

The effect of Zambia's Food Reserve Agency on agricultural market outcomes

This report employs the latest data on the Zambian Food Reserve Agency's (FRA) purchases, household characteristics, and crop production to better understand the effects that the FRA has on different agricultural markets.

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Summary and policy recommendations

The FRA, established in 1996 following the Food Reserve Act of 1995, aims to ensure national food security and to stabilise food prices. The FRA buys agricultural produce, primarily maize, at a pan-territorial price higher than typical market rates during a brief window around harvest. In periods of high prices or production shocks, like droughts or floods, the FRA releases its stock to alleviate food shortages consequently stabilising market prices.

Past research conducted on the FRA indicates that the agency has proven effective in enhancing farmer welfare by reducing poverty and increasing incomes.¹ Furthermore, there exists evidence in support of the FRA's effectiveness in stabilising maize prices,² but at the expense of increasing maize market prices for consumers.³ There is also evidence suggesting that the FRA contributes to stimulating agricultural production.⁴ Nevertheless, it should be emphasised that these studies are based on data that only extends up to 2008, which may limit their current relevance. This report employs the latest data on FRA purchases, household characteristics and crop production which is leveraged to better understand the effects that the FRA has on a variety of different agricultural market outcomes. The analysis reveals the following:

1. **Increase in maize production:** Past procurement by the FRA is associated with an increase in maize production.
2. **Higher prices for FRA farmers:** Farmers selling to the FRA tend to receive higher prices compared to those who do not sell to the FRA.
3. **Higher prices faced by consumers:** The price premium offered by the FRA to farmers is passed on to consumers through higher market prices, suggesting a negative impact on net buyers.
4. **Reduction in price volatility:** FRA activity is associated with higher harvest season prices and lower lean season prices, reducing within-season price volatility.
5. **No detectable effect on distance to sale:** Selling to the FRA is not associated with a reduction in the distances from a farmer's homestead to the point of sale.
6. **Reduction in number of traders:** Selling to the FRA is associated with a reduction in the number of traders approaching farmers.
7. **Negative impact on soybean cultivation:** Farmers who sell to the FRA have a reduced likelihood of producing soybeans and have less area allocated to soybean cultivation.
8. **Negative effect on crop diversification:** Farmers selling to the FRA exhibit lower levels of crop diversification.

¹ Fung, Winnie, Lenis Saweda O. Liverpool-Tasie, Nicole M. Mason, and Ruth Uwaifo Oyelere. "Do crop purchase programs improve smallholder welfare? The case of Zambia's Food Reserve Agency." *Agricultural Economics* 51, no. 4 (2020): 519-533.

² Zhou, Yujun, and Kathy Baylis. "Effects of stockholding policy on maize prices: Evidence from Zambia." *Journal of Agricultural & Food Industrial Organization* 18, no. 1 (2019): 20190057.

³ Mason, Nicole M., and Robert J. Myers. "The effects of the Food Reserve Agency on maize market prices in Zambia." *Agricultural Economics* 44, no. 2 (2013): 203-216.

⁴ Mason, Nicole M., Thomas S. Jayne, and Robert J. Myers. "Zambian smallholder behavioral responses to food reserve agency activities." *Gates Open Res* 3, no. 657 (2019): 657.

9. **Negative impact of late payments:** Late payments by the FRA negatively affect fertiliser usage among farmers.

To enhance the effectiveness of the FRA, this report suggests five primary recommendations derived from the report's findings:

- i. **Earlier repayment:** The FRA should consider prioritising prompt payments to farmers, ideally transitioning to a spot cash market. This change addresses the common issue of late payments, which hinders farmers from purchasing essential inputs like fertilisers. A spot cash market would enable rural farmers to reinvest their earnings promptly, boosting both production and income.
- ii. **Defining and following purchasing targets:** Establishing and adhering to consistent purchasing targets aligned with the requirements of a strategic reserve could prevent the displacement of private sector activities in the sector.
- iii. **Effective targeting of vulnerable farmers:** The FRA's focus on economically disadvantaged and remote farmers could be refined. The current delayed payment system and the requirement for farmers to buy their own bags may unintentionally exclude the most vulnerable farmers, those who are most likely going to resort to selling their produce at lower prices to immediate buyers. To truly benefit its target demographic, the FRA should ensure quicker payments and eliminate hidden selling costs, by providing farmers with the necessary bags.
- iv. **Establishment of an effective Warehouse Receipt System:** The implementation of a well-functioning Warehouse Receipt System (WRS) could stabilise market prices and ensure market access for farmers with less market intervention compared to direct purchases by the FRA. Key to its success would be establishing trust among stakeholders, ensuring farmers' access to real-time market prices, and developing adequate warehouse infrastructure.
- v. **Longer purchasing window:** The existing narrow window compels farmers to sell their produce immediately after harvest, at a time of lower prices. This situation is disadvantageous for net buyers who sell to the FRA post-harvest and repurchase during the lean season at higher prices. A prolonged purchasing window could encourage farmers to store their produce, potentially profiting from price increases over the duration of the agricultural season.

The report is structured as follows. **Section 1** provides an overview of the FRA, detailing its mandate and the regions where it operates. **Section 2** elaborates on the data sources utilised for this report, including an initial exploration of key variables of interest. **Section 3** consists of the statistical analysis which delves into the FRA's impact on agricultural market outcomes. This includes production, prices received by farmers, market prices, market access, competition, crop diversification, as well

as how delayed payments affect fertiliser application. Lastly, **Section 4** of this report presents a set of policy recommendations aimed at enhancing outcomes for farmers and the agricultural market overall.

Section 1: What is the FRA

The Zambian Food Reserve Agency (FRA), established under the Food Reserve Act of 1995, is a government agency responsible for maintaining Zambia's national strategic food reserve. While the original mandate was defined in 1995, it underwent a legislative review between 2016 and 2020. This review was initiated in response to concerns by various stakeholders regarding the Agency's heavy reliance on government funding, elevated operating costs, and the unsustainable nature of its subsidies. The revised Food Reserve Act, which was legislated in 2020, aimed to improve the FRA's operations and enhance its efficiency.

Mandate

Overarchingly, the FRA is responsible for managing the National Strategic Food Reserve. Its core *functions* include marketing and trading of designated agricultural commodities, the purchasing and handling of imports and exports, as well as establishing and managing storage facilities. Additionally, the FRA is tasked with collecting market-related information and advising the Minister of Agriculture on matters concerning the National Strategic Food Reserve. The *purpose* of the Reserve is multifaceted. It aims to maintain adequate levels of certain agricultural commodities, ensure a consistent supply of said commodities within the country, address local supply shortfalls, and respond to food emergencies caused by natural disasters like droughts and floods. When determining the quantity of commodities to store, the FRA considers various factors such as consumption needs, industrial and livestock requirements, resource mobilisation, and climate change.

Operationally, the FRA has two *key vehicles* it uses to deliver on its mandate namely the buying and selling of produce. The FRA can purchase produce from domestic and foreign markets. In domestic markets, the FRA should do so especially in rural areas, establishing prices and creating markets. When selling produce, the FRA should do so to meet local shortfalls in supply, meet food emergencies, and export any excess. Furthermore, it must be ensured that sales from the Reserve are offset by new purchases.

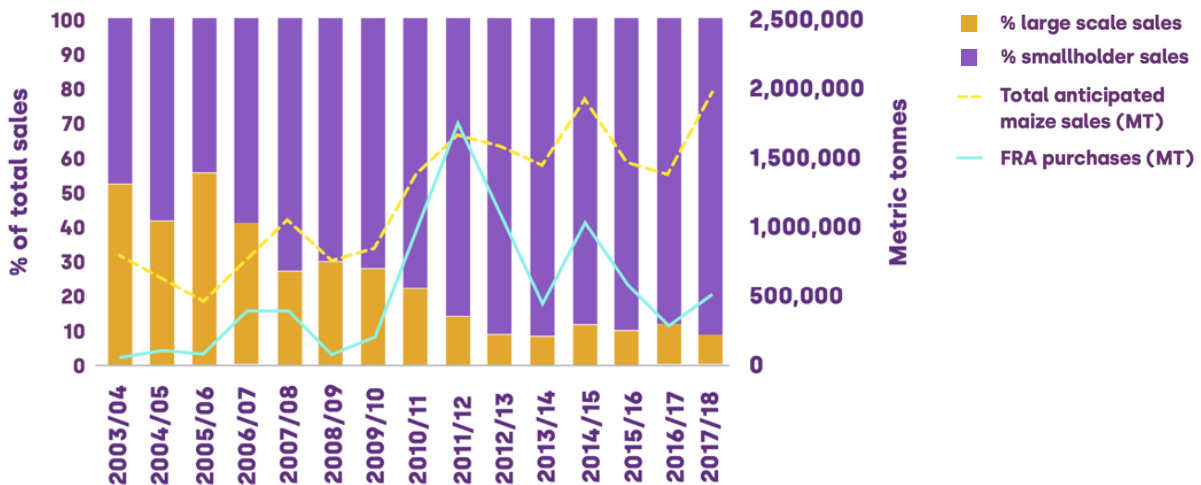
FRA activity

Maize is the main crop purchased by the FRA. Maize accounts for over 96% of FRA's purchases (Mt) and for 70% of Zambia's total agricultural output (Mt) among primary crops. As such, when this report discusses FRA purchases, prices, and other market or farmer outcomes, it focuses solely on maize, unless stated otherwise.

A recurring topic in discussions about the FRA is the extent of its operations. **Figure 1** highlights this by comparing the FRA's maize purchases with Zambia's total projected maize production over time.

The data reveals that the FRA consistently buys a significant portion of the nation's total maize output, prompting questions about how such substantial activity of a dominant market player affects agricultural market outcomes. Additionally, the diagram highlights the fluctuations in FRA purchases over time. These purchases vary considerably from year to year, largely due to the absence of consistent rules or triggers guiding them.⁵

Figure 1: FRA purchases vis-à-vis anticipated maize sales between 2003 and 2018



Note: This diagram plots total anticipated maize sales in Zambia against maize purchases by the FRA. The bars show the proportion of total maize sales which are sold by smallholders versus large scale farmers in a given year. Source: World Bank (2021). The Role of Strategic Grain Reserves in Enhancing Food Security in Zambia and Zimbabwe (English). Washington, D.C. : World Bank Group. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/729811624275553286/the-role-of-strategic-grain-reserves-in-enhancing-food-security-in-zambia-and-zimbabwe>

Understanding where within Zambia the FRA is active, requires analysing where production and purchasing activities take place. As illustrated in **Figure 2**, maize production is widespread across the country, especially concentrated in Central, Eastern, Southern, and Muchinga Provinces. **Figure 3**, on the other hand, showcases where in Zambia the FRA is purchasing maize. It represents a slightly different pattern, with Luapula, Northern, and Muchinga Provinces exhibiting high purchase volumes despite their relatively lower levels of production. In contrast, Central Province, despite significant maize production levels, sees less FRA purchasing.

The ratio of FRA purchases to production in each district, illustrated in **Figure 4**, reveals what percentage of produce in each district was purchased by the FRA between 2010 and 2021. In some districts, FRA purchases exceeded 60% of total maize production, while others experienced minimal purchasing relative to production. The map highlights significant FRA activity in Luapula, Northern, Muchinga, and Northwestern Provinces, with the lowest activity occurring in parts of the Western, Central, and Eastern Provinces.

⁵World Bank (2021). The Role of Strategic Grain Reserves in Enhancing Food Security in Zambia and Zimbabwe (English). Washington, D.C. : World Bank

Figure 2: Maize production by districts (2012-2022)

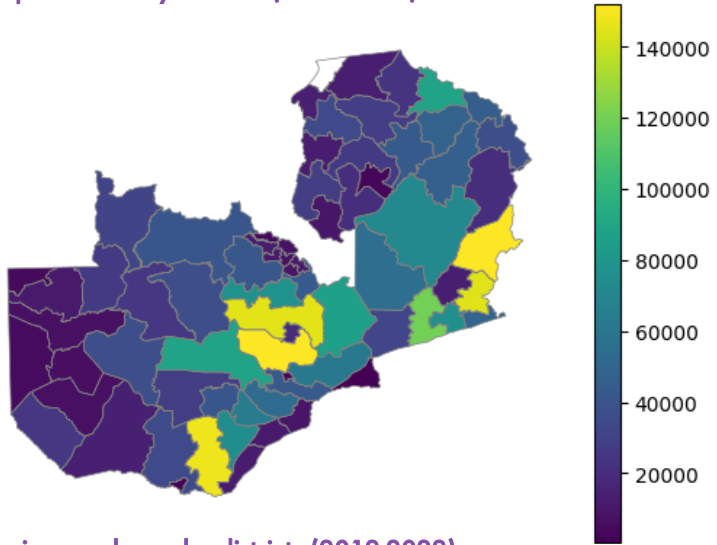


Figure 3: FRA maize purchases by districts (2012-2022)

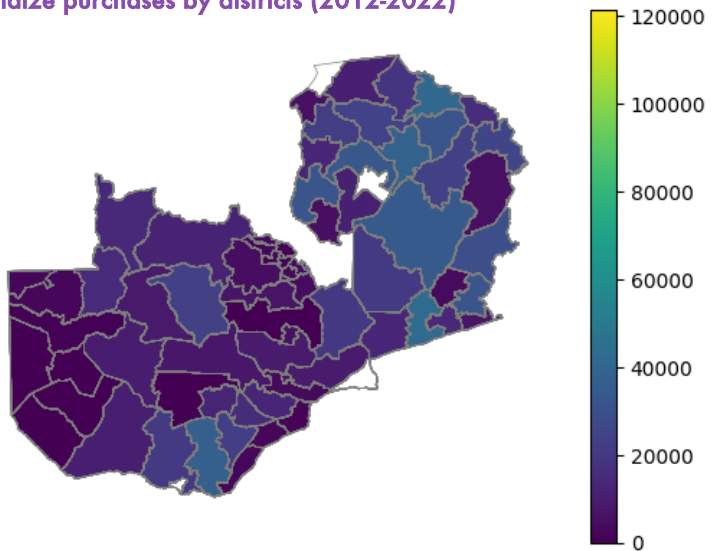
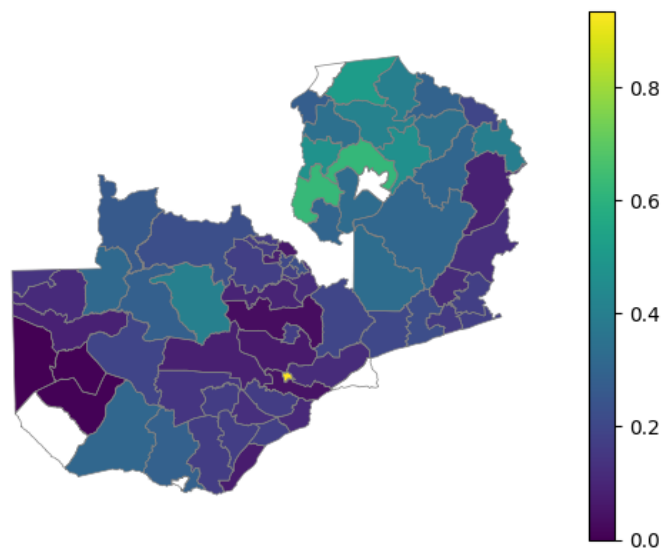


Figure 4: FRA activity (purchases/production) by districts (2012-2022)



Note: The maps illustrate maize production, FRA purchases, and FRA activity for different districts in Zambia between the years 2012 and 2022. Dark blue indicates lower values whereas yellow indicates higher values. FRA activity is defined as FRA purchases over production in each district. The map is made up of the original 72 Zambian districts rather than today's 116. Data points for districts which were split up were merged into the original districts. The values are averaged by district over time.

The figures illustrate that while the FRA purchases more in high production areas, there exist differences in purchasing activity between districts which are not solely explained by production. For the remainder of the report, activity is defined as the fraction of total production FRA acquired in a region in any given agricultural season.

Section 2: Descriptive Statistics

In conducting this analysis, four comprehensive datasets are used:

- The first dataset is the **Rural Agricultural Livelihood Survey (RALS)**, a substantial, household-level and nationally representative panel survey. This survey from the Indaba Agricultural Policy Research Institute (IAPRI) encompasses data from over 6,000 households, collected in the years 2012, 2015, and 2019. It offers valuable insights into key characteristics of small- and medium-scale farmers across Zambia.
- Secondly, Zambia's **Crop Forecast Survey (CFS)** from the Zambia Statistics Agency (ZamStats) is used which estimates Zambia's crop production for each agricultural season at the district level.
- Thirdly, **monthly maize market price data** from ZamStats, collected at the district level, is utilised.
- Lastly, the report uses detailed **purchasing data provided by the FRA**, spanning from 2012 to 2022. The purchasing data is at the depot level and provides exact information on where the FRA is buying.

Using all four datasets conjointly enables this analysis to explore the impact of FRA activities on small- and medium-scale farmers as well as on the agricultural market more broadly.

Difference between FRA and non-FRA farmers

The RALS datasets specifies whether a surveyed household sells produce to the FRA or not. Some initial differences in key household characteristics are presented in **Table 1**. It is important to emphasise that the differences highlighted in this table are purely descriptive and should not be interpreted as causal effects. An analysis of more causal relationships between key variables of interest will be thoroughly explored in Section 3 of this report.

Table 1 reveals that farmers selling to the FRA typically have higher *asset values*, secure larger *loans*, and earn more *cash* from maize sales. Some of these observed disparities might be attributed to financial challenges associated with selling to the FRA. The FRA's tendency to delay payments created an obstacle for less affluent farmers to sell their produce to the FRA. This is because many farmers depend on immediate funds for necessities such as school fees and daily living expenses. Furthermore, selling to the FRA incurs additional costs, such as

procuring specific bags for maize and meeting moisture standards, making it a more labour-intensive and costly process compared to other market options.

Another interesting difference to explore is the fact that distance to the nearest market is lower for farmers selling to the FRA. This is most likely related to FRA's strategy of setting up satellite depots close to farming communities. This approach intends to reduce transportation burdens for farmers, making markets more accessible. Other indicators such as household consumption, total harvest, and household size show minimal variation between the two groups.

Table 1: Differences in key statistics between Households selling and not selling to FRA

	Did not sell to FRA	Sold to FRA	Difference
Total harvest (kg)	3,087.81	3,145.11	-57.3
Net seller (1 if net seller and 0 if net buyer)	0.73	0.76	-0.03***
Household size	7.55	7.02	0.53***
Distance to markets (sample that sold to market)	20.06	18.96	1.10***
Distance from homestead to point of sale	7.12	13.25	-6.13***
Total number of maize sales in a season	1.23	1.11	0.12***
Access to loans (1 if they have a loan and 0 if not)	0.26	0.28	-0.02***
Value of outstanding loans (kwacha)	42.99	129.99	-87.00***
Total assets owned (kwacha in '000)	552.66	1,307.23	-754.57***
Cash received from maize sales (kwacha in '000)	241.48	489.68	-248.20***
Value of maize received (kwacha in '000)	31.52	59.34	-27.82***
Monthly household consumption (kg)	37.73	35.08	2.65***
Annual household consumption (kg)	452.74	420.94	31.80***

Note: This table illustrates differences in key variables between households who sell to FRA vs. those who do not. The RALS data is used for the calculations of these differences. The table includes only households that do indeed sell. The first column specifies the variable of interest. The second column shows the average value of the respective variable for households that do not sell to FRA. The third column shows the same value for those households which do sell to FRA. The fourth column indicates the difference between columns 2 and 3 as well as the statistical significance of this difference, where 3 stars reflect $p < 0.01$, 2 stars reflect $p < 0.05$, and 1 star reflects $p < 0.1$.

Liquidity constraints and payment issues

Unlike many other buyers, the FRA often does not provide instant cash payments to farmers. This can result in significant payment delays, with some farmers waiting several months to receive compensation.⁶ **Figure 5** plots distributions of the number of months it took the FRA to pay farmers in 2012, 2015, and 2019.

⁶Fung, Winnie, Lenis Saweda O. Liverpool-Tasie, Nicole M. Mason, and Ruth Uwaifo Oyelere. "Do crop purchase programs improve smallholder welfare? The case of Zambia's Food Reserve Agency." *Agricultural Economics* 51, no. 4 (2020): 519-533.

Figure 5: Distribution of FRA payment delays to farmers by months after transaction (2012, 2015, 2019)



Note: The diagram plots the distribution of months that passed between a transaction and payment by the FRA for the years 2012, 2015 and 2019. This data comes from the RALS which indicates how many months have passed between transaction and payment. Since the RALS only extends up to 2019, the report can't provide information on how late repayments have evolved since.

The payment timeline for farmers selling to the FRA has progressively extended from 2012 to 2019. In 2012, over 50% of farmers experienced a 2-month delay in payment. This delay increased to 3 months by 2015. By 2019, over 50% of farmers had not been paid even 4 months after the transaction. Moreover, in 2012, nearly 10% of farmers had not been paid after 4 months. This delay extended to 5 months in 2015, and by 2019, over 10% of farmers had not been paid even after 6 months. The lack of prompt payment can be a significant deterrent for farmers to sell to the FRA, especially for those in immediate need of funds for essential expenses, leading them to opt for sales to other buyers at lower prices. Additionally, the issue of late payments can have a significant impact on farmers' investment decisions, something that will be explored in more detail in Section 3 of this report.

Returns to storing

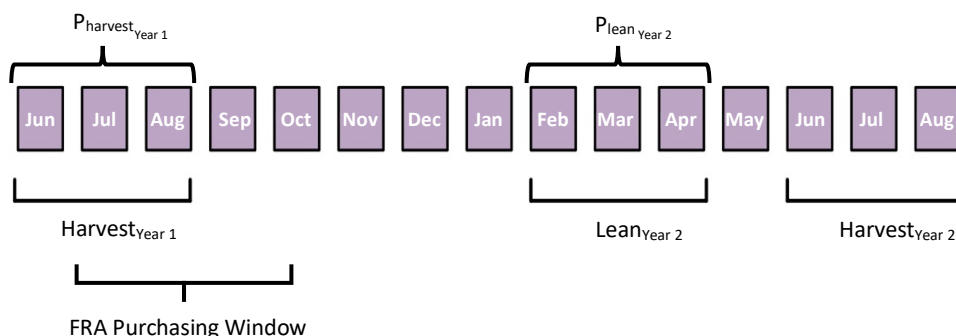
To understand the impact of the FRA on returns to storing in Zambia, it's crucial to first understand *the timing* of agricultural activities.

Zambia's agricultural season typically spans from November to August, coinciding with rainfall patterns. Harvest takes place from June to August, aligning with reduced rainfall intensity. Decisions on production and storage depend on observed rainfall leading up to harvest. Following harvest, the lean season occurs between February and April and is characterised by maize stock depletion, resulting in shortages.⁷ The FRA starts buying maize from farmers in July, and continues until October. During this time, the FRA purchases at a pan-territorial price slightly above the market price. The FRA, therefore, purchases maize at harvest when supply is high and prices are low and releases stock during the high-price lean season when supply is low. This strategy aims to

⁷Simtowe, Franklin, and Hugo De Groot. "Seasonal participation in maize markets in Zambia: Do agricultural input subsidies and gender matter?" *Food Security* 13 (2021): 141-155.

dampen market price volatility. The timeline of harvest and lean season is outlined in **Figure 6**.

Figure 6: Timing of harvest and lean season in Zambia



Note: This diagram illustrates the timing of Zambia's harvest and lean season as well as the FRA purchasing window. Diagram made by the authors.

Building on this knowledge, one can think of *returns to storing* as the difference between the lean season and harvest season price. Positive returns indicate higher prices in the lean season compared to the harvest season, while negative returns suggest higher prices in the harvest season compared to the lean season.

Returns to storage impact farmers and their decisions around storing crops and investing in agriculture. They also affect consumers as returns define what prices they face throughout the season. When market returns are *positive*, prices will be higher during the lean season, rewarding farmers for storing their produce. However, positive returns can negatively affect credit constrained net buyers who have to sell their crop around harvest for cheap and must purchase it again later for a higher price. Conversely, *negative* returns discourage farmers from storing maize, as holding onto their produce would result in lower profits. If these negative returns are unexpected and farmers have already stored their produce, it can lead to decreased revenues for those farmers. This may also result in reduced maize production in future seasons due to insufficient investment.^{8,9} However, this situation can benefit consumers, as it results in lower maize prices during the lean season, when supply is generally assumed to be scarce. One objective of the FRA is to keep market returns for maize as close to zero as possible. This means the FRA's interventions are designed to reduce significant price fluctuations between the harvest season and the lean season.

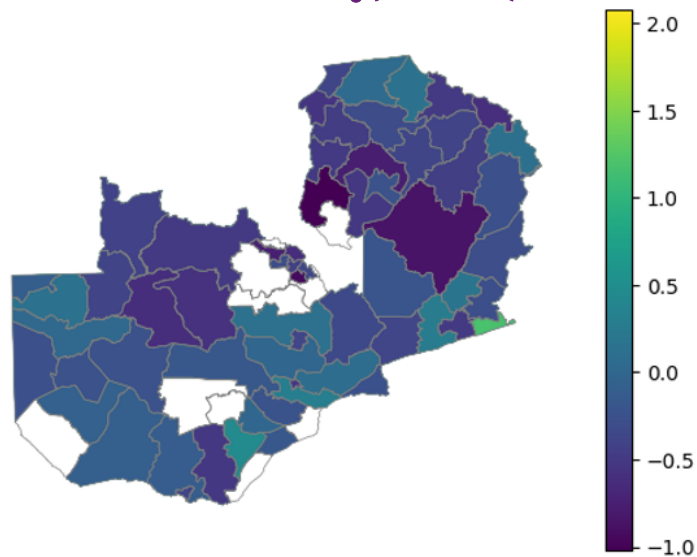
Returns for different districts across time are mapped in **Figure 7**. Without the FRA's intervention, one would expect lower harvest season prices compared to lean season prices due to abundant supply and limited storage. As such, in the absence of the FRA returns are likely to be positive. In a world of perfect within-season price stability, each

⁸ Mason, Nicole M., and Robert J. Myers. "The effects of the Food Reserve Agency on maize market prices in Zambia." *Agricultural Economics* 44, no. 2 (2013): 203-216.

⁹ Hadunka, Protensia, and Joe Janzen. "Weather Shocks and Seasonal Commodity Market Returns: Evidence from Zambia's Maize Market." *farmdoc daily* 13, no. 234 (2023).

district would exhibit zero returns, meaning there would be no difference in prices between the harvest and lean season.

Figure 7: Spatial distribution of returns to storing (2010-2021)



Note: This map illustrates returns to storing for different districts in Zambia between the years 2012 and 2022. Returns are defined as the difference between lean season and harvest season prices for maize. Dark blue indicates lower returns whereas yellow indicates higher returns. The map is made up of the original 72 Zambian districts rather than today's 116. Data points for districts which were split up were merged into the original districts.

However, as indicated in **Figure 7**, the reality shows varying returns across districts, both in terms of their direction (positive or negative) and magnitude. In many developing countries, market connectivity is a challenge, leading to price disparities between different areas. This arises because it is often costly to transport goods between markets, resulting in fewer transactions. Regions with lower transportation costs, for example, those in proximity to Lusaka or those situated along major export routes, generally experience returns closer to zero, resulting in smoother prices. Conversely, markets located near international borders or border ports are more likely to face challenges related to negative returns. This pattern may arise from a common practice among farmers, whereby grains are transported to border districts to take advantage of higher prices in neighbouring countries. However, when the government imposes export bans, these farmers are left unable to reroute their maize back to the districts where it was produced. As a result, farmers are sometimes forced to sell their surplus at reduced prices in the border districts. This sudden influx of supply can lead to an oversaturation of the market in these areas. During periods of export bans, this dynamic significantly increases the probability of border districts experiencing negative returns.

FRA activity and returns to storing

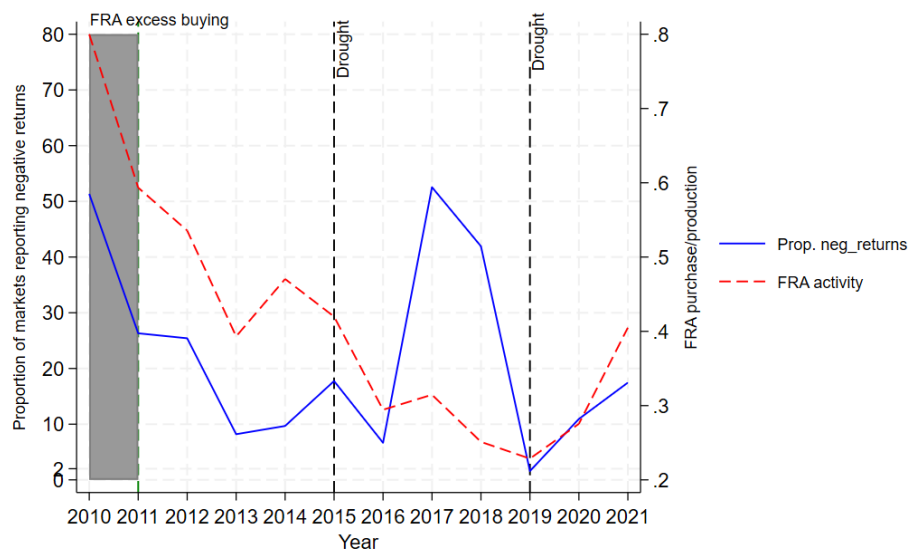
Intuitively, greater FRA activity is expected to lead to a reduction in returns to storing. Increased FRA activity should lead to higher prices during the harvest season and lower prices during the lean season. This

would, in turn, reduce returns to storing and minimise price fluctuations within the season. **Figure 8** looks at this relationship by comparing the percentage of Zambian districts experiencing negative returns in a given season against the proportion of produce purchased by the FRA between 2010 and 2017. Following this reasoning, a parallel movement between the FRA's purchase/production ratio and the percentage of districts experiencing negative returns is expected.

Looking at **Figure 8** one can observe a discernible correlation between these variables. As the FRA activity decreased between 2010 and 2016, so did the number of districts which experienced negative returns. An exception to this relationship occurred during the 2016/17 and 2017/18 agricultural seasons, which were marked by high levels of production just after a previous drought, as well as government-imposed export restrictions.

This diagram underscores two important things. Firstly, a correlation between FRA activity and returns to storing can be identified, even though the relationship is somewhat noisy. While one can think of a reduction in returns from positive towards zero as good, negative returns can significantly harm producers especially if negative returns are not anticipated. Secondly, the diagram shows the often complex relationship between two variables, making it difficult to disentangle the effect of one on the other. Therefore, to understand this relationship better, more sophisticated statistical methods are required. In **Section 3**, this report will delve into a more refined investigation of the relationship between FRA activity and key agricultural market outcomes.

Figure 8: Relationship between FRA activity and districts reporting negative returns



Note: The diagram plots the fraction of districts which experience negative returns in a season against FRA activity, namely purchase over production, between 2010 and 2017. The left y-axis shows the proportion of markets reporting negative returns while the right shows FRA purchases over production. The price data used for the calculations of negative returns comes from ZamStats. The production data comes from the Crop Forecast Survey (CFS) and the purchase data from the FRA. Since the production data consists only of forecasts, this analysis excluded district-year pairings with an FRA activity ratio above 1.2. Districts with an FRA activity ratio between 1 and 1.2 are rounded down to 1.

Section 3: Main results

This section discusses the statistical analysis examining the effect of FRA interventions on specific agricultural market outcomes:

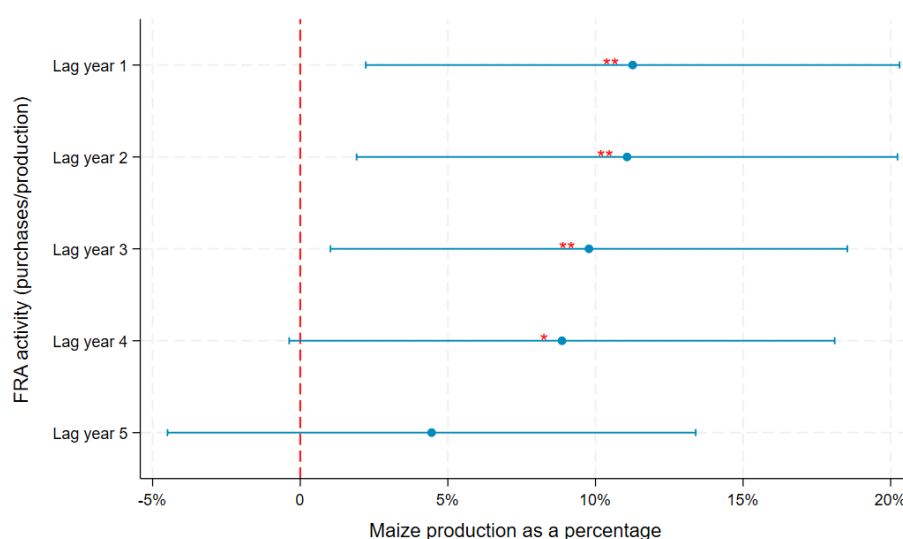
First, it explores how FRA activity affects **production**. Next, it examines the effects of selling to the FRA on **prices received by farmers**. Then, the analysis considers whether this price premium is passed on to consumers by analysing the impact of FRA interventions on **market prices** throughout the entire agricultural season, as well as specifically during both the harvest and lean seasons. This section also looks at the effect of selling to the FRA on the **distance** farmers travel to their **point of sales**. Additionally, it investigates the impact of selling to the FRA on the **number of traders** approaching farmers. Further, the analysis explores the effect of selling to the FRA on farmers' decisions to **produce soybeans** and on **crop diversification** more broadly. Lastly, it examines the impact of **delayed repayments** on the **application of fertilisers**.

Effect of FRA activity on production

The findings suggest that the **FRA activity leads to an increase in maize production**. The analysis looks at how FRA activity, particularly the proportion of total production purchased by the FRA in preceding years, impacts production at the district level. The data reveals that higher purchasing activity by the FRA in previous years is linked to higher production levels. This not only considered the previous season's purchases but also extending back 2, 3, 4, and even 5 seasons. Looking at **Figure 9**, it is found that the FRA increasing its activity by 10 percentage points translates into an increase in district-level production by 1.2%. While purchasing activity over the preceding four years also contributes to an increase in maize production, the most recent year's procurement activities exert the most significant impact.

To contextualise these results, it is estimated that an increase in the FRA's maize procurement from 0% to 50% of the total production would result in a 6% increase in maize production in the subsequent season. This positive effect on production is anticipated to continue, albeit at a decreasing rate. This trend suggests that the FRA's procurement strategy has a sustained, though gradually diminishing, impact on maize production over time.

Figure 9: Estimated effects of past FRA activity on production



Note: The regression uses a two-way fixed effects approach. This analysis uses the Crop Forecast Survey (CFS), which provides consistent yearly production data at the district level as well as FRA purchasing data aggregated at the district level. Production at the district level is then regressed on lagged purchases over production. The analysis controls for production inputs such as cultivated area. Additionally, it controls for district and year-fixed effects. The stars indicate statistical significance.

There are two reasonable explanations for the relationship between past procurement and production. Firstly, the trend could suggest that when the FRA amplifies its procurement in a given agricultural season, farmers gain additional income. This would enable them to invest more in inputs for the following season which would increase production. A second explanation could be that farmers take into account the FRA's past purchasing patterns when planning their production strategies. For example, they might evaluate the FRA's procurement history to predict its likely purchasing activity in the forthcoming year.¹⁰ A consistent and favourable procurement history from the FRA could encourage farmers to upscale their production, anticipating a continued beneficial relationship with the agency.

Effect of selling to FRA on prices received by farmers

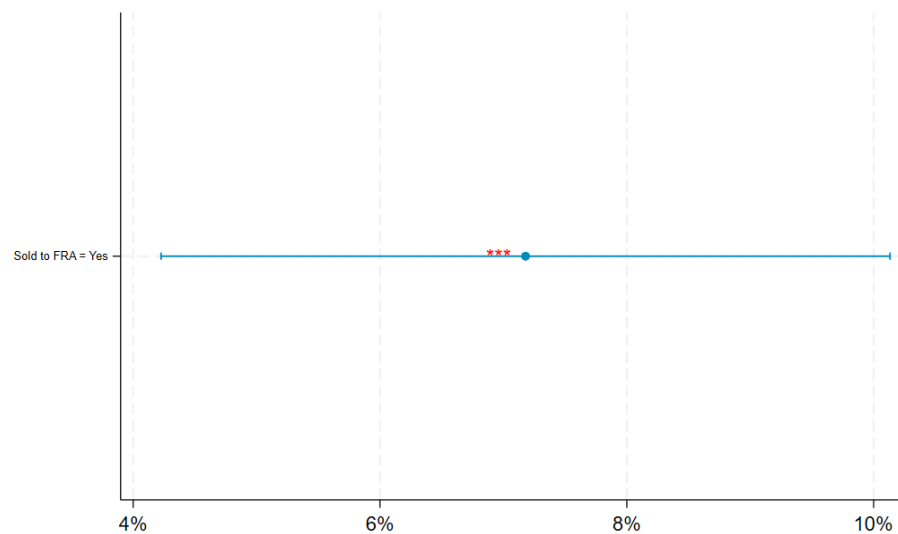
Selling to the FRA is associated with an **increase in the average prices received by farmers** during an agricultural season. Looking at **Figure 10**, the data points to a 7% increase in maize prices received by farmers selling to the FRA in contrast to those not selling to the FRA.

The underlying driver of this relationship is the FRA's practice of buying maize at a pan-territorial price, typically higher than market prices at harvest time. There are multiple considerations which could explain why the FRA is offering prices above the prevailing market rates. Firstly, the primary objective of a strategic reserve is to have a sufficient stock of essential agricultural commodities, like maize, to handle periods of food

¹⁰Mason, Nicole M., Thomas S. Jayne, and Robert J. Myers. "Zambian smallholder behavioral responses to food reserve agency activities." *Gates Open Res* 3, no. 657 (2019): 657.

scarcity. By offering higher prices, the FRA can motivate farmers to sell their produce to the agency rather than to other buyers, ensuring that the FRA can meet its stockpile targets. Other considerations might consist of supporting farmers, incentivising continued production, as well as supporting rural development. While some might argue that it is desirable for the FRA to pay farmers higher prices, the question remains to what extent these price premiums are passed on to consumers. This will be explored in the next sub-section.

Figure 10: Estimated effects of selling to the FRA on prices received by farmers



Note: In this regression, the analysis utilises information from the RALS as well as Zamstats maize price data. The FRA dummy serves as a binary indicator, determining whether the household sold to the FRA or not. Prices received by a household are regressed on the FRA dummy. To address endogeneity, distance to the nearest FRA depot and the timing of FRA payments in the previous year are employed as instrumental variables. Household, and year fixed effects are also controlled for. The stars indicate statistical significance.

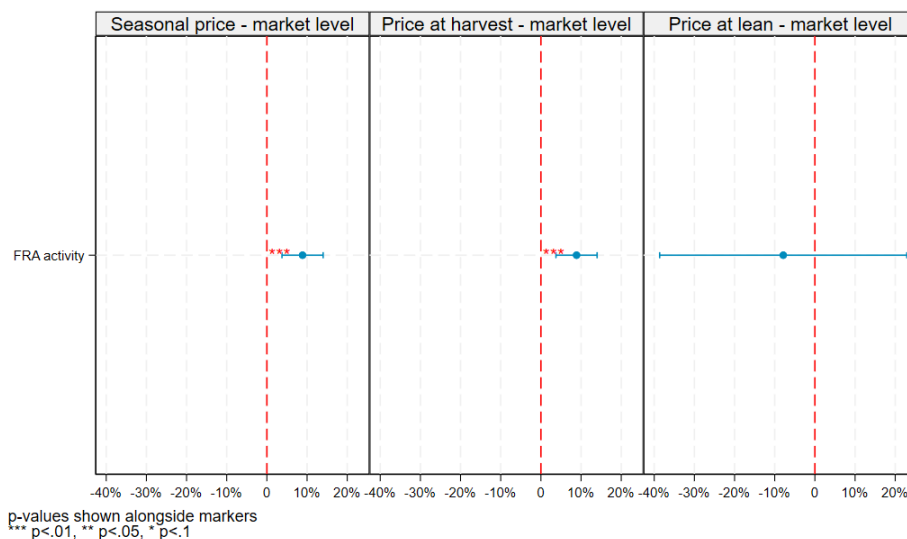
Effect of FRA activity on market prices

Results presented in **Figure 11** reveal that activities of the FRA have a notable impact on market prices, leading to a **reduction in within-season price fluctuation** as well as **an increase in average prices** during the agricultural seasons. Specifically, a 10 percentage point increase in FRA activity is associated with a 1% overall increase in market prices. However, the effect varies by season; the same increase in FRA activity results in a 1% rise in market prices during the harvest season, whereas it leads to a 0.9% decrease during the lean season.

Putting these numbers into context, if the FRA were to increase its purchasing from 0% to 50% of the total maize production, this would translate into a 5% increase in market prices throughout the agricultural season. Specifically, during the harvest season, one would anticipate a 5% rise in prices, while during the lean season, prices would be expected to decrease by about 4.5%. This illustrates a significant influence of the

FRA purchasing patterns on maize market prices and confirms the notion that price premia for farmers are passed on to consumers.

Figure 11: Estimated effects of FRA activity on market prices



Note: This analysis uses a two-way fixed effects model, leveraging maize price data from Zamstats and purchasing data from the FRA. Maize prices at the district level are regressed on FRA activity. Among other things rainfall, border policy, as well as district and year-fixed effects are controlled for. As there is lower market activity during the lean season the government collects less price data and hence the confidence intervals for the lean season are much larger. The stars indicate statistical significance.

To fully understand these findings, it is crucial to consider two key dynamics. Firstly, the overall increase in market prices can be attributed to the FRA offering premium prices to farmers. This premium, in turn, is passed on to consumers, leading to higher overall market prices. Secondly, the seasonal variation in this effect is linked to the FRA's purchasing and selling timelines. During the harvest season, characterised by an abundance of supply and naturally lower prices, the FRA's purchases significantly shift market demand. By buying large quantities, the FRA prevents the market from being flooded with maize, thereby elevating prices. Conversely, during the lean season, when market prices are typically higher, the FRA releases its stockpiles. This increase in supply results in a reduction of prices. Both taken together lower within-season price volatility.

These findings are somewhat consistent with prior studies on the effect of the FRA on market prices. Zhou and Baylis (2019) reported a 5% increase in harvest prices and a 7% decrease in lean season prices due to FRA's purchasing activities.¹¹ Similarly, Mason et al. (2019) found that FRA activities are expected to increase the effective market price by 6.7% during the harvest period.¹²

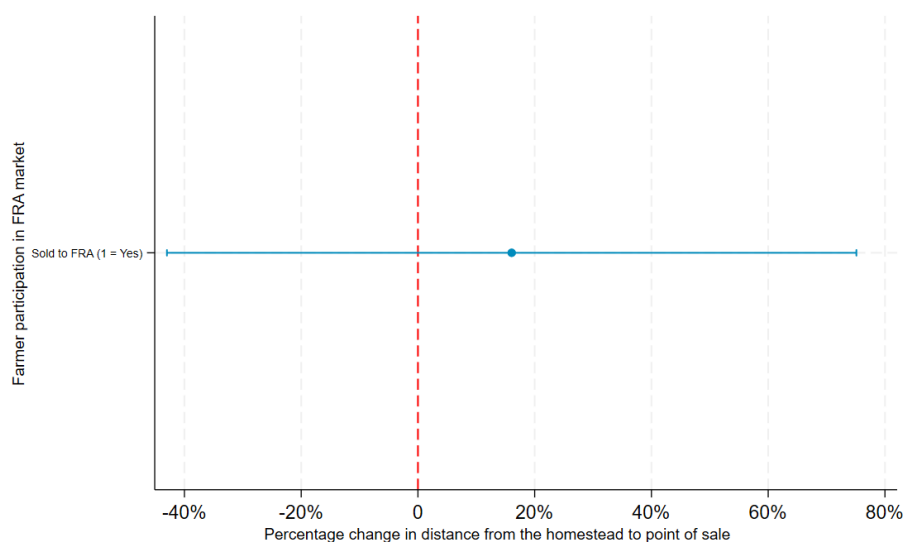
¹¹ Zhou, Yujun, and Kathy Baylis. "Effects of stockholding policy on maize prices: Evidence from Zambia." *Journal of Agricultural & Food Industrial Organization* 18, no. 1 (2019): 20190057.

¹²Mason, Nicole M., Thomas S. Jayne, and Robert J. Myers. "Zambian smallholder behavioral responses to food reserve agency activities." *Gates Open Res* 3, no. 657 (2019): 657.

Effect of selling to the FRA on market access

Figure 12 illustrates that farmers selling to the FRA face a slightly longer distance, about 17%, to their actual point of sale compared to their counterparts even though this effect is not statistically significant.

Figure 12: Estimated effect of selling to the FRA on distance to sale



Note: The distance between the homestead and the sale of produce is regressed on the binary variable indicating whether a household sold to the FRA or not. The distance from the homestead to the point of sale is noted as zero when selling to traders at home and greater than zero for those selling at the market. To mitigate endogeneity concerns, the lagged timing of FRA payments is used as an instrumental variable. Additionally, household and year fixed effects are accounted for.

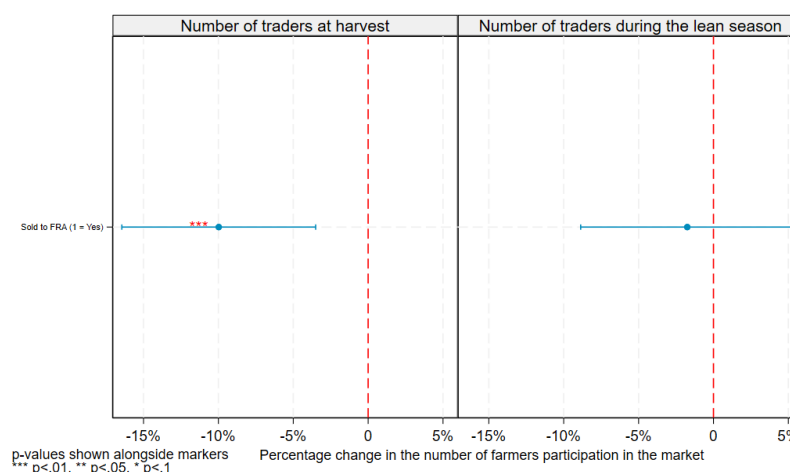
The Zambian government is committed to enhancing market accessibility for farmers. This is largely done through the efforts of the FRA, which purchases maize and establishes satellite depots near farming areas. With over 1,200 depots across Zambia, this initiative aims to enable farmers to sell their produce closer to their homes, thereby reducing transportation costs. In assessing market access, it's crucial to consider two distinct aspects: the distance to the nearest market and the distance to the actual sale point. This distinction matters because a farmer's nearest market may be far, yet the sale might occur at their doorstep through transactions with other buyers. Hence, this analysis looks at how selling to the FRA relates to the distance between farmers and their actual point of sale.

While many farmers engage primarily with the FRA, a significant number also transact with other buyers. Despite offering lower prices, these buyers are sometimes preferred for their immediate cash transactions, which help farmers with liquidity issues. Additionally, the convenience of these buyers purchasing directly from the farmers' homesteads eliminates transportation and bagging costs, adding to their appeal. These findings suggest that farmers selling to the FRA do not necessarily experience shorter distances to the point of sale and, consequently, do not necessarily have better market access compared to farmers who do not sell to the FRA.

Effect of the FRA on market participants

The presence of the FRA correlates with a **reduction in the number of traders** engaging with farmers. **Figure 13** illustrates that farmers who sold their produce to the FRA reported being approached by approximately 10% fewer traders during the harvest season with no detectable change during the lean season.

Figure 13: Estimated effect of selling to the FRA on number of traders active



Note: The number of traders which approached farmers during the harvest and lean season is regressed on a binary indicator, indicating whether the household sold to the FRA or not. To tackle endogeneity, distance to the FRA depot, and the lagged timing of FRA payments are used as instrumental variables. Additionally, the analysis accounts for household and year fixed effects.

During the harvest season, the FRA emerges as a dominant market player. By offering a high pan-territorial price and purchasing large quantities of maize, the FRA effectively crowds out private sector traders. Consequently, these traders approach fewer households. This dynamic reduces the competitiveness of traders and can lead to various market distortions. These issues include:

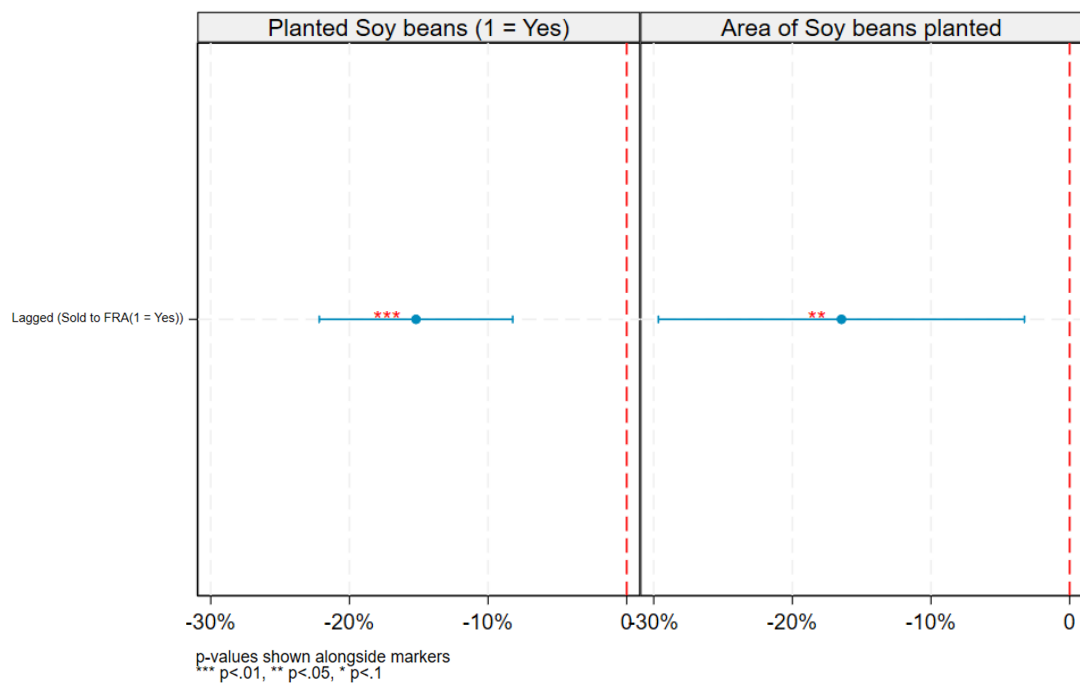
- a potential over-reliance of farmers on the FRA, and by extension, on government intervention.
- supply chain disruptions, especially during periods of operational challenges.
- and questions about whether private traders might operate more efficiently.

Effect of the FRA on Soybean cultivation

Figure 14 illustrates how selling to the FRA influences Zambian farmers' decisions to grow soybeans, which is a high-value crop. Soybeans typically offer lower production costs and higher market value compared to maize, as they require fewer inputs and fetch better prices. This analysis reveals that farmers who sell to the FRA are **15% less likely to plant soybeans and dedicate 18% less planting area to soybean cultivation**.

The fact that farmers selling to the FRA receive a guaranteed market for maize incentivises the production of maize and correspondingly disincentivises the production of other, potentially higher value crops. This is particularly significant given that maize prices in Zambia are consistently much lower than world prices, often falling about \$50-80 per ton below global market rates. Coupled with exceptionally high fertiliser costs, this suggests that the profitability of maize farming in Zambia is among the lowest globally.¹³ Therefore, by prioritising the importance of maize, the FRA may also inadvertently perpetuate a cycle that prevents farmers from choosing potentially higher value crops. The report investigates this question further by looking at crop diversification in the next sub-section.

Figure 14: Estimated effect of selling to the FRA on soybean cultivation



Note: In the first regression, a panel probit model is used. A binary variable indicating if a household was planting soybeans in a given season is regressed on a lagged variable indicating if that household sold to the FRA last season. To tackle endogeneity, distance to an FRA depot is used as an instrumental variable. Household and year fixed effects are also included. In the second regression a generalised two-way fixed effects model is used. The area of land used by a household for soybean production is regressed on a lagged FRA variable. Again, to tackle endogeneity, distance to an FRA depot is used as an instrumental variable, as well as accounting for household-specific year fixed effects.

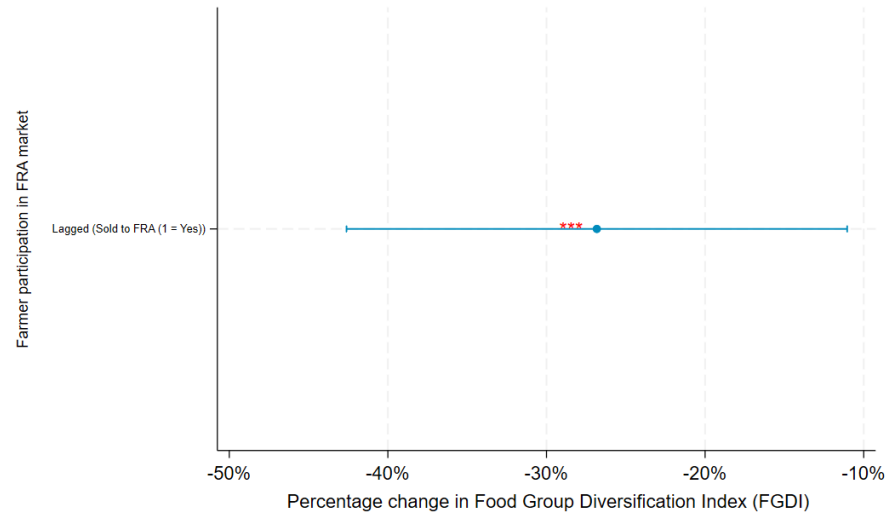
Effect of the FRA on crop diversification

The analysis proceeds by looking at the impact the FRA on household production diversity. **Figure 15** show that **households engaged in selling to the FRA in previous seasons typically exhibit lower levels of production diversification** compared to those not involved in FRA transactions. A metric called the Food Group Diversification Index (FGDI)

¹³ Grace, Nsomba and Simon Roberts. "Building competitive agricultural markets for Zambia: Unlocking export potential." *IGC Policy Paper*. (2023).

is used to measure the level of production diversification in terms of food groups derived from a household's own production. Specifically, households that sold to the FRA exhibited a FGDI 28% lower than households that didn't sell to the FRA. A reduction of 28% can be interpreted as 2 fewer crops planted by farmers selling to the FRA in contrast to those not selling to the FRA.

Figure 15: Estimated effect of selling to the FRA on crop diversification



Note: The Food Group Diversification Index (FGDI) of a household is regressed on a lagged FRA variable, specifying if a household has sold to the FRA in the previous season. The FGDI quantifies the level of diversification in terms of food groups derived from a household's own production. A higher FGDI value signifies greater diversity in the range of food groups produced by the household. To mitigate endogeneity concerns, the distance to FRA depots from the preceding year is utilised as instrumental variables. Additionally, household and year fixed effects are accounted for.

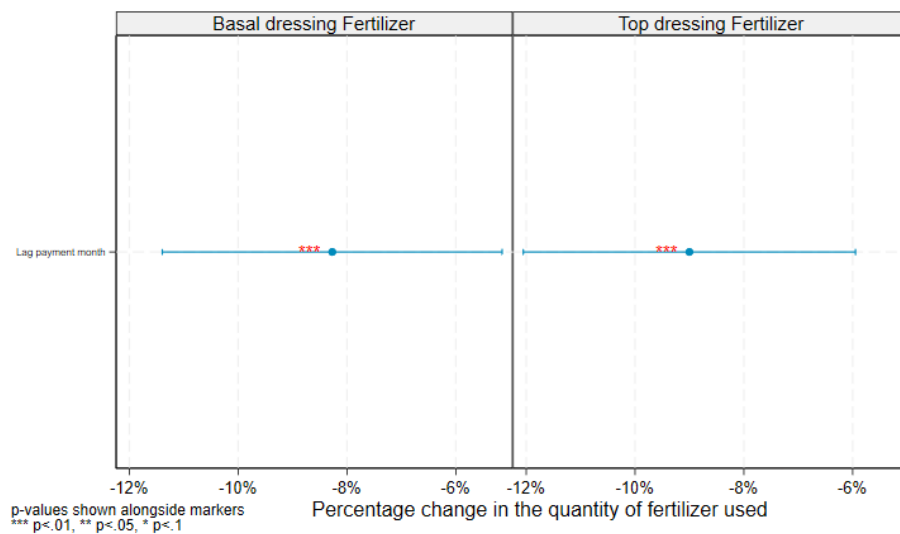
The FRA's emphasis on maize procurement incentivises farmers to predominantly cultivate maize, often at the expense of other crops. This presents several problems. First, what farmers produce often reflects what they consume, so reduced crop diversification can lead to less dietary diversity, directly impacting health. This is true at a household level as well as on a national level. Additionally, crop diversification is vital for mitigating agricultural risks like crop failures, maintaining soil health, managing price fluctuation risks for farmers, and adapting to climate change.

Effect of late repayment by the FRA on fertiliser use

Building on the previous discussion of FRA's delayed payments to farmers, this section delves into how these delays impact farmers' investment decisions. Specifically, it examines the effect of an additional month's delay in payment on the usage of basal and top dressing fertilisers. **Figure 16** presents these findings. It is found that a one-month payment delay by the FRA corresponds to an **8% decrease in basal dressing fertiliser usage and a 9% decrease in top dressing fertiliser usage.**

The findings suggest a rather substantial effect of late repayment on the use of fertiliser. In Zambia, the planting season commences around November, a period that necessitates the acquisition of essential inputs like fertiliser. Delayed payments from the FRA, particularly if they extend up to or beyond this critical period, hinder farmers from making timely purchases of these necessary inputs. While not explored in this report, one can expect that reduced usage of inputs will translate into lower levels of productivity and production for farmers affected by late repayment.

Figure 16: Estimated effect of late repayment on fertiliser use



Note: The RALS data includes the payment month to farmers who sold to FRA. The quantity of fertiliser used by farmers in the following season is then regressed on the difference in months between transaction and payment during the last season. This analysis controls for various factors including access to credit and asset index. To address endogeneity concerns, distance to an FRA depot is employed as an instrumental variable. Additionally, household and year fixed effects are accounted for.

Section 4: Policy Recommendations

Reflecting on the findings of the above analysis, this report would like to make the following recommendations to improve the effectiveness of the FRA in fulfilling its objectives:

Earlier repayment

It is crucial for the FRA to consider prompt payments to farmers, preferably transitioning to a spot cash market. This analysis has shown that late repayment is a frequent issue that farmers face when selling to the FRA. Furthermore, the analysis has shown that late repayment can cause liquidity constraints that prevent farmers from acquiring relevant inputs, such as fertiliser. A spot cash market could ensure that rural farmers can reinvest the generated income, elevating production, and income.

Clarifying FRAs role

Currently, the FRA is tasked with multiple objectives at once, including managing the strategic food reserves, stabilising maize market prices, facilitating market access for rural farmers, and operating a de facto subsidy program by purchasing crops at above-market rates during the harvest season. This multifaceted role prompts a reassessment of FRA's core purpose.

Fundamentally, the FRA is tasked to oversee the National Strategic Food Reserve and to penetrate markets that are less accessible to the private sector. These findings show evidence that, rather than complementing the private sector, the FRA is at times competing with it. Defining and sticking to clear purchasing targets that are reflective of the needs of a strategic reserve would help prevent the crowding out of the private sector activity in the agricultural space.

Effective targeting

Part of the FRA's focus area is supporting poor and remote farmers. However, existing policies might inadvertently hinder the most vulnerable farmers from benefiting from FRA's pricing conditions. One significant issue is the delayed payment system. Farmers facing immediate financial needs will be much more likely to sell their produce to other buyers, at lower prices, due to their inability to await FRA's delayed payments. Additionally, the requirement for farmers to provide their own bags introduces a hidden cost which could deter poorer farmers from engaging with the FRA. The comparative analysis reveals some contrasts between farmers who sell to the FRA and those who do not. Typically, farmers selling to the FRA possess more assets, receive larger loans, and earn more from maize sales, despite having similar harvests as their non-FRA counterparts. This raises the critical question of whether these differences reflect a scenario where more affluent farmers are self-selecting into the FRA purchasing program. This pattern calls into question the FRA's effectiveness in reaching and benefiting its intended demographic, in particular poor and remote farmers. An effective strategy for improving targeting might look to enforce prompt payments as well as eliminate the transaction costs associated with selling to the FRA. For example, transaction costs could be reduced by providing farmers with appropriate bags.

Warehouse Receipt System

A Warehouse Receipt System (WRS) offers a less intrusive yet effective means of price stabilisation and enhanced market access. This would provide similar benefits to those provided by the FRA, but with reduced direct market intervention. This system could empower farmers by allowing them to deposit their harvest in certified warehouses in exchange for a warehouse receipt. This receipt serves multiple purposes:

it can be used as collateral for securing loans, enable farmers to retrieve their stored maize, or can be sold as a financial asset. By facilitating access to secure storage, farmers gain the ability to capitalise on arbitrage opportunities, potentially selling their produce at higher prices later in the season. This strategic timing of sales can contribute to price stabilisation throughout the season.

For the WRS to function optimally, a couple of critical conditions must be met. The first is the establishment of a robust trust and recognition framework among all stakeholders, including farmers, banks, traders, and governmental bodies. Without widespread trust in the system's integrity and reliability, its utility and adoption may be limited. The second condition revolves around farmers' access to and awareness of market prices. The potential for the WRS to aid in seasonal price stabilisation hinges on farmers making informed decisions about when to store versus when to sell their produce. This necessitates the availability of real-time pricing data from various regions, ensuring farmers can make decisions based on comprehensive market insights. Effective price stabilisation and the realisation of the WRS's full benefits for farmers depend on the dissemination of accurate pricing information. Without this knowledge, there's a risk that the primary beneficiaries of the value of storage will be well-informed traders, rather than the farmers the system is designed to support. Lastly, a WRS needs adequate warehouse infrastructure nationwide to ensure that farmers have access to these services. This infrastructure could partially come from existing FRA facilities.

Longer purchasing window

The FRA should consider increasing its purchasing window. The current narrow window forces farmers to sell all their produce within the first few months after harvest and at prices which are most likely below those they would face a couple of months down the line. Nevertheless, net buyers who initially sold their maize to the FRA around harvest are likely to buy it off the FRA in the lean season at higher prices. Even though the FRA releases the stock when the lean season prices are high to reduce lean season prices, in most years, lean season prices are still higher than harvest season prices. This translates into net buyers making a loss on their transaction with the FRA. A longer purchasing window could encourage storage among farmers which could allow them to capture gains from storage rather than incentivising them to sell off all their produce immediately after harvest.

Conclusion

This report reveals that the impact of Zambia's Food Reserve Agency (FRA) on agricultural market outcomes is nuanced and multifaceted.

This report suggests that the FRA's procurement practices have contributed to an increase in maize production and that farmers who sell their maize to the FRA typically benefit from higher prices. Furthermore, the FRA's purchasing and selling activities tend to stabilise maize market prices. This is because they are associated with higher prices during the harvest season and lower prices during the lean season, thus mitigating within-season price volatility. On the other hand, while higher prices offered to farmers selling to FRA are advantageous for net-sellers, this often results in higher prices faced by consumers, as the price premium offered to farmers is being passed on to the market.

The report finds that the establishment of satellite depots by the FRA has not been effective in reducing the distance farmers must travel to sell their produce. This is particularly concerning as it coincides with the FRA crowding out alternative buyers who could otherwise provide farmers with market access. More precisely, the report shows that FRA's operations are linked to a reduction in the number of traders approaching farmers, which could have significant long-term implications for market competition.

Investment in general, and fertiliser application in particular, is crucial for agricultural productivity. Therefore, it is important to highlight the impact of late payments on farmers as these delays hinder farmers' ability to purchase fertilisers, potentially reducing yields in the following season. Additionally, late payments make selling to the FRA less appealing for poorer households. Farmers not selling to the FRA, hence, tend to be poorer as they cannot afford delayed payments, or the other additional costs associated with selling to the FRA.

Lastly, farmers selling to the FRA tend to use less diverse cropping systems, which can trap them in a cycle of producing predominantly maize, a crop of relatively low value. This reliance on maize not only exposes farmers to significant financial risks but also has broader implications. Limited crop diversity can lead to poorer health outcomes due to reduced dietary variety as well as undermine soil health, impacting long-term agricultural sustainability. Therefore, the FRA's influence on cropping choices can have far-reaching effects on both economic stability and community well-being.

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