

Structuring African Warehouse Receipt Systems to Succeed

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Development economists have preached that functioning warehouse receipt systems (WRSs) will help smallholder African farmers access loans to help reduce poverty and enhance financial inclusion. Unfortunately, many reviews of African country WRSs have concluded that anticipated benefits are not accruing to smallholder farmers. Given the theoretical case and positive experience elsewhere, this paper meticulously reviewed reports that WRSs are not working in the interest of African farmers to identify the challenges. Then, several scenarios in respect of use of WRSs were formulated and analysed for Ghana and Uganda. Scenarios include paying/not paying collateral management fees, grading/not grading maize, using/not using warehouse receipts (WR) as collateral, using community warehouses, etc. Malawi and Zambia are also discussed. The paper concludes that the potential for positive impact of WRSs on the lives of smallholder African farmers exists. However, it is necessary to structure WRSs to suit the situation of smallholder African farmers. The key to profitably implementing WRSs in Africa is not to blindly replicate WRSs as implemented in other jurisdictions. Important African specific context ingredients include focusing on community warehouses rather than commercial warehouses, not focusing on grading of grains and not implementing full-scale collateral management arrangements.

Keywords: warehouse receipts, smallholder farmers, Africa, Ghana, collateral management fees, community warehouses

Introduction

Development economists are beginning to wonder why warehouse receipt systems (WRSs) in Africa appear not to be having anticipated positive results on smallholder African farmers, in spite of their success in other jurisdictions, given the promise that they hold in principle. It has been argued that paying attention to smallholder agriculture in Africa will play a major role in poverty reduction, help achieve food security and financial inclusion. Indeed, agriculture in Africa employs upwards of 50% of the labour force of most countries. Unfortunately, studies have shown that smallholder farmers, face major liquidity challenges which curtail their farm output and productivity growth. Liquidity challenges mean that many smallholder farmers are not able to access key farm inputs such as seed and fertilizer and so are not able to enhance their yields and farm sizes.

Many studies have shown that access to appropriate small loans to the poor positively impacts poverty reduction. Unfortunately, the majority of the poor in

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Africa do not possess collateral that is acceptable to financial institutions that grant loans, hence such persons are unable to access loans.

In response, a number of development practitioners have argued that farm produce that farmers harvest and own are assets which can be structured as collateral. WRSs have been proposed as a solution to this liquidity problem of smallholder African farmers.

Traditionally, to avoid the high losses associated with grain storage, farmers have adopted the practice of selling their grains soon after harvest, resulting in them realizing low market prices as many farmers try to sell at the same time. To hold on to the harvest for higher prices, farmers would dry some of the crop soon after harvest to reduce molds and insect infestation and store then in barns on their farms. But only the farmer knows the quantity and quality of the grain in his/her barn. Faced with this situation, the idea that an accredited warehouse would store agricultural produce safely and maintain its quality over a given period of time so that farmers are not tripping over each other to sell their limited produce at harvest would appear to be an enticing proposition to African farmers.

Accepting the theoretical advantages of WRSs, a number of African countries have adopted the modern concept of formal WRSs. They include Burkina Faso, Cameroon, Cote d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mozambique, Niger, Senegal, Tanzania, Uganda, and Zambia. Some have even institutionalized commodity exchanges.¹

However, Miranda et al. (2018), argued that warehouse receipt financing in Ghana and Africa has not yielded the theoretical promises to smallholder farmers. In fact, in Miranda et al. (2019), the authors posit that "Warehouse receipt financing involves significant transaction costs and complex risk transfers that undermine its value to the smallholders."

Before them, Sitko and Jayne (2012) had reported on six main factors that they said impeded volumes of agricultural produce traded on the Zambian Agricultural Commodity Exchange. Not long after, Chapoto and Aboagye (2017), looking back at 2014 data two years after Ghana Grains Council (GGC) started its WRS, documented that due to low output, no smallholder farmer targeted by the GGC WRS had been issued with tradable certified warehouse receipt to serve as collateral to potential lenders. However, Chapoto and Aboagye noted that grain aggregators (non-farmers) had aggregated enough grains from farmers to be issued warehouse receipts. They added that, small-scale grain farmers however report substantial reduction in post-harvest losses when they lodged farm proceeds with community warehouses.

This study probes deeper into the literature on performance of the WRSs in Africa and finds that all is not lost. Imposing how WRSs work elsewhere wholesale on smallholder African farmers is the problem. Requiring relatively high minimum quantities for commercial warehouse storage, commercial arrangements that require grading of grains and bearing the cost of traditional collateral management fees, bureaucratic dealings with warehouse operators, etc.

¹South Africa is in a league of its own.

constitute challenges for the smallholder African farmer. High lending rates too are a problem.

Following this introduction is a brief review of the literature on WRSs and empirical studies on warehouse receipts in Africa. This is followed by the methodology adopted here. Findings are the presented, followed by discussion and conclusion.

Literature

Warehouse receipts (WR) are receipts issued to depositors as evidence that standardized specific assets (agricultural produce) of a certain quality and quantity have been deposited by a named depositor in a certified warehouse. Such receipts may then be presented to potential lenders as evidence that the depositors have collateral. Beyond facilitating access to finance, a functioning WRS has the potential of helping farmers earn more for their produce as farmers store their agricultural produce in well-equipped and secured warehouses and then sell at higher prices during lean seasons. Post-harvest losses too will be arrested. And farmers will be able to smoothen their consumption across seasons.

Standardisation of commodities allows trading by description, thereby reducing transaction costs, and also safeguarding against cheating on weights and quality. Also, trade using the WR shortens the marketing chain and can potentially increase producer margins. The WR can also help reduce the cost of procuring and managing public food reserves and create incentives for private players to invest in new business ventures. Further, commodities are better stored by professional warehouse operators, therefore reducing storage losses.

The concept of a warehouse receipt system for grains relies on the idea that during harvest season, because all farmers are harvesting and seeking to sell their surplus grains, the price of produce falls. A few months down the road, when much of the grains produced during the last harvest season have been consumed/sold and others have been lost to post-harvest insects, etc. prices rise. Thus, the advice is that farmers should store some of the grains they produce at harvest at secured locations that are protected against post-harvest losses and then sell same later when prices would have risen. In the meantime, while waiting for more favourable prices, they may pledge the stored grain as collateral for a loan from a financial institution.

Warehouse Receipt Systems in Africa

In Africa, WRSs are operational in many countries. Some have even established commodity exchanges. Table 1 provides some evidence about establishment of WRSs and quantum of business undertaken in certain years. Clearly, these formal African WRSs are young. The last column is particularly interesting. It makes clear that for many countries, produce quantities for which WRSs were issued were miniscule percentages of country productions. Ethiopian and Tanzanian commodities are basically for exports.

Table 1. Country WRS: Year of Establishment and Quantum of Commodities for which WRs were issued in 2015, 2016 and 2017 versus Crop Production in Metric Tonnes

Country	Established	2015	2016	2017	% of Total National Production in 2015
Ethiopia	2009	590,000			66% Coffee; 100% Sesame
Ghana!	2008	29,000	18,000		1.2% Maize
Tanzania	2005	130,000	140,000		80% cashew
Kenya, Uganda & Tanzania*	2014	30,000	70,000		0.5% of maize
Malawi⁺	2011	150,000	110,322	16,373	5% of maize
Zambia	2014	11,440	12,760	10,560	4.4% of Maize
Nigeria	2014	48,000	48,000	29,000	0.5% maize
Rwanda	2014	15,000	10,000		2% maize

Source: Thunde and Baulch (2020), African Development Bank (2017), Safo (2017) and Miranda et al. (2019).

!A second WRS, Ghana Commodity Exchange, started in 2018. In 2019, quantity of maize for which its WRs were issued was 0.03% of the 2.9 million metric tonnes produced; in 2020, the proportion traded was 0.04% of 3.1 million metric tonnes; in 2021, it was 0.14% out of 1.8 million metric tonnes.

*One operator operates a common warehouse system in the three countries.

+Figures for Malawi's two operators.

Smallholder Farmers and WRS in Ghana

Miranda et al. (2018) analysed several scenarios that smallholder farmers face with their produce in the context of WRS. They concluded that for the smallholder farmer to benefit from warehouse receipt financing, one of two things must happen: i) either smallholder farmers realise substantially higher price for their graded grain which is stored in commercial warehouse, or, ii) the cost of warehouse receipt financing must come down for the undertaking to be worthwhile to farmers.

Much earlier, the United States Agency for International Development (USAID) (2012) worked out a Ghanaian scenario in which a bag of 100 kg of maize was harvested and stored for six months in an accredited warehouse for a WR which was then used as collateral for a loan on which the lender pays prorated interest at the rate of 20% p.a. Then, after 6 months the maize was sold and loan and interest paid off. The going cost of transportation and applicable handling and storage costs were also paid.

Their analysis showed that if the bag of maize would have sold for GHS 35 (USD 12) at harvest, a price increase of 50% would be required at sale time to break-even. If the cost of the bag of maize at harvest was GHS 45 (USD 15), a price increase of 41.1% would be needed to break-even. Note that break-even price calculated here has not included a profit margin for the farmer. The main point here is that such high price increases are not common.

Collateral Management and Warehousing Costs

Historically, commodity financing has depended on collateral management agreements. Under these agreements, a third party who specializes in inspection

and control assumes control of the warehouse in which commodities are stored and monitors safety and quality of all stocks as well as goods received, and goods taken out. Unfortunately, the cost of doing this is high, to reflect the risks. Thus, use of collateral management services has been limited to transactions/commodities with high market values and has involved large and well-established counterparties.

For grains, warehousing costs include fees for sampling, grading, cleaning, drying, and bagging the grain on delivery, charges for pest and interest control, fumigation, use of electricity and use of warehouse space, charges for security, moisture monitoring and insurance. If the service is subsidized by government in a public warehouse, it does not take long for the quality of service to fall with time in many parts of Africa.

The International Finance Corporation (2013) discusses that the cost of collateral management services is relatively high in Sub-Saharan Africa. Unfortunately, financial institutions that finance warehouse receipts pay particular attention to collateral management arrangements.

This Study

This study identifies and documents details of WRSs in Ghana, Malawi, Zambia and Uganda. The rich evidence gathered in respect of Ghana, Malawi, Uganda and Zambia is analysed highlighting the challenges and positive evidence of WRSs in these African countries. The benefits of WRSs are realised when the traditional model of grading commodities that are received into storage, expensive collateral management and high the interest rates are not imposed.

Reference is made to maize much of the time for good reason. The International Institute for Tropical Agriculture reports that maize is “the most important cereal crop in sub-Saharan Africa (SSA) and an important staple food for more than 1.2 billion people in SSA and Latin America.” It is the main staple for over 300 million Africans, it adds. Over 30–50% of low-income household expenditures in Africa is spent on maize. Maize is rich in dietary fiber and other nutrients.

Methods

The approach adopted in this study was to review and analyse previous studies on the performance of WRSs and commodity exchanges to identify the basis for the findings in the literature and to recommend how to work on those challenges for WRSs to begin to unleash they promise they hold in Africa.

First, there was a search of the internet on the following key words and phrases and downloading same: *warehouse receipt systems in Africa; commodity exchanges in Africa; warehousing grains in Africa; warehousing maize in Africa; African warehouses for grains; trading grains in Africa; post-harvest losses in Africa; agricultural output in Africa; agricultural productivity in Africa; farm sizes in Africa, agricultural GDP in Africa, etc.*

Following this, downloaded articles, books and other publications were scrutinized for information and data relating to operation of WRSs in Africa. The following are noted: *types of grains deposited in warehouses for which warehouse receipts were issued; types of warehouse (commercial, government owned or community owned); how warehouses are managed; quantities (volumes) of grains for which warehouse receipts were issued and their market values; terms under which warehouse receipts were issued; whether depositors who were issued with warehouse receipts pledged them as collateral for loans; how depositors fared when deposited grains were finally sold and expenses incurred paid; whether storage was in accredited commercial warehouses for warehouse receipts; those who stored in non-commercial warehouses; those who sold all their grains at harvest (did not warehouse); proportion of depositors who pledged their warehouse receipts for loans; interest paid on loan; seasonal price fluctuations for various commodities over time, etc.*

Then, using pertinent data on the cost of maize, collateral management costs including grading cost and interest rates in Ghana and Uganda, several scenarios of outcomes realisable by farmers in each country were contrasted against the base case of the farmer selling all produce at harvest rather than storing harvest in a commercial warehouse.

Findings

Ghana

In Ghana today, the Ghana Grains Council (GGC) is one of two entities involved in the certification and regulation of warehouse receipt systems. The other is the Ghana Commodity Exchange (GCX). Each has its own WRS. The GGC introduced an electronic commercial WRS in 2012. The warehouses are usually found in urban areas. Alongside the commercial warehouses, the GGC also put in place community warehouses. Community warehouses are located in farmer communities and are much smaller than the commercial warehouses and are less equipped. The GGC is a private sector-led initiative, led by players in the grain business in Ghana. GGC was formed with funds provided by the United States Agency for International Development (USAID). GGC started by receiving only maize into storage.

Operation of Commercial Warehouse Receipt System in Ghana

A farmer seeking to deposit maize in a GGC registered commercial warehouse brings the maize to the premises of warehouse, where it is tested for its moisture content. If the content is no more than 13%, the maize is accepted for further processing, which includes removing all chaff and stones. The cleaned maize is then weighed and re-bagged into 50kg bags. However, 51 kg of maize are put into each bag to allow for weight loss during storage. The warehouse also ensures that

the maize that is received into storage is free of agrochemical contamination and its aflatoxin content is tolerable (not more than 15 parts per billion).

Samples of the maize just received are sent to the Ghana Standards Authority (GSA) for grading. The depositor receives a legal WR that bears the name of the depositor, location of the warehouse, number of bags and specific grade of maize stored and expected duration of storage. Maize received into GGC commercial warehouses may remain in storage for up to 5 months. The minimum quantity to deposit in the commercial warehouse is 5 metric tonnes (5,000kg). GGC initially attached to each commercial warehouse, a collateral manager who monitored activities that took place in the warehouse on daily basis to ensure that grains stored are not compromised. By 2021, GGC was operating 12 commercial warehouses with total storage capacity of 54,000 metric tonnes. To access credit, a depositor with maize in the commercial warehouse pledges the warehouse receipt to an interested financial institution as collateral against the stored maize.

Unfortunately, loans based on GGC warehouse receipts have been issued mainly to corporate bodies or large traders. The financial institutions have hardly done any business with smallholder farmers. In fact, an overwhelming majority of warehouse receipts have been issued by the certified warehouse operators to themselves. The warehouse owners then present receipts issued to themselves as collateral for loans (Mulangu et al. 2017).

Community Warehouses

Alongside certified commercial warehouses, the GGC maintains warehouses in farming communities for smallholder farmers and farmer groups in farming communities which are far from urban areas to store their maize, possibly as a first stop ahead of transferring to a commercial warehouse. Quantities as low as 500kg of maize are accepted into the community warehouses, whose capacity does not exceed 100 MT. Besides, the criteria for accepting maize into the community warehouses were nowhere as stringent as what is required of maize to be accepted into certified warehouses. Stocks of grains in the community warehouses are managed with local expertise. Some technical support may be provided by non-governmental development organisations, government agencies and/or private consultants. Depositors may be asked to make some financial contributions.

To give smallholder farmers who deposit their produce in the community warehouses some chance at accessing finance, the GGC works to link the community warehouses to commercial warehouses. The GGC oversees 22 community warehouses with total storage capacity of 2,480 metric tonnes. Formers who store their maize in community warehouses are likely to leave their maize in the community warehouse until the beginning of the next farming season.

Often, formers storing their maize in community warehouses work with a nucleus farmer, who is likely to move the grains to a commercial warehouse in his/her name. The nucleus farmer may then contract a loan. Borrowed funds are used to procure farming inputs for his/her out-growers to purchase improved seeds, fertilizers and insecticides. The nucleus farmer also arranges ploughing of the farmland of the smallholder farmers for a fee. Farmers also receive advice on agronomic practices to enhance their productivity. At harvest, the nucleus farmer

arranges transportation to the community warehouse and from there to accredited warehouses in the urban areas if need be. When an out-grower is ready to sell, the nucleus farmer buys the produce at market prices.

Ghana Commodity Exchange WRS

The second WRS in Ghana is overseen by the Ghana Commodity Exchange (GCX). Commodities are deposited in GCX certified warehouses which issue warehouse receipts. These may be presented as collateral for loans at designated financial institutions. For now, commodities are held in storage for three months only. Cash settlement is effected within 24 hours of trade. Buyers have up to 10 days to pick-up their purchases from the warehouses.²

Operation of both GCX and GGC WRS is enshrined in Ghanaian law, the Securities Industry Act, 2016 (Act 929). The law recognizes the warehouse receipts as financial instruments. The receipts are backed by insurance, performance bonds and indemnities. The GCX emphasizes the quality of management of warehouses that are affiliated with it. Warehouse management services include regular fumigation, regular stock taking, around-the-clock security and camera surveillance and readiness to mitigate losses which may arise from unforeseen occurrences.

In July 2021, the Chief Executive Officer of the GCX held a press conference at which she disclosed that “More than 250 smallholder farmers who trade on the Ghana Commodity Exchange (GCX) have used their warehouse receipts to access loans to finance their activities.” She did not give any indication about smallholder quantities or quantum of loans.

Commodity Prices and WRS

USAID (2012) reported on maize price fluctuations in Ghana (month-on-month) from 2003 through 2011. Further, the Ghana Ministry of Food and Agriculture (MOFA) (2020) indicated the price of maize in January and in July from 2015 through 2019. In addition, this author supplemented with 2020 and 2021 prices. MOFA works with the rule of thumb that prices for maize are lowest in January and highest in July reflecting demand and supply. The average of the annual price fluctuations between 2003 through 2011 was as high as 40.8%, while the average for the period 2015 through 2021 was only 10.7%, suggesting that price swings are narrowing.

Malawi

A study undertaken for IFPRI-Malawi in 2020 by Thunde and Baulch reported that the Agricultural Commodity Exchange for Africa (ACE) which currently operates only in Malawi is one of two warehouse receipt issuers in Malawi. The second is Auction Holding Commodity Exchange (AHCX). After some checkered history, ACE re-branded and re-started issuing WRs in 2011. AHCX started in 2013. Between 2011 and 2016, the number of warehouse receipts issued and

²<https://gcx.com.gh/services/>.

quantum of agricultural produce deposited by both certified warehouses, principally maize, grew.

Malawi passed their Warehouse Receipt Act in 2017 and subsequently issued a Commodity Exchange Directive in April 2019. Following the Directive, ACE and AHCX were licensed as commodity exchanges in 2020.

Thunde and Baulch lament the high cost of servicing loans received with WR pledged as collateral in Malawi. They add that this has adversely affected the development of Malawi's WRS. They point to domestic currency denominated commercial bank lending rates that were above 35% between early 2012 and end of 2016, which remained above 25% throughout 2018 and 2019.

Who Uses Warehouses in Malawi?

Another Malawian study for International Food Policy Research Institute (IFPRI) by Baulch (2019), documents that most reported trades involving Malawian grains were on behalf of processors of agricultural commodities and large national trading companies. The study points to a national survey conducted for IFPRI in July/August 2016 and repeated in August/September 2018, which found that no smallholder farmer had used the WRS. The study however found a small number of farmers associations/cooperatives and small traders who had been issued with WR.

Table 2. Warehouse Receipts by Type of Depositor, 2011-2018

Depositor Type	Number of WRs issued	% of Total WR	Number of Maize WR	% of Maize WR	Total Volume (MT)	% of Total Volume
Large Trader	194	27%	135	29%	8,048	67.2%
Medium Trader	128	18%	83	18%	1,435	12.0%
Medium/Large farmers	136	19%	90	19%	589	4.9%
Small Trader	189	27%	126	27%	1,315	11.0%
Farmer Group or Association	63	9%	30	6%	597	5.0%
TOTAL	710	100%	464	100%	11,985	100.0%

Source: Thunde and Baulch (2020). WR= warehouse receipt. MT= Metric tonne.

Further analysis of the Malawian WRS over the 2011-2018 period is provided by Thunde and Baulch (2020). Of the total of 710 WRs issued, Large traders and Medium traders, who typically supply grains to processors, as well as Medium/Large farmers were issued with 64% of total warehouse receipts, (Table 2). The interesting thing is that these three categories of depositors owned 84% of total grains deposited, of which maize is the largest by far.

Analysis of the data by grain is provided in Table 3. It says 54% of WR were issued to maize depositors. This represents 70% of volume of grains deposited.

Table 3. *Number of Warehouse Receipts Issued by Grain Type (2011-2018)*

Commodity	Number of WRs issued	WR with financing	% WRs Financed	Total volume of commodity, MT	% of total volume	Annual Average Volume, MT
Maize	464	252	54.3%	8,429	70.3%	1,053.7
Soya beans	136	63	46.3%	2,246	18.7%	280.8
Pigeon peas	84	52	61.9%	1,139	9.5%	189.9
Groundnuts	7	0	0.0%	33	0.3%	16.5
Beans	8	5	62.5%	87	0.7%	29.1
Cow peas	6	3	50.0%	35	0.3%	17.5
Other	5	3	60.0%	15	0.1%	4.9
Total	710	378		11,985	100%	

Source: Thunde and Baulch (2020). WR= warehouse receipt. MT= Metric tonne.

Profitability of Use of WRS

Smallholder farmers are rational. Thunde and Baulch (2020) observed and analysed a trading rule used by some farmer groups in Malawi. The rule was designed to reduce the storage and financing costs associated with WR yet positioning the farmer group to benefit from price increases. The rule works this way. *Half the group's produce was sold at harvest to meet immediate cash needs. The other half is deposited for a WR but the WR was not used for a loan. This half was earmarked to be sold when prices were higher.*

This rule was applied to an experiment involving several farmer groups for different grains in one growing season (21 contracts). Authors found that the mean and median profits of this group, who did not borrow against their WRs, were +12% and +22% respectively. On the other hand, the mean and median returns for the same 21 contracts for a control group who sourced financing using WR as collateral were -4% and -7% respectively. One surmises that the potential for profits using WRS exists but that financing costs are high.

Zambia

The Platform for Agricultural Risk Management (2019) reported that after going through some teething stages, the Agricultural Credits Act of 2010 was eventually enacted into law in 2014. The law created the Zambian Commodities Exchange (ZAMACE) as the 'authorised agency' of the Agricultural Credits Act with powers to create, manage and enforce a warehouse receipt system.

By 2019, eight warehouse operators had been licensed to operate 300,800 metric tonnes of certified storage space. Other warehouse operators in Zambia include Zambia National Farmers Union, Food Reserve Agency, Grain Traders Association of Zambia, and Millers Association of Zambia.

In another document, CUTS International (2018) states that for the 2016/2017 agricultural marketing season, ZAMACE traded only 12,000 MT of grains (valued at USD 3 million). For that season, Zambia's maize production was estimated 3.6 million MT. Unfortunately, in 2017/2018, ZAMACE traded only 4,000 MT. CUTS conjectured that, for ZAMACE's operations to be sustainable, it should be trading about 250,000 metric tonnes of commodities annually.

Smallholder farmers dominate Zambian agriculture, like many other African countries. Table 4 shows annual production for 2013/2014, 2014/2015/, 2015/2016 and 2017/18 and the proportions produced by small-scale and commercial farmers. By a wide margin, the bulk is produced by smallholder farmers.

Table 4. *Zambian Annual Production and Proportions of Smallholder and Commercial Farmers ('000 MT)*

Crop	2013/14	2014/15	2015/16	2016/17	2017/18	Smallholder %	Commercial %
Maize	3,350.7	2,618.2	2,873.0		2,394.9	95.6	4.4
Soya beans	214.2	226.3	267.5		302.7	39.9	60.1
Cotton	120.3	103.9	111.9		88.2	98.8	1.2
Wheat	201,504	214,229	-		114,463	19.1	80.1

Source: Platform for Agricultural Risk Management (2019).

The Platform for Agricultural Risk Management stresses that because the collateral management system in place was based on the Agricultural Credit Act of 2010, receipts issued by licensed warehouses could not be traded. However, since February 2020, the law has been amended to now allow for trading of receipts. However, before the amendment, commercial farmers could access finance using their own receipts as collateral.

Costs to Warehouse Operators

ZAMACE derives its revenues from annual Warehouse Operator Certification fees (for operators) and annual Warehouse Certification fees (for warehouses). It also charges for issue of warehouse receipts, for changes in warehouse receipt ownership and for pledging of receipts for loans.

Interestingly, the structure of the fee system is such that large-scale and medium-scale warehouse operators benefit from economies of scale. To illustrate, a large-scale operator who has five warehouses that together have capacity for a total of 50,000 MT pays about USD 0.03 per MT as licensing fee. A medium-scale operator who has three warehouses that together have capacity for a total of 20,000 MT pays about USD 0.05 per MT. However, a small-scale operator with one warehouse that can store 200 MT pays as much as USD 2.92 per MT as licensing fee.

Another level of costs are charges that certified and non-certified warehouse operators charge depositors. Both charge for handling and storage, but in addition certified warehouse operators charge about USD 1 per MT for issuing warehouse receipts.

Uganda

The Ugandan Warehouse Receipt System was established in 2006. The law guiding its operations is the Warehouse Receipt System Act of 2006. The act provides for the body that will license warehouses, license warehouse keepers, license warehouse inspectors and for the issue warehouse receipts to depositors. Unfortunately, things did not take off satisfactorily. In 2017, the government

decided to re-launch the whole initiative under the 2006 law under the Uganda Warehouse Receipt System Authority established earlier in 2015 to drive the new WRS initiative. Katunze et al. (2017) stated that their findings suggest that in spite of challenges, actors within the revamped WRS were “optimistic that reinstating the WRS will lead to better access to markets and credit.” The study noted however that, dealing with two grades of maize, Grade I and Grade II was causing some confusion in the marketplace.

Ethiopia

In 2008, several international donors including United Nations Development Programme, USAID, and the World Bank helped fund the establishment of Ethiopian Commodity Exchange (ECX). The ECX initially focused on grains, but coffee and sesame seeds were soon added and have become the major commodities traded. Available data indicate that ECX volume of commodities traded in 2008/2009 was 48,000 MT; 222,000 MT in 2009/2010; 509,000 MT in 2010/2011, 593,000 MT in 2011/2012 and 590,000 MT in 2014/2015. This exchange is cited as doing well, second only to South Africa, on the continent, but their performance data are not readily available.

Discussion

Having presented an overview of the state of WRSs in a number of African countries, the state of African agriculture and variables that have bearing on successful WRSs or otherwise are now analysed.

The State of Agriculture in Africa

To buttress the point on the state of agriculture in Africa, reference is made to the findings of Ghana’s agricultural census conducted over 2017/2018 as a case study for Africa (Ghana Statistical Service 2021). Salient findings are: agricultural activities are mainly rural and rudimentary with little innovation and modernisation in the sector; little use of modern tools such as tractors, incubators, hatching and milking equipment; practically dependent on rain; most farmers do not use fertilizer; pesticides use is highly prevalent; the level of formal education among farmers low; most farmers produce for their own consumption; individuals cultivate less than two acres; and the youth are not attracted to agriculture.

Jayne et al. (2016) studied farm sizes in Africa and reported that, in Ghana in 2012, 84.5% of farms were less than 5 hectares in size; in the same year in Tanzania, 91.4% of farms were less than 5 hectares; in Zambia, in 2014, 78.7% of farms were less than 5 hectares and in Kenya, in 2006, 98.8% of farms were less than 5 hectares.

Also, within the typical African country, the connectedness of cities to towns to villages and to smaller communities is weak. Roads are the main modes by which to get from one place to the other. Unfortunately, in many countries, the

roads have been deteriorating. And this constitutes a barrier to trade and weakens the supply response to rising food demand.

Given this uninspiring state of affairs, African farmers' capacity to produce quantities that will promote other value-chain activities is low. The consequence of all this is that the surplus of the output of smallholder farmers is unlikely to meet the minimum quantities the commercial warehouses will accept into storage.

Use Versus Grading of Maize

A working rule of thumb about how the maize produced in Ghana is used was confirmed by USAID (2012). This rule of thumb was used by the Miranda et al. (2019). It says about 45% of maize produced in Ghana is used as subsistence consumption by households that produce it. Post-harvest losses are also included in this figure; 23% is used as animal feed, mostly poultry; 18% is informally traded and consumed by non-producing households. The remaining 14% is formally traded and bought by processors for industrial use and processed food producers.

The situation in Ghana and many African countries is that marketed maize for private household consumption is not graded to segregate quality. Households have found the quality of ungraded maize acceptable. It will be a huge challenge to convince households to pay premium for higher quality maize for household consumption. Next, the bulk of maize for animal feed is fed to poultry. This maize has also not been traditionally graded to segregate quality. Livestock farmers are unlikely to be willing to pay for high grade maize just to feed animals.

Then, about 25% of marketed maize is used by breweries, beverage producers and the packaged food industry. White maize grits used by breweries faces keen competition from local sorghum producers and imported barley. As such, breweries are also unlikely to pay more for higher grade maize. Beverage producers use maize in the form of corn syrup. This must compete with locally produced sugar or imported sugar. Thus, beverage producers too are unlikely to pay more for syrup extracted from higher grade maize.

However, the packaged food industry which targets the high-end consumers (subsidiaries of Nestlé S.A. of Switzerland, etc.) and the export market may benefit from grading maize. This category of users may be prepared to pay a premium for higher quality maize. In fact, they are likely to gain a marketing edge if they market their products as having been made from higher quality maize.

Some Scenarios that Ghanaian and Ugandan Smallholder Farmers Face

Table 5 presents realistic hypothetical scenarios of possible outcomes that maize farmers in Ghana and Uganda face when the store maize in commercial warehouses. These scenarios borrow from Miranda et al. (2019) for Ghana and International Finance Corporation (2013) and Katunze et al. (2017) for Uganda. The cost of handling and processing grain to meet regulatory standards for issue of warehouse receipts and storage costs are estimated at 30% of the value of the farmgate price in Ghana; 27% for Uganda. If a commercial loan is taken with the

WR, additional 10% is paid in Ghana as interest (5 months storage); 4% in Uganda (3 months storage). Historical price volatility in Ghana is 40%; 50% in Uganda. An unusual price rise of 50% may be realised in Ghana (Ministry of Food and Agriculture (2020); 70% in Uganda (Katunze et al. 2017). This is akin to earning a premium on graded maize – scenario (7). Scenarios involving no grading of maize and no interest on loans are informed by Safo (2017).

The base case is a smallholder farmer who harvests 100 kg of maize and sells it (no storage). Alternatives scenarios (2) to (7) are spelt out in Table 5.

The third and fourth columns of Table 5 rank the outcomes of the scenarios. In Ghana, the farmer fares best when he/she does not grade nor take a loan against maize stored in the commercial warehouse - scenario (6). Practically, for most applications, grading does not attract a premium in the marketplace. The farmer fares worst under scenario (1), when he/she sells proceeds at harvest and invests proceeds in treasury bills. In Uganda, the farmer fares best if he/she stores maize in the warehouse, for three months and pledges the WR for a loan but realizes an unusual price increase. The Ugandan farmer fares worst when he/she pays full collateral management fees and pledges the WR for a three-month loan.

Table 5. Seven Scenarios Investigated for Ghana and Uganda. Usual Historical Price Increase: 27% for Ghana and 35% for Uganda Above Prevailing Price at Harvest Time, Except Scenario (7)

Scenarios	Details of scenario	Ranking of outcome	
		Ghana	Uganda
(1)	Sell all produce at harvest and invest in treasury bills (16% p.a. in Ghana; 14% in Uganda)	7th	6 th
(2)	Store the maize on the farm and lose 20% to shrinkage, pests, etc. Such does not qualify for a loan.	2 nd	3 rd
(3)	Farmer stores the maize in a commercial warehouse and bears transportation, handling including grading costs and takes a loan with the warehouse receipt.	6 th	7th
(4)	Farmer stores the maize in a commercial warehouse and bears transportation, handling including grading costs but takes no loan	4th	5th
(5)	Farmer stores ungraded maize in a commercial warehouse. Bears only half the handling charges but takes a loan so pays interest	3rd	4 th
(6)	Farmer stores ungraded maize in a commercial warehouse. Bears only half the handling charges and takes no loan, so pays no interest	1st	2nd
(7)	Maize is graded, a loan is taken, and the farmer realized a huge price increase of 50% in Ghana and 70% in Uganda above the price at harvest time.	4th	1st

Source: Author's construction.

The outcomes of the scenarios for the two countries are different. Analysts should bear this in mind. The crux of the matter is that grain storage in anticipation of high enough price to make a good profit is speculative business. If in addition, a smallholder depositor must borrow with WR as collateral, he/she would be up against seasoned lenders who would cover themselves either by charging high

interest or granting loan amounts that are well below the current face value of the receipts such that even if prices fall, the collateral represented by the warehouse receipts will likely remain valuable. Cost of grading and loan interest payment are a disincentive to a rational farmer.

Community Warehouses Come in Handy

As part of his PhD thesis, Safo (2017), administered structured questionnaires to 400 smallholder individual maize farmers in northern Ghana who had grown maize during the 2014/2015 cropping season. 141 of the farmers participated in the community WRS (overseen by GGC), 259 did not. Farmers who participated in the community warehouse receipt system reported that they stored an average of 17 bags maize (110 kg per bag) for an average of five months. They paid a storage fee of GHS 1 (USD 0.35) per bag. They were however allowed to withdraw part or all their produce from the warehouse anytime they wanted.

The community warehouse neither grades nor insures the maize. Only 2% of the participants in the WRS issued by the community warehouse reported that they experienced some post-harvest losses. The mean number of 110 kg bags realized by WRS participants was 29.6, while non-participants realized only 16.1 bags. The difference in these means was statistically significant at the 1% marginal level. The explanation is that WRS enhanced access to inputs.

Also, there were differences in the prices that the two groups realized when they sold their maize. WRS participants realized a mean of GHS 135.5 per bag (USD 35), while non-participants realized a price of GHS 103.6 (USD 29). The difference in the two means is once again statistically significant. Here, non-participants sold earlier after harvest than participants.

Thus, on both scores, quantity produced and price at which produce were sold, WRS participants fared better. But to speak of profitability, one must now consider the costs that were incurred, which data was not available.

Table 6. Profitability when Warehouse Receipt is Pledged as Collateral for a Loan, 2011 to 2018

Panel A: Warehouse storage with financing			
Commodity	Number of WR	Profit/Loss	
		Mean	Median
Maize	270	-7.4%	-6.2%
Pigeon peas	52	-81.5%	-115.8%
Soyabeans	63	6.5%	11.5%
Panel B: Warehouse storage without financing			
Commodity	Number of WR	Profit/Loss	
		Mean	Median
Maize	194	14.2%	5.6%
Pigeon peas	32	-7.8%	-0.8%
Soyabeans	73	0.1%	0.0%

Source: Thunde and Baulch (2020).

Malawi

For Malawi, indication of the profitability or otherwise of the country's WRS is obtained from two tables provided by Thunde and Baulch (2020). Table 6 speaks to the profitability or otherwise of using warehouse receipt for maize, pigeon beans and soya beans as collateral for loans for the 2011 to 2018 period.

Table 6 says, over the entire period, the average maize depositor who used his/her warehouse receipt to obtain a loan lost 7.4% of the harvest value of maize. Pigeon peas lost even more. There was however a positive profit to using soya bean warehouse receipt as collateral.

Of those who stored their grains in warehouses but did not pledge their warehouse receipts as collateral for loans, maize depositors realized a mean positive return of 14.2% of the price of maize at harvest. Pigeon peas receipts lost money but only about one-tenth the mean loss suffered by those who took loans. Soyabeans broke even.

Thunde and Baulch (2020) also reported that of the 710 warehouse receipts issued by ACE between 2011 and 2018 (Tables 2 and 3), depositors made profit on only 48% of them. For all warehouse receipts, they found that profits and fewer losses were associated with shorter periods in storage. Commodities for which warehouse receipts made profits were in store for 5.5 months on average, whereas, those that made losses were in storage for an average of 7.5 months.

Senegal

Senegalese evidence is interesting. Adjognona et al. (2020) report the results of an experiment involving 1,079 rice farmers, of whom 363 were offered access to WRS. Only 2% took-up the offer. Of those who did not take-up the offer, 48% cited high transaction costs as their reason, 43% said they did not have any rice leftover to put into warehouse storage, 2% said they were not convinced that they will realise a satisfactory price if they put their rice into storage and 7% cited other reasons. This finding emphasizes the fact that farmers are rational and have a sense of how the WRS works. It is also an admission that their outputs are low.

Community Warehouses Come in Handy

Evidence provided by Safo (2017) in respect of use of community warehouses is very instructive. 2% post-harvest losses reported by participants suggests that these warehouses maintain quality and quantity pretty well. That, patrons pay as little as USD 0.35 per 100kg bag stored makes this fee affordable to smallholder farmers. This fee is affordable because the community warehouses are not maned by expensive collateral managers. Handling charges too are low.

Concluding Remarks

This review has revealed that use of warehouse receipt systems involving commercial accredited warehouses in many African countries has not succeeded in serving the purpose of enhancing smallholder farmer's liquidity during lean seasons. This is due principally to the fact that the price at which maize is sold during the lean season does not, on average, cover the relatively high cost of commercial warehouse handling, grading, storage and loan interest payments if loans are taken. However, the story has not been all doom and gloom. A number of bright spots have been revealed by all the Ghanaian, Malawian and Ugandan case studies.

The price at which warehoused maize is sold in the lean season is not high enough to ensure profitability of smallholder farmers principally because consumers do not, in general, pay premium for maize that is graded as high quality. In fact, for most applications/uses, premium quality maize is not demanded. Counting costs, convenience and required minimum quantities, certified warehouses should be targeted at large depositors and exporters, not smallholder farmers. For the smallholder farmer, the community warehouse provides an acceptable solution. They may not be "high class" storage facilities, but they serve the needs of smallholder farmer.

Direct dealings with financial institutions appear not to have benefited farmers much. But alternate arrangements that enable farmers to access seeds, fertilizer, insecticides, etc. exist. For example, as out-growers of nucleus farmers who are linked to accredited warehouses. These should be encouraged.

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