

# Importance of genetic modification within today's economy and agriculture

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## Preface

We chose this topic mainly because we wanted to find out, how exactly genetic modification affects the farm animals, whose meat, eggs and milk we eat every day. How are these animals treated to make sure their products can be eaten safely? Or by any means, how are they treated to make sure they produce as much food as possible? Are they genetically modified at all?

So our goals are to find out:

- If farm animals worldwide are getting genetically modified to increase efficiency.
- If so, how they are modified/treated.
- How/ if these modifications eventually influence the human species.
- What the ethical problems concerning the genetic modification of farm animals are.

We never really made any experiences concerning genetic engineering techniques (apart from our Geography classes), so we had to start from scratch pretty much.



## Introduction

There is no actual case of genetically engineered farm animals which gained big media attention very recently. Actually, in the EU, the studies revolving around the genetic manipulation of industrially used animals remain mainly studies, since the effects of actual genetic engineering on said animals would be too unpredictable, not only to the animals themselves but also to the human consumer.

Of course there are some cases, in which animals are modified in a particular way, in order to make them grow faster or get fatter in a shorter amount of time, but those changes are mostly a result of their special diet. For example: In the last few years, since the human started to industrialize the gathering of food (meaning crops as well as meat, eggs and milk), farms like we know them kind of stopped existing, making place for factories, focusing on the production of meat, not animals. The average chicken is supposed to be ready for killing in about 30 days, the average pig needs half a year to grow up completely, while the modern cow is expected to provide 60 liters of milk per day.

There are examples of genetically modified pigs in Canada, the so-called “Enviropigs” (called “Frankenpigs” by critics). This “enhanced” race of Yorkshire pigs was created with the capability of digesting plant phosphorus more efficiently than other pigs. These pigs created an enzyme with their saliva, which, once in contact with their food, breaks down the otherwise indigestible. That allowed the pigs to release up to 70 percent less phosphate, which would otherwise overfertilize rivers and fields. The gene which lets them do that is a composite gene, created by a gene from the E. coli bacteria, which makes them produce phytase and a gene from mice, which lets them control the production of proteins secreted in the salivary gland. The studies revolving about this project were stopped in 2012, since there was too much negative feedback from different sides and the investors were no longer willing to pay.

## Genetic engineering

Genetic engineering, also called transformation, is the process of controlled manipulation of the genes in an organism with the intent of making that organism better in some way. This is usually done independently of the natural reproductive process. The result is a so-called genetically modified organism (GMO). Today, most of the effort in genetic engineering has been focused on agriculture.

Genetic engineering is done by physically removing a gene from one organism and insert it into another, so it gets the ability to express the trait encoded by that gene.

In more detailed way it is done by finding an organism that naturally contains the desired trait. The DNA is extracted from that organism. The one desired gene must be located and copied from thousands of genes that were extracted. This is called gene cloning. The gene may be modified slightly to work in a more desirable way once inside the recipient (Empfänger) organism. The new gene(s), called a transgene, is delivered into cells of the recipient organism. This is called transformation.

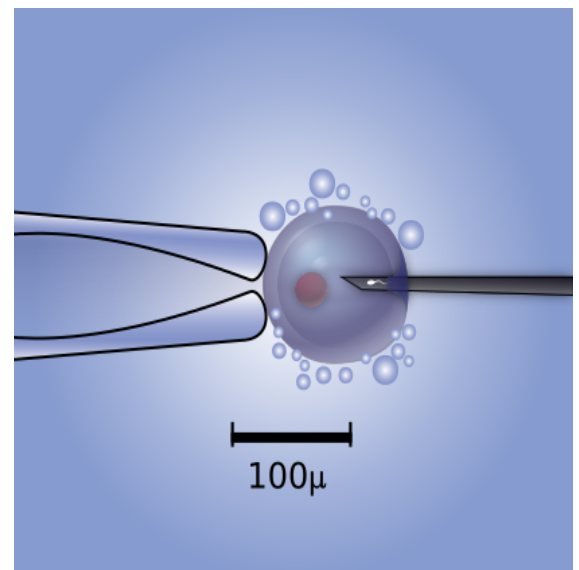
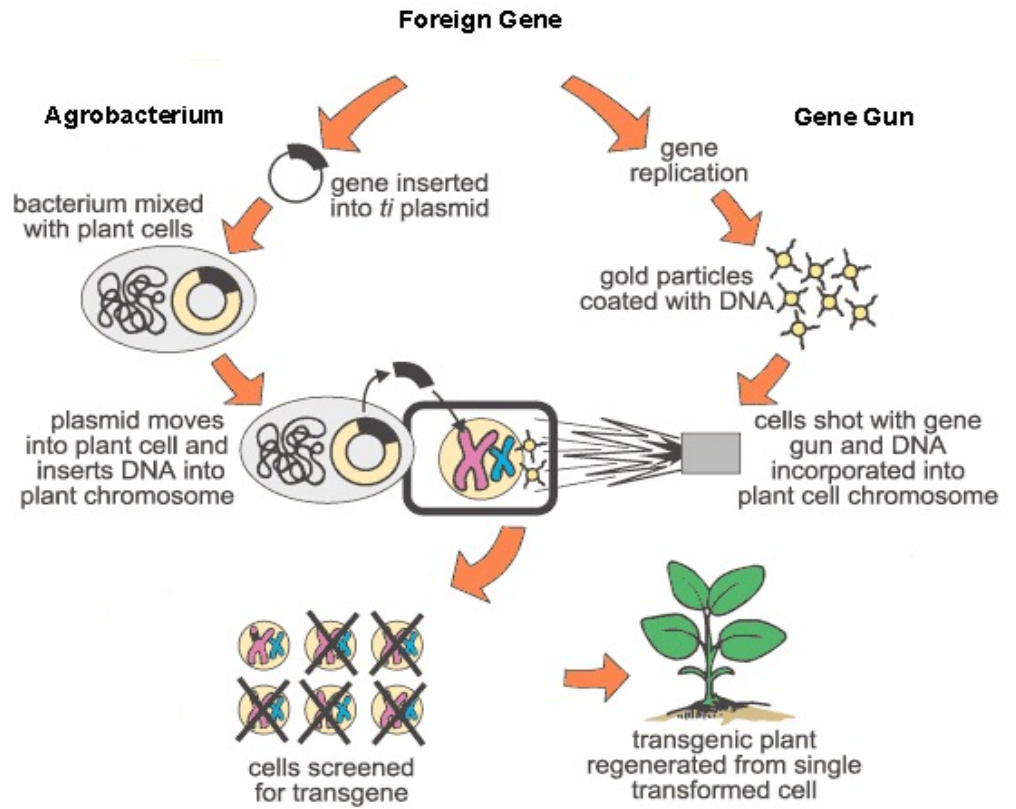


Diagram of the intracytoplasmic sperm injection of a mammal egg. Micromanipulator on the left holds egg in position while microinjector on the right delivers a single sperm cell.

The most common transformation technique uses a bacteria that naturally genetically engineer animals with its own DNA. The transgene is inserted into the bacteria, which then delivers it into cells of the organism being engineered. Another technique, called the gene gun method, shoots microscopic gold particles coated with copies of the transgene into cells of the recipient organism. There is also a technique called Microinjection in which a glass micropipette is used to inject a liquid substance (i.e. sperm) into the nucleus of a gem cell. With either technique, genetic engineers have no control over where or if the transgene inserts into the genome. As a result, it takes hundreds of attempts to achieve just a few transgenic organisms.

Once a transgenic organism has been created, traditional breeding is used to improve the characteristics of the final product. So genetic engineering does not eliminate the need for traditional breeding. It is simply a way to add new traits to the pool.



Graphic of gen insertion techniques



## Interview with Pascale Steck

**What are your concerns as the director of this institution?**

We as an organization try to achieve that the government, not only in Switzerland, releases laws and guidelines to control the use of Genetic Engineering. And with that we want to give the general public a voice in the discussion about this topic.

**How common is the use of gene technology in agriculture at the moment?**

Genetic modified Food is more common as most people think. I don't know exact numbers but I know that India as well as the United States are packed with modified food. In Europe it's luckily not as popular but that's just a matter of time. You might add that livestock products are not affected momentarily. The majority of genetically engineered foods are crops and rise.

**Which are the risks of genetic engineering?** The most dominant risk is the uncertainty in which experiments are made and modified products are sold. In my opinion it's too early but as you can see some people think differently. Currently science has not the necessary knowledge to estimate the time dependent effects of gene technology.

**What do You think? How will this technology be used in the future?** I'm sure that this technology will play an important part in the future of agriculture and the mankind in general. And this is the reason why it is so important to start a discussion about the topic. If gene technology becomes a cornerstone of the future society I hope the power over it will be in the hand of the general public and not in those of some big companies.

**So you think genetic engineering is a chance for mankind?**

Of course I just think it is important to regulate the use in a ethical and ecological passable way. Every discovery needs boundaries.



Pascale Steck (biologist)  
Director of the Basler  
Appell gegen  
Gentechnologie.

## Discussion

Through the usage of this kind of manipulation, the human is now theoretically able to change an animals' genome to improve living conditions for himself (mostly) there are still some problems left to be solved. By the combination of different plants/ animals' genes, there is a huge variety of new possibilities concerning the changement of the environmental impact of those animals/ plants (as shown in the example of the "Enviropigs").

In the future they will most likely amend the faults that are present now and will improve the techniques or/ and search for other ways of genetic engeneering which are more efficient. So the modified animals won't get disease or deform however have the desired trait. Furthermore they will try to use these animals in an agricultural way and will farm them, so we can feed the growing earth population, which is until know not legal.

A good example is the salmon (geneticly modified to grow bigger in a shorter period of time) they are trying to get legally sold since ten years, it is highly possible it will get accepted in the next ten years and when the first animal is on the market others will follow.

We think the first country to legalese genetically modified animals will be the U.S. we don't believe it will happen in the next years in the EU. This not only because they already sell modified crops but also because for the time being it is to dangerous and unpredictable.

The use of gene technology in general opens a ethical dscussion. We tried to collect the arguments of both parties.

### Pro:

- The human profits a lot more from genetically modified animals, is therefore theoretically able to kill less for the same amount of products.
- through the genetic modification, animals are able to produce products which have a similarity to human products, which may help some human individuals, who are not able to produce said substances (e.g. Human breast milk).
- The price of genetically engineered products is less than that of regular substances (meat)

### Contra:

- Is it okay to "play god", by swapping genes around, changing the nature so fundamentally?
- The risks of genetically engineered foods to the human are not completely clear.
- Although the price might be lower, the quality may lack as a result of these changes.
- It is not sure, if the animals are experiencing harm due to their genetic change.

## Summary

On the first pages of this paper, we mainly focused, how today's farm animals were genetically modified, how these changes influenced their life. But soon, we had to realize that the aspect of genetic manipulation with animals are not as common as we thought, which was, of course, somewhat of a disappointment. Nevertheless, we found out, that there are, in fact, some cases, some studies (all over the world except the EU apparently), which include the genetic manipulation of said animals. Much like we thought, the animals' DNA was combined with traits of other animals' DNA to achieve specific goals. What might sound amazing to the inexperienced viewer leaves scientists all over the world with a very ethical question which they are asked by several institutions and organisations. These critical opinions are of course understandable, in some cases also supportable. But one has to realize, that genetic manipulation is generally practiced with a good will behind it. The scientists try to improve, or, for this matter, change the environment, the product or the possibilities of regular farm animals for the better. (Here, it may be discussed, if genetic manipulation ever changes something for the better.) So there is, and maybe always will be some kind of controversy whether it's okay to change other animals' way of living if it makes the life of human beings easier.

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