

ERRORS IN HORTICULTURAL COST-OF-PRODUCTION SURVEYS¹

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ABSTRACT

Cost of production studies on horticulture like those published in Agricultural Enterprise Studies are extremely inaccurate and unreliable. Survey methodology is poor: samples are very small, response is low and there is no control over interviewer bias. The variance of measures like gross revenue, gross margin and profit are particularly high so these are likely to be inaccurate. There is room for major errors and differences of opinion when costs are imputed; costs imputed for one purpose are wrong for most other purposes. By the time the results are published, they are obsolete. Data collection and analysis are often carried out without any apparent aim in mind. In this paper a system of collecting production costs is suggested which is simpler and cheaper, and which presents data that are more accurate, more useful and more timely.

INTRODUCTION

Horticultural production economists spend much of their time either collecting production costs, or drawing conclusions from the results of cost-of-production surveys. It will be shown here that most of these surveys produce information which is of little practical value and which is inaccurate and obsolete.

Because I have worked on several of the surveys in the British Agricultural Enterprise Studies series, and because they are well-documented, I shall aim my criticisms at these, though similar criticisms could be made of studies published elsewhere, and many of the criticisms apply to cost-of-production studies on other enterprises.

The Farm Management Survey and the Horticultural Management Survey have too little detail and too small a coverage to provide data useful for planning horticultural production (this is not their aim), and they will not be discussed here.

AIMS OF THE STUDY

Horticultural costings are required primarily for planning farms but they may also be needed for planning scientific research, for sociological research or for planning Government policy. It may be possible to collect data for several

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purposes at the same time, but the analysis of the data and the range of the data collected depends on the purpose for which they are collected.

The aim of the study should be defined in terms of the use to which the results will be put, rather than in terms of the results that will be obtained. This means specifying “The results will be used in planning large East Anglian farms” rather than “National average gross margins will be calculated.” This avoids wasting time in calculating measures like “national average cost of producing Brussels sprouts” which are of no practical use. It will be shown below that measures such as “gross margin” or “average cost” calculated for one purpose are meaningless for most other purposes. The degree of accuracy and the sampling error that is permissible should also be laid down—there is no point in basing a complex statistical analysis on inaccurate data. In practice, the aims of the study are seldom published in the report and they may not even be clearly formulated.

GENERAL ACCURACY

Publication

The reports of horticultural cost-of-production surveys are usually published 12 to 26 months after the harvest begins, 20 months on average in the Agricultural Enterprise Studies. When there are early and late crops or the crop is produced all the year round, the report may come as late as 30 months after the first crop was harvested. Inflation, the adjustment of inputs to deal with inflation and changing techniques mean that these costings are useless to the farmer planning his cropping programme.

Sample size

Because the money available for research must be spread over the many horticultural crops, samples are small, 13 to 30 farmers for most crops and 51 to 100 for the main crops in the Agricultural Enterprise Studies series. The farmers differ in area, climate, soil, marketing, season of production, method of production and scale and, as a result, the variance can be expected to be so high that samples of this size are useless. No attempt is made by the researchers to analyse the variance or to quantify the sampling error.

Response

In my experience, only 30 to 50% of British farmers will co-operate in a survey and 10 to 20% of those who do cannot give enough information to be useful (details of response are seldom given in the published reports). The low response may be due to the fact that farmers are approached time and again to take part in surveys. Irish farmers, who are not surveyed to the same extent, have a much higher response rate. The effect of the low response rate is particularly obvious with stratified samples; in England, if there are 30 large farmers growing vegetables in a region, and 20 will not co-operate, the

remaining 10 are in the surveys on carrots, cauliflower, cabbage, sprouts and possibly the Farm Management surveys and one or two surveys on arable crops as well. The amount of bias caused by this is unknown, but I believe that the yields and prices obtained by the farmers who do take part are well above average. With such a low response rate, the results cannot be considered typical of the population from which the sample is drawn.

Another response bias occurs with sharecropping, as both farmer and merchant must respond and the chance of refusal is doubled.

The effect of a bias in yields or prices is serious. Table 1 shows that if one overstates yield and price by only 20%, one may overstate gross margin by 132% and profit by 1320% (strictly speaking one should not attribute profit to one crop).

Interviewer bias

Fully-structured questionnaires cannot be used for these surveys. Very few growers can give figures for the number of hours per acre spent on ploughing, planting etc. and a certain amount of detective work is needed to obtain a figure from the information they can give. The interviewer must prompt the respondent and it is hard to do this without suggesting an answer. Sometimes the grower does not know the answer and refuses to guess or gives what is obviously a wild guess, so the interviewer may invent replies or induce the respondent to invent replies, as there is strong pressure on him to return a complete questionnaire. It must be assumed that these biases are normal and serious unless tape recorders are used at all interviews (1) and check interviews are carried out. Certainly, the standard of control is well below that demanded for market research or sociological surveys.

Variance

Some reasons are given below for believing that the variance of measures like gross revenue, gross margin and profit are higher than the variance of measures of inputs or total costs. This means that the small samples used may possibly give useful estimates of inputs or costs, but that they give most unreliable estimates of gross revenue, gross margin and profit. While this is true of most crops, it is particularly true of horticultural crops.

One reason is that prices fluctuate violently throughout the season. If the crop is one that must be marketed the week it matures, one farmer may get a good price, while another, harvesting a fortnight later, gets a low price, though their costs are identical. When the crop is harvested over a long period, there may still be a big difference between the prices returned.

Le Gallais (2) has shown that, over a period of 3 months, some wholesalers have returned an average price 26% higher than others for identical flowers, and similar results have been reported by other farmers and producer groups. Even when production costs are uniform, therefore, prices and gross

margins can vary from farmer to farmer.

When a vegetable is produced all year round like cauliflower and prices fluctuate from week to week and from year to year, an enormous sample would be needed to answer the question “What is the average gross margin of all British farmers producing cauliflower?”

If prices fluctuate, the effect on margins depends on the production system. When prices are low, for instance, firms with low production costs and high marketing costs would plough in a crop at a price where firms with high production costs and low marketing costs would continue to harvest. In the long run, the two systems might be equally profitable.

Production costs do not vary much with yield, but harvesting and marketing costs do, often in a close linear relationship (single-harvested crops being the main exception). However, instead of expressing costs as, for example, £120 per acre production costs plus £8 per ton harvesting and marketing costs, researchers almost invariably give the average cost per acre, £150. The estimate £120+£8 per ton is easier to calculate, it has a lower variance, it applies to a wide range of farms, it is equally applicable when there is a crop failure, and it is particularly valuable when the farmer is wondering whether or not to harvest the crop (he will harvest when the price is greater than the cost of harvesting and marketing). I have found too, that it is very difficult to get respondents to record harvesting and marketing costs throughout the season, though they will record detailed costs per ton over a short period of one or two weeks, which is long enough to calculate harvesting and marketing costs per ton.

Because the farmers in a survey may adopt any of nine or ten marketing systems, ranging from selling in a wholesale market, through farm gate sales, to sharecropping with a merchant, prices are recorded at different levels of the distribution chain so it is difficult to find more than five or six farmers who have even approximately the same marketing costs or prices. This means that returns are more variable than costs and it emphasises the need for specifying production costs and marketing costs separately. It also suggests that one cannot usefully compare returns per acre or variable costs per acre.

When prices and yields fluctuate independently, as they will appear to in a survey of this sort, the revenue and the gross margin will fluctuate even more. Sampling error is of course high and the effect will be that shown in Table 1.

IMPUTING COSTS

Many of the costs, particularly those for labour, machinery and rent, cannot be measured objectively and a cost must be imputed by the researcher if gross

TABLE 1: Effect of a 20% bias in yield and price data on gross margin and profit

	True figures	Biased figures	Error
Total yield	15 tons	18 tons	+20%
Total price per ton	£10	£12	+20%
Total revenue	£150	£216	+44%
Minus variable costs	£100	£100	
Gross margin	£50	£116	+132%
minus fixed costs	£45	£45	
Profit	£5	£71	+1320%

margin and profit are to be worked out. Different methods of imputing costs may be acceptable, depending on the purpose of the survey. The price of labour on a large farm is the wage paid to labourers plus the cost of social welfare stamps, etc. On a small farm where all work is being done by family labour, often by children too young to be employed legally, the cost is not the wage paid, if any, but the opportunity cost, the amount lost by transferring labour to this crop. If there is no productive work apart from this crop then the true cost of labour is zero. There are circumstances where one should charge employed workers at cost and family workers at zero cost, but it limits inter-farm comparisons. The system in use now, where the hours worked are multiplied by the agricultural wage, requires justification; it is a conversion of a measured variable, hours, into an imputed one, cost, by multiplying by a constant. It is better to quote the measured variable.

In the calculation of gross margins, casual labour and sometimes permanent labour on piecework, are counted as variable costs, while permanent labour and family labour are charged as fixed costs. This makes comparison of costs difficult; in Lincolnshire, for instance, it is normal to use casual labour for cutting cauliflower, so cutting is a variable cost, while in other areas cutting is done by permanent labour and is a fixed cost. The gross margins from the two regions do not cover the same operations.

Difficulties also arise in imputing the cost of tractors and machinery. Traditional methods of calculating depreciation are useless at the present rate of inflation. There is the problem of comparing the costs of the farmer who has a new tractor and the farmer who has a five-year old tractor and will buy a new one next year. They are operating identical tractors on identical replacement policies. Farmers may use several tractors of different ages and as many as 10 or 12 different cultivation implements on one field, so it is not possible, or useful, to work out the written-down value, the depreciation, the fuel consumption and the number of hours worked, in order to calculate the cost per acre of cultivating a cabbage field. Again, it is more useful to the farmer to know the number of

hours his tractor will have to work than to know the imputed costs of farmers in very different circumstances to himself.

The cost of a farmer's own transport used for marketing can be imputed from interest, depreciation, fuel, repairs, and miles per year, but this does not take into account the social benefits of owning a car. Many farmers run a car or van largely for social purposes, so it would not be strictly accurate to charge the overheads to the carrot crop in proportion to the miles travelled marketing carrots, even if they are charged to the farm for tax purposes. The driver's time could be costed at the agricultural wage or the opportunity cost but this ignores the fact that the entrepreneur performs functions that the hired carrier does not; he is communicating with his customers, assessing the market and taking orders.

Actual land rents may be low, because they were fixed several years before the survey, or high, because they are for a one-year tenancy, or because they are determined by a high local demand for land rather than by the productivity of the soil. No rent is paid for owner-occupied land. Imputing a theoretical economic rent which reflects the productivity of the farm requires more time and skill than is available, and economic rent should be reflected in the gross margin. Since economic rent cannot be measured and it is difficult to interpret actual rents, it would be better to ignore rent entirely.

Table 2 shows that two economists could reach very different estimates of the costs of production on the basis of imputed costs, and each could make a very strong case for his estimates. It follows that if costs are imputed for one purpose they are wrong for most other purposes.

RISK

A single-crop cost of production survey cannot provide a measure of risk for the crop or farm, so risk is excluded from all such surveys. Murphy (3) has studied the effect of risk on the farm business using Farm Management Survey data, but these data are not available for sufficient horticultural enterprises to include them in such a study. The degree of risk is generally higher for horticultural crops than for others and it varies among horticultural crops, so that gross margins are not comparable between, say, wheat and cauliflower.

DELAYS

If the results are delayed, they are of little use for planning. The chief delay is in the collection of the returns, especially in a crop that is marketed over some months, but also when returns are not available because they are with the accountant, the tax-inspector or the sharecropping merchant. Many farmers give full details of production costs but must be dropped from the survey because they do not give details of returns, and this aggravates the non-response

problem. Another delay is caused by collecting figures for harvesting and marketing over the full season.

Analysis of all the figures, working out imputed costs, margins, etc., is time consuming. Some months are wasted if a report is printed instead of being duplicated.

TABLE 2: Costs incurred in the production of carrots in the Athlone district, 1973

	Costs per acre	Low estimate	High estimate
Seed, Fertiliser, Insecticide, Herbicide		£52.41	£52.41
Rent ¹		6.00	65.00
Overheads ²		2.01	5.25
Tractor and machinery ³		4.65	66.26
Labour ⁴		0.00	36.36
<i>Total per acre costs</i>		£65.07	£225.28
<i>Cost per ton</i>			
Materials		2.45	2.45
Labour ⁵		0.62	5.12
Transport to farm ⁶		0.50	1.00
Transport to market ⁷		8.00	18.00
<i>Per ton costs</i>		£11.57	£26.57
<i>Total cost for 10-ton crop (excluding risk)</i>		£180.77	£490.98

Source: Based on inputs recorded in a pilot study of carrot production on peat soils

- 1 Low cost is actual rent paid by a farm in the sample. High rent is typical when land is rented for a single crop.
- 2 £2.01 for 15-23 acre farms with creamery milk and tillage; £5.25 for farms over 200 acres with dry stock and tillage, according to the Farm Management Survey (4). Variation within categories is ignored.
- 3 A 35 h.p. tractor operated 1,000 hr per annum and replaced after 14 years at cost price £1,100 costs 32p per hour. A 35 h.p. tractor operated 100 hr per annum and replaced after 8 years at £3,365 (15 percent inflation) costs £4.65 per hour. A similar difference exists with machinery.
- 4 Family labour is free having zero productivity in alternative enterprises. For the high figure all labour is charged at the agricultural rate plus 10%.
- 5 The low cost is for free family labour with children working as casual workers at £1 per day. For the high figure all labour is charged at the agricultural rate plus 10%.
- 6 The low figure is based on using small tractors at optimum efficiency with free family labour. The high figure is based on using a large, under-utilised tractor with labour paid the agricultural rate.
- 7 Low figure—£8 per ton is contractor's charge; £18 is the cost of driving a 3-year old 30 cwt van 160 miles plus the driver's time at £8 per day.

SUMMARY

Horticultural cost-of-production figures of the sort published in Agricultural Enterprise Studies are extremely inaccurate and unreliable for the following reasons.

1. Survey methodology is poor: sample sizes are far too low, response is poor and there is no control over interviewer bias.
2. The variance of measures like gross revenue, gross margin and profit is particularly high, so these are particularly likely to be inaccurate.
3. There is room for major errors and differences in opinion when costs are imputed. If costs are imputed for one purpose, they are wrong for most other purposes.
4. By the time the results are published, they are obsolete. Delays are caused by collecting details of returns, of harvesting costs and of marketing costs and by the large amount of analysis needed to calculate gross margins and profit.
5. Data collection and analysis are often carried out without any apparent aim in mind, so the results are useless for most purposes.

AN ALTERNATIVE

An alternative system is suggested here which will provide farmers with the information needed to plan their own production programme and to see how efficient they are, and which would still be valuable to economists, sociologists and scientists. It aims at providing accurate information which can be processed by farmers, economists, etc., for their own purposes, rather than at providing measures such as gross margins which can be used for one purpose only. Imputed costs and calculated margins cause most of the errors so the system does not use them.

The farmer needs to know the physical inputs not the costs. He can cost the inputs at the price applying to his own farm, ignoring labour if he does not employ any; he can allow for inflation by using expected costs rather than historical costs; he can work out how profitable the crop is on his own farm; he can compare his inputs with those of the farmers in the sample. Even if the survey costings, gross margin and profit were perfectly accurate, they would not tell the individual how profitable the crop was on his own farm, nor would they help him compare his technical efficiency with that of other farmers.

It is suggested that the production survey should be confined to recording physical inputs of materials, labour and machinery and to recording

the operations. Harvesting operations and materials used in harvesting and marketing could be recorded over 2 weeks, perhaps. Inputs used for growing should be presented on a per acre basis while inputs used for harvesting and marketing should be on a per ton basis. This provides all the information needed and it provides the information least subject to sampling error. It may also be worth presenting the costs of the inputs, provided the limitations of imputed costs are made clear. Collecting figures on returns and prices and calculating margins and profits causes major delays and produces inaccurate figures, so the suggested system does not use them.

Since money and resources are limited, the survey should be restricted to the most important growers. These might be the large-scale producers throughout the country or the early producers in some areas or the “best” farmers. Variance is then much lower and a higher percentage sample is drawn. Consequently, more accurate and meaningful information is obtained. Little is to be gained by choosing a random sample of perhaps 50 or 100 farmers from a population of all producers including small farmers, inefficient farmers and farmers in areas which produce very little. One might get a “National average cauliflower production cost” but it would be most inaccurate and it would serve no purpose. Accurate figures referring to the best farmers in one region are useful to other farmers as an indication of what can be done and how. Figures on the performance of the worst farmers are irrelevant as one can expect them to change to other crops or to improve their methods.

The information should be available within a few weeks of the beginning of the harvest, as the main causes of delay do not arise. It is not necessary to collect prices or returns or to record costs throughout harvesting and the analysis is relatively simple. An article in the trade press could be printed immediately to present the main points to perhaps 20,000 farmers in plenty of time for them to plan their next crop.

A duplicated report on the survey, giving details of sampling, response, standard errors, etc., might follow. Printed reports should be avoided as this information is sometimes excluded to reduce costs, or to give the report more popular appeal, and printing causes delays. A later supplementary report can be published giving details of yields and gross margins if the researcher considers it necessary.

The system suggested is cheaper than the existing system as both collection and analysis are simpler and it presents information that is more accurate, more useful and more timely.

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