Combined Argumentation and Simulation to Support Decision

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Combined argumentation and simulation to support decision

Example to assess the attractiveness of a change in agriculture

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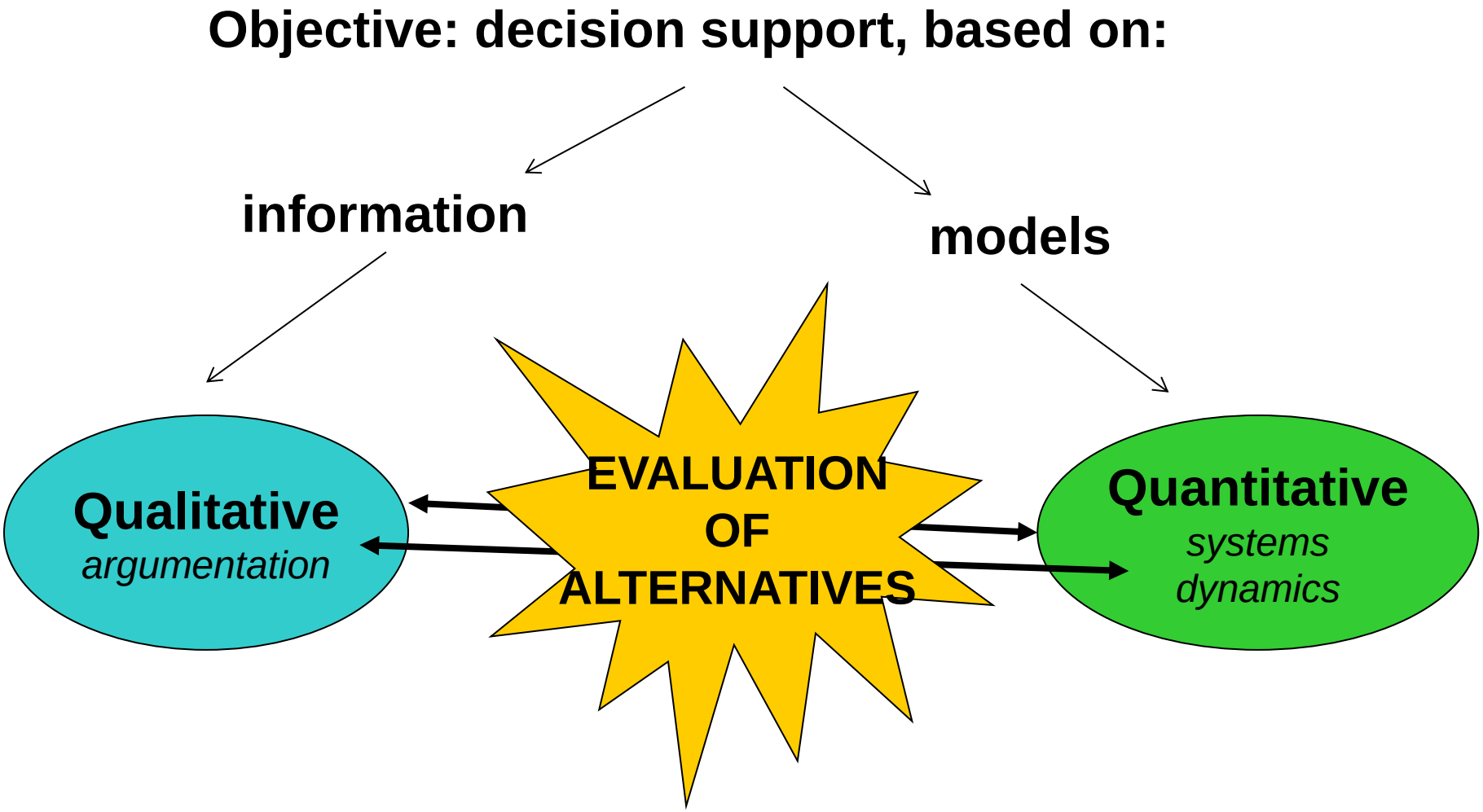
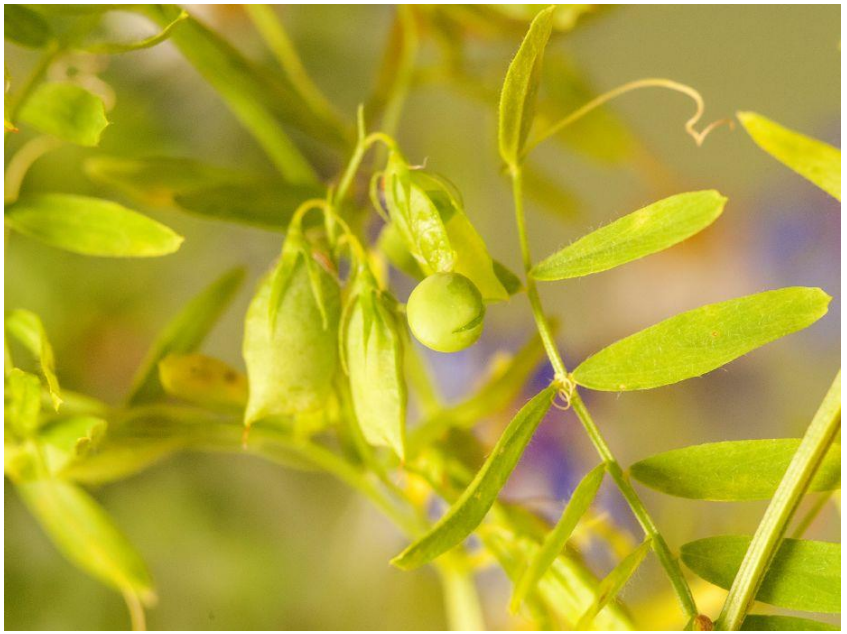
Research context



Cultural alternatives

1) Cereals in monoculture

2) Associated with legumes

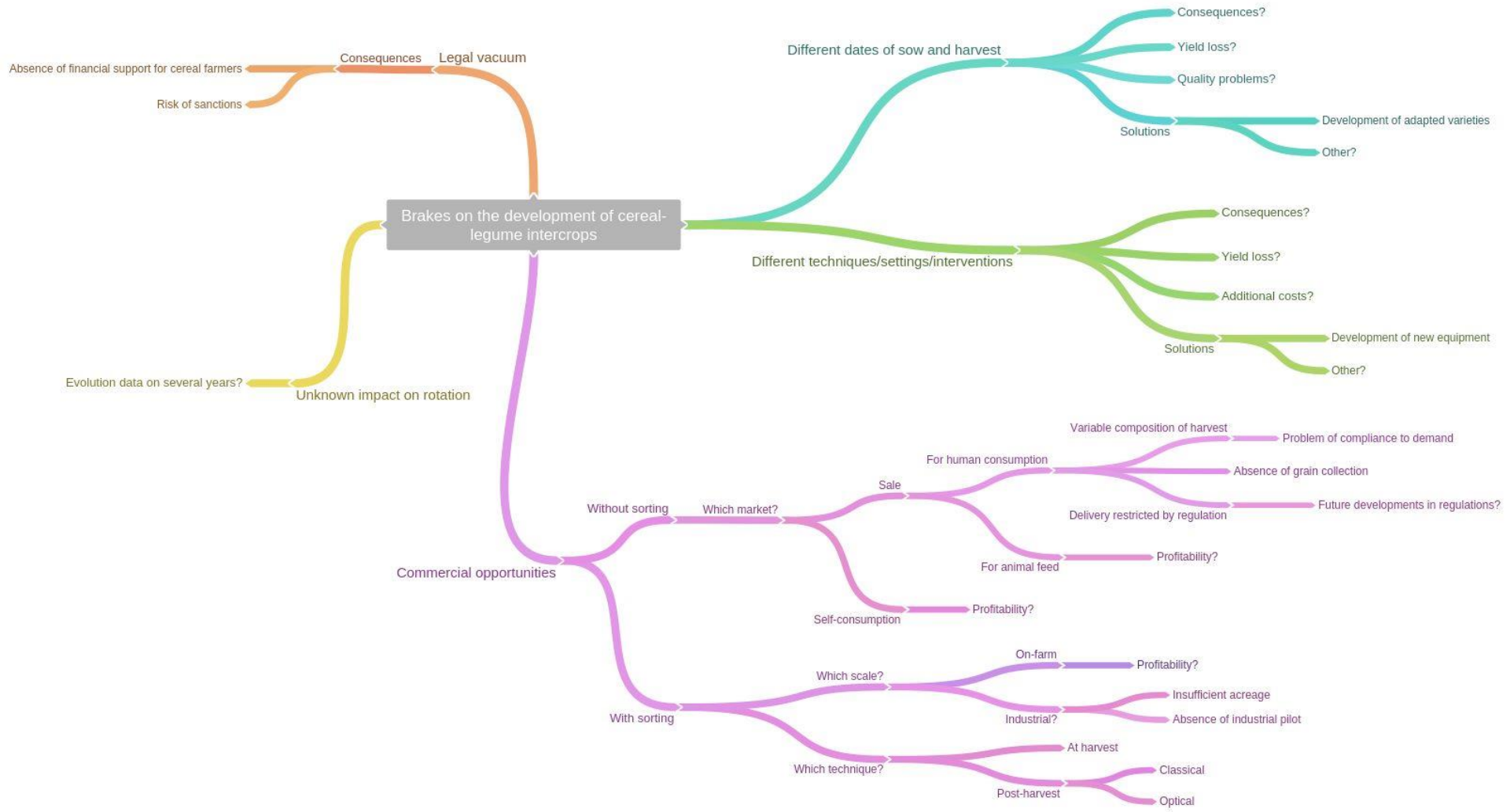


Arguments (1)

+ improved soil fertility
+ reduction of organic nitrogen fertilizers, expensive and inefficient
+ higher protein content of harvested grain, which is a quality criterion for durum wheat
+ better control of weeds
+ better resistance against plant aggressors
+ more stable yields despite climate variability.

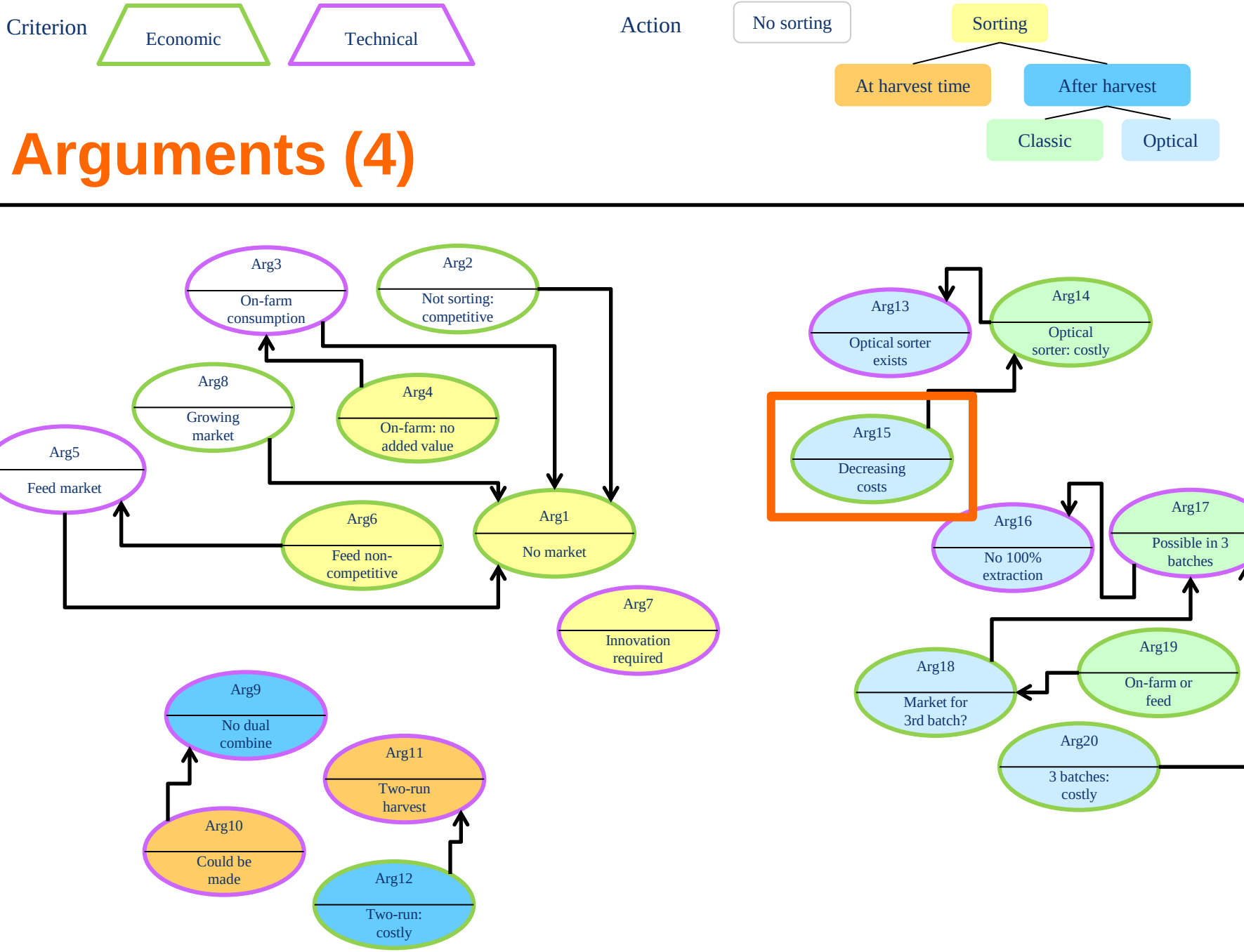
– non-synchronized optimal dates for sowing and harvest of the two species
– variable composition of harvest
– specific sorting operation required for human consumption
– lack of distribution and valorization networks
– restricted marketing possibilities due to the absence of a regulatory state for cereal-legume intercrops
– discouraging European aid policies.

Arguments (2)


Brakes on the development of cereal-legume intercrops
Legal vacuum
Consequences
Absence of financial support for cereal farmers
Risk of sanctions
Unknown impact on rotation
Evolution data on several years?
Different dates of sow and harvest
Consequences?
Yield loss?
Quality problems?
Solutions
Development of adapted varieties
Other?
Different techniques/settings/interventions
Consequences?
Yield loss?
Additional costs?
Solutions
Development of new equipment
Other?
Commercial opportunities
Without sorting
Which market?
Sale
For human consumption
Variable composition of harvest
Problem of compliance to demand
Absence of grain collection
Delivery restricted by regulation
Future developments in regulations?
For animal feed
Profitability?
Self-consumption
Profitability?
With sorting
Which scale?
On-farm
Profitability?
Industrial?
Insufficient acreage
Absence of industrial pilot
Which technique?
At harvest
Classical
Post-harvest
Optical

Arguments (3) – After-harvest sorting

Id	Arg. type	Explanation	Option	Criterion	Intended use
13	+	Optical sorting type effective technology exists	After-harvest optical sorting	Technical	Commercialization of separate grains
14	-	Optical sorting type technology is costly	After-harvest optical sorting	Economic	Commercialization of separate grains
15	+	Prices for optical sorters are trending downwards	After-harvest optical sorting	Economic	Commercialization of separate grains
16	-	100% extraction of wheat and legume during classic sorting is impossible, since some of the broken legume grains have the same size as some of the wheat grains	After-harvest classic sorting	Technical	Commercialization of separate grains
17	+	A 3-batch sorting is possible: easily separable wheat, easily separable pea, non-separable wheat and pea mix	After-harvest classic sorting	Technical	Commercialization of separate grains
18	-	In case of 3 batches, the question of the use of the non-separable wheat and pea mix still remains	After-harvest classic sorting	Economic	Commercialization of separate grains
19	+	The non-separable batch may be used for own consumption or for commercialization in animal feed	After-harvest classic sorting	Economic	Commercialization of separate grains
20	-	The 3-batch solution is still costly, since it requires handling, several repetitions, and leads to a lower financial benefit of the non-separable batch	After-harvest classic sorting	Economic	Commercialization of separate grains


Criterion
Economic
Technical
Action
No sorting
Sorting
At harvest time
After harvest
Classic
Optical
Arguments (4)
Arg3
On-farm consumption
Arg2
Not sorting: competitive
Arg8
Growing market
Arg4
On-farm: no added value
Arg5
Feed market
Arg6
Feed non-competitive
Arg1
No market
Arg7
Innovation required
Arg9
No dual combine
Arg11
Two-run harvest
Arg10
Could be made
Arg12
Two-run: costly
Arg13
Optical sorter exists
Arg14
Optical sorter: costly
Arg15
Decreasing costs
Arg16
No 100% extraction
Arg17
Possible in 3 batches
Arg18
Market for 3rd batch?
Arg19
On-farm or feed
Arg20
3 batches: costly

Systems dynamics translation?

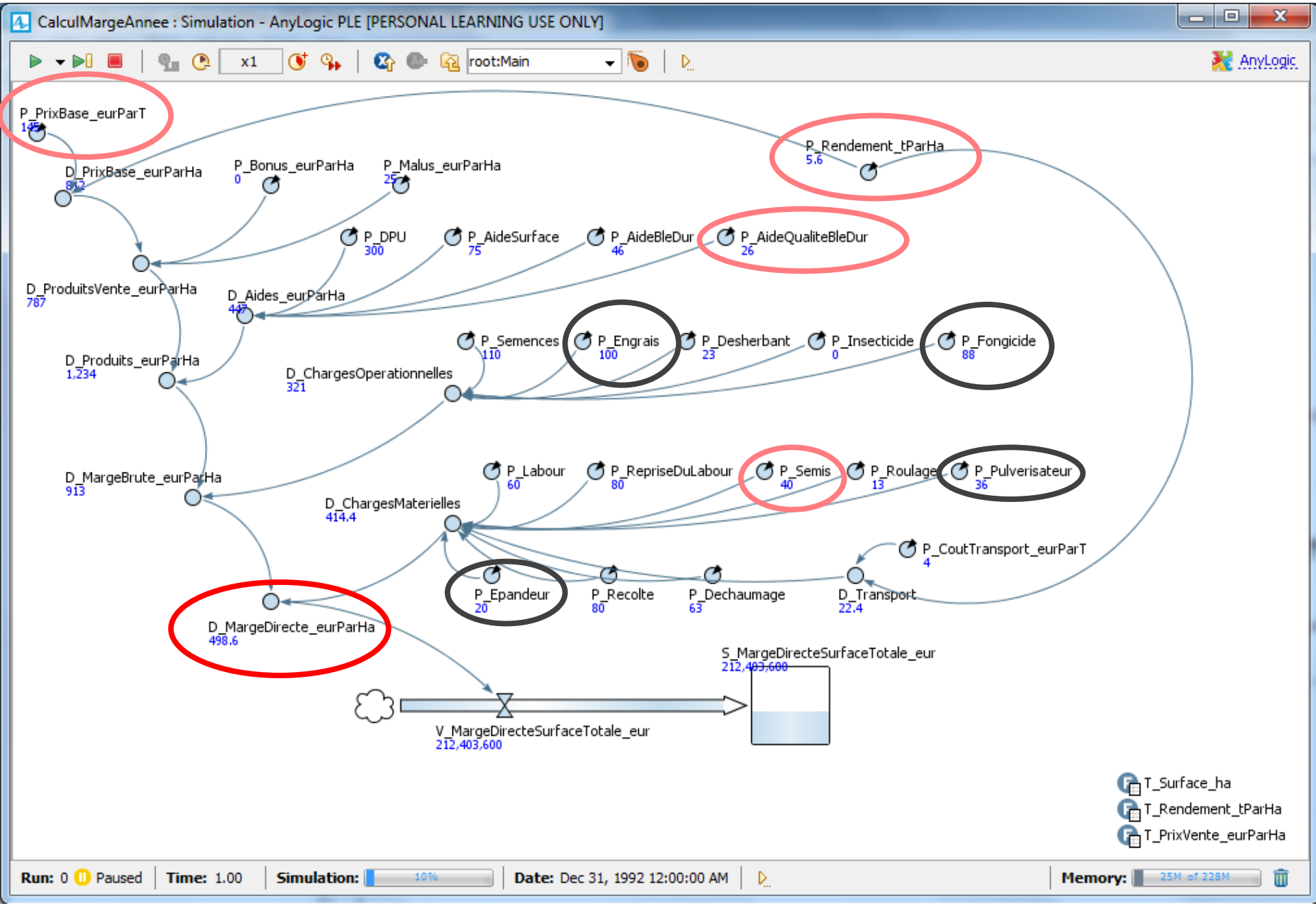
The system:
a set X = {t, x_1, …, x_n} of variables

Distinguished variables (option/goal, controlled/imposed)

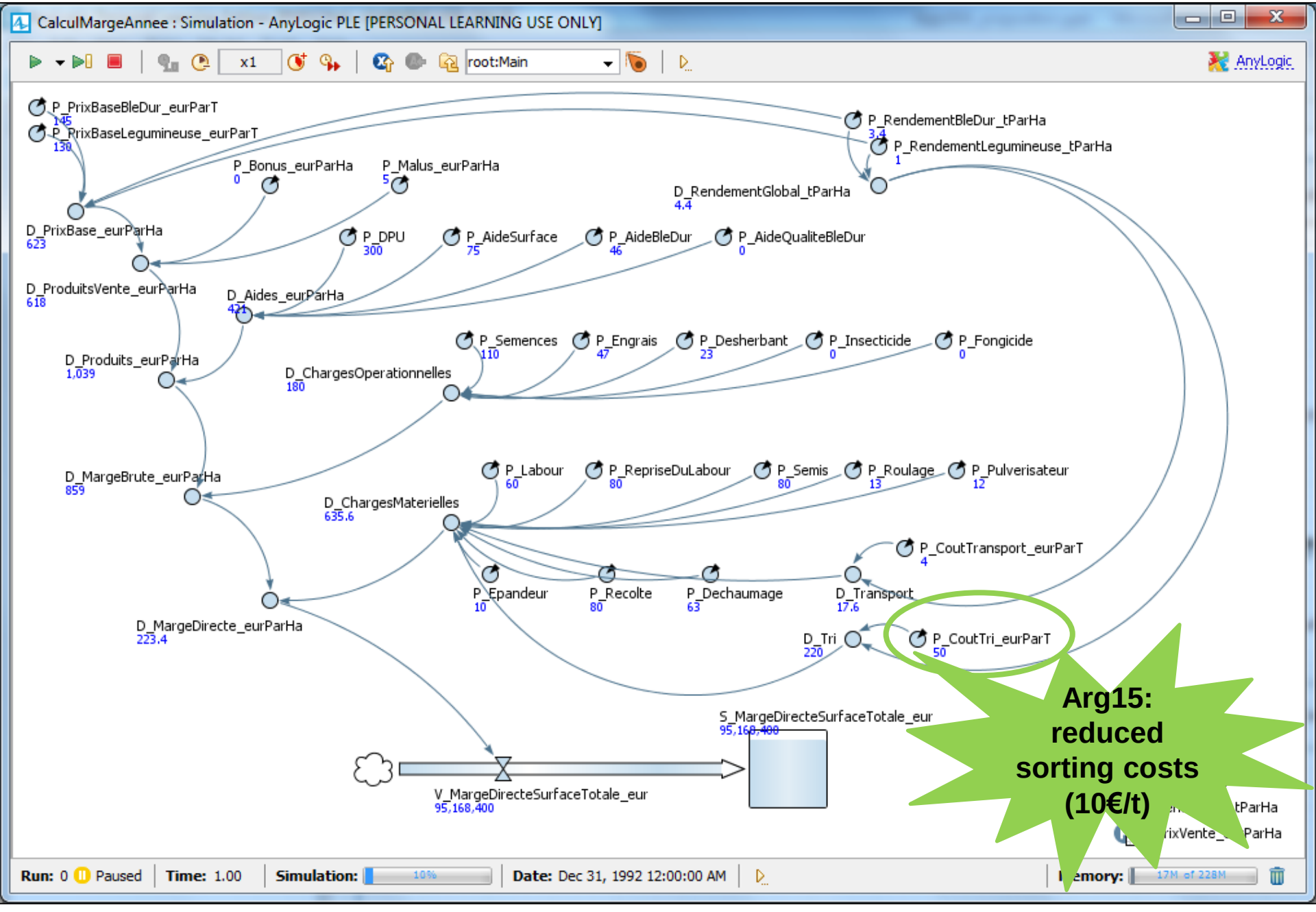
Argument:
a triplet < o, x_g, J >

Test Argument 15:
< Intercrops with post-harvest sorting,
half-net margin,
reduced sorting costs >

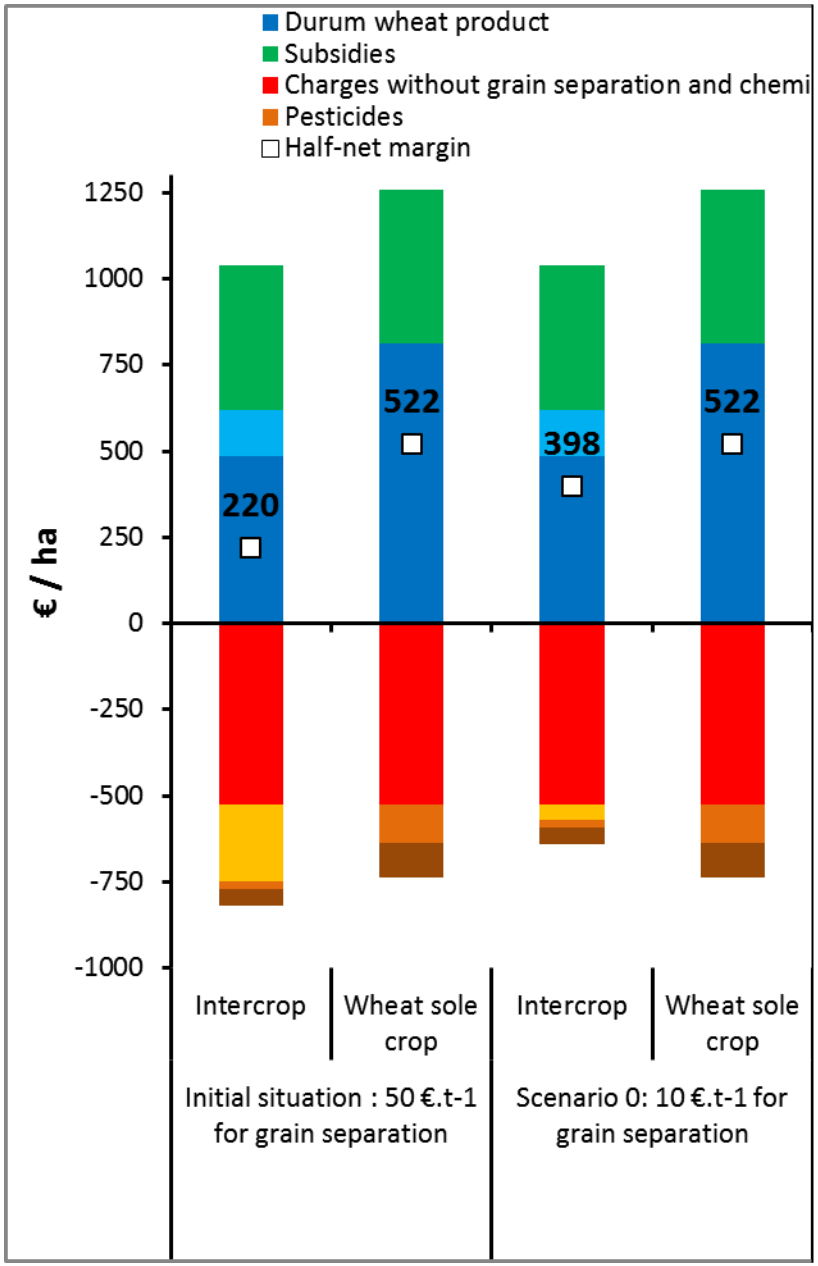
Initial simulations – sole Durum wheat



Simulating Argument 15



Comparison of scenario results



Conclusion: Towards what-if scenarios