A TOOL FOR BORDER IRRIGATION MANAGEMENT BASED ON AN OBJECT-ORIENTED BIODECISIONAL MODEL

Application to the hay cropping system in Crau

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INTRODUCTION

❑ **Objectives: To build a tool for border irrigation management at cropping system scale**

→ based on a biodecisional model of to design alternative water management scenarios which integrates: i) irrigation constraints at field and farm level, ii) farm layout related to irrigated area in the farm, iii) spatial heterogeneity of the fields.

❑ **Specificities of the system:** different durations of the irrigation events; different spatial orders of water distribution in the farm; plurispecific grasslands for COP-labelled production, interactions between irrigation and mowing; importance of the spatial design of the farm for the decision-making process.

MATERIALS AND METHODS

❑ **A six steps participative approach:**

- (i) identification of the objectives of the tool with water advisors and agricultural managers
- (ii) data collection – from fields experiments [1,2] and detailed farm surveys [3]
- (iv) adaptation/evaluation of a crop model [4] and a irrigation model [2]
- (iii) conception/evaluation of a rule-based decision model from the farm surveys [3]
- (v) conceptual architecture of the overall biodecisional model, coupling of the three models and development of interfaces
- (vi) participative evaluation of the tool

❑ **Some key-points of the building of the computer-based tool :**

- Complementary methods for data collection
- Re-use of previous models
- Use of easily accessible data for initialisation and input variables to run the model
- Prototypal loop of implementation
- Participative approach and co-construction

STRUCTURE OF THE BIODECISIONAL MODEL

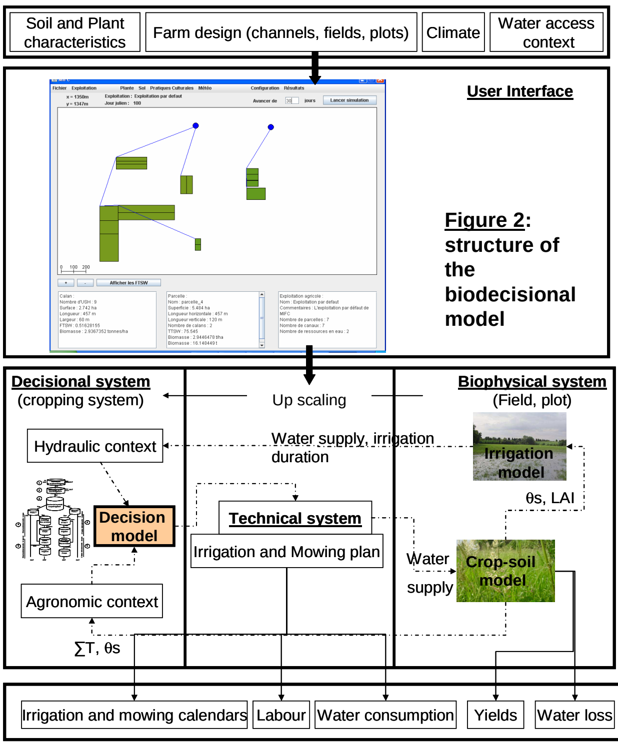


Figure 2: structure of the biodecisional model

❑ **The tool is composed of four elements (fig.2):**

- a dynamic decision-making model at farm scale [3],
- a dynamic crop model at field scale [4],
- a hydraulic model at border scale [2],
- a graphic user interface,
- biophysical indicators to trigger action at the cropping system scales are: the soil water deficit (θs), the leaf area index (LAI) and the cumulative temperature (∑T).

❑ **Scales (fig. 2) :**

- three time scales : irrigation season, day, and hour;
- four geo-referenced decision-making scales: irrigated area on the farm, group of fields associated with a water resource, field and irrigation border.

❑ **Programming:**

- models are encapsulated in independent and modular objects
- object-oriented programming language (Java) (decision and crop models) associated with Fortran (hydraulic model)
- a 1-day time step
- a graphic user interface was developed

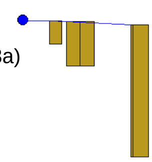
OUTPUTS

❑ Outputs are dynamically linked with Excel (fig. 3) and propose a three-point of view representation:

- environmental (water used, water lost by drainage)
- organisational (labour consumption)
- agronomic indicators (yields, water productivity)

❑ Outputs at border, field and farm scale

3a)



3b)

	Mowing 1
Yield (t/ha)	4,6
Cumulative evapotranspiration (mm)	241
WUE (t/ha/mm)	0,019
Water supply (mm)	723
Drainage (mm)	344
Labour for irrigation (h)	3,4
Duration of irrigation (h)	693
Number of irrigation events	7

Figure 3: Example of outputs

- The farm simulated is composed of 3 fields associated to 1 water resource (3a)

- Example of outputs at field scale, results for the first mowing (3b)

- Extracts of the simulated irrigation calendar at border scale with irrigation duration (3c)

3c)

Date from 1st jan	128	129	130	…	138	139	140	…	158	159	160	…	168	169	170	…	178	179	180	…	189	190	191
Border 1 Field 1		83				82				92				90				93				77	
Border 1 Field 2		95				100				116				107				111				95	
Border 2 Field 2		94				99				114				107				110				96	
Border 1 Field 3		180					169				191				187				191			155	
Border 2 Field 3			102			102				102				102				102				102	

CONCLUSION

A biodecisional model was built. The numerical tool was co-constructed and its structure validated by the targeted users i.e. agricultural advisors and water managers. Specific scenarios have already been identified with these groups to test the model and evaluate how it supports their strategic thinking for designing alternative water management scenarios. The three major sources of concern are: (i) for water managers and administrations, reorganizing water distribution during a period of water shortage; (ii) for water managers and farmers, optimising water distribution and (iii) for farmers, designing water channels and fields.

[1] Merot A., et al. 2008. Response of a plurispecific permanent grassland to border irrigation regulated by tensiometers. Europ. J. Agron. 28(1), 1-8.

[2] Mailhol J.C. and Merot A. 2008. SPFC: a tool to improve water management and hay production in the Crau region. Irrig. Sci. In press.

[3] Merot A., et al. 2008. Analysing farming practices in order to develop a conceptual model of the decision-making process of farming system - Application to the irrigated Crau Hay System. Sub.

[4] Merot A., et al. 2008. Adaptation of a functional model of grassland to simulate the functioning of irrigated grasslands under a Mediterranean climate: The Crau case. Sub.