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Cereal Production in the Eastern Free State, 1981 – 2007: Can Agricultural Extension Deliver Food Security?

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ABSTRACT

Since 1989, South Africa's agricultural productivity growth has reached a standstill while the South African population has kept growing at 1.93% per annum. Although the country is a surplus maize producer, per capita maize production has fallen at -0.38% p.a. since 1989. A provincial breakdown of food grain production will allow the government to monitor future food security, making prompt interventions possible. In this region, we need interventions that can relieve the stresses on the already over-burned natural resources, and this can be implemented through agricultural extension by raising agricultural productivity. This paper examines the field crop production trends in the Eastern Free State province of South Africa for positive or negative trends at the district level. The data reveals a decline in cereal, legume, and oil seed production between 1981 and 2007. The negative trajectory we see in all crops in all districts is concerning. In most districts, the decline is due to fewer hectares planted, but unfavourable weather and the withdrawal of support by the government may also be contributing factors. This disastrous trend could be turned around by greater investment in farmer education and skills development in the public extension service.

Keywords: Eastern Free State, Field crop, Legumes and oil seeds, Cereals, Production

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1. INTRODUCTION

Agriculture is still the backbone of many African economies. It is a key sector in solving food insecurity, hunger and malnutrition. It can reduce poverty by boosting rural incomes and employment, thereby stimulating national output growth (Gillespie & Van den Bold, 2017; Mlambo, Mukarumbwa & Megbowon, 2019). Firstly, food security requires enough calories, but a country must also deliver diets of acceptable nutrition and diversity to its citizens. At 2.8% of the Gross Domestic Product (GDP), South Africa's economy is the most industrialised and diversified on the African continent (The World Factbook – SA, 2018). Yet, we run the risk of becoming food insecure.

Agricultural productivity trends in South Africa can be traced from 1910 (Liebenberg & Pardey, 2012), with clear fluctuations apparent over the years. However, the agricultural sector performed poorly compared to other sectors of the South African economy, with its contribution to the GDP dropping from 9% in the 1960s to only 2.5% in 2021 (The World Bank and OECD, 2023). The global climatic changes, insufficient government funding, and the exploration of other natural resources contributed to the agricultural sector's suboptimal performance. With the declining role of agriculture in the South African economy, it is quite important to ask whether the sector can still meet the country's food demands.

Numerous scholars have researched this question since the mid-1950s, and it has become a growing concern for decades among policymakers, researchers, and other stakeholders (Van Zyl, Nel & Groenewald, 1988; Oehmke, Anandajayasekeram & Masters, 1997; Greyling, 2012). One of their findings was that the sector has been unable to meet the demand for the main food items consumed domestically since 2000. Greyling (2012) argued that agriculture played a growth-permissive rather than an initiating role in the national economy. Dethier (2011) noted a discrepancy between population growth rates and the yield of major grain crops. Since 1989, South Africa's agricultural productivity growth has reached a standstill, while the South African population has kept growing at 1.93% per annum (Department of Agriculture, Forestry and Fishery, 2017). Although the country is a surplus maize producer, per capita maize production has fallen at -0.38% p.a. since 1989. The warning is clear; we may still have enough food now, but food security has declined. Expanding production by cultivating more land is not the solution since

82% of the arable land was already under crops in 1991 and consumed 60% of the available water for irrigation purposes (Blignaut, Ueckermann & Aronson, 2009). The only solution is, therefore, to increase agricultural productivity.

Since a third of agricultural productivity in South Africa can be explained by past investment, the decline in agricultural production per capita can, in part, be attributed to underinvestment (Wiebe, Schimmelpfennig & Soule, 2001). Reduction in public and private agrarian investors particularly concerns since public investment in basic infrastructure, technology adoption, input use, human capital formation, research, and development facilitates private investment and is needed for marketing the agricultural goods produced (Feder, Just & Zilberman, 1985; Pardey, Roseboom & Craig, 1992; World Food Summit, 1996). A 37% reduction in government expenditure allocated to agricultural development and transfer between 1971 and 1991 did not help the situation in Sub-Saharan Africa (Oehmke, Anandajayasekeram & Masters, 1997).

Economic growth in the Eastern Free State is determined by the performance of agriculture (Vink & Van Rooyen, 2009), and several factors feed into the sector's performance (Mashabela, 2019). The most apparent condition for prosperity is optimal rainfall, and there have been three severe droughts during the period under review in his paper. The 1991/92 drought reduced the Free State Province's maize production by 60% compared to the previous year. In 1994/95, another drought reduced maize output by 71%; in 2005/6, maize production declined by 49% compared to the previous year. Claassen *et al.* (2014) spotlighted removing commodity and input price subsidies as South African agriculture re-entered the global market in the post-apartheid period. At the same time, the government refocused the brief of the public extension service towards small-scale emerging agriculture, causing many losses to emerging commercial farmers, including technical support.

Agricultural extension programs provide farmers with information on farming technologies, support adult education in rural areas and cultivate farmers' technical and managerial farming skills, all contributing to enhanced agricultural productivity and improved household income (Agungu, 2017; Raidimi & Kabiti, 2019; Danso-Abbeam, Ehiakpor & Aidoo, 2018).

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Assessing agricultural production trends over the past decades can help illuminate what may happen in the future. Such projections are essential to ensure prompt intervention to enable the agricultural sector to meet the nutritional needs of the South African population. This study will assess trends in agricultural production of primary agricultural commodities (cereals, legumes and oil seeds) in the Eastern Free State province of South Africa from 1981 to 2007 to determine whether agricultural production is on a negative or positive trajectory in this province. Given the withdrawal of government subsidies, a negative production trajectory may show the need to urgently reinstate government subsidies to enable agricultural extension programs to help farmers improve agricultural productivity in the region. A study by Danso-Abbeam, Ehiakpor & Aidoo (2018) indicated that extension programmes are expected to contribute to the improvement of increased farm productivity.

2. DATA AND METHODS

This study analyses data from various editions of the farm census to determine broad trends in field crop production and land productivity in the Free State over the past thirty years. The analysis is at the district level. Trends are determined by plotting planted areas and total output over time and by regressing the natural logarithms of these data on the years of observation to decide if growth rates or rates of decline are statistically significant. The crops covered are cereals (maize and wheat), legumes and oil seeds. The period under consideration is 1981 to 2007 (26 years), during which South African agriculture transitioned from heavily subsidised, exclusively white-owned production into unsubsidised, supposedly globally competitive and deracialised production.

Our study covers the nine districts that constitute statistical region 63 in the 1981 census, a total area of 2.9 million hectares, of which 30% was devoted to rainfed field crop production during the year of the 1981 census. Most of these districts form part of Thabo Mofutsanyane District Municipality northeast of Bloemfontein. Table 1 matches the old magisterial district names to the new local district names and gives each district's total farmland and the amount of arable land according to the 1981 census. A significant difference is noted in the proportion of arable land, from 46% of the district for Reitz to 17% for Harrismith.

TABLE 1: **Districts Included in the Study**

Magisterial district	**Local municipality**	**Farmland (ha)**	**Arable[2] land (ha)**	**%**
Reitz	Nketoana	199 515	91 785	46
Frankfort	Mafube [1]	355 704	138 742	39
Lindley	Nketoana	273 989	101 583	37
Bethlehem	Dihlabeng	353 938	126 712	36
Senekal	Setsoto	331 728	119 004	36
Ficksburg	Setsoto	129 329	43 714	34
Fouriesburg	Dihlabeng	96 420	25 654	27
Vrede	Phumelela	510 297	107 852	21
Harrismith	Maluti-A-Phofung	687 205	113 467	17
Total (region 63)		**2 938 121**	**868 513**	**30**

[1] Mafube Local Municipality was in the Fezile Dabi District Municipality [2] Area under rainfed annual crops in 1981

There were five farm censuses taken by Statistics SA in this period, in 1981, 1988, 1993, 2002 and 2007, and Vink, Conradie and Matthews (2022) will argue that the coverage of the census progressively worsened over time. In every case, the unit of observation was the magisterial district. In 1988 Statistics SA reported coverage problems for the first time in the history of the South African farm census but also indicated that they had enough prior information to correct the official figures for the measured non-response levels. In 1981 and 1988, the semi-autonomous homeland areas were excluded. These were still not in the 1993 census since they were only officially reintegrated in South Africa in 1996. Due to the political uncertainty surrounding land rights before the 1993 census, it recorded an exceptionally low 67.9% response rate. Statistics SA adjusted provincial numbers to correct this non-response rate but did not attempt to adjust district-level data. This was the last time in a while that land use was recorded. In 2002 there were two changes to how the farm census was collected: 1) It included the former homelands, and 2) Statistics SA upgraded to "an improved sampling frame". The new sampling frame used the 45,818 VAT-registered firms as the universe. Since VAT registration is only compulsory for firms with a

turnover of more than R300,000 at the time (now R1 million), the 2002 sample was 20% smaller than the estimated number of farms that were supposed to be covered in 1993, which introduced a bias into the official figures. However, by targeting a smaller number of farms, the response rate should have increased, but instead, it decreased to 62.7%. The final census in our series was taken in 2007, the last to report data per magisterial district, and in it, the estimated number of farmers decreased to 39,966, and the response rate was 58.4%. The implication of these data will be addressed in the Discussion section.

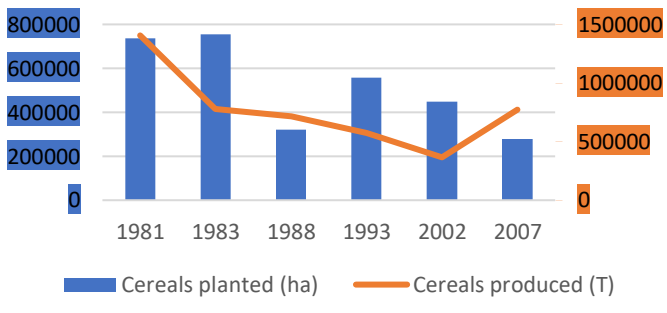
The extra data point for 1983 comes from a survey of large-scale agriculture conducted by Statistics SA as a midpoint between two major censuses.

3. RESULTS

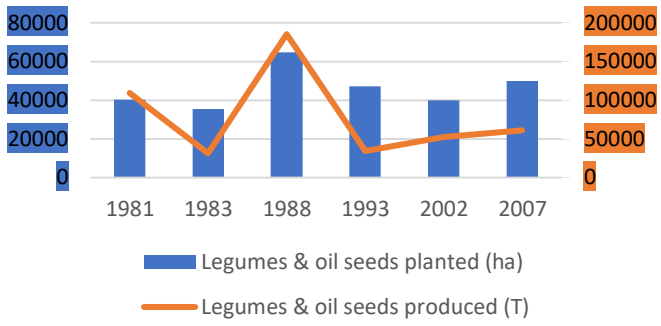
The total hectares of cereals, legumes and oil seeds planted and the total tons produced in the Eastern Free State from 1981 - 2007 appears in Table 2. Although there were some fluctuations between the years, the total hectares of cereals planted decreased substantially between 1981 and 2007, with the lowest point reached in 2002. Therefore, not surprisingly, the total tons produced decreased in accordance with the total hectares planted. In contrast, the total hectares of legumes and oil seeds planted showed minor fluctuations throughout the years, with a slight increase between 1981 and 2007. That said, the total tons produced was substantially lower in 2007 than in 1981.

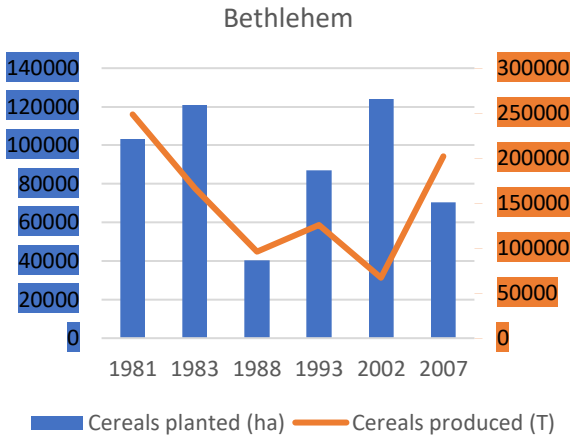
TABLE 2: Area Planted and Output Produced in Statistical Region 63 from 1981 to 2007

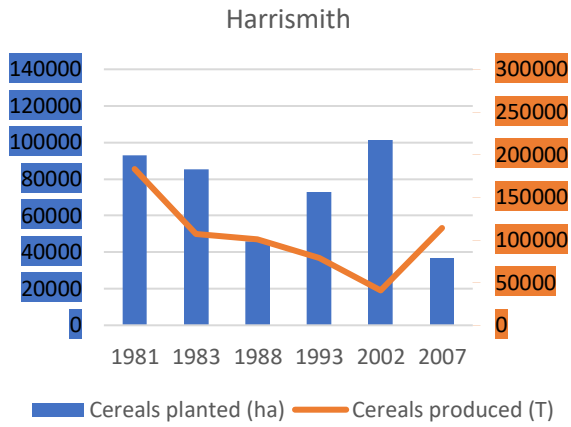
Crops	Year	Area planted	Output
Cereals	1981	737 016	1 406 038
	1983	754 379	778 410
	1988	321 844	716 004
	1993	556 961	572 883
	2002	448 064	365 962
	2007	277 447	772 628

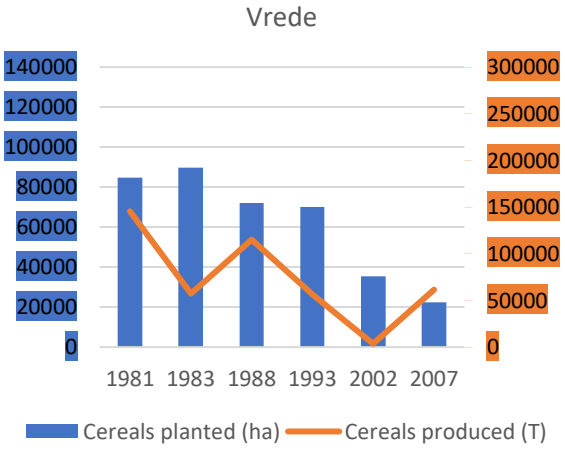


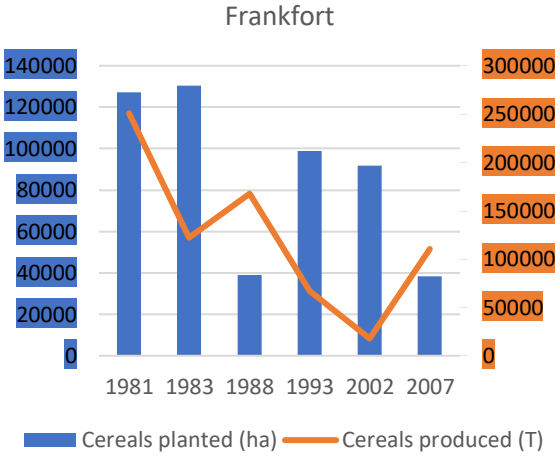
Legumes and oil seeds	1981	40384	108888
	1983	35559	31357
	1988	64873	185301
	1993	47325	33992
	2002	40085	52526
	2007	49885	61132

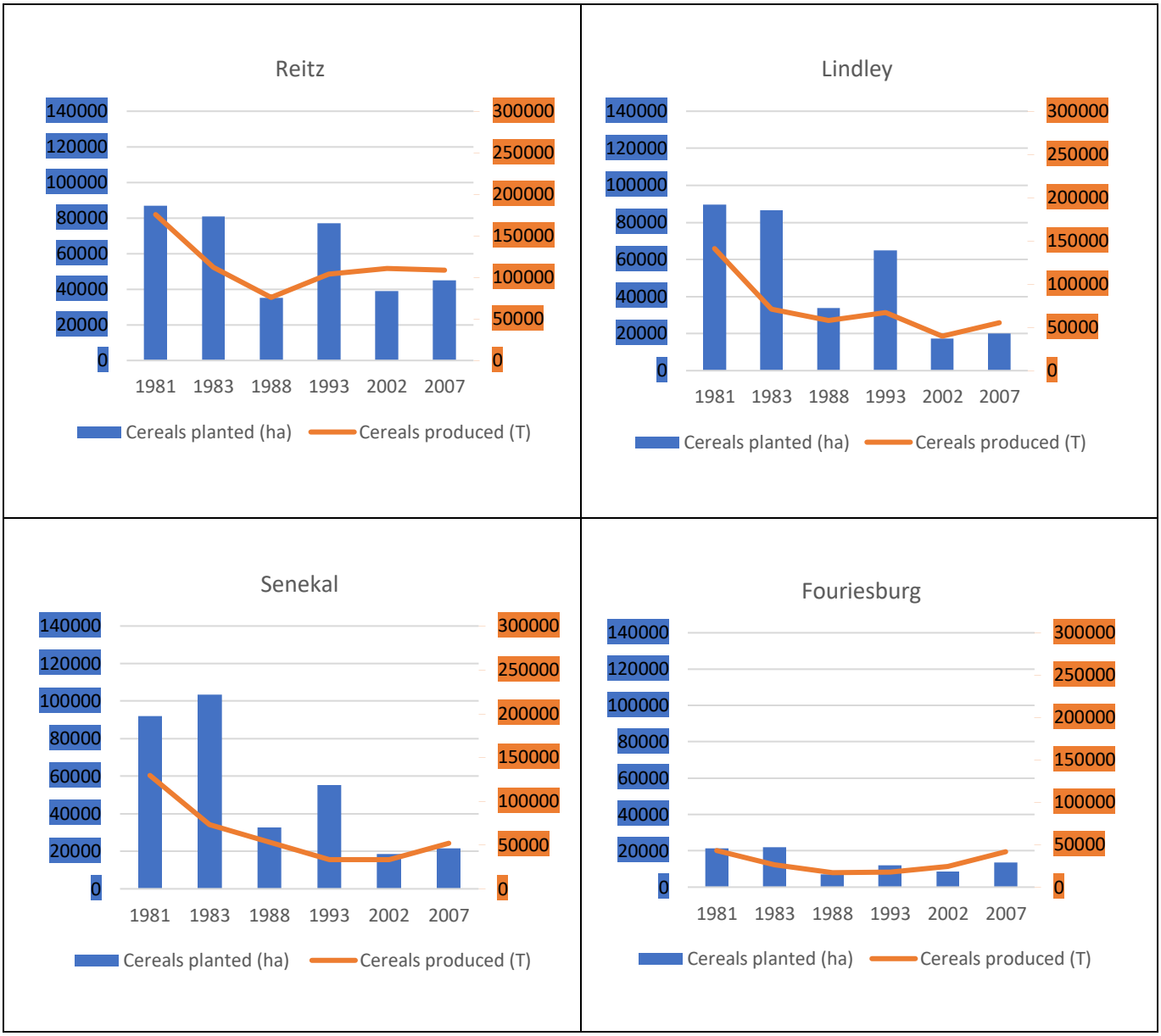












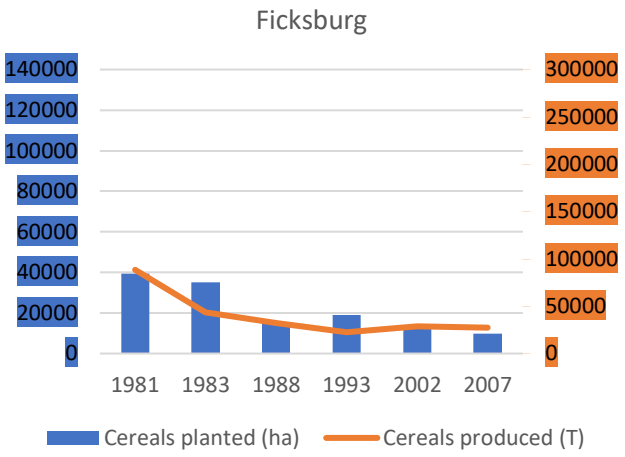


FIGURE 1: **Area Planted and Output Produced By District, 1981 – 2007.**

Disaggregating data on area planted and output by districts for cereals (Figure 1) showed a drop in the number of hectares planted with cereals in all districts between 1981 and 2007. All the districts have shown a decrease in output from 1981 to 2007, except Fouriesburg, which reached a low in 1988 and increased after that. From the data presented in Table 2 and Figure 1, it looks as if 1988 was a dry year since the area planted in the region decreased by 56% compared to 1981.

However, if it were a dry year, the yield would also be down; instead, yields were up 17% compared to 1981. This was the time in South Africa when agriculture began to reap the Green Revolution benefits from the adoption of improved seeds and more scientific fertilisation and pest control methods, and larger equipment allowed farmers to get closer to ideal timings of the various tillage practices (Thirtle & van Zyl, 2000). If the dip in 1988 was solely due to adverse weather, there should have been a substantial recovery in area planted by 1993, which indeed there was in most districts except Vrede, where the 1988 decline was smaller than in the rest of the region. While the area planted for cereal crops recovered by 1993, this year's yields were much lower, only 1.03 tons per hectare compared to the 2.22 tons per hectare recorded in 1988. Yields continued to be low in 2002, especially in Vrede and Frankfort but were at their highest average level of the whole study period by 2007.

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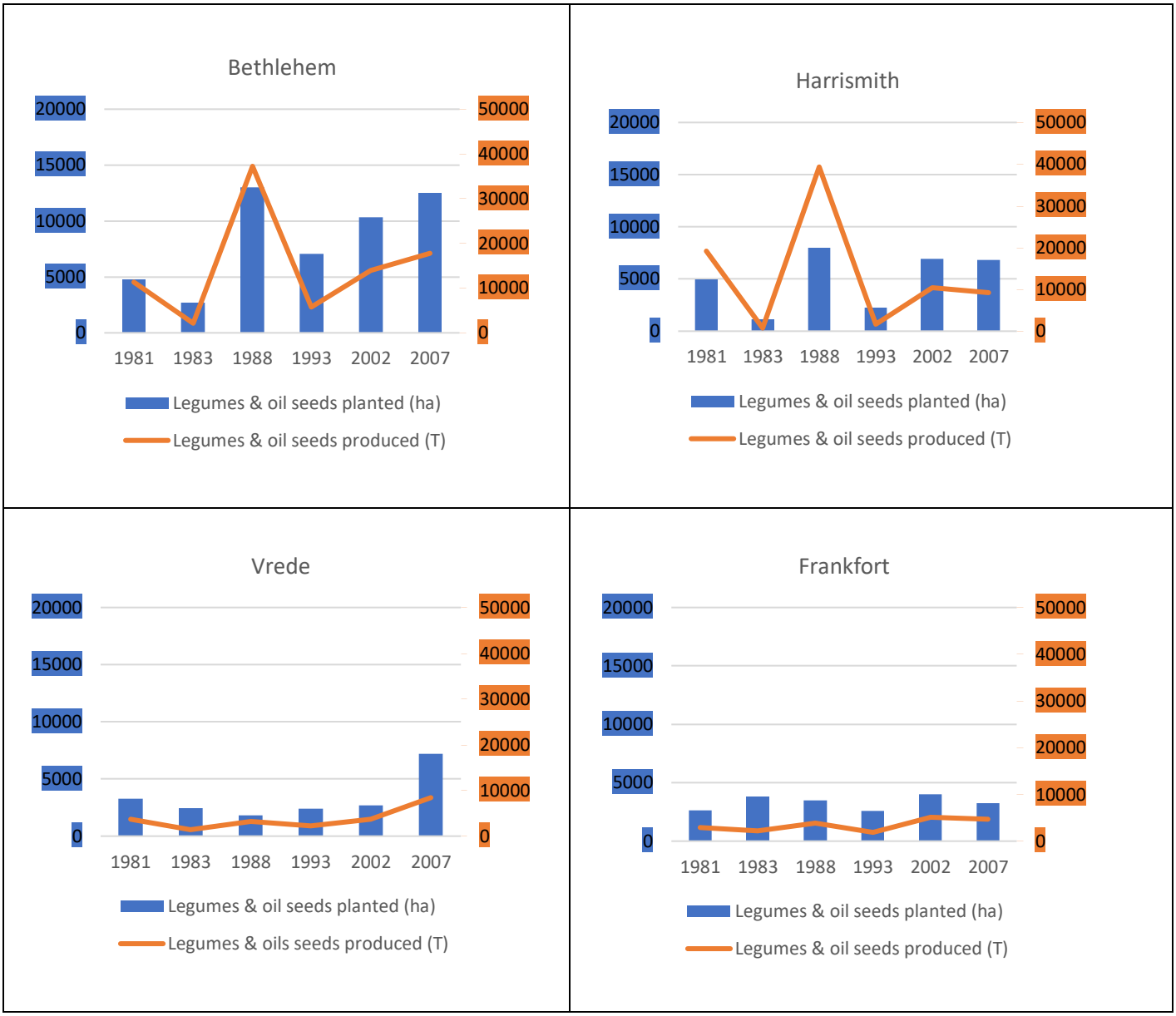
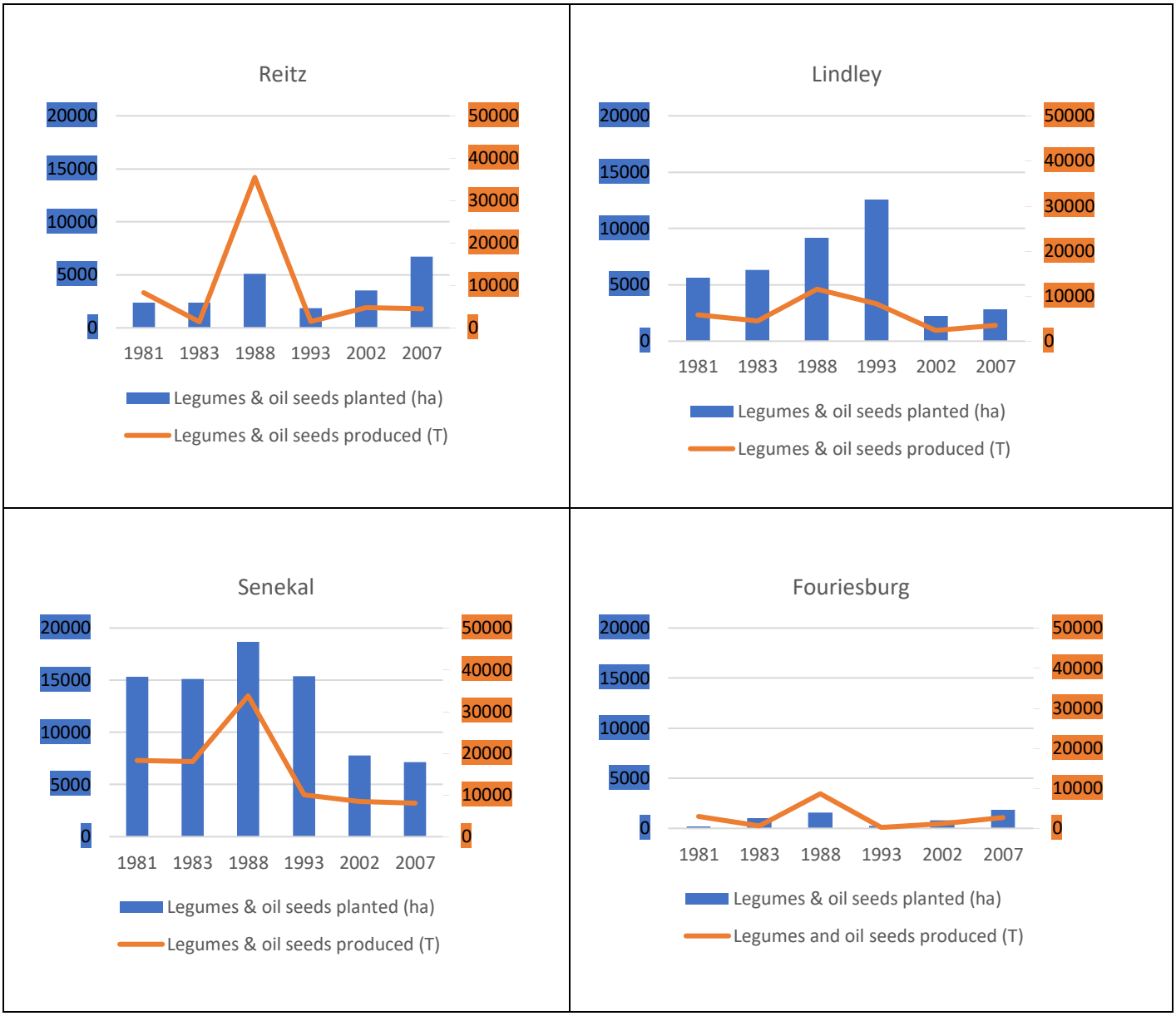
Without disaggregated rainfall data and additional information on district-level response rates in the various census years, it is difficult to say more about what is happening in cereal production in the region.

Figure 2 presents disaggregated data for a combined legumes and oil seeds category. Over the thirty years covered by the study, crop production became more diverse in the Eastern Free State. In 1981 legumes and oil seeds barely accounted for 5% of the area planted in the region and by 2007 legumes and oil seeds made up more than 15% of the area planted. Because the numbers are so small, there was substantial variation in hectares planted and tons produced between the districts. Bethlehem experienced a doubling of the area planted for these crops, from less than 5000 hectares to more than 10 000 hectares, between 1981 and 2007. Over the same period, slight increases in hectares planted were also recorded in Harrismith, Vrede, Reitz, and Fouriesburg. In contrast, the hectares of legumes and oil seeds planted decreased somewhat for Lindley and more substantially for Senekal between 1981 and 2007.

Output fluctuated significantly, especially for Bethlehem, Harrismith, Reitz, Senekal and Ficksburg. In most districts, the figures end in 2007, where they started in 1981. Bethlehem experienced a moderate increase, and Senekal a moderate decrease over the period. Still, the only real difference was in Ficksburg, where output fell by three-quarters from approximately 40 000 tons in 1981 to less than 10 000 tons in 2007.





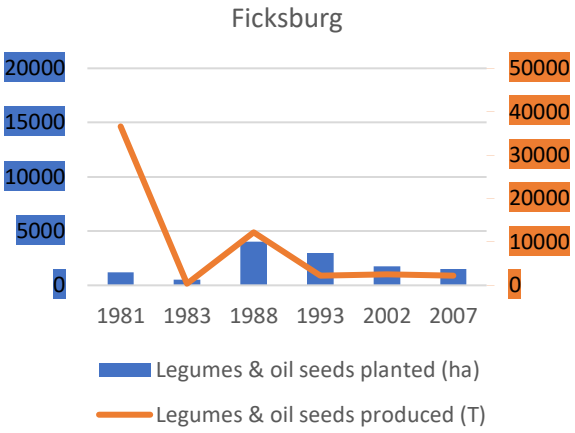


FIGURE 2: Descriptive Statistics of Legumes and Oil Seeds Planted and Produced From 1981 To 2007 – By District.

We measured land productivity as tons harvested per hectare planted, in other words, as yield. These regional yields are plotted in Figure 3, and the corresponding district-level data for land productivity appears in Figure 4. Cereal yields fluctuated considerably between 1981 and 2007, whereas ideally, they should have risen steadily to meet the food needs of a growing South African population. For cereals, tons produced per hectare were at their lowest in 2002 and highest in 2007, suggesting a measurement problem in 2002. However, considering only 1981 and 2007, an apparent increase in yield from below 2 tons per hectare to above 2.5 tons per hectare can be seen between these two data points. For legumes and oil seeds, the opposite is true. Production started above 2.5 tons per hectare in 1981 but fell below 1.5 tons per hectare in 2007.

Suppose crop production in tons per hectare is considered for each cereal district. In that case, an apparent deviation from the trend can be seen for Ficksburg in 1988, where production was considerably greater than for any other district. The trends also differed in 2002 between the two clusters of districts. Vrede, Frankfort, Harrismith, and Bethlehem showed a decrease in tons per hectare produced between 1993 and 2002. In contrast, Reitz, Fouriesburg, Ficksburg, and Lindley increased in tons per hectare produced between 1993 and 2002. If only 1981 and 2007 were considered, tons per hectare production increased for all the districts between the two years.

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District-level yields are a predictable reflection of relative local growing conditions, except Frankfort, which broke the trend in 1988 and 1993. Therefore, these data points should be re-checked. Otherwise, the only remarkable diversion of reported yields was in 2002 when Reitz, Vrede, Fouriesburg and Frankfort reported yields 75% lower than those reported in the rest of the region.

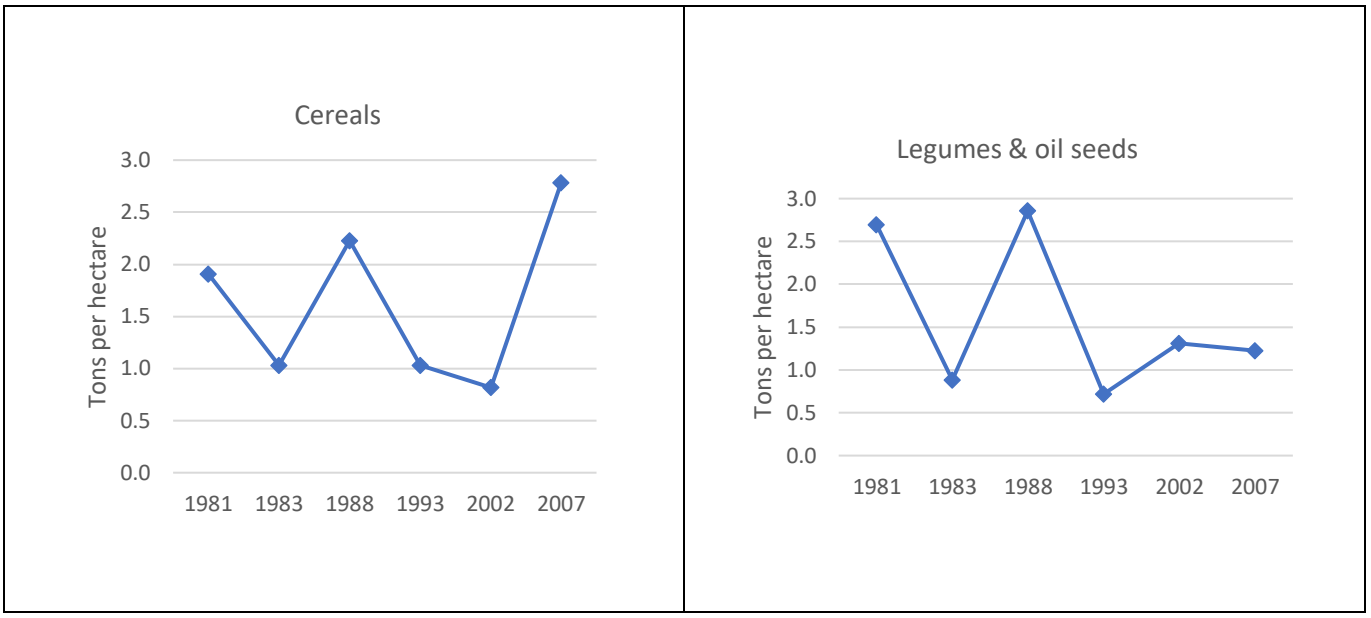

FIGURE 3: Crop Production in Tons Per Hectare From 1981 to 2007.

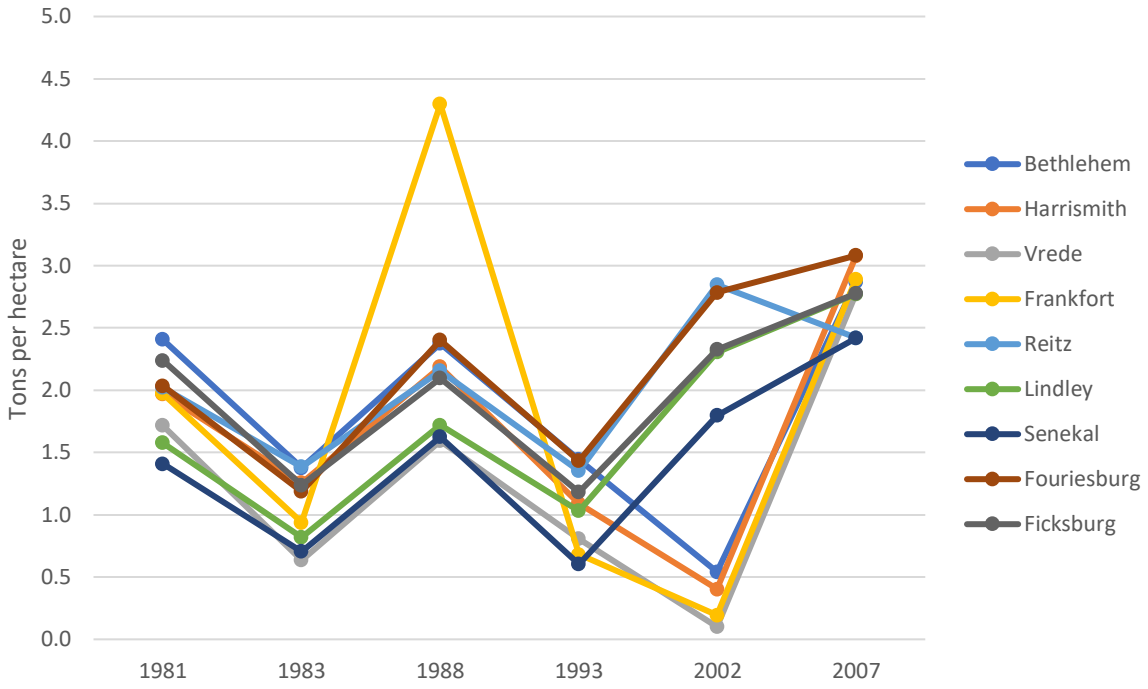

FIGURE 4: Cereal Yields By District, 1981 - 2007.

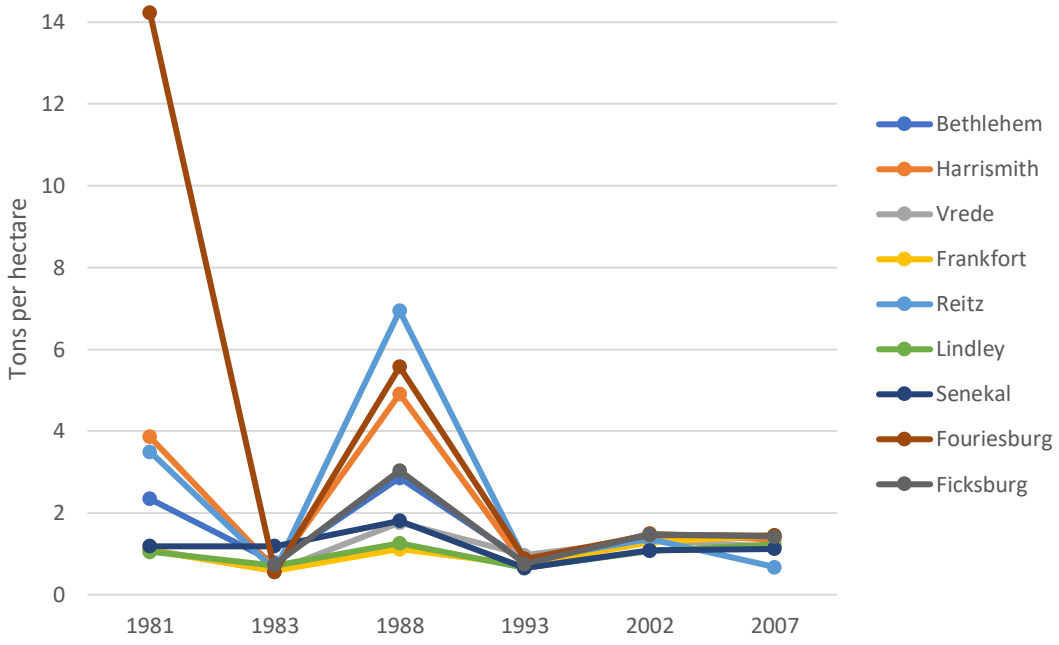

FIGURE 5: Legume and Oil Seed By District, 1981 - 2007.

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For legumes and oil seeds, slight reductions in tons per hectare can be seen for most districts when comparing production in 1981 and 2007 (Figure 5). The 14 tons yield per hectare recorded in Fouriesburg in 1981 looks highly implausible compared to the rest of the districts for the remainder of the study. The average yield only broke above 2 tons per hectare in 1981 and 1988, revealing that the Eastern Free State has lost some of its capacity to produce these crops or is feeding soybeans directly to local livestock rather than bringing them to market.

3.1. The Contribution of Extension to Food Security

Thirtle and van Zyl (2000) explained South African agriculture's total factor productivity levels with four factors, including investment in the public extension service. The other factors were private R&D expenditure, proxied by the number of patents registered per year in the United States of America, South African farmers' average level of formal schooling and a weather index. The hypothesis was, and the data confirmed that three of these factors, except foreign patents, were positively correlated to productivity levels. Therefore, any concerns about the state of food security affairs described in the previous section raise questions about the state of the public extension service in this country.

This study found that extension services could close agriculture's management and technology gaps. The two services, public and private extension, were complementary in some respects and competing with each other. Still, farmers who used both public and private extension services were the most productive. In the Karoo, the best productivity outcomes were associated with using private extension services, mainly because of a complete lack of offerings from the public sector (Conradie, 2016).

4. DISCUSSION

Food crop production needs to be increased to meet the growing demand for food in South Africa. However, production needs to increase despite using the same or fewer natural resources since the sector already utilises most of the available land and water for agricultural production (DAS, 2012; Blignaut, Ueckermann & Aronson, 2009; Department of Agriculture, Forestry and Fishery, 2017).

Agricultural extension programs have been shown to increase production by educating farmers on available farm technologies and improving their technical and managerial farming skills (Agungu, 2017; Raidimi & Kabiti, 2019; Danso-Abbeam, Ehiakpor & Aidoo, 2018). Determining the trajectory of agricultural productivity in the Eastern Free State is especially important given the reduction in government subsidies to emerging farmers in this region since the 1990s and the consequent lack of agricultural extension support provided to these farmers (Claassen *et al.*, 2014).

The findings of this study show that cereal crop production in tons per hectare increased for all the districts in the Eastern Free State between 1981 and 2007. Although this is encouraging, there was a decrease in all districts' total tons of cereal crops produced between 1981 and 2007, with the decline especially pronounced in the Ficksburg area. The lowest point in total tons produced was reached in 2002, with some recovery evident in 2007. For legumes and oil seeds, both tons produced per hectare and total tons produced decreased between 1981 and 2007, with the drops in total tons produced especially pronounced in the Senekal and Ficksburg areas. The lowest point in total tons produced was reached in 1993, with a slight recovery between 1993 and 2007. These findings align with Mashabela's (2019) findings that the region's agricultural development has declined. However, the findings contrast with the trends in the country, with Chauvin, Mulangu and Porto (2012) indicating that South Africa's cereal and oil seed crop yields have grown by an annual rate of 2.94% and 1.30%, respectively, showing a sharp upward trend with no significant breaks.

The decline in total tons produced for all the crops studied can partly be attributed to fewer hectares being planted, as a clear decrease in the planted areas was evident for several districts for cereals, legumes and oil seeds. Unfavourable weather conditions, including some of the worst droughts in a century, have undoubtedly contributed to the reductions in hectares planted and production (Vink & Van Rooyen, 2009).

However, given the important role that agricultural extension has played in agricultural productivity, the loss in total production and hectares planted may also result from reduced government subsidies to emerging farmers in the Eastern Free State since the 1990s. This has

negatively affected agricultural training and development and left a void in support systems available to commercial farmers (Claassen *et al.*, 2014).

Agriculture's percentage share in South Africa's economy is relatively small and is constantly dropping as the economy expands and diversifies. From our findings, agricultural crop production in the Eastern Free State is declining. This is concerning since there is a need to significantly increase the productivity of agriculture in the Eastern Free State to ensure long-term food security (Baiphethi & Jacobs, 2009). Greater investments by the government are required to enhance the production and profitability of crop farming in the Eastern Free State and to help protect farmers from the negative consequences of changing climatic conditions. According to van Niekerk *et al.* (2011), agricultural extension must fulfil five core activities to help farmers with all these challenges: training, integrated support systems, innovation, improved communication systems and capacity development. Reinvesting in agricultural extension programs that educate farmers on the available technologies and improve their technical and managerial skills may play a particularly key role in reversing the negative agricultural production trajectories evident for this region.

5. CONCLUSION

With food security at risk, increased agricultural production of major field crops is required in South Africa's provinces. However, long-term yield trends show stagnancy in agricultural growth in the Eastern Free State. Unfavourable weather conditions, coupled with a reduction in government subsidies to support emerging farmers in the area, could result in the loss of productivity. Production may be enhanced by reinstating government subsidies to revitalise agricultural extension programs to educate farmers and improve their skills to improve agricultural productivity without further burdening already taxed natural resources.

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