Integrated assessment of agricultural systems and Modelling

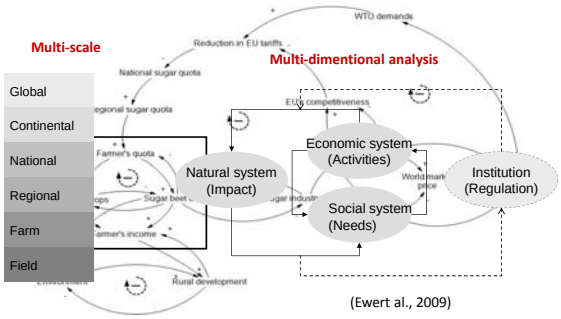
H. Belhouchette
CIHEAM-IAMM, UMR-System.

Objectives of the presentation

- Integrated assessment of agriculture systems (IAAS): concept.
- Some examples of IAAS
- Main challenges for research

Causal Loop Diagram

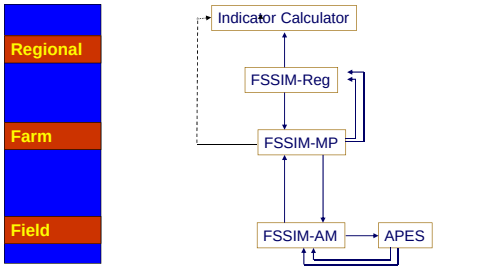
Sustainability, resilience, adaptive capacity… of farming systems



(Ewert al., 2009)

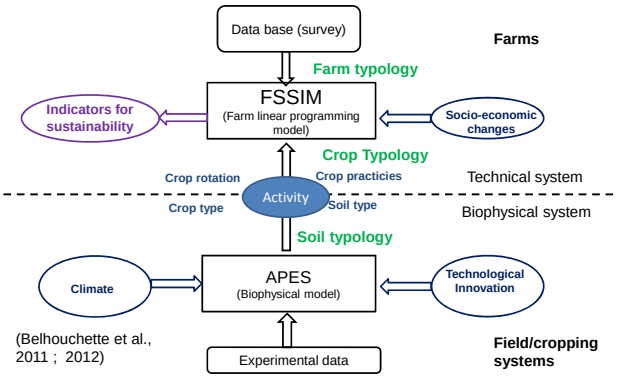
Irina Bezlepkina (LEI - Wageningen UR)

Modeling chain and spatial scales



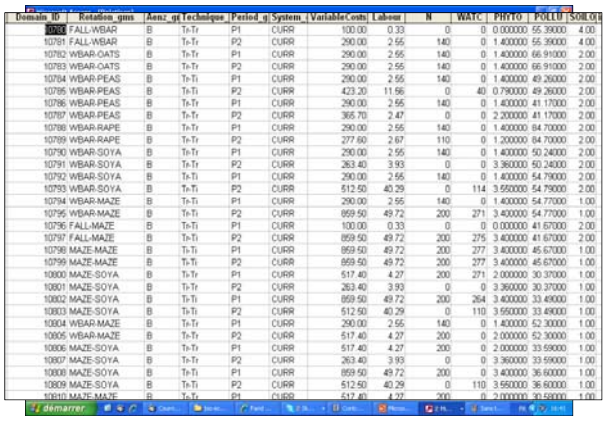
SEAMLESS Project.

Modelling chain for integrated impact assessment Ag. Sys.



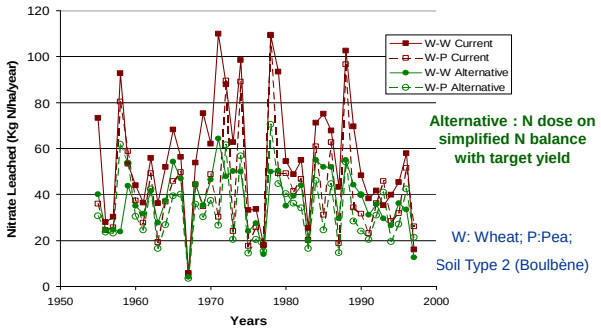
(Belhouchette et al., 2011 ; 2012)

An example of FSSIM-AM output



Domain_ID	Rotation_gms	Aanz_qt	Technique	Period_g	System_	VariableCosts	Labour	N	WATC	PHYTO	POLLU	SoilLoss
10760	FALL-WBAR	B	Tr-Tr	P1	CURR	100.00	0.33	0	0	0.000000	55.39000	4.00
10761	FALL-WBAR	B	Tr-Tr	P2	CURR	290.00	2.55	140	0	1.400000	55.39000	4.00
10762	WBAR-OATS	B	Tr-Tr	P1	CURR	290.00	2.55	140	0	1.400000	66.91000	2.00
10763	WBAR-OATS	B	Tr-Tr	P2	CURR	290.00	2.55	140	0	1.400000	66.91000	2.00
10764	WBAR-PEAS	B	Tr-Tr	P1	CURR	290.00	2.55	140	0	1.400000	49.26000	2.00
10765	WBAR-PEAS	B	Tr-Tr	P2	CURR	423.20	11.56	0	40	0.790000	49.26000	2.00
10766	WBAR-RAPE	B	Tr-Tr	P1	CURR	290.00	2.55	140	0	1.400000	41.17000	2.00
10767	WBAR-PEAS	B	Tr-Tr	P2	CURR	365.70	2.47	0	0	2.200000	41.17000	2.00
10768	WBAR-RAPE	B	Tr-Tr	P1	CURR	290.00	2.55	140	0	1.400000	84.70000	2.00
10769	WBAR-RAPE	B	Tr-Tr	P2	CURR	277.60	2.67	110	0	1.200000	84.70000	2.00
10790	WBAR-SOYA	B	Tr-Tr	P1	CURR	290.00	2.55	140	0	1.400000	50.24000	2.00
10791	WBAR-SOYA	B	Tr-Tr	P2	CURR	263.40	3.93	0	0	3.360000	50.24000	2.00
10792	WBAR-SOYA	B	Tr-Ti	P1	CURR	290.00	2.55	140	0	1.400000	54.79000	2.00
10793	WBAR-SOYA	B	Tr-Ti	P2	CURR	512.50	40.29	0	114	3.550000	54.79000	2.00
10794	WBAR-MAZE	B	Tr-Ti	P1	CURR	290.00	2.55	140	0	1.400000	54.77000	1.00
10795	WBAR-MAZE	B	Tr-Ti	P2	CURR	859.50	49.72	200	271	3.400000	54.77000	1.00
10796	FALL-MAZE	B	Tr-Ti	P1	CURR	100.00	0.33	0	0	0.000000	41.67000	2.00
10797	FALL-MAZE	B	Tr-Ti	P2	CURR	859.50	49.72	200	275	3.400000	41.67000	2.00
10798	MAZE-MAZE	B	Tr-Ti	P1	CURR	859.50	49.72	200	277	3.400000	45.67000	1.00
10799	MAZE-MAZE	B	Tr-Ti	P2	CURR	859.50	49.72	200	277	3.400000	45.67000	1.00
10800	MAZE-SOYA	B	Tr-Ti	P1	CURR	517.40	4.27	200	271	2.000000	30.37000	1.00
10801	MAZE-SOYA	B	Tr-Ti	P2	CURR	263.40	3.93	0	0	3.360000	30.37000	1.00
10802	MAZE-SOYA	B	Tr-Ti	P1	CURR	859.50	49.72	200	264	3.400000	33.49000	1.00
10803	MAZE-SOYA	B	Tr-Ti	P2	CURR	512.50	40.29	0	110	3.550000	33.49000	1.00
10804	WBAR-MAZE	B	Tr-Ti	P1	CURR	290.00	2.55	140	0	1.400000	52.30000	1.00
10805	WBAR-MAZE	B	Tr-Ti	P2	CURR	517.40	4.27	200	0	2.000000	52.30000	1.00
10806	MAZE-SOYA	B	Tr-Ti	P1	CURR	517.40	4.27	200	0	2.000000	33.59000	1.00
10807	MAZE-SOYA	B	Tr-Ti	P2	CURR	263.40	3.93	0	0	3.360000	33.59000	1.00
10808	MAZE-SOYA	B	Tr-Ti	P1	CURR	859.50	49.72	200	0	3.400000	36.60000	1.00
10809	MAZE-SOYA	B	Tr-Ti	P2	CURR	512.50	40.29	0	110	3.550000	36.60000	1.00
10810	MAZE-MAZE	B	Tr-Ti	P1	CURR	517.40	4.27	200	0	2.000000	30.68000	1.00

An example of cropping system output



(simulations done with CropSyst)

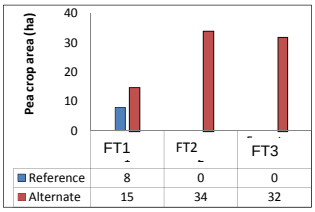
(Belhouchette et al., 2012)

Evaluation of combined scenarios

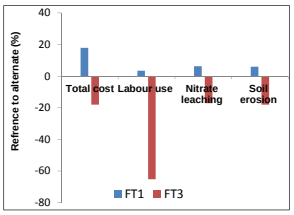
Scenario combining:

- New rotations (with legume crops, better and stable yield)
- New premium specific to legume crops
- Transaction cost to introduce new rotation.

1. Cropping system behaviour



2. Indicators for sustanability assessment



(Faisal et al., in revision)

An Example of Indicator Calculator output at regional Level

Belhouchette et al., 2012

Environmental indicators (weighted average per ha)

	Base year	% change (reference to base year)	% change (Policy to reference)
Water use (mm)	56.5	-54.0	29.6
Nitrogen use (kg/ha)	125.6	-15.0	-1.3
Nitrogen leaching (kg/ha)	50.8	-6.0	-0.3
Pesticide consumption (kg/ha)	1.9	-12.0	1.5
Soil erosion (t/ha)	2.0	15.0	-23.0
Water drainage (mm)	155.6	-4.0	2.0
Organic matter (%)	1.8	2.0	-0.5

Economic indicators (weighted average per farm)

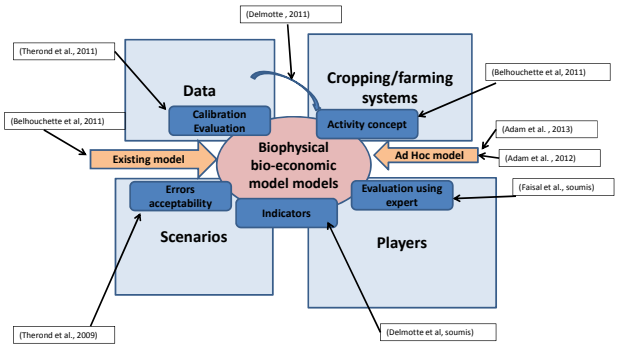
	Baseyear	% change (reference to base year)	% change (Policy to reference)
Farm income (Euros)	92940	-1,67	-0,34
Premiums (Euros)	38444	-5,12	-3,01
Total costs (Euros)	42241	-5,83	1,67
Total labour use (Hours)	1125	-68,18	85,40

Policy Instruments : Subsidises – Cross-compliances

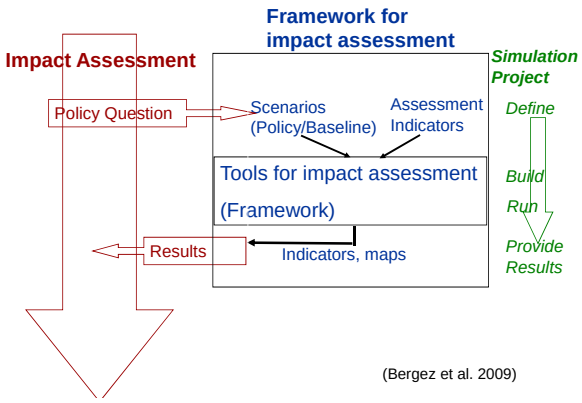
	Penalty (1)	Additional premiums (2)
FT1 – cereal	17%	65 €/ha
FT2- cereal / fallow	13%	55 €/ha
FT3- mixed	13%	65 €/ha

(1) Threshold of penalty to apply in order to enforce farmers to respect the nitrate directive.
(2) Threshold of additional premiums to apply in order to stimulate farmers to respect the nitrate directive.

Model selection?

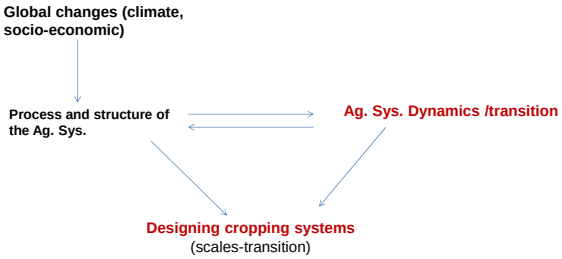


Which interaction with users?



(Bergez et al. 2009)

To conclude…


Global changes (climate, socio-economic)
Process and structure of the Ag. Sys.
Ag. Sys. Dynamics /transition
Designing cropping systems
(scales-transition)