9 | Spain | 5,066 | 10.72 | 60 |
| 10 | Italy | 4,751 | 9.92 | 55 |
| 11 | Belgium | 4,127 | 8.23 | 52 |
| 12 | Japan | 5,555 | 7.61 | 52 |
| 13 | Sweden | 2,254 | 12.17 | 52 |
| 14 | Switzerland | 3,485 | 8.96 | 51 |
| 15 | Norway | 1,494 | 12.22 | 48 |
| 16 | New Zealand | 1,946 | 10.17 | 48 |
| 17 | Brazil | 10,393 | 5.98 | 45 |
| 18 | Ireland | 1,339 | 8.95 | 41 |
| 19 | South Africa | 1,939 | 7.29 | 40 |
| 20 | China | 3,129 | 10.16 | 39 |
| 21 | Argentina | 1,330 | 8.44 | 36 |
| 22 | Czech Republic | 1,779 | 6.62 | 35 |
| 23 | South Korea | 2,087 | 9.84 | 35 |
| 24 | Austria | 1,841 | 5.91 | 33 |
| 25 | Hungary | 1,996 | 4.19 | 33 |
| 26 | India | 13,340 | 1.72 | 33 |
| 27 | Mexico | 1,700 | 7.99 | 33 |
| 28 | Poland | 6,144 | 2.78 | 31 |
| 29 | Turkey | 6,626 | 2.88 | 27 |
| 30 | Iran | 2,125 | 4.17 | 23 |

A more in-depth analysis should look at the publication habits of veterinary researchers (domestic or international journals), specialist areas of strength (veterinary parasitology, toxicology, etc), highly productive institutions and highly productive researchers. This will allow a reflection on the types of research model that are working well and those which can be improved on.

It is nonetheless clear that the veterinary sciences are well ranked nationally and internationally, in terms of efficiency and impact. It should be noted, however, that *"the global landscape of research is fluid, dynamic and intensely competitive. Other countries are outpacing the UK in terms of growth in numbers of researchers and spending in research. The UK is well-positioned, but its ability to sustain its leadership position is far from inevitable."*[33]

## 2.2 Investment in veterinary research

### 2.2.1 Overall values

In 1997, the total identifiable investment in animal health and welfare research in the public sector and the universities was reported to be between £92m and £108m (corrected for inflation).[2] Government and research councils such as the BBSRC were then acknowledged as the main funders, with some financial contributions also being made by a variety of charities, especially for niche areas of research. A partial value of £62m to £77m was also found, excluding the contribution of the Higher Education Funding Council (HEFC) in supporting the research infrastructure in the veterinary schools and from animal welfare societies or pharmaceutical companies.

An informal survey carried out by the RCVS for the purposes of this report has attempted to draw a comparison between the values of investment in veterinary research then (1996/97) and in 2009/10.

Unfortunately, following up the numbers accounted in the Selborne report proved challenging due a number of factors, chief amongst which was the lack of a common definition for "veterinary research" between the funding bodies over time. For example, in the 14 years that separates the Selborne report and this document, the BBSRC has widened its definition of veterinary research beyond "studies in animal health and welfare" to include "underpinning" research (ie research directly related to animal diseases but not involving the animals directly). This inclusion has obvious effects on the overall numbers, largely contributing to the apparent increase of £26m to £27m in the UK investment in veterinary research over the last 14 years.[i] An administrative change, rather than a true investment, is therefore responsible for the numbers below (details can be found in the "further information" section). Further to the administrative difficulties expressed above, the Selborne Report does not list the different levels of investment for each of the commissioners of research, which makes some of the values not comparable.

**Table 4 – Investment in veterinary research**
Total and partial estimated values accounting and NOT accounting for the significant changes in BBSRC funding. Individual values can be consulted in the "Further information" section of this document. All the values presented are corrected for 2011 inflation (1996: av 2.9%/year, 2009: av 4.9%/year).

| | 1996/1997 | 2009/2010 |
|---|---|---|
| **Partial**[ii] **(Selborne parameters)** | £62.0m - £77.0m | Not comparable |
| **Partial**[iii] **(calculated by this report)** | £77.5m | £102.6m - £103.7m |
| **Partial (not counting BBSRC)** | £60.4m | £57.1m - £58.2m |
| **Total**[iv] **(Selborne parameters)** | £92m - £108m | Not comparable |
| **Total (calculated by this report)** | Not comparable | £126.8m - £127.9m |

Discounting the effect of both the administrative changes of BBSRC and the values that could not be compared due to unavailability of data, a rough estimate can be advanced in that the investment in veterinary research has suffered a decrease of 5.5% in the last 14 years, even in the face of increasing challenges related to veterinary science.

i See detailed analysis of BBSRC funding in 'Further information' – Annex a.
ii Partial investment is limited to the investment made by the BBSRC, Defra, RESAS, Wellcome Trust and the industrial funding bodies.
iii Not including the values for RESAS, which were not published or available for the year 1996/97.
iv Total investment according to Selbourne parametres includes HEFC funding, animal welfare societies and pharmaceutical companies. This last value was estimated by the report on informed assumptions.

### 2.2.2 Academic research

Another way to analyse the investment trend in veterinary science over the last 14 years is to study the value of research grants and contracts received by UK universities undertaking veterinary research (Figures 5 and 6). It should be noted, however, that veterinary research happens beyond the university environment and thus these numbers do not represent the total (absolute) amount spent in UK veterinary science. Nonetheless, since universities are still thought to constitute the largest supplier of research, they are expected to take up a large part of the funding available for veterinary research, therefore constituting a representative sample of the trends in research investment over the last 14 years.

**Funding in veterinary research (academia)**

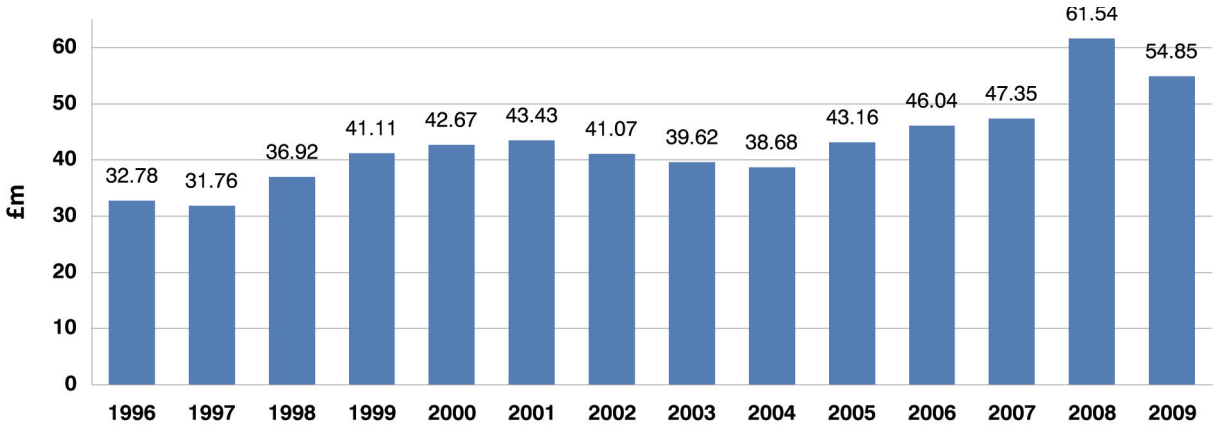


**Figure 5** - Research grants and contracts income reported by UK universities by cost centre – veterinary sciences from 1996/1997 to 2009/2010 (source: HESA). All values are corrected for 2011 inflation as reported by the Bank of England.

**Percentage growth in grants and income**

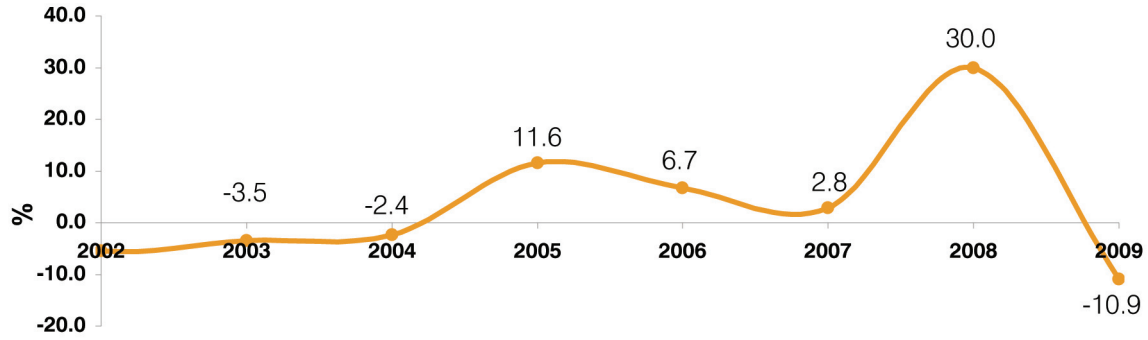


**Figure 6 -** Percent growth of UK universities income in research grants and contracts in the veterinary sciences, taken from the values of "research grants and contracts income". (Raw data sourced from HESA)

Both Figures 5 and 6 show that the last decade has seen a large variation with regards to the amount of funding available for academic veterinary research. Whilst any growth in investment is generally welcomed by the providers of research, having such a large variation in income can place a big strain on resources, hinder the establishment of a solid research infrastructure and compromise the long-term sustainability of the UK's veterinary research environment.

The research income for universities can be further analysed in terms of the type of funder (Figure 7).

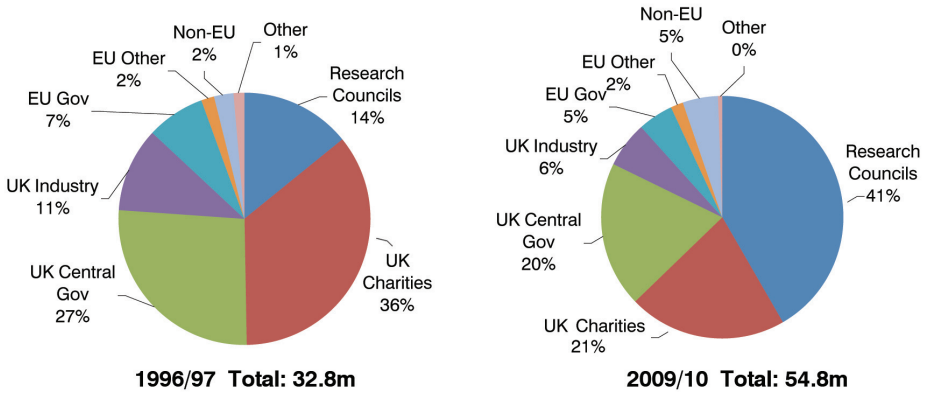


**Figure 7** - Research grant income breakdown by type for the veterinary science cost centre for 1996/97 and 2009/10 (raw data sourced from HESA). Values corrected for 2011 inflation (average value 2.9 and 4.9% respectively). Notes: UK industry refers to UK-based industry, commerce and public corporations; UK Central Gov refers to UK central government, local authorities, health and hospital authorities. EU Other includes EU charities and EU industry.

In the last 14 years the research councils have established themselves as the main funders of academic veterinary research, now distributing 42% of total funding. In fact, the £22m increase investment in veterinary academic research during this time has been largely shouldered by the research councils, with the remaining contributors maintaining or reducing their investment in university-based veterinary research.

This increase can partly be attributed once again to the variation in the definition of veterinary research across the different funders, but factors related to the changes in the funding of the research infrastructure, which are now somewhat included in the grants and contracts, should not be overlooked.

It cannot be denied that the last five years have witnessed major economic pressures and it is likely that this might have played a part in discouraging investment in research. The charity sector seems to have been particularly hit by the recession and at present some institutions which were contacted in our survey are gradually suspending or dramatically decreasing their research investment.

### 2.2.3 Defra Animal Health and Welfare Research

Outside the academic environment, a considerable amount of veterinary research happens under the budget of Defra. Between 1996/97 and 2009/10, their Animal Health and Welfare Research (AHWR) programme has seen a budget decrease of 10%, but it is unclear if the financial repercussions of closing down (or limiting the functions of) the National Animal Institutes are fully reflected in the published numbers.

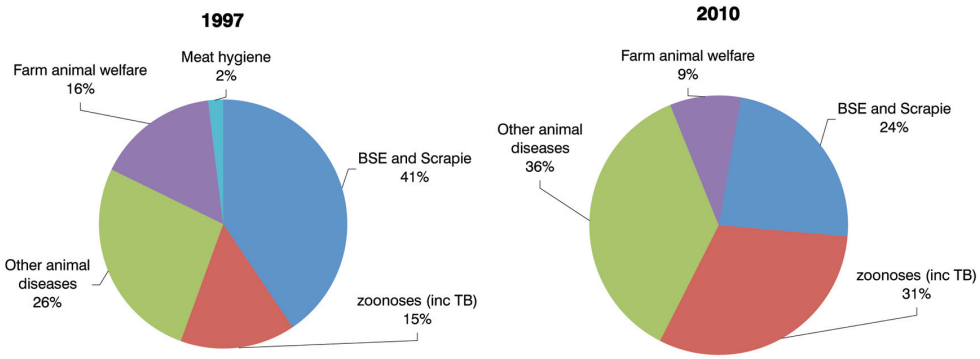


**Figure 8 -** Distribution of spend in the Animal Health and Welfare research programmes in 1997 (left) and in 2009/10 (right), corrected for 2011 inflation. Source: [10]

Interestingly, an analysis of the spending distribution in Defra's AHWR programmes reflects the changing nature of the scientific challenges to which veterinary research has had to respond in the last decades (Fig. 8). As expected, in 1997, at the height of the BSE crisis, most funding was allocated to research in TSEs (such as BSE and Scrapies), which was then halved in 2010, when the threat was considered under control. Investment in research regarding bTB, on the contrary, has been almost doubled in view of the recent bTB outbreaks. These changes in distribution seem to indicate a reactive approach to veterinary research, rather than a proactive strategic outlook.

Research in the veterinary sciences constitutes approximately 20% of Defra's overall R&D budget. Considering the high financial impact of animal health and welfare in the country's economy, it can be argued that this value might not adequately reflect the risks associated with animal disease and the sustainability of the food-chain.

Perhaps more concerning is the simultaneous disinvestment in agricultural research as a whole: between 1986 and 1997 circa 45% of Defra's budget allocated to R&D was cut, prompting widespread concern in the agricultural sector.[40] Since then, the disinvestment in agricultural research has continued, even though it has been more gradual,[41] with cuts of 20% reported for Defra's R&D programme for the period 2001-2010,[i] a large part of which corresponded to the AHWR programme.

Since the risks associated with animal health and welfare are demonstrably so high, a proactive approach towards animal-related issues would see an appropriate investment in veterinary research being made, which would allow (1) the right measures to be quickly taken in times of emergency, (2) ***prevention*** of food scares – minimizing consumer panic and consequently human, animal and economical losses, (3) ***maximisation of resources***, increasing the productivity and sustainability of the food-chain, (4) adequate strategies of co-existence with wildlife, protecting ecosystems and avoiding remediation work, and (5) ***prevention*** of issues related to companion animals, whilst maximising their enormous economic and social potential.

i Source: Science, engineering and technology indicators from the Department of Business, Innovation and Skills.

# 3. Investing in the veterinary sciences

## 3.1. The agri-food sector

The agri-food sector employs one in five European citizens and generates 6% of the EU-27 GDP,[15] 11% of which is attributed to the UK[i].

In Britain, around 13% of the UK's workforce is involved in the process of getting food "from farm to fork", generating in the process around £88 billion p.a. to the economy (7% GDP).[25, 42-43] At European level, the UK is well positioned as a livestock producer (see Table 5) and is considered to be especially productive in manufacturing and selling food (wholesale).[43]

**Table 5 – Total number of livestock and total slaughtered production in the UK**: comparison with EU average values and European ranking (Dec 2010 ) No eurostat data for **

| | **Total livestock** (million) | | **Production** [15] (1,000 tonnes weight) | | |
|---|---|---|---|---|---|
| | **UK**[44] | **EU-27**[15] | **UK** | **EU-27** | **UK's position** (in EU-27) |
| Cattle and Calves | 9.9 | 88 | 925 | 7,918 | 4th |
| Pigs | 4.4 | 161 | 774 | 22,011 | 8th |
| Sheep and lambs | 21.3 | 95 | 281 | 725 | 1st |
| Poultry | ** | ** | 1571 | 11,651 | 2nd |

In real terms, the price of food has fallen over the last twenty years.[45] The average UK household spend in food in 2008 (9% of disposable income) was almost half of what it had been in 1984 (16%).[12] The role of technological innovation in these numbers needs to be acknowledged, as advancements in animal health and welfare can quickly lead to a more productive food-chain.

However, despite being a key player in the European agri-food market and having technically observed a decease in food prices, some families in the UK have witnessed a loss in food purchase power, since the incomes of the poorest have not accompanied the rise in food prices (33% increase in food prices since 1998 – which is three times higher than France or Germany – compared to a 22% increase in income).[43]

Against what seems to be the trend in the rest of the world, countries like Brazil and China have significantly invested in their domestic agricultural research base (£0.7bn and £1.1bn respectively). As a result, Brazil is today one of the world's largest agricultural exporters[ii] and China is taking seven people out of poverty for every £900 invested in agricultural R&D. Indeed, "***a study of the impact of agricultural research in developed and developing countries indicated economic rates of return of around 40%.***"[5] The US Department of Agriculture, for example, reports that each US dollar invested in agricultural research generates $20 back to the economy.[46]

Veterinarians are involved in advising or administering 3% of the total expenditure on the agri-food sector but their impact is felt far and wide over the food-chain.[15] Their clinical skills, combined with a profound knowledge about the animal in its wider ecosystem, support the decisions of all the players in the food-chain – from farmers to policy makers and food retailers. Their breadth of knowledge therefore needs to be encouraged and supported.

The economic importance of veterinary science, however, goes far beyond the agricultural activity.

i In turnover (Eurostat data from 2007).
ii Brazil is already the fastest growing agricultural sector by far, predicted to grow by over 40% until 2019, when compared to the 2007-09 base period.

## 3.2 The companion animal market

Further to farm animals and the economic wealth generated by animals for human consumption, two fast growing markets assure an estimated £80bn turnover in Europe alone: the pet food and equine sectors (Table 6).

**Table 6 – Economic impact of industries related to animal care**

| | Market value | | Jobs | |
|---|---|---|---|---|
| | UK | EU-27 | UK | EU-27 |
| Agri-food Sector [15, 43] | £ 85 bn GVA (7% GDP) | £ 751 bn GVA (6% GDP) | 3.5 million | 48 million |
| Pet food [47-48] | £ 2.05 bn (market value) | £ 20.5 bn (annual turnover) | *ca*.8,000 (direct employment) | 50,000 (direct employment) |
| Equine industry[49-52] | £ 4.20 bn (annual turnover) | Up to £ 59 bn[7] (estimated) | 70,000 (direct employment) | 400,000 (direct employment) |

As the social fabric of developed nations changes, and as numbers of people delaying marriage and children increases, many pet owners are elevating the place that their animals have in their lives.[53] Companion animals are increasingly being seen by their owners as members of their immediate family, and as such, deserving of the same quality of food and health-care. Consequently, a multimillion pound industry has developed to support this growing need.

In the UK, the pet food market caters for about 20 million pets[i], which are present in 46% of households. Despite a recession economy, this industry has been growing steadily: in 2010 the overall growth of the industry was of around 2%, with 0.3% yearly growth[48] in the volume of product sold.[ii] In the wider EU-27 context, 196 million pets are being provided for by 650 companies, which not only provide jobs and wealth (see Table 6) but also purchase 2.75 million tonnes of agricultural by-products[iii] thus adding value to material that would otherwise have to be disposed of.[47]

Veterinary research supports the sector in two ways:

- by building up the knowledge base required by the industry to create new products that can improve pet health and comfort, thus responding to the market;
- by carrying out inspections on the raw materials, as required by current legislation,[48] preventing disease outbreaks (such as avian influenza or Foot and Mouth disease) which could significantly affect the market, jeopardizing animal welfare and people's livelihood;

## 3.3 The equine market

Another highly performing sector is the equine market. Constituting one of the only examples of growing industries in rural areas today, the equine industry is the largest spender in the British countryside and employs directly and indirectly over a quarter million people. Equine sports are popular (second only to football in the UK) and highly profitable: in the EU, a job is created for every 3-10 horses, and each animal provides an annual turnover of €5,000 to €12,000.[52] In the UK alone, the industry generates around £325m for the Government in taxation revenue.

Given the high performance of the sector, it is of no surprise that the healthcare of the circa one million horses and ponies in the UK is of critical importance. Appropriate equine veterinary care helps to secure Britain's "highly regarded" position in the international racing market, a fact that is illustrated by its supply of top ranked thoroughbred racehorses (16% market worldwide).[iv]

i Excluding fish.
ii In certain sectors, both the premium and value end of the market have risen with values reaching 19% growth in certain products (dog treats).
iii 500,000 tonnes of which sourced in the UK.
iv Veterinary fees are estimated to amount to £254m per annum (74% of total expenditure).

## 3.4 Aquaculture

Aquaculture plays a key role in UK and worldwide food security, providing high quality protein and lipids essential for a healthy human diet[54]. The Food and Agriculture Organisation of the United Nations provides a clear picture of the importance of aquaculture[55]. Against a backdrop of declining wild fish stocks aquaculture has been one of the fastest growing food production sectors for more than 40 years. It is the only food production sector growing faster than human population and provides 47% of the aquatic food in the human diet. Globally aquaculture produced more than 59.9 million tonnes of food for humans in 2010 with a value of more than £77.1 billion and aquatic products are the world's largest traded food commodity. In the UK, salmon farming alone produced more than 154,164 tonnes in 2010 with a worldwide retail value of over £1 billion, making it Scotland's largest agricultural export and a very significant UK agricultural export[56].

Fish, as cold-blooded animals, have very efficient food conversion (<1:1 for dry food to wet weight) and advances in feeding have made production more sustainable and less reliant on marine food sources whilst maintaining the nutritional value of the end product (eg work by Bell, et al[57]). In addition to aquaculture, wild fisheries and angling represent a major source of income and employment in the UK often in vulnerable rural communities. Anglers have been estimated to spend up to £1.18 billion per annum in England and Wales[58].

In more general terms, the vast majority of living space on the planet and is aquatic, and fish represent more than half of all vertebrate species. Aquatic environments are essential to many ecosystems and a key natural resource in the UK. In research, fish are the most numerous experimental animal after mice, with the zebra fish becoming increasingly important as a laboratory animal model in the 21st century[59].

Diseases are a key constraint to the sustainable production of aquatic farming systems and exploitation of natural aquatic population. Veterinarians in the UK have pioneered and continue to lead research that has made a major contribution to the control and prevention of aquatic animal diseases and zoonoses as well as improving the welfare of farmed fish. The research has underpinned a successful industry providing a competitive advantage to UK farmed fish and has played an important role in training and development worldwide.

## 3.5 The avian market

Production of avian species in the UK is dominated by the chicken. Approximately 20 million eggs are eaten in the UK each day and in excess of 850 million birds are reared for meat each year. Both industries make a valuable contribution to the UK economy and to the health and well-being of the nation. However, chicken meat and eggs can cause major public health problems and both production systems can compromise the welfare of the animals. For the last 25 years there has been an international pandemic of Salmonella Enteritidis infection associated with the contamination of egg contents. This is now controlled in the UK but is still important elsewhere.

Chicken meat production in the UK, as elsewhere in the developed world, has increased markedly in the last 40 years in the UK and chicken is now a staple food rather than the luxury item it used to be. Such change has been brought about by industrialisation of production systems and genetic selection to produce rapidly growing bird types. Such changes have had significant negative consequences for bird health and welfare and have been associated with a rise in human Campylobacter cases. There were an estimated 700,000 cases in the UK in 2010. Chicken is estimated to cause up to 80% of human cases. Research is needed to bring this major public health problem under control.

# 4. Conclusions

Veterinary research - in the UK and elsewhere – has already been directly responsible for major scientific achievements such as the global eradication of rinderpest, control of Foot and Mouth diease, control of Bluetongue virus, reduction in salmonella food-borne infections, the first attenuated coccidiosis vaccine, the production of the first vaccine for a retrovirus (Feline Leukaemia Virus) and, more recently, the first recombinant viral vector vaccine to control both myxomatosis and rabbit haemorrhagic disease virus (RHDV). Many other examples of "seminal contributions to the improvement of animal and human well being" exist, yet many more challenges remain to be addressed.

Animal diseases such as bTB are responsible for major economical losses every year and a vaccine is still unavailable. Campylobacter, for example, despite being the bacterial genus responsible for most of the acute bacterial enteritis in the Western world, is yet to be fully studied in terms of its epidemiology and pathophysiology.

It is clear from this paper that the pivotal role of veterinary research in a country's economy can be easily argued. From a purely economic perspective, assuring the proliferation of knowledge in the animal sciences can enhance the health and welfare of livestock, secure jobs in the farming, equine and companion animal sectors and produce significant wealth for the British economy. However, perhaps as important as the direct generation of wealth and jobs, the veterinary sciences can contribute to shield these important sectors against unpredictable financial losses arising from disease outbreaks – whose consequences go far beyond the financial costs.

Further investment in veterinary research would not only help secure the UK's leading position in one of its most successful scientific areas, but also potentially support the economy at a time where competition – both in economic and in scientific terms – is fierce from emerging economies across the globe.

"Our increasing interdependence with animals and their products may well be the single most critical risk factor to our health and well-being with regard to infectious diseases."[14] Acknowledging that profound and complex interdependence needs to be translated in visible support for the veterinary profession and veterinary research.

# 5. Acknowledgements

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At the time of writing, the Research Subcommittee had the following composition: Professor Duncan Maskell, Professor Mick Bailey, Professor Sheila Crispin, Professor Julie Fitzpatrick, Dr Michael Francis, Professor Robin Franklin, Professor Dirk Pfeiffer and Professor The Lord Trees.

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# Annex

## Investment in veterinary research: available data

### Methods

The amount of investment in veterinary research for the different organisations in 2009/2010 was obtained from published information, direct email and telephone enquiries and is indicated in Table A. The values presented for 1996/97 were obtained from the Selborne Report[2] and from published reports by the institutions. All values were corrected for 2011 inflation, with the average inflation values indicated by the Bank of England

(http://www.bankofengland.co.uk/education/Pages/inflation/calculator/flash/default.aspx)

### Total amount of research spend

The Selborne Report mentions two different estimates of the total amount of investment in veterinary research: the 'partial total' and the 'overall total'.

### I.1 Partial total

The "partial total", as defined in the Selborne report does not include the contribution of the HEFC in supporting research infrastructure in the veterinary schools and other university departments or of research funds from other sources such as the animal welfare societies or pharmaceutical companies.

It consists solely of the aggregate investment given by BBSRC, MAFF (now Defra), SOAFED (now RESAS), the Wellcome Trust and the industrial funding bodies[i] and it was estimated to be between £40m and £50m in 1996/97 (£62m to £77m if corrected for inflation).

#### BBSRC investment in animal research

Unfortunately the values for RESAS in 1996/1997 are not known and therefore the "partial total" previously reported cannot be fully verified. Data retrieved by the RCVS Research Subcommittee from the funding bodies for that year suggests that the Selborne Report might have slightly underestimated the investment in research for that year, since the sum of all the values for 1996/97 ***excluding RESAS*** reaches the top end of Selborne's estimate (£77.48m). For 2009/10, ***if RESAS is excluded*** again, this number would be £102.65m, which suggests a 32% increase in the amount of investment in veterinary research over the last 14 years.

Again, this value cannot be taken as a true account of investment. Not only does it disregard the contribution of RESAS which is not ideal, as it is artificially boosted by changes in the definition of "veterinary research" by the BBSRC occurred in this time frame.

This effect can be seen in detail in Figure a, where the absolute values of BBSRC's investment in animal health research in the last 14 years are plotted alongside the percentage of gross annual expenditure invested in the veterinary sciences for the same period of time.

The large increase in (absolute) funding is therefore attributed to a administrative change, even if the percentage of the BBSRC's investment in veterinary research compared to their total spend hasn't changed significantly over the years (Figure a).

i Horseracing Betting Levy Board, Milk Development Council, Meat and Livestock Commision and British Egg Marketing Board Research and Education Trust).

**BBSRC investment in animal research**

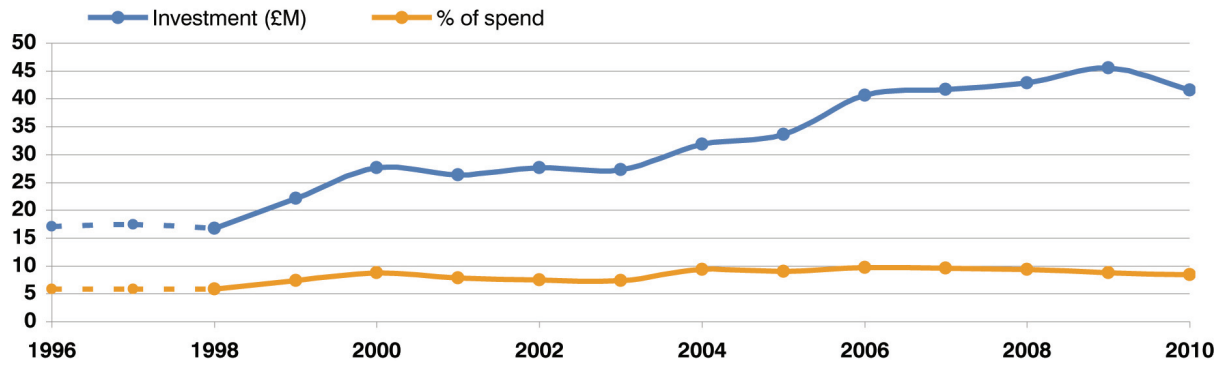


**Figure a -** BBSRC's investment in veterinary research from 1996/1997 to 2010/2011 (all values corrected for 2011 inflation) and % BBSRC gross annual expenditure spent in veterinary research for the same period of time. The dotted lines indicate that the values were estimated. (Source for raw data: BBSRC)

An (arguably) more valid comparison between investment levels needs to be carried out, discounting RESAS (because the true numbers are not known for 1996/97) and BBSRC (because administrative changes introduce artificial increase in numbers).

Discounting these two bodies, the Research Subcommittee estimates that there is actually a 5.5% decrease in veterinary funding over the last 14 years.

It is acknowledged, however, that due to the limitations in comparing the values between the two periods, these numbers should be quoted with caution.

| Investment | 1996/97 | 2009/2010 | Difference |
|---|---|---|---|
| BBSRC | £17.04m | £45.56m | Not comparable |
| Defra | £39.70m | £35.70m | ↓10% |
| RESAS | Not available | £11.0m | Not comparable |
| Wellcome Trust | £7.70m | £12.1m - £13.2m | ↑57% - 71% |
| Industrial funding bodies | £13.04m | £9.29m | ↓29% |
| 'Partial total' reported | £62m - £77m<br>Selborne estimate | £112.65m - £113.75<br>This report | ↑46% - 82%<br>(apparent increase) |
| 'Partial total'<br>(discounting RESAS) | £77.48m<br>This report | £102.65 - £103.75m<br>This report | ↑32%<br>(apparent increase) |
| 'Partial total'<br>(discounting RESAS and BBSRC) | **£60.44m** | **£57.09m - £58.19** | **↓5.5%**<br>(estimated decrease) |

## I.2 'Overall' total

The second estimate mentioned in the Selborne report focuses on the annual research spending of the veterinary schools, the Institute for Animal Health, Defra, the Animal Health Trust, the Morendun Research Institute and other bodies not predominantly involved with research) was estimated to be between £60m and £70m (£92m to £108m, with correction for inflation).

Once again, comparisons between investment values in the two different time periods are challenging not only because the reasons behind the choice of these organisations are unclear but also because some of these values are difficult to source and trace back.

This report chose to take a different approach, comparing the research income (rather than the research spend) of academic veterinary research between 1996/1997 and 2009/2010, since both these values were available and comparable.

Values of investment in academic veterinary research can be obtained from the Higher Education Statistics Agency (HESA) by analysing the Research Grants and Contracts Income for the "Veterinary Sciences" cost centre (results in the table below corrected for inflation).

| Veterinary academic research investment | | |
|---|---|---|
| **1996/97** | **2009/10** | **Difference** |
| £32.8m | £54.8m | ↑67% |

Veterinary research happens beyond the university environment and therefore these values cannot be taken as a true measure of the change in the trend of investment. It seems, however that academic research has been successful in attracting increasing amounts of funding, even in a recession economy, which further confirms its status as one of the most competitive academic bases in the world.

Other factors can also come into play here, such as administrative changes in the way that research funding is made by the funding bodies, with contributions to the research infrastructure that were previously not seen as part of "grants" or "contracts" now having to be included in such projects. These issues are too complex to analyse here and were not pursued further.

It became apparent that comparisons between levels of funding could only be made with gross assumptions since so many of the values were not comparable between 1996/97 and 2009/10, or did not reflect an accurate picture. For this reason, the authors chose to fully report the figures obtained by enquiry, in the hope that such as task will be made possible in the future. Such numbers can be found in Table A, already corrected for inflation at 2011 values.

The value found for 2009/10, taking account of the major funders of research and some of the small charities, is between £126.8 and 127.9m, which should not be compared with the 'overall total' found by the Selborne Report.

From what was said before:

- Data suggests that there was a decrease of about 5% in investment in veterinary research since 1996/97;
- Reported funding for veterinary university research has seen an increase of 67%; and,
- In the year of 2009/10 there was £127-128m available for veterinary research in the UK.

**Table a:** Funding available for research in the veterinary sciences at present and comparison with 1996/1997 values[2] corrected for inflation[i] at 2011 values (for 1996/97 average inflation/year=2.9%, for 2009/20010 average inflation=4.9%). Data collected by phone or email enquiry in Aug 2011. (n/a: information not available, even though the value is possibly accounted for in the final figure published in the Selborne report)

| **Funding Body** | **1996/1997** (corrected for inflation 2.9%) | **2009/2010** (corrected for inflation 4.9%) | **Observation** |
|---|---|---|---|
| Defra (formerly MAFF)[8] | £39.7 m | £35.7 m | Published information and email enquiry |
| BBSRC | £17.04m[9] | £45.56 m[10] | Email enquiry |
| EU | n/a | £ 2.86 m | Email enquiry |
| Wellcome Trust | £7.70 m | £12.1 - £13.2[11] | Email enquiry |
| Medical Research Council | £1.08 m | £3.41 m | Published Information and email enquiry[12] |
| RESAS | n/a | £11.0 m | Published information |
| Horserace Betting Levy Board (HBLB) | £2.31 m | £1.32 m | Published information |
| Dairy Co (formerly Milk Development Council) | £4.72 m | £2.97 m | Published information |
| British Egg Marketing Board Research and Education Trust | £1.39 m | £0.16 m | Published information |
| EBLEX and BPEX (formerly the Meat and Livestock Commission) | £4.62 m | £4.84 m | Published information |
| RCVS Charitable Trust | £0.29 m | £0.15 m | Email enquiry |
| Dogs Trust | n/a | £0.55 m | Email enquiry |
| Guide Dogs for the Blind | £ 1.00 m | £0.55 m | Email enquiry |
| The Horse Trust | £ 9.70 m | £0.86 m | Email enquiry |
| Pet Plan Charitable Trust | £0.46 m | £0.22 m | Email enquiry |
| Animal Health Trust | n/a | £3.63 m | Published information |
| BVA Animal Welfare Foundation | n/a | £0.14 m | Published information |
| Kennel Club Charitable Trust | £0.11m | £0.44 m | Email/telephone enquiry |
| RSPCA | n/a | £ 0.22 m | Published information |
| Pet Savers | n/a | £0.13 m | Email enquiry |
| Total | n/a | £126.8m-127.9m | -------- |

i. http://www.bankofengland.co.uk/education/Pages/inflation/calculator/flash/default.aspx

ii. Animal Health and Welfare Programmme and specific policy programmes.

iii. Estimated value, including animal welfare, animal disease pathogenesis, BSE, and aspects of plant disease. Excludes "underpinning research".

iv. Excludes spend on studentships and non-disease/welfare aspects such as animal genome sequencing, but includes "underpinning research".

v. Veterinary related research and research training in the 2009/2010 funding year.

vi. "Studies of animal health and systems that can contribute to medicine".

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