

# Farming in 2050

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## Introduction

Intensive animal farming, also known as factory farming, is controversial for two reasons. First of all, it has a huge negative impact upon our environment – cattle is, for instance, one of the major sources of methane (a greenhouse gas stronger than carbon dioxide) emission. Second but not least, is the suffering imposed on animals kept as livestock. Though animal slaughter is an unpleasant aspect of livestock farming, the way we keep animals is probably far more cruel than merely killing a sentient being.

In this essay I want to explore a not-too-far future in which technology has reconciled our demand for animal products and animal welfare. Of course, I know that certain animal welfare activists will argue that we should become all vegans in order to put an end to animal suffering. However, I do not believe such strategy will be successful. Too many people like meat and other animal products, while current plant-based alternatives cannot (yet) satisfy this demand.

What are the main animal products we humans consumer? Meat, dairy, eggs and leather. I will discuss each product one by one. Thereafter I will argue that we can return to small scale farms that both respect animal welfare and play an important social function.

## Meat

Many of you will probably remember how in 2013 the first test-tube burger was presented to the world. At the time it was probably the world's most expensive hamburger. However, the significance of this burger was not its price as such, but the reason why it was so expensive. This reason was that the meat used for this particular burger was cultured in the lab by a team of scientists led by Mark Post [1].

His idea is that we will be able in the near future to collect stem cells from a living animal and to use those stem cells to grow meat in a lab. According to Post one tiny stem cell could deliver up to 10,000 kilogram of meat. A major consequence hereof is that the amount of animals needed to

supply our demand of meat. Post's estimation that about 50,000 animals could be sufficient to meet global demand.

To put this number in perspective, in 2015 there were about 4.1 million cattle and 12.6 million pigs in the Netherlands. And that is only one single country, which supplies only a portion of the global market. Of course, Post's prediction is most likely a bit too optimistic but nevertheless, cultured meat could reduce the number of animals kept for meat production. And importantly this technology will make it possible to out-phase intensive animal farming.

Despite this cultured meat is not without issues. At the moment we can only make ground meat this way. But we have to notice that a very large part of meat consumption consist of processed meat such as sausages, pizzas and so on. For those we like meat with bones, scientists have developed a process to create bones using rattan and calcium. Though this method is intended for medical purposes, this procedure is inexpensive enough to be used in meat production [2].

Another issue, more problematic from an animal welfare perspective is that currently tissue cultures require a serum made of animal blood. If this remains so, then cultured meat is hardly an alternative for the current method of meat production. Fortunately, a group of scientists at the University of Amsterdam is working on producing a serum made of algae.

## Leather

Another popular animal product which requires to kill animals is leather. Usually leather is a by-product of meat production. However, if cultured meat would become a reality and would replace "traditional" meat in a large number, then we could expect a shortage of leather. Leather as a material is quite durable and strong, hence it is used in a wide range of applications. In some cases the use of imitation leather is a suitable alternative, but not in other cases.

But wait a second, if we can grow muscle tissue in a lab, why not skin tissue? Actually, this is what Andras Forgacs' company Modern Meadow is doing. They take skin cells and grow this in the lab to make leather. This method has several advantages of traditional leather production. Firstly, product quality is more predictable and secondly cultured leather allows for better customizing to customer preferences [3] [4].

From an economic perspective, cultured leather could be better matched to meeting demand as its supply will be separated from meat production, hence avoiding both under and over supply of leather.

We can even go step further. A team of scientists led by Karl Koehler has managed to grow (mouse) skin tissue with *hairs* in a petri dish. The primary motivation for this project is to develop new methods to study skin diseases and to test potential treatments [5]. However, skin with hair is better known among the general public as fur.

Like leather, fur is a highly popular animal product. However, fur farming is also highly controversial. Save from the inevitable killing of fur animals, the way those animals are kept before their death is subject of severe criticism. Many countries have already fur farming, either completely or for specific animals.

Though fake or faux fur does exist, it has several disadvantages. For instance current artificial furs are not as isolating as natural fur and they might take several hundreds of years to decompose once they are disposed by their owners. In vitro fur might therefore be the perfect solution as it is real fur but without the abuse and killing of animals.

## Dairy

Milk is another popular animal product. Though milk itself does not require the killing of animals, the fact is that female mammals only produce milk if they get offspring. In order to maintain milk production cows have to have a calf each year. Half of those are male and “useless” and are slaughtered in short term after birth. Not to mention that milk cattle is usually kept at the cowshed, too often with poor conditions.

The question is, if we can make animal-friendly meat and leather, why not making test-tube milk as well? If we consider what the composition of milk is, water, proteins, fats, sugars and calcium, we should think test-tube milk would be easier than cultured steaks or shoes. So do Perumal Gandhi and Ryan Pandya, two vegans and founders of Perfect Day (formerly Muufri, “moo-free”)[6] [7].

Their idea is to use genetically engineered yeast to produce milk proteins. Once these proteins are harvested, the other ingredients are added. This method allows us to make healthier milk than the

natural product by replacing saturated fats by unsaturated ones. Also lactose, people who allergic to milk are usually allergic to this type of sugar, could be replaced by other sugars [6].

Importantly this process could be just to make other types of milk than cow milk, such as buffalo or goat milk – or even human milk, as alternative to breastfeeding. Just making a different yeast culture to produce the milk proteins of those species.

The founders of Perfect Day use plant-based fat to make milk. Several sources of vegetable fat are available, but algae fat seems the most promising one. Biotech company Solazyme is using algae to make butter. Milk consists of about 3.25 percent fat, while butter is about eighty percent fat. Or to make one kilogram of butter, one needs twenty liters of milk. Butter fat is a mixture of several fatty acids and by carefully selecting the algae used, one can mimic “natural” butter fat. And in fact algae butter compares well to other plant-based butter substitutes [8] [9].

The Perfect Day method of using modified yeast to produce milk protein, will also simplify the production of cheese. Basically cheese is casein, a protein which derived its name from Latin *caseus* (cheese). Cheese making boils down to separate the casein from the water and whey present in milk.

## Eggs

When it comes to eggs, the over all majority of eggs is used as a binding agent in a wide variety of food products. However, numerous plant-based alternatives for this particular use are available and could reduce the human consumption of chicken eggs with about ninety to ninety-five percent. Since most consumers are not even aware of the presence of eggs in the product they buy, most people would not notice if eggs were replaced by plant-based alternatives.

Save from binding agent, people will like to eat omelets in the future. However, for making omelets you do not need egg shells, just only the egg proteins. Biotech company Clara Foods is developing modified yeast to produce egg proteins and its competitor Follow Your Heart uses algae to produce a powder one could use to make an omelet [10] [11]. Only for boiled eggs we seem to need real eggs, but this will only require less than one percent of the current egg production.

## Silk

Silk has been a popular substance for several thousands of years. Beyond being a nice fabric, it is also a very strong material. Though there are several animals who produce silk, the most well known producer of silk is *Bombyx mori* – better known as the “silkworm” – a butterfly whose larvae make cocoons from, obviously, silk. In order to obtain the silk, cocoons are boiled in hot water and killing the transforming larvae as well.

Several attempts has been made to make GMOs, both plants (including potato and tobacco plants) and goats, to producer spider silk – with several degrees of success. There is no reason why this could not be done with *Bombyx* silk as well [12] [13] [14]. So rather can breeding silkworms, we could grown genetically engineered plants to meet our demand for silk.

### Animal by-products

In addition to meat and leather animal slaughter provides numerous and widely-used by-products. Some of those can easily be replaced by plant-based alternatives, though for others finding suitable replacements is much harder. Since many of these substances are proteins, most of them could be produced through genetic engineering of plants of yeast.

Gelatin is perhaps one of the most used animal by-products. This product is derived from collagen, a protein which accounts of twenty-five to thirty-five percent of all proteins in an animal body. Currently most gelatin is derived from animal bones and hides, typical slaughter waste products. For many purposes gelatin could be replaced by agar-agar – a plant-based product with similar properties – or carrageen, another plant-protein [15]. However, for some uses gelatin might be preferable. And scientists have created genetically engineered yeast to produce collagen, from which gelatin can be derived [16].

Cysteine is another widely-used animal by-product and is used in, among other products, bread. Currently most cysteine is produced from animal hair. However, this substance can also be produced by plants and bacteria, hence eliminating the need to obtain it from slaughter by-products [17].

### Scenario

If the technologies described above become widespread, it will significantly reshape animal husbandry. First of all, the total number of livestock will be enormously reduced and many, if not

most, farmers will probably find that keeping animals will not be profitable anymore. Consequently present-day factory farms will be closed.

Since only a small number of animal will be required as stem cell donors, petting zoos could easily replace factory farms. Local petting zoos will not only supply their neighbourhood with meat, it will also offer local residents – and children in particular – the opportunity to reconnect with the production of their food.

Care farming, the practice of using animal husbandry as a kind of therapy, is another function which could be taken up by the remaining livestock farmers. Probably the new food industry will sponsor these farms, in order to secure their supply of stem cells. However, the big difference will be that these donor-animals will live in peace until their natural death [18].

Large herbivores, like cattle, horses and deer, are used in nature management. By grazing they prevent grassland from becoming woodland. Essentially this could be classified as a type of extensive farming [19]. Similar to animals kept at petting zoos and care farms, these grazers could also serve as stem cell donors. From the perspective of animal-welfare, this might even be preferable to petting zoos and care farming.

A more controversial proposal would be the introduction of a new type of hunting. This will involve the capture of wild animals and a subsequent biopsy. Afterwards the captured animals will be released – rather than being killed. Of course, I realize many animal-welfare activists will be opposed to this idea, however, it might be a workable compromise between hunters and their opponents. In a similar vein we could replace traditional whaling with an alternative that has no risk for extermination [20]. Possibly this new type of hunting could be combined with a wildlife contraceptive program – this is a method of population control based on the use of contraceptives rather than by killing.

Reducing the number of livestock to just 50,000 (predicted by Mark Post), will also mean that much less land is needed to grow the feed all these animals need. This land can be used for other things, such as nature restoration projects.

Objections

In this section I will discuss three possible discussions. As entire books have written about these objections, I will only briefly address them.

One argument some people use against the technologies as described above, is that as we need less animals, they won't exist at all. However, this object assumes that existence is always preferable to existence. South-African philosopher David Benatar has argued that non-existence is actually preferable to existence, as the latter is full of suffering. Though his views might be a bit extreme, we could still argue it is better for an animal not to exist than to live a life of suffering.

Another argument is that if factory farming becomes obsolete, many people will lose their jobs. Yes, it is absolutely true that many people will lose their *current* jobs. But on the other hand, these technologies will simultaneously create many new jobs as well. With proper retraining those people currently employed in the animal product industry, can work in the new animal-free industry and hence maintain their source of income.

The final objection I want to discuss, is the argument of *unnaturalness*. However, "natural" is not identical to better or safer (for instance many plants contain lethal poison). Also our modern world is full of unnatural things, from cars to airplanes and from computers to washing machines. Any person who rejects the alternatives for factory farming presented in this essay because of unnaturalness, should bite the pill and reject virtually all modern technology.

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