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COMPUTERISED EFFICIENCY ANALYSIS IN FARM BUSINESS ADVISORY

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ABSTRACT

Danish research and extension organisations have developed a computerised system for the comparative analysis of farmers' past production economic performance. The analysis can be considered a sort of benchmarking whereby individual farmers are compared to similar farmers selected from a central database containing nearly 15,000 Danish farm accounts. This paper gives a description of the new management system and provides some user experiences and ideas for future developments.

INTRODUCTION

This paper describes a new computerised efficiency analysis system for management and advisory purpose that can be used to analyse the individual farmer's productive efficiency*). The development of the new computerised system for efficiency analysis is the result of a cooperation project between the Danish Institute of Agricultural and Fisheries Economics (DIAFE) and the Danish Agricultural Advisory Centre (DAAC). DIAFE is an applied agricultural research institute and DAAC is a national organisation owned by the farmer unions, which supports the local extension offices with information, education and management tools.

The purpose of the computerised efficiency analysis is to improve the farm manager's use of the many production and accounting figures for his business, which he already receives through his existing advisory support. These data can be better utilised if the farmer can use them to identify the strengths and weaknesses of his business operation.

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Because of increasingly dynamic and competitive environment in agriculture, it is important that the farmer takes advantage of his business strengths and seeks to improve the weak points of his present performance. Use of the new system cannot explicitly specify what managerial actions should be taken to improve the future business performance, but it can indicate which economic results are due to poor performance and give ideas for further detailed analyses.

The framework for the efficiency analysis at farm level is summarised in the second section, while the third and fourth sections describe the selection procedures and performance standards available. The fifth section presents the analysis results. The paper closes with a discussion of some experiences obtained from using the presented efficiency analysis in practical extension work and gives some suggestions for future developments. A more comprehensive description is given in a Danish research report, Lund and Ørum (1996).

MODEL FRAMEWORK

The model framework for efficiency analysis at the farm level is depicted in figure 1. As seen in the figure, the computerised efficiency analysis can be considered as a sort of automated benchmarking, where the individual farmer's present accounts are analysed and compared with some estimated standards. The comparison standards are calculated on the basis of actual accounting results obtained from a group of comparable farms. These farms are selected from a central farm accounts database established by DAAC. The central database enables selection of accounts from approximately 15,000 farms.

Although the performance standards are estimated by use of a central database, the benchmarking system is actually used at the local extension office. All 100 Danish local offices have online access to the database and thus have the opportunity to use the system. The efficiency analysis is implemented as an integrated sub-system of the ec90 economy control system, a centralised computer system used by most Danish extension offices. See Landskontorene for Driftsøkonomi (1996).

SELECTION PROCEDURES

In the central accounting database, the farmer's economic adviser chooses the group of farms that should serve as a reference for the farmer in the efficiency analysis. The selected farms are called the reference group.

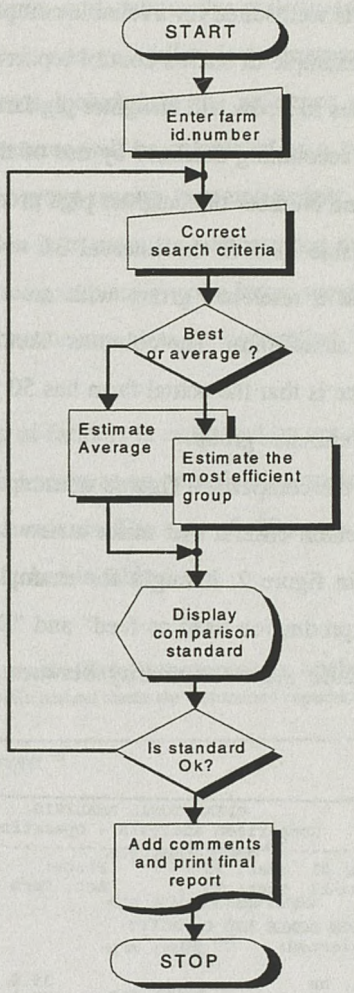

Figure 1. **Model framework for efficiency analysis**

In principle, it is possible to search among all the accounts included in a normal accounting statement when selecting the reference group. However, in order to ease the work of choosing an appropriate number of comparable farms, some a priori criteria for selection have been included in the system. The a priori search criteria include the number of arable hectares, dairy cows, sows and the number of pigs produced. The predetermined criteria will select a sample of farms approximately similar in organisation and size.

A control report enables the adviser or the farmer to check whether or not the selected group of farms is well suited for a reliable comparison with the farmer's own accounting results. An example of such a control report screen is shown in figure 2. This control screen relates to a sow and slaughter pig farm. As shown, 10 farms have been selected from the accounting database by use of three search criteria: Land in use, Number of sows, and Number of slaughter pigs produced. For example, the first criterion limited the arable land to the interval 31 - 47 hectares. Altogether, the chosen criteria result in a reference group with an average of 41 hectares, two hectares more than the actual farm. The columns "Act. farm" and "Average" show that one major difference is that the actual farm has 50 percent higher depreciations than the average of the reference group.

If the adviser finds the comparison figures unacceptable, it may be necessary to redefine some of the search criteria and make a new selection of farms. From the information presented in figure 2, it might for example be an idea to include the items "Cereals of own production used as feed" and "Depreciations" as new search criteria in order to ensure greater similarity between the analysed farm and the reference group.

```
Farm number: 1234            OPERATIONAL ANALYSIS          Screen Page code: DSD
Kristian Landmand     Comparison analysis - operating account
-------------------------------------------------------------------------------
From Day: 01  Month: 01  Year: 95          Place:                 Lower   Upper
To   Day: 31  Month: 12  Year: 95          Act. farm  Average     limit   limit

CONTROL OF PRODUCTION SCALE AND CAPACITY
 Number of farms selected:       10

 Land in use, total, ha                        39.0      41.0      31.0     47.0
 Sales crops, ha                               32.0      36.0
 Number of cows, annual average                                    6.0
 Number of sows, annual average               146.0     142.0     117.0    175.0
 Number of slaughter pigs produced          2,457     2,480     1,966    2,948
 Number of piglets sold, net.                  720       357
 Cereals of own prod. used as feed, Hkg                  614

SUPPLEMENTARY FIGURES (in 1,000 DKK)
 Sundry farm receipts excl. contractor inc.  9,598     6,845
 Contractor and machinery income                      16,805

 Contractor and machinery costs              3,385-   21,997-
 Wage costs                                 84,350-   69,903-
 Depreciations                             281,262-  193,187-

 Operational Profit                        756,359   710,112

=)
-------------------------------------------------------------------------------
PF1: Help       PF3: Menu      PF5: Search    PF9: Undo       PF7: Page up
PF2: Return     PF4: New input PF6: Compare                   PF8: Page down
```

Figure 2. **An example of a control screen**

PERFORMANCE STANDARDS AVAILABLE

By using the search criteria, two options for making an efficiency analysis are available. As seen in figure 1, one possibility is to compare the farmer's accounts with the average of all farms included in the reference group. In this case the benchmark performance measures will be calculated as a simple average where all farms in the chosen reference group receive the same weight.

The other available option is to estimate performance measures where the most efficient farms in the reference group are given a larger weight than the less efficient farms. The calculated performance measures are here called 'the most efficient group' of farms.

The most efficient group of farmers is estimated by use of a linear programming (LP) model. LP is more well-known as an optimising planning tool than as a method for estimation of efficiency standards. The type of efficiency information obtained by solving the LP model are sketched in table 1.

Table 1. **Calculation of most efficient group as an optimisation problem.**
eff marks estimated capacities and profit, and ***act*** marks the constrained capacities determined by the actual farm.

Maximise operational profit ^{eff}		
subject to		
total area ^{eff}	<=	*total area* ^{act}
sales crop area ^{eff}	<=	*sales crop area* ^{act}
cows ^{eff}	<=	*cows* ^{act}
sows ^{eff}	<=	*sows* ^{act}
slaughter pigs produced ^{eff}	<=	*slaughter pigs produced* ^{act}

In the efficiency analysis the LP model is formulated and solved in a manner which identifies the linear combination of farms - selected among all farms included in the reference group - where the operational profit is maximised subject to the constraints that the capacity resources of the farm combination is less or equal to production capacity of the actual farm. Thus, the obtained farm combination is considered efficient in the sense that this constructed "farm" has achieved the highest profit with the utilisation of equal or less capacity resources than the analysed farm.

In table 1 the estimated linear combinations of farms with the highest profit is shown on the left hand side and marked with an index *eff*. The figures of the actual farm are marked with an index *act* as shown on the right hand side of the equation.

It can also be seen that the total area, sales crop areas and number of cows, sows and slaughter pigs produced have been chosen as measures of the capacity constraints in the estimation procedure. These variables are considered to be the best figures at hand as the central database contains very few figures measuring the actual physical capacity of the individual farms, e.g. size of machines and buildings.

The operational profit is defined as the value of total production minus total production costs and thus excludes interest costs, private consumption and tax expenses. These items are excluded from the analysis in order to shed light on the short-term productive efficiency of the actual farm operation. In the case of limited capital funds, the distinction between production and financing might give misleading results. Normally, however, insufficient financial resources might be considered a major constraint in the long-term development of the farm operation.

The main difference between the calculated average efficiency numbers and the efficiency standards estimated by LP is that by the former method all farms are given equal weight while the farms by the latter procedure are given different weights. The individual weights are determined by the LP model according to single farm's realised results. Therefore, the choice between comparison standards calculated as simple average numbers or by the LP procedure should not be based on the argument that the average numbers are more realistic.

Both types of comparison standards are linear combinations of real farms and in this sense do not represent any actual single farm. The main advantage of using the optimisation procedure is that it provides a logical procedure for selecting the most efficient farm units to be included in the standards and gives a straightforward way of estimating the appropriate weight for each of the selected farms. See Lund, Jacobsen and Hansen (1993). Furthermore, this optimisation procedure is grounded on well-established theory, which is not the case when estimating the single average. In order to make an appropriate evaluation of the analysis results obtained, a theoretical foundation is necessary. In the model for most efficient group, the theoretical foundation is that farmers are assumed to maximise their profit by the best utilisation of the available capacity.

It is to be expected that an analysis based on the most efficient group is of particular interest to those farmers who have an above-average performance, but still wish to learn from the best practice attained by other comparable colleagues. The use of average standards could be rationalised from a psychological point of view: if the revealed gap between the analysed farm and the estimated standards is too big, the farmer might be too disillusioned to change the future performance of his operation. Thus, an efficiency analysis based on average standards might be more acceptable to farmers with a significantly below-average technical and economical performance.

PRESENTATION OF THE ANALYSIS RESULTS

The results of the efficiency analysis are presented in a final report. The format for the report is the same whether the analysis has been based on standards estimated as a simple average or by the optimisation procedure. The format adopted is very similar to the format utilised in the accounting system ec90. The intention has been to improve the credibility and usefulness of the efficiency analysis by adopting the accounting concepts and formula which are already well-known and generally accepted among farmers and advisers.

Each report consists of five independent statements:

A profit statement

A cash-flow statement

A summary of the balance sheet

A production statement

A search criteria statement

In general, each of the generated efficiency reports contains a column with the farmer's own accounting figures, a column with the estimated standards - which can be calculated as a simple average or as 'most efficient group' - and a column illustrating the deviations between actual and standard performance on key figures.

The printed report consists of five pages which makes it impossible to show all the analysis results here, but a partial profit statement is shown in figure 3, and a partial production statement in figure 4. The analysis is for a slaughter pig producer and based on average standards. It can be seen from figure 3 that the realised operational profit is above average. Because of a higher production value (TOTAL GROSS OUTPUT) and lower variable costs, the farmer's gross margin is 164,557 DKK

higher than the comparable average figure of the nine farms included in the reference group.

However, the operational profit of the analysed farm is only 19,150 DKK above the average. The main causes for this reduction in the difference between the actual farm and the standards are higher wages and maintenance costs along with higher depreciation costs for the analysed farm.

An example of a production statement is shown in figure 4. Here the farmer may find more detailed explanation of the deviations in the economic results. Furthermore, technical information is often more helpful in the process of improving the future production of the farm compared to aggregated economic figures.

Figure 3 shows that the realised output from sugar beets are 42,000 DKK or 22 pct. below average.

1 Profit and loss report Page 2

	Act. farm	Average	Deviation
		1,000 DKK	
Number of selected farms: 9			
Cereals	169,281	299,458	
Grass seed crops	185,571	49,572	
Sugar beets	146,777	188,901	
Other arable crops	113,901	71,076	
Cattle increase		886	
Pigs increase	953,776	976,045	
Other livestock		24	
Sundry farm receipts	204,189	48,653	
TOTAL GROSS OUTPUT.....	1,773,495	1,634,617	138,878
Seeds	20,861-	38,376-	
Fertiliser	30,505-	46,066-	
Chemicals etc.	47,727-	47,592-	
Hire of contractor and machinery	42,351-	29,175-	
Sundries concerning arable farming	9,877-	11,289-	
Cereals and concentrates	333,291-	362,210-	
Breeding costs, sundries conc. livest.	31,159-	19,203-	
Energy	37,994-	25,533-	
VARIABLE COSTS.....	553,765-	579,443-	25,678
GROSS MARGIN.....	1,219,730	1,055,173	164,557
Wages costs	112,196-	61,179-	
Maintenance	161,742-	113,491-	
Property tax and insurance	50,946-	53,226-	
Sundry costs	71,734-	52,126-	
FIXED COSTS.....	396,618-	280,022-	116,596-
RESULTS BEFORE DEPRECIATION.....	823,112	775,151	47,961
Depreciation	201,903-	173,092-	28,811-
OPERATIONAL PROFIT	621,209	602,059	19,150

Comparison analysis A 01.01.95-31.12.95 Date 14.05.96 GMT 17.11 522-02-1234-

Figure 3. **An example of a profit statement**

Figure 4 specifies that the land used for sugar beets are approximately the same for the analysed farm and the average; but the sugar beet yields are 51,700 kg or 10 pct. below average. In other words, half of the deviation may be explained by lower yields per ha, whereas the other half is probably due to poorer beet quality.

6 Production report Page 4

	Act. farm	Average	Deviation
PIGS			
Number of piglets purchased	2,515	2,580	
Weight purchased piglets, kg	30.0	28.0	
Price purchased piglets, DKK	418	378	
Number of slaughter pigs produced	2,500	2,533	33-
Number of slaughter pigs sold	2,459	2,510	
Price per sold slaughter pig, DKK	798	773	
CROP YIELDS			
kg cereal per ha	75,300	75,300	
kg sugar beets per ha	435,600	487,300	51,700-
kg peas/beans pr. ha	80,300	80,300-	
kg cereals of own prod. used as feed	284,100	267,800	
LAND USE			
Land in use, total, ha	88.8	87.9	0.9
Ha Sales crops, total	79.4	77.2	
Ha cereals	38.7	56.9	
Ha field seeds	18.9	5.5	
Ha oil seeds	11.2	2.6	
Ha sugar beets	10.6	11.1	
Ha peas		1.1	
Ha set aside	9.4	10.3	
Ha grass in rotation		0.1	
Ha permanent grass		0.4	
Ha rented land	58.0	20.6	

Comparison analysis A 01.01.95-31.12.95 Date 14.05.96 GMT 17.11 522-02-1234-

Figure 4. **An example of the production report**

USER EXPERIENCES AND FUTURE DEVELOPMENTS

The experience to date indicates that the developed benchmarking analysis can be used in different ways in the agricultural advisory service. More than 4,000 analyses have been carried out during the last ten months, although the computer programming and final validation is not yet completely finished. Considerable amounts of feedback to the project committee indicate that farmers and local advisers are very satisfied with the new system.

The benchmarking system, for example, has been used to identify and diagnose some overall problems and potential development areas in the farm businesses.

As another example, the efficiency analysis has been used to examine previous years economic results. For a long time, farmers have wanted advisers to evaluate the realised economic results. By making an efficiency analysis as described above, it has now becomes possible for the adviser to make an objective evaluation of past economic performances, which can be discussed with the individual farm manager.

The presented efficiency analysis system can only make an overall analysis, i.e. the information provided is not enough to identify specific actions necessary to improve the future performance of the farm. Much more detailed information could be obtained by a decomposed efficiency analysis. As a first step in such an analysis, the accounting figures are separated into their technical and price components. As a second step the decomposed components are evaluated in comparison to standards obtained from the "best practice" of similar farms.

A decomposed efficiency analysis would allow the farmer and his advisers to identify and analyse more specific problems existing in the farm firm. However, this would require much more data than currently included in the central accounting database used in this project. More practical experience is also needed before it can be decided whether it is cost-effective to extend the developed management and advisory system to include a decomposed efficiency analysis.

REFERENCES

Landskontorene for Driftsøkonomi (1996): *Economy Control 90 - Main purpose and structure*, The Danish Agricultural Adviscory Centre, Århus, Denmark.

Lund, M., Jacobsen, B. H. and Hansen, L. C. E. (1993): *Reducing non-allocative costs on Danish dairy farms: Application of non-parametric methods*, European Review of Agricultural Economics 20 (1993): 327-341.

Lund, M. and Ørum, J. E. (1996): *Effektivitetsanalyser på landbrugsbedriften - en beskrivelse af sammenligningstal (Efficiency analyses on the farm)*, Report nr. 88, Danish Institute of Agricultural and Fisheries Economics, Copenhagen.

BIOGRAPHICAL SKETCH

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