Notes on the macro-economic effects of the drought

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South Africa is currently experiencing one of the severest droughts of the past century and agricultural production in the summer rainfall regions is expected to be markedly lower than what could have been expected in a normal rainfall year. Although the relative percentage contribution of the agricultural sector to the gross domestic product has declined sharply since the 1960s, agriculture still plays a prominent role in the South African economy. The drought not only influences the economy via its direct effect on the agricultural sector, but also through the linkages of agriculture with other sectors of the economy.

In this note the effects that the drought may have on macro-economic variables, such as the economic growth rate, investment, the current account of the balance of payments, inflation and employment are discussed in some detail, as are the financial implications for farmers and the government. The Reserve Bank's macro-econometric model was used to estimate the extent of the dam-

age caused by the 1992 drought. Although the quantified impact of the drought has been determined as scientifically as possible, the results should be interpreted with some care. Even with the help of a macro-econometric model it is not possible to take all the indirect links between the agricultural sector and the rest of the economy into consideration, and no attempt has been made to estimate the impending long-term effects of the drought.

The structure of the Reserve Bank's macro-econometric model

In his explanation of an econometric model, Klein[1] states that such a model is "a schematic simplification that strips away the non-essential aspects to reveal the inner workings, shape, or design of a

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[1] Klein, L.R.: *Lectures in Economics*, Amsterdam, North-Holland, 1983,p.1.

Graph 1: Real gross value added by the agricultural sector

Dark area: drought periods.

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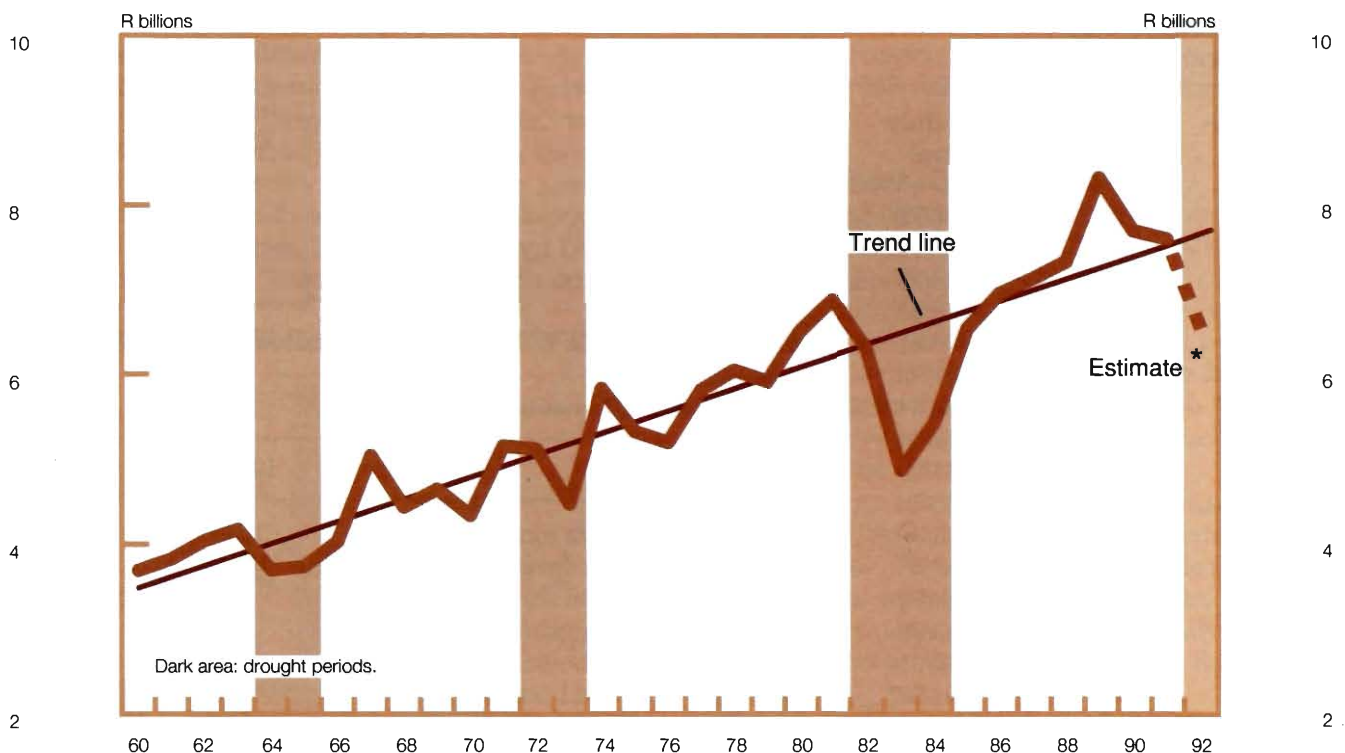
more complicated mechanism" He continues: "It, by itself, is not reality, but merely a simplified picture of reality that man can understand."

It is important to bear in mind that no two models will look alike or produce the same results, as each economist will construct his model according to his personal views on the interdependences in the economic system. The same main theoretical principles may, however, be incorporated in different models. The macro-econometric model of the Reserve Bank is based on the Keynesian income-expenditure approach. The circular flow of income and expenditure, as measured in the national accounts, links the expenditure and income variables. The supply side of the economy is taken into account in a number of equations that model the value added by different output sectors. This entails the transformation of aggregate demand components into value added per sector by means of an input-output transformation matrix. On their own these equations allow for no supply side constraint on production. The supply side constraint of the model is determined by the full employment of the potential labour force and the fixed capital stock in a neoclassical production function.

The long-term growth trend in agricultural output

The long-term trend of real gross value added by the agricultural sector is calculated by fitting a con-

Table 1: Rainfall figures

(Millimetres)

Year (July-June)	Average rainfall	Year (July-June)	Average Rainfall
1960/61	596	1976/77	607
1961/62	432	1977/78	650
1962/63	536	1978/79	475
1963/64	441	1979/80	549
1964/65	472	1980/81	635
1965/66	448	1981/82	489
1966/67	691	1982/83	394
1967/68	443	1983/84	586
1968/69	530	1984/85	542
1969/70	424	1985/86	535
1970/71	616	1986/87	501
1971/72	673	1987/88	816
1972/73	430	1988/89	647
1973/74	814	1989/90	547
1974/75	644	1990/91	562
1975/76	849	1991/92*	438

* Estimate

Source: The Weather Bureau, Department of Environment Affairs.

stant growth equation to this specific time series. The potential growth of the agricultural sector is estimated by the fitted trend line, which is presented graphically in Graph 1.

The graph highlights large deviations in the value added by the agricultural sector from its long-term growth trend. The most prominent negative deviations were recorded in the periods 1964-1965, 1972-1973 and 1982-1984, which can be regarded as drought periods. These periods correspond to a large extent with years of abnormally low rainfall. Admittedly, the rainfall dispersion during a season also plays a decisive role in determining agricultural output volumes. The average annual rainfall figures measured in the summer rainfall regions, as defined by the Weather Bureau, are shown in Table 1.

Simulations with the aid of the Reserve Bank's macro-econometric model

In order to determine the effect of the drought on the main economic aggregates, a baseline simulation based on the assumption of a normal agricultural year is compared with an alternative simulation taking drought conditions into consideration. In the baseline simulation the gross value added by the agricultural sector is presumed to be determined by the long-term growth trend of 2,5 per cent per annum. Under normal conditions agricultural production provides in all domestic requirements, which means that there is no need to import agricultural products.

The alternative simulation takes the drought into consideration and assumes that the gross value added by the agricultural sector is set to decline by 14 per cent in 1992 compared with its level of the previous year. This rate of decrease is based on the summer crop production estimates for 1991/92 as indicated in Table 2. The decline in gross value added by the agricultural sector is also based on the assumption that "normal" winter grain crops

Table 2: Production estimates of summer crops

(Thousand tons)

	1990/91	1991/92
White maize	3 810	985
Yellow maize	4 016	1 448
Grain sorghum	240	95
Groundnuts	78	81
Sunflower seed	589	173
Soya beans	126	68
Dry beans	100	27

Source: The National Crop Estimate Committee, 15 May 1992.

will be harvested. It is further assumed that approximately 4,6 million tons of maize will have to be imported at a cost of about R500 per ton in order to satisfy domestic demand[2].

Economic growth

Although the agricultural sector's relative contribution to the gross domestic product of the country is small and still declining, it nevertheless plays an important role in the creation of wealth in South Africa, specifically in the rural areas. As shown in Graph 2, the share of agricultural production in total output has been severely affected at times by poor weather conditions and droughts. In 1992 the drought and the expected poor harvest of summer crops will not only lead to a further decline in the contribution of agriculture to the gross domestic product, but it will also cause a lower-than-expected economic growth rate.

The agricultural sector does not only have a direct impact on the growth of the economy, but as a result of the forward and backward linkages with other sectors it also affects the economy in indirect ways.

The forward linkages of the agricultural sector originate from the agricultural sector's delivery of a wide range of raw materials to the secondary sectors. A report by the Economic Advisory Council of the State President[3] indicates that according to the input-output table of the national economy, approximately 58 per cent of the value of agricultural production was delivered to secondary industries for

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[2] Estimate by the Maize Board.

[3] *Report on the Investigation on the Reconstruction of Agriculture*, Economic Advisory Council of the State President, 20 November 1986.

Graph 2: Contribution of real agricultural production to the real gross domestic product

Dark area: drought periods.
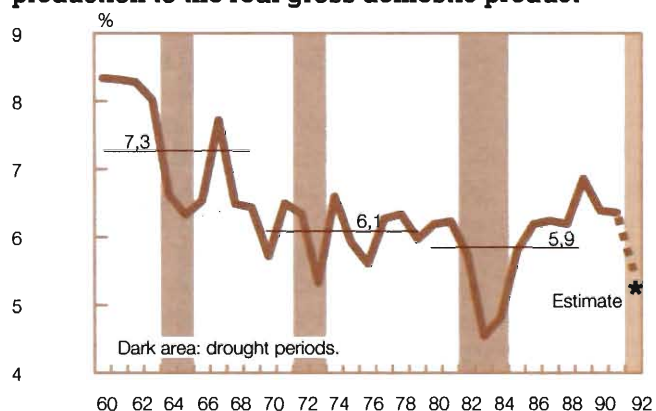
further processing, whereas the delivery of agricultural production to processing industries amounted to 8,2 per cent of the total value of manufacturing production.

The backward linkages of agriculture with other sectors arises from the fact that the agricultural sector is an important purchaser of the products and services of other sectors. The manufacturers of livestock feed, fertilisers, insecticides, agricultural machinery and implements can be singled out as fairly exclusively dependent on sales to farmers. If the production in the agricultural sector should decline because of drought conditions, this will inevitably influence activity in these industries.

The total impact of changes in the production of a sector on the other sectors of the economy can be calculated by means of sectoral multipliers. The agricultural multiplier has been calculated as 1,6, which means that for every R1 million of agricultural production, additional output amounting to R600 000 will be generated in all the other sectors together[4]. This multiplier is calculated as an average for the country as a whole, but it may differ considerably for different regions, depending on the importance of agriculture in a particular region. It is possible that the multiplier could be larger in rural areas that are mainly dependent on agriculture.

The simulation results indicate that a decline of 14 per cent in the value added by the agricultural sector will lower the real gross domestic product by approximately 1,8 percentage points, which represents a direct impact of 1 percentage point and an indirect impact of 0,8 percentage points. The nominal gross domestic product in the alternative simulation is R4 550 million lower than in the baseline simulation.

Private households

The expected decline in farm income and the associated decline in the profits of related industries will have a negative effect on personal disposable income. The alternative simulation shows that real disposable income decreased by 1,8 percentage points as a result of the drought. This implies that personal disposable income per capita is approximately R70 lower in the alternative simulation than in the baseline simulation.

The lower personal disposable income will inevitably lead to lower private consumption expenditure. The expected higher level of consumer prices as a result of the drought, especially that of food prices, will also have an adverse effect on private consumption expenditure. Real private

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[4] Cloete, K. and Swart, T.: *Die skakelingseffek en sosio-ekonomiese rol van die landbou en die gevolg van die droogte daarop*, Directorate of Agricultural Economics of the Department of Agricultural Development, March 1992.

Graph 3: Real fixed investment in the agricultural sector as a percentage of total real fixed investment

Dark area: drought periods.
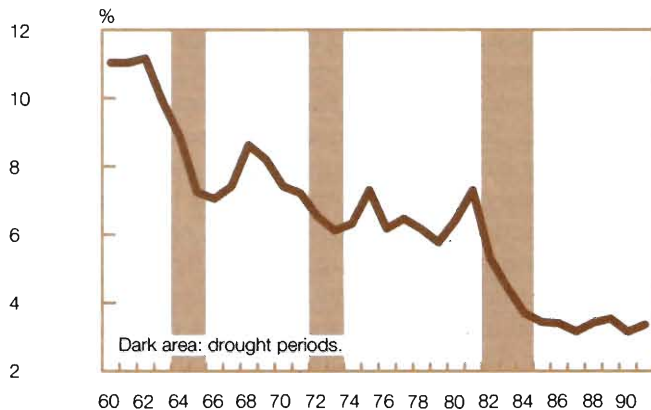
consumption expenditure is 0,5 per cent lower in the alternative simulation than in the baseline simulation.

Private savings will be negatively affected by the drought if private consumption expenditure does not decline to the same extent as disposable income. The simulation results show that personal savings were R2 920 million lower in the alternative simulation than in the baseline simulation. This decrease, together with the increased dissaving of the general government, partly because of greater financial support to the farming community, has a negative impact of 5 per cent on gross domestic saving.

Investment

The share of agricultural fixed investment in total gross domestic fixed investment has declined considerably over the past three decades. During the 1960s agricultural fixed investment contributed 9 per cent to total domestic fixed investment, but this declined to only 4 per cent in the 1980s. The sustained decline in agriculture's relative contribution to aggregate fixed investment over the past few decades, and especially the declines during drought periods, are illustrated in Graph 3. This graph also indicates that the relative investment ratio of agriculture never recovered after the drought of 1984. This can possibly be attributed to the deteriorating financial position of the farming community since the beginning of the 1980s.

National accounts estimates indicate that the value of fixed improvements and the purchase of tractors, machinery and implements usually decline only moderately in drought periods, and that large falls in livestock numbers can be identified as the main factor responsible for the sharp

decrease in investment during periods of drought.

The simulation results show that gross domestic fixed investment is R230 million lower in the alternative simulation than in the baseline simulation; this represents a decline of 0,5 per cent. However, the intensity of the current drought is such that the actual decline in fixed investment may easily exceed the amount simulated by the model.

Imports of goods

In normal times, South Africa is largely self-sufficient with regard to food production and a large proportion of its agricultural production is exported. Agricultural products therefore represent a small percentage of the total value of goods imported. The average share of agricultural products amounted to 2 per cent of the value of merchandise imports during the period 1970 to 1991. However, during periods of drought South Africa is often forced to import fairly substantial quantities of agricultural products. Graph 4 illustrates the very sharp rise in 1984 of imported agricultural products as a percentage of the total value of goods imported, which resulted from the drought of that year.

As noted earlier, the Department of Agriculture and the Maize Board currently estimate that approximately 4,6 million tons of maize at a landed cost of about R500 per ton will have to be imported during the period April 1992 to March 1993. The direct impact of these maize imports on the balance of payments is expected to amount to approximately R1 725 million in 1992[5].

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[5] Calculated for the nine month period April 1992 to December 1992 as: 4,6 x 500 x 9 ÷ 12.

Graph 4: Imports of agricultural products as a percentage of total merchandise imports

Dark area: drought periods.
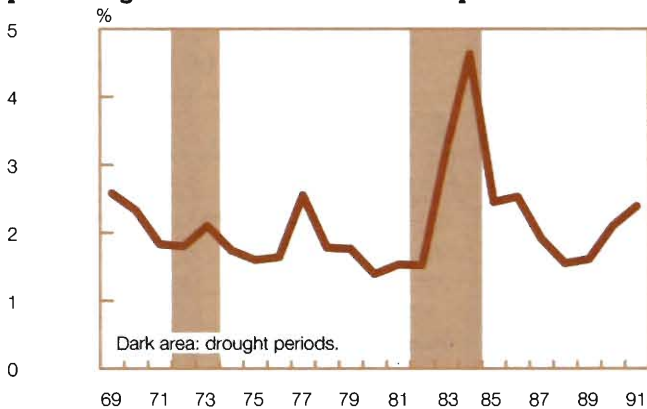
The lower level of aggregate domestic demand as a result of the drought will also have an impact on the volume of imports. The higher imports of agricultural products owing to the drought will be neutralised partly by the lower imports resulting from the lower level of domestic demand. The simulation results show the value of other non-agricultural imports to be lower by R1 225 million as a result of the lower domestic demand, resulting in a net increase in merchandise imports of R500 million as a result of the drought.

Exports of goods

The relative importance of agricultural products exported as a percentage of total merchandise exports contracted from approximately 10 per cent in the early 1970s to an average of 4 per cent over the past two years. Maize exports as a percentage of the value of merchandise exports also declined from 4 per cent to a mere 1 per cent over the same period. Although the severity of the current drought is greater than that of previous droughts, the gradual decline in the relative importance of maize exports suggests that the impact of the current drought on the total value of merchandise exports may in fact be smaller than in previous drought periods.

All maize exports were discontinued fairly early in the year because of the weak maize crop. It is also expected that the export of maize in 1993, should there be a normal harvest, will be low because of inventory replenishment. Using the average value of maize exports in the past five years as a benchmark to estimate the loss of export earnings in 1992, the direct influence of maize exports on the balance of payments can be estimated at approximately R365 million. The indirect negative impact on the value of exports resulting from the linkages with other sectors and from the lower aggregate domestic demand is calculated at R335 million. The total expected impact of the drought on the value of exports will thus be about R700 million.

The current account of the balance of payments

The combined direct negative effect of the higher maize imports and the lower maize exports in 1992 on the current account of the balance of payments will be approximately R2 090 million. This amount reflects only the influence of the drought on maize production. Although the drought will also have an impact on other summer crops, such as sunflower seed, dry beans, soya beans and grain sorghum, these products represent a much smaller share than maize in the total value of goods exported and it can be expected that their effect on the current account of the balance of payments will be small.

Table 3: Direct and indirect impact of the drought on the balance of payments

(R millions)

	Imports	Exports
Direct impact..................	+ 1 725	– 365
Indirect impact	– 1 225	– 335
Total impact	+ 500	– 700

Indications are that sugar production and exports will also be significantly lower because of the drought and that this could cause an additional lowering of export values.

If the indirect impact of the lower level of economic activity and other forward and backward linkages are taken into consideration, the higher value of imports and the lower value of exports are estimated to have a combined net negative effect of approximately R1 200 million on the current account of the balance of payments in 1992. To this should be added an unquantified additional amount for the impact of agricultural products other than maize, so that these estimates should be seen as a minimum projection for the adverse impact that the drought may have on the balance of payments.

Inflation

The changes in food prices have a significant influence on the consumer price index, owing to the fact that food prices account for 18,6 per cent of the 1990 weighting structure of the consumer price index; the 1985 weight of food prices was even higher at 22,7 per cent. In the past two decades the average rate of increase in the consumer prices of food was higher than that of other consumer prices[6]. This may be indicative of increasing relative scarcities of foodstuffs which, in turn, may have been occasioned by South African population growth outpacing increases in domestic food production. The rate of growth in the consumer prices of food also fluctuated considerably more than that of the other consumer prices. These wide fluctuations contributed to the disturbing feature of movements in the consumer price index of every upper and lower turning-point of changes in the index being at a higher level than its immediate predecessor.

Graph 5 illustrates the sharp increases in food prices during the drought periods of 1964 and 1972, when food prices rose faster than the prices of other items. Surprisingly, food prices increased at a

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[6] The reason for these sharp increases in food prices is the subject of an investigation by the Board of Trade and Industry.

Graph 5: Consumer prices
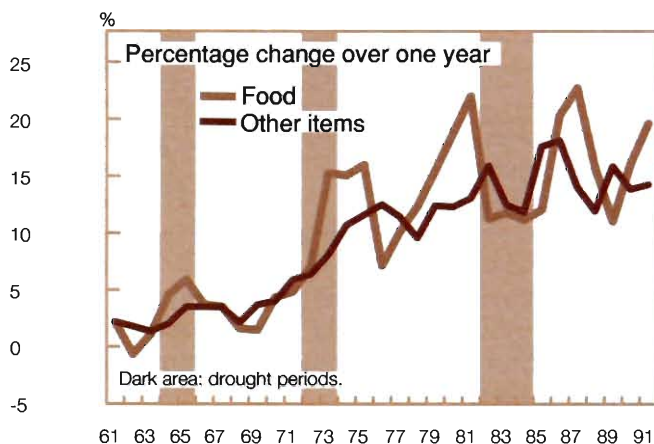
Graph 6: Agricultural production prices and the volume of agricultural production
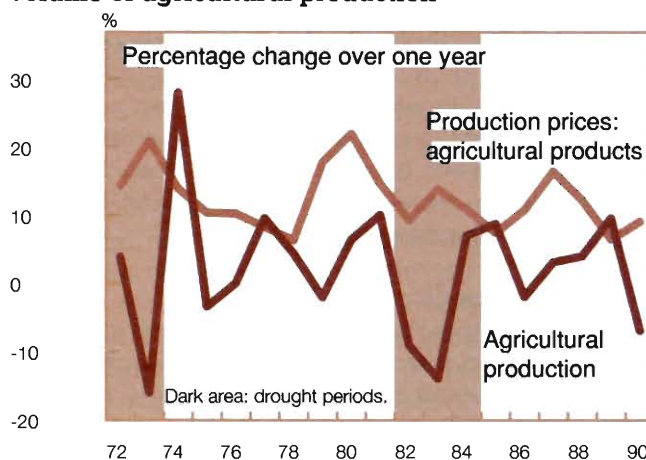
slower rate than other prices during the 1982 drought. This can possibly be attributed to the relatively low rates of increase in meat prices that occurred in that period. During droughts farmers are usually forced to step up the marketing of livestock, and the resultant increase in the supply of meat can dampen potential food price increases. As meat prices have a relatively large weight in the consumer price index of food (33,1 per cent), they have a decisive influence on the eventual change in the food price index.

Meat prices were still 38,8 per cent higher in December 1991 than in the corresponding month in 1990, but there are indications that its rate of increase was slowing and that prices have even been declining recently. During the period January to April 1992 meat prices actually declined at an average rate of 1,4 per cent per month. Once rainfall returns to normal, livestock farmers usually replenish their livestock. The resultant decrease in the number of slaughterings could cause meat prices, and consequently consumer prices in general, to rise faster.

Increases in the prices of other items in the food price index, such as vegetables, milk, milk products and grain products, usually also accelerate during periods of drought. The combined weight of these products in the food price index is 38 per cent, while their weight in the consumer price index is 7,1 per cent.

Although erratic weather conditions have an important influence on the supply, and consequently also on the prices of food products, regulatory practices aimed at dampening excessive price volatility often have precisely the opposite effect when abrupt price changes are required to correct

market imbalances. Graph 6 nevertheless illustrates that the rate of increase in the production prices of agricultural products is inversely correlated with changes in the volume of agricultural production and that these prices usually tend to increase faster when supply is slow or declining.

The changes in the consumer price index of food followed the trend in the changes in the production prices of agricultural products with a relatively short lag during the 1970s and early 1980s. The sharp increases in the production prices of agricultural products during the droughts of 1972 and, to a lesser extent 1982, are accordingly reflected in the rate of increase in the consumer price of food. From 1985 the rate of increase in the consumer price index of food was consistently higher than that of the increase in the production prices of agricultural products.

It can therefore be expected that the current drought will put upward pressure on the prices of a wide variety of agricultural products, which will in due course become visible in an increase in the consumer price index. The simulation results indicate that consumer price inflation in 1992 could be approximately 0,8 percentage points higher than what it would have been during a normal rainfall year.

Employment

Available statistics indicate that the agricultural sector generated employment for approximately 1,2 million people in 1988, or 12 per cent of the economically active population. If their dependants are taken into consideration, the agricultural sector provides a livelihood to some 6 million people, which represents roughly 20 per cent of the South

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African population, excluding the population of the TBVC countries[7].

Agricultural activities are the single most important income generator in most rural districts and a large portion of the rural population is directly dependent on agricultural production. The drought therefore does not only affect the farmers; many business enterprises in rural districts are faced with bankruptcy as a result of the diminished purchasing power of the farming community.

It appears as if employment in the agricultural sector remains relatively stable during drought periods. This can be attributed to the fact that attempts are made to keep permanent employees on the farms and that farmers usually receive aid from the government to support them during these periods. The employment of seasonal or contractual workers on farms is, however, heavily influenced by drought situations and this category of labourers will normally be the first to become redundant. In contrast to this normal pattern, the latest employment figures indicate that farmers are also reducing their permanent labour force, thereby seriously aggravating existing urbanisation and social problems.

The so-called employment coefficient can be applied as a measure for determining the potential employment of the agricultural sector. This coefficient is determined as the number of persons employed in the agricultural sector for every R1 million worth of output that is produced, and therefore provides a method to estimate the approximate number of employment opportunities that could be lost when production decreases.

The employment coefficient was used to determine the effect of a 4 per cent decline in nominal agricultural production on employment numbers in the agricultural sector in 1992[8]. The estimated value added by the agricultural sector was used as a criterion for production and it was assumed that the employment level remained unchanged from 1988 to 1991. The calculated employment coefficient of 98,2 implies that the agricultural sector may shed 98 job opportunities for every R1 million decrease in the value of agricultural production. Based on these assumptions, the current drought can cause an approximate loss of 49 000 job opportunities in the agricultural sector during 1992. If these farm labourers' dependants are also taken into consideration, 245 000 people in the agricultural sector will be forced to find another livelihood, unless special assistance is made available in the form of transfer payments to enable farmers and their workers to stay on the land.

As a result of its strong linkages with other sectors, the employment effects of the drought will not be restricted to the agricultural sector. The simulation results indicate that approximately 20 000 jobs will also be lost in other sectors. These results are applicable only to the formal economy and it can be assumed that the informal sector will have to absorb a sizeable number of the unemployed.

Financial implications for farmers and the Government

The drought increases the financial liabilities of the agricultural community and that of the government and associated business enterprises. During the years from 1971 to 1991 the debt burden of the agricultural community increased at an average annual rate of 13 per cent from an initial R1,46 billion to R16,72 billion. Financial liquidity in the agricultural sector deteriorates as a result of the farmers' weaker solvability and a shift in their debt structure from predominantly long-term debt to short-term debt. The ratio of agriculture's total debt to total assets (i.e. the debt ratio in agriculture) averaged approximately 13 per cent during the 1970s, but it rose considerably from 1980. During the drought of 1982 and 1983 the debt ratio moved higher to a level of 20,4 per cent in 1983, but since then it has increased further to a level of 23,9 per cent in 1991. It is expected that as a result of the current drought this debt ratio will continue to increase sharply in 1992.

The operating costs of farmers increased at an average rate of 16 per cent per year during the period 1971 to 1991. This is significantly higher than the average annual increase of 14,2 per cent in their gross revenues over the same period. In periods of drought the cash flow[9] of farmers is weakened further by reduced farm revenues, whereas operating costs remain high. The cash flow decreased by 13,4 per cent during the drought of 1982 and by a further 40,9 per cent in 1983. The agricultural sector's cash flow has weakened again over the past two years and the current drought is expected to exert even greater pressure on cash flows. This anticipated cash flow deterioration is one of the problems that the agricultural sector will have to address to improve the operational efficiency in the industry. The financial situation of the agricultural sector is further aggravated by the relative high nominal interest rates - forced on South Africa by the relative high level of interest rates in other countries, relative

[7] *South African Labour Statistics*, Central Statistical Service, 1991.
[8] This figure represents a decline of 14 per cent in the real value added by the agricultural sector and a 12 per cent increase in the value-added deflator of the agricultural sector.

[9] Calculated as gross income less purchases of intermediate goods and services, remuneration of employees, interest payments and rent payments.

low savings level in South Africa, large outflows of capital to the rest of the world in the past decade and the relatively high level of inflation in the country.

The critical financial position of farmers was emphasised in a press release by the Minister of Agriculture on 9 April 1992. The Minister stated that about 4 265 farmers will not be eligible for further credit from co-operatives because of their existing indebtedness and additional debt incurred during the recent planting season. It is estimated that at least R2 billion is required for the planting of the next summer crops.

Many contingency plans have been initiated by the government in co-operation with the Land Bank, agricultural co-operatives and commercial banks and it is clear that heavy demands will be made on these institutions and on every taxpayer in the years to come. On 7 May 1992 the Minister of Agriculture announced the introduction of the most extensive relief action in South Africa's agricultural history. A total amount of R2 826 million is to be allocated to farmers for financial assistance over the next three tax years. This amount is provided in addition to the R355 million for financial aid and the R1 000 million for the Emergency Drought Fund allocated in the Central Government's budget for 1992/93. The aid package consists of an initial input subsidy of R375 per hectare for crop farmers by the 33 co-operatives in the emergency drought areas and a variety of other measures to assist farmers and the industry. Among the relief schemes are the subsidisation of certain interest costs, a rebate on the transportation of livestock feed, and aid to wool and mohair farmers.

The decline in farm revenues will necessarily result directly in lower government tax revenues. Government revenue will also be affected indirectly by the lower profits of business enterprises related to the agricultural sector.

The lower revenue and higher expenditure will result in an increase in the deficit before borrowing. If the 1992/93 Budget did not have to provide for R1 000 million aid to the agricultural community, the increase in real government expenditure would have been a mere 1,1 per cent instead of the budgeted 2,1 per cent. The budget deficit before borrowing of almost R16 billion, or 4,5 per cent of the gross domestic product, would have been R15 billion or equal to 4,3 per cent of the gross domestic product.

Conclusion

The extent of the drought is obviously far more severe than originally estimated and will be especially harmful to the producers of summer crops. Although the agricultural sector's contribution to the gross domestic product has declined continually since the 1960s, it nevertheless still plays a very important role in South Africa's national economy, especially because of its interdependence with the other sectors.

The results obtained with the macro-econometric model of the Reserve Bank indicate that the growth in the real gross domestic product may be as much as 1,8 percentage points lower as a result of the drought. It is further estimated that without any special financial assistance, as many as 69 000 job opportunities may become redundant as a consequence of the drought.

The simulation results also indicate that the average inflation rate could be approximately 0,8 percentage points higher as a result of the lower agricultural production. Although most food prices will probably increase at a faster rate because of the restricted supply of agricultural products, meat prices usually tend to rise at a slower rate and may even decline during periods of drought. Meat prices may, however, start affecting consumer prices at a later stage when grazing conditions improve again.

The current account of the balance of payments will be directly affected by a rise in imports and a decline in exports. The direct negative effect of R2,1 billion on the current account balance as a result of the lower maize crop could be partly neutralised by a decline in imports because of the lower level of economic activity. This, together with the lower exports of agricultural products, could result in a net negative effect of approximately R1 200 million on the current account of the balance of payments, which could be further affected by the adverse effect of the drought on agricultural products other than maize.

The drought will not only tighten the overall financial position of farmers, but also that of the government and other business enterprises associated with the farming industry. The Minister of Agriculture has already granted additional financial aid for the next three years. This demonstrates the fact that the drought not only has a once-off impact on the economy, but that its effect will still be felt in forthcoming years.