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# FACTORS CONTRIBUTING TO ZAMBIA'S 2010 MAIZE BUMPER HARVEST

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## Key Points

- Zambia's maize crop grew by 48% between the 2009 and 2010 harvests, leading to the largest crop recorded in recent history.
- Yield growth accounted for 59% of the maize production growth between 2009 and 2010. Expansion of area planted to maize explains an additional 23%, while the remaining 18% can be attributed to a rise in the ratio of harvested to planted land.
- Favourable weather conditions contributed 47% of the maize yield growth between 2009 and 2010, whilst, 25% came from increased fertilizer use from both the private and public sectors, and 23% from area expansion. The remaining 5% can be attributed to hybrid seed use and improved management.
- Due to favorable weather conditions in both 2008/09 and 2009/10 growing seasons, maize yield response rates to fertilizer application rose from about 3 kg of additional maize for each kg of fertilizer applied in 2006 to nearly 4 kg in 2010.
- Though Zambia had a good harvest in 2010, the country remains vulnerable to weather shocks.
- The unpredictability of government maize policies continues to generate uncertainty for participants in the marketing system. A decrease in maize production may occur next year due to the marketing problems faced by smallholder especially those caused by FRA's lateness in paying farmers.

**INTRODUCTION:** Zambia's maize crop grew by roughly 48% between the 2009 and 2010 harvests, leading to the largest crop recorded in recent history. The 2009 maize harvest was also very good, making the 48% rise in 2010 even more remarkable. The forces driving that increase, however, remain widely debated. Many in government and media have attributed the recent production increase to the government fertilizer subsidy program as well as to the state's recent efforts to raise maize prices through the operations of the Food Reserve Agency. Others have argued that the bumper harvest is partially due to the adoption of conservation farming techniques by farmers. Still others attribute the maize production growth mainly to favorable weather. Unfortunately, none of these claims have been backed up by solid evidence-based research.

Fertilizer use has increased from the 2008/09 agricultural season to the 2009/10 season. Through the government Farmer Input Support Program (FISP), 25% more subsidized fertilizer was distributed, which the Crop Forecast Survey results indicate totaled 69,100 tons. It is noteworthy that this is well short of the government's target to distribute 100,000 tons. Moreover, the private sector fertilizer sales in 2010 increased by 62% (selling more than 94,000 metric tons compared to 58,000 metric tons in 2009). Total fertilizer use in Zambia increased from 2009 to 2010 by more than 50,000 metric tons.

In light of the controversy surrounding the causes of the 2009/2010 bumper harvest in Zambia, this study is motivated by the need to understand the factors driving Zambia's record bumper harvest of 2010 versus the 2009 harvest and earlier years.

**OBJECTIVES:** The study has three objectives as follows:

1. To determine the relative contributions of yield growth, area expansion, and changes in the ratio of maize area harvested to planted to the growth in maize production from the 2009 to 2010 harvest seasons.
2. To identify the factors driving the changes in these sources of overall production growth in order to assess the relative contributions of fertilizer, weather, seed use and other factors.
3. To examine the sources of the longer-run growth in maize production between 2010 and the prior four production seasons using Crop Forecast Survey data.

**DATA AND METHODS:** We decompose the growth in Zambian maize production from 2009 to 2010 into contributions from 3 possible sources: yield increases, increased area planted to maize, and increased ratio of harvested to planted land. More specific determinants of production such as fertilizer use, type of seed, etc. can only affect production through one of these sources of growth.

The study is carried out using several years of nationally representative survey data from Crop Forecast Surveys, which are collected annually by the Ministry of Agriculture and Cooperatives (MACO) in collaboration with the Central Statistical Office (CSO). These nationally representative samples provide data on 14,122 and 14,034 maize fields grown by 11,518 and 11,224 farm households in 2009 and 2010, respectively. Analysis comparing the 2010 harvest to the average of prior years uses data from CFS 2006, 2007 and 2008, with 8,367, 13,521 and 13,390 observations on maize plots respectively.

**FINDINGS:** The study highlights four findings. First, for Zambia as a whole, 59% of the increase in maize production from 2009 to 2010 can be attributed to yield growth. The ratio of harvested to planted land and area expansion can be credited with 18% and 23% of the remaining production growth (Table 1). The importance of yield growth in driving maize production growth is fairly consistent across provinces. Average yields nationwide rose from around 2 metric tons of maize per hectare (mt/ha) to just over 2.5 mt/ha.

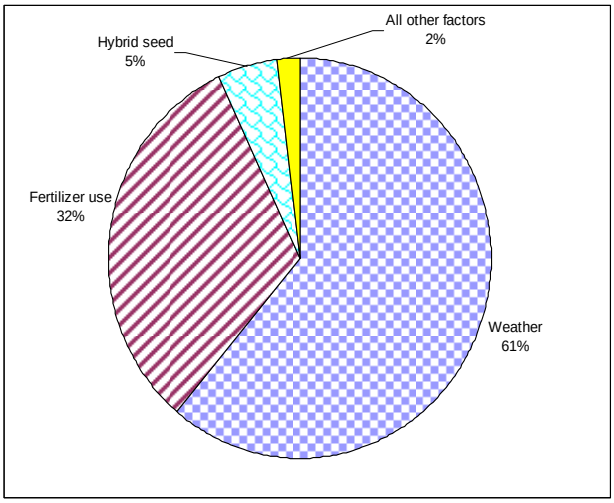
**Table 1: Contributions to Maize Production Growth by Province (2010 vs. 2009)**

| | Relative Contribution to Production growth between 2009-2010 harvests from changes in: | | | |
|---|---|---|---|---|
| Province | Yield | Ratio of Harvested to Planted land | Area Expansion | Residual (unexplained share) |
| | ----------Percent ---------- | | | |
| Central | 45 | 24 | 31 | 0.0 |
| Copperbelt | 47 | 02 | 51 | 0.0 |
| Eastern | 102 | 00 | -2.0 | 0.0 |
| Luapula | 59 | 01 | 40 | 0.0 |
| Lusaka | 51 | 16 | 32 | 0.0 |
| Northern | 39 | 1.0 | 60 | 0.0 |
| North Western | 56 | 7.0 | 37 | 0.0 |
| Southern | 45 | 31 | 24 | 0.0 |
| Western | 47 | 58 | -4.0 | 0.0 |
| All Zambia | 59 | 18 | 23 | 0.0 |

Source: Central Statistics Office Crop Forecast Survey 2008/09 and 2009/10

Second, based on the model of determinants of yield growth between 2009 and 2010, Figure 1 shows that the largest factor contributing to yield growth has been weather, which explains 61% of the increase in maize yields between 2009 and 2010. Increased fertilizer use from both the private sector and subsidy program explains an additional 32% of the yield increase, while increased hybrid seed use can be attributed with another 5%. When assessing the factors accounting for the 2010 maize yields compared to the four previous years, the combination of favorable weather, increased fertilizer use, and the beneficial interactions between good weather and fertilizer application accounts for over 90% of the yield gains achieved over this period.

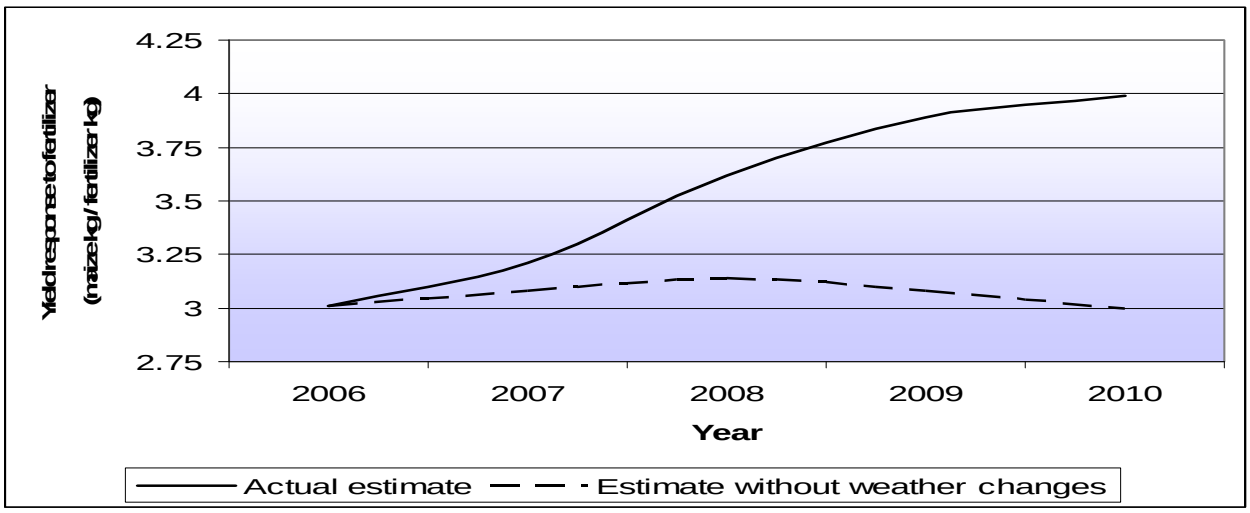
**Fig 1: Factors driving increased yield from 2009 to 2010**




Third, due to favorable weather conditions in both 2008/09 and 2009/10 growing seasons, maize yield response rates to fertilizer application rose from about 3 kg of additional maize for each kg of fertilizer applied in 2006 to nearly 4 kg in 2010. Figure 2 presents the actual estimates for marginal response to fertilizer applications (solid line), as well as a counterfactual estimate of what response rates would have been if everything else changed, but weather variables are held constant at 2006 levels (dashed line). The figure shows that the steady increase in marginal yield response to fertilizer application over the past 5 survey years disappears after holding weather variables constant at 2006 levels. These findings indicate that the majority of the increase in fertilizer's effectiveness was due to increasingly favorable weather. Indeed, the counterfactual 2010 estimated response rate is virtually identical to that of 2006.

All together, if the factors driving yield growth also explain the change in the ratio of harvested to planted land, then we can conclude that 47% of the difference in production from 2009 to 2010 was due to weather, 25% was due to increased fertilizer

**Figure 2: Marginal yield from fertilizer use over time without changes in weather**




Source: CFS 2006, 2007, 2008, 2009, 2010 and author's calculations

use from both the private and public sectors, and 23% was due to area expansion. The remaining 5% can be explained by increased hybrid seed use and improved management.

***IMPLICATIONS FOR POLICY:*** Zambian policy reforms have successfully contributed to raising maize production over the past year. A companion FSRP working paper to be released shortly shows that the total value of crop output has also risen over the past 4 years, although there have been shifts out of some other crops (most notably cassava, cotton, and groundnut) in response to the greater production incentives for maize. This is an achievement and should not be minimized.

However, though Zambia had a good harvest in 2010, policy makers and other stakeholders should not overlook that the potential exists for huge swings in maize production over the coming years. First, the country remains vulnerable to major shifts in weather conditions.

Second, maize production instability may be exacerbated because of problems that the government has faced in trying to meet smallholders' marketing needs during the 2010 bumper harvest. For example, the Food Reserve Agency announced a producer price in 2010 far above market prices, but did not have the financing in place to pay many farmers or to transport the crop from open air satellite depots to covered storage facilities. As a result, many farmers remain unpaid several months after delivering their maize to FRA. A large proportion of FRA's accumulated maize is at risk of damage once the rains start, and for all the government's expenditure and effort, there seems to have been limited effect on market prices, which remain relatively low. In fact, anecdotal evidence suggests that many traders who would otherwise be buying from small farmers (providing income) are avoiding the smallholder market until after the FRA buying season is over. The problem of low maize prices has been exacerbated by the continued focus on government led exports and, which, along with restrictive export licences, limits private sector exports.

For all of these reasons, farmers' planting behavior in the coming 2010/11 crop season may be very different from the 2009/10 season. Specifically, if farmer response to unpredictable maize policy is to plant less area to maize next year, it could stimulate increased (and increasingly unpredictable) government intervention going forward. The long run risk is highly volatile maize production levels and prices in the future. Unpredictable government maize policies generate uncertainty for participants in the marketing system and create unintended consequences for the performance of maize and other food markets. Therefore, predictable and transparent rules dictating the government's involvement in the maize market would reduce market risks and enable greater coordination between private and public decisions in the market. Also, greater policy stability is necessary for sustained maize surplus production and may contribute to broader grain market development in the country.

Finally, if FRA continues to buy maize above import parity levels while Zambia is a surplus producer, there is no way to avoid the fact that there will be a substantial cost to Treasury when the FRA attempts to find a market for its maize, either domestically or for export.

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The Food Security Research Project is a collaborative program of research, outreach, and local capacity building, between the Agricultural Consultative Forum, the Ministry of Agriculture and Cooperatives, and Michigan State University's Department of Agricultural Economics. Comments and questions should be directed to the Food Security Research Project Director, 86 Provident Street, Fairview, Lusaka: tel +260 (21)1 234539; fax +260 (21)1 234559; email: *kabaghec@msu.edu*

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