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Profitability of herd health control and management information systems under field conditions

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Objectives

From this chapter the reader should gain knowledge of:

- basic requirements for an economic analysis of field data on animal health and management support
- the profitability of herd health control programs
- the profitability of management information systems

15.1 Introduction

As also indicated in Chapter 2, veterinary services to individual farms are increasingly changing from the so-called first-aid practice or fire-brigade approach into planned prevention and control programs. For a sound economic analysis of such programs, data from both the 'with' and 'without' situations should be available (Dijkhuizen, 1992). This may be realized in two ways: data from 'before' (b) and 'after' (a) application of the program, collected on farms participating in the program (P), as well as on comparable control farms (C). When available, these data make it possible to estimate the causal effects of the program more precisely, ie, $(P_a-P_b) - (C_a-C_b)$, especially when particular herds with obvious health and management problems take part in the program. Collection of data in the 'without' situation should be done concisely, however. Otherwise an interference with the program may occur, leading to an underestimation of the program effects.

In this chapter two field trials in the area of animal health and management support that were designed and analysed along these lines are presented and discussed. The first application includes a 2-year herd health and management program in dairy cattle, carried out on 30 program and 31 control farms (Sol *et al.*, 1984). The second one focuses on the so-called management information systems (MIS) on pig farms, designed to support the farmer's management by providing information on the performances of single animals and the herd as a whole (Verstegen *et al.*, 1995).

15.2 Herd health and management control in dairy cattle

In the Netherlands, a 2-year dairy herd health and management program was carried out from 1974/75 to 1976/77, including 30 program and 31 control farms. The program was a joint experiment of the Animal Health Service and the Agricultural Extension Service in the province of Overijssel. Each of the 37 extension workers was asked to select three dairy farms with at least forty cows and without specific herd health problems. Further requirements were a modern housing system for cows and youngstock, artificial insemination, milk recording, roughage analysis and a reasonable economic and herd health recording system. The program and control farms were randomly chosen from each set of three, the third farm being excluded from the trial. Seven program and six control farms were excluded from the initial program evaluation because they did not have the necessary economic data at the time of analysis.

The year 1974/75 was used as a base year in which relevant data were collected from both groups before the program started. During the program years (1975/76 and 1976/77), the program farms were visited every six weeks by the veterinarian of the Animal Health Service, the local veterinarian and the local extension worker. These visits primarily focused on reproduction, udder health, foot care, nutrition, cow culling, grassland exploitation and economic results. The control farms were visited twice a year, only to collect the necessary data.

Table 15.1 Comparison of program and control farms before and during the experiment

	Situation 'before' (1974/75)			Changes during program (1976/77 - 1974/75)		
	30P	31C	P-C	30P	31C	P-C
Labour equivalents	1.7	1.6	0.1	-0.1	0.0	-0.1
Grassland area (ha)	31.1	24.7	6.4*	0.3	2.3	-2.0
Dairy cows (no)	69.3	60.9	8.4*	4.7	6.6	-1.9
Fertilizer (kg N/ha)	300	351	-51	42	-24	66*
Milk per cow (kg)	5121	5123	-2	524	390	134
Calving interval (d)	378	376	2	-5.3	3.3	-8.6*
Cell count (x1000/ml)	240	330	-90	-20	20	-40
Total culling rate (%)	21.4	18.7	2.7	0.0	7.1	-7.1*
for reasons of:						
- health/fertility probl.	12.6	10.6	2.0	0.1	5.9	-5.8*
Revenues (US$/cow)	1740	1768	-28	452	385	67
Feed cost (US$/cow)	569	576	-7	198	227	-29
Margin (US$/cow)	1171	1193	-23	256	158	98

* $p < 0.05$

Table 15.1 shows a comparison between the program and control group before and after two years of program application. In the preparatory year (1974/75), the groups showed no large differences. The farms of the program group were slightly larger (hectares of grassland and number of cows) and applied somewhat more nitrogen per hectare. Milk production per cow and health and fertility parameters (including culling data) did not differ between the groups, nor did the costs and returns per cow. The effects of the program were measured by comparing both groups for the changes in the various parameters per farm during the two successive years of program application. Neither group showed much difference in the development of farm structure (labour force, herd size, grassland area), although the program group increased nitrogen fertilization, compared with the control group. Statistically significant effects were found, regarding both calving interval and replacement rate of cows because of ill health and reproductive failure. Regarding udder health (ie, cell count) no significant effect was found. The average increase in the margin of revenues over feed cost per cow turned out to be US$256 in the program group, which is US$98 more than in the control group. Additional - veterinary - costs were estimated to average US$20 at the most, indicating this herd health program to be a sound investment.
From both the farmers' and veterinarians' point of view it is also important to know whether or not such programs should be applied on a more than temporary basis. From these farms, therefore, data were gathered until ten years after participating in the program experiment to see whether the initial effect on income had increased, decreased or remained the same. The necessary data were not available on all 61 farms. Therefore, two new groups were formed, consisting of 15 program farms and 20 control farms respectively. Since the initial and new groups differed in number, the short-term program effects were also re-evaluated. Results are summarized in Table 15.2.

Table 15.2 Margin over feed cost per cow per year (US$) on the program (P) and control (C) farms

	Initial groups			New groups		
	30P	31C	P-C	15P	20C	P-C
1974/75	1170	1193	-23	1156	1191	-35
1976/77 - 1974/75	256	158	98*	232	167	65
1976/77	1426	1351	75	1388	1358	30
1980/81 - 1976/77				235	414	-179*
1980/81				1623	1772	-149*
1985/86 - 1980/81				599	575	24
1985/86				2222	2347	-125

* $p < 0.05$

During the years of program application (1975/76 to 1976/77) margin over feed cost per cow in the initial groups increased significantly more (US$98) on the program farms than on the control farms, as also indicated before in Table 15.1. In the new groups the short-term program effect was smaller (US$65), and not statistically significant, but showed the same

tendency. In the first few years after the program had finished (1976/77 to 1980/81), margin over feed cost per cow increased significantly more (US$179) on the control farms than on the program farms, as a result of both higher milk production and lower feed costs. In the period 1980/81 to 1985/86 the increase in income for both groups was almost the same, ie, between US$575 and US$600 per cow. So, the initial increase in income soon had disappeared after the program had been finished. Such an outcome is not totally unexpected, but - at least beforehand - opinions often differ on this issue. Farmers' decisions, however, have to be taken under continuously-changing price and production conditions. In such dynamic circumstances, therefore, it seems to be profitable to apply herd health and management programs on farms on a more than temporary basis.

15.3 Management information systems in pigs

A longitudinal survey was carried on 71 pig farms in 1992, about 10 years after the first introduction of MIS. All farmers already participated in a socio-economic survey in 1983, henceforth referred to as the 1983 survey. In the 1983 survey, various sociological, technical and economic data of the farms were recorded. Very few farmers made use of MIS at that time, which means that the 1983 data could very well serve as pretest data. In the 1992 survey, data on MIS use and technical production data of the entire period in between the two surveys (1983 to 1992) were collected and formed a unique **panel data** set. In this period, some farmers started to use MIS while others did not.

The objective of the 1983 survey was to relate farmers' characteristics to their production performance. The survey was conducted by means of a questionnaire that was distributed by farm advisers. The research population of the 1983 survey was selected using the following three criteria: (1) the pig farms should include sows as well as fattening pigs, (2) the pig farms should be located in the operating area of the state advisory service, and (3) the pig farmers should be a member of the state advisory service during the entire year of 1982. An important consequence of this last criterion was that all farmers made use of the central Herd Record System which was maintained by the advisory service. This means that all selected farmers received basic information about their farm performance. Hence, farmers with only manual record keeping practices or farmers with no record keeping at all were excluded. The only criteria in the 1992 survey were that: (1) the participants also participated in the 1983 survey, and (2) they still operate a pig farm.

The objective of the evaluation study was to evaluate the effect of MIS on the average number of piglets per sow per year. The panel data were statistically analysed through analysis of variance procedures. Hypotheses about factors that may interfere with the effect of MIS on farm results led to the initial formulation of the statistical model described below. With this model, the annual observations of the parameter **'number of piglets per sow per year'** over the period 1982 to 1991 are explained. The great advantage of having panel data is that effects can be estimated within farms. In this way, distorting effects (such as management quality and motivational aspects of the farmers) can be excluded by inserting a FARM effect into the statistical model. In regression terms, this can be regarded as having one dummy variable for each individual farm (except for the last farm because this farm is

already defined by the n-1 other dummy variables). The advantage of having multiple time series is that year effects can be estimated across farms. The process of MIS installation, data entry, learning and, finally, use of its information in farm management takes time and delays the benefits coming from MIS. Including this starting period in the estimation of MIS effects would cause an underestimation of the effect. Therefore, a dummy variable 'First Year Adjustment' (FYA) was defined. The variable FYA corrects the MIS effect for starting problems and for not having MIS during the entire year of adoption. For example, when a farmer starts using MIS in November 1984, an effect of MIS on the 1984 parameter 'number of piglets per sow per year in 1984' can hardly be expected. To estimate the MIS effect, a dummy variable MIS was added to the model and so was a FARM x MIS interaction. This interaction accounts for differences in MIS effects among farms. It was hypothesized that the value of information and thus the value of MIS depends on the information that is already available to the user. For example, farmers with a tradition of intensive recording of sow data are likely to receive less added value of MIS than farmers who obtain more detailed information than before MIS use. It was also hypothesized that there exists a FARM x FYA interaction indicating that some farmers have fewer problems starting to use MIS than others. This interaction was not significant and was removed from the final model. Eventually the following model was estimated:

$$\underset{}{Y_{ijkl}} = \underset{(p\leq 0.001)}{YEAR_i} + \underset{(p\leq 0.001)}{FARM_j} + \underset{(p=0.09)}{FYA_k} + \underset{(p=0.08)}{MIS_l} + \underset{(p\leq 0.001)}{FARM \times MIS_{jl}} + e_{ijkl}$$

where

Y	=	piglets per sow per year;
$YEAR_i$	=	year effect (i=1982, 1983...., 1990, 1991);
$FARM_j$	=	structural farm differences (j = 1,..71);
FYA_k	=	first year adjustment (two levels: k = 1 in the first year that an MIS is mentioned; otherwise k = 0);
MIS_l	=	MIS effect (l=0: no MIS use; l=1: MIS use);
$FARM \times MIS_{jl}$	=	interaction between farm effect and MIS effect; and
e_{ijkl}	=	mutually independent error terms: $N(0,\sigma^2)$.

The significant main effects, ie, YEAR, FARM, FYA and MIS and the interaction FARM x MIS accounted for 80% of the total variation of the number of piglets per sow per year (R^2=0.80). With this model, the effect of MIS on the number of piglets per sow per year was estimated. The average value of the FARM x MIS-interaction-term was added to the 'pure' MIS effect. This resulted in an average MIS effect of **0.56 piglets** per sow per year. This means that using MIS increased the level of the yearly production by 0.56 piglets per sow (from the second year of MIS use onwards). The profit of MIS use equalled US$15 to US$17 per sow per year, meaning a return on investment of 220 to 348% and 7.7 to 8.7% of a farmer's typical income per sow per year in the Netherlands.

Another important outcome of the study was that the MIS profitability differed significantly

among farms. An in-depth analysis on the differences among farms was conducted, using the sociological classification methods that were included in the survey study in 1992. Farmers were divided into categories based on their management quality and styles of farming. 'Styles of farming' is a self-classification method. In an earlier study, four short descriptions of farming styles were constructed based on 'open-attitude interviews' with pig farmers (Appendix 15.1). In the survey study, the farmers had to select the description that fitted in best with their opinion on 'how a pig farm should be managed'. The management quality classification depends on a series of questions on farmers' training and education, modernity of farm facilities, farm policy, tactical and operational planning and social aspects. The survey farmers completed the questionnaire and farm management experts rated the answers.

Analysis per category demonstrated that great differences in MIS effect exist between styles of farming. Moreover, the two most extreme categories of management scores are significantly different, suggesting a positive relationship between MIS profitability and farmers' management quality (Table 15.3).

Table 15.3 MIS effect in relation with sociological classification methods

Classification method	Category	Number of farmers per category	Number of MIS users per category	MIS effect[a]
Styles of farming	'entrepreneur'	10	7	+1.41
	'manager'	44	27	+0.42
	'pig farmer'	16	10	+0.49
	'withdrawer'	6	1	-0.69
Scores on management questions (range: 1-1000)	< 380[b]	19	9	-0.48[c]
	381-445	19	12	+0.67
	446-520	20	12	+0.38
	> 520	18	12	+1.42[c]
Total		76[d]	45[e]	+0.56

[a] Defined as changes in the average number of piglets raised per sow per year

[b] Thresholds were defined to get an equal number of farmers per category

[c] The two categories are significantly different (F-test: P<0.05)

[d] Five of them have not participated in the 1983 survey

[e] Fifty-four farms used MIS but only 45 of them could provide production data before and after MIS use, and thus contribute to the MIS estimate

15.4 Future outlook

Both field trials in the area of animal health and management support described in this chapter showed that it is actually possible to influence and improve farmer's management. Both studies also showed considerable differences in improvement among farms, and it is a challenge for future research to find out why and how. A disadvantage of survey studies in

this respect (such as the MIS application in this chapter) is that they cannot prove causality of relationships found. Uncontrolled effects may have interfered with the relationship found. Field experiments (such as the herd health application) have greater control on intervening variables but are not frequently applied due to practical limitations. Requirements are that none of the farmers already uses the program under consideration, that every farmer participates voluntarily, and that no contamination (information exchange) between the true control and program group takes place. It is not easy to get people participate voluntarily, especially not when they are assigned to the control group. Moreover, conducting experiments in the field is time-consuming and expensive. **Experimental economics** is a means to benefit from the strengths of field experiments and to overcome some of their practical limitations (Davis & Holt, 1993). In this approach people solve decision problems in a laboratory environment that are abstract representations of the natural decision problem under consideration. The basic assumption of experimental economics is that the results, obtained in a laboratory environment, represent the more complex natural environment. Experimental economic institutions need to have some typical characteristics to achieve this (Smith, 1982). The key elements of the natural decision-making environment (eg, type of decision problems, information supply) have to be incorporated into the abstract laboratory institution. Another typical characteristic of experimental economic institutions is that the participants receive **monetary incentives**; they get paid in cash according to the effectiveness of their decisions. Experimental economics is considered a promising approach to gain further insight into the profitability of animal health and management support in general, and the differences in effects among farms in particular.

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Appendix 15.1 Portraits of 'styles of farming'

Portrait 1 - entrepreneur

I consider myself an entrepreneur. My aim is to follow new developments as well as possible. I make sure that I am ready for the future. My farm is well structured. I have a good idea of what is going on on my farm because I have a strong work plan and many production figures that show me how I am doing my job. I consider it a challenge to have the best production results. I find stories of other pig farmers (in farm magazines or at peer meetings) usually not very interesting. Farm magazines and farm advisers have an important task in keeping me informed. However, I draw the conclusions myself.

Portrait 2 - manager

The economy goes on and, therefore, a pig farm has to expand to keep in pace. However, it is not my aim that the farm grows but reaches a high added value per animal. I do not envy farmers having those gigantic facilities; they have to work hard to keep their bank satisfied. I prefer having some leisure time to do something other than pig farming. To get a high added value per animal, contacts with other pig farmers (eg, peer meetings) are very useful. Farm advisers must be able to think along the many aspects of pig farming, and should not be too specialized.

Portrait 3 - pig farmer

I love working with animals on the farm. I enjoy my pigs performing well. Health care of the animals is one of my major topics in farm management and keeps the involuntary replacement costs low. I avoid risks as much as possible. Advice of the farm adviser or veterinarian are a crucial element. Technical and financial recordkeeping has to be done, but it is something I do not like and costs too much time. If the government does not put too many restrictions on pig farming, we can keep our business going for many more years because we keep a good eye on our costs and avoid risks.

Portrait 4 - withdrawer

I am a bit older and probably do not have an heir. I regularly make some new investments on my farm, but I will not expand my farm any more (even if I were allowed to do so). My investments are intended to make farming easier. I do not invest in entirely new developments such as a management information system. The farm advisers and the veterinarian give good advice which I usually implement. Governmental regulations give me an awful lot of paperwork. It is a tough job to keep pace with all of these things.