Modelling farmers’ decisions of splitting agricultural plots at different time scales:

a contribution for modelling landscape spatial configuration

Noémie Schaller, Christine Aubry, Philippe Martin
UMR Inra/AgroParisTech SAD-APT, Thiverval-Grignon, France
Introduction: landscape spatial organization results mainly from farmers’ decisions in their farming territory
(Benoît, 1990; Joannon et al., 2008; Thenail et al., 2009)

Farmer decisions dealing with:

• Crop choices

• Crop allocation to land

• Plot splitting
  = Decisions a farmer has to make to divide his farming territory into several plots at any given time (≠ regrouping of lands)

Few approaches for modelling the changes in the spatial arrangements of plots in agricultural landscapes... (Gaucherel and Houet, 2009)
Outline

“Modelling farmers’ decision-making processes dealing with plot splitting and their contribution to landscape spatial configuration and dynamics over different time scales”

• Overview of the method for identifying and modelling farmers’ decisions

• The different time scales involved in plot splitting decisions

• Perspectives for landscape modelling
General modelling framework

Aubry et al., 1998; Navarrete and Le Bail, 2007; Mawois, 2009

Decisions dealing with plot splitting:
Decisions a farmer has to make to divide his farming territory into several plots at any given time
(≠ regrouping of lands)

What is the decision about?
Ex: suitable crop area (SCA) for deciding the crop allocation to land

All elements influencing the decisional variables
Ex: SCA for corn depending on the type of soil, irrigation capacity...

Rule used to make the choice
Ex: corn only grown in plots with sufficient water supply

What temporal dimension for plot splitting decisions?
Specific on-farm surveys to fill in the rule-based model

12 surveys
Accounting for the regional diversity of:
- Farming systems
- Spatial structure and scattered nature of the farming territory

May 2009       Nov. 2009       May 2010

3 successive surveys on each farm: dynamic point of view
In order to go into detail on the determining factors and the different time scales of farmers’ decisions

SCHALLER Noémie – noemie.schaller@grignon.inra.fr ; ESA congress 2010, Montpellier
Results: 3 different time scales

- Long-term decisions > 5 years
- Mid-term decisions 2 to 5 years
- Annual decisions 1 year

For each time scale:

- Different combinations of decisional variables
- All variables mainly determined by the farming system and the scattering of the farming territory

Example of one farm:
- 124 ha
- Goat’s milk
- Fodder and commercial crops

9 km

SCHALLER Noémie – noemie.schaller@grignon.inra.fr ; ESA congress 2010, Montpellier
Long-term decisions (> 5 years)

Decisional variables

- Desired Crop Area
- Suitable Crop Area

Determinants

- Type of soil
- Area of pieces of land
- Farming systems
- Fodder needs

Decision rules

- 10 to 15 ha in order to guarantee fodder needs
- Corn located in the most humid soils to secure yields

Stable plots with:
- Corn monoculture (12 ha)
- Crops in rotation
Long-term decisions (> 5 years)

Decisional variables

- Maximum desired plot area

Determinants

- Total farm area
- Crop rotation length
- Area of pieces of land

Decision rules

Maximum plot area = area with crop rotation / crop rotation length 
= 104/9 = 12 ha

in order to balance annual cropping plans
Mid-term decisions (from 2 to 5 years)

Decisional variables
- Suitable Crop Area for pluriannual crops
- Crop function

Determinants
- Type of soil
- Plot area
- Scattering of the farming territory
- Type of grassland valorisation
- Farming system
- Farm resources
- Farmers’ objectives
- Role of grasslands in the herd alimentation strategy

Decision rules
- Splitting of plots of >10 ha in this compact part
- No plot splitting in this scattered part

Different strategies of mid-term plot splitting
→ Diversity of plot spatial arrangements
Annual decisions (only one year)

**Decisional variables**

- Crop function
- Mini/maxi desired area for priority crops

**Determinants**

- Farming system
- Farm resources
- Farmers’ objectives
- Contribution of the crop to the income
- Risk associated to the crop

**Decision rules**

Annual plot splitting when the area of a priority crop becomes lower than the minimum desired (or higher than the maximum for a non-priority crop)

---

SCHALLER Noémie – noemie.schaller@grignon.inra.fr; ESA congress 2010, Montpellier
Conclusion and perspectives of using farmers’ decisions for landscape modelling

• The spatial arrangement of agricultural plots changes over time due to farmers’ decisions of splitting their farming territory into plots lasting for different time scales.

• Conceptual modelling framework with

  Decisional variables
  Determinants
  Decision rules

→ Useful in accounting for spatial configuration changes in landscape simulation models

• Perspectives: implementing the desional variables and decision rules in the LandSFACTS software (Castellazzi et al., 2008) to simulate the effects of farmers’ plot splitting decisions on landscape configuration
A few more information: comparison of the presented example with the other surveyed farms

Number of land units that can be annually split with changing plot limits
Number of land units that can be split but with constant plot limits
Number of land units always split and with constant plot limits
Number of land units that are never split

Average plot unit area (ha) Minimum plot unit area (ha) Maximum plot unit area (ha)
A few more information: discussing the genericity of the approach

- See the poster in session S 3.3.3 « modelling regional land use... »
- Presentation during the symposium « environmental change and sustainable agricultural systems » on Friday
A few more information:
the temporal dimension of annual crop choices

May 2009

July 2009

Sept. 2009

Oilseed rape

Sunflower

Pea

Maxi 4 ha

Sunflower