ArchiMod: a metamodel of farming systems functioning to address future livestock challenges

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Introduction

Animal nutrition

Diversity

Network

Flow

Soil science

Crop science

Interactions

Cycle

Computer science

Social science

Organization levels

Management science
Introduction

Complexity

Interdisciplinarity

Integrated Crop-Livestock Systems (ICLS)

Objective

Describe and organise knowledge

Support collaborative working

Provide a representation of the system conceptual | generic | shared

→ A metamodel of livestock farming system

↔ ARCHItecture for MODelling
Methods

• 3-y collaborative project (PHASE funding) | ≈ 40 INRA scientists, multi-sp

• Series of seminars → Emergence of a shared representation
Results: the graphical language

• Process → building block

Biomass: living organism operating biotransformation process

Process: connection w/ environment through uptake|release

Entities: material|immaterial, living|inert, organic|inorganic
Results: the graphical language

- System’s functioning → putting building blocks in contexts
Results: the graphical language

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Results: the graphical language

- System’s functioning → putting building blocks in contexts
Results: the graphical language

- Organizing diversity of processes $\rightarrow$ description through hierarchy of contexts
  - Organism stage: a living organism that uptakes and releases entities in the environment

Biotransformation process: a synthetic view of all processes within the organism $\leftrightarrow$ exchange of entities
Results: the graphical language

- Organizing diversity of processes \(\rightarrow\) description through hierarchy of contexts
  
  - Organism stage: a living organism that uptakes and releases entities in the environment
  
  - Species pathways: transitions through time

  Transition among stages \(\leftrightarrow\) ontogenic process
Results: the graphical language

• ± complex pathways
Results: the graphical language

• Organizing diversity of processes $\rightarrow$ description through hierarchy of contexts
  • Organism stage: a living organism that uptakes and releases entities in the environment
  • Species pathways: transitions through time
  • Environmental interactions: spatial cut

Locating entities and organisms
Results: the graphical language

- Organizing diversity of processes → description through hierarchy of contexts
  - Organism stage: a living organism that uptakes and releases entities in the environment
  - Species pathways: transitions through time
  - Environmental interactions: living organism transforming entities
Results: the graphical language

• Organizing diversity of processes → description through hierarchy of contexts
  • Organism stage: a living organism that uptakes and releases entities in the environment
  • Species pathways: transitions through time
• Environmental interactions: among species → biotic processes

Food web
↓
i/o connection
Harvest | Predation
Results: the graphical language

- Organizing diversity of processes → description through hierarchy of contexts
  - Organism stage: a living organism that uptakes and releases entities in the environment
  - Species pathways: transitions through time
- Environmental interactions: among species → biotic processes

Insect pollination
Results: the graphical language

- Organizing diversity of processes → description through hierarchy of contexts
  - Organism stage: a living organism that uptakes and releases entities in the environment
  - Species pathways: transitions through time
  - Environmental interactions: among entities → abiotic processes

Gas diffusion
Results: the graphical language

• Organizing diversity of processes → description through hierarchy of contexts
  • Organism stage: a living organism that uptakes and releases entities in the environment
  • Species pathways: transitions through time
  • Environmental interactions: biotic and abiotic processes

• Management operations: anthropic processes

Ontogenic, biotic and abiotic processes implemented by human
Results: the graphical language

• ArchiMod as a game box
ARCHIMOD 2013-2015
METAMODELE DES SYSTEMES D'ELEVAGE
SYSTEME POULET DE CHAIR
MODELE DE FONCTIONNEMENT D'UN ELEVAGE DE POULET AVEC PARCOURS:
FOCUS SUR LES EMISSIONS GAZEUSES

LE NIVEAU MINIMAL DE REPRESENTATION
Les organismes vivants, le patrimoine de ressources, les effets de production des animaux

LES TRANSIITIONS AU SEIN DE L'ESPECE
Les organismes choisis évoluent au fil du temps au sein de leur espèce

LES ENVIRONNEMENTS LOCAUX DU SYSTEME
Les organismes vivants interagissent avec différents environnements au sein de processus biologiques et bioclimatiques

LA GESTION DU SYSTEME
Les prises de décision pour réduire l'impact des animaux et le besoin

ECHANGE D' ELEMENTS ET LIENS AVEC SYSTEMES AMONT / AVAL
Les organismes vivants interagissent avec d'autres environnements au sein de processus biologiques et bioclimatiques

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Conclusion
What happens when you’re drawing your ArchiMod scheme?

• ArchiMod as a game box, to play with complexity
  • Pedagogical approach
    • From knowledge → model
  • Multiple views of the system
    • 1 view ↔ 1 feature
  • Comprehensive listing of system’s functioning
    • Facilitating concept → code
Session 6: Mixed Farming systems - does diversity bring any benefits and at what scale?

Not answering the question...

But providing a tool to do so!

Thanks for your attention

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