S. Afr. J. Anim. Sci. 3, 169–172 (1973)

FORECASTING RESEARCH REQUIREMENTS FOR PIGS – A SUGGESTED METHOD

S.D. Parsons and D.H. Holness

Department of Agriculture, University of Rhodesia, Salisbury, and

Department of Research & Specialist Services, P. Bag 222A, Salisbury.

In recent years there has been an increasing tendency for donors of research funds throughout the world to exercise their prerogative in calling for a critical examination of the nature and usefulness of research conducted by the recipients of their funds. In particular, this changing attitude has required research institutions to examine the requirements of the industries concerned and to evaluate research productivity in terms of development inspired by research innovations (du Plessis, 1969). Not surprisingly the trend toward "mission orientated" research has resulted in critical examination of the objectives of research institutions (Donovan, 1969) and growing emphasis on research management (Bosman, 1969, 1970). As a consequence, several techniques for the determination and clarification of research objectives have been developed (Anderson, 1972). The application of decision making techniques to research problems is as yet in its infancy and by and large involves sophisticated forms of analysis which are unlikely to find widespread application in the near future. Such techniques as linear programming and simulation models, which enable the handling of large amounts of data and the *a priori* determination of possible outcomes of research findings require in turn a specialized training. Few biological scientists have such training and it is unlikely that they will be prepared to deviate from their chosen vocation to acquire it.

Certainly, there is a dearth of information in Southern Africa on the objective allocation of limited resources, both human and capital, to alternative research projects. Clearly when resources are limited it is the function of Research Councils and Research Directors to determine the order of priority of research projects. Presumably the allocation of priorities to such projects is currently undertaken on the assessment of project proposals made by the research workers involved, and within the framework of the compatability of the proposed research with the on going programme of the institute. Such subjective assessments are necessary, simply because no objective quantitative method of forecasting the needs of industry is as yet generally available.

The purpose of this paper is to present a technique occasionally used in determining vital control areas in the production process and to examine the applicability of this technique for research forecasting purposes. The technique as employed for mangement purposes is known as Vital Factor Analysis (VFA) and is described by Lloyd (1967). Its purpose as so employed is to rank the various factors of production in order of their influence on the gross margin* (or profit) of an enterprise. Since vital factor analysis is directly concerned with the profitability of an enterprise, we would suggest at the outset, that its application to research forecasting would be limited to developmental research in a direct manner, and indirectly to applied research. To use the terminology employed by Bosman (1970), VFA might have application to directed research but almost certainly not to fundamental (non-directed) research.

Since directed research projects must be selected to result in maximum economic gains in the industry, it is obvious that the economic efficiency of the production system must be considered in determining which research projects should be selected.

Typically, the available economic data is presented in the form shown in Table 1. Obviously from these data, the methods employed by those "superior" producers are more remunerative than those of the average producers. However, from the above data it is also possible to directly identify at least four factors (number of litters, pigs weaned/litter, pounds of pork/litter and market price) which could influence the financial margin. Possibly several more factors could be identified with more complete data. However, the significance of Table 1 is that the data are presented in a form which does not readily enable the determination of the relative importance of each of these factors. For example, it is conceivable that number of pigs per litter is a major contributory factory to profitability while the number of litters per farm is not, but from the available data there is no means of allocating a priority rating to these factors. Vital factor analysis serves to isolate independently the impact of each factor on gross margin.

Table 1

Selected Data from Average and "Superior" Hog Enterprises, 1968 (Mucller, 1970).

	Average Producers	Superior Producers
No. of litters	77	163
No. of pigs weaned/litter	7,3	8,5
Pounds of pork/litter	1 679	1 904
Market price per 100 lbs. sold ($)	18,54	19,23
Returns above feed cost/litter ($)	127	180
Feed cost per 100 lb gain ($)	10,88	10,19

Derivation of Vital Factor Analysis

The usual starting point of VFA is a gross margin table showing the source(s) of income and of expenditure (Appendix 1). From this table the factors likely to affect profits are extracted. These factors are tabulated in column 1 (Table 2) for analysis. Column 2 shows the level of the factor in physical as opposed to monetary terms of the

* gross margin = gross income – variable costs.

Table 2

Vital Factor Analysis Derived from Gross Margin Data (Appendix 1).

Factor (1)	Standard (2)	Change in Standard (3)	Percentage Standard (4)
Pigs marketed/sow/annum	13	0,0534	0,41
Pigs/litter	7,2	0,0074	0,103
A grade (%)	80	1,479	1,85
A grade price (c/kg)	44,5	0,160	0,36
Other grade price (c/kg)	35,75	0,64	1,79
Sow feed (kg)	1 200	-18,86	1,57
Sow feed cost ($/tonne)	53	- 0,83	1,57
Creep feed (kg)	141	-18,52	13,13
Creep feed cost ($/tonne)	54	- 7,12	13,13
Bacon feed (kg)	3 592	-20,0	0,56
Bacon feed cost ($/tonne)	50	- 0,28	0,56
Man days	22	- 1,82	8,27
Wage/man day ($)	0,55	- 0,045	8,18
Boar price ($)	100	-40,0	40,0
Sows/Boar	20	-13,3	66,56
Building space (M^2)	16	- 0,95	5,9
Annual building cost (per M^2)	1,05	- 0,063	5,95

population under consideration (standard level). In column 3 the amount of change in the standard level required to effect a unit ($1 in this case) increase in gross margin is set down.

Calculation of Column 3.

The figures shown in column 3 correspond to the marginal or incremental concept of economic analysis. For example, one more pig per sow per annum would not change the price per kilogram and is assumed not to change the percentage of A-grade pigs marketed. Hence gross income per sow would increase by the value of one baconer, or by $25,65. Offset against this increase in income are increased feed costs calculated from the increased requirements of one extra pig marketed. Thus the total requirements for sow, creep and bacon feed increase by 15,91; 10,84 and 276,3 kg respectively for a total increase of expenditure of $6,92 at prevailing feed prices. Again it is assumed that the building requirements, labour requirements and boar costs are related to the sow rather than to the individual baconer marketed and therefore these costs do not increase. Should this not be the case, it would be a simple matter to increase costs in proportion to the individual pig's requirements. The net result of increasing number of pigs marketed per sow is that gross margin increases by $18,73 ($25,65 – 6,92). Therefore, to achieve a one dollar increase in margin would require 0,0534 ($^1/18,73$) increase in the number of pigs marketed per sow.

Ranking the importance of factors affecting profit.

In order to facilitate the comparison of factors represented by diverse units (e.g. number of piglets per litter versus feed requirements in kilograms) the change in the factor required to increase gross margin by $1 (column 3) is expressed as a percentage of the standard level (column 2). This percentage is shown in Column 4. Thus in Table 2 we find that the factor which requires the least amount of change to effect a unit increase in gross margin is the number of pigs per litter (0,10 %), followed by the A grade price of baconers and the number of pigs marketed per sow per year (0,41 %). The three least sensitive factors in this analysis are: the number of sows per boar (66,5 %), the price of (40%) and price and quantity of creep feed used (13,1 %). Thus using a vital factor analysis it is possible to rank the relative importance of the factors which affect profit for any particular situation and set of conditions. However, two questions remain unanswered. These concern, a) the stability of the relative ranking with improving technological environments and b) the potential for improvement of any single factor.

Stability of rank

One would anticipate that as the technological environment improved, through the efforts of research and extension, factors that were regarded as critical might become less so and vice versa. To test this theory hypothetical data were selected for a "poor" level of technology approximating the standards which might have been expected to exist on the better commercial farms in the 1950's and a "good" situation equivalent to current demonstration farms. The V.F.A. for these conditions is shown in Appendix 2 and summarized in Table 3. Comparison shows a surprisingly small variation in the relative ranking of the factors as "technological level" improves. This suggests that

Table 3

Percentage change in factor required for a $1 increase in gross margin and rank of factor importance, for "poor" and "good" levels of technology.

Factor	Percentage change in Factor		Rank of Factor Importance	
	"Poor"	"Good"	"Poor"	"Good"
Pigs marketed/sow/annum	0,64	0,29	2	3
Pigs marketed/litter	0,16	0,08	1	1
A grade (%)	3,29	1,23	7	5
A grade price (c/kg)	0,96	0,24	4	2
Other grade price (c/kg)	1,3	3,27	5	7
Sow Feed (kg)	1,68	1,65	6	6
Sow feed cost ($/tonne)	1,68	1,64		
Creep feed (kg)	37,0	12,35	10	10
Creep feed cost ($/tonne)	37,0	12,35		
Bacon feed (kg)	0,73	0,47	3	4
Bacon feed cost ($/tonne)	0,68	0,47		
Man days	6,7	9,28	9	9
Wage/man day($)	6,7	9,33		
Boar price ($)	57,0	33,34	11	11
Sows/boar	133,0	50,0	12	12
Building space (M^2)	6,1	4,9	8	8
Annual building cost ($1/$M^2$)	6,6	4,79		

for pig production, and for the factors selected, the order of importance in husbandry research has not changed much over the past 20 odd years, and may not change radically in the foreseeable future. However, it may well be that as research on a particular factor has advanced so the potential for change in that factor diminishes. This phenomenon would be consistent with the law of diminishing returns whereby an incremental unit of input (research effort) yields an increasingly diminishing output (improvement in the factor under consideration).

As the degree of factor improvement diminished, research effort could logically be devoted to other factors which had been less well researched, but only if it was anticipated that the overall return to the enterprise would be greater from such substitution of one factor for another.

In reality, of course, these various factors interact with one another so that improvement in a secondary factor increases the potential for improvement in a primary factor. For example, with a given type of building the heritability of feed conversion efficiency may be so low that improvement by selection is not worth the cost of measurement and data processing. If building design is now improved in such a way as to allow better control of the environmental variation, the heritability may be increased to a degree which could make selection for improvement of feed conversion efficiency economically feasible.

Forecasting Research Results

The greatest difficulty that arises concerns the estimation of the improvement that will result from a particular research project. By definition planning involves forecasting and unfortunately no simple technique has yet been evolved which circumvents man's role in this difficult task. Certainly there are methods which facilitate forecasting. For example, the commonly used scientific technique of literature review followed by causative analysis (Bosman, 1970), and the more recently described approach of decision theory (Dillon 1971).

However, the vital factor analysis described above is of little assistance in forecasting and is mainly of value in guiding research towards the more economically important areas requiring research. Several more sophisticated techniques such as linear programming and model simulation are also available for this purpose. Although they are almost certainly of greater value than V.F.A. when correctly used, it is felt the method described above has more universal application since it does not require specialist staff for implementation.

References

ANDERSON, J.R., 1972. Allocation of resources in agricultural research. *J. Aust. Inst. Agric. Sci.* 38 (3), 191.

BOSMAN, D.L., 1969. Research and development – a prerequisite for economic progress in industry. *C.S.I.R. Research Unit.* 1: 65.

BOSMAN, D.L., 1970. The management of research and development for results. *Wood and fibre,* 1 (4); 290.

DILLON, J.L., 1971. An expository review of Bornoullian Decision Theory in agriculture. Is utility futile? *Rev. Mktg. agric. Econ.* 39:3.
DONOVAN, P.A., 1969. The objectives and organisation of agricultural research. *Proc. Conf. research and the farmer.* Dept. Res. Spec. Serv. Salisbury: Government Printer.
DU PLESSIS, S.J., 1969. Future trends in research, with particular reference to agricultural research. *Proc. Conf. research and the farmer.* Dept. Res. Spec. Serv. Salisbury: Government Printer.
LLOYD, D.H., 1967. Business control in poultry keeping through records, costing and forward estimating. *Min. Agric. Fish. Food. Bull. 191,* London: H.M.S.O.
MEULLER, A.G., 1970. Economic significance of reproduction in the hog enterprise. *Proc. conf. maximising reproductive efficiency of swine.* University of Illinois publication 1970.

Appendix 1

*Gross Margin/Sow/Annum ($) **

Gross income		$ 333,45
Variable costs		
Feed costs		250,81
Sow	63,60	
Creep	7,61	
Bacon	179,60	
Labour		12,10
Share of boar		2,50
Buildings (annual cost)		16,80
Total variable costs		282,21
Gross margin		51,24

*Derived from:

1) Sixth Annual Report of Farm Management Data, Econ. & Mkts Branch, Ministry of Agric. Salisbury 1972.

2) Comparative Figures (1970/71). Management Advisory Service, Rhod. Nat. Farmers Union, Rhod. Farmer Pub, Salisbury.

Appendix 2

Vital Factor Analysis for "Poor" and "Good" levels of technology on Pig Farms

	POOR			GOOD		
		Change Required			Change Required	
	Standard	Actual	Percent	Standard	Actual	Percent
Pigs marketed/sow/annum	9	0,058	0,64	17	0,05	0,29
Pigs marketed/litter	6	0,01	0,16	8,09	0,006	0,08
A grade (%)	65	2,14	3,29	92	1,13	1,23
A grade price (c/kg)	44,5	0,4275	0,96	44,5	0,11	0,24
Other grade price (c/kg)	35,75	0,463	1,3	35,75	1,17	3,27
Sow Feed (kg)	1120	-18,86)	1,68	1145	- 8,86)	1,65
Sow Feed cost ($/tonne)	53	- 0,89)		53	- 0,87)	
Creep feed (kg)	50	-18,52)	37,0	150	-18,52)	12,35
Creep feed cost ($/tonne)	54	-20,00)		54	- 6,67)	
Bacon feed (kg)	2757	-20,00)	0,725	4258	-20,00)	0,47
Bacon feed cost ($/tonne)	50	- 0,34)		50	- 0,23)	
Man days	30	- 2,0)	0,67	18	- 1,67)	9,33
Wage/man day ($)	0,50	- 0,033)		0,60	- 0,06)	
Boar price ($)	70	-40,0	57	120	-40,0	33,34
Sows/boar	20	+26,7	133	20	+10,0	50
Building space (M^2)	18	- 1,1	6,1	14	- 0,69	4,9
Annual Building cost ($\$1/M^2$)	0,91	- 0,06	6,6	1,40	- 0,07	4,79