# Implementation Of A Breeding Programs

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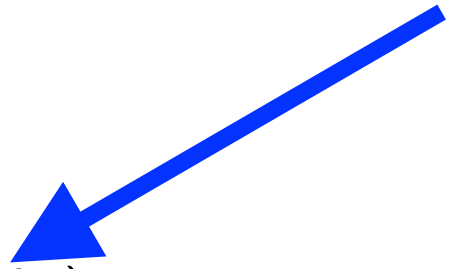
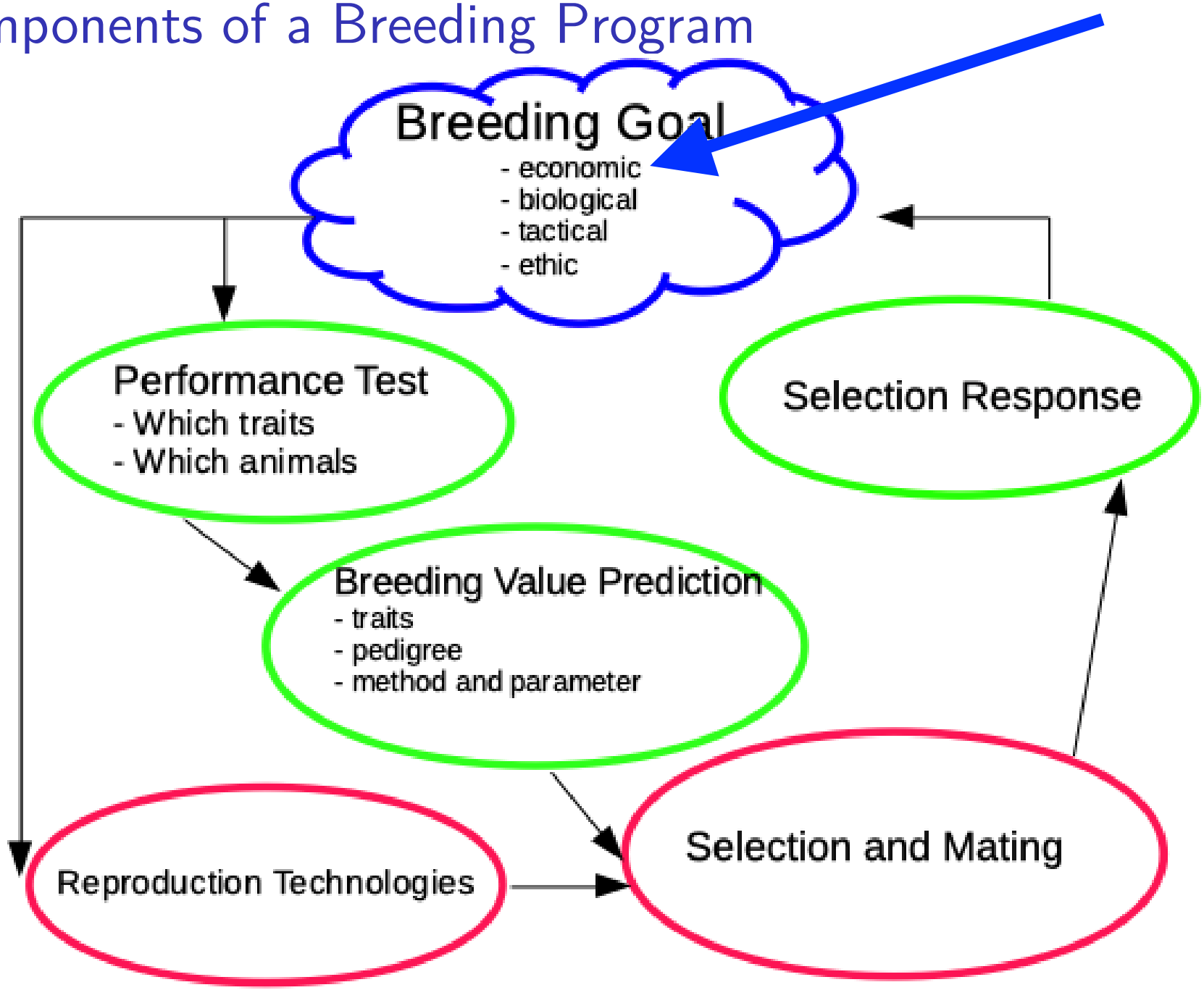
# Recall

Types of breeding programs:



- focus on selection response (scientific)
- focus on customers and services (political)

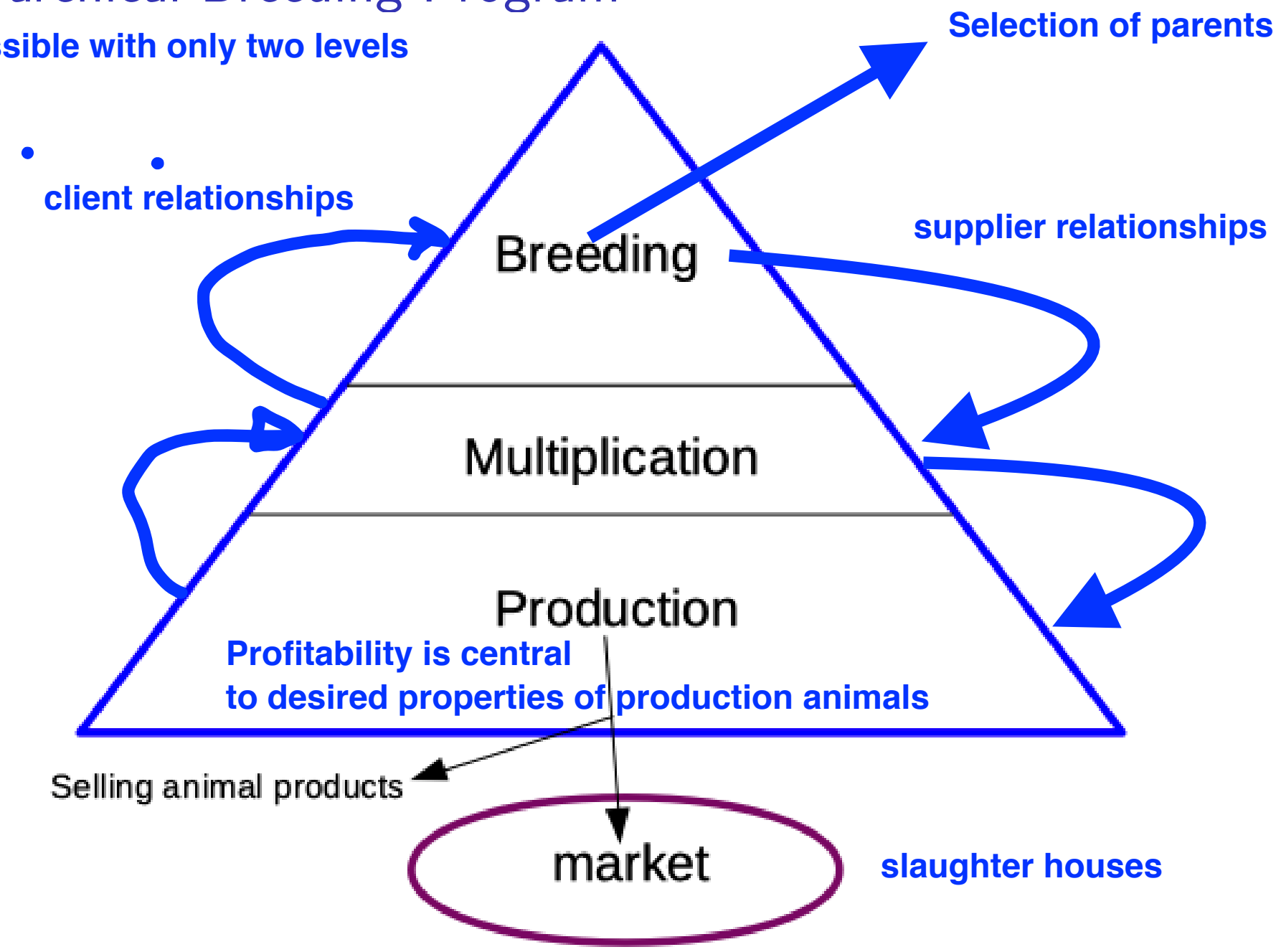
# Components of a Breeding Program



# Example of Implementation

- Assume: beef breeding organisation
- Improvement of animal at production level with respect to economic profitability
- Implementation of scientific breeding program
- Start to design and to develop economic breeding goal
- Combine economically important traits into an aggregate genotype ($H$)
- Use hierarchical structure

# Hierarchical Breeding Program

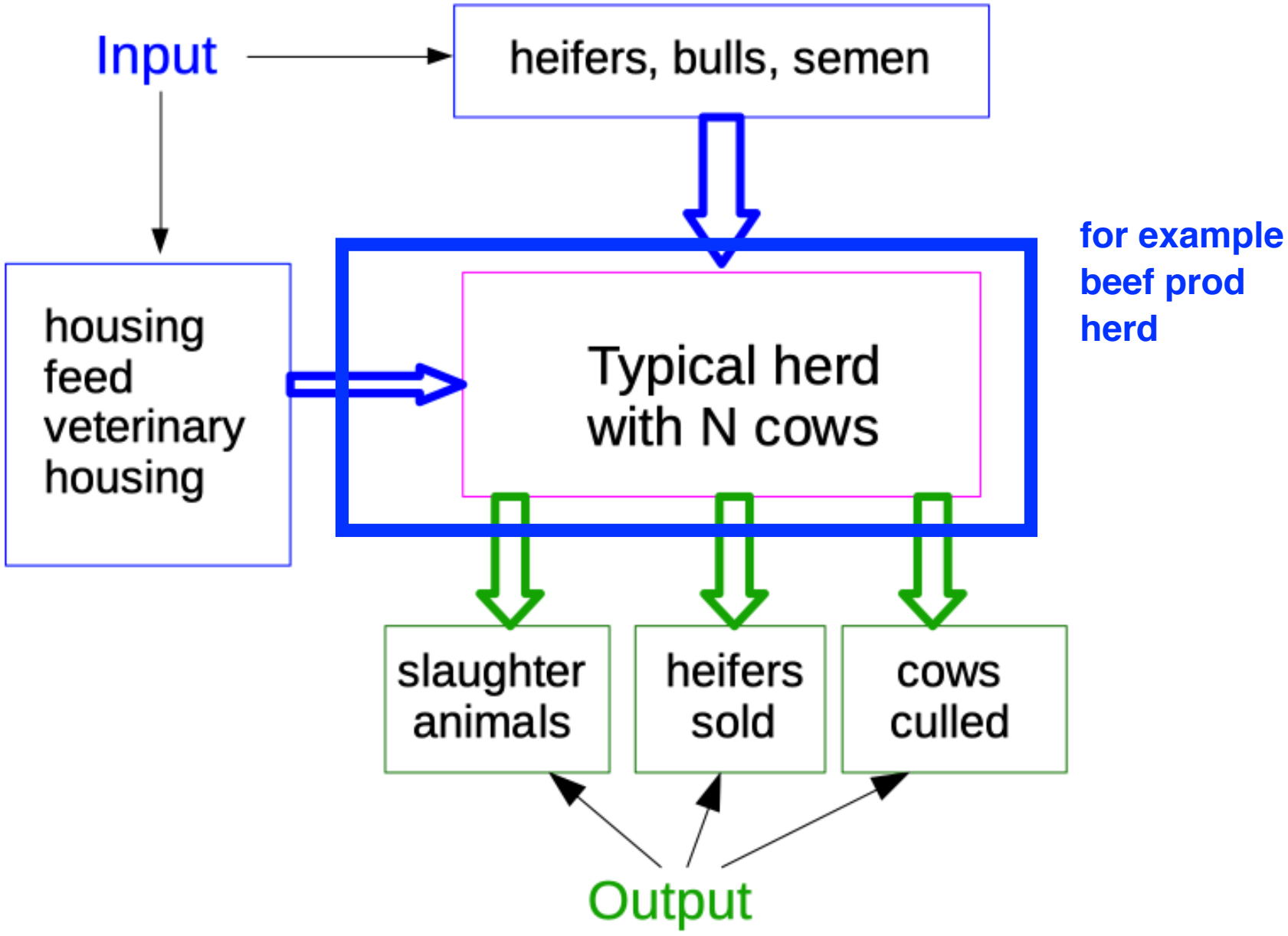


# Three Steps To Design Economic Breeding Goal

The following steps are needed to implement a breeding program

1. description of production system
2. modelling profit of a typical herd
3. derive economic values

# Production System



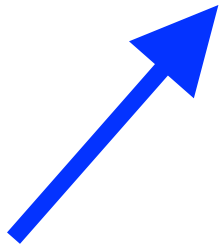
# What is a Production System

- Simulation of production herd
- Collect input parameters (costs, biological parameters, labor, ...) from literature
- Use collected input parameters for simulation
- Run simulation
- Record output quantities (revenue, animals sold)

# Why Production System

- Profit is computed based on revenue and costs
- Characteristics and traits of animals with impact on profitability are found **e.g. feed intake, daily gain, coat color?**
- Impact of traits on profitability detected by changing input parameters **ranking of the traits with respect to their impact on profit**
- Progeny must meet needs of production farms
- Breeders must select parents such that optimal progeny produced for production farms

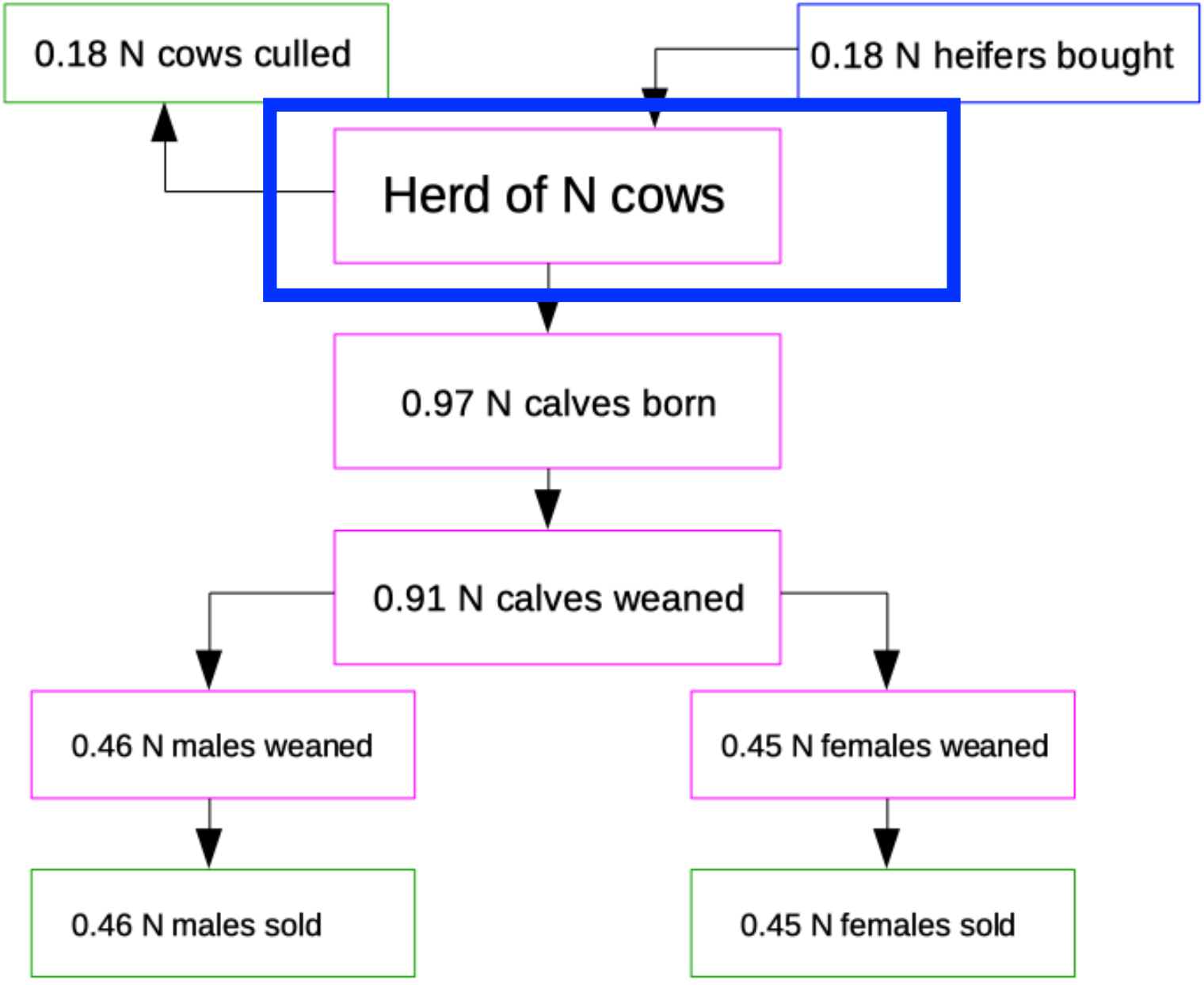
# Structure of Production System



**strong separation between breeding and production ==> pigs and beef**

- Assume a hierarchical structure of the breeding program
- Alternatively: mixed farms in monolithic structure
- Breeding (and possibly multiplier) farms are selling their progeny to production farms

# Example Of Typical Production Farm



# Traits Of Interest

- Profit ($P$) of production farm determined by revenues ($R$) and costs ($C$)

$$P = R - C$$

- Traits of economic interest influence $P$
- Restrict ourselves to output
  - age corrected carcass weight (CW)
  - carcass confirmation (CC)
  - carcass fat (CF)
- Above traits will be included in aggregate genotype ($H$)

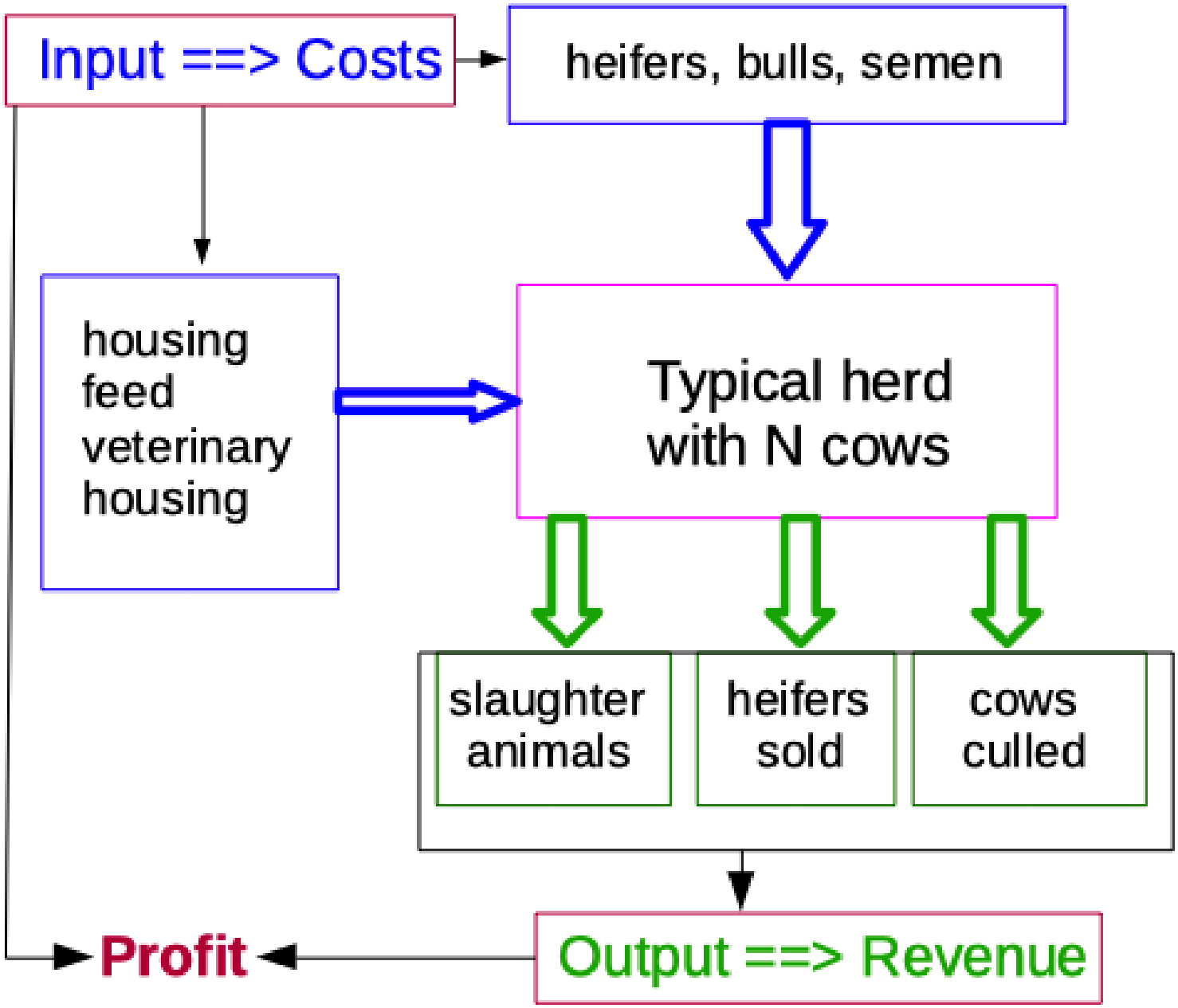
**Obtained by economic evaluation**

$$H = a^T \cdot u$$

**a: economic weights**

**u: true breeding values**

# Economic Evaluation



# Economic Values

**Computation:**
*** Simulation of the production system which is run with default parameters (input and output) over a certain period of time**
*** second step: change mean of trait x, let simulation run with changed parameters**
*** Compare profit from both simulation runs**

- . . . also known as economic weights
- Change of profit ($P$) due to small change of trait mean ($\mu_x$)
- For trait $x$ with mean $\mu_x$, the economic value $a_x$ is defined as

**for our example, x can be either**
*** carcass conformation (cc)**
*** carcass weight (cw)**
*** carcass fatness (cf)**

$$a_x = \frac{\partial P}{\partial \mu_x}$$

**change in profit**

**change in population mean**

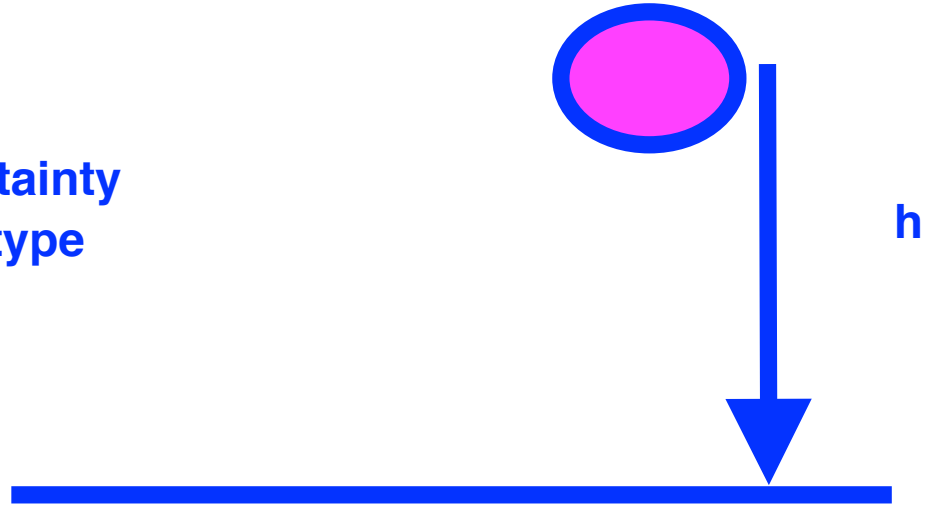
# Genetic Evaluation

**Aggregate Genotyp H consists of two parts**
**1. economic values (a) ==> economic evaluation**
**2. true breeding values (u) ==> genetic evaluation**

**Statistical modelling of the phenotypic expression (phenotype of a trait) as a function of the underlying genotype**

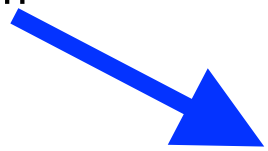
- Statistical modelling
- Stochastic relationship between genetic background and phenotypic expression
- Contrast: deterministic modelling in physics, e.g. law of gravity

**required to account for the uncertainty in the relationship between genotype and phenotype**



# Statistical Modelling

- In most cases, two steps plus preparation
- Given: dataset on breeding animals containing traits of interest as response variables and predictor variables
- Preparation: do model selection to eliminate unimportant predictor variables
- Steps:
  1. variance components estimation
  2. prediction of breeding values



**variability is needed to use a trait as selection criterion.**

**variance components estimation is done using mixed linear models and the important fixed effects are determined by procedure that is called Model Selection**