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AN EFFICIENCY COMPARISON BETWEEN PART-TIME AND FULL-TIME FARMERS ON THE TRANSVAAL HIGHVELD*

by M. NEL and J.A. GROENEWALD** ***

ABSTRACT

Three groups of farmers on the Transvaal Highveld were compared: Full-time farmers, part-time farmers entering the industry with the aim of eventually becoming full-time farmers and persons intending to farm part-time on a permanent basis. Management indices based on production functions indicate that full-time farmers were most efficient entrepreneurs and those who intend to farm part-time permanently the least efficient. The general organisation of full-time farmers appears to be better than that of part-time farmers. The difference between the two groups of part-time farmers appears to be operational in nature. Those intending to become full-time farmers fared better in most individual enterprises than permanent part-time farmers.

INTRODUCTION

As in many countries of the world, part-time involvement is expanding in South Africa's commercial farming sector. Fairly little knowledge has yet become available in this regard. Odendaal (1976) conducted a study on this in the Eastern Cape. Country-wide surveys were also made with the aid of mail questionnaires (Division of Agricultural Production Economics, 1982; Boel and Nel, 1984). Knowledge concerning the comparative efficiency of part-time and full-time farmers is, however, almost non-existent in South Africa.

A comparative study was done for this purpose in the Transvaal Highveld (Region B1 of the Agro-Economic Survey - Union of South Africa, 1948). In this region, the Division (now Directorate) of Agricultural Production Economics conducted a full managerial survey in 1948, involving a randomly selected sample of full-time farmers, all of whom had planted at least 80 hectares to maize. A similar survey was conducted thereafter with a randomly selected sample of part-time farmers, each also with

at least 80 hectares of maize. The part-time farmers were divided into two categories, corresponding to the categorisation of the Division of Agricultural Production Economics (1982): Category I consisted of individuals farming on a part-time basis with the intention of using it as a stepping stone to become full-time farmers.

Category II consists of persons intending to farm part-time on a permanent basis.

In the survey, data were collected from 60 part-time farmers. In order to facilitate comparisons, 28 farmers were randomly selected from the sample of full-time farmers. The selection was made in order to prevent full-time farmers dominating a function constructed for purposes of management indices, because of relative numbers.

MANAGEMENT INDICES AND RETURNS TO SIZE

Cobb-Douglas type production functions were used to determine management indices. Functions were fitted for the total group of farmers (full-time and part-time). Six functions were fitted, each with gross income (Y) as dependent variable. Measures of land, capital, short-term inputs and labour were used as independent variables.

The results appear in Table 1. In only one function were all the coefficients significant at a $p = 0,10$ level of confidence. The coefficient of determination (R^2) was consistently higher than 0,93 and all the F values were significant at $p = 0,005$.

The expected farm income of each farmer was determined separately with each function, and a single expected gross income was compiled by calculating the geometric mean of the six separate estimates for each farmer.

Thereafter, following the technique as applied by Viljoen and Groenewald (1977) and also Martinson and Groenewald (1978), a management index was calculated for each farmer, using the formula:

$$\text{Management index (MI)} = \frac{\text{Real gross income} - \text{Estimated gross income}}{\text{Estimated gross income}} \times 100$$

Estimated gross income

Farmers with above average levels of efficiency will have positive management indices and those with below average levels of efficiency will have negative indices.

The geometric means of individual management indices were calculated and differences between the

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TABLE 1 - Regression coefficients and related data for calculated production functions in the Eastern Transvaal Highveld, 1984

Item	Equation number					
	1	2	3	4	5	6
Number of farmers (n)	97	97	97	97	97	97
Independent variable (bi)						
Intercept	2,282 4	5,036 1	7,081 4	7,413 7	2,100 3	2,735 9
Farm area (ha)	-0,082 0	0,135 6***	-	-	0,162 3**	-0,039 0
Area of arable land (ha)	-	-	0,186 9*	0,187 4***	-	-
Area of grazing and waste land (ha)	-	-	-0,009 9	0,032 8 (0,1)	-	-
Percentage arable land	-	-	-	-	0,082 3	-
Percentage grazing and waste land	-	-	-	-	-	-0,021 0
Capital investment (R)	0,280 0***	-	0,159 9 (0,1)	-	0,187 7*	0,341 7**
Capital investment minus bare land value (R)	-	-0,080 3	-	-	-	-
Bare land value (R)	-	0,133 5***	-	0,120 2**	-	-
Short-term inputs (R)(a)	0,691 3***	0,809 6***	0,659 8***	0,650 6***	0,578 5***	0,720 1***
Labour costs (R)	0,098 4	-	-	-	-	-
{ bi	0,987 7	0,998 4	0,996 7	0,990 9	1,010 8	1,001 8
t value for { bi -1,0	-0,069 2	-0,044 1	-0,032 4	-0,046 1	0,026 8	0,055 9
R ²	0,936 2	0,938 7	0,939 6	0,942 0	0,940 4	0,936 4
F	337,52***	352,45***	357,83***	373,34***	363,14***	338,43***

(0,1) = significant at $p = 0,1$

* = significant at $p = 0,05$

** = significant at $p = 0,01$

*** = significant at $p = 0,001$

(a) Including depreciation and, in equations 2 to 6, also labour costs

three groups were subjected to the t test for statistical significance. The results appear in Table 2.

It appears that on the average full-time farmers maintain the highest level of efficiency. This efficiency level differs significantly at $p = 0,1$ from that of the Category I part-time farmers and highly significantly ($p = 0,000 5$) from that of Category II part-time farmers. The average level of efficiency so measured is, in contrast, considerably lower among Category II farmers than in the other groups (both cases, $p = 0,000 5$). Category I farmers form an intermediate group.

In the Cobb-Douglas function, the sum of production elasticities ({bi}) represents returns to size. It did not deviate significantly from 1,0 in any one equation and constant returns to size are thus accepted. It therefore cannot be logically argued that efficiency differences among the three groups were caused by size. One deficiency of the analysis is that only one year's data were used.

TABEL 2 - Geometric means of management indices for three groups of farmers, Transvaal Highveld, 1984

Item	Value	
<i>Geometric mean management index</i>		
Part-time farmers, Category I		9,25
Part-time farmers, Category II		-22,37
Full-time farmers		15,25
Total of group		- 0,05
<i>t value for differences in geometric means</i>	<i>t value</i>	<i>Level of significance</i>
Category I - Category II	7,59	0,000 5
Category I - Full-time farmers	-1,13	0,10
Category II - Full-time farmers	-7,29	0,000 5

COMPARATIVE ANALYSES

Differences in levels of efficiency between groups of agricultural producers can stem from many sources, for example, general organisation and efficiency within specific farming enterprises.

With regard to general organisation, factors such as land utilisation, the nature and composition of capital and the composition of costs and of income can have important effects on efficiency.

In order to determine whether the three groups of farmers differ from one another in certain aspects, differences between average measurements of the groups were subjected to the test. Although the use of the test is subject to certain limitations in this type of comparison, it was hoped that it could nevertheless yield useful indications.

In view of the fact that, as was pointed out above, returns to scale inclined towards constancy, only ratio data, and not size considerations, will receive further attention. Some ratios appear in Table 3.

The first significant difference between the three groups concerns percentage of land that is arable. Category I farmers operate on farms with smaller arable areas, relative to the total, than the other two groups ($p = 0,05$). There are also significant differences ($p = 0,05$ and $p = 0,01$) with respect to percentages of arable land that are cultivated.

The full-time farmers used significantly larger tractors ($p = 0,000 5$) than part-time farmers, but also cultivated significantly larger areas ($p = 0,000 5$) per tractor and eventually larger areas per unit of 26kW ($p = 0,10$). These results suggest

TABLE 3 - Comparative data for two groups of part-time and one group of full-time farmers, Transvaal Highveld, 1984

Items	Category I	Category II	Full-time farmers (F)	t value for differences		
				I - II	II - F	I - F
Percentage arable land	44,97	53,63	53,47	-1,692*	0,032 n.s.	-1,924*
Percentage arable land cultivated	92,95	98,52	95,74	-2,441**	2,168*	-2,143*
Hectares cultivated per tractor	61,50	59,45	84,15	0,345 n.s.	-3,525***	-3,029***
Hectares cultivated per tractor unit of 26 kW	29,55	29,84	34,66	-0,098 n.s.	-1,465 (0,1)	-1,485 (0,1)
Average kilowattage per tractor	55,04	53,03	65,78	1,000 n.s.	-4,252***	-3,621***
Land capital, rand per hectare	476,07	491,33	660,02	0,473 n.s.	-2,019*	-2,984**
Total fixed capital, rand per hectare	533,68	572,36	744,97	0,144 n.s.	-2,586*	-3,265**
Tractor investment per hectare arable land	72,70	69,26	113,73	0,236 n.s.	-2,611**	-2,425**
Implement investment per ha arable land	44,17	52,49	81,78	-1,312 (0,1)	-2,664***	-3,408***
Total investment in equipment per ha arable land	89,60	101,22	186,01	-1,048 n.s.	-3,318***	-3,850***
Livestock investment per ha grazing	114,30	130,57	121,21	-0,893 n.s.	0,546 n.s.	-0,461 n.s.
Total capital per ha of farm	800,88	821,67	1 051,17	-0,347 n.s.	-3,807***	-3,928***

(0,1) = significant at $p = 0,1$ * = significant at $p = 0,05$ ** = significant at $p = 0,01$ *** = significant at $p = 0,001$

higher efficiency in cultivation on the part of full-time farmers. The two groups of part-time farmers did not differ significantly from each other in this respect. Information regarding tractor ages is not available, but the higher investment in tractors and implements per hectare of arable land suggests that the machinery of full-time farmers may have been newer. The higher investment in land per hectare of farm as found with full-time farmers may, on the one hand, be ascribed to differences in value perceptions, but may, on the other hand, be interpreted as a tendency among full-time farmers to occupy on the average more productive, higher potential land than part-time farmers.

No significant differences were encountered in livestock capital per hectare of grazing. The differences in equipment and investment in land per hectare logically meant higher total investment per hectare on the part of full-time farmers.

Cost comparisons were also made (Table 4). It was arbitrarily decided to devote attention only to

cost items which amounted to at least R10 per hectare in at least one group.

Per hectare cultivated, full-time farmers incurred higher tractor, implement and vehicle costs than the part-time farmers, while labour expenses did not show significant differences. By themselves, these findings cannot contribute to an explanation of higher efficiency on the part of full-time farmers.

Although Category I farmers cultivated proportionately less land than the other two groups (Table 3), their labour costs per hectare (Table 4) were not significantly different from those of the other two groups. Their labour costs per labour month were, however, significantly higher. This evidently sufficed to lead to a lack of significant differences in labour costs per hectare.

The higher costs incurred by full-time farmers were associated with significantly higher gross incomes per hectare of farm land (Table 5). There was no significant difference between the two categories of part-time farmers in this respect. Crop

TABLE 4 - Comparative cost data for full-time and two groups of part-time farmers average per farming enterprise, Transvaal Highveld, 1984

Item	Category I	Category II	Full-time farmers (F)	t values		
				I - II	II - V	I - V
Tractor costs (1) (4)	61,07	54,04	71,36	0,941 n.s.	-2,398**	-1,491 (0,1)
Implement costs (1) (4)	12,53	14,48	22,48	-1,018 n.s.	-2,724***	-3,422***
Vehicle costs (3) (4)	9,20	9,15	13,31	0,036 n.s.	-1,841*	-1,832*
Tractor fuel (1)	31,92	27,72	31,22	1,259 n.s.	-1,181 n.s.	0,225 n.s.
Labour (3)	16,85	18,17	20,02	-1,081 n.s.	0,601 n.s.	-0,953 n.s.
Cost per regular labourer per month	122,97	106,70	112,26	2,007 *	-0,657 n.s.	1,233 (0,1)
Seed purchased (1)	14,96	16,42	23,57	-0,687 n.s.	-1,658 (0,1)	-1,895*
Fertiliser (1)	79,27	81,46	85,13	-0,165 n.s.	-0,271 n.s.	-0,354 n.s.
Pesticides (1)	1,64	3,12	9,87	-0,990 n.s.	-2,405**	-3,204***
Weedicides (1)	8,06	6,40	22,03	1,311 (0,1)	-3,496**	-3,069***
Feed purchased (2)	23,75	12,37	30,94	1,318 (0,1)	-2,298**	-0,643 n.s.

(1) Rand per hectare of arable land

(2) Rand per LSU

(3) Rand per hectare of farm land

(4) Fixed and variable costs

(0,1) = significant at $p = 0,1$ * = significant at $p = 0,05$ ** = significant at $p = 0,01$ *** = significant at $p = 0,001$

TABLE 5 - Comparative income measures for full-time and two groups of part-time farmers, average per farm, Transvaal Highveld, 1984

Items	Cate- gory I	Cate- gory II	Full- time farmers (F)	I - II	II - F	I - F
Crop revenue per ha of fields	452,32	460,12	475,42	-0,115 n.s	-0,254 n.s	-0,304 n.s
Livestock revenue per LSU	168,21	102,65	195,30	1,655 (0,1)	-2,743**	-0,559 n.s
Gross farm income per ha farm land	215,16	250,25	299,24	-1,111 n.s	-2,449 (0,1)	-2,225*
Gross farm income per R100 expenses	182,85	186,52	166,86	-0,371 n.s	1,687*	1,519 (0,1)
Net farm income per R100 expenses	82,85	86,52	66,86	-0,371 n.s	1,712*	1,546 (0,1)

(0,1) = significant at $p = 0,1$

* = significant at $p = 0,05$

** = significant at $p = 0,01$

revenues per hectare of fields did not yield significant differences, while Category II - those persons who plan to farm on a part-time basis permanently - achieved significantly lower incomes per livestock unit.

The full-time farmers' significantly smaller average gross and net incomes per R100 expenses give rise to suspicion that their expenditures were closer to the optimum and that part-time farmers are in many cases still in such a position that if they should expand, marginal revenue would exceed marginal costs.

The analyses already presented do yield some indications of differences between full-time and part-time farmers, but little to explain differences in efficiency between the two groups of part-time

farmers.

The relative contributions of the most important farm enterprises were analysed next (Table 6).

It appears that Category II farmers plant a significantly lower proportion of their cultivated land with maize. Full-time farmers utilise relatively more land for grain sorghum ($p = 0,10$) and less for feed and pasture crops than part-time farmers.

Category II farmers obtain proportionately more of their revenue from crops and proportionally less from livestock than the other two groups. It is particularly from dairy cattle and sheep (fine-woolled and mutton-woolled) that these farmers obtain relatively less of their gross income. In view of the fact that the Category II farmers grow a good deal

TABLE 6 - Contributions of farm enterprises, full-time and two groups of part-time farmers, Transvaal Highveld, 1984

Items	Cate- gory I	Cate- gory II	Full- time farmers (F)	I - II	II - F	I - F
<i>Percentage of arable area</i>						
Maize	65,55	79,85	70,18	-1,413 (0,1)	1,859*	0,391 n.s
Grain sorghum	3,35	3,17	9,49	0,011 n.s	-1,595 (0,1)	-1,510 (0,1)
Sunflowers	1,23	3,27	5,35	-1,019 n.s	-0,614 n.s	-2,070*
Fodder and pasture crops	13,16	10,79	5,46	0,767 n.s	1,554 (0,1)	2,329*
Other (including fallow)	16,71	2,92	9,52	2,667***	-3,178***	-0,028
<i>Percentage contributions to gross income: Crops</i>						
Maize	69,95	77,54	66,44	-1,488 (0,1)	2,705***	1,430 (0,1)
Grain sorghum	3,26	3,56	7,18	0,531 n.s	-0,596 n.s	0,021 n.s
Sunflowers	1,09	3,15	1,71	-1,089 n.s	1,742 (0,1)	-0,684
Other crops	2,84	2,17	4,68	-0,307 n.s	0,475 n.s	0,153 n.s
Total crops	77,14	86,42	80,01	-2,613**	2,691***	0,463 n.s
<i>Livestock</i>						
Dairy cattle	11,99	1,99	8,29	-1,667 (0,1)	-1,484 (0,1)	-0,168 n.s
Dual purpose cattle	0,52	2,61	2,33	-1,036 n.s	1,550 (0,1)	0,498 n.s
Beef cattle	2,68	3,83	1,88	-0,761 n.s	1,459 (0,1)	-0,655 n.s
Fine-woolled sheep	3,75	3,47	4,60	1,439 (0,1)	-1,514 (0,1)	-0,588 n.s
Mutton woolled sheep	3,07	0,81	1,97	2,076*	-1,443 (0,1)	0,673 n.s
Other livestock (a)	0,07	0,03	0,03	-	-	-
Total livestock	22,08	12,74	19,10	2,539**	-2,586**	-0,367 n.s
Other farm income	0,78	0,84	0,89	0,890 n.s	-0,533 n.s	-0,456 n.s

(a) The values were not calculated because this enterprise is operated by only one or two farmers

(0,1) = significant at $p = 0,1$

* = significant at $p = 0,05$

** = significant at $p = 0,01$

*** = significant at $p = 0,001$

TABLE 7 - Gross margins and related data, full-time and part-time farmers, Transvaal Highveld, 1984

Item	Category I	Category II	Full-time farmers (F)	I - II	t values II - F	I - F
<i>Maize</i>						
Total directly allocable costs per ha (DAC) (R)	157,27	133,14	179,36	1,099 n.s	-2,370*	-1,593 (0,1)
Gross margin per ha (R)	494,85	407,11	426,82	1,514 (0,1)	0,041 n.s	1,245 n.s
Yield per ha (tons)	2,93	2,42	2,64	1,376 (0,1)	-0,285 I n.s	0,771 n.s
Gross production value per R1,00 DAC (R)	4,15	4,06	3,38	0,656 n.s	1,832*	2,467**
<i>Dairy cattle:</i>						
Gross margin per LSU (R)	138,96	30,74	165,94	2,006*	-1,978*	-0,508 n.s
Gross production value per R1,00 DAC (R)	1,61	1,21	1,56	0,773 n.s	0,315 n.s	0,425 n.s
Gross production value per R1,00 feed costs	2,20	1,29	1,94	2,311*	-1,414 (0,1)	0,628 n.s
Litres of milk per cow	1 559	787	1 960	1,445 (0,1)	-3,336***	-0,728 n.s
<i>Fine-woolled sheep</i>						
Capital revenue per SSU (R)	10,93	12,80	13,95	-0,588 n.s	-0,343 n.s	-0,834 n.s
Product revenue per SSU (R)	11,13	8,02	11,53	2,200*	-1,884*	-0,226 n.s
Gross production value per SSU (R)	22,06	20,82	25,48	0,572 n.s	-1,429 0,1	-1,013 n.s
Gross margin per SSU (R)	13,47	8,04	13,25	1,493 (0,1)	-1,467 (0,1)	0,083
Gross production value per R1,00 DAC (R)	2,57	1,63	2,08	1,397 (0,1)	0,868 n.s	0,465 n.s
<i>Mutton-woolled sheep</i>						
Capital revenue per SSU (R)	12,81	9,01	23,05	1,270 n.s	-3,435***	-2,531*
Product revenue per SSU (R)	8,53	4,32	3,94	3,174***	0,251 n.s	3,639***
Gross production value per SSU (R)	21,34	13,33	26,99	2,271*	-3,313***	-1,526 (0,1)
Gross margin per SSU (R)	5,54	0,83	14,00	1,061 n.s	-3,689***	-1,860*
Gross production value per R1,00 DAC (R)	1,90	1,12	2,38	1,397 (0,1)	-1,536 (0,1)	0,726 n.s

(0,1) = significant at $p = 0,1$ * = significant at $p = 0,05$ ** = significant at $p = 0,01$ *** = significant at $p = 0,001$

in the line of feed crops on a percentage basis more than full-time farmers, ($p=0,10$) and that they should have substantial crop residues available for livestock, this appears to indicate an under-utilisation of material which could be used by livestock. This may contribute to the fact that full-time and Category I part-time farmers maintained higher efficiency levels than the Category II farmers as determined by management index measurements.

GROSS MARGIN COMPARISONS

Further analyses were done to determine differences in gross margins and related differences on a farm enterprise basis between groups. Results appear in Table 7.

Physical yields per hectare of maize yielded few significant differences. Category II farmers' yields were, on the average, 0,51 tons per hectare less than those of Category I farmers and this difference was significant at $p = 0,10$. The full-time farmers had a larger expenditure on directly allocable costs per hectare than part-time producers and a significantly smaller gross production value per rand of directly allocable costs. The Category I farmers have a significantly higher gross production value per rand

of directly allocable costs. Category I farmers realised a significantly higher gross margin per hectare of maize ($p = 0,10$) than farmers in Category II. Seen in the light of the importance of the role of maize in the farming system, this factor must have contributed to a higher level of general efficiency.

Since only limited numbers of producers in each category produced grain sorghum and sunflowers, no data on these crops are included in Table 7.

15 farmers in Category I and 15 full-time farmers kept dairy cattle and 7 Category II farmers did so. Those Category II farmers who did keep dairy cattle, realised significantly smaller gross margins per LSU and gross production values per R1,00 feed costs. This result could also contribute towards explaining these farmer's lower general efficiency as measured by the management index. This could largely be ascribed to low milk yields.

No significant differences occurred with respect to dual purpose and beef cattle.

12 farmers from Category I, 14 from Category II and 10 full-time farmers kept fine-woolled sheep. Category II farmers realised significantly ($p = 0,10$) smaller gross margins per SSU than the other two groups and lower gross production values per rand

of directly allocable costs than Category I farmers.

The numbers of farmers keeping mutton-woolled sheep were as follows: Category I: 15; Category II: 9; Full-time: 9. The most salient feature is the good performance of the full-time farmers relative to the other two groups concerning capital revenue and gross margin per SSU. Category II farmers fared significantly worse than full-time farmers in all but one of the criteria shown, and also significantly worse than Category I in regard to product revenue per SSU, gross production value per SSU and gross production value per R1,00 directly allocable costs.

CONCLUSION

Based on production function analysis and management indices emanating from them, it was concluded that, according to 1984 results, full-time farmers on the Transvaal Highveld maintained a higher level of efficiency than part-time farmers. Part-time farmers entering the industry with the aim of eventually becoming full-time farmers (Category I) fared better in this respect than those who intended a permanent part-time involvement in farming. This finding, although based on only one year's data, is in accordance with what could logically be expected. Full-time farmers are able to devote more managerial attention to their farming enterprises. Those who enter the industry with the aim of eventually becoming full-time farmers are probably more motivated towards higher performance than farmers intending to operate permanently on a part-time basis.

Comparisons of operations of the three groups of farmers created the following impressions: First, that the full-time farmers, in the sense that their land has a higher valuation, probably operate on better land than that of part-time farmers. They cultivate larger areas per mechanical unit and this suggests higher efficiency in cultivation. They have incurred higher expenditures per hectare and obtained correspondingly higher incomes. It was hypothesised

that their expenditure was closer to the optimum.

Category II farmers received relatively less of their revenue from livestock than was the case with the other two groups. An analysis of the major enterprises revealed that the Category II farmers tended to obtain lower gross margins per livestock unit and/or lower gross production values per R1,00 of directly allocable costs than the other part-time or the full-time farmers. With respect to mutton-woolled sheep, full-time farmers fared the best, and Category II farmers the worst.

Seen as a whole, the above creates the impression that the general farm organisation of full-time farmers was superior to that of part-time farmers.

Those with the intention of eventually farming full-time, fared better in an operational sense than those who intend to engage in part-time farming permanently, in the sense that the first-mentioned group obtained better results in individual enterprises.

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