



Opportunities for Animal Biotechnology in Livestock and its Impact on the Industry in the Philippines

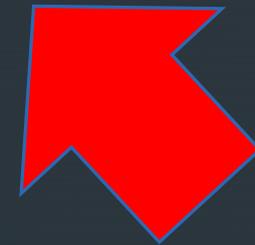
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Livestock Industry in the Philippines



**Transboundary
animal
diseases**



**High cost of
farm inputs**

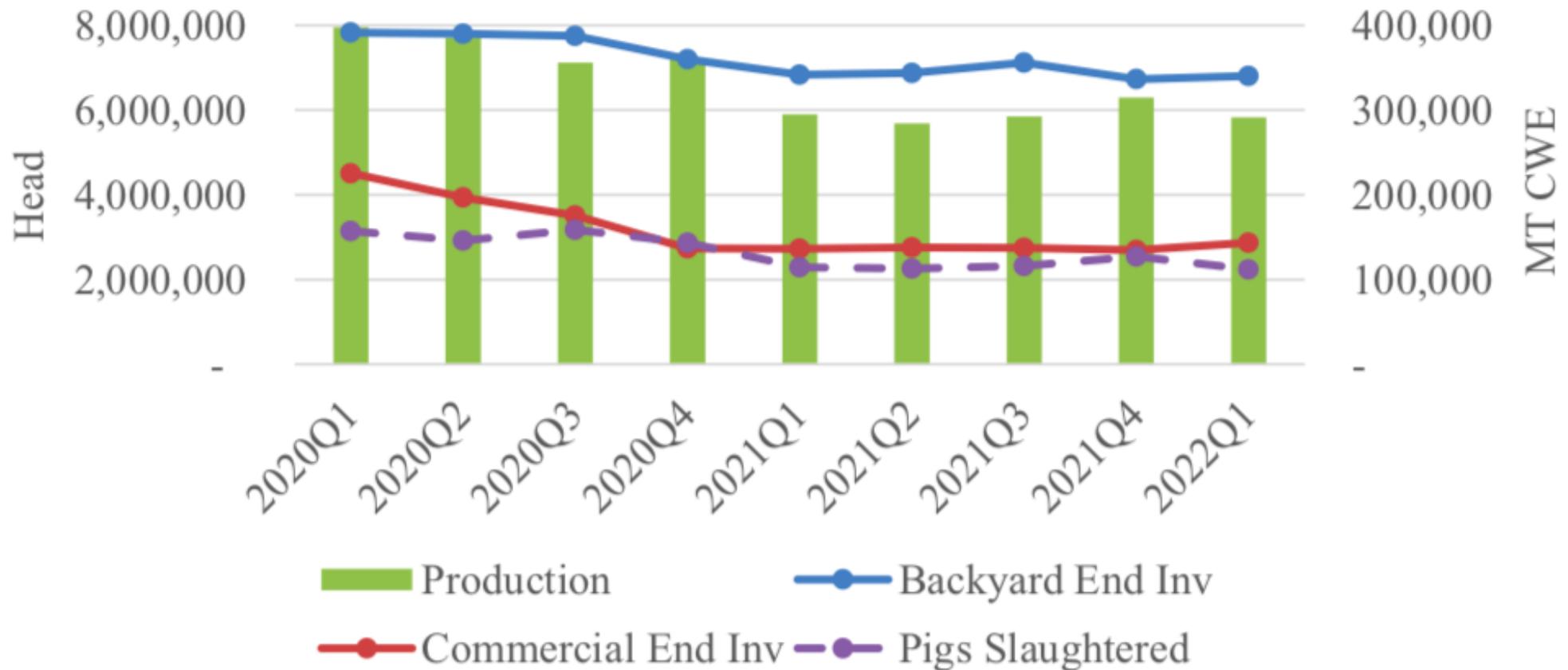


**Lack of new
breeding animals**

**Negative effects
of COVID-19**

Philippines: Livestock and Poultry Update

Figure 1: Pork Production, Slaughtered, and Inventory



Source: PSA

Pork supply is decreasing, due to continuous effect of ASF. Importation helps meet the demand.

Philippines: Livestock and Poultry Update

African Swine Fever Zoning Status as of May 23, 2022

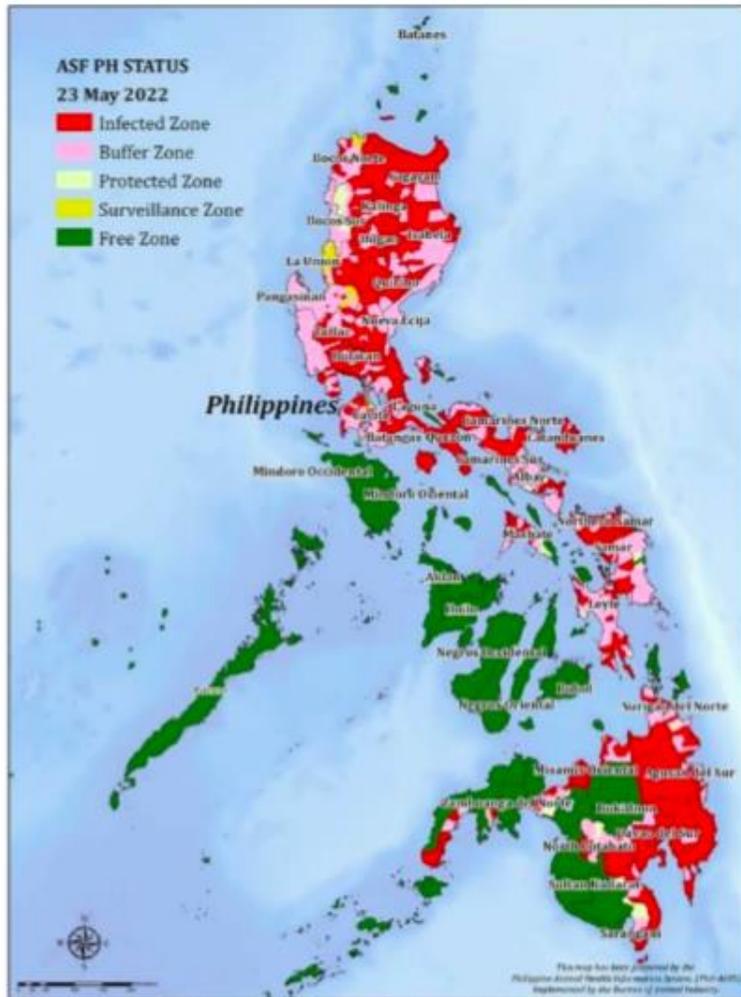


FIGURE 1. Map of the Philippines showing Zoning Status per City / Municipality

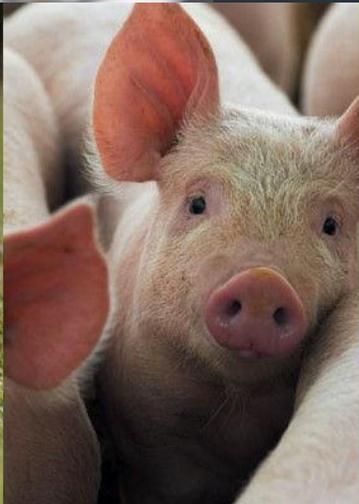


FIGURE 2. Map of the Philippines showing City / Municipality with no reported ASF case for ≤ 90 days (Red), 91 to 180 days (Blue) and ≥ 181 days (Grey).

Source: Department of Agriculture (DA)-Bureau of Animal Industry (BAI)

BIOTECHNOLOGY

The art or set of techniques of utilizing living creatures and their products for food, drink, and medicine production or for other benefits for humans and other animals.



ANIMAL / LIVESTOCK BIOTECHNOLOGY

- Has a long history, beginning as far as 8,000 years ago

Selective Breeding

'Wild' cow



'Beef' cow

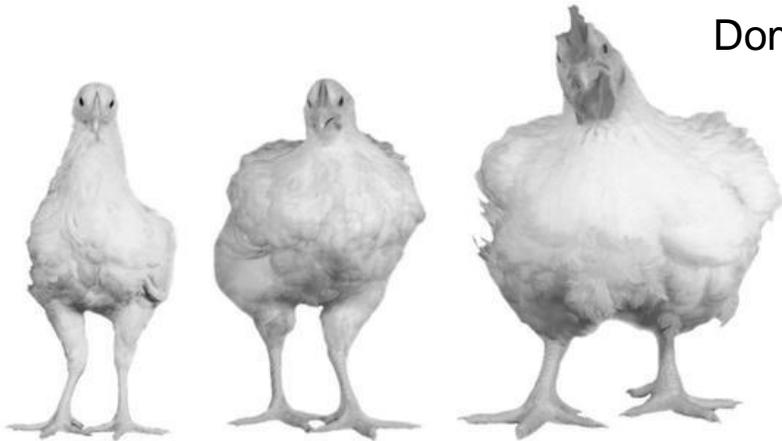


What differences can you see?



Domestication and Artificial Selection

Traditional Animal Biotechnology



56 d

905 g

1,808 g

4,202 g



Vaccination and Artificial Insemination

Modern Animal Biotechnology began only following discovery of genetic code

ANIMAL / LIVESTOCK BIOTECHNOLOGY



Climate Change and Disease Resilient or Resistant Animals

Increased Income for Livestock Food Producers



Doubling Food Production to meet the supply for demand

Proper Animal management

Rapid Diagnosis and Modern Disease Surveillance



Increased Income for Livestock Food Producers



The *Cartagena Protocol on Biosafety to the Convention on Biological Diversity* is an international treaty governing the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another. It was adopted on 29 January 2000 as a supplementary agreement to the Convention on Biological Diversity and entered into force on 11 September 2003.

(Cartagena, Colombia to Montreal, Canada)

CARTAGENA PROTOCOL

Article 3 – Use of Terms

(g) "Living modified organism" means any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology;

(h) "Living organism" means any biological entity capable of transferring or replicating genetic material, including sterile organisms, viruses and viroids;

(i) "Modern biotechnology" means the application of:

a. *In vitro* nucleic acid techniques, including recombinant deoxyribonucleic acid (DNA) and direct injection of nucleic acid into cells or organelles, or

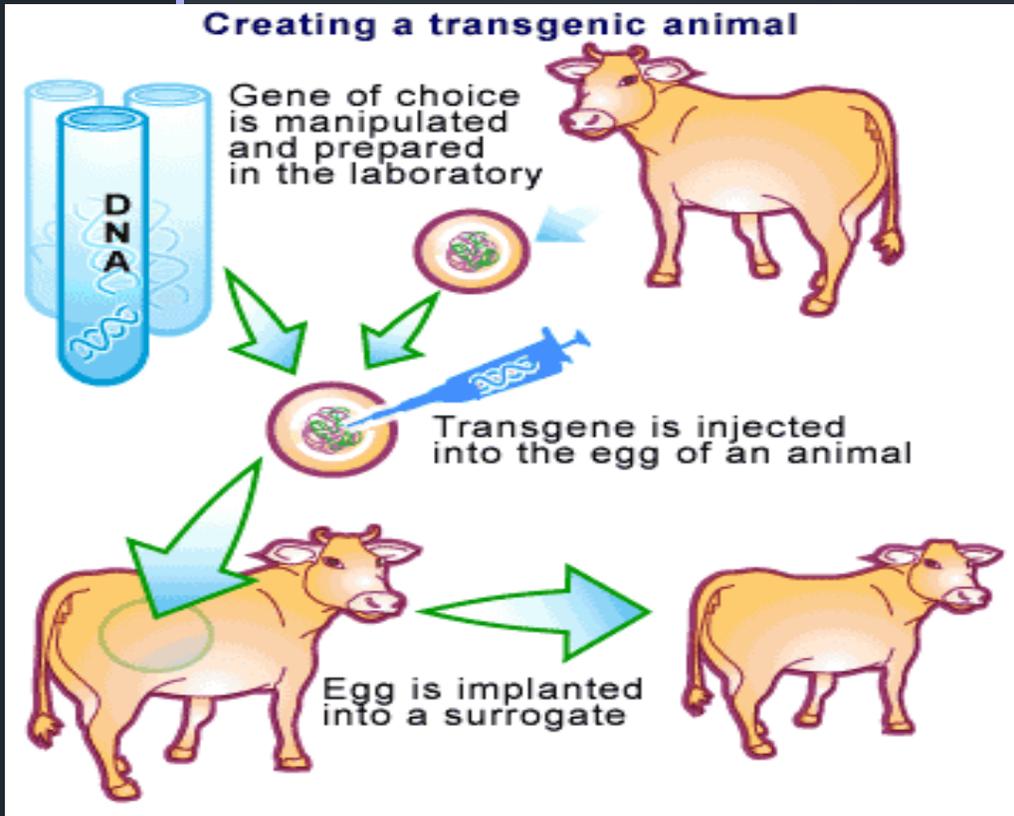
b. Fusion of cells beyond the taxonomic family, that overcome natural physiological reproductive or recombination barriers and that are not techniques used in traditional breeding and selection;

Introduction of Genetically Modified (GM) Animals

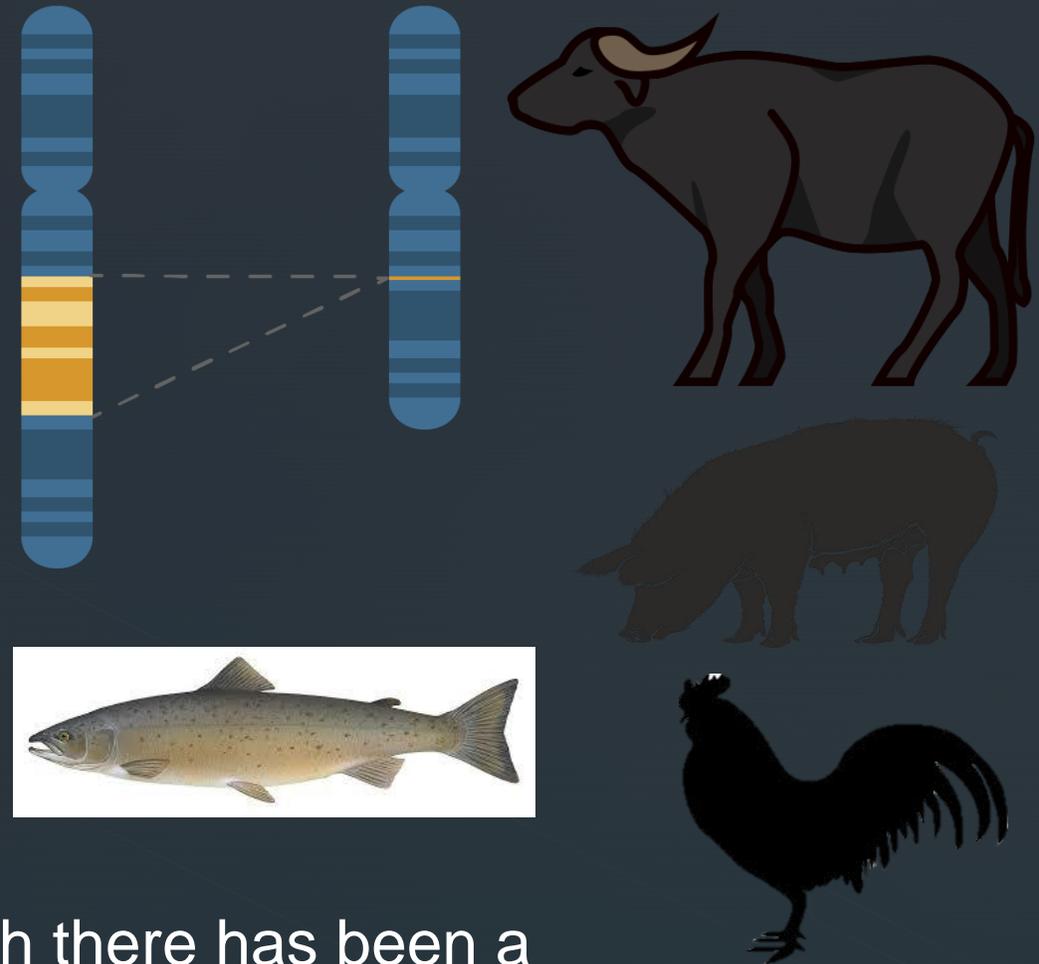
- **GM Animal** - involves altering its genetic material by adding, changing or removing certain DNA sequences in a way that does not occur naturally. It aims to modify specific characteristics of an animal or introduce a new trait, such as disease resistance or enhanced growth (EFSA).
- Two Methods:
 - Transgenesis / Cisgenesis (transfer of genes) in animals
 - Deletion of genetic information



A. TRANSGENESIS / CISGENESIS



B. DELETION OF GENETIC MATERIAL



TRANSGENIC ANIMAL - an animal in which there has been a deliberate modification of its *genome*, the genetic makeup of an organism responsible for inherited characteristics (European Laboratory Animal Associations)



- Nutrition
- Breeding
- Trait Loci
- Marker Assisted Breeding
- Copy Number Variation
- Genome-Wide Associated Study
- Genomics
- Proteomics
- Metabolomics
- Nuclear Transfer / Cloning
- Microinjection
- Phenotype Assay
- Proper Management

INPUTS



OUTPUTS

Biomedical / High Value

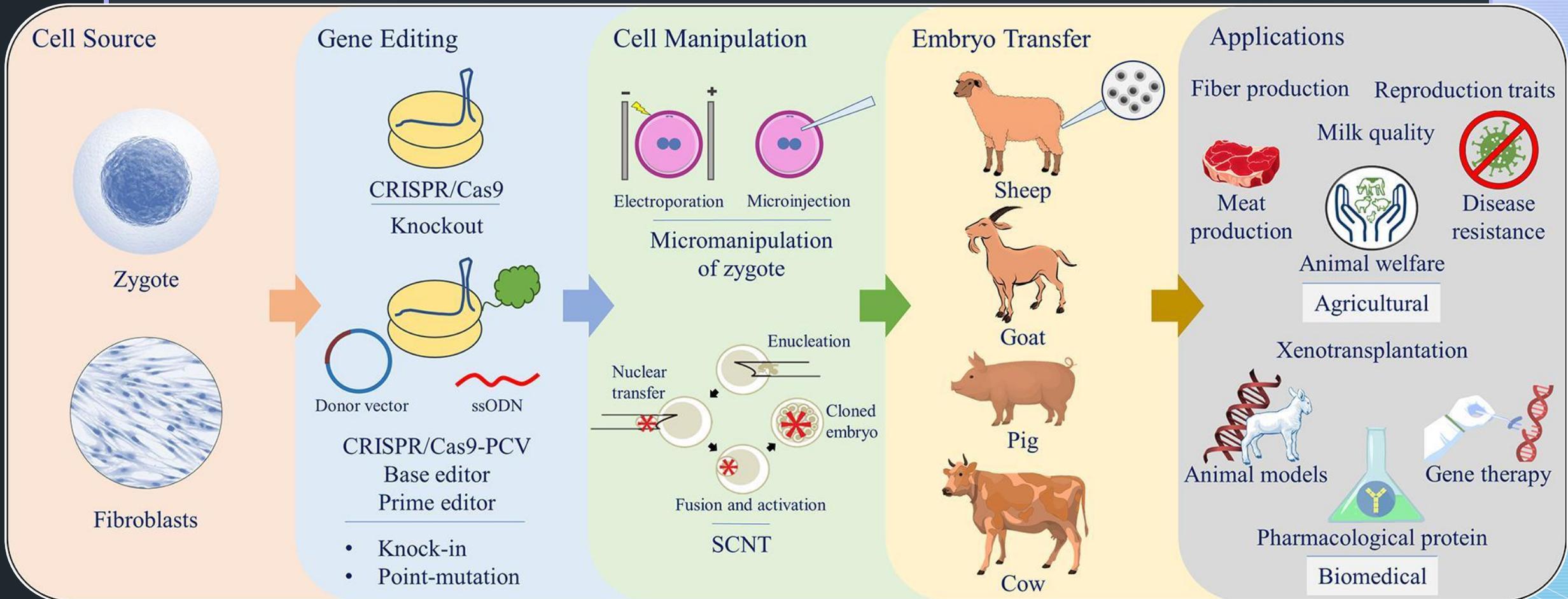
- Disease Models / Resistance
- Xenotransplantation
 - Cells
 - Tissues
- Organs
- Bio Pharmacology
 - Drugs
 - Devices
 - Biologicals
- High Value Products

Agriculture

- Milk and meat quality
- Milk and meat composition
- Productivity increased
- Conformation
- Robustness
- Fecundity
- Environmental Resilience
- Environmental Footprint

Use of New Breeding Innovation as a Driver for Change in Livestock

Cell Mediated Genomic Editing

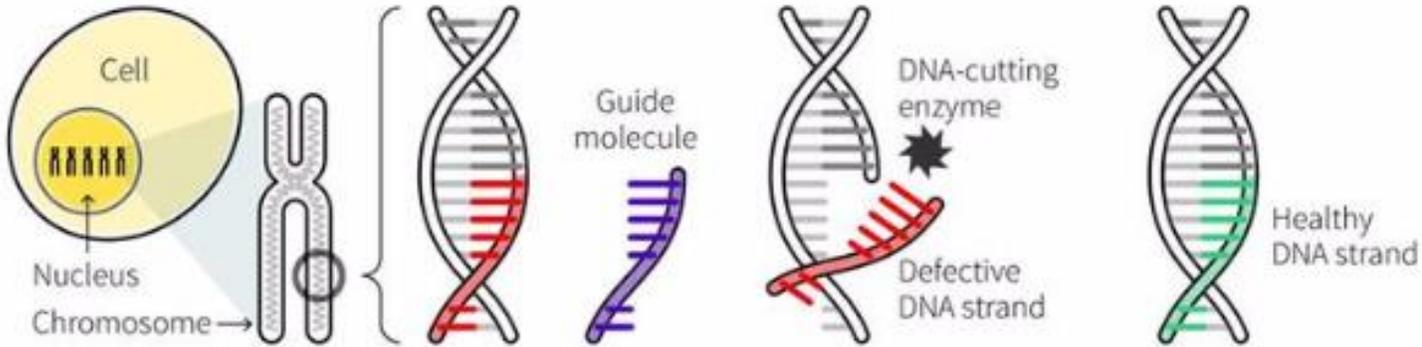


Introduction of Gene Editing

DNA editing

A DNA editing technique, called CRISPR/Cas9, works like a biological version of a word-processing programme's "find and replace" function.

HOW THE TECHNIQUE WORKS



A cell is transfected with an enzyme complex containing:

- Guide molecule
- Healthy DNA copy
- DNA-cutting enzyme

A specially designed synthetic guide molecule finds the target DNA strand.

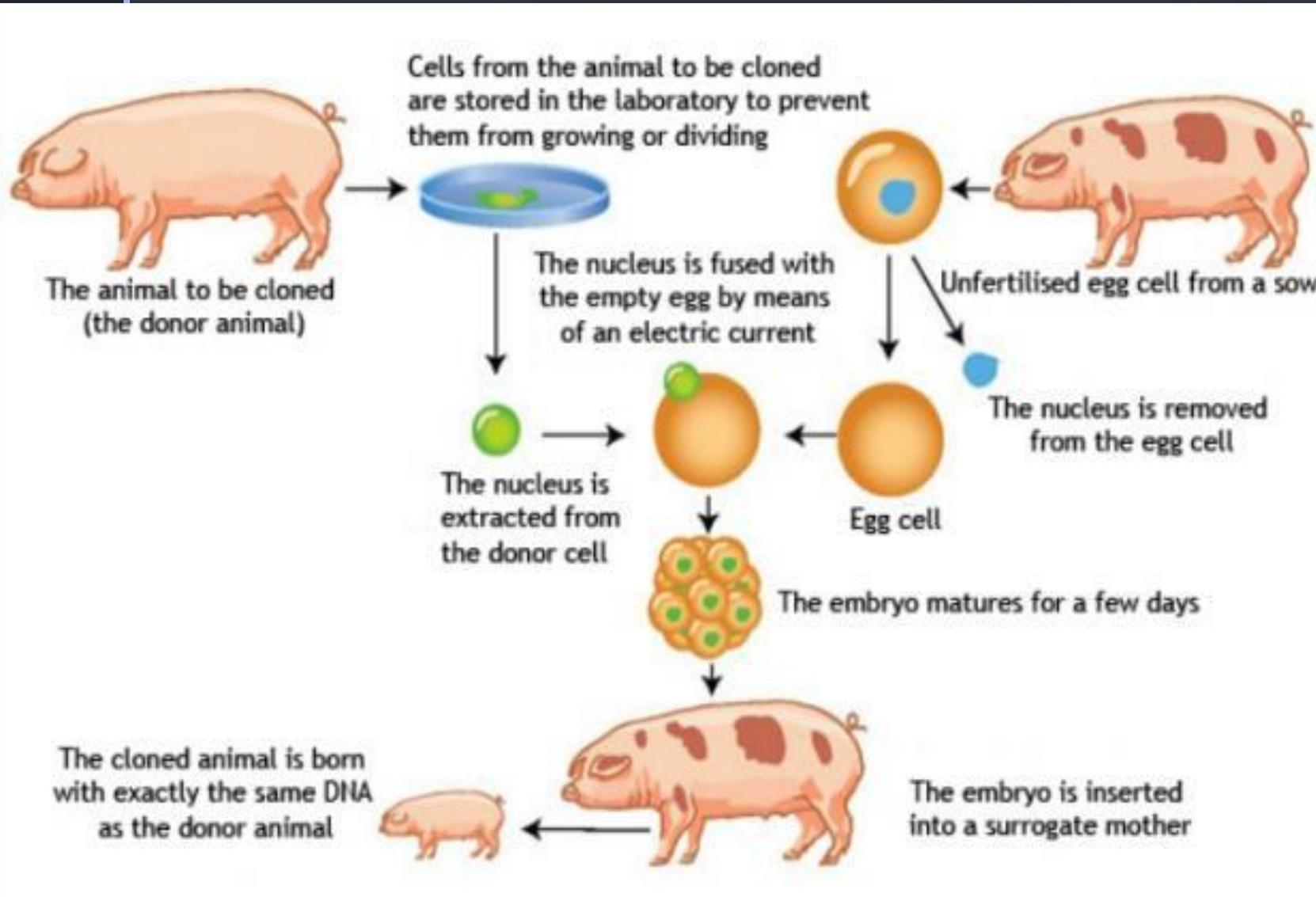
An enzyme cuts off the target DNA strand.

The defective DNA strand is replaced with a healthy copy.

Sources: Reuters; Nature; Massachusetts Institute of Technology



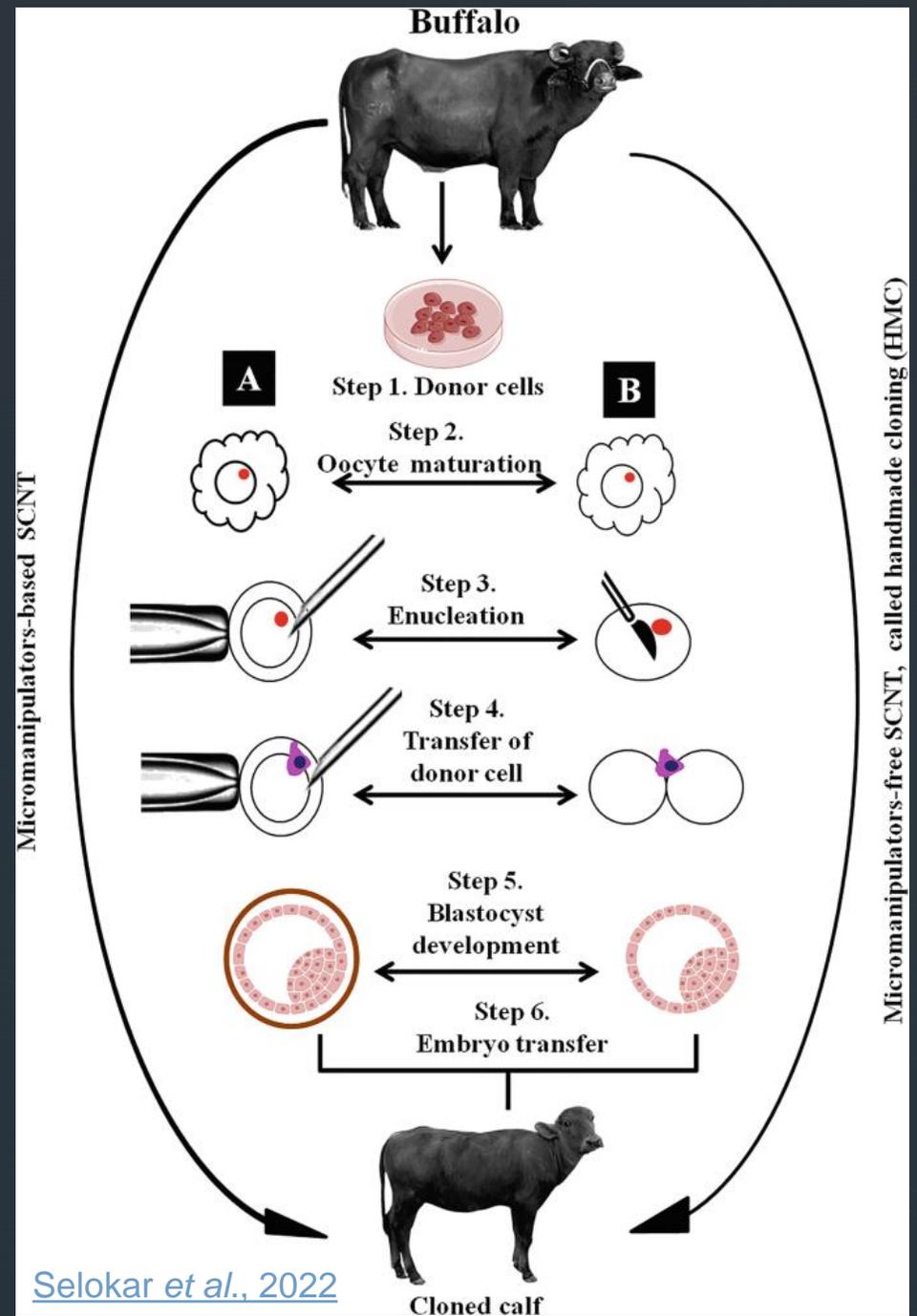
ANIMAL CLONING



The Philippine Carabao Center has adopted the **SOMATIC CELL NUCLEAR TRANSFER** technology to complement other existing reproductive tools for buffaloes. The present work was conducted to develop/optimize a system for cloning through somatic cell nuclear transfer in water buffalo. Buffalo clone embryos had been successfully produced in-vitro.



The Philippine Carabao Center is steadily moving toward its target of improving the genetic traits of Philippine carabaos to produce better sires. Through its Carabao Development Program, thousands of dairy farmers in the Philippines have availed of and utilized the technologies in artificial insemination and the use of riverine bulls for natural mating to produce quality crossbreds.





GM Mosquitoes

ASF Vaccine



“Slick” Coat Type Cattle



PRRS-Resistant Pigs

The Roslin Institute, The University of Edinburgh

Bird Flu Resistant Chicken



*The Roslin Institute,
The University of Edinburgh*

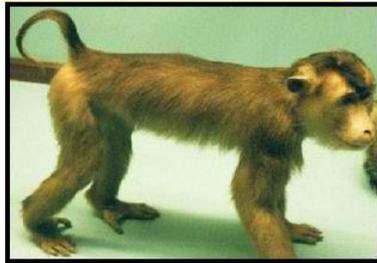
Applications and uses of GM / GE Animals

DISEASE MODELS

Nonhuman primate models for AIDS

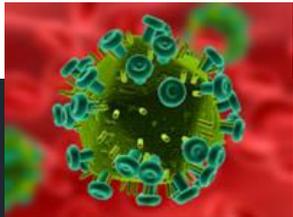


Macaca mulatta (rhesus)
Macaca nemestrina (pigtailed)
Macaca fascicularis (crab-eating)



- HIV-1: only replicates in chimpanzees--disease in 10 years
- SIV: simian immunodeficiency virus; transferred from African to Asian macaques in captivity and caused disease like AIDS
- SHIV: chimera that has the HIV Envelope and the backbone of SIV; these viruses cause disease after passage in macaques

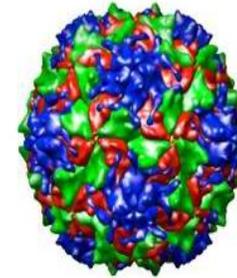
Nancy L. Haigwood
Seattle Biomedical Research Institute



- Work is in progress to develop new models by altering the susceptibility of mice to pathogens of humans.

TEST SYSTEM DEVELOPMENT

Transgenic mice have been invaluable tools:



An example:

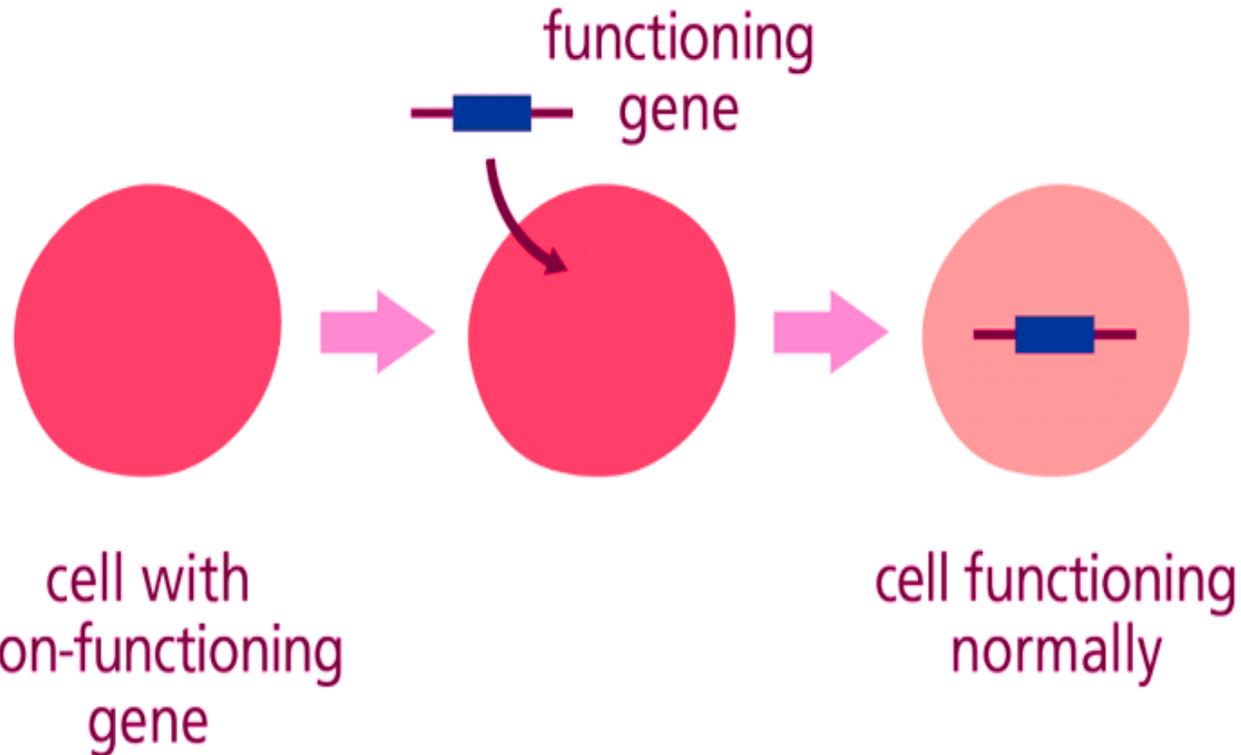
Normal mice cannot be infected with polio virus. They lack the cell-surface molecule that, in humans, serves as the receptor for the virus. So normal mice cannot serve as an inexpensive, easily-manipulated model for studying the disease. However, transgenic mice expressing the human gene for the polio virus receptor

- * can be infected by polio virus and even
- * develop paralysis and other pathological changes characteristic of the disease in humans.

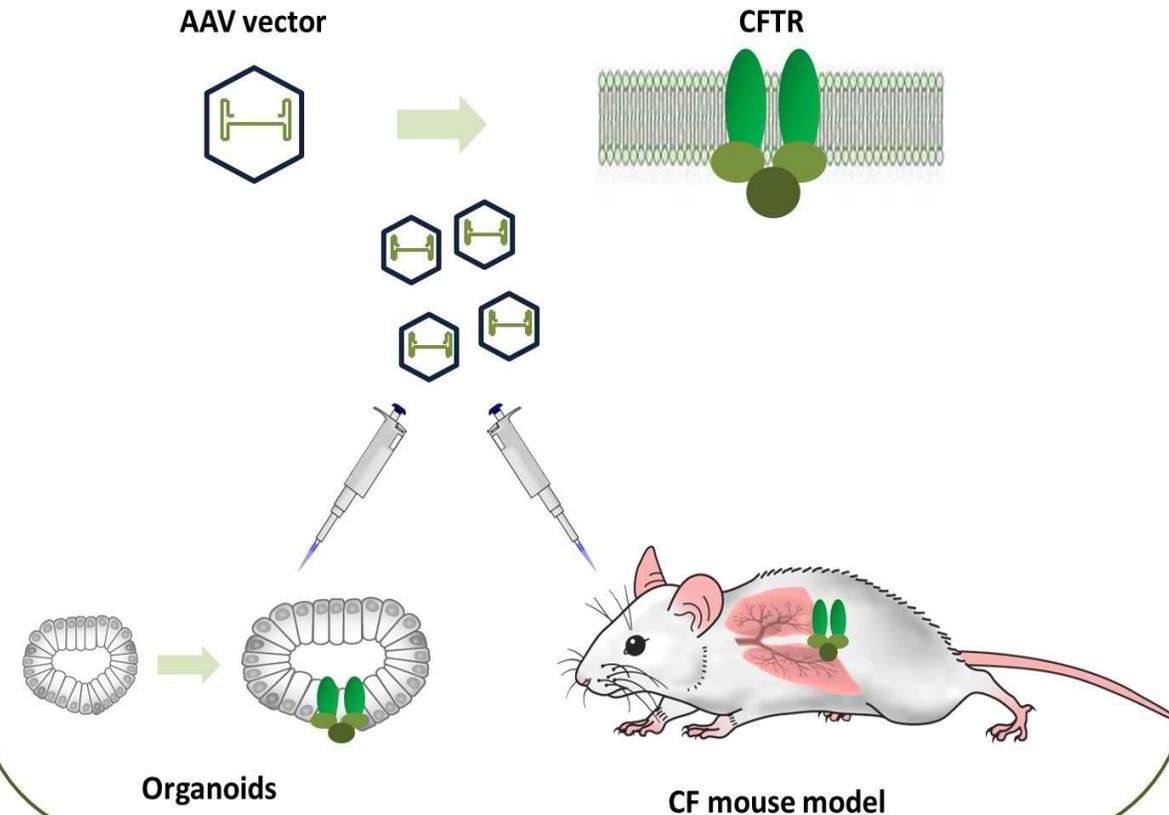
Applications and uses of GM animals

GENE THERAPY

Gene Therapy



GENE THERAPY FOR CYSTIC FIBROSIS

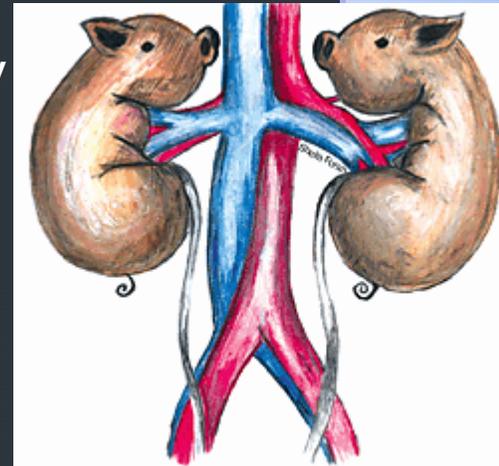
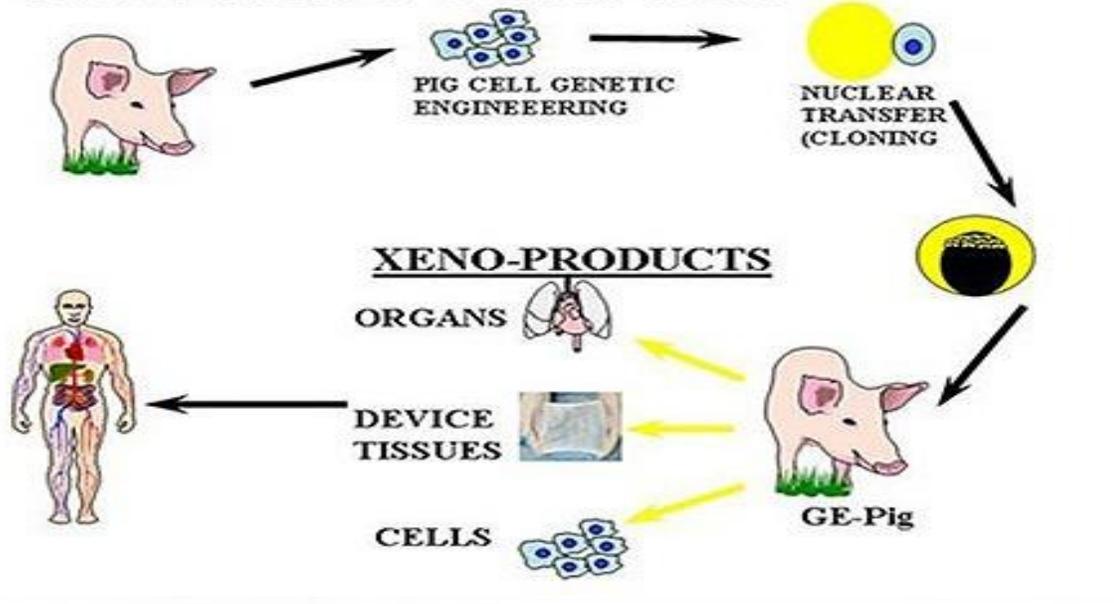


Applications and uses of GM animals

XENOTRANSPLANTATION

- Larger species, such as pigs and baboons, are preferred for development as donors because of the similarity of their organ size to that of humans.
- However, mice are being used in preliminary studies to assess feasibility and establish procedures to make the animal tissues compatible.

XENOGRAFT PLATFORM



Applications and uses of GM animals

INSERTION OF GENETIC MATERIAL

IMPROVEMENT OF FOOD QUALITY



Excretion of
Biopharmaceuticals in milk

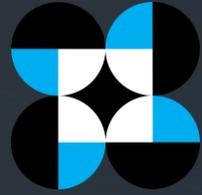


Protein expression to
alter meat composition



Transgenic mice
expressing green
fluorescent protein

GM Animals Regulatory Policy



**DOST-DA-DENR-DOH-DILG
Joint Department Circular
No. ____, Series of 2022**

Subject: Rules and Regulations for the Research and Development, Handling and Use, Transboundary Movement, Release into the Environment, and Management of Genetically-Modified Animal and Animal Products Derived from the Use of Modern Biotechnology

GM Animals Regulatory Policy

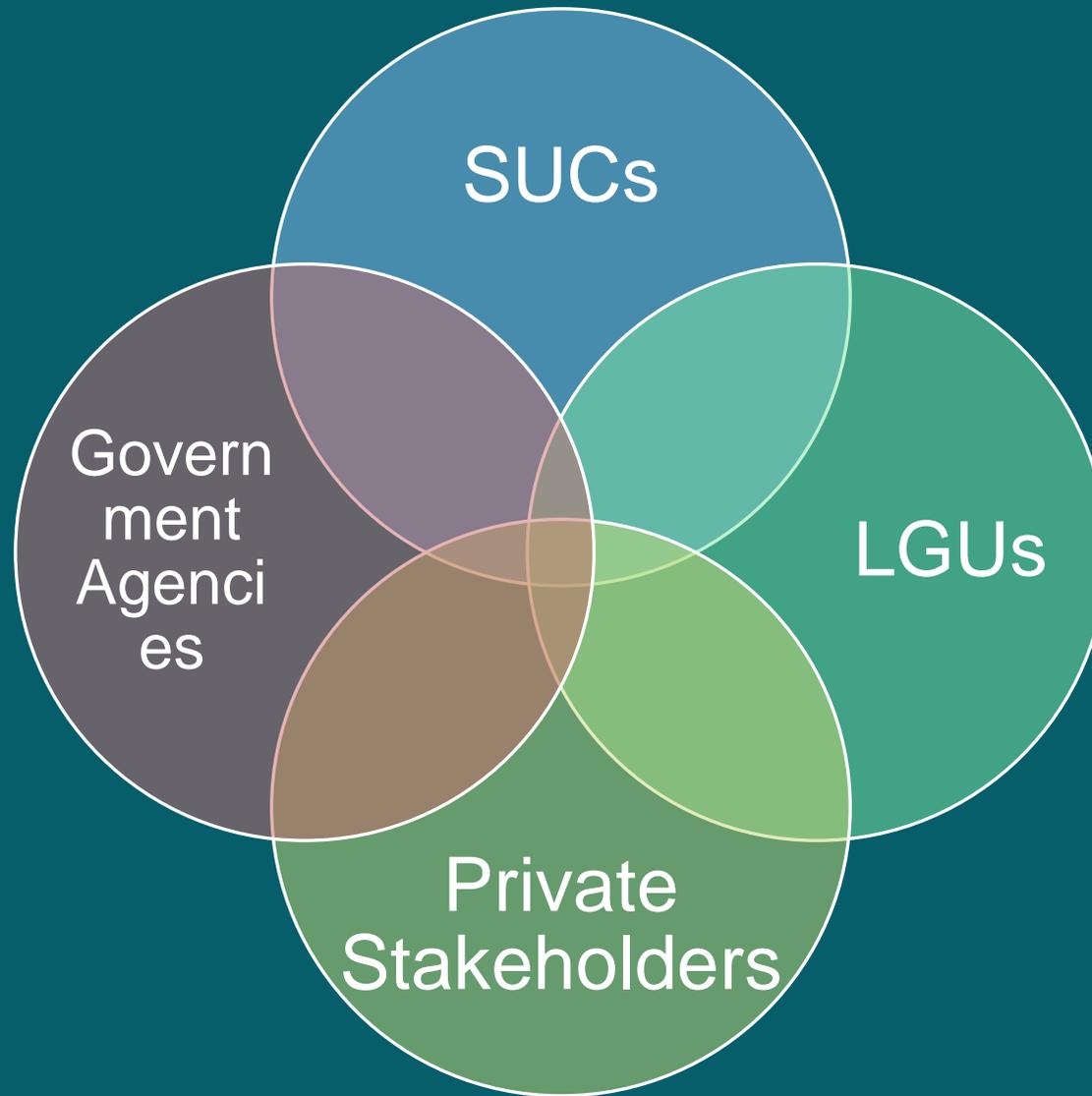
Applicability

- genetically-modified fisheries and other aquatic resources
- domesticated animals and biological products used for animal husbandry or veterinary purposes
- biological agents used for biocontrol derived from the use of modern biotechnology and containing novel combinations of genetic materials

Products of gene editing that do not contain novel combinations of genetic materials are not covered by this Circular.



Harmonious Collaboration



Enabling environment of backed by sound policies on GM animals





THANK YOU

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