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Articles in the field of agricultural economics, suitable for publication in the journal, will be welcomed.

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The measurement of managerial inputs in agriculture

IV Application with business results*

by

A.A. JANSEN,** G.H. SWANEPOEL***
AND J.A. GROENEWALD****

INTRODUCTION

In order to test the scale of managerial aptitude, as developed by Burger,¹⁾ in an economic framework, these data were later collected together with farm management data in a management survey carried out in the Letaba district of the Northern Transvaal lowveld.

The analysis was based on a premise that the farmer's managerial aptitude, together with his use of this aptitude may be regarded as a quantitative measurement of his managerial inputs. Full-time farmers may be expected to utilise their aptitudes more fully than part-time farmers.

If it is accepted that the scale of managerial aptitude constitutes a measurement of managerial inputs, then managerial aptitude must exert a clear effect on farm management results. The nature of this effect will also be very important; although much has been speculated about the effects of managerial input or ability it has not, as far as could be ascertained, been determined empirically.

DESCRIPTION OF AREA OF APPLICATION

Due to the heterogenous nature of the Letaba district, it had to be subdivided into agro-economic subregions before management results could be analysed and interpreted. The district was divided into ten agro-economic subregions on the basis of climatological, soil, biological and eco-

nomic characteristics.²⁾ Farm management analyses were done in nine of these.³⁾ The nine subregions are:

1. The Mooketsi Area is the most westernly situated subregion. It is relatively flat and its average annual rainfall varies between 600 millimetres in the lower, and 1 000 millimetres in higher parts. Average farm size was 279 hectares; of this area, 17 hectares were under irrigation whilst 41 hectares were under dryland cultivation. The main crop was tomatoes, which yielded 89 per cent of gross farm receipts in the year of the survey. Total capital investment amounted to an average of R44 218 per farm, consisting of an investment of R35 994 (81 per cent) in land and fixed improvements, whilst investment in machinery and implements amounted to R6 258 (14 per cent). The average net farm income was R2 449.⁴⁾

2. The Duiwelskloof Forestry region lies between the Mooketsi area, the Transitional area, the Tzaneen Smallholdings region and Pietersburg district. The average farm size is 217 hectares, and it has a high annual rainfall (average 1 336 millimetres). It is a mountainous region, and production consists largely of forestry and fruit mainly avocados and citrus) which respectively yielded 38 per cent and 49 per cent of the gross farm income. Total capital investment amounted to an average of R103 489 per farm, of which R97 519 (94 per cent) consisted of investment in land and fixed improvements. Average net farm income was R8 533.

2) See Jacobs, Z.H. (1968). 'n Agro-ekonomiese indeling van die Letabagebied. M.Sc. (Agric.) thesis, University of Pretoria.

3) Corporate estates and State forestry plantations of which many are found in the Letaba district, were not included in the samples.

4) Swanepoel, G.H. (1969). 'n Bedryfsekonemiese ondersoek na sekere boerdertipes in die Letabadistrik. M.Sc. (Agric.) thesis, University of Pretoria.

5) Jansen, A.A. (1968). 'n Ekonomiese evaluering van kleinboerderyeenhede in die Letabadistrik. M.Sc. (Agric.) thesis, University of Pretoria.

* This article is partially based upon M.Sc. (Agric.) theses handed in at the University of Pretoria by Messrs. Jansen and Swanepoel.

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1) Burger, P.J. (1971). The measurement of managerial inputs in agriculture. III. The construction and evaluation of a scale. Agrekon, Vol. 10, No.4.

3. The Tzaneen Smallholdings region consists of smallholdings around Tzaneen. Many occupiers are pensioners or persons with jobs in Tzaneen. The average size of the holdings is 26 hectares, average annual rainfall amounts to 981 millimetres and total capital investment was R26 000 per holding. Land and fixed improvements contributed 90 per cent (R23 540 per holding) to capital investment. The most important farming activities were production of fruit (mainly avocados, citrus and pawpaws) and field crops (mostly cotton) which respectively yielded 56 per cent and 18 per cent of gross farm receipts. Average net farm income amounted to only R247, whilst holders received an average revenue of R1 975 from other sources.⁶⁾

4. The New Agatha Highlands is situated south from Tzaneen and is bordered by the Tzaneen Smallholding region, Duiwelskloof Forestry region, Letsitele Valley and the Mhulava Bantu area. It is a mountainous area. Landholders consist partially of full-time farmers and partially of part-time farmers, similar to those on the Smallholdings. This area is high above sea level and average rainfall amounts to 1 161 millimetres per annum. The average farm size was 93 hectares, of which 51 hectares (54 per cent) were taken up by forestry plantations. On the average, 14 morgen (13 per cent) were under irrigation. The main enterprises were fruit (largely avocados and bananas) which yielded 51 per cent, and forestry products which yielded 44 per cent of gross farm receipts. Capital investment amounted to an average of R44 499 per farm, of which 94 per cent consisted of investment in land and fixed improvements. Average net farm income amounted to R3 156, whilst holders received an average of R2 369 from other sources.⁷⁾

5. The Letsitele Valley is a fertile valley between mountains, and is bounded in between the New Agatha Highlands and the Mhulava Bantu area. The average annual rainfall varies between 900 and 1 200 millimetres. The Letsitele River which flows through the valley is the main source of irrigation water. Average farm size was 150 hectares, of which 23 per cent (34 hectares) was under irrigation, whilst 6 per cent (9 hectares) was used for dryland cultivation. Plantations covered an average of 12 hectares (8 per cent of the total size) per farm. The main sources of income were fruit (particularly citrus and bananas) and vegetables (mainly tomatoes), which yielded 73 per cent and 16 per cent of gross farm receipts respectively. Average capital investment amounted to R58 212, of which 90 per cent (R52 080) consisted of investment in land and fixed improvements. In 1966/67 the average net farm income amounted to R3 440.⁸⁾

6. The Letaba River area is a narrow, flat strip on both sides of the Great Letaba River and stretches from Letsitele Station to the Kruger National Park. Average annual rainfall varies be-

tween 500 millimetres in the east and 800 millimetres in the west. Irrigation water is obtained from the Letaba River, and water shortages crop up periodically, including the year of the survey. The average farm size was 403 hectares, of which 17 per cent (68 hectares) was irrigated, 10 per cent (39 hectares) cultivated dryland and 69 per cent (279 hectares) taken up by natural grazing. Average capital investment amounted to R121 814 of which R106 039 (87 per cent) consisted of investment in land and fixed improvements. Fruit (mainly citrus) and vegetables (mainly potatoes, pumpkins and tomatoes) were the most important enterprises, yielding respectively 62 and 30 per cent of gross farm revenue. Average net income per farm amounted to R6 954.⁹⁾

7. The Transitional area lies between the Letaba River area to the east, Bantu areas to the north and south, whilst the Tzaneen Smallholdings and Duiwelskloof Forestry regions are situated west of this area. This area's soils are mostly shallow, and average annual precipitation is 1 035 millimetres. Farm sizes were 368 hectares in the average, of which 36 hectares (10 per cent) were irrigated and 128 hectares (35 per cent) under plantations. Fruit (mainly pawpaws, bananas, mangoes and citrus), vegetables (mostly tomatoes and pumpkins) and forestry products contributed 81, 8 and 6 per cent respectively of gross farm receipts. The farms yielded an average net income of R4 865 whilst average capital investment amounted to R80 943, of which 93 per cent was taken up investment in land and fixed improvements.¹⁰⁾

8. The Trichardtsdal region is called thus because the hamlet of Trichardtsdal is in its centre; it is bordered by the Drakensberg in the west, Bantu areas in the north and south and the Cattle Ranching area in the east. Average annual rainfall varies between 700 millimetres in the east and 1 000 millimetres in the west, and irrigation water is obtained from the Selati River and mountain streams. This region is virtually frost-free, and fruit (largely bananas, pawpaws and mangoes) yielded 36 per cent of gross receipts, while vegetables (mostly tomatoes and potatoes) yielded 44 per cent. Average farm size was 433 hectares, of which 68 hectares (16 per cent) and 39 hectares (9 per cent) were under irrigation and dryland cultivation respectively. Average capital investment amounted to R75 539. Of this, R65 066 (86 per cent) consisted of investment in land and fixed improvements. The farms yielded an average net income of R4 271.¹¹⁾

9. The Cattle Ranching area is situated to the east of the Letaba River and Trichardtsdal areas, west of the Kruger National Park, and to the north of the Pilgrims Rest district. In contrast to the other subregions of the Letaba district, a large proportion (39 per cent) of the farms in this area are rented farms, being rented from the Department of Mines on a tender basis. En-

6) Ibid.

7) Ibid.

8) Swanepoel, G.H., op. cit.

9) Ibid.

10) Jansen, A.A. op. cit.

11) Swanepoel, G.H., op. cit.

couragement to improve the farms over the long run is, therefore, absent in many cases. The average annual precipitation is about 550 millimetres, and only 14 hectares (0,7 per cent) of the total average farm area of 2 175 morgen were cultivated. Cattle contributed 75 per cent of gross farm incomes, whilst other livestock and vegetables (mainly pumpkins and tomatoes) contributed 8 per cent each. Total investment amounted to R56 500 per farm. Of this amount, R36 826 (65 per cent) consisted of investment in land and fixed improvements, whereas R16 752 (30 per cent) was invested in livestock. Net farm income amounted to R2 067 per farm.¹²⁾

DISTRIBUTION OF MANAGERIAL APTITUDE

The scores on the scale of managerial aptitude caused farmers to be distributed as shown in Table 1.

Arranged in the order of the average index of managerial aptitude, (high to low) the subregions appear as follows:

Duiwelskloof Forestry, Letaba River, Transitional, Trichardtsdal, Mooketsi, Tzaneen Smallholdings, Letsitele Valley, Cattle Ranching and New Agatha Highlands. It is remarkable that in an arrangement of subregions in the order of net income, the first four subregions are in the same order; the only subregions with radically different positions are Mooketsi and the Tzaneen Smallholdings, respectively in the seventh and last places on a gradation of net farm income.

The smallest variation in managerial aptitude was encountered in the Transitional area with a coefficient of variation amounting to only 7,8 per cent. The Duiwelskloof Forestry region exhibited the second lowest coefficient of variation (14,4 per cent); the coefficients for Mooketsi, Tzaneen Smallholdings, New Agatha Highlands, Letaba River and Trichardtsdal varied between 18,3 and 28,5 per cent. The Letsitele Valley had a much higher coefficient (62 per cent), and the Cattle Ranching area showed the largest variation with a coefficient of 103,9 per cent. This high variation in the Cattle Ranching area may, to some extent, be ascribed to its tenure system; one may expect people who rent their farms to devote less attention to the business side of their ventures than farmers who own their land.

EFFECT OF MANAGERIAL APTITUDE ON BUSINESS RESULTS

The effect of managerial aptitude will be illustrated in two ways - an ordinary tabular analysis devoid of statistical significance tests in which average gross and net farm incomes of groups of farmers in different managerial aptitude intervals are compared, and a statistically fitted production function with managerial aptitude being used as a measurement of managerial inputs.

Some factors may exert a serious influence on the results or their statistical significance:

1. The large number of rented farms in the Cattle Ranching area may cause a large variance of calculated coefficients, thereby causing these coefficients to be less significant. This expectation is based on the findings of Smith¹³⁾ that private owners on the Loskop and Hartebeespoort irrigation schemes used their resources more efficiently than renters and land-letter holders. Blignaut¹⁴⁾ came to similar conclusions in the Marico Bushveld irrigation complex and also found private owners to move along a higher production function than other settlers.
2. On the New Agatha Highlands and Tzaneen Smallholdings, many people practise farming as a subsidiary venture, and it is to be expected that these persons will not apply their managerial skills as productively as full-time farmers.
3. The low coefficients of variation in the Transitional area with regard to managerial aptitude may cause the effect of this variable not to be measurable in a realistic sense.
4. The small sample sizes in the Letsitele Valley and Transitional area may have a disadvantageous effect on the significance of results - in both a logical and statistical sense.¹⁵⁾

The tabular analysis is done with the aid of Table 2.

According to Table 2, both gross and net farm incomes increased sharply with increased managerial aptitude in the following subregions: Duiwelskloof Forestry, Tzaneen Smallholdings, New Agatha Highlands, Letsitele Valley and Letaba River. In Mooketsi, Trichardtsdal and the Cattle Ranching area general upward trends were also encountered with interruptions, while the scale of managerial aptitude evidently did not show any important effect on financial results in the Transitional area - probably as a result of reasons already mentioned.

Thus it appears that a positive relationship existed between managerial aptitude and financial results in eight of the nine subregions.

PRODUCTION FUNCTION ANALYSES

Cobb-Douglas type production functions were also fitted to the data. Managerial aptitude, as a means of measuring managerial inputs, was used with inputs of land, capital and labour to determine the relationship between inputs and gross production value.

- 13) Smith, D.J.G. (1962). Die doeltreffendheid in die gebruik van landbouhulpbronne onder verskillende toestande van grondbesetting van die Loskop- en Hartebeespoortbesproeiingskema. D.Sc. (Agric.) dissertation, University of Pretoria.
- 14) Blignaut, C.S. (1966). 'n Sosio-ekonomiese vergelyking tussen verskillende besettingsvorme in die Marico-Bosveldbesproeiingskompleks. M.Sc. (Agric.) thesis, University of Pretoria.
- 15) Efforts to draw larger samples in these areas were not successful.

12) Ibid.

TABLE 1 - Distribution of farmers in the Letaba district according to scale of managerial aptitude, 1966/67

Agro-economic subregion	Frequency class (points)								Total sample size	Arith-metic mean	Standard devia-tion	Coeffi-cient of va-riation
	0-15		16-20		21-25		26-30					
	a	b	a	b	a	b	a	b				
		%		%		%		%				%
Mooketsi	4	18,2	11	50,0	4	18,2	3	13,6	22	19,9	4,60	23,1
Duiwelskloof												
Forestry	0	0	2	10,5	12	63,2	5	26,3	19	24,1	3,48	14,4
Tzaneen												
Smallholdings	13	29,5	9	20,5	17	38,6	5	11,4	44	19,7	5,45	28,5
New Agatha												
Highlands	6	31,6	5	26,3	7	36,8	1	26,0	19	17,7	4,41	24,9
Letsitele												
Valley	1	8,3	7	58,4	4	33,3	0	0	12	19,5	12,09	62,0
Letaba River	0	0	8	36,4	6	27,2	8	36,4	22	22,9	4,26	18,6
Transitional area	0	0	3	21,4	11	78,6	0	0	14	21,6	1,68	7,8
Trichardsdal	1	4,8	7	33,3	9	42,9	4	19,0	21	21,2	3,87	18,3
Cattle Ranging area	9	29,0	7	22,6	12	38,7	3	9,7	31	19,0	19,74	103,9

a = number of cases

b = percent of total sample

TABLE 2 - Relationship between managerial aptitude and financial results per farm, Letaba district 1966/67

Item	Index of managerial aptitude (points)			
	0-15	16-20	21-25	26-30
<u>Mooketsi</u>				
Gross farm income	2 375	18 164	13 718	28 593
Net farm income	-1 771	3 667	764	5 573
<u>Duiwelskloof Forestry</u>				
Gross farm income	-	6 249	9 859	39 871
Net farm income	-	204	3 776	19 318
<u>Tzaneen Smallholdings</u>				
Gross farm income	1 259	1 274	4 867	7 615
Net farm income	-194	-744	53	2 758
<u>New Agatha Highlands</u>				
Gross farm income	2 595	4 577	7 140	56 493
Net farm income	291	1 754	3 926	22 143
<u>Letsitele Valley</u>				
Gross farm income	5 451	7 775	23 734	-
Net farm income	1 025	1 269	7 716	-
<u>Letaba River</u>				
Gross farm income	-	21 173	44 115	27 241
Net farm income	-	4 941	5 268	10 195
<u>Transitional</u>				
Gross farm income	-	12 315	12 278	-
Net farm income	-	4 620	4 063	-
<u>Trichardsdal</u>				
Gross farm income	2 460	16 512	15 911	34 253
Net farm income	-1 853	523	4 548	11 866
<u>Cattle Ranching area</u>				
Gross farm income	3 409	5 512	7 712	6 992
Net farm income	460	621	3 451	1 959

The Cobb-Douglas type production function has the following form:

$$Y = b_0 X_1^{b_1} X_2^{b_2} \dots X_n^{b_n}$$

with Y = gross value of production

$X_1 - X_n$ = quantity of inputs of $X_1 - X_n$

b_0 = calculated intercept

$b_1 - b_n$ = calculated coefficients

The values $b_1 - b_n$ are the elasticities of production of the inputs. These elasticities are constant in the Cobb-Douglas type function. Elasticity of production can be presented algebraically as follows:

$$\frac{\delta Y}{\delta X_i} \cdot \frac{X_i}{Y} = \frac{\text{Marginal product}}{\text{Average product}}$$

The sum of elasticities, i.e. $\sum_{i=1}^n b_i$ gives the returns to scale. If larger than one, it indicates increasing returns to scale, if equal to one, it indicates constant returns to scale, and if smaller than one, it indicates diminishing returns to scale.

Four different selections were made and fitted by means of least squares regression.

In the four selections, managerial inputs are defined according to the scale of managerial aptitude in each case, but inputs of other resources are defined according to different criteria, as follows:

Land : Land value, area in hectares.

Labour : Labour costs, labour days.

Capital : Depreciation, interest, total capital investment (excluding land), variable capital and fixed capital (including land).

The t-test was used to determine whether elasticities of production deviated statistically significantly from zero, and also to determine whether returns to scale showed statistically significant differences from one. The multiple correlation coefficient was tested for significant deviation from zero by means of the F-test.

The calculated results are given in Tables 3, 4, 5 and 6; in the ensuing discussions attention will be bestowed only on managerial aptitude, and not on other inputs.

The coefficients of determination indicate that a large proportion of the variance in gross farm income is explained by the models - with the exception of the Cattle Ranching area, between 70,2 and 96,1 per cent of the variance in the dependent variable is in each case explained by the independent variables. In the Cattle Ranching area, the models accounted for between 48 and 51 per cent of the variance. The significance of the multiple correlation coefficients indicate a good fit between models and data.

In Mooketsi, the Duiwelskloof Forestry region and Trichardtsdal, the elasticity of production of

managerial aptitude consistently differed significantly from zero. The coefficients all exceeded one, indicated that in these subregions increasing, rather than diminishing marginal returns, are prevalent regarding managerial inputs. In all four selections the sums of elasticities for the Duiwelskloof Forestry region and Trichardtsdal, which in every case exceeded one, was also statistically significant from one. In Mooketsi the sum of elasticities showed significant differences from one in selections 2, 3 and 4. It may thus be concluded that these three subregions show increasing returns to scale. With the exception of the Tzaneen Smallholdings, where the units are so small that enlargement of these is required in order to achieve full utilisation of other inputs, none of the other regions' sums of elasticities deviated significantly from one. Thus it has to be accepted that constant returns to scale prevail in those subregions. It may be added that increasing returns to scale have seldom been encountered in agriculture; empirical studies in South Africa¹⁶⁾ as well as overseas¹⁷⁾ indicated constant returns to scale almost without exception. Those studies did not, however, include management as an input. When the functions concerned in the cases of the Duiwelskloof Forestry region, Mooketsi and Trichardtsdal were fitted with the same definitions of land, labour and capital, but without management as an input, the results indicated constant returns to scale. It may thus be accepted that managerial aptitude was the factor leading towards increasing returns to scale.

16) See for example: Heady, Earl O. and du Toit, Schalk J. van N. (1954). Marginal resource productivity for agriculture in selected areas of South Africa and the United States. *Journal of Political Economy*, Vol. 63.

Behrmann, H.I. (1959). A study of the economics of sugar-cane production in Natal. Ph.D. dissertation, University of Natal.

Smith, D.J.G., *op. cit.*

Blignaut, C.S., *op. cit.*

Diemont, J. (1967). 'n Sosio-ekonomiese evaluering van huurders op die Sterkrievier-nederstelling. M.Sc. (Agric.) thesis, University of Pretoria.

Kassier, W.E. (1966). A production function study of marginal returns and optimum intensity on East Griqualand farms. *South African Journal of Economics*, Vol. 34.

Le Clus, C.F. (1969). Die ekonomie van Griekwaland-Oos met besondere verwysing na die landbou. M.Sc. (Agric.) thesis, University of the O.F.S.

De Swardt, J.B. (1965). Die besluitnemingsproses by tafeldruifboere in die Hexrivier-vallei. D.Sc. (Agric.) dissertation, University of Pretoria.

17) Cf. Heady, Earl O. and du Toit, Schalk J. van N., *op. cit.* Heady, Earl O. and Dillion, John L. (1960). *Agricultural production functions*. Iowa University Press, Ames.

TABLE 3 - Elasticities of production and related statistical results as obtained from selection 1 with the Cobb-Douglas production function, Letaba district, 1966/67

Area	Intercept (b_0)	Elasticities of production (b_i)						Multiple correlation coefficient (R)	Coefficient of determi- nation (R^2)	t-value for deviation of Σb_i from 1,0
		Land value	Labour costs	Depre- ciation	Interest (a)	Managerial aptitude	Sum of elasticities (Σb_i)			
Mooketsi	0,002	0,122	0,826**	0,382	-0,167	2,110*	3,273	0,849***	0,720	1,520
Duiwelskloof Forestry	0,117	-0,052	0,167	0,848	-0,552	2,734**	3,175	0,877**	0,770	2,000*
Tzaneen Smallholdings	0,001	0,746**	1,073**	-0,207	0,062	0,421	2,094	0,873***	0,762	3,481***
New Agatha Highlands	0,0004	0,271	1,369*	1,218	-0,735	0,087	2,210	0,891**	0,793	0,748
Letsitele Valley	0,223	-0,018	1,512@	-0,164	-0,335	0,822	1,817	0,904*	0,816	0,469
Letaba River	6,270	-0,136	0,641*	0,736	-0,156	0,007	1,091	0,882***	0,778	0,094
Transitional	0,918	0,272	0,265	-0,168	1,330	-1,032	0,667	0,944**	0,891	0,102
Trichardtsdal	0,003	-0,044	0,893**	0,500	-0,273	2,236***	3,312	0,941***	0,885	3,039**
Cattle Ranching area	1,287	0,226	0,024	-0,090	0,487	0,991	1,637	0,714***	0,510	0,821

@ : significant at the 10% level of significance

* : significant at the 5% level of significance

** : significant at the 1% level of significance

*** : significant at the 0,1% level of significance

(a) : excluding land

TABLE 4 - Elasticities of production and related statistical results as obtained from selection 2 with the Cobb-Douglas production function, Letaba district, 1966/67

Area	Intercept (b ₀)	Elasticities of production (b _i)					Multiple correlation coefficient (R)	Coefficient of determi- nation (R ²)	t-value for deviation of Σb_i from 1,0
		Land value	Labour costs	Capital (a)	Managerial aptitude	Sum of elasticities (Σb_i)			
Mooketsi	0,001	0,060	0,885**	0,192	2,226*	3,363	0,846***	0,715	2,24*
Duiwelskloof Forestry	0,242	-0,007	0,250	0,064	2,674**	2,982	0,851**	0,724	6,84***
Tzaneen Smallholdings	0,001	0,734**	1,084**	-0,120	0,368	2,065	0,872***	0,761	5,43***
New Agatha Highlands	0,0003	0,134	1,669**	0,245	0,334	2,382	0,869**	0,755	1,10
Letsitele Valley	0,796	-0,017	1,548*	-0,507	0,805	1,829	0,903*	0,815	0,68
Letaba River	5,261	-0,155	0,669*	0,541@	-0,295	0,759	0,861**	0,742	0,32
Transitional	0,026	0,278	0,314	1,130	-1,070	0,652	0,944**	0,891	0,19
Trichardtsdal	0,004	-0,088	1,040***	0,098	2,194***	3,245	0,935***	0,875	3,93***
Cattle Ranching area	0,354	0,218	-0,015	0,457	0,957	1,617	0,713**	0,508	0,90

@ : significant at the 10% level of significance

* : significant at the 5% level of significance

** : significant at the 1% level of significance

*** : significant at the 0,1% level of significance

(a) : excluding land

TABLE 5 - Elasticities of production and related statistical results as obtained from selection 3 with the Cobb-Douglas production function, Letaba district, 1966/67

Area	Intercept (b_0)	Elasticities of production (b_i)					Multiple correlation coefficient (R)	Coefficient of determi- nation (R^2)	t-value for deviation of Σb_i from 1,0
		Land value	Labour costs	Capital (a)	Managerial aptitude	Sum of elasticities (Σb_i)			
Mooketsi	0,004	0,242	0,937***	-0,010	1,718*	2,886	0,881***	0,776	2,05*
Duiwelskloof Forestry	0,140	0,091	0,056	0,192	2,755*	3,094	0,838**	0,702	1,99*
Tzaneen Smallholdings	0,021	0,511	1,085***	0,082	0,234	1,912	0,836***	0,698	3,36***
New Agatha Highlands	0,001	0,406	1,257*	0,219	0,484	2,365	0,858**	0,736	0,99
Letsitele Valley	0,224	0,146	0,486	0,110	1,592	2,334	0,821*	0,674	0,94
Letaba River	1,404	-0,045	0,498@	0,614*	-0,264	0,804	0,834**	0,695	0,27
Transitional	0,008	0,165	0,986**	0,637*	-0,455	1,333	0,980***	0,961	1,11
Trichardsdal	0,0002	0,024	0,950***	0,060	2,881***	3,915	0,930***	0,864	4,94***
Cattle Ranching area	0,628	0,041	0,123	0,430	1,145*	1,739	0,693**	0,480	0,98

@ : significant at the 10% level of significance

* : significant at the 5% level of significance

** : significant at the 1% level of significance

*** : significant at the 0,1% level of significance

(a) : excluding land

TABLE 6 - Elasticities of production and related statistical results as obtained from selection 4 with the Cobb-Douglas production function, Letaba district, 1966/67

Area	Intercept (b ₀)	Elasticities of production (b _i)					Multiple correlation coefficient (R)	Coefficient of determi- nation (R ²)	t-value for deviation of $\sum b_i$ from 1,0
		Labour costs	Fixed capital (b)	Variable capital	Managerial aptitude	Sum of elasticities ($\sum b_i$)			
Mooketsi	0,001	0,888**	0,088	0,142	2,204*	3,321	0,845**	0,715	2,12*
Duiwelskloof Forestry	0,048	0,117	-0,039	0,356	2,886**	3,320	0,874**	0,763	3,53***
Tzaneen Smallholdings	0,001	0,866**	0,848**	-0,018	0,243	1,976	0,869***	0,756	5,158***
New Agantha Highlands	0,0002	1,574*	0,314	0,202	0,248	2,337	0,872**	0,760	1,00
Letsitele Valley	1,588	1,367**	-0,744*	-0,042	1,670@	2,252	0,947***	0,897	1,36
Letaba River	4,033	0,760**	0,448@	-0,107	-0,211	0,890	0,861**	0,742	0,15
Transitional	0,004	1,271@	0,334	0,320	-0,409	1,516	0,925**	0,856	0,28
Trichardtsdal	0,004	1,096***	0,181	-0,218	2,297***	3,356	0,937***	0,879	3,90***
Cattle Ranching area	0,963	0,011	0,279	0,216	1,194*	1,700	0,698**	0,486	1,11

@ : significant at the 10% level of significance

* : significant at the 5% level of significance

** : significant at the 1% level of significance

*** : significant at the 0,1% level of significance

(a) : including land

In the Cattle Ranching area, managerial aptitude yielded significant results in two of the four selections. In both these selections the elasticity of production was close to one, thus indicating constant marginal returns. This did not, however, result in increasing returns to scale. It does appear thus, that managerial aptitude also made a significant contribution to production value in this subregion. In the Letsitele Valley, the coefficient for managerial aptitude deviated significantly from zero in one selection (selection no. 4) at the 10 per cent level of significance; this selection also yielded the highest coefficient of determination for the Letsitele Valley, and returns to scale did not show a significant deviation from one. The coefficient involved was larger than one, thus it appears that increasing marginal returns to managerial aptitude may also prevail in the Letsitele Valley. In view of the fact that it did not differ significantly from zero in the other three selections, this result should not, however, be accepted without further evaluation. It may only act as an indication.

In the Tzaneen Smallholdings, New Agatha Highlands and Transitional area, managerial aptitude, probably largely as a result of previously mentioned reasons, did not yield statistically significant effects in the production functions. Results in the Letaba River area were also not significant.

EVALUATION AND IMPLICATIONS

The analyses in this article showed that the index of managerial aptitude as developed recently, is a definite step forward in the study of farm management economics, because management can now be handled significantly quantitatively as an input, and its effect on production can be measured. This instrument of measurement has not been perfected yet, and improvements to it can definitely be made.

One factor warranting closer attention in further developments of the technique, is the buying and selling aspects of the farming business. This factor is an important part of sound managerial aptitude. Wood¹⁸) could not determine any relationship between the calculated scale of managerial aptitude and farmers' buying and selling practices in the Letaba district.

A significant fact emanating from the analyses is that managerial inputs make a significant contribution to management results, provided that other factors are above a critical minimum level - as could be seen, it did not yield a significant marginal product on the Tzaneen Smallholdings, probably as a result of the divided attention between farming and other occupations, but also because the holdings were too small anyway. When the management factor manifests itself, it appears that it happens under conditions of increasing marginal

returns. Thus, the production increments accompanying managerial improvement are small at a low level, but increase as the level is improved upon. This result corresponds to views expressed by Kolbé¹⁹) namely that planned agricultural change goes through an initial period of delay until it is brought into harmony with cultural-educational norms, whereafter change takes place at an increased rate.

It appears, therefore, that the improvement of the managerial ability of farmers by means of education or extension is the most important prerequisite for agricultural progress in an area or region. It further appears that globally, the largest increases in production will occur by increasing the knowledge of the competent even more. Whether extension will achieve the biggest success by concentrating on the more competent rather than average or below average managers, will depend upon the rate at which these different groups can improve their managerial aptitudes. If it is accepted that the already skillful operators are the most intelligent and thus able to absorb new knowledge faster, it will appear that concentration of extension on these people will have the largest effects on efficiency.

The increasing returns to scale which according to these calculations accompany managerial aptitude, also has important implications. If this phenomenon is a more general one and not limited only to regions in the Letaba district, the larger and more efficient producers may be expected to expand their production at such a rate and thus create market conditions which will gradually make it more and more difficult for smaller and less efficient producers to survive. One therefore has to accept that the growth potentialities of these people are small, and that their future as agricultural producers is dim. If it is Government policy to keep these people in agriculture, such a policy will have to be accompanied by large and perpetually increasing subsidies. Such subsidies will, in reality, amount to subsidising inefficiency. In the absence of such a system of subsidies, more and more of these persons will be compelled by economic pressure to seek and obtain other earning possibilities rather than continuing their farming enterprises.

If the Government accepts efficiency of production as the principle aim of agricultural policy, it will, once again provided that increasing returns to scale is a general phenomenon, be important for the State to make it possible for the smaller, inefficient producers to cease their farming activities and enter alternative occupations in society.

Our agriculture can only improve its efficiency and thus maintain or improve its competitive position on the world markets for agricultural goods if producers are efficient and competent.

18) Wood, M.I. (1968). The marketing and purchasing behaviour of farmers in the Letaba district. M.Sc. (Agric.) thesis, University of Pretoria.

19) Kolbé, F.F.H. (1964). *Vertraagde verandering in die landbou*. Tydskrif vir Geesteswetenskappe, Vol.4.