Profitability of twelve small-scale organic vegetable crops grown in a greenhouse in the North East of Scotland

Konrad Dybek, MSc, freelance consultant: Walton Farmhouse, Craibstone Estate, Bucksburn, AB21 9TT, Scotland; e-m: riverwest@o2.pl

Summary

Paper examines profitability of twelve polytunnel vegetable crops grown for an organic box scheme in Scotland. All inputs attributable to specific crops, labour in particular, were recorded during 2008 growing season and expressed in monetary values. Costs of the tunnel construction and maintenance have been included. Based on sales data and inputs, annual net margins were calculated. Assuming the cost of labour as 7.25 £/hour only five of twelve vegetables were profitable. Results varied from 25.2 £/m^2/year for cucumbers to -9.7 £/m^2/year (loss) for batavian lettuce, average for all the crops was 3.38 £/m^2/year. No significant difference in profitability could be ascertained between the following cultural methods: direct sown versus transplanted and under black plastic mulch versus open ground.

1. Introduction

Protected cultivation is regarded to be an intensive production system requiring high investment in several aspects of set-up, production and maintenance. Area of fully organic land devoted to horticulture in the UK has risen by 10% between 2006 and 2008 to reach 10,660 ha [Soil Association, 2009]. Intensive cropping such as glasshouse and polytunnel areas rose by 22% during the same period to 4037 ha [*ibid.*]

Benefits of greenhouses include the possibility of season extension and growing greater variety of produce, including higher value niche crops. In addition to self-sufficiency at national level, it improves cash flow for the grower. Also, workload on the farm can be spread over longer period. Jobs would be found inside in case inclement weather does not permit fieldwork [Davies and Lennartsson, 2005]. Glass or plastic shelter plants from wind and pests like rabbits or pigeons. Control over humidity and temperature can serve as a disease prevention measure, especially for grey mould (*Botrytis cinerea*) or downy mildew (*Bremia lactucae*), both of which are seriously damaging diseases of lettuce (*Lactuta sativa*) [Soil Association, 1999]. Both thrive in moist, humid and cool conditions [Davies and Lennartsson, 2005] that can be controlled under protection.

Direct marketing such as organic box schemes have gained in popularity over recent years. Delivering fresh, local fruits and veg appeals to the ethical consumer which is in accord with the ideas of low food miles, provenance and sustainability in food production.

There is evidence that vegetables may be the most profitable of all farming systems. Little gem lettuce gives gross margins as attractive as 24,500 £/ha [Lampkin *et al*, 2008]. One has to bear in mind that horticulture is a risky and high-input enterprise in terms of labour and costs.

The aim of this study is to compare profitability of 12 vegetable crops grown in a polytunnel under organic conditions in North-East of Scotland. The farm where data for the project were collected is located in maritime temperate climate, 57º 15’ N, 2º 09’ W. Annual mean temperature (as East of Scotland): 7.5°C; 1225 Growing Degree Days, 282 days of growing season [Barnet *et al*, 2006], however earlier authors quoted shorter period of 210 days [Hay *et al*, 2000]. The soil is heavy sandy clay, imperfectly drained, brown forest soil belonging to Thistlyhill Series of the Tarves Association [Soil Survey of Scotland, 1962] - dystric cambisol according to FAO classification. Crops and their basic specifications are listed in table 1 below.

Table 1. Basic information about the crops analyzed for the project.

Crops analyzed (*Latin names* in parenthesis)	**Variety**	**Sale price per unit [£/pc]**	**Area [m^2]**	**Transplants or direct drilled**	**Plastic mulch [yes/no]**	**Length of crop cycle [weeks]**
Mixed salad leaves (MSL) made up from:		1.4 (120 gram a portion)	77.8	direct drilled	no	continuous[a]
1. Mizuna (*Brassica rapa* var. *nipposinica*)	Mizuna					
2. Rocquette (*Eruca sativa* spp. *sativa*)	Salad rocket					
3. Oriental mustard (*Brassica juncea* var. *rugosa*)	Giant red mustard					
4. Mustard spinach (*Brassica rapa* var. *komatsuna*)	Taisai					
5. Oriental mustard (*Brassica juncea*)	Ruby streaks F1					
butternut squash (*Cucurbita moschata*)	Early butternut	2	76.8	transplants	yes	15
Spring onion (*Allium cepa*) open ground	White Lisbon, Ramrod	0.8 per bunch	42.8	direct drilled	no	continuous[a]
Batavian lettuce (*Lactuca sativa*)	Joconda	0.75	38.7	transplants	no	9
Spring onion (*Allium cepa*) under plastic	White Lisbon, Ramrod	0.8 per bunch	29.5	transplants	yes	8
Basil (*Ocimum basilicum*)	Lettuce leaf, Petra Red, Nufar	0.75	29	transplants	yes	9
Celery (*Apium graveolens*)	Daybreak	1.5	27.2	transplants	yes	14.5
Cucumber (*Cucumis sativus*)	Pasandra F1	0.5	24.6	transplants	yes	26
Ruby chard (*Beta vulgaris* var. *cicla*)	Vulcan	0.8	18.8	direct drilled	no	17
Radish (*Raphanus sativus*)	Rudolf	0.7 per bunch	18.75	direct drilled	no	12.5
mini leek (*Allium porrum*)	Zarmatt	0.95 per bunch	16.5	direct drilled	no	25
Chives (*Allium schoenoprasum*)	n/a	0.7 per bunch	8.6	transplants	yes	26

a – continuous or multi-cropped which means new seeds were sown in the same place where harvest had occurred

Source: Own measurements, sales records and based on information given by the farmer.

All of the above vegetables were marketed through the farmer-owned box scheme supplying Aberdeen and its vicinity. As a 7 ha farm, with around 500 customers, it can be described as a small scale, intensive horticultural business.

Given sales figures and prices on one hand and carefully adding up all the costs on the other, one can calculate profitability of each distinctive crop. Knowing the area taken up in the polytunnel, length of cropping cycle 'from sowing to sowing' one is able to calculate profitability expressed in £/m^2/year.

On top of economical comparison of range of vegetables, a couple of interesting questions can be asked. It is often assumed that black plastic as mulch saves money because the need for weeding is almost completely eliminated. At the same time, the set-up of polyethylene cover is labour intensive too. Hence, do crops under plastic mulch perform better economically comparing to those grown on bare soil? Secondly, one of the one of the advantages of producing vegetables as transplants is, again, reduction of weeding effort by creating an early start competitive advantage over weeds. On the other hand, caring for seedlings, growing media and planting out itself are all expensive items. Therefore, are crops grown as transplants more profitable than those direct-drilled?

2. Methodology

There are three ways of approaching profitability:

- Gross margins for different enterprises which are derived by subtracting variable costs from financial output,

- net margins, similarly for an enterprise, that on top of variable costs include easily allocatable fixed costs,

- full-cost accounting which, in addition to variable costs, considers both allocatable and overhead costs. This method requires access to farm accounting data and can be done on a rotational basis (which is more appropriate for organic farming systems).

For comparison and farm planning purposes, gross margins are usually published (at least in the UK). Limitations of their use have been acknowledged [Lampkin *et al*, 2008], [Firth, 2002].

In this study, net margin methodology has been adopted. In fact, hand labour was, as expected a major part of the costs. For the most part, all the jobs were allocated to specific vegetable mini-enterprises so net margins seem to suit best the purpose of this project.

The idea was to record and time all the operations carried out in one polytunnel (with the exception of celery cultivated in separate tunnel on the same holding). A form used for this purpose, for each vegetable separately, is included in Appendix A.

All labour inputs were recorded as man-hours between May and October 2008, the duration of the study. The value of one man-hour was taken from the most recent Organic Farm Management Handbook – 7.25 £/hour which is slightly higher than workers actually received. It is close to rate of pay of 'a craft worker' (7.39 £/hour) or 'a lead worker' (6.89 £/hour) ordered by Agricultural Wages Board for England and Wales effective from October 2008. [Lampkin *et al*, 2008] Work done by the owner-farmer equalled in value that carried out by volunteers or paid-for employees for the purpose of this research.

Virtually all work inside the tunnel was carried out by hand, using simple gardeners' tools such as a hoe, rake, fork, spade, dibber, trowel, watering can. The expense to purchase these tools, if brand-new, would add up to perhaps £200. Considering that such equipment is long lasting and was utilized elsewhere on the holding, the cost of usage could amount to very little so was omitted. More valuable machinery such as rotovator, flame weeder or, in a few instances, a tractor represented a fraction of other inputs but an attempt to include them was undertaken, based on above-mentioned Organic Farm Management Handbook [Lampkin *et al*, 2008] or Scottish Agricultural College Farm Management Handbook [SAC, 2008].

The polytunnel was owner-built from manufacturer-supplied frame and fittings, made from galvanized steel, in 2002. Including irrigation and all the labour during installation it cost £8126 taking into account the inflation. It corresponds to 15.26 £/m^2 and generally agrees with similar calculations done for greenhouse production in Turkey [Engindeniz and Tuzel, 2006]. Following net margins methodology, the cost of the tunnel was allocated to every crop as 'rent', based on the area it was occupying and duration of its growing cycle. Tunnel maintenance was recorded separately; watering, manuring, fixing of irrigation sprinklers and washing of the plastic were included under this category.

The breakdown of costs and other essential information about the greenhouse is revealed in Table 2.

Table 2. Essential data about the polytunnel and the breakdown of construction costs.

	[man-hours]	**[£ in 2008 prices[a]]**
Materials		5676.33
Labour	183	1326.75
overhead irrigation materials		775.25
water tank (second hand)		238.54
irrigation and water tank installation	15	108.75
tunnel and irrigation total		**8125.62**
Number of years of amortization	10	
size of the tunnel - 19.2 m x 27.7 m [m^2]	532.6	
workable area of the tunnel [m^2]	504	
% workable area	94.6	
tunnel 'rent' per workable area [£/week/m^2]	0.0372	

a – Retail Price Index between 2002 and 2008 was used to convert year 2002 values into 2008 prices [National Statistics, 2009]

Source: Own calculations and measurements based on information given by the farmer.

As far as 'workable area', it was calculated by deducting 20 cm-wide strips along the edge, around the supporting posts and unused patch by the entrance. Analogically, it was assumed that the polytunnel stayed dormant for two months in a year; the ten month period was referred to as the maximum possible season span. Both the workable area and ten month period were used to figure out what fraction of the season a crop occupies.

For transplanting, 80-pieces modules were used (value 0.25 £/tray) and coir (coconut based) as the growing medium (1£/tray). The speed of sowing varied in the range of 3-5 trays per hour depending on seed shape and size.

Seeds came from the following suppliers: Tamar Organics, Moles Seeds, Elsom Seeds, all of whom are based in the UK. Prices were obtained from online catalogues or directly from the farmer. Miscellaneous items such as kerosene for the flame weeder, plastic mulch, and timber for cucumber trellis were grouped together for clarity and simplicity.

In this study the following costs or revenues were not included:

- cost of the land; some researchers treat all farms as tenanted and add the rent to fixed costs regardless of actual ownership status [MAFF, 1999];
- administration and distribution of the box scheme operations;
- taxes and insurance;
- organic farming subsidies or payments for the agri-environmental programmes.

All of the above would be more appropriate to consider if full accounting methodology was adopted [Nieberg and Offermann, 2000].

3. Results and discussion

The main results, given in Table 3, are quite surprising. Cucumbers proved to be the most profitable per area (25.2 £/m^2/year), followed by salad leaves and celery. What is striking is that for most of the crops, cost outweighed sales revenues. This kind of outcome can be easily explained for two crops which failed: butternut squash and batavian lettuce. Squash yielded no fruit as all the plants turned out to be males. The reasons for this are unknown. Lettuce suffered from early frost, only a fraction of heads was harvested.

The secret of cucumber success lies in the excellent variety in terms of yield and mildew resistance, as well as chicken manure application prior to planting. Mixed salad leaves are characterized by rapid abundant growth, allowing for three repetitive cuttings of the same batch. Green leaves, unlike seeds or fruits embody the majority of a plant's biomass captured via photosynthesis. This helps to explain high profitability of salad or leafy crops. The same applies to celery which, in addition, was grown under plastic mulch and needed no care from planting out until harvest with the exception for watering.

Insight why the crops were grown despite their poor profitability lies in the nature of box scheme. It requires a wide range of products available to customers who may demand or prefer local produce. One has to bear in mind that the whole business delivers to around 450-600 clients. Most of the vegetables and fruits come from outside the farm, from associated regional growers or the wholesale market sellers who source elsewhere. Packing operations are more efficient, sales generated though them can easily cover moderate losses on the growing front. Moreover, actual cash expenditure would be smaller than those calculated for the crops in question. It is the case because part of the work was done by the farmer-owner or students volunteering to gain job experience. Students. The assumed rate of pay 7.25 £/hour was higher than the workers really received. Margins are very sensitive to the cost of labour as they are a major input. If the National Minimum Wage (5.52 £/hour) was used for labour costs, two more crops, namely radishes and open ground spring onions would have become slightly profitable as column G 'net margins NMW' (far right) in Table 3 indicates.

A 2006 report prepared for the National Horticultural Forum 'The Future of UK Horticulture' briefly commented that: *Fruit and vegetable box schemes, often linked to organic produce, offer the potential for more direct consumer contact and improved margins, albeit on a comparatively small scale. 'Whilst clearly a niche sector, organic production presents some differentiated opportunity for producers, although* ***additional costs in terms of labour should not be underestimated.*** [Promar International, 2006]. A similar remark is presented in the aforementioned 2009 Organic Farm Management Handbook: *'Growers must undertake to provide a very wide variety of vegetables, creating a heavy workload and the managerial input needed should not be under-estimated'* [Lampkin *et al*, 2008].

Table 3. Net margins and other most important results of the work placement project.

crop	A	B	C	D	E	F=D x E	G
	Sales [£]	**Labour costs [£]**	**Total costs [£]**	**Net margins [£/m^2]**	**Multicropping coefficients[a]**	**Annual net margins [£/m^2/year]**	**Annual net margins NMW[b][£/m^2/year]**
Cucumber	855.0	284.2	358.2	20.2	1.25	25.2	28.8
Mixed salad leaves	2685.2	1350.0	1471.2	15.6	1.25	19.5	24.8
Celery	406.5	121.4	173.9	8.6	2	17.1	19.4
Chive	257.6	165.3	188.6	8.0	1.25	10.0	15.1
Mini leek	370.5	315.6	339.8	1.9	2	3.7	15.9
Radish	185.5	169.7	186.9	-0.1	3	-0.2	6.4
Onion open ground	465.6	447.3	504.2	-0.9	1.5	-1.4	2.5
Butternut squash	0.0	90.6	181.3	-2.4	1.5	-3.5	-3.0
Basil	105.8	129.1	183.7	-2.7	2	-5.4	-3.2
Ruby chard	26.4	62.0	79.8	-2.8	2	-5.7	-4.0
Onion under plastic	128.8	165.3	219.1	-3.1	3	-9.2	-5.1
Batavian lettuce	11.3	105.1	160.9	-3.9	2.5	-9.7	-8.0

a – arbitrary coefficient was deployed to adjust net margins to take into account the period a crop was occupying the ground. Coefficient = 2 means that the same crop could be grown twice on the same area during the growing season. Value of 1.25 was assigned to continuous crops such as salad leaves and chives because data were collected for part of the season. Limited range of hardy vegetables could be grown prior or after cucumbers, thus value of multicropping coefficient of 1.25 was appropriate. Column F is the product of multiplying column D data by column E data.

b – Net margins produced in this column assumes the National Minimum Wage for the rate of pay which was 5.52 £/hour during this study.

Source: Own calculations and measurements based on project data.

Table 4. Breakdown of costs by category for each vegetable crop listed in order of descending net margins.

Crop	Labour [%]	Seeds and transplants [%]	Tunnel 'rent' and maintenance [%]	Other costs[a] [%]	Costs total		Total costs per area [£/m^2]
					[%]	[£]	
Cucumber	79.3	6.4	8.6	5.7	100	358	14.6
Mixed salad leaves	91.8	2.3	5.3	0.6	100	1471	18.9
Celery	69.8	12.9	10.9	6.4	100	174	6.4
Chive	87.6	5.5	5.7	1.2	100	189	21.9
Mini leek	92.9	1.5	5.6	0.0	100	340	20.6
Radish	90.8	3.2	6.0	0.0	100	187	10.0
Onion open ground	88.7	2.0	6.9	2.4	100	504	11.8
Butternut squash	50.0	7.3	30.5	12.2	100	181	2.4
Basil	70.3	18.8	6.8	4.2	100	184	6.3
Ruby chard	77.7	3.1	19.2	0.0	100	80	4.2
Onion under plastic	75.4	15.9	5.2	3.5	100	219	7.4

a – black plastic mulch, fuel, timber, wire etc.

Source: Own calculations and measurements based on project data, a more detailed table is provided in Appendix B.

Labour represents a major cost – from 50% for squashes up to 93% for mini leeks. Data of costs' breakdown for every crop is provided in table 4. Costs varied from £80 (ruby chard) to £1471 (mixed salad leaves) so small scale of production has to be emphasised.

It is worth looking into labour category in more details. Chart 1 shows the costs of labour divided into:

- cultivations and planting;
- weeding;
- harvesting and packing.

Weeding does not dominate as the most significant input. However, plenty of weeding was carried out during bed preparation when previous crop residues were removed at the same time. Patches of ground were left unused for several weeks. This allowed a number of species of weeds to grow and spread, for example: chickweed (*Stellaria media* L.), fat-hen (*Chenopodium album* L.), shepherd's purse (*Capsella bursa-pastoris* L.), common nettle (*Utrica dioica* L.), docks (*Rumex* spp), couch (*Elytriga repens* L.) and other various grasses.

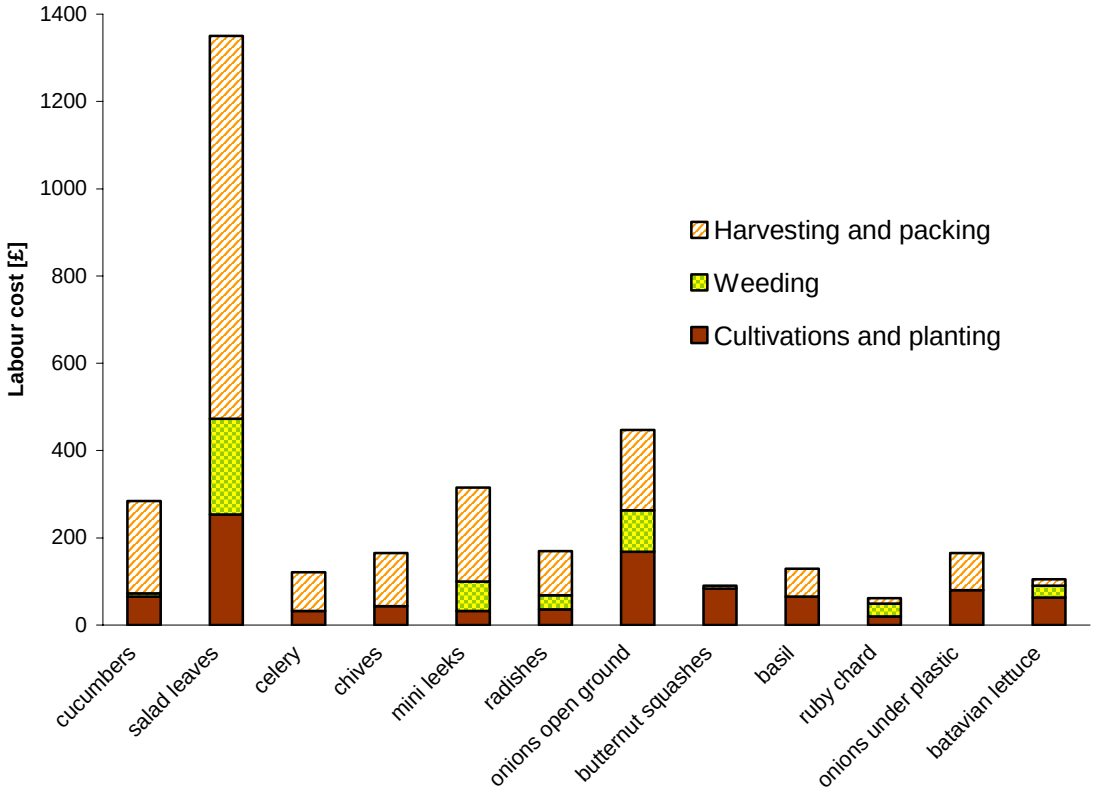

Chart 1. Labour costs in absolute values for each vegetable crop divided into three categories. Crops have been listed according to descending net margins.

It is worth noting that on this particular farm there were no costs associated with pest and disease control. Items such as sprays, *Bt* control agent, fly traps or slug pellets were not used at all. Removing crop debris, resistant and vigorous varieties along with some help from resident toad worked well. Occasional slugs were hand picked and damage done by them was not a problem.

A simple t-student statistic was used to compare arithmetic averages for each group of crops. This was done to ascertain which cultural method was more profitable: direct drilled versus transplanted and those raised under plastic mulch versus grown on open ground – Results are given in Table 5 and chart 2.

Table 5. T-test comparison of two pairs of cultural methods.

Cultural method	Mean value of adjusted net margins [£/m^2/year]	Standard deviation of mean values [£/m^2/year]	Value of t-test statistic
Direct sowing	3.19	9.71	0.97 (not significant)
Transplanting	3.51	13.92	
Under plastic mulch	5.71	13.86	0.52 (not significant)
Open ground	1.05	10.15	

Source: Own calculation using spreadsheet software.

The differences between mean values are not statistically significant in both pairs of cultural methods; therefore no strong conclusion can be drawn. The sample is small. Standard deviations, represented on chart 2 as vertical error bars, are relatively big, which means that results are spread.

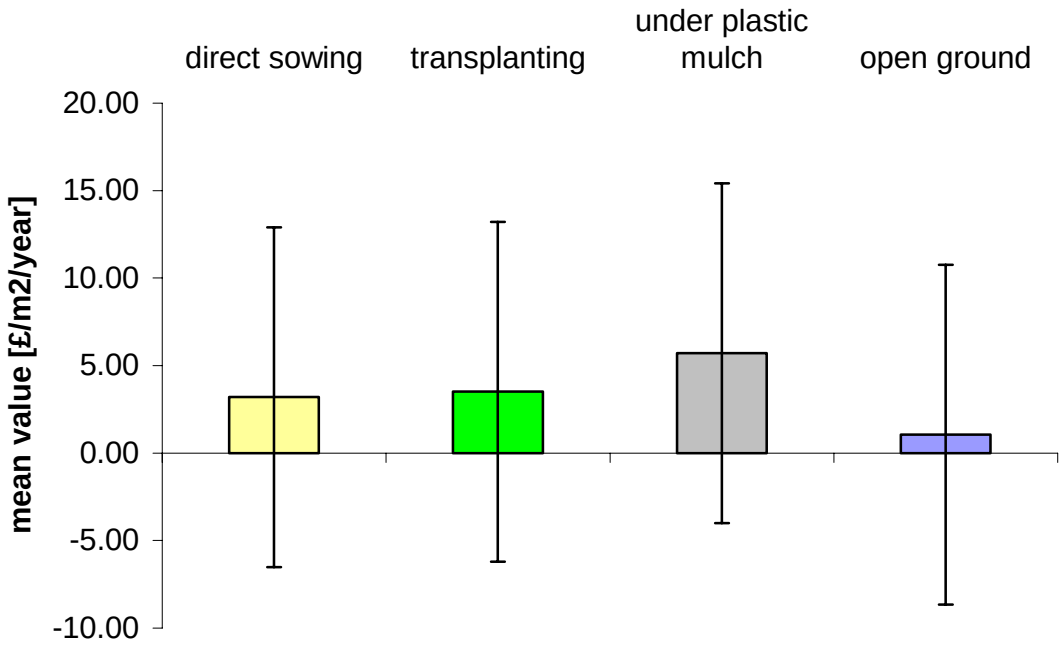

Chart 2. Results of comparisons of two pairs of cultural methods. Vertical lines represent error bars – standard deviations of mean values.

This comparison does not follow rigorous experimental plan methodology. Certain plants by nature have to be direct drilled which adds limitations to the crude comparison. Nevertheless, small dissimilarities incline towards the expected direction: transplanted crops are more profitable; crops under plastic mulch are more profitable.

4. Conclusions

The farm analyzed in this study is undoubtedly successful and a viable enterprise serving around 500 customers. The business employs ten people on a full- and part-time basis. The average net margin for twelve crops in question is 3.38 £/m^2/year (corresponding to 33,805 £/ha/year). This in itself not a bad return and in agreement with scarce horticultural data published for Scotland [Laurence Gould Partnership Ltd., 2007]. Cucumbers gave annual net margin of 25 £/m^2/year. Mixed salad leaves, celery and mini leeks brought profit too, albeit small in absolute values. This is due to the size of the area under cultivation. However, seven out of twelve vegetables proved to be unprofitable. Batavian lettuce (failed crop) gave annual net margin (loss) of -10 £/m^2/year.

Direct marketing offers unique opportunity, not only to develop robust community-based food production systems. It additionally generates fair income for the grower. In order to maintain competitiveness, small-scale producers have to monitor their gardening techniques and ensure they are as efficient as possible, especially for repetitive tasks.

Current practice of packing fruit and vegetables which have been grown elsewhere may undermine trust of present customers who suppose they are given local produce. Considering that some supermarkets in the UK offer vegetable ‘box schemes’, it is the actual growing that will remain distinctive feature of a farmer who aims for selling directly to the public.

References

Barnett, C.; Hossell, J.; Perry, M.; Procter C. and Hughes, G. 2006. *Patterns of climate change across Scotland: Technical Report.* SNIFFER Project CC03, Scotland & Northern Ireland Forum for Environmental Research 8: 14-15. internet accessed 19.12.2007: www.sniffer.org.uk/exe/download.asp?sniffer_outputs/CC03.pdf

Davies G. and Lennartsson M. (eds.), 2005. *Organic Vegetable Production: A Complete Guide.* Henry Doubleday Research Association; Crowood Press Ltd., Marlborough, UK

Engindeniz, S. and Tuzel, Y. 2006. *Economic analysis of organic greenhouse lettuce production in Turkey.* Scientia Agricola 63: 285-290; Piracicaba, Brazil; internet accessed 17.5.2008: www.scielo.br/pdf/sa/v63n3/29834.pdf. doi: 10.1590/S0103-90162006000300012

Firth, C. 2002. *The use of gross and net margins in the economic analysis of organic farms.* in: Powell *et al*. (eds.) 2002. *UK Organic Research 2002:* Proceedings of the COR Conference, 26-28th March 2002:. 285-288; Aberystwyth; internet accessed 25.4.2009: www.organic.aber.ac.uk/library/Gross%20and%20net%20margins%20for%20economic%20analysis.pdf

Hay, R. K. M.; Russell, G. and Edwards, T. W. 2000. *Crop Production in the East of Scotland.* Scottish Agricultural Science Agency and University of Edinburgh; Edinburgh, Scotland

Lampkin, N.; Measures, M. and Padel, S. 2008. *2009 Organic Farm Management Handbook.* University of Wales and Organic Advisory Service (EFRC)

Laurence Gould Partnership Ltd., 2007. *Organic Enterprise Cost Study*. Report for Scottish Government. ISBN 978 0 7559 1602 3**;** internet accessed 15.12.2008: www.scotland.gov.uk/Resource/Doc/202759/0054070.pdf

MAFF, 1999. *Conversion to Organic Field Vegetable Production.* Final Research Project: OF 0126T; internet accessed 21.4.2009: orgprints.org/9915/

National Statistics, 2008. Retail Prices Index: annual index numbers of retail prices 1948-2008 (RPI) (RPIX); internet accessed 15.3.2009: www.statistics.gov.uk

Nieberg, H. and Offermann, F. 2000. *Economic Performance of Organic Farms in Europe. Organic Farming in Europe: Economics and Policy Vol. 5*. Universität Hohenheim, Stuttgart – Hohenheim; internet accessed 21.4.2009: orgprints.org/8473/

Promar International, 2006. *The Future of UK Horticulture. A Case Study Analysis and Overview of the UK Horticultural Production Industry and its Future over the Next 10-20 Years. Prepared for the National Horticultural Forum.* Internet accessed 21.4.2009: www.nfuonline.com/documents/Horticulture/NHF%20report%20on%20the%20future%20of%20the%20horticultural%20industry.pdf

Scottish Agricultural College, 2008. *Farm Management Handbook.* 29th Edition. Edinburgh, Scotland.

Soil Association, 2009. *Organic market report 2009.* Soil Association, Bristol, UK

Soil Association, 1999. *Organic Lettuce Production.* Technical Guide. Soil Association, Bristol, UK

Soil Survey of Scotland, 1962. *Land Capability for Agriculture. Sheet 38 Aberdeen.* Macaulay Institute for Soil Research; Aberdeen, Scotland

Appendix B

Crop				
area and position				
Date sown/transplanted				
Harvest period				
	Man-hours and dates			cash
Inputs				
Seeds/transplants				
Bed preparation				
Drilling/transplanting				
Weeding				
Watering				
Pest/disease control				
Harvesting				
Heating				
Fuel				
Machinery				
Fertility materials				
Fertility labour				
Packing + storage				
Other				
Outputs				
Yield				
Price				
profit				
Other/fertility				

Comments (continue on the reverse):

Appendix B

Table 4bis. Cost breakdown by category for each vegetable crop listed in order of descending net margins – more detailed account.

Crop	Labour [%]	Seeds [%]	Transplants [%]	Tunnel and irrigation 'rent' [%]	Tunnel maintenance inc. watering [%]	Other costs[a] [%]	Costs total		Total costs per area [£/m^2]
							[%]	[£]	
Cucumber	79.3	4.0	2.4	6.6	1.9	5.7	100	358	14.6
Mixed salad leaves	91.8	2.3	0.0	4.1	1.2	0.6	100	1471	18.9
Celery	69.8	1.7	11.2	8.4	2.4	6.4	100	174	6.4
Chive	87.6	1.0	4.5	4.4	1.3	1.2	100	189	21.9
Mini leek	92.9	1.5	0.0	4.3	1.3	0.0	100	340	20.6
Radish	90.8	3.2	0.0	4.7	1.4	0.0	100	187	10.0
Onion open ground	88.7	2.0	0.0	5.4	1.6	2.4	100	504	11.8
Butternut squash	50.0	1.8	5.5	23.6	6.9	12.2	100	181	2.4
Basil	70.3	1.1	17.7	5.3	1.5	4.2	100	184	6.3
Ruby chard	77.7	3.1	0.0	14.9	1.3	0.0	100	80	4.2
Onion under plastic	75.4	1.4	14.5	4.0	1.2	3.5	100	219	7.4
Batavian lettuce	65.3	5.2	16.6	8.1	2.3	2.5	100	161	4.2

a - black plastic mulch, fuel, timber, wire etc.
Source: Own calculations and measurements based on project data.