Cost price calculations for organically and conventionally grown apples in Sweden

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Abstract

Environmental considerations are important in Swedish agricultural policy and organic farming is being promoted for its potential positive contribution to national environmental objectives. To help growers evaluate the economics of apple production, cost price calculations are presented here for organic and conventional orchards of two sizes; 5 and 20 ha. All four types are modern orchard systems with high total yields; 40 t/ha in conventional production and 22 t/ha in organic. The estimated cost price of producing organic apples in a 5 ha orchard is €1.14 per kg, which is twice as high as for conventionally produced apples, mainly due to lower yields in organic production. The production costs in a 20 ha organic orchard are 20% lower than in a 5 ha orchard. The cost of storage, packaging and marketing is €0.38 per kg in a small unit handling 200 tonnes per year, and 10% lower in a larger packaging company handling 1000 tonnes per year. The total costs of production, storage, packaging and marketing are 60-85% higher for organic apples than for conventional, depending on orchard size. The cost prices presented are in line with the normal market prices to growers, which indicates similar profitability in organic and conventional production. However, few conventional growers convert to organic production. One obstacle is the three-year conversion process, during which growers experience a yield decrease but no price premium. Another reason is that conventionally grown varieties are not always suitable for organic production. Therefore, fruit growers need continued support from the government and industry to assist conversion, and more research and development to improve production techniques.

Keywords: economics, organic, fruit, apple, production

Introduction

Environmental considerations are important in Swedish agricultural policy and organic farming is being promoted by the government in Sweden for its potential positive contribution to the national environmental objectives. One of these national objectives is for the organically certified agricultural area to increase from 7% in 2005 to 20% in 2010.

There is a large demand for domestically grown apples in Sweden. However, approximately 85% of the apples consumed in Sweden are imported, and the percentage of imported organic apples is even higher. Total top fruit production in Sweden is about 1800 ha, of which 85% are apples. The average yield of apples is only 15 ton/ha, because there is a large proportion of old and extensively grown fruit trees. Modern apple orchards have average yields of 40 ton/ha in conventional production and around 20 ton/ha in organic production.

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The majority of Swedish apples are produced by relatively large companies in the south-east of Sweden, around Kivik, in 10-50 ha orchards. However, the average orchard size in Sweden is 5.5 ha.

Organic fruit is produced on 4% of the orchard area. Most organic orchards are small, with an average size of only 2 ha. The largest organic orchards in Sweden are 10 ha in size. Small-scale fruit growers usually sell their fruit on the local market. If organic fruit production is to occupy a considerable share of the market, organic orchards need to be larger and have reliable delivery capacity to be sold through wholesale channels.

No comprehensive calculations on Swedish apple production have been published in recent years and there are no studies where organic and conventional top fruit production in Sweden have been compared. However, there are recent data from other countries, e.g. Denmark (Nielsen, 2009), Norway (Bøthun et al., 2008; NILF, 2008), Germany (KTBL, 2002, 2005), Switzerland (Arbokost, 2009) and the UK (Firth, 2005; Lampkin et al., 2006).

The overall aim of this project was to prepare an extension booklet with sample calculations for apple production, with the main target groups being advisors and growers. These calculations were intended to serve as models and starting points when evaluating the profitability of existing orchards, aid decision-making in a transition phase from conventional to organic production, and help forecast the effects of investments and other changes in future production. The extension booklet produced has been published in Swedish (Ascard et al., 2010).

Material and Methods

Calculations are presented for apples only, since this is the dominant top fruit in Sweden. Swedish orchards differ widely in terms of size, intensity and yield, which has a great impact on costs and economic returns. Therefore, calculations are presented for four types of orchards; 5 ha and 20 ha conventional and organic systems.

All four types of orchards were assumed to be modern, intensively managed orchards with 3200 trees/ha in conventional systems and 2600 trees/ha in organic systems. Overall yields were set relatively high; 40 t/ha in conventional production and 22 t/ha in organic.

The 20 ha orchards were assumed to be a full-time enterprise for the grower and to be managed using new, modern technical equipment. The 5 ha orchards were assumed to be a part-time enterprise for the grower and to use the same growing system as the larger orchards, but with less advanced machinery partly bought on the second-hand market. The apples were assumed to be either stored and packed on the farm or delivered to a larger central packing unit for storage, packaging and marketing.

Data were collected from fruit growers, advisors and other sources cited in this paper. The prices of inputs and equipment were checked with the suppliers. Annual machinery costs were calculated according to a modified method used by the Swedish agricultural extension service (Algerbo et al., 2008). For the 20 ha orchards, calculations were based mainly on new machines, while for the 5 ha orchards they were mainly based on second-hand technical equipment. The purchase prices, depreciation times and maintenance costs of new and second-hand machines were estimated after consultations with growers and machinery dealers. When the first version of the calculations was ready, they were sent to growers for review. Certain data were adjusted following these reviews.

Cost price calculations were made by means of the Net Present Value (NPV) method for computing the production price of dessert apples in the orchards. In conventional production, 5% of the yield was assumed to be sold as juicing apples at €0.15 per kg and 2% discarded, while in organic production an estimated 25% of the yield was sold as juicing apples at €0.20 per kg and 5% discarded.

In accordance with the code of practice in Swedish horticultural calculations, labour was regarded as a variable cost regardless of whether it was supplied by the grower, permanent employees or seasonal workers. Wage costs for seasonal workers were assumed to be 23% less than for a permanently employed foreman.

To simplify computing the effects of different yield levels, a consistent division was made of all costs into area-related and harvest-related costs. Fixed costs such as those for machinery, buildings, land and administration were included in the calculations. Establishment costs for the planting year, denoted as year 0, were computed separately.

The orchards were assumed to be in production for 15 years. An operational calculus for a normal year of full production was made as a basis and used in the total rotation period calculation. During the first four years, yield was assumed to be 10-80% of the normal yield attained in years 5 to 15. Harvest-related costs were assumed to be proportional to these yield levels. Area-related costs in the first four years, on the other hand, were assumed to be 70-90% of those in full production years. The software Excel was used for the calculations and the Solver was utilised for adjusting the price of dessert apples to make the NPV of the entire 15 year production period equal to zero.

Results

This paper presents a summary of the costs of production for the four model orchards and some detailed information on the 5 ha organic orchard. For a complete set of data, see the full report by Ascard et al. (2010).

The total cost of producing organic apples, including storage, packing and marketing was found to be €1.52 per kg in a 5 ha orchard and €1.29 per kg in a 20 ha orchard (Table 1). The cost of growing and harvesting organic apples was €1.14 per kg in the 5 ha orchard (Tables 2 and 3), which was twice as high as for conventional apples. However, because the costs were the same for storage and packaging, the total cost of packed apples from orchards of similar size was approximately 60% higher for organic apples. In reality, organic orchards are normally smaller and most costs are higher than in conventional production and therefore a relevant comparison may be that the total cost price in the 5 ha organic orchards was 85% higher than in the 20 ha conventional system.

The high cost price of organic apples was mainly due to lower yields in organic production, but also higher costs for weed control. The production costs in a 20 ha organic orchard were 20% lower than in a 5 ha orchard, mainly due to lower labour costs in the more mechanised larger orchard.

The cost of storage and packaging in a small farm unit handling 200 tonnes per year was estimated to be €0.38 per kg, but 10% lower in a larger packaging company handling 1000 tonnes per year. Because of the high costs of storage and packaging units, many growers are members of a producers' association that takes care of storage, packaging and marketing.

Table 1: Cost price of dessert apples for wholesale trading in 5 ha and 20 ha production systems. The yield level in organic and conventional production is 22 and 40 t/ha, respectively.

Apple production system	Production and harvest € per kg	Storage, packing and marketing € per kg	Total cost price € per kg
Organic, 5 ha	1.14	0.38	1.52
Organic, 20 ha	0.95	0.34	1.29
Conventional, 5 ha	0.54	0.38	0.92
Conventional, 20 ha	0.48	0.34	0.82

Table 2: Overall cost calculations for the entire 15 year productive life of a 5 ha organic apple orchard. Discount rate set at 6.0%

		Cost price		**1.14€/kg**			
	Units	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Years 5-15**
Establishment costs	€/ha	32 704					
Percentage of full yield	%	0	10	25	50	80	100
Yield, Class I and II apples	kg/ha		1 540	3 850	7 700	12 320	15 400
Yield, juicing apples	kg/ha		550	1 370	2 750	4 400	5 500
Environmental support and single farm payment	€/ha	970	970	970	970	970	970
Revenue	**€/ha**	**970**	**2 832**	**5 625**	**10 280**	**15 867**	**19 591**
Area-related costs	€/ha	1 687	4 725	5 062	5 400	6 075	6 750
Yield-related costs	€/ha	0	345	863	1 727	2 763	3 453
Total variable costs	€/ha	1 687	**5 070**	**5 926**	**7 127**	**8 838**	**10 203**
Administration	€/ha	600	600	600	600	600	600
Fixed machinery costs	€/ha	1 600	1 600	1 600	1 600	1 600	1 600
Buildings	€/ha	300	300	300	300	300	300
Land rent and certification costs	€/ha	400	400	400	400	400	400
Total costs	€/ha	**4 587**	**7 970**	**8 825**	**10 026**	**11 737**	**13 103**
Cash flow	€/ha	**-36 321**	**-5 138**	**-3 200**	**254**	**4 130**	**6 488**
Current value factor		1	0.9433	0.8899	0.8396	0.7920	6.2471
Current value	€	-36 321	-4 847	-2 848	214	3 271	40 532
Total current value	€	**-36 321**	**-41 168**	**-44 017**	**-43 803**	**-40 532**	**0**

The calculated cost price of apples was in line with normal market prices to growers. In practice, profitability varies widely depending on yield levels and wage costs.

The total establishment costs for an orchard with 2600 trees per hectare (spacing 1 m x 3.25 m) were thus approximately €32 000 per ha (Table 2), of which €13 000 was for trees, €9 000 for stakes, guards and other materials, and €10 000 for labour and machine operations.

Table 3: Cost price calculations per hectare for organic apples from a 5 ha orchard.

Gross yield	22 000 kg/ha
Juicing apples	25%
Rejects (discards)	5%

Revenue	**Units**	**Quantity**	***Price*** €	***Sum*** €/ha
Dessert apples, Class I and II	kg	15 400	**1.14**	17 521
Juicing fruit	kg	5 500	0.20	1 100
Single farm payment		1	220	220
Environmental support		1	750	750
Total revenue (income)				**19 591**
Variable costs				
Labour, seasonal workers	h	115	17	1 955
Labour, foreman	h	124	22	2 728
Orchard advisory services	ha	1	120	120
Manure		1	700	700
Plant protection products		1	600	600
Tractor fuel, area-related	h	52	5.2	270
Bee hives	No.	2	70	140
Analyses, soil and plant		1	40	40
Hail damage insurance		0	0	0
Interest in working capital		6 553	3%	197
Sum of area-related costs				**6 750**
Labour, harvest, seasonal workers	h	152	17	2 579
Labour, harvest, foreman	h	35	22	770
Tractor fuel, harvest-related	h	20	5.2	104
Sum of yield-related costs				**3 453**
Total variable costs				***10 203***
Gross margin				**9 388**
Fixed costs				
Machines		1	1 486	1 486
Irrigation central		1	114	114
Buildings		0.2	1 500	300
Administration and other fixed costs		1	600	600
Land rent		1	300	300
Certification fees		0.2	500	100
Depreciation of plant		1	6 488	6 488
Total fixed costs				***9 388***
Outcome				**0**

The estimated investment cost of machinery in the 5 ha orchard was €38 000, assuming that most machines are purchased second-hand. In the 20 ha enterprise the corresponding cost for mainly new machines was €120,000. The machinery needs are roughly similar in conventional and organic farming.

Total labour hours in a 5 ha organic orchard with a yield of 22 t/ha amounted to an estimated 426 hours per ha, of which 267 hours were for seasonal workers and 159 hours for the foreman (the owner).

Sensitivity analysis showed the cost price to be heavily affected by yield level, fruit quality and labour costs (Tables 4 and 5). High yields and minimum discards are therefore important factors for the production of apples at low cost. Labour costs also have a significant impact on production costs.

Table 4: Effect of total yield (t/ha) on the cost price of organic dessert apples (€/kg). Normal yield = 22 t/ha. The proportion of Class I apples was assumed to be 70% of total yield

Yield (t/ha)	10	15	22	30	40
Cost price (€/kg)	2.37	1.63	1.14	0.86	0.67

Table 5: Effect of labour inputs by seasonal workers (h/ha) on the cost price of organic apples (€/kg). Normal labour hours = 267 h/ha

Seasonal labour (h/ha)	167	217	267	317	367
Cost price (€/kg)	1.00	1.07	1.14	1.20	1.28

Discussion and Conclusions

The calculations show that a new, modern apple orchard can be profitable according to the costs and revenue estimates used. There is scope for increased Swedish fruit production. The high price of organic produce indicates that organic apple production in the current situation may have similar or greater profitability than conventional production.

The production costs are relatively high in Sweden, mainly due to high labour costs, but also to relatively low yields in our cool climate. Labour costs €17/h for seasonal field workers (including all taxes and social contributions) and €22/h for a permanent foreman.

Apple yields are relatively low in Sweden due to the short, cool summer season. However, in these calculations we used similar yield levels as in the corresponding German and Swiss calculations. For example, German calculations by KTBL (2005) are based on modern orchards with 3000 trees per hectare and organic apple yields of 18 t/ha, of which 12 t/ha are Class I and 6 t/ha are juicing fruit. The Swiss data are based on 2000 trees per hectare, with 22 t/ha yield for organic apples and 37 t/ha for conventional (Arbocost, 2009). However, British calculations (Firth, 2005) are based on lower yield levels (10 t/ha) because they use data from average organic orchards. Norwegian calculations by NILF (2008) are also based on relatively extensively managed orchards with yields of 10-17 t/ha.

In our calculations we estimated the cost prices for modern, relatively large orchards, which are common among progressive full-time growers. In reality, however, most Swedish organic orchards are smaller than 5 ha, with lower yields than 22 t/ha, which probably makes the cost price much higher than in our calculations.

Many mature, extensive orchards have significantly lower yield levels than the modern orchards assumed here, which suggests that their production costs are much higher. On the other hand, many growers find simpler and cheaper solutions and have longer depreciation periods for machinery and buildings than were used in these calculations.

The largest conventional fruit producers probably have lower cost prices than in our calculations because they have larger orchards and packing units than were assumed here.

The large differences in size between organic and conventional orchards lead to the conclusion that in reality, the price premium for organic fruit often has to be higher than the 60-85% estimated in these examples. In fact, the price paid to growers of organic apples in Sweden is roughly twice the conventional price.

Although it is possible to generate similar economic returns from organic production, few conventional growers in Sweden are converting to organic production. One obstacle is the three-year conversion process, during which growers experience a yield decrease but no price premium. In addition, conventionally grown apple varieties are not always suitable for organic production. A better option in many ways would be to establish new organic orchards using plant materials and systems that are more suitable for organic production. However, there are currently obstacles to conventional fruit growers establishing new organic orchards, one being that EU organic rules do not allow organic and conventional production on the same production unit for more than a five-year transition period. Another obstacle is that growers fear low yields and poor quality in organic production due to pests, diseases and weeds. Therefore, fruit growers need continued support from the government and industry to assist conversion, and more research and development to improve production techniques.

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References

Ascard. J., Hansson, A. Håkansson, B. , Stridh, H. & Söderlind, M. (2010). Ekonomi i fruktodling – Kalkyler för äpple. *Jordbruksinformation XX-2010*. Jordbruksverket (in print)

Algerbo, P.-A. et al. (2008). *Maskinkostnader 2008. Underlag och kalkylexempel för lantbruksmaskiner.* HIR Malmöhus, Bjärred, Sweden

Arbokost. (2009). Simulationsprogramm für Obstproduzenten und Obstbauberater. Forschungsanstalt Agroscope Changins-Wädenswil. Available on internet: www.agroscope.admin.ch/obstbau/00879/00882/00885/index.html?lang=de

Bøthun, M., Vidar Tyssen, A., Sørum, O. & Røen, D. (2008). Økologiske eple till juice. *Norsk frukt og bær*, **1**, 16-18.

Firth, C. (2005). *Economics of organic top fruit production (OF0305).* Garden Organic (HDRA), Coventry, UK. http://orgprints.org/10775/

Lampkin, N., Measures, M. & Padel, S. (2006). *2007 Organic Farm Management Handbook. 7th Edition.* University of Wales, Aberystwith.

KTBL. (2002). *Obstabu. Betriebswirtschaftliche und produktionstechnische Kalkulationsdaten. Datensammlung. 3. Auflage*. KTBL. Darmstadt,Germany.

KTBL. (2005). *Ökologischer Obstbau.* KTBL Darmstadt, Germany.

Nielsen, S. (ed.) (2009). *Håndbog for frugt- og baeravlere 2009.* GartneriRådgivningen, Odense, Denmark.

NILF (Norsk Institutt for Landbruksøkonomisk forskning) (2008). *Økologisk fruktdyrkning – kalkyler.* Bergen, Norway. www.landbruksforum.no/frukt/kalkyle.