Development of a dynamic mechanistic model of dairy cattle capable of predicting milk production, dry matter intake and Body Condition Score change

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Overview

- Biological systems are complex and dynamic in nature
- Modelling allows experimentation of key system components
  - Low cost
  - Timely
  - Effective manor
- Many interchanging components require:
  - Complex mechanistic, stochastic, dynamic, farm models capable of replicating the system

Objective

- To develop a dynamic, mechanistic cattle model
  - Calf and Heifer Model
    - Stages of Growth
  - Cow Model
    - Intake
    - Milk production
    - Condition Score Change
  - Output Indicator
    - Profitability
    - GHG emissions

Herd Demography

Herd Demography

Calf

Herd Demography

- Submodel:
  - Intake
  - Growth
    - Increase of body weight

- Bulls are sold at the age of…

Herd Demography

Calf

90 days

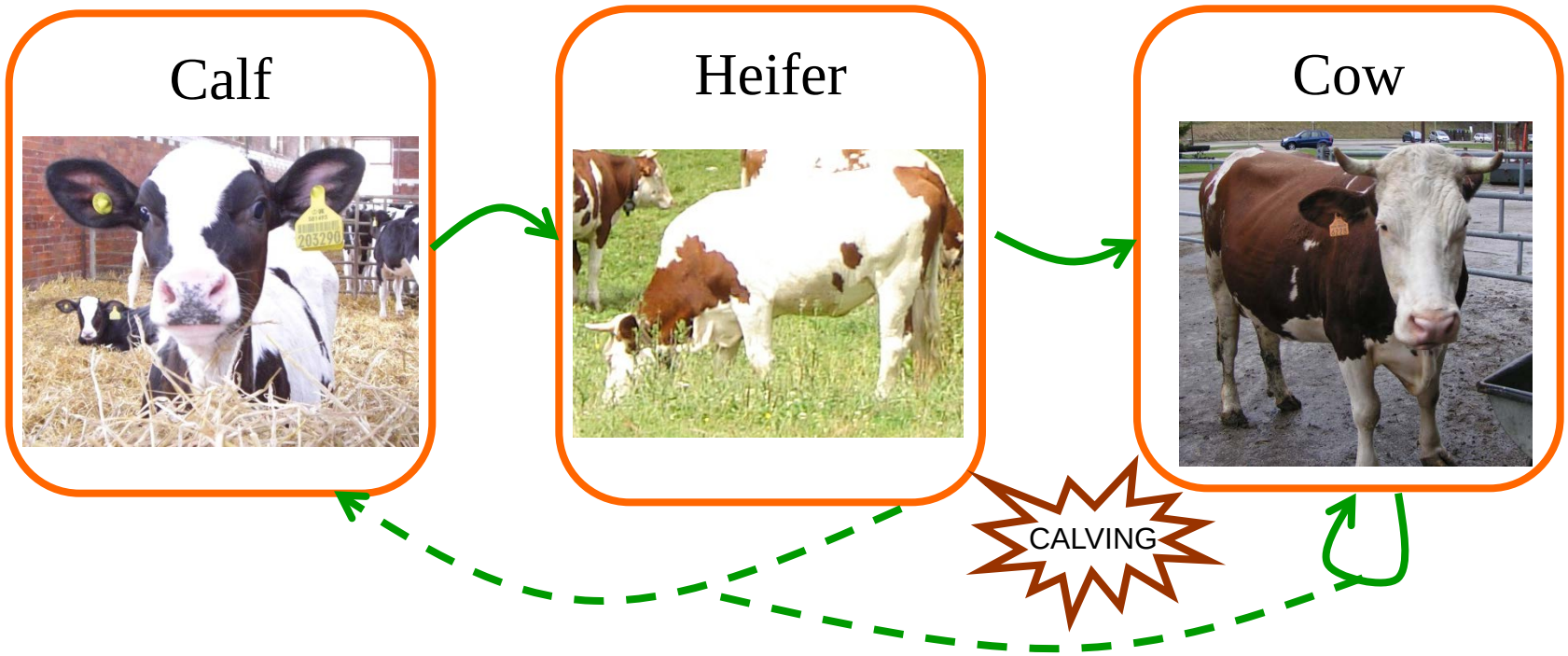
Heifer

Herd Demography

- Submodel
  - Intake
  - Growth (BW)
  - Fertility (Puberty)

- Farmer Decisions
  - Insemination
    - Date/Age/Weight

Herd Demography

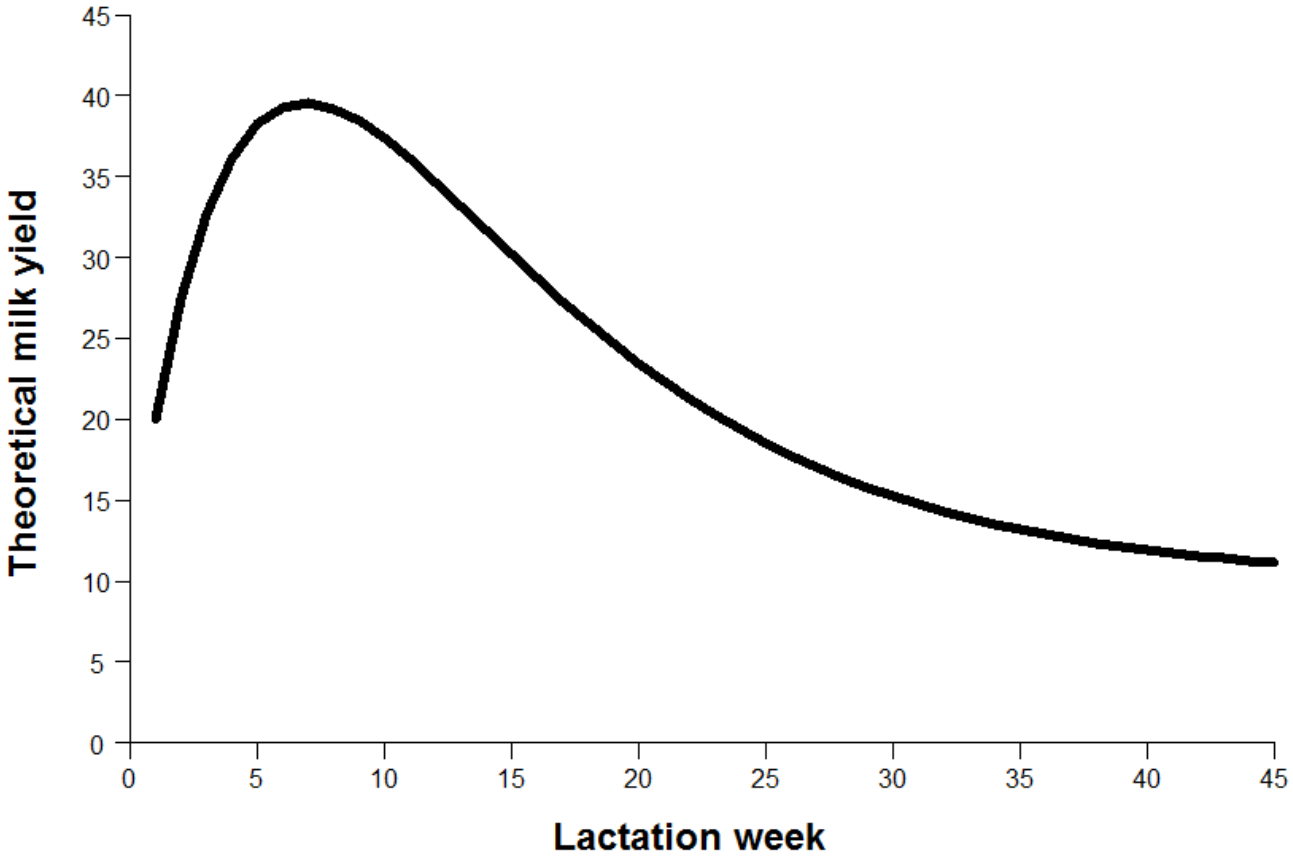


Herd Demography

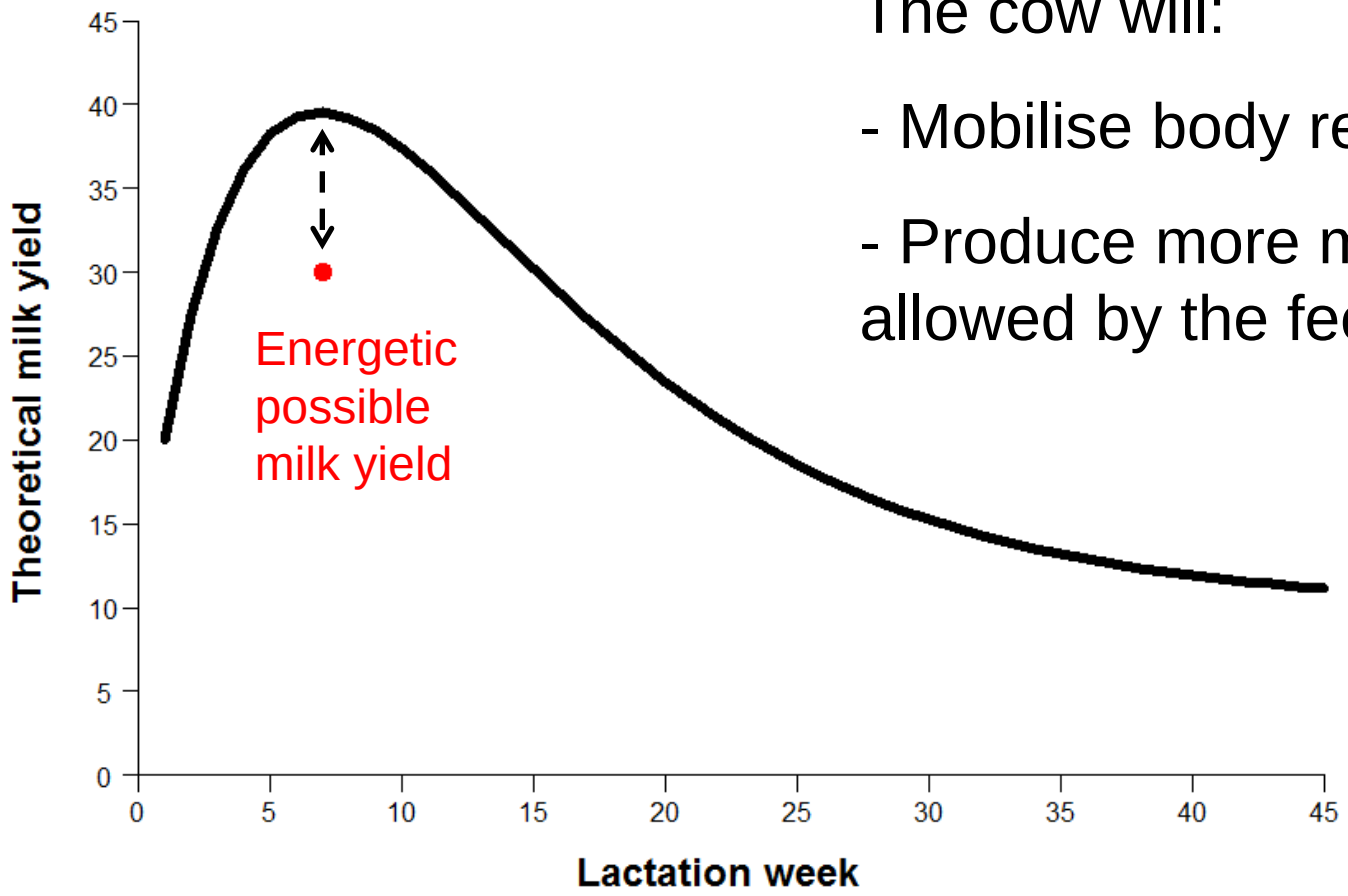
- SubModel:
  - Intake (INRA 2010)
  - Growth (BW) (age <40 month)
  - Fertility
    - Return in heat
    - Insemination success
    - Embryonic death
    - Dystocia
  - BCS and Milk production
- Farmer action
  - Insemination
  - Ending lactation

Milk Yield and BCS change

Milk Yield and BCS change



Milk Yield and BCS change

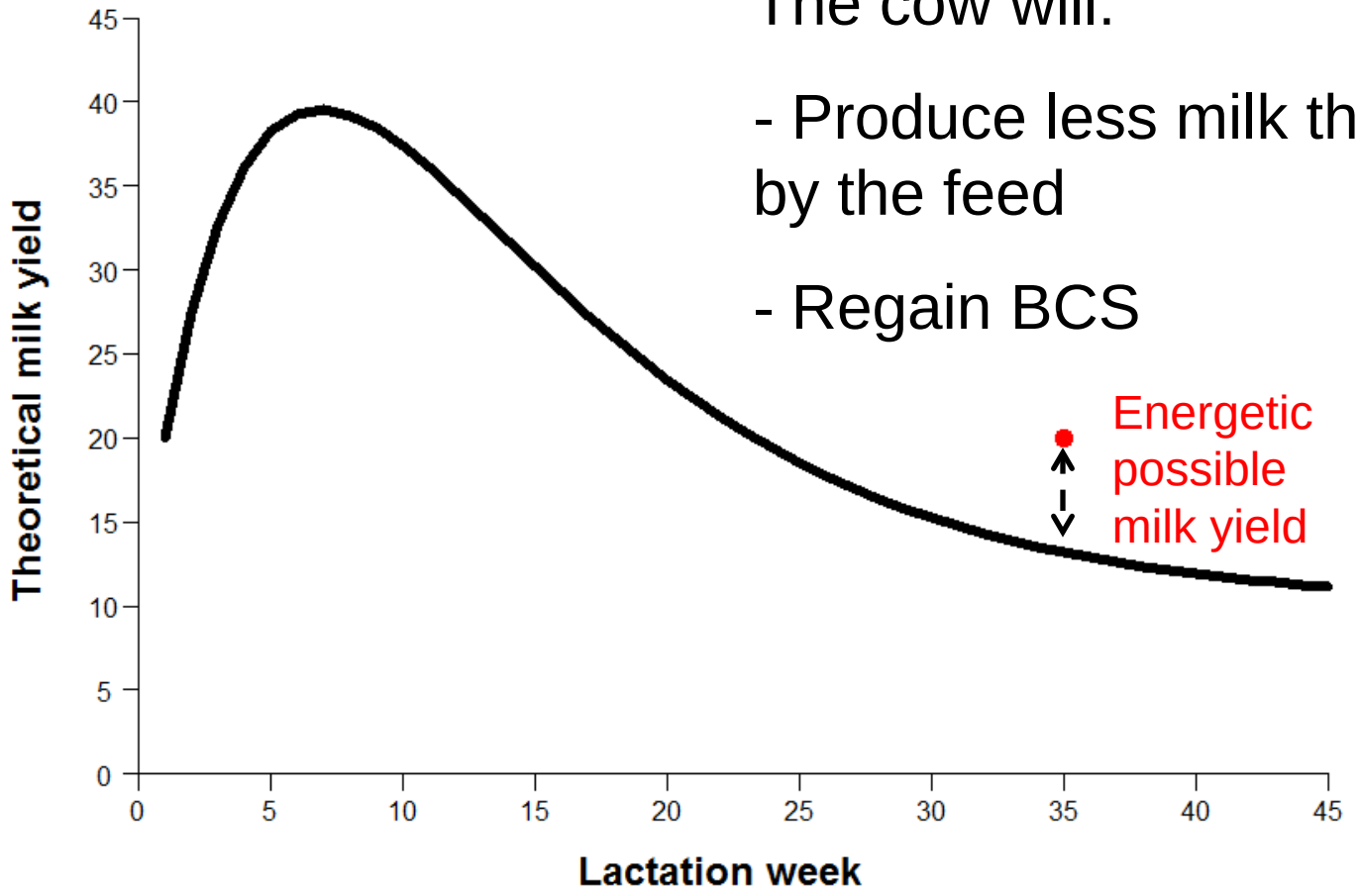


The cow will:

- Mobilise body reserve

- Produce more milk than allowed by the feed

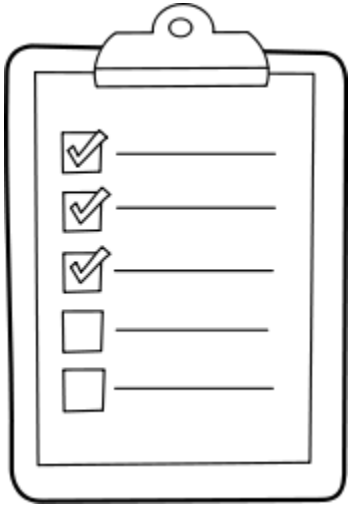
Milk Yield and BCS change



The cow will:

- Produce less milk than allowed by the feed

- Regain BCS

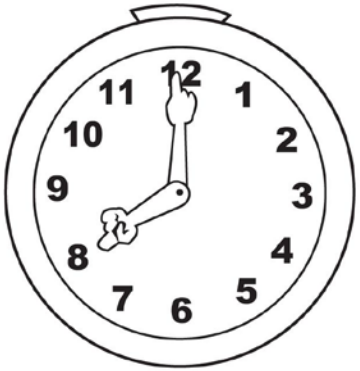


User Input

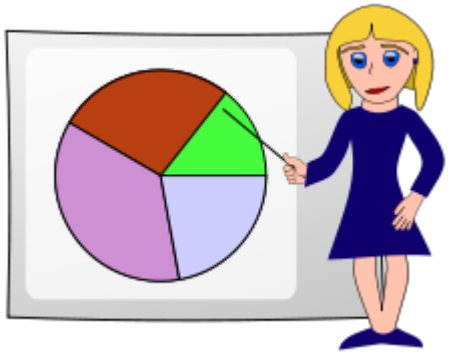
User Input

Initial cattle

Duration of the simulation

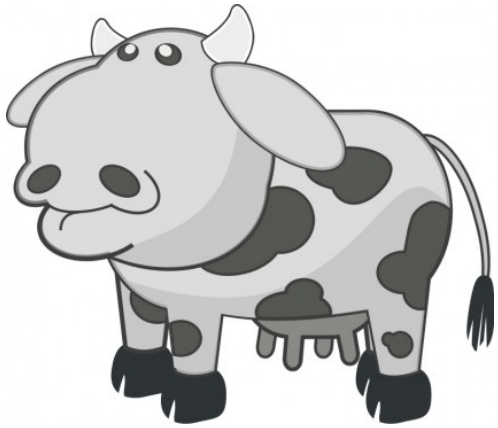


Management Rules



Internal evaluation

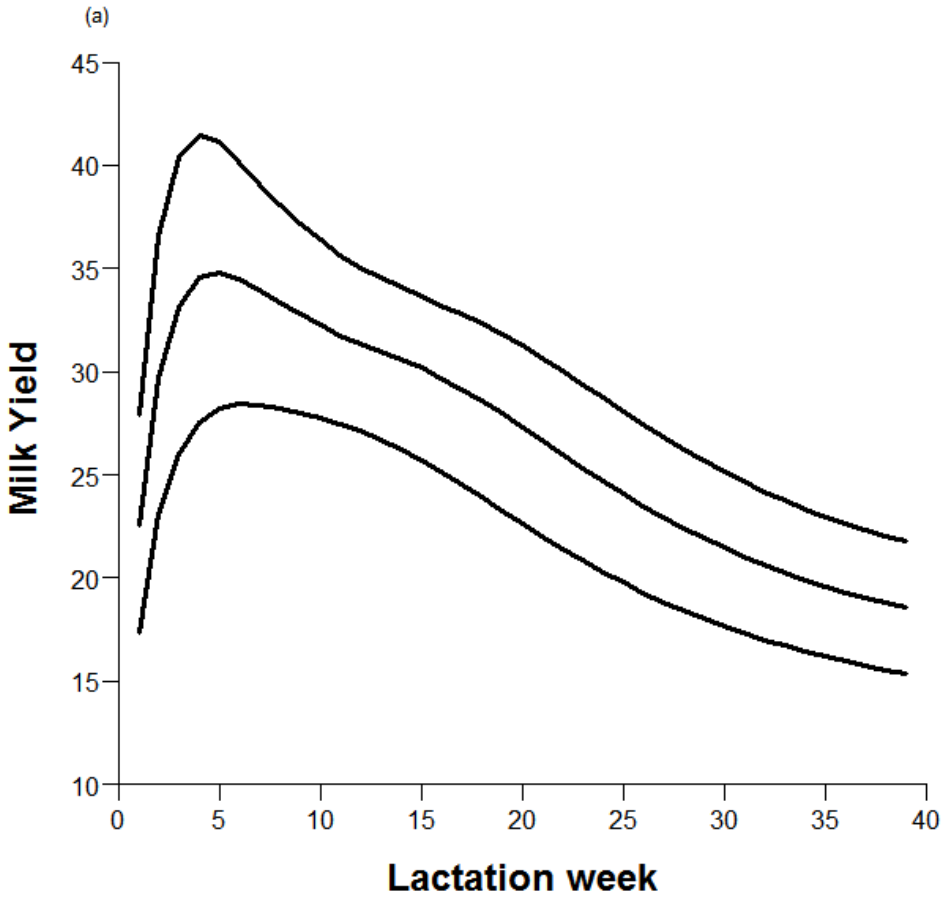
?



Simulation

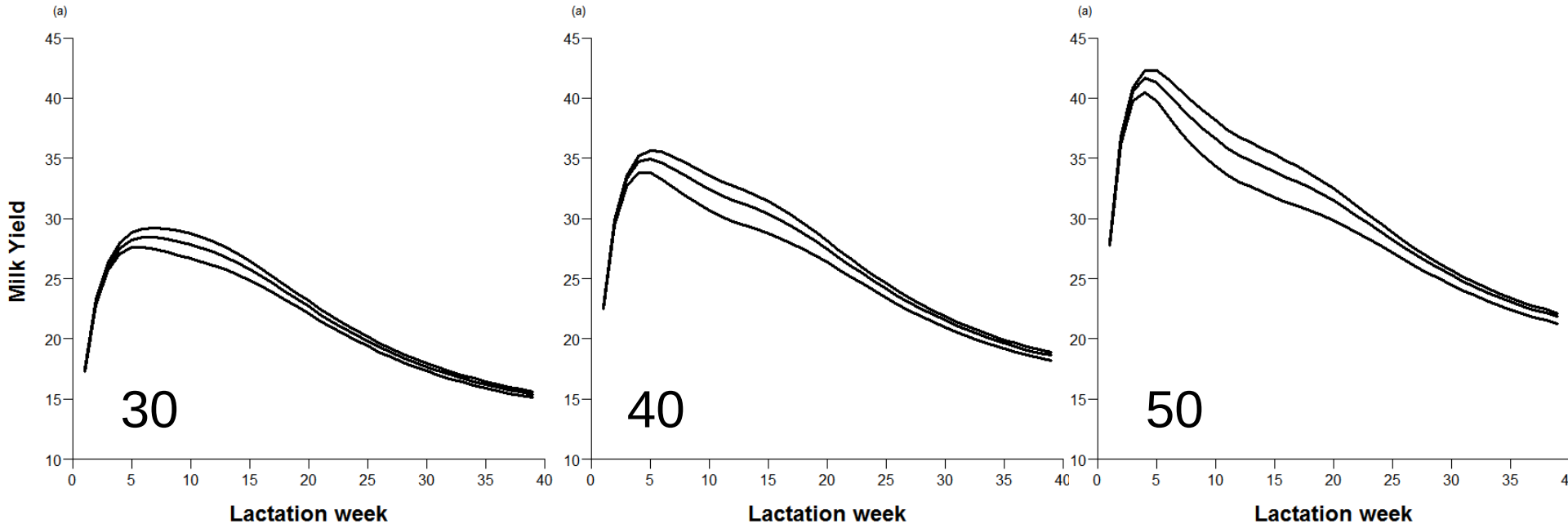
- Simulation with different:
  - Genetic potential
    - 30 kg of standard milk
    - 40 kg of standard milk
    - 50 kg of standard milk
  - Herbage allowance
    - 14kg of MS
    - 18kg of MS
    - 22kg of MS
  - Concentrate suplementation
    - 0kg
    - 4kg

Impact of the genetic index



50
+4.2kg/day/cow
40
+4.5kg/day/cow
30

Impact of the HA

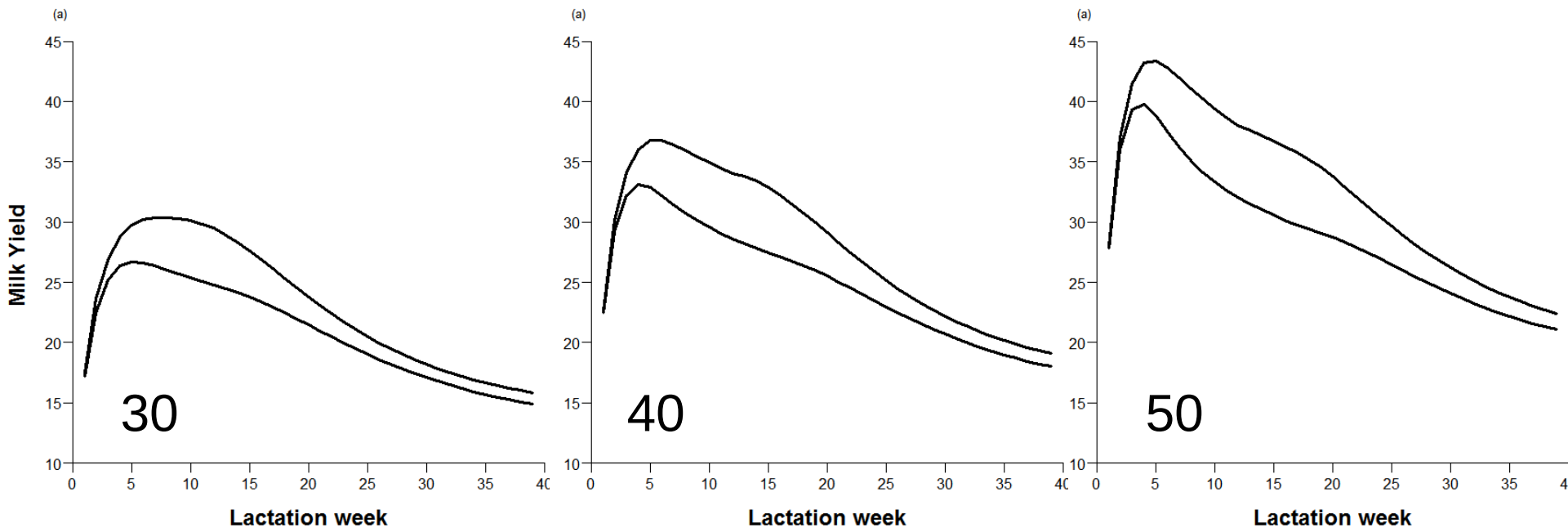


14 -18	0.14	0.25	0.36
18 -22	0.12	0.15	0.20

kg of milk per kg of DM per day per cow

Literature: 0 – 0.48

Impact of concentrate



0-4 0. 58 0.75 0.94

kg of milk per kg of DM per day per cow

Literature: 0.23-1.63

Conclusion and next step

- The model is operating in a logical manner;
  - variation of genetic potential
  - herbage allowance
  - concentrate supplementation
- Next step: the creation of the whole farm model
  - Simulating grazing
  - Individual representation of the paddocks
  - Additional output:
    - Total herbage mass intake
    - Pre and post grazing height
- Finally to integrate with a grass growth model

Teagasc
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