

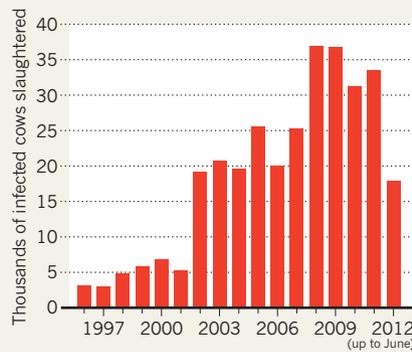
► Trust, a non-profit organization based in East Grinstead, UK, that opposes the killing of badgers. He adds that controlling cattle movements and increasing TB screening on farms would have a greater impact. Adam Quinney, a beef farmer and vice-president of the National Farmers Union in Stoneleigh, which is lobbying for the cull, disagrees. “If I said to you, ‘I’m going to give you an increase in income of 16%,’ would you say that was significant?”

In July 2011, the Department for Environment, Food and Rural Affairs (DEFRA) laid out a plan for bovine TB eradication in England. The plan included increased surveillance and security measures on farms, as well as what the government described as a “science-led policy” of killing badgers in areas of high bovine TB. The plan reflects the reality that “this little micro-organism is really getting the better of us”, says Ian Boyd, DEFRA’s chief scientific adviser, who supports the cull. Politicians do not expect that the cull alone will eradicate bovine TB, but they hope that it will at least help to stabilize infection rates. Boyd insists that the new policy is rooted in the science of the RBCT trial.

Test culls will begin in Somerset and Gloucestershire, two of the most heavily infected regions in the country. The cull areas will be larger than those in the original trial, and will use physical boundaries, such as rivers and roads, to prevent infected badgers from roaming in or out of the cull zone. For many scientists, however, the new cull seems too distant from the RBCT to deserve the title

BOVINE BURDEN

English farmers have struggled to control bovine tuberculosis over the past decade.



of ‘science-led’ policy. The 70% reduction is a particular sticking point, as it is virtually impossible to determine badger populations in advance of actually killing them. On 14 October, 31 academics warned in a letter to *The Observer* newspaper that if the targets are missed, then levels of bovine TB could actually increase, because infected badgers will begin to roam more widely. “They say that their policy will be science-based but that’s simply not true,” says Krebs, who signed the letter. “They feel they have to do something, and the easiest something to do is to shoot badgers.”

Other parts of the British Isles have already taken action. The Irish have used targeted snare-trapping to all but eliminate badgers

from selected areas. That system would be more affordable but it is considered unethical in England. In Wales, officials have begun an expensive campaign to immunize badgers against TB. Both techniques depend on the peculiarities of local geography and badger populations, but they reflect the range of approaches that can be supported by the scientific evidence.

Policy-makers, meanwhile, are frustrated. “Politicians feel that the scientists have let them down,” says Phil Willis, a Liberal Democrat and member of the House of Lords Science and Technology Committee. “They’ve not come with clarity, not just in terms of the science but in terms of the solution.” Willis says that based on his understanding of the data, the government policy is unlikely to work.

As both farmers and protesters gird themselves, Donnelly acknowledges that science has given few straight answers. But, she says, it has helped to shift the debate: farmers now admit that tougher biosecurity standards will be instrumental in controlling bovine TB, and conservationists concede that badgers are a major reservoir for the disease. “They may not be singing from the same hymn sheet,” she says, “but at least they’re looking at the same data table.” ■ SEE EDITORIAL P.310

1. Independent Scientific Group on Cattle TB *Bovine TB: the Scientific Evidence* (ISG, 2007); available at go.nature.com/7gdmhd
2. Donnelly, C. A. et al. *Nature* **426**, 834–837 (2003).
3. Donnelly, C. A. et al. *Nature* **439**, 843–846 (2006).
4. King, D. *Bovine Tuberculosis in Cattle and Badgers* (DEFRA, 2007); available at go.nature.com/lmkgec

FOOD SCIENCE

Politics holds back animal engineers

Funds and approvals lag for transgenic livestock in US.

BY AMY MAXMEN

When she saw the trailer for the documentary *Genetic Roulette*, Alison Van Eenennaam wanted to laugh, then cry. The film touts the risks of genetically engineered (GE) organisms, calling them “the most dangerous thing facing human beings in our generation”. For Van Eenennaam, a geneticist at the University of California, Davis, the scientifically unfounded assertions — that transgenic foods are responsible for increased incidence of autism, Alzheimer’s disease and type 2 diabetes in the United States — cannot be taken seriously. But the film reflects attitudes that have thwarted Van Eenennaam’s

research into the genetic modification of animals to reduce food costs and improve quality.

“Twenty years ago, the technology was our hurdle,” says Mark Westhusin, who works on GE animals at Texas A&M University in College Station. “Now the technology is great and the sky is the limit,” he says, “but good luck getting money for GE animals.”

Inquiries by *Nature* reveal that fewer than 0.1% of research grants from the US Department of Agriculture (USDA) have gone to work on GE food animals since 1999, in part because of a poor public image. In one case, James Murray, another geneticist at the University of California, Davis, was told in 2003 that the USDA had rejected his proposal to

develop a goat that produces milk rich in human lysozymes — enzymes that fight diarrhoeal disease — because the agency felt that “the general public would not accept such animals”.

Van Eenennaam once hoped to engineer a cow that produced milk rich in omega-3 fats, but the USDA rejected her proposals, and she ended the project because of a lack of funding. The agency now funds her work on conventional breeding techniques to create dairy cows without horns, sparing farmers the danger and expense of removing them. Van Eenennaam says that she might do better by disrupting the genes that lead to horns, but there is no money for that. “I’ve got plenty of funding now, but the project is completely inefficient compared to genetic engineering,” she says.

The USDA supports research to improve livestock and agriculture, but a spokesperson says that it has not considered work on GE animals to be the best use of its funding. The US National Institutes of Health (NIH)

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For more on the controversy over transgenic foods:
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occasionally supports research on transgenic pigs that model human diseases, but rarely funds proposals to produce drugs or vaccines

OFF THE TABLE

A brief history of some of the genetically engineered food animals submitted to the US Food and Drug Administration (FDA) for review. No such animal has yet been approved.

Animal	Purpose	Created	History
Salmon	Grows to market size faster than conventional salmon	1989 (Massachusetts)	1995 FDA receives application 2008 Fish farm moved to Panama 2010 Cleared by FDA scientific advisory panel
Pig	Produces more milk to nurse healthier young	1993 (Illinois)	1999 FDA receives application
Goat	Milk has human lysozymes to treat diarrhoeal disease	1999 (California)	2003 Funding denied by USDA 2008 FDA receives application 2011 Research moved to Brazil
Pig	Efficiently digests plant phosphorus, reducing pollution	1999 (Ontario, Canada)	2007 FDA receives application 2012 Pigs killed owing to lack of commercial interest
Cow, sheep, goat, pig	Increased muscle mass without reduced fertility	2010 (Texas)	2009 FDA receives application

in the milk of transgenic livestock. An NIH spokesperson says that decisions are based on many factors, including the needs of the research community.

For GE animals that have been developed despite these hurdles, market approval has stalled. On 27 September, Van Eenennaam was a panellist at a meeting in Washington DC, where advocates of GE animal research aired their frustrations with the US Food and Drug Administration (FDA), which has yet to issue a decision on any GE food animal submitted for approval (see 'Off the table'). A fast-growing salmon developed by AquaBounty in Maynard, Massachusetts, has been under review since 1995; in 2010, an FDA scientific advisory panel evaluated 21 years of data on the fish and deemed it safe for the environment and human consumption (see *Nature* 467, 259; 2010), yet the agency has still not announced a final decision. The FDA will not comment on its process.

"AquaBounty has done everything they are legally required to do, and, yes or no, now we just want an official word from the FDA," says Van Eenennaam, who was on the advisory panel. "We will never have investment in this field if there is no way to move it forward." She was one of 56 biotechnology advocates who wrote to US President Barack Obama on 15 September, asking why there has been no update.

The White House has not responded, and AquaBounty's salmon is swimming against the tide of politics. Legislation introduced last year in the US House of Representatives and the Senate would ban the FDA from approving it. The protest in Congress comes mainly from salmon-exporting states such as Alaska, Washington and Oregon, amid fears that an inexpensive new source of salmon would undermine the industry. Politicians also reference unforeseen dangers from GE foodstuffs.

The FDA evaluates animals as strictly as it does drugs. In the 17 years that the salmon

has been under review, AquaBounty has spent more than US\$60 million on, for example, showing that its allergenic potential is no greater than that of Atlantic fish. To ensure that the mainly sterile GE salmon can't mate with native species, the company keeps them in multi-walled tanks on a mountain in Panama. If the fish were to be sold commercially, they would be reared similarly isolated from the ocean.

The prospects for research are better outside the United States. Last year, Murray moved his goat project to Brazil, where the government funds his research; the childhood diarrhoea that the goats' milk is intended to treat is a serious problem in the north of the country. And China invested nearly \$800 million in transgenic pigs, cattle, sheep and crops

"The technology is great and the sky is the limit, but good luck getting money."

China, he says, including a fast-growing carp and cows that produce milk with reduced allergenic potential. However, a Chinese researcher who asked to remain anonymous because he did not have permission to speak to the press predicts that approval for the animals will lag because the government has not determined how to ensure that the products are safe.

Even in the United Kingdom, where public opposition to GE plants and animals has been fierce, researchers seem to be better off than their US counterparts. The Biotechnology and Biological Sciences Research Council (BBSRC) supports work on GE food animals, including chickens engineered to be resistant to the bird-flu virus. A BBSRC spokesperson told *Nature*: "We consider it important to fund research that provides a range of technological options that can be applied to the challenges that we face as a society." ■

between 2008 and 2012, says Ning Li, director of the State Key Laboratories for AgroBiotechnology in Beijing. More than 20 GE food animals are in development in