



**Do the production of researchers match to the
expectation of the farmers?**

Example in ruminant feeding management

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Introduction

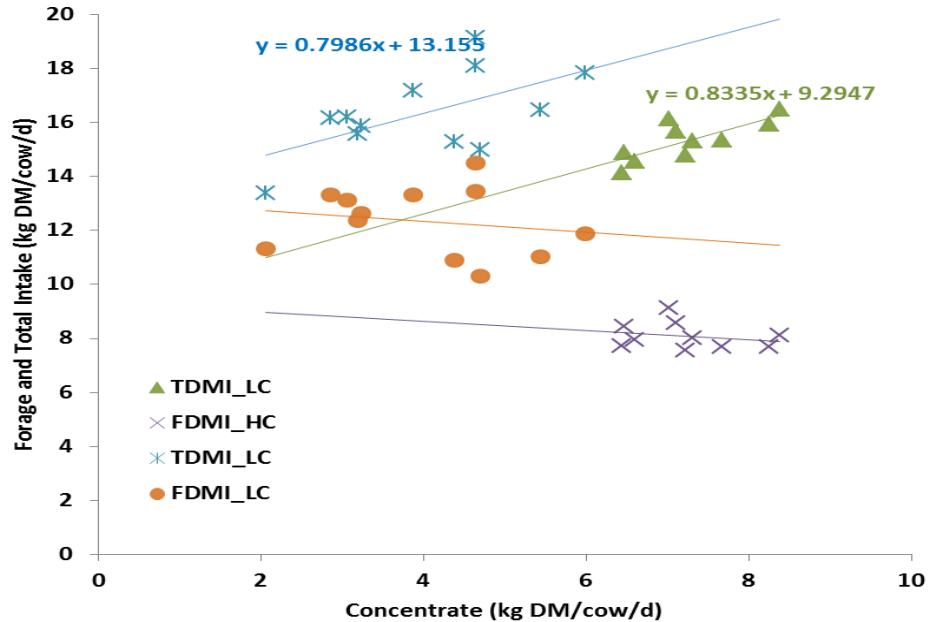
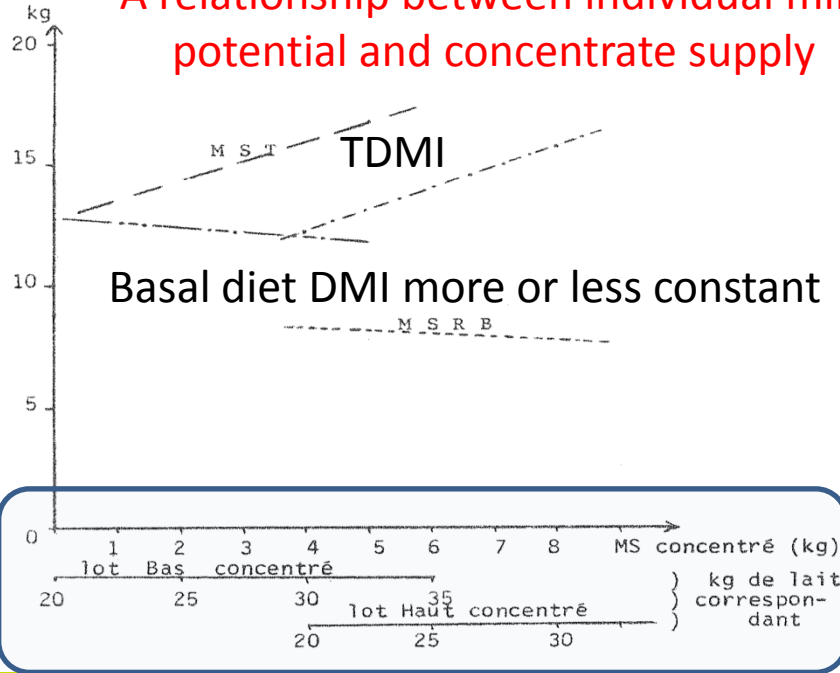
- Applied science is producing more and more tools and products for practice than are often not use
- A French anthropologist, Bruno LATOUR, declared that applied research is producing a lot of RANA (ARNA in English): The Applied Research Non Applicable!
- As scientists, are we producing a lot of RANA?
- Is the way of defining the problems in research is in line with the application of these results by end-user?
- How can we improve our approach to be more applicable?

A personal historical view of the application of research in ruminants feeding

- **The normative approach:
Apply the rules!**
- **The revolution of the « What if » approach:
The simulators!**
- **And if the « How to » approach is the good answer:
A new look on the decision tools**

Concentrate feeding proportional to milk potential at peak (1 kg/2.5 kg Milk)

A relationship between individual milk potential and concentrate supply



Hoden 1978, Faverdin and Rémond 1979, Journet et al 1983



The normative approach

- **This approach is simple, operational**
- **Easy to transfer, easy learned**
- **Not adapted to the diversity of context, of objective**
- **Not evident to demonstrate this is the best strategies:**
→ a lot of different “blueprints”
(a lot of debate in France concerning the slope of 2.5 kg)
- **Farmers know the rule, but often work differently**

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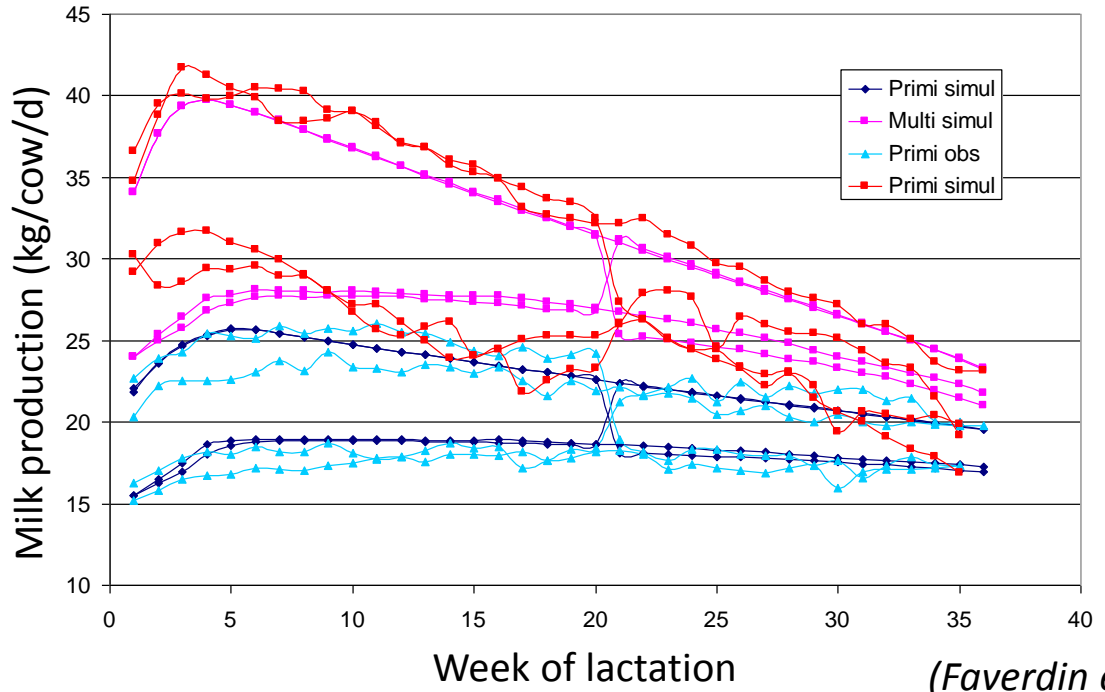
The “Grail” of research: “What if”

- **Hypothesis: The farmer knows what he want to do, but he want to see what happens if he decides to...**
- **The scientist will try to forecast the response according to a certain number of levers**
- **The modelling approach will take more room**
- **The scientists “play” with models**

The integration in a simulation model to assess the impact of different feeding strategies on milk production

The graz'In model
(Grazemore project)

Enable the simulation of lactation curve (including intake) with a precise description of feeding.



(Faverdin et al 2011)

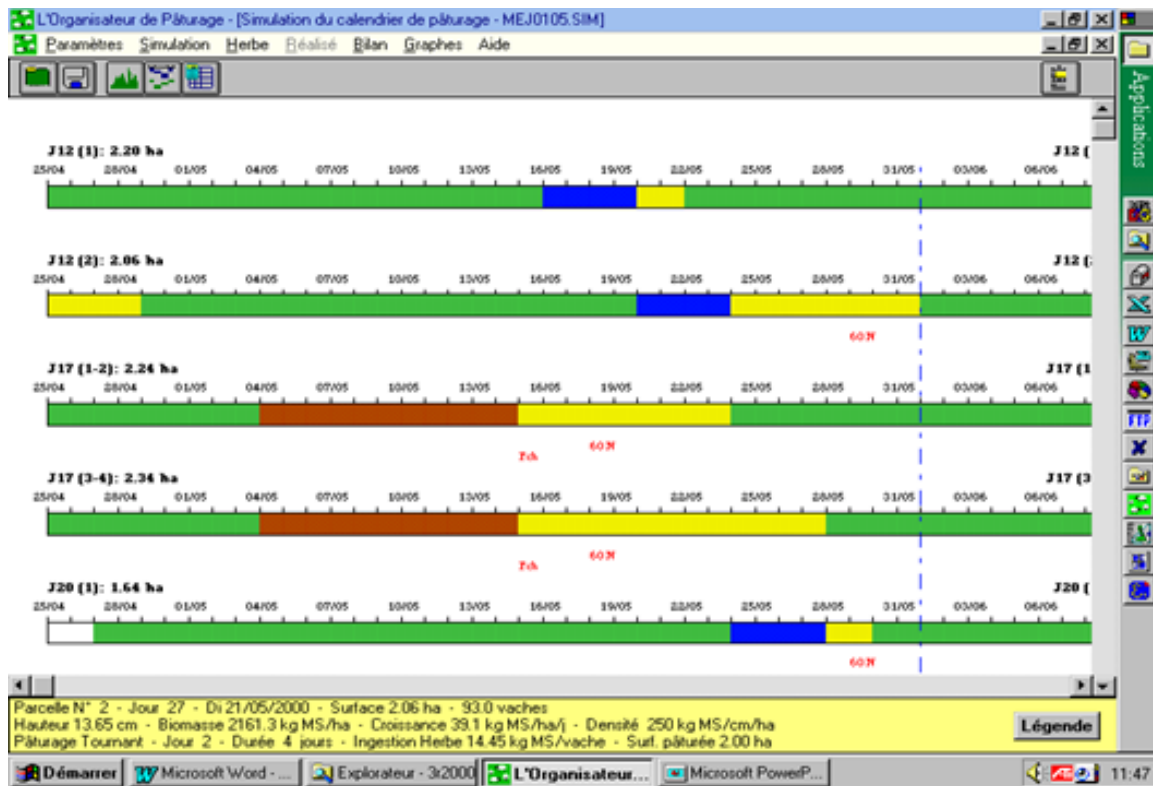
Patur'in: the simulation of grazing management

Very interactive tools for grazing management with the possibility to change

- Fertilisation
- Feed supplementation
- Cutting
- Rotation

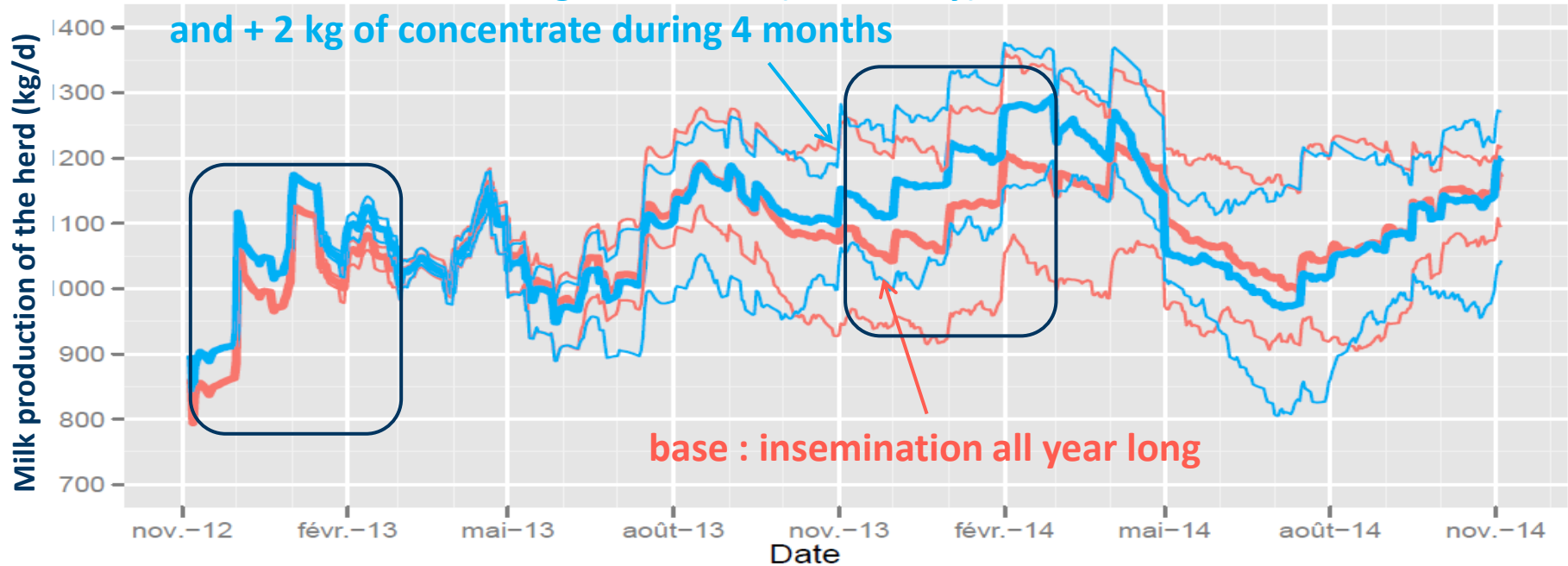
An easy interface with a grazing calendar

→ Requires precise information on biomass



Simulation of milk production curve of the farm according to herd management (feeding, reproduction)

No insemination during 1.5 month (June - July)
and + 2 kg of concentrate during 4 months



The simulation tools: not so easy for farmers

- **These models are useful and exciting because they are able to forecast.**
- **Largely used to balance diet.**
- **They are not always adapted to answer to the questions of farmers**
- **They require a lot of precise information, often dynamically**
- **They are more complex to use, even with good interface, due to the way of thinking behind.**
- **The scientists “play” with models improvements, but the quality of the tools is not only a function a precision in forecast.**

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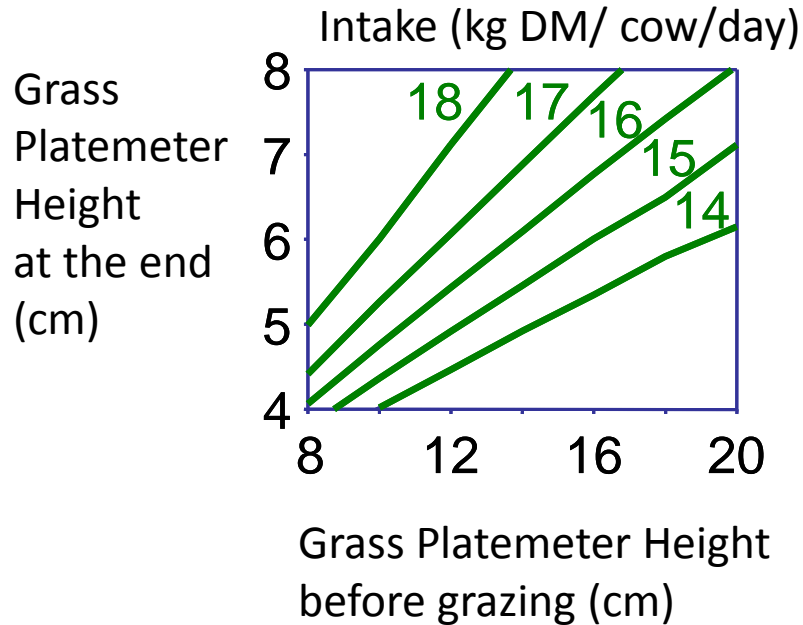


The question « How to » should be very stimulating for science

- **What can we learn from running models on the management of the system to help the farmers or the advisors?**
- **Generating large global sensitivity analysis or set of scenarios and analysing the emerging properties**
- **To give direct answers or proposals to take decision**

A sensitivity analysis of complex models to create a simple metamodel of decision

A grassland management decision to decide when to leave the paddock
(Delagarde et al. 2007)

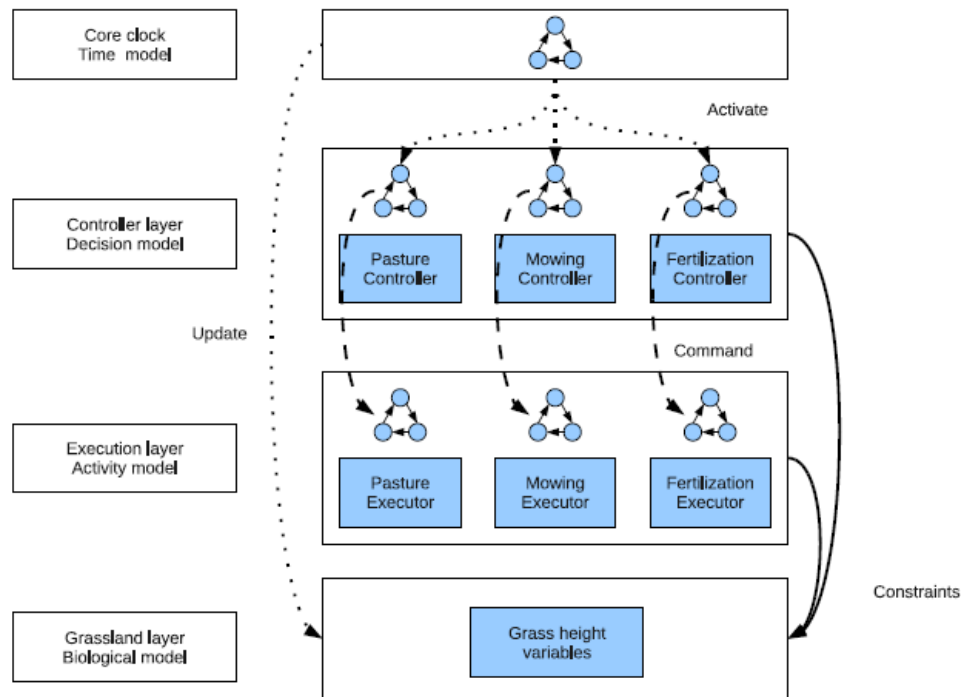


Use of model-checking to find the rules of grazing management according specific objective

Patur'In was totally rebuild to use model-checking approach

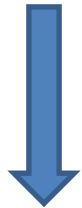
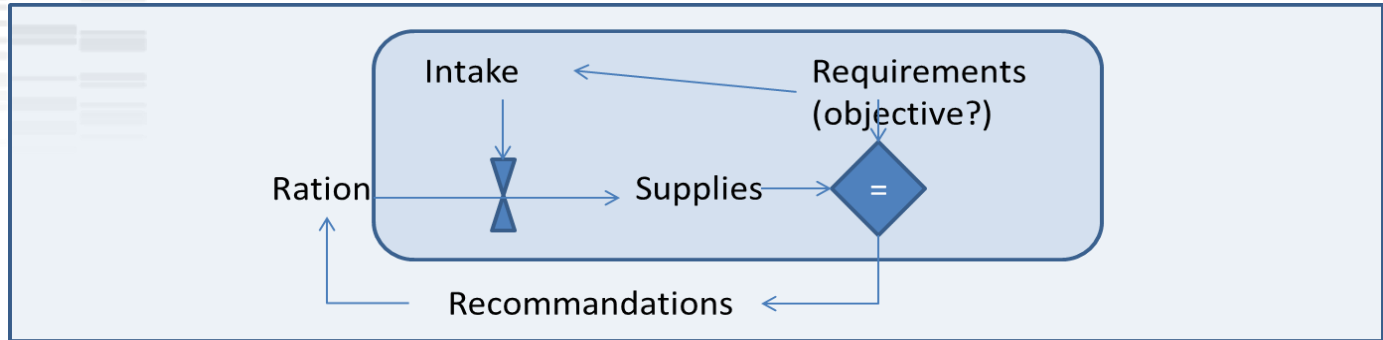
→ Rules emerge but differ too much from farmer's representation

(Y. Zhao 2014)

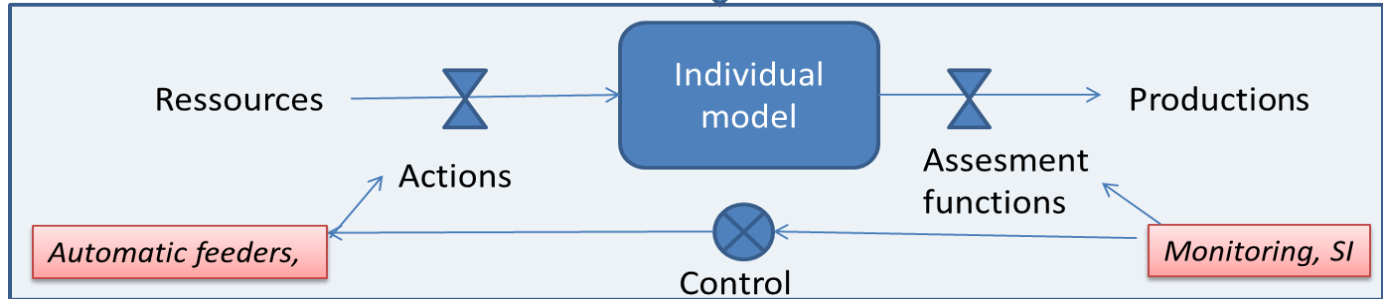


New paradigm of precision feeding

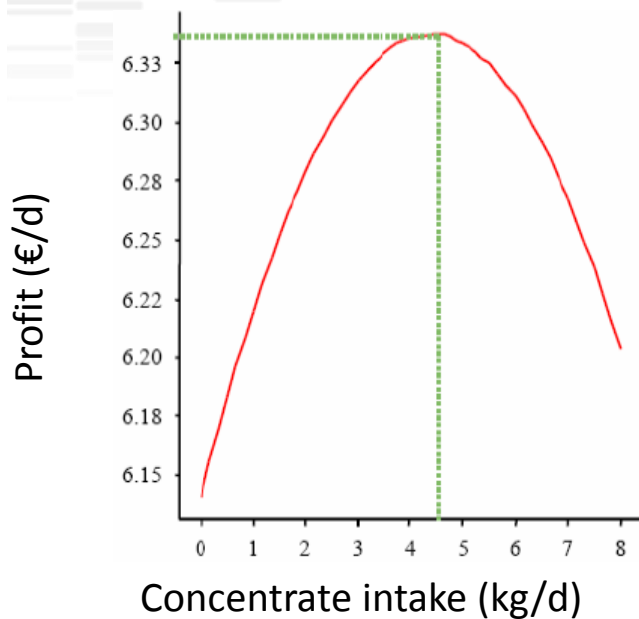
Classical
feeding
systems



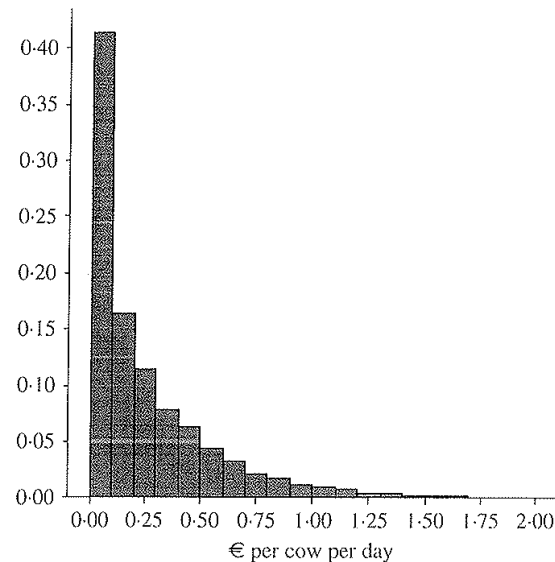
Precision
feeding



The automatic optimisation day by day and cow by cow of concentrate distribution to maximize profit



André et al 2010

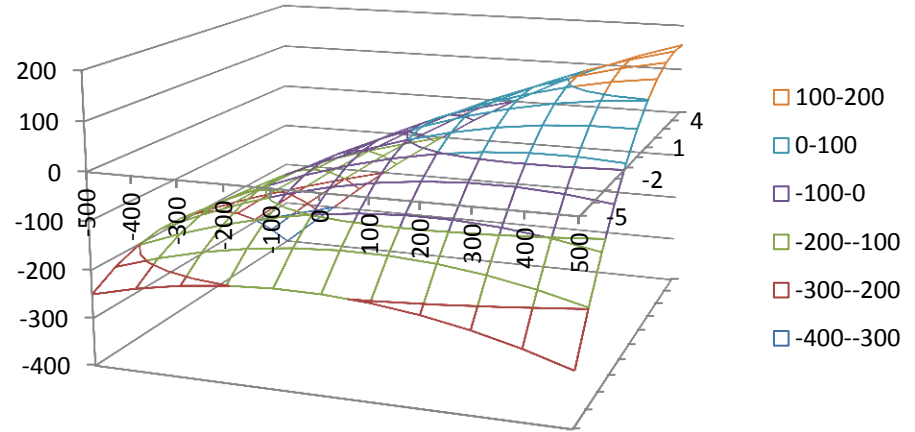


$$C_{Opt, ij} = - \frac{(\pi_M \theta_{1, ij} - \pi_C)}{2\pi_M \theta_{2, ij}}$$

A new challenge for animal nutrition

- **Better predict the laws of animal response to different levers combined together**
- **Find good indicators of the different objectives to achieve (efficiency, animal state)**
- **Develop models to better interpret sensors information**
- **Develop functions able to adapt dynamically inputs to better fit objectives**

Exemple of milk protein response to energy and protein intake



Brun-Lafleur et al. 2010



The question « How to » should be very stimulating for science

- The “What if” approach is often necessary to answer to “How to”
- Develop new technics of interpretation of large amount of data: sensitivity analysis, data learning...
- Try to find the best algorithm to reach the objective with the best strategy
- Ask questions with the tool in the same manner as the farmers

Conclusion

- **We produce more models than we have learned from or model
→ Stop to play continuously with the building of models,
but learn more want they say**
- **Moving from “What if” to “Ho to” questions to be more applicable**
- **Working with end-users is necessary but not sufficient**
- **The RANA → Less tools but better tools: beware on the trend of each project to produce their own tools**
- **We have to be creative to provide better operating tools**
- **A good tool is not always largely used**