


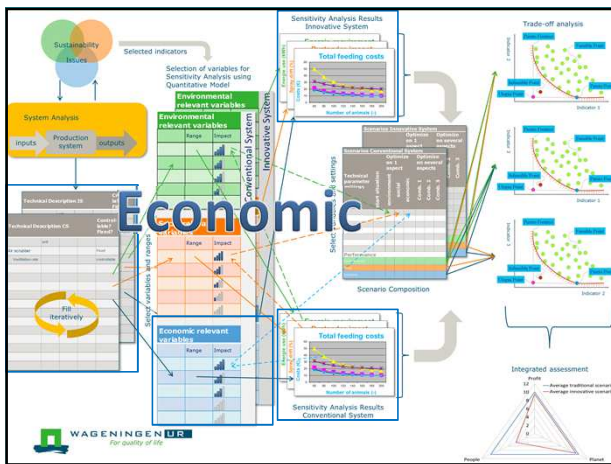
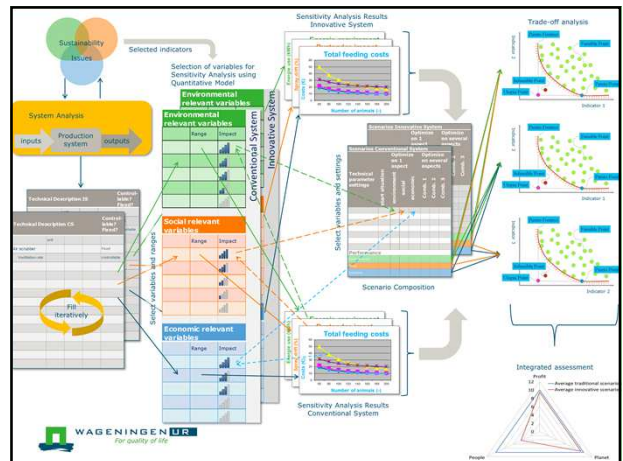
Economic aspects QAIB fruit case – innovative systems

MSc course Quantitative Analysis of Innovative Biosystems

November 25th 2014, Peter Roelofs



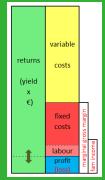


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Content fruit case

- Wk 3: Environmental aspects
 - Rik de Werd
- Wk 4: Social aspects
 - Peter Roelofs
- Wk 5: Economic aspects
 - Peter Roelofs

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Elements in the innovative system

- Autonomous spraying 
- Pheromone confusion and warning system 
- Mechanic pruning 

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Case study: Economic effects of said innovative systems

Effects on cost price and farmers income?

Assumptions case Westreenen:

- 73 ha:
 - 37 ha at home plot: 20 ha Kanzi, 17 ha Elstar
 - 25 ha Conference (pear) and 17 ha Jonagold at ... km (sensitivity analysis: vary between 1 and 10 km)
- 36 sprayings/year: 30x3000/ha, 6x6000/ha
- Must be done within 8 hrs.

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Repetition of relevant terms

1. Economic health of the farm

- liquidity
- solvency
- Profitability



2. Profitability of the crop

- Gross Margin
- Marginal Gross Margin

3. Cost price

- depreciation

4. NFI: Net Farm Income (from Operations)

note that:

Cost price

- Includes all costs (like farmers labour, depreciation of durable assets, depreciation of the establishment cost)
- Selling price not relevant, just looking at costs
- Per kg/ton

Marginal gross margin

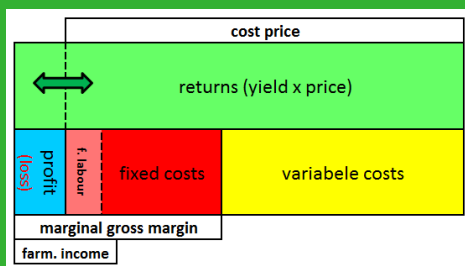
- Starts with returns (yield x price)
- Variable costs subtracted
- Per ha

Net farm income

- Returns +/- (variable costs & paid interest & depreciation & maintenance)
- Selling price +/- cost price + cost of (own labour & debt capital)
- Per farm



Profitability of the crop



Economic aspects of autonomous spraying

Combination A1 and A2:

CDS sprayer + normal tractor (A1) or autonomous tractor (A2)

- 3 row (operating width 9 m)
- Tank volume 3000 l
- Driving speed: road 20 km/hr
during spraying 7 km/hr
- Tank volume: 3000 l
- Filling of sprayer: 15 min.
(sensitivity analysis: vary filling time)
- Prices: see excel sheet



Economic aspects of autonomous spraying

Combination B1 and B2:

Tunnel sprayer + normal tractor (B1) / autonomous tractor (B2)

- 2 row (operating width 6 m)
- Tank volume 3000 l
- Driving speed: road 20 km/hr
during spraying 7 km/hr
- Tank volume: 3000 l
- Filling of sprayer: 15 min.
(sensitivity analysis: vary filling time)
- Prices: see excel sheet



Comparison of sprayers

To compare sprayers: first fill this worksheet (Sprayer general input), then 'spraying schedule apples' and 'spraying schedule pears' and finally 'comparison of sprayers'. Check and adapt the yellow fields, the other fields cannot be changed.

General data			
discount percentage	6	%	
list price (base)	€ 4.92	l	
wages labour (permanent employees)	€ 23.29	/hour	
Farm data			
# ha apples	12	ha	
# ha pears	10	ha	
width of paths between apple trees	3.00	meters	
width of paths between pear trees	3.35	meters	
annual number of sprays in apple orchards	25	sprays/year	
annual number of sprays in pear orchards	22	sprays/year	
Labour demand			
spraying system			
Minutes backhoe per ha for each spraying	35	min /spraying/ha	
Minutes for filling & transportation to the field per spraying tour	05	min /spraying/tour	
For checking (if needed: change data at worksheet 'comparison of sprayers')			
total labour time per spraying tour in all apple orchards	7:30:00	(hr:min:sec)/spraying of all apple trees	
total labour time per spraying tour in all pear orchards	6:15:00	(hr:min:sec)/spraying of all pear trees	
Working hours per day			
maximum number of hours for spraying /day	8:30	hours per day per tractor/sprayer	

Comparison of sprayers

note here your spraying schedule for apples, with dosage for a cross-flow orchard sprayer

Pesticides used in apples	freq	dose	price	cost/ha
Fungicides				
Belles	1	0.8 l/ha	78 €/kg	€ 62.40
Captan flow	2	2.5 l/ha	7 €/l	€ 14.00
Desio WG	7	0.4 l/ha	42 €/kg	€ 117.60
Exalt plus	2	0.7 l/ha	34 €/l	€ 67.80
Fit	4	0.1 l/ha	155 €/kg	€ 52.40
Morpan spk	11	1.5 l/ha	10 €/l	€ 165.00
Topmix M45	1	1.4 l/ha	33 €/l	€ 52.20
Nimrod abx	0.5	0.5 l/ha	35 €/l	€ 17.50
Shovo WG	0.2	0.2 l/ha	73 €/l	€ 14.60
Switch	1	1 l/ha	130 €/kg	€ 130.00
soliflow 450	1.2	1.2 l/ha	12 €/l	€ 14.40
Insecticides				
Admix	1	0.1 l/ha	475 €/kg	€ 47.50
Elstar	1	0.4 l/ha	193 €/l	€ 77.20
Insegar 25 WG	2	0.2 l/ha	144 €/kg	€ 57.60
Mader	2	0.05 l/ha	528 €/kg	€ 52.80
Plinor	1	0.4 l/ha	90 €/l	€ 36.00
Runner	1	0.4 l/ha	109 €/l	€ 43.60
Shavard	1	0.17 l/ha	286 €/kg	€ 48.62
Topmix	4	0.14 l/ha	202 €/kg	€ 113.12
Colypsa	0.25	0.25 l/ha	190 €/l	€ 47.50
Others				
Rotopas	2	1 l/ha	104 €/kg	€ 208.00
total, excluding herbicides	45			€ 1,241.84

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Comparison of sprayers

	cross-flow sprayer	tunnel sprayer on CDS	self-propelled tunnel or CDS sprayer	autonomous sprayer
Power of tractor or self-propelled sprayer	€ 45,000	€ 75,000	€ 60,000	€ 60,000
Replacement value tractor	€ 13,000	€ 13,000	€ 140,000	€ 190,000
Replacement value sprayer	€ 13,000	€ 13,000	€ 140,000	€ 190,000
Annual working hours tractor (default: 70% for spraying C-F sprayer)	412 hr	384 hr	184 hr	202 hr
Minutes to network per ha for each spraying	30 min/ha	22 min/ha	28 min/ha	5 min/ha
Average speed during spraying (turning at the headland included)	0.7 km/hour	0.5 km/hour	0.5 km/hour	0.7 km/hour
Minutes for filling & transportation to the field per spraying hour	50 min/ha	45 min/ha	40 min/ha	30 min/ha
post-order use (compared to current system)	100%	70%	70%	100%
Depreciation costs tractor	10%	10%	10%	10%
Depreciation costs sprayer	10%	10%	10%	10%
Maintenance costs tractor	2%	2%	2%	2%
Maintenance costs sprayer	2%	2%	2%	2%
Results				
Total per ha per time spraying	4.8 h/ha	3.8 h/ha	3.8 h/ha	4.8 h/ha
total fuel use for crop protection per year	2275 liter	2480 liter	2303 liter	2254 liter
pesticide costs per ha	€ 1,242	€ 880	€ 880	€ 1,242
total labour demand for spraying	289 h/ha	217 h/ha	217 h/ha	78 h/ha
number of tractors/sprayers needed	2	1	2	2
Costs at farm level				
annual costs tractor (activity based costing)	€ 9,450	€ 1,156	€ 1,156	€ 9,450
annual costs sprayer	€ 1,900	€ 9,000	€ 21,000	€ 54,000
total costs pesticides	€ 24,812	€ 17,380	€ 17,380	€ 24,812
fuel costs	€ 2,502	€ 2,744	€ 2,253	€ 2,481
labour costs	€ 7,985	€ 3,507	€ 3,507	€ 1,923
Total costs for crop protection	€ 47,770	€ 41,591	€ 48,223	€ 83,247
Savings compared to current sprayer		€ 1,546	€ 1,546	€ 35,477
costs per ha				
annual costs tractor (activity based costing)	€ 473	€ 350	€ 9	€ 9
annual costs sprayer	€ 195	€ 450	€ 1,050	€ 2,700
costs of pesticides	€ 1,242	€ 880	€ 880	€ 1,242
fuel costs	€ 125	€ 137	€ 127	€ 125
labour costs	€ 204	€ 350	€ 200	€ 96
Total costs per ha (weed control not included)	€ 2,388	€ 2,080	€ 2,311	€ 4,162

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Break-even Analysis

- Compare A & B:
 - At which price is 3-row CDS-sprayer as attractive as 2-row tunnel sprayer (Tunnelsprayer: € 65.000)?
 - Pesticide use, labour demand, fuel use differ
 - All other variables remain the same

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Economic aspects of pheromone confusion

- A: What is the effect of pheromone confusion on marginal gross margin?
 - Replaces 8 sprayings/year (Insegar (virus), 300 l/ha)
 - Compared to standard system and to innovative system A
 - For both a normal tractor and an autonomous tractor
 - Labour demand spraying as calculated last week
 - 800 – 1000 wisps/ha (dependant of parcel shape):
 - 2 hrs/ha to hang
 - 1.5 hrs/ha to collect
 - Material costs: € 240/ha
 - Yield and quality not affected

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Economic aspects of warning system

- B: What is the effect of the warning system (apple scab) on farmers income?
 - Saves 4 Captan sprayings
 - Labour demand: 0.1 hrs/ha (checking of e-mail)
 - Annual variable costs: € 150/year/farm
 - Replacement value weather station:
 - Replacement value € 3000
 - Life time 10 years
 - Salvage value: € 0
 - Yield and quality not affected
- For both a normal tractor and an autonomous tractor.

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Economic aspects of mechanic pruning

- Is mechanic pruning profitable (compared to manual)?
 - A: Kanzi B: Jonagold
 - Assumption labour demand manual pruning Westreenen:
 - pear: 100 hrs/ha
 - apple (source: FC, 2012):
 - Elstar: 90 hrs/ha
 - Kanzi: 100 hrs/ha
 - Jonagold: 70 hrs/ha
 - Manual pruning after mechanic: 30 hrs/ha
 - Yield (ton/ha) not affected: pear 55, Elstar 50, Kanzi 55, Jonagold 70
 - Quality: manual pruning: 79% class 1, mechanic pruning 70% class 1
 - Prices: next slide, fruits that are not class 1 are for processing
 - Tariff manual pruning € 15,50/hr, mechanic pruning € 70/hr

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Economic aspects of mechanic pruning

■ If time available: which labour demand is acceptable?

- Selling prices of apples and pears (€/100 kg):
- Apples for processing: € 0.15/kg
- Pears for processing: € 0.07/kg

	Gewogen vijftalig gemiddelde 2008/09 t/m 2012/13
Appels	
Elstar	45,7
Golden Delicious	37,8
Jonagored en mutanten	39,1
Boskoop	44,1
Red Prince	45,0 ²
Junam ¹	82,8
Kanzi ¹	97,7
Rubens ¹	65,5
Wellant ¹	73,0 ²
Pieren	
Beurré Alexandre Lucas	46,8
Conference	61,8
Doyenné du Comice	53,8
Sweet Sensation	125,0 ³
Xenia	- ⁴

Success with the task

Some general assumptions:

- Pruning and other manual work by temporary workers
- Tractor work by permanent labour (farmers labour)



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