Farm Animal Cloning from an Animal Welfare Perspective

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There are two ways in which we view farm animals in society. We can view them as living creatures with functional value, their level of care often determined by their profitability as animals used for breeding, food, adornment, entertainment, experimentation etc. We see them in terms of their purpose, which is, of course, determined by us.

Or we can view farm animals as sentient beings with inherent, intrinsic value. At the CIWF Trust conference on animal sentience in March 2005, the most generally aired definition of sentience was: "Sentient animals have feelings which matter to them".

The functional view of farm animal cloning has a number of motivational bases. Firstly for basic biological research and secondly for commercial production of animals - either to reproduce large numbers of high value, elite animals or as a method to disseminate genetically engineered animals (for example, transgenic animals carrying human proteins for use in the pharmaceutical industry). All of these motivational bases give rise to concerns.

Some scientists seem to ask themselves the question "Can I?" rather than "Should I?" It can seem more important for them to prove that cloning can be done than to ask whether it needs to and should be done. When sentient beings are involved, this is a cause of great concern.

Using cloning to perpetuate selective breeding for greater productivity will inevitably perpetuate many of the serious welfare problems already widespread in high-tech farming (e.g. lameness in broiler chickens, pigs and dairy cows).

There are concerns over 'pharming'. Biotech companies are planning to develop production herds of GM, probably cloned, animals for pharming, not because these proteins cannot be obtained in other ways- they can- but because this will be the least costly method compared with fermentation and cell culture facilities. But alternatives are clearly available and decisions to use animals in pharming are being taken on economic grounds, apparently without detailed ethical assessment.

Producing elite dairy cows could indeed increase yield per cow, but it will not solve the health and welfare problems of high-yielding cows – the endemic lameness and mastitis from which they suffer. Identical beef animals with identical carcases could aid butchery and supermarket purchasing. But although these clones will appeal to large farmers and corporations, small farmers may not be able to afford such animals and even more of them will go out of business.

Cloning has other risks. A herd of identical cloned cattle may be identically vulnerable to a disease challenge, unlike a normal herd where immunity would vary. And what of the risks of loss of biodiversity – already hugely under threat in farmed animal species?

Cloning and genetic engineering of farm animals is taking us in the wrong direction- towards perpetuating factory farming when all other society trends point towards sustainable farming and respect for animals as sentient beings. The aims of cloning themselves are therefore an ethical issue. The practice of cloning raises ethical and welfare issues.

Welfare concerns over cloning of farm animals

Welfare concerns over farm animal cloning come under various headings:

Reproductive and other invasive medical interventions (required on a large scale because the process is so inefficient). These are performed on donor animals - for oocyte extraction - and on surrogate mothers, who often give birth by caesarean. Oocyte extraction methods vary across species - in the case of cows it does not require surgical intervention, but for pigs and small ruminants surgery is usually required to obtain oocytes from the oviducts of live animals. Anesthesia for embryo transfer is not compulsory in all countries.

Suffering caused to surrogate mothers - Pregnancy is typically prolonged and cloned calves (and lambs) may be 25% heavier than normal. Higher birth weights lead to painful births and often the need for caesarean section.

Abnormal foetal development and late pregnancy mortality, leading to frequent death at various stages of development. Death in the second half of gestation is common, with the occurrence of hydroallantois, excess accumulation of fluid in the allantois.

Postnatal mortality - the viability of cloned offspring at delivery and up to weaning is reduced compared to normal, and this is despite greater than usual veterinary care. Surviving newborn clones have altered neonatal metabolism and physiology - an elevated proportion of them dies before weaning (complications include gastroenteritis, umbilical infections, defects in the cardiovascular, musculoskeletal and neurological systems, as well as susceptibility to lung infections and digestive disorders). These animals have short lives of suffering. Jeff Carroll writes, "post-natal survival of cloned calves can be as low as 33% in some studies, and we have experienced similar losses in cloned piglets."[1]

Health problems during life - Clones may have a greater propensity in later life for respiratory problems and immune system deficiencies compared with normal animals (Wells 2005)[2].

Many clones have died or have had to be put down at a young age. N D Wells[2] (2005) wrote "Any underlying frailties in cloned animals may not be fully revealed until the animals are stressed in some manner." Professor Wolf Reik of the Babraham Institute, speaking to the BBC (BBC Online Aug 7th 2003), said, "What could happen is that the clone is born looking quite normal in early life but later on these animals could develop all sorts of diseases."

Wastage of life - (this includes embryos, foetuses and mature animals - these are killed as part of the procedures). Dr Harry Griffin, who worked on the Dolly project, warned any attempt to clone a human would be inefficient and unsafe. He said: "inefficient because in Dolly's case we used 277 reconstructed eggs to produce one successful pregnancy, collecting eggs from perhaps 40 donor ewes, and unsafe because a good proportion of our pregnancies fail late in pregnancy and we have had lambs that die soon after birth"[3].

The number of invasive procedures and the wastage of life could be huge. Cloning and exchange of high yield animals on a worldwide scale is estimated to use 4 surrogate mothers for every clone born[4]. Australian scientists calculate that the production of 100,000 identical animals for one clonal line would require 2 million successful fusions of donor cell and oocyte and 400.000 embryos transferred to surrogate mothers.

Species specific animal welfare concerns

Cattle.

Most cloning efforts have concentrated on cattle in recent years, due to the high commercial value of individual cattle. Some scientists and companies have suggested that cloned cattle embryos could be sold instead of semen to increase the productivity of farmers' herds, by making multiple copies of the most productive animals- a potential mass production method for elite farm animals.

There are also specific welfare issues apparent with cattle cloning. Embryos reconstructed by nuclear transfer and then transferred to surrogate mothers are slow to be born and are commonly 25 to 30% larger than normal, so that birth becomes difficult and painful. Elective caesareans are common.

For cloned cattle the main mortality cause after weaning is euthanasia due to musculoskeletal abnormalities. This includes animals with severely contracted flexor tendons, and chronic lameness in milking cows. But a range of abnormalities have been seen in cloned calves.

A calf cloned at INRA, the French agricultural research institute, appeared normal at birth but at 6 weeks old suffered a sudden fall in its level of white blood cells and haemoglobin and died within a week from severe anaemia. When the calf died there was no evidence of infection or malformation but a post-mortem examination showed the spleen and lymph nodes had not formed properly. It was concluded this was due to the cloning process, because the DNA in the differentiated somatic cell used for cloning had not been reprogrammed properly to produce all organs normally[5].

The much-heralded birth of the cloned gaur calf - the world's first cloned endangered species - was swiftly followed by his death. He was born apparently healthy but died within 48 hours of birth of a bacterial infection[6]. (It is unclear whether the death was related to the fact it was a clone - but see Carroll *et al*'s study on immune system development in clones[14]).

Pigs.

The levels of invasiveness due to the cloning procedures are greater for pigs and sheep than for cattle. Oocyte extraction is usually surgical, with all the accompanying stresses of recovery. We tend to read about the successful birth of cloned piglets, but we don't always get informed about the follow-on picture. We are also left to wonder about the number of unsuccessful attempts at cloning, where the cloned animals may have died within hours of birth. Scientists, understandably, prefer to publish success stories.

In August 2003 three cloned adult pigs dropped dead from heart attacks. The three pigs, part of a group of four (the 4th one died only a few days after birth) did not live to six months. Research leader, Jerry Yang, of the University of Connecticut, said it was' dramatic and shocking when all three died suddenly from similar problems'[7]. In Lee *et. al. (*2003)[8] he had described the animals as 'normal, cloned piglets'. The sow from whom the piglets had been cloned was still alive in 2003 and showed no signs of cardiovascular problems. Furthermore, the piglets all had separate surrogate mothers. According to Yang himself, that puts suspicion firmly on the cloning procedure.

In 2001 the biotech company Immerge Biotherapeutics and the University of Missouri produced transgenic cloned miniature piglets. Twenty eight surrogate sows were implanted with cloned embryos. Three sows, implanted with approx 100 embryos each, gave birth by caesarean to seven cloned piglets. Two piglets died shortly after birth from breathing problems and a third died after 17 days from heart failure. Of the surviving piglets, one had heart and lung abnormalities, one had eye and ear abnormalities and one had a leg joint abnormality. Of the dead piglets, two had leg problems and one had a cleft palate.[9]

Sheep.

It is worth noting the apparently accepted routines of superovulation of "donor" ewes: administration of hormone by injection and insertion of a vaginal tampon, followed by surgical removal of oocytes. In some cases sheep have been naturally mated and killed a few weeks later to have their fetuses removed for cell extraction (FAWC)[10]. In addition, the use of a temporary surrogate ewe for in vivo culture of oocytes in her ligated oviduct has been used. All these procedures raise serious welfare and ethical questions.

Sheep cloning has mainly been used as a way of aiding genetic engineering, rather than multiplying normal sheep (individual sheep are not very valuable).

As with cloned piglets, we see a similar story with cloning of sheep: a substantially greater incidence of peri-natal loss, often associated with congenital abnormalities in the cardiovascular and urino-genital systems and poor lung development, huge wastage of life and sudden death at later stages of development in cloned animals.

The Roslin Institute deleted two genes from cloned sheep, one of them the prion gene associated with BSE. In these experiments, 120 embryos were transferred to 78 ewes and eight lambs were born, four live and four dead. The four live lambs all died within 2 weeks.[11]

Rhind et al (2003)[12] published a detailed pathological study of a group of cloned lambs that were not viable after birth (see table 1). The analysis revealed evidence for a series of cloning-related abnormalities. The authors argue these results raise the question of whether subtle expressions of the defects could be present in clones that are apparently normal.

Physical defects	***No. cases that suffered from the defect (out of 8)***
Body wall	4
Musculoskeletal	3
Renal	8
Pulmonary	5
Cardiovascular	4
Hepatic	4

Table 1: Summary of pathology of cloned lambs born dead (from Rhind *et. al.* 2003)[12]

In February 2003 Matilda, Australia's first cloned sheep, died unexpectedly of unknown causes at two and a half years of age. Rob Lewis, executive director of the South Australian Research Institute, said the sheep seemed 'remarkably healthy' and 'particularly sprightly' on the day she died. An autopsy failed to find any reason for the merino ewe's abrupt death[13].

Seeking explanations- insights from recent research

In the last few years there has been increasing interest in the reasons for such a high number of sudden and often unexpected deaths in young clones.

A study undertaken at the US Department of Agriculture and published in October 2005[14] suggested that clones may be born with crippled immune systems. The finding could explain why clones often die from infections soon after birth.

The objective of the study was to evaluate the innate immune response of apparently normal cloned piglets. Two groups of animals - one group of cloned piglets and another of genetically similar non-cloned ones - were injected with an endotoxin and the immune response was measured in the two groups. The response curve was dramatically different in the two groups - the cloned group had a weakened immune response when compared to the non-cloned in all the three parameters that were measured.

Team leader Jeff Carroll says: 'I've looked at the immune response of hundreds of young pigs and I've never seen anything that low until I looked at a clone'.[15]

Wells states that 'any underlying frailties in cloned animals may not be fully revealed until the animals are stressed in some manner'[2]. If further research along the lines of Carroll *et al*'s study[14] confirms that clones have compromised immune systems, that would account for their increased vulnerability to infection, increased susceptibility to disease when under stress, and the large numbers of clones that die shortly after birth or have to be put down at an early age after developing medical problems.

Conclusion.

Compassion in World Farming campaigned vigorously for animals to be recognised as "sentient beings" in EU law. Their campaign achieved success in 1997 when a legally binding Protocol on the welfare of animals "as sentient beings" was attached to the European Treaty at the Amsterdam summit, and ratified by all member states by 1999.

But fine words alone cannot ensure good welfare for farm animals. Yet just a year after the summit a new EU Directive 98/58/EC made some very strong statements about the welfare of animals on our farms: "Natural or artificial breeding or breeding procedures which cause, or are likely to cause, suffering or injury to any of the animals concerned must not be practised." (Annex: Article 20)[16] The Directive also says, "No animal shall be kept for farming purposes unless it can reasonably be expected, on the basis of its genotype or phenotype, that it can be kept without detrimental effect on its health or welfare" (Annex: Article 21)[16]

It is clear that many animals have already suffered or been killed in experiments attempting to clone farm animals. Many cloned farm animals have led short lives which often ended in euthanasia due to the severity of their health problems, or in sudden death.

In welfare terms alone, cloning has brought about much suffering. Compassion in World Farming does not believe that any possible beneficial ends can justify the continuation of this technology. CIWF also believes that consumers in the EU will be opposed to consuming meat and products obtained from cloned, often genetically modified animals.

CIWF believes that an EU moratorium on the use of cloning in commercial agriculture would send a strong message to those involved in its development, to turn their skills and knowledge elsewhere. There is already much to be done to improve more common methods of selective breeding which have grossly compromised animal welfare in the cause of productivity.

In the UK, the government's independent advisory body, the Farm Animal Welfare Council, said in its 1998 Report on cloning, "It is not clear that a radical distinction between human and non-human is now defensible, either biologically or ethically, nor that any such disjunction is sufficient to warrant the treatment of other living creatures merely as means."[10]

The old view of animals as production units is rapidly being superseded by the more honest view, led by science, that animals such as large mammals are not so very different from ourselves in many ways and that they have highly developed capacities for both physical and mental suffering. To continue to inflict a high degree of distress and suffering on these sentient beings in the cause of agricultural productivity or protein production is clearly unethical.

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