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Labour-Related Structural Trends in South African Maize Production

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Abstract

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The substitution of capital goods, including new technology, for land and labour has played an important role and has influenced the structure of Sout African agriculture.

Farm labour-related trends in the summer rainfall grain-producing area of South Africa are considered. The amount of labour used, the remuneration of labour, the substitution of capital for labour and productivity trends are analyzed. Growth rates were obtained by fitting exponential functions with time as independent variable. The decline in the number of farm employees per 1000 hectares under cultivation since 1970 probably resulted from mechanization and thus capital-labour substitution in maize production, especially in harvesting. Tax concessions on new capital improvements, the subsidization of agriculture in general and the increasing rate of urbanization contributed to this trend.

The scarcity of capital relative to unskilled labour, which has been reinforced by policy measures favouring capital intensity (capital formation has increased by 4.0% per annum between 1950 and 1980, compared with an increase of 0.71% per annum in the number of farm employees in the same period); this implies that corrective policy changes are required to improve the present distorted situation.

This will enable the commercial agricultural sector of South Africa to play a more meaningful role in the socio-economic development of the whole subcontinent.

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Introduction

Changes in the ratio of the quantity of land, capital and labour used in agricultural production have played a fundamental role in the transformation of agriculture throughout the world in the post-1945 era. The substitution of capital goods, including new technology, for land and labour has played an especially important role in, for example, the U.S.A. (Schertz, 1979, p.24) and has influenced the structure of farming there (Penn, 1979, p. 11). The same is true for the commercial sector of South African agriculture (Biggs, 1982; De Klerk, 1983).

South African agriculture is highly dualistic, comprising of a commercial farming sector utilizing 85.4×10^6 ha and a subsistence-oriented sector occupying 15.1×10^6 ha (1983 figures) in the so-called homelands. The emphasis in this article is on the commercial sector. The level of technology and the use of hired labour differ substantially between the two agricultural sectors (Fényes, 1983; Fényes and Van Rooyen, 1984), and analysis thereof will necessitate a separate study.

Of the total land farmed in the commercial sector, 14% is cultivated and 80% is utilized as natural grazing. The total employment of hired labour was 1.1×10^6 in 1980, and production, in South African rands*, R9600 per person employed or R1000 per hectare cultivated in 1985 (Anon., 1986).

The number of commercial farms has decreased from 91 855 in 1968 to 69 372 in 1980; the average size increased from 970 ha to 1 235 ha over the same period. The number of regular labourers per farm increased from 9.0 to 9.5 but decreased from 8.5 to 7.2 per cultivated hectare (Anon., 1986). The number of seasonal workers decreased on both counts, namely from 8.8 to 7.0 per farm and from 8.7 to 6.1 per cultivated hectare (Joubert and Van Wyk, 1984). Nevertheless, most commercial farms remain completely dependent on hired workers.

Of all people engaged in commercial agriculture in 1982, 8.9% were farmers, 1.3% were managers or supervisors, 74.2% were regular labourers, 13.1% were seasonal labourers and 2.2% mechanical operators (Fényes and Van Rooyen, 1985). Thus, 87.3% of the work force is hired; most do physical labour. Nearly 90% of the work force has had 5 years of formal schooling or less.

In 1970 the agricultural sector was the major employer in South Africa, employing 30.6% of the economically active population (Fényes and Van Rooyen, 1985). At present, the commercial agricultural sector employs 15.4% of the total labour force and produce about 6% of the gross national product (Reserve Bank, 1986). Commercial agriculture is thus relatively labour intensive. If it is considered that over 50% of the total population and 75% of the economically active population of South Africa lives in urban areas, then it

*In 1982, one rand (R1.00) = US$ 0.90. In 1987 one rand (R1.00) = US$ 0.45.

TABLE 1

Annual growth rate in the number of farm employees and real gross capital formation in commercial agriculture of the Republic of South Africa for different periods between 1950 and 1980

Period	Growth (%)	
	Total number of farm employees	Real gross capital formation
1950–1960	2.08	3.21
1960–1970	4.38	5.34
1970–1980	−2.67	5.09
1950–1970	2.77	3.69
1950–1980	0.71	4.00

All values are significant at the 10% level.
Source: Anon. (1986)

follows that commercial agriculture provides employment for more than half of the economically active population in rural regions (R.S.A., 1980).

All of this causes labour-related trends in agriculture to play an important role in the development of rural areas, as well as in the supply of and demand for labour in and from the so-called homelands. These trends are, however, frequently not taken into account by policy-makers in the formulation of development policy both for the commercial and subsistence farming areas. Such trends may also have important effects on the supply of labour in urban areas.

Table 1 shows the annual growth rate in the number of farm employees, and the real gross capital formation in the commercial agricultural sector of the Republic of South Africa for different periods between 1950 and 1980. The total number of farm employees increased from 1950 to 1970, but decreased from 1970 to 1980.

This study is particularly concerned with the analysis of trends concerning farm labour in the three major maize producing areas: the North-Western Free State, Western Transvaal and the Transvaal Highveld. The data were obtained from maize production cost surveys done by the Department of Agriculture and Water Supply on a rotation basis. Physical and financial data have in each survey been collected from a random sample of approximately 80 farmers, each with more than 100 ha under maize. Maize accounts for over 80% of the total area cultivated. The particular relevance of the analysis becomes evident when it is borne in mind that maize is South Africa's major crop; 40% (4.25×10^6 ha) of the total area under cultivation is planted to maize in an average year (Anon., 1986). Data from the end of the second World War (1945) to the 1985 production year were used to quantify the pace of change in the structure of farming with regard to labour. Where possible, explanations of certain param-

eters are put forward with the aim of identifying the economic problem with regard to farm labour. In chronological order, discussions involve labour usage in quantitative terms, labour remuneration, capital–labour substitution and productivity of labour.

Only trends and annual changes are considered. The exact level of the different parameters for any given year can be found in Fényes (1983), as well as in unpublished reports of the Department of Agriculture. Growth rates were obtained by fitting an exponential curve with time as the independent variable.

Because of the obvious differences in the annual growth rate of the number of farm employees before and after 1970 (Table 1), trends are given for the periods 1945–1970 and 1970–1985, as well as for the whole period 1945–1985.

Amount of labour used

The annual growth rates of a number of key variables involving labour employment and related attributes are shown in Table 2 for the periods involved in the analysis.

It appears that the increase in the number of employees per farm unit was highly significant in the period 1945–1970, increasing by more than 2.5% per annum in all three of the major maize producing areas. Changes in number of employees per farm unit in the period 1970–1985 were insignificant. The area under cultivation per farm unit showed significant increases in all the periods, except for the Western Transvaal in the period 1970–1985. However, increases in the area under cultivation as a percentage of total farm area in the period 1970–1985 were insignificant in all three areas. In general this resulted in a positive annual growth rate in the number of farm employees per 1000 ha farm area and per 1000 ha under cultivation in the period 1945–1970, but a negative annual growth rate in the period 1970–1985. This can partially be attributed to the increase in farm size over the same periods, as well as to the intensification of farming as shown by the positive annual growth rate of the area under cultivation as a percentage of total farm area.

In 1970–1985, the number of farm employees per 1000 ha under cultivation declined faster than did the number of farm employees per 1000 ha total farm area in all three regions. It can thus be concluded that the number of farm labourers per unit area under cultivation declined faster than in extensive livestock production, which is generally practised on non-cultivated portions of farms. There seems, for that matter, to be an increase in the number of labourers per unit area under livestock production over time in all three regions. This trend probably has its origin in the higher degree of mechanization, and thus substitution opportunities, between capital (machinery) and labour that existed in crop cultivation (Biggs, 1982). According to Joubert and Van Wyk (1984), the decline in the number of seasonal farm workers both per farm unit

TABLE 2

Mean annual growth rates (%) in employment and some related attributes in three maize producing areas for the periods 1945-1970, 1970-1985 and 1945-1985

Item		North-western Free State			Western Transvaal			Transvaal Highveld		
		1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985
Employees per farm unit	Growth rate	3.82**	− 0.29	2.51**	3.69**	0.01	2.59**	2.60**	− 0.64	3.04**
	R^2	95.9	8.2	90.2	92.7	1.2	86.2	65.7	18.4	87.0
Total farm	Growth rate	1.85**	1.08	1.85**	1.68*	1.47	2.16*	2.24*	0.35**	3.01**
	R^2	79.4	18.5	93.5	51.6	10.8	72.1	37.4	49.1	81.5
Area under cultivation	Growth rate	3.47**	1.18**	3.17**	3.50**	1.53	4.05**	3.96**	3.65**	3.93**
	R^2	81.4	60.7	95.4	95.8	14.6	87.8	58.0	50.0	86.7
Cultivation as percentage of total farm area	Growth rate	1.62**	0.47	1.31**	1.83*	0.01	1.89*	1.72**	0.15	0.92*
	R^2	80.0	13.3	90.1	79.1	0.1	59.4	81.6	8.6	70.6
Employees per 1000 ha farm area	Growth rate	1.98**	− 0.93*	− 0.59	2.00**	− 1.13	0.38	0.40	− 0.73	− 0.14*
	R^2	81.6	26.9	29.3	81.8	7.3	36.8	25.7	6.4	61.8
Employees per 1000 ha under cultivation	Growth rate	3.65	− 1.40**	− 0.72	0.17	− 1.19*	−0.51*	0.11**	− 0.88*	− 1.06*
	R^2	27.9	66.3	75.4	11.5	18.5	75.8	44.4	27.9	76.1

**,Highly significant ($P<0.05$); *, significant ($P<0.10$).;
R^2 = Coefficient of determination.

TABLE 3

Distribution (percentages of farmers) of harvesting methods of maize in the Western Transvaal, 1968-1981

Year	Harvesting by hand	Mechanized harvesting	Hand and mechanized harvesting
1968	81	16	3
1973	54	38	8
1977	11	81	6
1981	5	89	6

Source: De Klerk (1983).

and per unit area, especially during the harvesting process, is a strong indication that this could well be the case.

From a sample of farmers who started farming maize before 1968 in the Western Transvaal, De Klerk (1983) obtained mechanization adoption rates as shown in Table 3. He also reports percentages of roughly the same order for farmers who started farming after 1968. These adoption rates show clearly that the majority of farmers in the Western Transvaal have already changed to mechanized harvesting, and this process must have contributed to a decline in the quantity of labour demanded, especially seasonal labour.

The mean annual growth rates in real investment in machinery (total, per hectare total farm area and per hectare under cultivation) are shown in Table 4. The total real investment in machinery per farm unit and per hectare of total farm area increased significantly in all three areas from 1945 to 1970. Growth in real investment in machinery per hectare under cultivation and investment in machinery as a percentage of total investment was, however, insignificant in all the regions for the periods 1945–1970 and 1970–1985.

The increases in both the number of farm employees per 1000 ha under cultivation (Table 2) and the real investment in machinery per hectare under cultivation (Table 4) in all areas indicate capital and labour to have been complements in crop production in the 1945–1970 period. However, the decline in the number of farm employees per 1000 ha under cultivation (Table 2) in the period 1970–1985, and the increase in the real investment in machinery per hectare under cultivation (Table 4) in the same period, illustrate a substitution of capital for labour in crop production since 1970 in all three regions. Mechanization was originally almost completely geared towards substitution of machinery for animal draught power in the processes of soil cultivation. It brought in its wake increased crop yields per hectare. Since the harvesting process had not yet been mechanized, this necessitated increased labour employment, hence the complementarity between labour and capital. The rapid mechanization in maize harvesting since 1970 (see Table 3) introduced the

TABLE 4

Mean annual growth rate (%) in real investment in machinery per farm unit, per hectare under cultivation and per hectare total farm area for the periods 1945–1970, 1970–1985 and 1945–1985

Item		North-western Free State			Western Transvaal			Transvaal Highveld		
		1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985
Real investment in machinery per farm unit	Growth rate	4.17**	3.41*	5.00**	4.62**	0.57	5.08**	4.96**	0.95	6.18**
	R^2	66.0	68.0	90.3	80.2	8.2	95.6	97.1	12.1	97.3
Real investment in machinery per hectare total farm area	Growth rate	2.31*	2.95*	3.18**	2.94*	1.85	3.00**	3.19**	2.20	3.48**
	R^2	42.7	63.3	82.5	71.8	10.3	90.9	75.6	5.6	84.6
Real investment in machinery per hectare under cultivation	Growth rate	0.70	2.56	1.85*	1.11	2.54	1.79*	1.66	2.19	2.32*
	R^2	8.9	44.1	64.9	21.5	14.4	68.9	15.9	6.4	72.4
Investment in machinery as percentage of total investment	Growth rate	− 1.78	1.30	− 0.10	−2.64	− 1.50	− 0.98	0.08	− 0.63	0.02
	R^2	30.3	16.1	15.7	53.5	10.0	14.1	21.1	12.2	14.6

**, Highly significant ($P<0.05$); *, significant ($P<0.10$).
R^2 = Coefficient of determination.

TABLE 5

Mean annual growth rate (%) in real total, in cash and in kind remuneration per farm worker for the period 1970–1985

Item		North-western Free State	Western Transvaal	Transvaal Highveld
Total remuneration per farm labourer	Growth rate	3.47**	2.55*	3.50*
	R^2	61.1	35.1	27.3
Cash remuneration per farm labourer	Growth rate	6.34**	5.00*	4.47*
	R^2	57.9	61.0	71.7
In kind remuneration per farm labourer	Growth rate	1.93	1.04	0.64
	R^2	25.8	4.3	18.4
Cash remuneration as percentage of total remuneration	Growth rate	2.88*	2.45*	3.14*
	R^2	33.5	32.1	51.2

**, Highly significant ($P<0.05$); *, significant ($P<0.10$).
R^2 = Coefficient of determination.
Note Only figures for the period 1970–1985 are presented, differences from the figures for the periods 1945–1970 and 1945–1985 are insignificant.

era of capital substituting for labour. Joubert and Van Wyk (1984) also point at decreases in employees per hectare under cultivation with increases in farm sizes. This may be associated with more intensive machinery use on larger farms and economies of scale.

Remuneration of labour

Concern is frequently expressed regarding the work and living conditions of farm employees (Wilson et al., 1977; Bosch, 1983). Criticism usually centres on the low level of cash remuneration and the "neo-feudal" system of paying farm labourers in kind rather than in cash (Antrobus, 1976; Moorcroft, 1976). However, Wilson et al. (1977) warn that comparisons between farm and other remuneration policies must be handled with caution because of possible differences in methods of calculation of remuneration, especially when considering payment in kind. In this latter case the difference between production and purchase cost for the farmer must be taken into account (Du Toit, 1980).

The mean annual growth rate in real total, cash and in kind remuneration per farm labourer are shown in Table 5. Both real cash and in kind payment increased over time in the three regions. Cash remuneration increased at a higher rate than payment in kind in the period 1970–1985 and it can be expected that in kind remuneration will play a progressively smaller role in future. This coincides with the results obtained by Fényes (1983) and Antrobus (1984).

The increases in total real remuneration per farm employee was respectively

3.47% for the North-Western Free State, 2.55% for the Western Transvaal and 3.50% for the Transvaal Highveld in the period 1970–1985. These figures compare favourably with the increase of only 1.92% in real total income per worker for the whole of the R.S.A. and the 2.54% for black workers over the same period.

Substitution of labour

In spite of an increasing trend in labour remuneration and total labour costs per farm unit over time, total labour costs constituted a declining proportion of total farm costs between 1945 and 1985. Table 6 shows the percentage real increase in labour costs per farm unit per annum against that of total farm costs, gross farm income, machinery costs and total direct and non-direct apportionable costs per farm unit. Real changes in gross farm income are also shown.

Table 6 shows that real total costs, real direct and non-direct apportionable costs and real machinery costs increased over time in all the regions. Real labour costs increased from 1945 to 1970, but decreased from 1970 to 1985. In spite of an increase in maize yields per hectare, real gross farm income decreased over time in all the regions. This is partly due to the difference between total farm output and maize production; the drought that has been experienced in Southern Africa since 1980, and the inflation experienced since the 1970s with input prices rising faster than output prices (Louw, 1986; Van Zyl, 1986a). This has led to a more efficient use of inputs (Kassier, 1986).

Using the Taiwanese and Japanese experience as examples, Ishikawa (1981) suggested that the historical paths of change in per-hectare labour input in rice production and the growth of yields may be represented by a curve with two distinct phases: in the early phase labour intensity increases and it only declines in the later phase. Ishikawa (1978) has therefore distinguished two types of technological factors, apart from the natural and institutional factors, affecting labour absorption: (1) labour-using technological factors, e.g. higher yield varieties, application of fertilizer, and improved cultivation practices, all of which have yield-increasing properties at the same time; (2) labour-saving technological factors, mainly agricultural mechanization.

Utilizing the above-mentioned data, it seems that the Ishikawa-curve also holds for maize production in South Africa. Before 1970 the effect of labour-using technology outweighed the effect of labour-saving technological factors with the result that labour utilization increased. After 1970 the opposite happened, resulting in a decrease of labour intensity with higher yields in maize production.

Labour cost as a percentage of gross farm income, total costs and machinery costs showed a negative annual growth rate over time in all cases. Table 7 depicts the situation.

TABLE 6

Mean annual growth rate (%) in real labour costs, gross farm income, total costs and direct and non-direct apportionable costs (DAC and N-DAC) per farm unit for the periods 1945–1970, 1970–1985 and 1945–1985

Item		North-western Free State			Western Transvaal			Transvaal Highveld		
		1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985
Real labour costs	Growth rate	6.37**	− 1.59**	4.58**	3.48**	− 0.88	2.77**	3.26**	− 0.10	3.56**
	R^2	91.5	90.1	93.8	92.9	13.8	94.2	67.5	1.2	98.8
Real gross farm income	Growth rate	− 3.28	−19.23*	− 5.54*	− 6.54**	−14.67**	− 9.57**	− 4.24*	− 8.89**	− 5.99**
	R^2	23.7	75.8	87.4	90.6	76.1	97.9	53.7	92.6	92.1
Real total costs	Growth rate	7.34**	3.49**	6.60**	6.26**	2.98	6.27**	6.53**	4.84*	6.88**
	R^2	93.5	80.43	97.6	99.5	20.7	99.2	95.0	55.0	96.5
Real DAC	Growth rate	7.17**	4.87*	7.16**	8.36**	4.31*	8.28**	7.68**	5.97*	7.89**
	R^2	87.5	69.5	93.3	91.8	57.6	97.4	95.5	46.3	94.9
Real N-DAC	Growth rate	7.28**	2.69	5.76**	5.68**	2.11*	5.34**	5.62**	3.82*	6.02**
	R^2	84.6	33.2	91.4	99.6	48.8	99.5	88.6	63.8	96.1
Real machinery costs	Growth rate	10.01**	5.30	6.39**	6.57**	2.73*	6.45**	7.66**	5.48*	7.82**
	R^2	59.1	39.2	83.1	98.2	45.9	99.4	81.4	70.0	94.8
Yield per hectare	Growth rate	1.01	1.24	2.54**	1.09*	− 0.45	0.90	5.01**	0.14	2.17**
	R^2	2.3	11.4	28.6	22.1	8.8	0.02	51.7	8.6	25.2

**, Highly significant ($P<0.05$); *, significant ($P<0.10$).
R^2 = Coefficient of determination.

TABLE 7

Mean annual growth rate (%) in labour costs as a percentage of real gross farm income, total costs and machinery costs per farm unit for the periods 1945-1970, 1970-1985 and 1945-1985

Item		North-western Free State			Western Transvaal			Transvaal Highveld		
		1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985
Labour costs as percentage of gross farm income	Growth rate	− 0.21	− 1.40	− 0.97*	− 1.65*	− 0.57	− 1.97*	− 1.89*	− 4.34*	− 2.42**
	R^2	6.6	9.8	58.6	58.6	2.1	75.4	32.5	73.0	82.5
Labour costs as percentage of total costs	Growth rate	− 0.97*	− 5.0**	− 2.02**	− 2.78**	− 2.87*	− 3.49**	− 3.26**	− 4.94**	− 3.32**
	R^2	35.4	84.6	84.2	94.4	53.5	98.3	85.5	87.3	93.3
Labour costs as percentage of machinery costs	Growth rate	− 4.83*	− 6.40*	− 4.81*	− 3.64**	−3.42**	− 3.76**	− 4.80*	− 5.01**	− 4.26**
	R^2	33.8	55.1	78.4	82.9	81.7	94.9	56.8	85.3	80.2

**, Highly significant ($P<0.05$); *, significant ($P<0.10$).
R^2 = Coefficient of determination.

The annual growth rates in real remuneration per farm employee (Table 5) were also lower than the real annual growth rate in total costs and machinery costs per farm unit.

At present (1980–1985), labour costs expressed as a percentage of total costs per farm unit are respectively 13.8%, 10.2% and 10.3% for the North-Western Free State, the Transvaal Highveld and the Western Transvaal.

The theoretical equilibrium for an economic optimum between the two factors of production, capital and labour, is found where:

$$\Delta X_1 / \Delta X_2 = P_2 / P_1 \qquad (1)$$

with $\Delta X_1 =$ change in quantity of labour; $\Delta X_2 =$ change in quantity of capital; $P_1 =$ price of labour; $P_2 =$ price of capital.

It appears from Tables 2–6 that both the relative prices and quantities of capital and labour varied over time. However, in spite of the lower tempo of increase in labour costs relative to that of capital, the relative share of labour decreased in maize production. This trend is contrary to expectations as dictated by the theoretical equilibrium for an economic optimum (eqn. 1). A possible cause is probably an overreaction to mechanization, partly due to the introduction of more productive technology, e.g. maize combines. There exists ample evidence that some farms in South Africa are over-mechanized (Van Rooyen, 1973; Brotherton and Groenewald, 1982). Tax provisions which enabled farmers to write off 100% of capital costs against taxes in the year of purchase, as well as subsidized interest rates have contributed to this overreaction (Biggs, 1982).

In the light of the input-price inflation presently experienced in South African agriculture (Louw, 1986; Van Zyl, 1986a), it can be expected that farmers and agricultural producers will be forced to economize on expenditures even to survive (Janse van Rensburg, 1985; Louw, 1986). A continually increasing investment in farm machinery is therefore not expected. However, savings and economizing can initially include the fuller utilization of existing capacity. Other economizing measures can result in an initial stagnation in the demand for labour at current levels. These factors probably contribute to a delay in movement back towards equilibrium between capital and labour. The higher rate of increases in real remuneration per agricultural employee compared to that in certain other sectors, as well as the high unemployment rate in non-agricultural sectors will probably contribute to a move towards the equilibrium.

The elasticity of substitution, which is a pure number that indicates the extent to which one input substitutes for another (Henderson and Quandt, 1971), may be of some interest in this regard. If a high elasticity of substitution exists between a pair of factors, the manager can quickly adjust the input mix in response to changing relative prices. With a low elasticity of substitution, however, the input mix can hardly be altered even in the face of large relative shifts in prices. Positive coefficients denote complementarity, whereas nega-

tive coefficients denote substitution. The long-term elasticity of substitution between labour and capital for commercial maize farming in South Africa as a whole, for the periods 1945–1970 and 1970–1985, utilizing the Shadow measure (McFadden, 1963), were respectively −0.814 and +0.734 (Van Zyl, 1986b). Labour and machinery were thus highly significantly inelastic complements during the period 1945–1970, but became highly significantly inelastic substitutes during 1970–1985. Movement in the direction of the economic optimum equilibrium between capital and labour may thus take even longer than initially expected. Institutional restrictions on the mobility of labour may have contributed towards the inelastic elasticities of substitution.

Productivity

The increase in productivity of the production factors such as land, capital and labour in the different regions can be calculated by relating gross output to the value of inputs over time (Van Niekerk, 1978; Butterworth and Nix, 1983). These changes for the different periods are shown in Table 8. It can be seen that the mean annual increases in productivity of labour were higher than that of machinery, regardless of the region. This coincides with the results of Joubert and Van Wyk (1984) for total agricultural production. Annual increases in the productivity of labour, however, were lower than the real total remuneration per farm labourer for the corresponding period in all the regions.

Policy relevance

The decline in the number of farm employees per 1000 ha under cultivation since 1970 was probably the result of mechanization, especially in the harvesting process. More intensive utilization of machinery (nearer to full-capacity) on larger farms may have contributed to this decline.

The accelerated rate of substitution of capital for labour in agriculture was probably partially due to tax concessions on new capital improvements and machinery, and also subsidization of agricultural production in general. This concomitant decreases in the demand for farm labour can also be related to the increasing rate of urbanization.

Although labour is a large cost item in agricultural production, labour expenditures are frequently small relative to other costs. The availability of farm employees, their productivity and labour costs are important factors in farm management decisions. The size and direction of the influence of labour decisions are easy to describe but much more difficult to explain and predict. Economic and social developments that may decrease the availability of labour, or increase labour costs, will lead to further mechanization that will impair labour-intensive production. However, the relatively declining share of labour

TABLE 8

Mean annual growth rate (%) in productivity of labour, land and machinery for the periods 1945–1970, 1970–1985 and 1945–1985

Item		North-western Free State			Western Transvaal			Transvaal Highveld		
		1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985	1945 to 1970	1970 to 1985	1945 to 1985
Productivity of labour	Growth rate	2.63*	2.24	3.14**	1.25	− 0.03	1.59**	2.53*	2.56	3.28**
	R^2	33.7	27.0	72.1	52.8	0.01	51.3	47.0	25.9	77.4
Productivity of land	Growth rate	4.61**	1.40	3.96**	3.26*	− 0.85	2.11**	3.25**	2.82*	3.25**
	R^2	63.5	15.7	81.3	74.8	2.57	55.1	71.3	49.6	90.3
Productivity of machinery	Growth rate	−3.82**	−25.24**	− 9.55**	− 5.27**	−23.1**	−11.2**	− 6.05*	− 1.91*	− 5.57**
	R^2	67.8	98.5	86.0	94.9	98.5	90.7	62.1	73.7	91.7

**, Highly significant ($P<0.05$); *, significant ($P<0.05$).
R^2 = Coefficient of determination.

costs in agricultural production indicates that the influence of labour on the structure of farming is decreasing.

The relative performance of the agricultural and farming sector is influenced by its structure and changes that may come in future. Performance criteria should therefore measure economic performance, as well as the quality of life in rural areas and communities (both for farmers and employees), and the use of natural resources and their influence on the environment.

The identified trends and other characteristics of the agricultural labour market have definite policy implications. Capital is relatively scarce in South Africa, while there is an abundance of unskilled and semi-skilled labour available. Capital should thus be used with a great deal of discretion to maximize income and work creation opportunities. Agriculture ultimately yields the largest number of job opportunities per unit of capital invested through the multiplier effect (Mullins and Scheepers, 1980), but can lead to unemployment in the short term.

Development policy should therefore also be centered on creation of job opportunities and the relief of poverty in the intermediate period. However, work opportunities should be productive, and it must, given the scarcity of available resources, be created at the smallest possible cost. The use of capital to enable the growth of agricultural production is therefore not always wrong; it can be essential to use scarce capital to create more job opportunities. Capital should, however, be used for labour-using technology rather than for labour-saving technology (Ishikawa, 1978, 1981), taking into account that management of relatively large numbers of labourers has a cost attached.

Technological progress is generally not neutral to the use of production factors. It can contribute to savings in either labour, capital or land, or a combination of these. Much technology adopted in southern Africa resulted from research and development in the U.S.A. and other advanced countries where labour is scarce and expensive relative to capital. Van Zyl et al. (1985) have shown that these technologies, such as maize cultivars, are frequently not suitable for local conditions. It is therefore essential that production techniques and technology in agriculture are adapted to the economic realities of southern Africa.

The appropriate use of available technology in agricultural production is a function of a variety of influences: availability and prices of different factors of production, their relative marginal and average return, financial and managerial status of farmers, investment already incurred in fixed or semi-fixed assets, and also risk or variability attached to any particular technology. The adverse effects of labour displacement, in the light of a relative scarcity of capital, are especially acute in South Africa, given the dualistic nature of the agricultural sector (Van Zyl et al., 1985).

The South African authorities should therefore review certain policy aspects that impair job creation opportunities in agriculture which have resulted in

distorted prices of the production factors relative to their scarcity. The major measures that kept the cost of capital relatively low were the control of interest rates in general, the subsidization of interest rates in agriculture, and tax concessions on capital investment. These, together with other measures that distort the relative cost of inputs, should be reviewed and modified.

Commercial agriculture still has a role to play in the development of southern Africa, and unless job creation abilities are enlarged, large-scale rural unemployment, poverty and social deterioration could be unavoidable.

Conclusions

As a factor of production, labour should not be seen in isolation. Since the Second World War, the following changes and trends were identified in the summer rain grain regions:

(a) The number of farm employees per farm unit and per 1000 ha under cultivation increased from 1945 to 1970, but decreased significantly from 1970 to 1985.

(b) Farm size and areas under cultivation increased over time. Increases, however, were lower during the period 1970–1985 than in 1945–1970.

(c) Total real investment in machinery per farm unit, as well as per farm area and per area under cultivation, increased over time.

(d) Both real cash and real in-kind payment increased over time, with cash remuneration increasing faster.

(e) During the period under consideration, labour costs increased at a lower rate than total farm expenditures and machinery costs. Real gross farm income has declined. Real labour costs increased from 1945 to 1970, but decreased from 1970 to 1985.

(f) Productivity of labour increased at a higher rate than that of machinery, but at a lower rate than real total remuneration per farm labourer.

Two structural trends in South African maize production are evident. The period 1945–1970 witnessed a large expansion in cultivated farm area, probably because tractors replaced draught oxen. Larger areas could be managed and more labour was required. Demands on labour for harvesting were heavy until the introduction of the combine harvester alleviated this problem. These trends were strengthened by policies aimed at lowering the cost of capital, giving rise to some of the socio-economic concerns expressed in this paper.

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