



## Exploring the Feasibility of the Food Reserve Agency to Implement Virtual Grain Reserves

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### Key Points:

- Strategic food reserves are an important component of national food security.
- Currently Zambia, through the Food Reserve Agency (FRA), holds all its food reserves as physical stocks with huge cost implications on the treasury.
- By embracing innovative grain trading systems such as commodity exchanges, FRA can reduce the cost of managing food reserves as well as diversify Zambia's strategic food reserve portfolio by splitting the recommended volume of strategic grain reserves into physical stocks and grain options (virtual reserves).
- By purchasing grain options, the FRA will only pay a small fee to hold the option (right) to purchase the grain for delivery at a later date as and when required.
- Virtual reserves would thus give FRA the flexibility of choosing when grain delivery can be made and where, with the possibility of exiting the contract in the event that the additional grain is not required

**INTRODUCTION:** National strategic food reserves play an important role in ensuring a country's food security, responding to emergency food needs, and help stabilize staple food prices. In Zambia, this role is played by the Food Reserve Agency (FRA). Typically, FRA purchases staple grains such as maize, rice, soybeans, etc., for strategic food reserves, with maize forming the bulk of all purchases owing to the commodity being the country's main staple crop. The FRA purchases, transports, and stores physical maize stocks for strategic food reserves, which are called upon when needed, for example, in times of emergency food needs, stabilizing domestic prices of maize and mealie meal. Over the years it has increasingly become typical for the FRA to purchase excess maize stocks beyond what is required for strategic reserves, at a huge cost to the country's treasury. Among the reasons for purchasing and storing excessive physical stocks is to respond to unforeseen deficits. However, this mode of operation has become increasingly costly for the FRA to continue,

which prompted President Edgar Lungu, in 2017, to call for changes to FRA's operations.

As the purchase and storage of excess physical stocks are one of the major contributors to FRA's high costs, FRA must consider diversifying its strategic grain reserve (SGR) portfolio by embracing modern and flexible market innovations that minimize costs and enhance the Agency's efficiency in responding to emergency food needs. FRA's activities of purchasing grain at an above-market price and storing large physical stocks are a drain on the treasury, distort the market, and foreclose space for private sector participation. FRA can reduce its operational costs (e.g., transportation and storage) and market intervention by deploying market innovations such as utilizing commodity futures markets to purchase grain futures contracts or options on commodity exchanges such as the Zambian Agricultural Commodity Exchange (ZAMACE) and holding a proportion of the SGR in the form of options or futures contracts. This is where virtual reserves come in.

Against this backdrop, the objectives of this report are threefold: 1) to demonstrate how commodity futures markets work and how they can be integrated into FRA's SGR portfolio; 2) to estimate the cost of implementing virtual reserves; and 3) to assess stakeholder support for virtual reserves.

In the sections to follow, we briefly describe data sources and analytical methods and then provide definitions of commodity futures markets, futures contracts, and commodity options. We also discuss how commodity futures markets operate and how they can be integrated into Zambia's SGR.

**Data and Methods:** Data for this study are drawn from commodity prices, transaction and exchange costs used in trading on ZAMACE, South African Futures Exchange (SAFEX), and Johannesburg Stock Exchange (JSE). Transaction costs associated with trading on ZAMACE and SAFEX were estimated. Various reports and information sheets from ZAMACE, SAFEX, and JSE were reviewed, as well as literature on strategic grain reserve management.

## How Commodity Futures Markets Work

### *Commodity futures market*

A commodity futures market is an open and organized market place, such as ZAMACE, South African Futures Exchange (SAFEX), which brings together many buyers and sellers of commodities to trade. Commodity trading on futures markets is governed by a set of rules. The main instruments used in trading commodities in futures markets are futures contracts, forward contracts, and commodity options.

### *Futures contracts*

A futures contract is a transferable, legally binding agreement to make or take delivery of a standardized quantity of a commodity, or standardized minimum quality grades, during a specific month, under terms and conditions established by the designated contract market on which trading is conducted (Leuthold, Junkus, and Cordier 1989). Therefore, a futures contract entails a contractual obligation to be fulfilled by

the parties involved. It is an obligation to buy or sell a specific quantity and quality of a commodity or financial instrument at a certain price at a specified future date (Carter 2017). Using futures exchanges, buyers and traders of commodities can buy or sell commodities today but for delivery in the future, without necessarily requiring physical contacts. Trading takes place online via exchange platforms.

Figure 1 presents a schematic depiction of the general flow of activities and players involved in placing an order to buy or sell commodity futures. To illustrate the basics of how commodity futures work, consider a case where in April, a trader in Lusaka contacts a commodity exchange (for example, ZAMACE) via a broker, with instructions to purchase 20,000 metric tons (MT) of *Grade A* maize to be delivered in December the same year at ZMW 5,300 per MT (*bid price*). The broker, registered with the exchange (for example, a ZAMACE registered broker) would then convey instructions from the client to the exchange. During the same period, another trader in Mkushi district might issue instructions to a broker to sell 20,000 MT of *Grade A* maize for December delivery at ZMW 5,400 per MT (*offer price*). Likewise, the broker would pass on the instructions to the exchange.

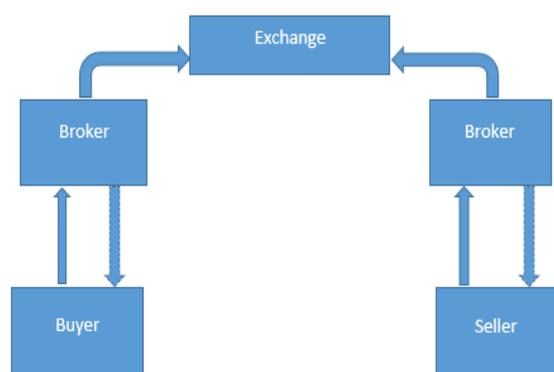
The broker for the buyer looks at various contracts on offer and sees the offer of ZMW 5,400, he immediately informs the buyer, and the buyer might ask the broker to negotiate for a price ranging between the bid and offer. The broker for the buyer contacts the broker for the seller with a bid price of ZMW 5,320 per MT. The broker for the seller contacts his clients (the seller) and informs him/her of the bid. The seller may ask the broker to negotiate a price of ZMW 5,350 per MT. When the two traders communicating through their respective brokers agree on a price, then a price is discovered, and the deal is done.

The trader in Lusaka who agreed to purchase maize has what is termed a *long futures position*, whereas the trader in Mkushi who agreed to sell the maize has a *short futures position*. The price at which both the buyer and seller agreed to trade is known as the *futures price*, and is determined

by the laws of supply and demand currently obtaining in the market. For example, if more traders are looking to sell September maize at a given time than buyers looking to purchase September maize, then the price drops. The drop in price will trigger a surge in the number of buyers wishing to purchase September maize. With new entrants (buyers) in the market, the number of buyers will increase, and eventually, a balance between the number of sellers and buyers will be achieved. The opposite is true if there are more traders wishing to buy September maize than there are sellers. In this case, the price of September maize will go up.

When the buyer decides to take delivery, the seller delivers the maize to a designated location as stipulated in the contract (e.g., a designated warehouse). The buyer could also arrange with the warehouse to transport the maize to a location of his/her choice, including homestead, and bears any transportation fees.

**Figure 1.** General Flow of Activities for Placing an Order to Buy or Sell Commodity Futures



**Source:** Authors' construction

### *Commodity options*

Similar to futures contracts, options are traded on exchanges, although they can be traded over the counter markets outside of the exchange. There are two types of options, namely the **call option** and the **put option**. A call option gives the holder the right, and not the obligation, to buy a commodity by a certain future date for a specific price. On the other hand, a put option gives the

holder the right to sell the commodity by a certain date for a certain price. To be able to hold the right to an option, the buyer pays the seller what is known as the **premium**. The price in the contract is known as the **strike price or exercise price**, which is a predetermined price at which a call option buyer can buy the commodity. For example, the buyer of a white maize call option with a strike price of USD 3,200 per MT can use the option to buy the maize at USD 3,200 before the option expires on the date specified in the contract known as the **expiration** or the **maturity date**.

One important distinction to be made between the futures contract and options is that under options, the holder of an option has the right to either exercise the option or may choose not to, whereas the holder of a futures contract commits to buying or selling the commodity at a certain future date for a certain price (Hull 2014). Among these two market instruments (futures contract and options), commodity options present a better investment route to use for a virtual reserve, owing to their flexibility wherein an option holder can either choose to exercise the option or exit the option, at no cost save for minimal costs in other fees.

### **What are Virtual Reserves?**

In this sense, virtual reserves refer to the purchase and to some extent, storage of strategic food reserves through commodity futures markets, as opposed to physical purchase in the open market or over-the-counter markets, and storage of SGR. Thus virtual reserve is what the terminology implies – a reserve that is not physically present but can easily be called upon as and when needed. The reserve availability is based on the contract between buyer and seller for the buyer to have access to a commodity, wherein the contract stands in as a substitute for the actual physical reserve of a commodity. This agreement, among other things, clearly outlines the price, quantity, quality, and time as well as location the commodity must be delivered. Virtual reserves can also be in the form of a SGR fund set aside by the government to purchase food reserves as and when need arise. However,

the advantage of commodity futures market instruments such as commodity option is that the buyer can lock in a favorable price early in the season when prices are lower for delivery at some future date.

#### *How can FRA implement virtual reserves?*

FRA can purchase grain options from local commodity exchange, such as ZAMACE, or international exchanges such as the Johannesburg Stock Exchange (JSE) or South African Futures Exchange (SAFEX) for delivery at a certain date and for a certain price. The delivery date could be tied to the period when the country expects reduced maize stocks on the market, which coincides with rising prices and food shortages, especially among rural households. For example, between October and March, food stocks in rural areas tend to decline, resulting in deficits. Therefore, targeting delivery around October would help bridge the deficits right when it occurs.

Around March/April of every year, the Disaster Management and Mitigation Unit (DMMU) conducts vulnerability assessments to assess the country's food security situation and identify potential deficit areas that will need emergency food relief. Using early warning information from DMMU, it would be strategic to have the futures contract specify the delivery location in areas that have been identified as potential deficit hotspots. By so doing, transportation and other distributional logistics costs are eliminated in delivering food to deficit areas. For example, the Southern and Western Provinces experienced extreme dry conditions that drastically reduced harvest and resulted in a serious food deficit for the past two seasons (2017/2018 and 2018/2019 production seasons). This happened at the backdrop of the country as a whole, recording a slight surplus production, implying that some areas had a good harvest and were in a surplus position. Thus, there was a need to move food for relief purposes, from strategic reserve locations, most of which are located in the northern half of the country, to the deficit areas. This posed a big challenge on the government due to logistical

hurdles, which required grain to be moved over a long distance to where it was needed the most. The logistical challenges resulted in delayed delivery of relief food, mostly maize and mealie meal.

With commodity options, FRA could purchase a call option which it can easily exercise (or call upon) and take a delivery of the futures contract for delivery in deficit hotspots, which will be delivered by the seller. For example, if FRA was to purchase a grain option on ZAMACE, for delivery in November, a retainer fee or deposit, which is 20% of the ruling market price at the time – which goes in the seller's account--would have to be paid for FRA to lock in the favorable price. In addition, FRA would have to pay other fees, which typically do not exceed 3% of the option's total value. This way, FRA is assured of grain supply when needed and delivered close to where it is most needed, thereby reducing operational and logistical costs and expediting distribution.

In the event that the grain is not required, for example, FRA can exit the option before maturity, thereby withdrawing from purchasing the grain and the 20% retainer fee will be credited back the FRA's account by the exchange using funds in the seller's account<sup>1</sup>. In so doing, the only cost FRA would have incurred is in the form of other fees. In the case of futures or forward contract, FRA can take a long position (purchase a contract), and in the event that the grain is not needed, FRA can offset its position by taking an opposite position (short position by selling the contracts of the exact amount it purchased). This way FRA saves resources by not purchasing excessively, as well as avoiding storage and transportation costs for grain that is not needed during that particular season.

Virtual reserves are not a substitute for physical reserves, but rather complement physical reserves by adding commodity futures position to the SGR. This entails the country holding a mix of physical and virtual reserves. Table 1

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<sup>1</sup> Sellers have to maintain an account with a set minimum amount based on their trading activities. This money is

used to ensure financial integrity of the exchange and is used to pay back the retainer fee, where the buyer decides to exit the option.

below gives an example of a possible mix of physical and virtual grain reserves.

**Table 1.** Example of how FRA can implement a mix of physical and virtual maize grain reserves

Type of Reserve	Quantity Held (MT)	Percent of Total SGR	Source
Physical	250,000	71%	Direct purchases from farmers and traders
Virtual	100,000	29%	ZAMACE, SAFEX
<b>Total Reserves</b>	<b>350,000</b>	<b>100%</b>	

The optimal mix of physical and virtual reserves would have to be informed by analytics conducted by researchers in collaboration with FRA and other concerned stakeholders. Data from Food Balance Sheet, such as national requirements, exports, and imports coupled with early warning information, is critical input into the analytics to determine the optimal mix.

#### *Stakeholder appetite for virtual reserves*

Stakeholders, including Zambia National Farmers Union, Grain Traders Association of Zambia, Musika, and others, have consistently been calling upon the government to consider using the structured markets like ZAMACE to purchase grain as a stimulant to the crowding-in private sector. FRA's participation in ZAMACE is critical for stimulating the full operationalization of the ZAMACE and the warehouse receipt system. This is because FRA, being one of the major players, purchases high volumes (which is a necessary precondition for a commodity exchange to be viable). An investment plan study by IFAD and IAPRI (2018) identified low trade volumes as one of the major impediments to full operationalization and viability of ZAMACE and the warehouse receipt system.

Generally, discussions around virtual reserves tend to arise when the country experiences a poor harvest, however, these are never followed up with action or concrete planning. In times of good harvest, discussions around virtual reserves

vanish. This indicates that stakeholders do consider virtual reserves as one of the viable options for securing the country's food security, but there is skepticism of whether this might work and how it would work.

To help address these concerns, FRA should consider piloting virtual stocks in partnership with other stakeholders to demonstrate the practicality and economic viability of virtual reserves. One way to pilot this would be to create a SGR fund, which the government can set aside for purchasing of grain forward/futures contracts or options through ZAMACE or grain options from regional platforms such as SAFEX and JSE.

#### *Costs of piloting virtual reserves*

FRA can consider to either operationalize virtual reserves by purchasing grain options via ZAMACE or grain options on the South African Futures Exchange. Suppose FRA intends to pilot the purchase of 20,000 MT in the form of virtual stocks, the costs and modalities will depend on the market instrument used, either futures/forward contracts or a call option. Table 2 below sets out an example of the indicative cost of purchasing 20,000 MT through grain options on ZAMACE or SAFEX.

**Table 2.** Estimated cost of purchasing 20,000 MT of maize grain options via ZAMACE or SAFEX

Cost Item	ZAMACE Call Option for November 2020 Delivery	SAFEX Call Option for December 2020 Delivery <sup>2</sup>
<b>Size of contract</b>	10 MT	100 MT
<b>Price per MT</b>	3Market price per MT: ZMW 5,300/MT	Premium per MT: ZMW 73.34/MT
<b>Price per contract</b>	Price per contract: 10 MT*5,300 = ZMW 53,000	Premium per contract: 100 MT*73.34 = ZMW 7,334
<b>Purchase volume</b>	Purchase volume: 20,000 MT	Purchase volume: 20,000 MT

<sup>2</sup> SAFEX computations are based on an exchange rate of ZMW 1 = ZAR 0.985 as at March 30, 2020, the time the study was conducted

<sup>3</sup> ZAMACE's other fees vary between 2% - 3%. In the above calculations we use the maximum percentage (3%)

<b>Number of contracts</b>	2,000	200
<b>Price of call option per contract</b>	Price of call option: 20% of market price (ZMW 10,600)	ZMW 7,334
<b>Cost of 20,000 MT option</b>	ZMW 10,600*2,000 = ZMW 21,200,000	ZMW 7,334*200 = ZMW 1,466,862
<b>Fees</b>	Other fees: 3% of total cost (ZMW 636,000) <sup>4</sup>	ZMW 11.10 per contract: Total fees = 11.10*200 = ZMW 2,220
<b>Total cost = Cost of Options + Fees</b>	<b>ZMW 21,836,000</b>	<b>ZMW 1,469,082</b>
<b>Amount to be paid if FRA exits option</b>	<b>ZMW 636,000</b>	<b>ZMW 1,469,082</b>

**Source:** ZAMACE, SAFEX, and JSE price data, 2020

In total, FRA would pay ZMW 21,836,000 to hold the right to purchase 20,000 MT of maize on ZAMACE, for delivery in November. The difference (80%, which translates to ZMW 84,800,000) would be paid if FRA exercises the option and takes delivery. If FRA decides not to take delivery, the 20% (ZMW 21,200,000) deposit will be credited back to FRA, and the only cost incurred would be the 3% (ZMW 636,000) representing other fees. If FRA was to purchase a call option on SAFEX, the total cost of holding the right to purchase 20,000 MT of white maize for December 2020 expiry would be ZMW 1,469,102, less other fees. This fee (premium) is non-refundable in the event that FRA exits the option, before expiry (i.e. if FRA does not take a delivery). If FRA takes a SAFEX delivery, the FRA would, in addition to the non-refundable fee, pay the price as quoted in the option. Based on the above estimates, FRA will incur less costs holding ZAMACE option than SAFEX, particularly in the event that delivery is not necessary. FRA would make an estimated saving of ZMW 833,102, representing about 57% by purchasing options on ZAMACE compared to purchasing on SAFEX. However, this might vary depending on the premium and strike price on SAFEX, which are highly variable depending on market conditions.

### *Advantages of virtual reserves*

By implementing virtual reserves, FRA can reduce its operational costs, by reducing FRA's direct costs such as transportation and storage. Further, by purchasing options early in the season when prices are relatively low, FRA can lock in a good price for grain that will be delivered later in the season when prices tend to be high. In addition, virtual reserves would give FRA the flexibility of choosing when grain delivery can be made and where and the possibility of exiting the contract if the additional grain is not required. Whereas, with physical stocks, FRA does not have the flexibility as the stocks have to be procured and stored.

To ensure that reserves account for possible unforeseen deficits, FRA tends to purchase excess physical stocks, which comes at huge cost in terms of procurement and storage. At a much broader level, virtual reserves can help reduce FRA market intervention and improving efficiency in responding to emergency food relief needs. Reduced direct market intervention by FRA is expected to create space for private sector participation, an important feature for the growth of the sector and spurring productivity. Furthermore, trading through commodity exchange markets, such as ZAMACE, will enhance transparency and predictability in grain markets and trade in Zambia by entrenching market-based price discovery mechanisms in the grain sub-sector. Commodity exchanges act as centralized sources of market information such as supply and demand and trade volumes, in a highly transparent manner for all market players to access and interpret the information. Market players can then use this information to form price expectations using the market process.

## **4.0 Conclusion**

This study set out to explore the feasibility of FRA implementing virtual grain reserves in order to diversify its SGR portfolio by splitting total SGR into virtual and physical stocks while maintaining the SGR size. Hence, FRA does not need to fully migrate to virtual grain reserves but

rather have a mix of virtual and physical stocks. To achieve this, FRA should consider embracing grain trade innovations such as futures markets, which eliminate the need to physically store grain, thus provide an alternative and cheaper way to store grain. This does not mean the country would be food insecure, but instead, it lowers the cost of safeguarding the country's food security by diversifying the SGR portfolio and fostering private sector investments in value addition, storage, and trade.

To effectively implement virtual reserves, there is a need to establish a strategic grain reserve fund, which the government can utilize to purchase grain options to be called upon when required. As the strategic grain reserve fund is a public reserve, it is crucial that the fund is well designed and governed -- with clear rules-- to ensure it stays above vested interests and abuse. Thus in addition to financial resources, there is a critical need for a well-trained human resource to oversee and coordinate the fund and ensure it is used for the intended purpose. For example, out of the 164,000 MT that was required for emergency food assistance in the 58 most affected districts in the 2019/2020 marketing season, the government could have partnered with stakeholders to purchase a third (54,000 MT) in form of virtual stocks. This could be implemented through a cost-sharing mechanism where stakeholders interested in piloting virtual reserves contribute 50% of the total cost and the other half contributed by the government.

If government is unable to use ZAMACE, it could contract traders to hold maize on its behalf by paying a deposit and thus hold the option to purchase the grain. These options can be called upon if really needed to respond to unforeseen deficits. The advantage is that the country will only pay a fee to hold the option instead of incurring huge procurement and storage costs as is currently the case.

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