Economic aspects of Innovative Biosystems in Fruit Production

MSc course Quantitative Analysis of Innovative Biosystems

November 24th 2014, Peter Roelofs

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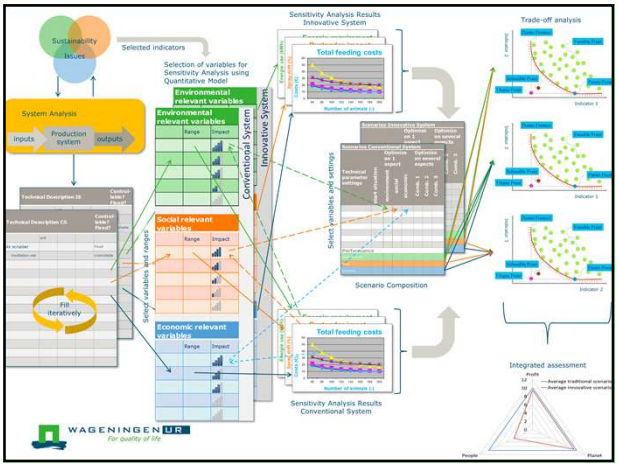

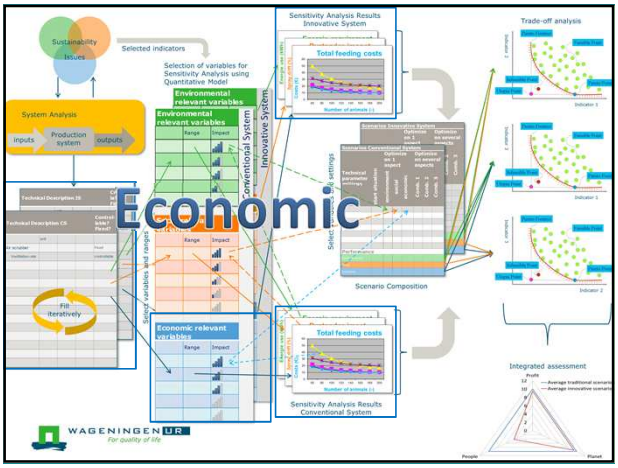

Economic aspects of Innovative Biosystems in Fruit Production

Elements in the innovative system:

- Autonomous spraying

- Pheromone confusion and warning system

- Mechanic pruning

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Programm: autonomous orchard spraying, pheromone confusion & mechanic pruning

1. What do we know about these innovative biosystems in orchards?
2. Some relevant economic terms
3. Calculation of Marginal Gross Margin apples (using model *as KWIN*)
4. Calculation of Cost price apples (using KWIN & model) and Net Farm Income
5. Partial budgetting
6. Costs of spraying (tomorrow: effects of autonomous spraying, pheromone confusion and mechanic pruning)

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What do we know about autonomous spraying, pheromone confusion and mechanic pruning in orchards?

- Think of:
  - Labour demand
  - Direct energy use
  - Crop protection costs
  - Cost price

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Relevant terms

1. Economic health of the farm
   - liquidity
   - solvency
   - profitability
2. Profitability of the crop
   - Gross Margin
   - Marginal Gross Margin
3. Costprice
   - depreciation
4. NFI: Net Farm Income (from Operations)

Relevant terms: Economic health of the farm

- Liquidity
  - Concerns expenditures and receipts (vs. costs and returns)
  - Current ratio (= "liquidity ratio" = "cash asset ratio" = "cash ratio"):
    - current assets/ current liabilities
    - measures a company's ability to pay short-term obligations
- Solvency
  - Concerns a company's overall financial strength
  - Affects interest rate (risk)
  - Equity ratio: equity / debt capital (also: equity / total assets)
- Profitability
  - ratio of 'total costs' to 'total returns'

Relevant terms: profitability of the crop

- Gross Margin
  - = Revenues per ha minus variable costs
  - a periodic cost that varies in step with the output of the farm. (e.g.: plants, fertilizer, pesticides, energy usage, labour, auction, distribution costs, etc.)
- Marginal Gross Margin
  - in fruit production
  - = Gross Margin -/- costs for:
    - Temporary labour (for culture, harvesting and grading)
    - Cold storage
    - Transport
    - interest liquid assets

Relevant terms: costprice

- Cost price
  - the price that it costs to make a product, without a profit being added
  - Includes all costs, including
    - Labour of the farmer (not payed for!)
    - Interest on debt capital & equity capital
    - fee for use of buildings and machinery: DEPRECIATION

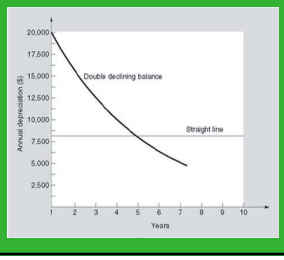
➢ Is there any income when a farmer sells his fruit at costprice?

Relevant terms: depreciation

- = annual loss in value of durable assets, due to use, wear, age, obsolescence
- At farm level!
- Durable assets:
  - Useful life of more than one year (*in contrast to materials*)
  - Not an unlimited life (*in contrast to land*)
- Terms:
  - Investment (*price paid for the asset*)
  - Useful life (*# years expected to be used in business*)
  - Salvage value (*at the end of its useful life*)

Depreciation methods

- Straight line :
  annual depreciation = (investment – salvage value)/useful life
  - Example:
    - Tractor costs € 70.000
    - Economic useful life: 12 years
    - Sold at € 10.000
- (Declining balance: %-age of Book value)



Profitability of the crop

- Term: Marginal Gross Margin
- Fruit producer needs the money in the Marginal Gross Margin ('Income above variable costs') to pay fixed costs:
  - Land (interest, water board charges)
  - Buildings (interest, depreciation, maintenance)
  - Machines (interest, depreciation, maintenance), NOT fuel/oil
  - Labour of farmer (and family)

➢What remains when Variable costs and Marginal Gross Margin are deducted from Returns?

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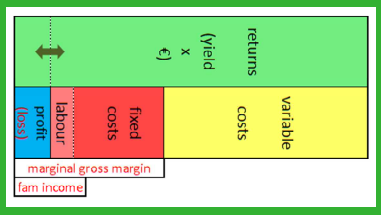
Profitability of the crop

➢What remains when Variable costs and Marginal Gross Margin are deducted from Returns?



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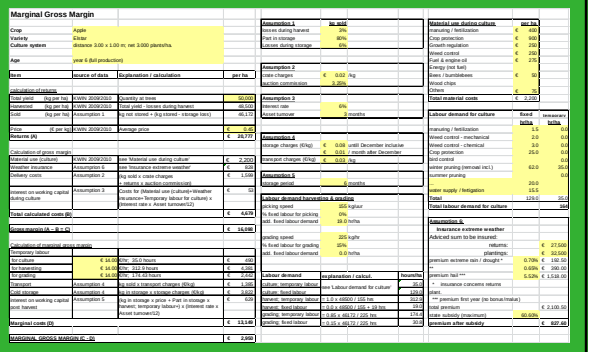
Profitability of the crop *(see Excel file)*



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Net Farm Income

- Remind: Cost price
  All costs needed for production of a kg (ton) of apples
  - All costs are included, also labour of the fruit grower, decepriation costs (machines, buildings) et cetera.
  - Decepriation of the planting! (establishment cost)
- NFI: Net Farm Income (from Operations)
  - = Total of returns -/- paid costs and depreciation
  - Reward for own labour, own capital (no interest payed)

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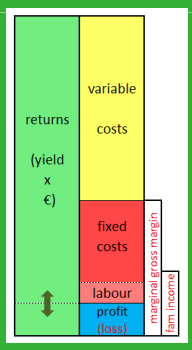
Cost price & Net Farm Income

- Returns (= revenues):
  - Yield x price
    (quality very important)
- Variable expenses:
  - Costs for materials used for this culture, depends of area
    (plants, fertilizer, fuel, crop protection, hired labour, et cetera)
- Fixed costs:
  - Independent of this culture
    (machines, buildings, family labour)
- Cost price:
  - (var. costs + fixed costs)/kg sold



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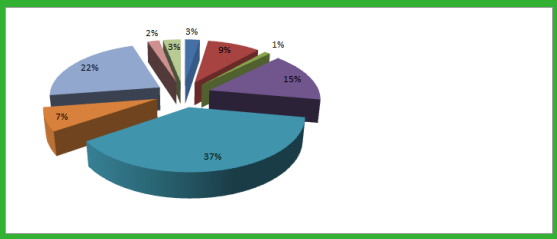
Cost price of apples in The Netherlands

- What are mayor costs?



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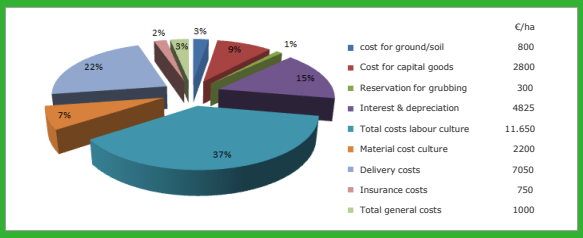
Cost price of apples in The Netherlands



	€/ha
cost for ground/soil	800
Cost for capital goods	2800
Reservation for grubbing	300
Interest & depreciation	4825
Total costs labour culture	11.650
Material cost culture	2200
Delivery costs	7050
Insurance costs	750
Total general costs	1000

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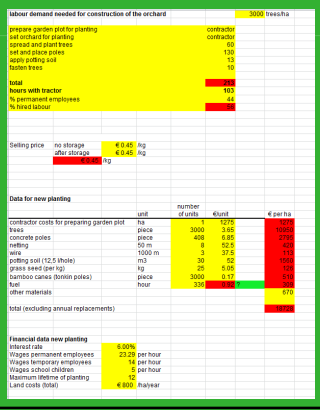
Cost price & NFI

Calculation using Excel model

1. Construction of the orchard



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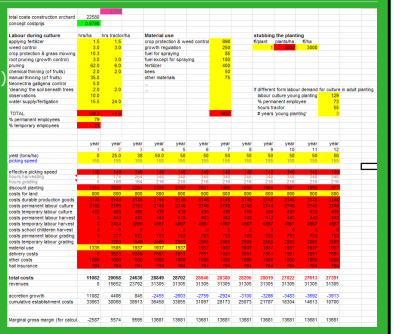
Cost price & NFI

Calculation using Excel model

2. Establishment costs (revenues (= returns) based on cost price!)



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Cost price & NFI

Calculation using Excel model

3. Costprice

calculation of production costs for growth-year: 8

max. lifetime of the planting	12
length of establishment period (fill)	3
establishment costs	38913
discount	6.00%

1	costs ground	800
2	costs durable production goods	3148
3	reservation of cost for stubbing the planting	333
4	discount and depreciation planting	5491
	total investment costs (€/ha/year)	**9772**
5	total costs labour	11815
6	total costs material use during culture	1937
7	total delivery costs	7051
8	weather insurance	764
9	total of general and 'other' costs	1000
	subtotal	**22567**
	total production costs	**32339**
10	total sales/ha during this year (kg/ha)	46172
	production costs per kg	**0.700**

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Partial budgetting

- To analyze a change in operations
- Procedure:
  - - New or additional costs to be included
  - + Current costs to be reduced or eliminated
  - + New or additional returns to be recieved
  - - Current returns to be lost or reduced
- Todays cases:
  - Returns are supposed not to be affected
  - Only effects on costs

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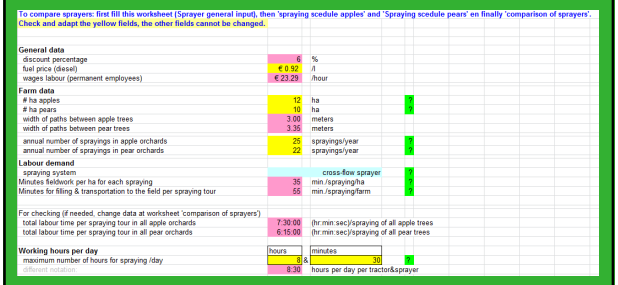
Comparison of sprayers



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Comparison of sprayers

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

Pesticides used in apples	freq	dose		price	costs/ha
Fungicides					
Bellis	1	0.8 kg/ha	78	€/kg	€ 62.40
Captan flow	4	2.5 l/ha	7	€/liter	€ 70.00
Delan WG	7	0.4 kg/ha	42	€/kg	€ 117.60
Exact plus	2	0.7 l/ha	34	€/liter	€ 47.60
Flint	4	0.1 kg/ha	156	€/kg	€ 62.40
Merpan spk.	11	1.5 kg/ha	10	€/kg	€ 165.00
Topsin M vb.	1	1.4 l/ha	23	€/liter	€ 32.20
Nimrod vb.		0.5 l/ha	35	€/liter	
Strody WG		0.2 kg/ha	73	€/kg	
Switch		1 kg/ha	130	€/kg	
Syllit flow 450		1.2 l/ha	12	€/liter	
Insecticides					
Admire	1	0.1 kg/ha	475	€/kg	€ 47.50
Envidor	1	0.4 l/ha	193	€/liter	€ 77.20
Insegar 25 WG	2	0.2 kg/ha	144	€/kg	€ 57.60
Madex	2	0.05 kg/ha	528	€/kg	€ 52.80
Plenmor	1	0.6 kg/ha	60	€/kg	€ 36.00
Runner	1	0.4 l/ha	109	€/liter	€ 43.60
Steward	1	0.17 kg/ha	286	€/kg	€ 48.62
Teppeki	4	0.14 kg/ha	202	€/kg	€ 113.12
Calypso		0.25 l/ha	160	€/liter	
Others					
Regalis	2	1 kg/ha	104	€/kg	€ 208.00
total, excluding herbicides	45				€ 1,241.64

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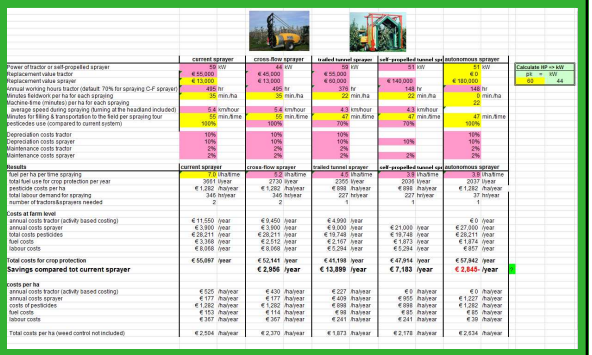
Comparison of sprayers



	current sprayer	cross flow sprayer	trailed tunnel sprayer	self-propelled tunnel sprayer	autonomous sprayer
Power of tractor or self-propelled sprayer	59 kW	44 kW	59 kW	51 kW	51 kW
Replacement value tractor	€ 55,000	€ 45,000	€ 55,000		0
Replacement value sprayer	€ 13,000	€ 13,000	€ 60,000	€ 140,000	€ 180,000
Annual working hours tractor (default 70% for spraying C-F sprayer)	455 hr	455 hr	378 hr	148 hr	148 hr
Minutes fieldwork per ha for each spraying	35 min./ha	36 min./ha	22 min./ha	22 min./ha	0 min./ha
Machine-time (minutes) per ha for each spraying					22
(average speed during spraying (turning at the headland included)	5.4 km/hour	5.4 km/hour	4.8 km/hour	4.3 km/hour	
Minutes for filling & transportation to the field per spraying tour	55 min./time	55 min./time	47 min./time	47 min./time	47 min./time
pesticides use (compared to current system)	100%	100%	70%	70%	100%
Depreciation costs tractor	10%	10%	10%		10%
Depreciation costs sprayer	10%	10%	10%	10%	10%
Maintenance costs tractor	2%	2%	2%		2%
Maintenance costs sprayer	2%	2%	2%	2%	2%
Results	**current sprayer**	**cross flow sprayer**	**trailed tunnel sprayer**	**self-propelled tunnel sprayer**	**autonomous sprayer**
fuel per ha per time spraying	7.0 l/ha/time	6.2 l/ha/time	4.5 l/ha/time	3.9 l/ha/time	3.9 l/ha/time
total fuel use for crop protection per year	3551 l/year	2730 l/year	2305 l/year	2036 l/year	2037 l/year
pesticide costs per ha	€ 1,282 /ha/year	€ 1,282 /ha/year	€ 898 /ha/year	€ 898 /ha/year	€ 1,282 /ha/year
total labour demand for spraying	346 hr/year	346 hr/year	227 hr/year	227 hr/year	37 hr/year
number of tractors&sprayers needed	2	2	1	1	1
Costs at farm level					
annual costs tractor (activity based costing)	€ 11,550 /year	€ 9,450 /year	€ 4,999 /year	€ 21,000 /year	€ 0 /year
annual costs sprayer	€ 3,900 /year	€ 3,900 /year	€ 9,000 /year	€ 19,748 /year	€ 27,650 /year
total costs pesticides	€ 28,211 /year	€ 28,211 /year	€ 19,748 /year	€ 19,748 /year	€ 28,211 /year
fuel costs	€ 3,366 /year	€ 2,512 /year	€ 2,167 /year	€ 1,973 /year	€ 1,974 /year
labour costs	€ 8,668 /year	€ 8,668 /year	€ 5,294 /year	€ 10,294 /year	€ 857 /year
Total costs for crop protection	**€ 55,697 /year**	**€ 52,141 /year**	**€ 41,198 /year**	**€ 47,914 /year**	**€ 57,842 /year**
Savings compared tot current sprayer		**€ 2,956 /year**	**€ 13,899 /year**	**€ 7,183 /year**	**€ 2,845- /year**
costs per ha					
annual costs tractor (activity based costing)	€ 525 /ha/year	€ 430 /ha/year	€ 227 /ha/year	€ 0 /ha/year	€ 0 /ha/year
annual costs sprayer	€ 177 /ha/year	€ 177 /ha/year	€ 409 /ha/year	€ 955 /ha/year	€ 1,227 /ha/year
costs of pesticides	€ 1,282 /ha/year	€ 1,282 /ha/year	€ 898 /ha/year	€ 898 /ha/year	€ 1,282 /ha/year
fuel costs	€ 153 /ha/year	€ 114 /ha/year	€ 98 /ha/year	€ 85 /ha/year	€ 85 /ha/year
labour costs	€ 367 /ha/year	€ 367 /ha/year	€ 241 /ha/year	€ 241 /ha/year	€ 39 /ha/year
Total costs per ha (weed control not included)	€ 2,504 /ha/year	€ 2,370 /ha/year	€ 1,873 /ha/year	€ 2,178 /ha/year	€ 2,634 /ha/year

Calculate HP <> kW	
pk	= kW
60	44

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INDIVIDUAL TASK

- Calculate marginal gross margin for mr. Westreenen's Kanzi and Conference
- Calculate cost price for his Kanzi and Conference, including labour demand for spraying and pruning as calculated last week & pesticide use as discussed in week 3.
- Can you calculate mr. Westreenen's NFI, or which additional information do you need?
- If time available (or tomorrow) sensitivity analysis: What are effects of distance and tank capacity (as calculated last week)

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Success with the task

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