

The challenges of managing agricultural price and production risks in sub-Saharan Africa

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ESA Working Paper No. 14-09

June 2014

Agricultural Development Economics Division

Food and Agriculture Organization of the United Nations

www.fao.org/economic/esa



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Food and Agriculture Organization of the United Nations, Rome, 2014

Recommended citation

Antonaci, L., Demeke, M. and Vezzani, A. 2014. *The challenges of managing agricultural price and production risks in sub-Saharan Africa*. ESA Working Paper No. 14-09. Rome, FAO.

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L. Antonaci, M. Demeke and A. Vezzani

Abstract

Agricultural production is prone to several risks which affect both producers and consumers. In order to enhance investment and achieve a sustained increase in production, coherent and integrated long-term strategies and policies are required to reduce risk aversion and build resilience among African rural producers. Furthermore, the critical importance of social protection and its complementarity to risk management initiatives must be recognised. This paper investigates possible tools and instruments to deal with various production and price risks. Market-based approaches are crucial for risk management options to thrive, but the country experiences examined have highlighted that most of the risk management instruments are not in place or are not fully developed in Sub-Saharan Africa. Farmers are not protected against production and price shocks and this underscores the critical role of governments in agricultural risk management. In view of the high correlation between production, price and market risks, African governments need to adopt an integrated and holistic approach in support of risk management interventions through incentives and by strengthening agricultural markets and financial institutions. Risk management tools need to be mainstreamed into agricultural policies and programmes as currently advocated by the New Partnership for Africa's Development (NEPAD) Planning and Coordination Agency (NPCA).

Key words: food, risks, price, production and management

JEL codes: D81, Q18, E64

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Acknowledgments

The study is funded through the EU/FAO Improved Global Governance for Hunger Reduction Programme. The authors are grateful for the valuable comments received from Dominique van der Mensbrugge, Jamie Morrison, Luca Russo and Franck Galtier. Special thanks go to Luca Russo for his support and encouragement as well.

1. Introduction

Firms operating in the agricultural sector face risks that are specific to this branch of the economy. Agriculture is not only prone to input and output price variability, but it also faces high financial risks resulting from the peculiarity of the production cycle. Given the long time span between the beginning of the production cycle (sowing) and the marketing of the output, farmers are exposed to output price risks and financial constraints. This peculiarity can result in insufficient cash being available to satisfy basic needs and to pay for production expenses, such as inputs. The lack of well-developed financial systems exacerbates these circumstances resulting in insufficient liquidity, loss of income and high interest rates. Moreover, agricultural producers have to deal with risks associated with negative outcomes mainly deriving from extreme weather shocks, such as drought, floods or cold waves. Finally, biological factors, such as insect pests, and crop and livestock diseases, are recurrent events affecting agricultural production. A widely recognized feature of such threats is their spatial correlation. Indeed, climatic and biological events normally hit the overall farming population of a certain area and this has serious implications in how to deal with agricultural risks.

Production risks are highly interrelated with price and market risks. This means that the variability in production can result in high food price instability; the less the markets are integrated with each other, the higher the price instability stemming from variability in local production. On the other hand, in well-integrated markets, price risks are easily transferred from one area to another. The downside of a well-integrated market is that price risks could more extensively affect producers. In fact, prices in integrated markets depend on global supply that can be negatively correlated to those of a specific area, thus leaving producers with no compensatory price effects. By contrast, in poorly integrated markets, production shortages result in higher prices that may compensate producers from production losses but, at the same time, negatively affect consumers.

In order to cope with various price and production risks, farmers in developing countries normally engage in informal risk management mechanisms, ranging from income diversification activities and production strategies to common risk sharing mechanisms based on kinship and social networks. However, these traditional risk management methods tend to fail in the presence of larger shocks affecting wider areas. Evidence suggests that without formal risk management, less risky and less profitable farming practices are adopted, resulting in lower productivity. Rashid and Jayne (2010) highlighted that farm income would increase by 30 percent if effective risk management strategies are used.

Formal risk management strategies have been classified by the World Bank (2005a) into two broad categories: ex-ante and ex-post strategies. This classification reflects the moment in which the reaction to risk takes place. However, in recent years the understanding of risk management has shifted towards approaches focusing not only on recovery (ex-post), but also on prevention (ex-ante). As a result, many of the tools that fall under the ex-post classification, such as disaster management, have increasingly included ex-ante features, such as prevention and preparedness; thus blurring the effectiveness of such a classification.

This paper is not a comprehensive review of all existing risk management tools in agriculture, but it aims to capture the most significant ones and document experiences in

several African countries. The objective is to identify major challenges and opportunities that will contribute to designing a policy framework for the mitigation of the negative effects of volatile prices and production shocks.

The first section examines tools that deal to a greater extent with price risks. These include warehouse receipt systems; commodity and futures exchanges; agricultural information systems; contract farming; grain stock management strategies and trade policies. The second section focuses on options to primarily reduce production and yield variability, describing financial markets as efficient services to rural communities in case of shocks, modern types of insurances as valuable risk sharing mechanisms, new technologies to increase and stabilize farm and off-farm incomes, and farmer safety nets programmes to enhance input use among the most vulnerable producers. The last section discusses measures to protect consumers against both price and production risks.

2. Options in reducing price risks

Following the peak of the 2007/08, commodity markets have generally experienced high and volatile prices. Increasing demand of grains for food, feed and bio-energy, coupled with a slow growth in agricultural productivity, are likely to continue putting upward pressure on prices and generate more volatility (OECD-FAO, 2011). This new market environment has catalysed a flurry of research on the approaches to stabilizing food prices. According to Galtier (2009), responses to price volatility can be grouped into those stabilizing prices and those reducing the effects of price instability. For each type of response, two possible interventions are available: market-based and government-based ones. The combination of these two dimensions (responses and interventions) gives rise to four different options to deal with price instability.¹ Each option is more suited for different stages of development.

According to the World Bank (2005), on the other hand, best practices for risk management and price stabilization policy should focus on long-term investments to increase the role of the private sector and build confidence in a market-based approach (Byerlee, Jayne and Myers, 2005). Increased investment and more stable production, together with free-trade policies, would decrease market volatility. However the price spikes of 2007/08, and the increased international price volatility, challenged the underlying assumption that world market volatility is less than the domestic sourced one (Abbot, 2012). In response to the price crisis, governments commonly pursued short-term measures to mitigate the effects of world price shocks on domestic markets. All-in-all, excesses of volatility observed in recent years have reinforced the argument that public-private partnership is essential for price risk management tools such as warehouse receipt systems, commodity exchanges and contract farming to thrive with the support of agricultural information systems, grain stock management and trade policies.

¹ The four different options are: *Category A*: market-based approaches to stabilize prices; *Category B*: market-based approaches to reduce the effects of price instability; *Category C*: public approaches to stabilize prices; and *Category D*: public approaches to reduce the effects of price instability.

2.1 Warehouse receipt systems

Warehouse receipt systems (WRS) are a relatively modern risk management tool, instrumental in reducing price volatility. This policy option is gaining momentum as a credible instrument within the development community thanks to its potential in the overall development of the agricultural sector. Warehouse receipts are certificates, issued by warehouse operators to depositors, which provide proof of ownership on a certain commodity deposited in a particular warehouse. WRS facilitate private storage and provides receipts in exchange of stored commodities. This mechanism offers storage facilities which protect farmers from seasonal price risk variability by giving them the opportunity to store their product and sell it during favourable price periods.

WRS can be designed in several ways; however a significant difference in their operational functioning depends essentially on how receipts are conceived. They can be transferable or not: in the first case they can be sold,² while in the second they can be used as proof of collateral for loans. In this case, WRS allow farmers to access formal credit markets by offering a collateralization service which is generally based on a tripartite agreement involving a financial institution, the borrower (the depositor) and the collateral manager (the warehouse operator). On the other hand, when the receipts are transferable, they foster impersonal trade avoiding the high transaction costs which derive from moving commodities before the transaction takes place (this is particularly true for those experiences based on electronic receipts). This reduces the inefficiencies typical of African agricultural markets, such as high transaction costs and imperfect commodity information. Poor rural transport infrastructure is one major driver of high transaction costs which hamper farmers from accessing markets far from production areas. This results in lower selling prices in production areas and higher purchasing prices in deficit areas. Besides these direct benefits, WRS can play an important role in introducing other market innovations, like commodity exchanges, for which WRS provide a mechanism for delivery against exchange contracts (UNCTAD, 2009).

Well-functioning WRS are based on clear definitions of crop quality and quantity, where the warehouse operator is able to guarantee stored products based on agreed standards. This resolves information uncertainties, a common feature in rural/informal trade in agricultural commodities. However, the lack of grading standards in many African countries hampers the adoption of such a tool as well as other innovative risk management market tools. From a large-scale buyer's point of view, lack of grades and standards raise transaction costs, limiting trade with small-scale traders/farmers; Onumha (2010) reported that the uncertainty surrounding the quality of maize supplied by smallholders in Zambia causes a price discount between 10 and 15 percent.

The implementation of WRS implies overcoming some difficulties and challenges which are mainly related to the institutional framework in which the system operates. First of all, it requires an enabling policy environment, whereby the government does not intervene with ad-hoc measures on basic crop markets. For instance, a food price stabilization policy may

² In this case, the property rights of the commodities are transferred free of any outstanding claim not reported on the receipt (e.g. outstanding storage charges), resulting in an exchange of the title of ownership over the underlying goods.

provide a disincentive for private agents running WRS in storing grain to minimize inter-season price variability. Furthermore, to fully exploit its potential, a WRS requires the existence of a well-developed financial market and a stable legal environment enforcing execution of contracts.

One example of these constraints is offered by the experience of Zambia in implementing the Zambia Agricultural Commodities Agencies Ltd. (ZACA). ZACA's demise was mostly determined by management difficulties (UNCTAD, 2009). First, continued government intervention in input markets, and increasingly in output markets, dampened incentives for private storage. Second, a general lack of supportive legislation kept banks from participating in the system. Finally, ZACA was not able to attract some key stakeholder groups; in fact, large traders did not perceive the initiative as profitable, whereas small farmers encountered some constraints to participating in the system. (In 2004 to 2005, the most successful year before ZACA collapsed and the new private-sector based Zambian Agricultural Commodity Exchange (ZAMACE) took over, smallholder groups deposited less than six percent of the total crop deposited (3,764 tonnes) and most of the stock came from commercial farmers).³

Evidence from the United Republic of Tanzania has shown mixed performances in the implementation of WRS: a more successful experience has been in the export cash crop sector, whereas a less successful one in the grain sector, particularly maize. As reported in the UNCTAD's 2009 "*Review of Warehouse Receipt System and Inventory Credit Initiatives in Eastern & Southern Africa*": the Government of United Republic of Tanzania began regulating WRS in 2005, registering some 20 warehouses, mainly for cashew and coffee, and, to a lesser extent, cotton and grains. The main reason for the varying extent of success between export crops and maize can be traced to the government approach towards these markets. Maize markets are extensively subject to policy interventions, mostly banning exports, which tend to undermine private incentives and make price movements difficult to forecast. On the other hand, coffee, cashew and paddy rice markets, mostly produced for export, are less subject to government interventions. Moreover, the coffee WRS took advantage from the already established Moshi Coffee Auction (MCA), being able to channel 20 to 30 per cent of exports through the system. Strong producer organizations (such as farmer business groups and cooperatives) were able to take advantage of the system, bulking on behalf of their members. The success of the WRS initiatives attracted banks in providing inventory finance against coffee stocks, facilitating access to finance for coffee producers.

The difficulty of setting up WRS for grains compared to export cash crops, such as coffee, is highlighted also by the Ethiopian experience. In Ethiopia, a warehouse receipt system was introduced in 2003 by the Ministry of Trade and Industry. Nonetheless, the absence of institutions supporting the system undermined its functionality. In 2010, the Ethiopian Commodity Exchange (ECX) launched a warehouse receipt financing system to allow producers and traders of agricultural commodities to access bank loans. This provides a guarantee as the warehouses are insured at maximum coverage to protect against loss and damage of deposits and it is certified by the accepted industry grades and standards reported on the receipts. However, this service mostly focuses on export crops such coffee and sesame.

³ The six percent is calculated starting from figures reported in UNCTAD 2009.

The exclusion of smallholder farmers from WRS has encouraged development partners to establish inventory credit systems projects targeting farmer groups. One example in West Africa is the so-called *Warrantage System* which has been developed in Niger.⁴ The project helps rural farmers to access bank loans in return for storage of their produce in a community-based warehouse. Once the harvest is stockpiled in the warehouse, the producer organization obtains a loan from a microfinance institution and distributes it to its members on the basis of their share of the total stored commodity. Loans are granted on a short period of time (four months), and represent up to 70 percent of the commodity stored, with a relative low interest rate (about 2.5 percent a month). In order to reinforce the trust linkages, the depots are locked with two keys held by the bank and the producer group. The project represents an interesting alternative to foster inventory credit at community-level. A study of the project by IFPRI in 2008 found that participating farmers have managed to significantly increase their income, thanks to improved access to higher-quality seeds and fertilizer (Pender *et al.*, 2008).

All-in-all, the most successful experiences of WRS in Africa are those for export cash-crops, such as coffee. Underlying preconditions for effective implementation of WRS can be summarized as: low and predictable government intervention in the market; supportive legislation and legal environment which involve financial institutions that guarantee contract enforcement; well-established standard and quality measurements; and strong producers' organizations which allow for a high rate of inclusion. In particular, a major challenge facing WRS is the minimum quantity requirement which hinders the access of smallholders and small traders to the system. Therefore, smallholders do not directly benefit from WRS, but they can always take advantage of declines in seasonal price variability derived from a widespread use of the system. One method to gain direct access is through smallholders' associations/cooperatives which bulk produce to meet the minimum quantity needed to access the WRS. The participation of farmer associations and cooperatives could help storage activities become more competitive and efficient.

2.2 Commodity exchanges

Evidence from more developed countries suggests that commodity exchanges are the best options to deal with price risk and market uncertainty. A commodity exchange is one of the pillars on which developing countries could rely to foster a long-term market-based approach. A commodity exchange is a market where commodity-linked contracts are traded on the basis of rules and procedures determined by the exchange; furthermore, by allowing multiple buyers and sellers to trade in the same 'location' (marketplace), it simplifies title transfers, increases market transparency and performs the 'price discovery' mechanism. One interesting feature of the commodity exchange is claimed to be the reduction of transaction costs faced by agents involved in the commodity supply chains. The most typical contracts traded include spot prices, forwards, futures and options. The last two dominate in developed countries' exchanges and in an increasing number of developing countries. That said, it must be noted: in order to guarantee well-functioning commodity exchanges, several conditions are required. Among others, a huge amount of liquidity in the market ensures that no actor has the capacity

⁴ FAO 2010: Warrantage scheme boosts Niger farm incomes. Available at: <http://www.fao.org/news/story/en/item/40281/icode/>

to influence prices; that is far more critical when markets do not involve physical movements of commodities exchanged, such as in futures and options contracts.

Futures (and options)⁵ contracts are normally used to reduce price risks associated with trade. A futures contract is an agreement between two parties to exchange a specified commodity of standardized quantity and quality for pre-agreed price with delivery occurring at a specified date in the future. Producers (and traders) can reduce their portfolio risk by taking futures positions. For example, a trader who buys a physical commodity (at a spot price) to sell it at a future date, can concomitantly sell a futures contract in order to hedge his/her cash position. When spot and futures prices are positively correlated, being a seller and buyer on the two markets (spot and futures) at the same time, protects the agent from price deviations. Futures and options contracts are normally traded during their life period without concurrent movements in the physical markets; in order to guarantee such contracts a supportive legislative system and rigorous financial institutions are required.

In Africa, commodity exchanges are not very common. In the 1990s, despite the market liberalization wave, few countries tried to implement agricultural commodity exchanges. Except for South Africa, which managed to set up a well-functioning and sustainable exchange, most countries failed in developing such markets. A number of factors, including small market sizes, infrastructural and institutional bottlenecks, and government interventions, have hampered the success of commodity exchanges in Africa. For instance, excessive price movements drove governments to intervene in commodity markets, leading to the consequent suspension of the first experiences of exchange markets in Zambia and Zimbabwe (Rashid 2010). Zimbabwe closed its Commodity Exchange in 2001 when the Government gave the monopoly on corn and wheat trading to the Grain Marketing Board (GMB). The new Commodities Exchange of Zimbabwe (COMEZ) was opened in 2011 to end the GMB monopoly; however, the State continues to play a strong role in the market.

The high potential of commodity exchanges motivated donors, like USAID and WFP, to support new initiatives and revitalize African markets. These new initiatives, such as the Malawi Agricultural Commodity Exchange (MACE), the Agricultural Commodity Exchange for Africa (ACE), the new Zambia Commodity Exchange (ZAMACE), the Ethiopian Commodity Exchange (ECX), the Kenyan Agricultural Commodity Exchange (KACE) and the Uganda Commodity Exchange (UCE) aimed to set up or revitalize a series of commodity exchanges, but remain limited to spot markets. As reported by Robbins P. (2011), it seems that these new schemes do not function well and are not sustainable without donor funding, with the only exception being Ethiopia where it is mandatory for exporters to use the exchange.

Evidence from most of African commodity exchanges suggests that the critical mass of exchange has not been reached. For instance, the KACE and the UCE were not able to attract enough trade volumes to be sustainable. KACE failed to establish a commodity exchange and thus focused on the collection and dissemination of market information; it, therefore, performed mainly as a market information system. On the other hand, funding for the UCE

⁵ Differently from futures, options give the right, but not the obligation, to buy or sell the underlying asset at a price (strike price) specified in the contract. Options can be seen as a sort of price insurance, where the price of the option is the premium paid in order to assure a minimum return, reducing price risk.

has ended and it is not certain whether it will receive further funding. Apparently, the government is trying to borrow funds from the World Bank to finance its operations (Robbins, 2011). Given the small market size which hampers the implementation of commodity (futures) exchanges in many African countries, some case studies investigated the hedging potential for agents in those countries represented by futures and options contracts on foreign exchanges such as the South African Futures Exchange (SAFEX). For example, Dana, Gilbert and Shim (2006) pointed out that hedging maize imports into Malawi and Zambia on SAFEX could be an effective risk management strategy. However, government interventions in grain markets and limited external trade, especially during periods of high price volatility, represent a major barrier to such hedging strategies by increasing the risk of default of national traders active on international markets.

SAFEX offers an example of the level of trade in a successful commodity exchange. The total value of futures and options traded in March 2012 was 3.9 billion USD with an average share of physical deliveries well below four percent (the rest are future contracts).⁶ Whereas, ZAMACE's traded value between October 2007 and April 2010, was reported to be about 600,000 USD per month. Between April and December 2008, the Ethiopian Commodity Exchange (ECX) traded, on average, less than 100,000 USD per month of maize, wheat, and beans. (Rashid S. *et al.*, 2010). Unable to make ECX workable through trade in primary cereals, the government of Ethiopia, at the beginning of 2009, imposed the use of the new exchange on coffee traders, suspending the already well-functioning coffee auction floor. The government has then decreed that other mainly exported commodities (sesame and haricot beans) have to be exported exclusively through the exchange. On the other hand, it has not yet been able to channel maize, sorghum and wheat exchanges into the exchange market because of the difficulties of controlling commodities traded on local markets (Robbins P. 2011).

As shown by the Ethiopian experience with the coffee commodity exchange, a well organized and structured market is a precondition of a successful implementation of commodity exchanges. Moreover, an adequate environment should include certainty about the availability of a specified commodity in a particular place and date. Indeed, standards of quality are necessary conditions together with storage facilities, such as warehouses. The institutional environment must also guarantee a reliable banking service together with a strong legal framework to enforce commercial law and contracts. Trade at a futures exchange requires a communication network that can provide traders with spot market information in order to estimate the basis. Ideally, the physical and communication infrastructure will ensure that information on product quality, quantity, and price in all relevant markets is available across various spot markets. In the absence of well-functioning infrastructure, price discovery in the spot markets may be unreliable. As a consequence, futures exchanges will be inadequate for managing price risks. As pointed out by Rashid *et al.* (2010), available data suggests that the lack of physical infrastructure may be a major constraining factor in many African countries.

⁶ SAFEX Commodity Derivatives Monthly Update (March 2012).

Besides resource and knowledge constraints, one major weakness of these countries is the capacity to channel domestic trade through the commodity exchanges. Among others issues, smallholders face a major hurdle: the minimum commodity amount that is required to trade in such markets. The high volumes underlying futures contracts require a farmer operating on a medium- or large-scale: some 21.5 and 48.1 hectares for wheat and maize respectively are requisite in Africa⁷ in order to meet the production traded in one contract.⁸ Clearly, small farmers and traders would be excluded from such contracts; some kind of product aggregation is therefore required to directly involve them in the system. In the absence of strong producer organizations, this is difficult to be forecast. Commodity exchanges are indeed better suited to large-scale farmers and traders. However, small farmers and traders could still indirectly benefit from commodity exchanges by taking advantage of features such as the price discovery mechanism. This is possible when strict linkages between local spot prices and a national commodity exchange facilitate the integration of local markets and provide information on prices, quantity and quality of commodities traded at a national level.

2.3 Contract farming

Contract farming is intended to solve the problems of an imperfect product market, price uncertainties and credit market failures. A contract agreement obliges farmers to supply their product to agro-enterprises or other users. The contract often includes a pre-agreed price, quality, quantity and time of delivery. By entering into a contract, farmers can gain easier access to inputs along with credit from sponsors.

Contract farming can take different forms: out-grower schemes, a multipartite model and an intermediary model. Under an out-grower scheme, the contracting company supports farmers with production inputs and other services and purchases the crop from the farmers with the objective of processing, packaging and marketing the product. Producers of cash crops, such as cotton, tobacco and sugar, often benefit from such schemes. A multipartite model involves the government, private sector and farmers working together to ensure that farmers have guaranteed access to the market. Under an intermediary model, a formal subcontract is signed between companies and intermediaries (e.g. farmer groups), and the latter have their own arrangements with farmers.

Contract farming can improve farmers' access to national and international markets. From the perspective of agribusiness companies, contract farming ensures a steady supply of agricultural products compliant with the agreed quality standards, as well as a reduction of administrative costs. The potential advantages for both parties are huge, but the success depends on the soundness of the contractual practices and the adequacy of the legal framework that supports the parties in the correct implementation of contracts (Pultrone, 2012).

Contractual enforcement is the main constraint to contract farming. Many agribusinesses and supermarkets do not want to work with small farmers. Contract farming also works better in the case of export crops (e.g. tea in Kenya) and high value crops than staple cereals.

⁷ Calculated on the average maize and wheat yields for Africa (2010), data are drawn from FAOSTAT.

⁸ For example, on SAFEX the contract size is 100 metric tonnes for different types of maize and sorghum, 50 for wheat and sunflower seeds and 25 for soybeans.

Governments have an active role to play in ensuring that a sound legal framework is in place to promote fair contract negotiations and enforcement.

2.4 Agricultural Information Systems

Information systems are knowledge infrastructures which facilitate the dissemination of information for risk awareness, market decisions, and policy decision-making. Information systems in agriculture can be classified as two main categories: Market Information Systems, and Weather Forecast and Early Warning Systems. For developing countries, enhanced agricultural information systems represent a valuable option to reduce uncertainties about the agricultural sector and increase awareness about price, weather, and other hazard risks, and thereby enable governments and the private sector to better plan their actions and allocate budget where is most needed.

An information system is a combination of information technology and human capacity to transform basic data into usable information. As suggested by Wolf *et al.* (2001), information is different from data in two important dimensions: it is context specific and decision-focused, whereas data are context specific but cannot directly be used for decisions without being first interpreted through an analytic process. Most often there is a communication gap between data specialists who use technical language and the final users. For instance, most farmers do not have the necessary knowledge to process raw data (Just and Zilberman, 2002) or interpret complex information. Therefore, it is of basic importance to provide them with analysis and possible implications to support understanding and decisions. Consequently, a clear understanding of user needs and capacities is a precondition for a useful information system.

2.4.1 Market Information Systems

Market Information Systems (MIS) are services used in gathering, analyzing and disseminating information about agricultural prices, quantities and other relevant information of widely traded products from rural assembly, retail and wholesale markets. In order to guarantee a well-functioning service, market information should be collected and disseminated on a regular basis, with the higher possible frequency (at least weekly) and should be channelled through various means to reach different types of audience. In Africa, MIS were set-up mainly under donor assistance, after the economic liberalization, when governments' 'roll-back' resulted in the abolition of many marketing boards (or *chaisse de stabilisation*) which previously regulated markets (Tollens, 2006). The aim was to correct marketing information asymmetries in order to provide more bargaining power to farmers and information to government officials to monitor markets and be able to intervene when needed. MIS tend to be operated by government services or international institutions that guarantee unbiased and independent information (Shepherd, 2011). These are instrumental for farmers as they contribute to create a transparent environment which reduces marketing risks. Up-to-date information, including different market prices of both commodities and inputs, and their intra-seasonal variation, allows farmers to make more profitable decisions on production activities. Thanks to market information, farmers are able to better plan planting and storage decisions, find appropriate markets for their produce, and gain from profitable trade deals. Moreover, by providing detailed spatial information on production quantities and transportation costs, MIS can reduce the likelihood of localized shortages.

Information Systems in Africa, however, have several challenges and weaknesses. First, poor quality and outdated information are common problems of existing systems. A recent FAO survey conducted on information systems in countries supported by the EU Food Facility highlighted that market information is collected on a monthly basis in 69 percent of the surveyed countries; while in almost 30 percent of the cases, the frequency was yearly or higher (FAO/EUFF, 2011). Such frequencies make information of no significant value for farmers, traders, millers and other stakeholders who normally need daily or weekly market information. Second, information systems, especially MIS, focus mainly on a few numbers of commodities, and report prices with scant information about production costs, such as fertilizers and transport, and other variables which may influence markets (e.g. production forecast). This information is necessary if MIS have to be tailored to the needs of specific users, such as farmers. Third, dissemination constraints are a major issue for the implementation of these systems. Internet access is not so widely diffused in remote areas; Short Messaging Service (SMS) text messages between mobile phones are increasingly in use, but broadcasting market information on radios is still the best way to disseminate information. One MIS based on internet technologies and mobile devices is Esoko. It began as TradeNet in 2005 with the support of FAO and other international agencies. Focused on agricultural marketing, it provides market data via SMS and the web to stakeholders within the agriculture and trade sectors in several African countries (mainly Burkina Faso, Ghana, Malawi, Cameroon, Nigeria, and Mozambique). The Esoko platform provides automatic and personalized price alerts. However, prices on the web pages do not report dates, therefore limiting its efficiency and utility, and analysis of the underlying data are not provided.

2.4.2 Weather Forecast and Early Warning Systems

While MIS are mainly thought to serve farmers and traders' needs, Early Warning Systems (EWS) are more targeted at governments, institutions and international organizations. Indeed, a EWS collects analyses and disseminates timely and effective information about hazards, allowing actions to avoid or reduce risks and prepare an effective response. Preconditions for well-functioning EWS are: data accuracy, clear risk assessment and definition of system' objectives, context-based indicators, timeliness warnings, and easy-to-use information.

Moreover, the successes or failures of EWS are dependent on a number of factors that are beyond the technical and analytical scope of the system itself (Alinovi *et al.*, 2012). In fact, to properly link information provided by EWS to appropriate actions, a clear process for translating alerts into decisions is required. A great attention to institutional context is a prerequisite to enable strong linkages with decision-makers.

Early warning systems operating in Africa are mainly donor-founded and internationally managed, and this has clear implications for their sustainability. There are several types of information systems, each of them with a particular focus, (e.g. Earthquakes, Health or Income monitoring), but the two major global EWS that are more suited to deal with agricultural risks are the USAID FEWSNET (Famine Early Warning Systems Network), and the FAO-GIEWS (Global Information and Early Warning System). These combine information on prices, crop production, weather hazards, and vegetation conditions in order to draw the most accurate figures and foster a holistic analysis that supports decision-making processes. Of course, a number of local systems providing early warning and market

information are in place; however, they have lower analytical and methodological capacities which hinder their functionality.⁹

In recent years major improvements in remote sensing satellites information collection and analysis has resulted in the possibility to forecast crop yield at national and sub-national levels at relatively low costs. In comparison to typical agricultural crop statistics products, which are based on surveys and sampling, yield forecasts are based on satellite imagery and collect data at every level, with high frequency, covering crop lands under investigation. The calibration of methodologies and algorithms for providing a timely, highly accurate end-of-season yield forecast system has improved dramatically. By combining yield forecasts, crop condition monitoring and weather forecasts, it is possible to provide a comprehensive, timely and accurate agribusiness crop intelligence had not been available until now.

2.5 Grain stock management

Government interventions in commodity markets are mainly designed to stabilize prices and to support producers and vulnerable populations through safety net schemes. One measure widely adopted to achieve these goals is the management of grain reserves. Stocks maintained by governments can be classified as strategic grain reserves (or buffer stocks), which deal with food price instability and emergency stocks in order to guarantee reserves for the implementation of food transfer programs. Strategic stocks may be publicly-owned and managed, or could be “privately held commercial stocks governed by national rules set by national governments” (Abbott, 2012). A food security reserves provide a first line of defence for coping with emergencies with food distribution schemes.

Strategic storage is a risk management tool used to smooth price fluctuations. Strategic grain reserves are generally operated through parastatal organizations that announce specific prices, a ceiling and/or floor at which they sell and buy grains.¹⁰ The parastatals influence market prices through large purchases and sales of commodities.

The costs and impacts of stock management strategies on food prices highly depend on the threshold prices adopted for purchases and sales. The band should be set in order to require government interventions only in the case of large shortages or surpluses, as this would trigger small running costs, and a less distortive intervention into the market; though lower levels of price stability. On the other hand, a constrictive price band, allowing less fluctuation than seasonal storage costs, would displace private trading activities. Tight bands may entail government annual purchases during the harvest season when prices are lower, and sales during the off-season when prices are higher, reducing both inter-annual and inter-seasonal price fluctuation (Minot, 2010), but generating high running cost and displacing private activities. Furthermore, the price band should be set with reference to market prices. In fact, when it is set too high, large reserves may be accumulated due to higher levels of purchases; this will increase costs and could exhaust storing capacities. When the price band is set too low, stocks will be depleted. In both cases, the government would not be able to support prices; this is why an in-depth analysis and monitoring of market prices to support

⁹ Please note that this review is not comprehensive of all existent information systems.

¹⁰ Floor price is the minimum price set by the buffer stock operator. When prices drop close to the floor price, purchasing on the market ensures that prices do not fall further. On the other hand, a ceiling price is the maximum price admitted by the operator.

price band decisions is extremely necessary. When setting the floor prices (to support producer prices), production costs should be considered in order to guarantee farmers' capacities to invest in the next production cycle, but to avoid extra-profits which would make the scheme more like a subsidy.

Finally, important variables to be taken into account in setting the price band are transport costs and location of storage facilities. In fact, the higher the transportation costs, the wider the effective price band would be compared to the one set by the government. Consider this example: the band price set by the government has a floor price of 90 and a ceiling price of 110; transportation costs from market A to a depot are 10. Producers would not bring their crops to the depot until the market price falls below 80 ($90-10=80$); on the other hand, traders would not move crops from the depot to market A until market prices are 120 ($110+10=120$). The effective price band is thus 80 and 120. Moreover, transportation costs determine the minimum price difference between markets in surplus and deficit areas. Where prices are driven by different market fundamentals, this should be taken into account when designing price stabilization policies. From all the above considerations, it appears that specific technical knowledge and continuous market monitor mechanisms are necessary to guarantee an efficient price stabilization policy.

Evidence from national and international experiences suggests that buffer stocks have been more effective in moderating downward price movements than price increases. In the latter case, buffer stocks can be released up to their depletion; beyond this point there are no means to limit price surges (AMIS, 2011). An effective strategy could be to use buffer stocks to defend producers from downward price risks by setting floor prices and using alternative approaches, such as safety net schemes or trade policies, to deal with price surges and support vulnerable consumers. An example of this approach is shown by the Government of India which pursues a remunerative and stable price environment through the implementation of a Minimum Support Price (MSP). At present MSPs are announced for 25 major agricultural commodities, covering all important cereals; these take into account several factors including production costs, changes to input prices and input/output price parities. In addition to ensuring a reasonable price to the farmers, the main objective is to keep prices depressed in the interest of consumers by maintaining a comprehensive Public Distribution System (PDS), and by keeping a Strategic Grain Reserve for food security reasons.¹¹

In Kenya, the grain market is currently fairly liberalized but the National Cereal and Produce Board (NCPB) still plays both commercial and social roles. The NCPB deals with various products and offers related services to its clients in competition with private players in the industry. Besides trading in key grain products such as maize, wheat, beans, rice, millet and sorghum, the Board offers additional services, such as grading, fumigation, cleaning and warehousing. The NCPB normally maintains a Strategic Grain Reserve (SGR) stock of up to four million bags on behalf of the Government to be used for food security. The Government has recently instructed NCPB to beef up the SGR stock to eight million bags. The Board facilitates the procurement, storage, maintenance and distribution of famine relief food to deficit areas, under the National Famine Relief Program. In recent years, operations of the NCPB have raised the price of maize by fixing a price floor well above market levels, with

¹¹ Government of India Planning Commission.

the result that Kenya's maize prices are among the highest in Africa. (Demombynes and Kiringai, 2011). The NCPB remains a major player in the market among medium- and large-scale farmers in the high production maize zone of the Rift Valley, where it raises prices and provides some degree of stabilization.¹² As reported in the World Bank's 2009 *World Development Report (WDR): Reshaping Economic Geography*, the government has intervened in maize markets in ways that kept maize prices high (World Bank 2009).

Malawi manages its grain stock through the Agricultural Development and Marketing Corporation (ADMARC), which is responsible for marketing all agricultural products, besides the price stabilization objectives and the management of food security reserves. In 1999, the government created the National Food Reserve Agency (NFRA), to manage emergency food stock, with the idea of concentrating ADMARC activities to market related ones. (Minot, 2010). Nonetheless, the experiences of these institutions show mixed results. In fact, during the 2001-2003 food crises and 2007-2008 price spikes, Malawi was not able to efficiently stabilize prices and ensure food security to the poor. Although the 2001-2003 food crises generated much speculation about its causes, the World Bank and IMF encouraged the government to end interventions in the maize market. This resulted in reduced stocks and a severe food crisis, which was exacerbated by the failure of the government to detect the upcoming crises through its early warning systems. The major factor behind the dramatic price spike of 2007-2008 was an overestimated production forecast (Dorward *et al.*, 2008, Jayne and Tschirley, 2009). Following the over-optimistic forecast, ADMARC set up a floor price which was too low and repeatedly increased (from 20,000 kwacha per ton off the harvest season to 40,000 kwacha per ton) to compete with traders. As a result, ADMARC was not able to build up sufficient stock to deal with the lean season, and market prices sharply increased. Supporting the view that private hoarding drove the price spike, the government banned private trade and restored the ADMARC monopoly on maize trade at controlled prices (Minot, 2010). The lack of clear guidelines, the exclusion of the private sector, and the mismanagement of ADMARC clearly caused maize price instability in Malawi (Jayne and Tschirley, 2009).

In Ethiopia, the government established a food security grain reserve in the early 1980s to deal with vulnerability to shocks and food insecurities. The grain reserve was established as the Emergency Food Security Reserve Administration (EFSRA) as an additional unit of the Relief and Rehabilitation Commission. EFSRA does not engage in buying and selling or distribution of grains. It provides inventory loans to well-established relief and rehabilitation agencies working in the country. It releases grain to agencies with an agreement that they will repay in-kind on a pre-agreed date. The stock levels have increased from about 200,000 tons in the 1980s and 1990s to about 400,000 tons in the early 2000s. EFSRA has maintained emergency stock with very little impact on prices. However, this might change if the plan to expand to 1.5 million tons is implemented as large stocks may depress domestic prices (negatively affecting producers), increase the costs of operation, and adversely affecting private sector participation in the cereal value chain (Rashid, 2011).

The Southern African Development Community (SADC) has plans to set-up a regional strategic grain reserve to help bail out countries experiencing food shortages and discourage

¹² http://todayfinancialnews.com/index.php?option=com_content&view=article&id=1202:tea-health-benefits-pushes-tea-consumption-in-the-united-states&catid=106:trade-and-investment&Itemid=553

member countries from imposing restrictions on maize trade within the region. According to the plan, a 500,000 ton facility, including a cash component for countries that do not have any surplus to contribute, would be set up. It has been proposed that about 75 percent of the reserve will comprise food in-kind, while the remaining 25 percent will be in the form of cash. Nonetheless, the reserve is not in place yet, mainly because officials have not discussed and finalized the proposal for setting up the regional facility.¹³

These experiences illustrate that good practices in stabilizing prices using strategic reserves are hard to come by. Several problems have contributed to the apparent limited success: lack of a well-functioning stock management system; the absence of market information systems that rely on solid production forecasts and consistent price analyses; and ad-hoc and non-transparent policies, among others. For instance, it has been noted that most private stockholding behaviour tends to destabilize market prices when there are expectations of shortages and rising prices (Timmer, 2010). This situation can be exacerbated by the uncertainty deriving from *ad-hoc* government interventions. If the government does not have a clear price policy, and intervenes in unpredictable ways, it distorts private incentives contributing to market destabilization. Therefore, it is of key importance that governments have transparent, credible and effective grain reserve and price stabilization policies. In addition, stock management needs to be seen as an effective short-run policy because it is better suited to deal with inter-seasonal price variability. In fact, the high costs to maintain stocks over a long period of time in order to deal with infrequent price crisis, make it a not efficient long-term policy to stabilize prices (Abbott, 2012).

2.6 Trade policies

Public interventions in commodity markets are intended to address market failures (Gilbert, 1996) and reduce short-term supply and demand imbalances to stabilize prices. However, public stock policies alone have a limited stabilization capacity, especially when taking a long-term perspective. Townsend (1977) suggested that under a government buffer stock programme, storage capacity in the long-term can be either, exhausted or saturated, hence unable to contain price rises or stop price falls. Furthermore, the high costs of stock management suggest that stabilization policies should rely not only on stocks, but also on trade policies. This is particularly true for those countries which are not food self-sufficient. One argument in favour of trade policies is the advantage coming from international markets which could be seen as providing an ‘unlimited stock’ at least in theory. A small import-dependent country can always cover its deficit by purchasing on the international market, provided it has the financial resources. On the other hand, the international market is always able to absorb surpluses from export countries, although price volatility can deter trade.

The recourse to the international markets often requires measures, such as export taxes, duties, subsidies, and quantitative measures to regulate import and export flows, thus stabilizing domestic availability (Galtier, 2009). Ad-hoc changes in import tariffs are used to protect domestic producers and tend to rise when international prices are low and decline when prices are high. At the moment, variable taxes and subsidies are prohibited by the WTO

¹³ Sahel and West Africa Club Secretariat and OECD (2011), Agricultural and Food Price Volatility: African views and perspectives, G20 Outreach Session, OECD conference Centre, 14-15 June (<http://www.oecd.org/dataoecd/18/49/48159499.pdf>)

(Abbott, 2012), whereas quantitative measures, such as cereal export bans, are permitted for food commodities in particular situations. It has to be noted that quantitative controls are less transparent and are generally more distortive for private trade, having a stronger depressive effect on private stocks (Galtier, 2009). The use of tariff-rate quota (TRQ) regimes (with lower tariff charged on imports below a quota threshold and vice versa) is limited in Africa (Demeke, *et al.*, 2013). Overall, tariff barriers are more effective than temporary impositions of quotas or trade bans in stabilizing domestic prices because prices resulting from their application are easier to anticipate. For many African countries, tariffs are also well below their binding commitments (under WTO agreements), giving them an opportunity to raise/lower tariffs at will, at least below their bound levels. However, trade restriction measures, especially by major actors in the international markets, distort prices and make world prices unpredictable. On the other hand, open trade policy fails to stabilize domestic prices when international prices are themselves unstable, too low or too high. Formulating the right trade policy is thus very challenging for many countries.

Countries' reaction to the price spikes of 2007-2008 highlighted the lack of coordination in trade policies among countries and the importance to support domestic price and supply stability in times of crisis. The adoption of trade and domestic policies that served to isolate markets was common. Some grain exporting countries imposed restrictions (and bans) in an attempt to ensure sufficient domestic supply; this in turn contributed to soaring prices (Demeke, Pangrazio, and Maetz, 2009). The preference for internal price stability has prevented broad-based multi-country approaches (World Bank, 2008). During 2009-2010, several developing countries put in place food import facilitation measures that generally involved a reduction or elimination of import tariffs in order to replenish domestic food stocks (Maetz *et al.*, 2011). These policies have been a natural consequence of the 2007-2008 events and were adopted in an attempt to avoid food shortages and new price peaks in countries that heavily rely on imports. For instance, Kenya adopted these import defence measures in 2008 and maintained such approaches throughout 2011. More specifically, in 2008 the government reduced import tariffs on wheat from 35 percent to 10 percent and then increased the duty again to 25 percent in 2009 as a reaction to a good wheat harvest and lower prices on the international market. However, in 2010, the import tax was reduced again to 10 percent due to resumption of high prices in international markets (Maetz *et al.*, 2011). Such fluctuating policies are likely to undermine the business environment for farmers and operators along the food value chain.

Table 1: Import oriented measures in Africa after 2008

Import tariff		Import restrictions and bans
<i>Removed/decreased</i>	<i>Imposed/Increased</i>	<i>Ban lifted/quota expanded</i>
Chad, DR Congo, Kenya (maize), Mozambique, Rwanda, United Republic of Tanzania, Uganda, Zambia, Zimbabwe	Gambia, Ghana, Kenya (wheat), Nigeria, Rwanda	DR Congo, Senegal

Source: Adapted from Maetz *et al.* (2011)

Regional trade is often viewed as an important means to stabilize prices. Indeed, regional trade helps reduce price variation by spreading supplies across geographically dispersed markets. Regional trade can buffer demand and supply shocks affecting individual countries and ensuring long-term food security. Markets with high-traded volumes and many buyers and sellers are less volatile, benefiting both producers and consumers. A ‘maize-without-borders’ concept is conceived as a key regional trade strategy to enhance maize markets in Africa. The key objective is to remove barriers and facilitate cross-border movement of maize, a strategic food crop, across the region. EAC, in collaboration with COMESA and the Regional Agricultural Trade Expansion Support (RATES) programme, have been working on this strategy since the early 2000s, in consultation with key maize-producing and -consuming countries in the region. Apart from improving transport, communication infrastructure, and customs procedures, countries of the region need to avoid ad-hoc and unpredictable agricultural and trade policies as well as harmonize standards of food safety, quality and products to facilitate regional trade and reduce the high risk of maize price volatility (RATES, 2003).¹⁴

In general, there are different trade policies that can be used to deal with price instability. Conversely, storage policies are seen as very costly options, especially if price spikes are infrequent and when international volatility is low. In fact, they imply high opportunity costs when stocks have to be held for a long time. On the other hand, taking into account a shorter time frame, seasonal dynamics, and production uncertainties, the role of stocks becomes critical due to a lag on the arrival of imports. Moreover, in the case of landlocked countries, high transport costs cause a significant difference between the parity prices for imports, making trade policies more costly. In light of this evidence, price stabilization could be pursued through a combination of trade policies and grain stocks and the exact nature of the approach should depend on the specific features of each country.

¹⁴ See RATES. Regional Maize Trade Policy Paper, September 2003: http://www.ifpri.org/sites/default/files/p6regional_maize.pdf

3. Options in reducing production risks

Most market approaches dealing with risk management tend to fail during catastrophic events, such as droughts or widespread floods. These types of risks are infrequent, but when they happen, they generate a large amount of damage throughout the agricultural value chain, distressing consumers' access to food and disrupting farming activities. The effects of systemic shocks may reveal the fragility of food production systems and their vulnerability to disruptions.¹⁵

As noted by Siegel and Alwang (1999), extensive damages triggered by extreme events would require unaffordable insurance premiums. They would also cause generalized default on bank loans (Anderson, 2002). In such cases, government interventions are needed. It would be important to foresee specific interventions that the Government can put in place together with the private sector in order to decrease the losses faced in case of extended drought or other natural disasters. These interventions can include the development and support of specific financial services, agricultural insurance products and development of appropriate technologies. Another possible intervention that the government can put in place to support producers is the implementation of well-designed farm safety nets schemes, often in the context of disaster risk management. It should be noted that more recent approaches to disaster risk management have emphasized the necessity of constructing more resilient food production systems and livelihoods (e.g. introduction of new technologies, insurance schemes) which are more capable to absorb impacts and deal with negative effects of disruptive events (FAO, 2011; WFP, 2011).

3.1 Financial services

The development of well-functioning financial systems is a precondition to effective market-based approaches to risk management such as WRS, commodity exchange or insurance products. Moreover, improved financial services enable small players involved in the rural economy to deal with risks by providing coping mechanisms. Indeed, access to credit facilitates borrowing to maintain consumption levels, make critical investments possible, and reduce distressing sales of assets (World Bank, 2005) which are detrimental to long-run productivity (Morduch 1995; Townsend 1995).

Financial systems in African countries are on average the least developed in the world, even compared to other developing countries (Allen *et al.*, 2011). Lack of access to credit and savings facilities, especially in rural areas, is a big issue that could be resolved through stronger microfinance institutions and more efficient financial products. Microfinance institutions provide financial services to people who do not have access to banking and related services as they cannot qualify for formal loans lacking collaterals. Moreover, they often do not require large loans or saving accounts which the banks usually go after. In Africa, microfinance institutions are expanding and their turnover is increasing. For instance, the Central Bank of French Western Africa in 2009 reported that microfinance plays a key role in grassroots financial tools with about 400 institutions operating in West African countries, and a surplus of 25-30 CFA billion deposited within the banking system. However, a recent review of the state of financial systems in Africa (Allen, 2011) highlighted that,

¹⁵ United Nations International Strategy for Risk Reduction: <http://www.unisdr.org/we/inform/terminology>

despite their boom in recent years, microfinance institutions are still not reaching the most isolated communities. High transaction costs cause financial institutions to avoid the agricultural sector. Because of high risks of default, especially when farmers are hit by shocks, financial institutions normally charge high annual interest rates.

A possible solution to expand financial coverage and make credit more appealing for rural households can be Credit Guarantee Schemes (CGSs). CGSs are aimed at increasing access to credit by covering a share of the default risk tied to loans, guaranteeing lenders with a minimum repayment in case of a customer default. Loan risk reduction would lower interest rates and encourage financial institution to reach rural markets. CGSs are a mechanism of risk transfer and diversification (OECD, 2011). In essence, CGSs absorb an important share of borrower risk and could compensate for factors such as insufficient collateral and weak creditor rights. Moreover, Wilcox and Yasuda (2008) suggest that loan guarantees, particularly during a time when many borrowers are in severe distress, may well be expected to raise non-guaranteed lending by sizeable amounts. In fact, by lowering the overall loss-given-defaults (LGDs), they enable banks to extend additional non-guaranteed loans to riskier borrowers without raising the original LGD. CGDs may take different forms: public guarantee schemes, corporate funds, international schemes and mutual guarantee associations (Green, 2003). A full overview of these schemes is beyond the objective of this paper. However, a possible application in developing countries may be applied through public guarantee schemes. These involve state subsidies that are less distortive for the market than other options. An advantage of public guarantee schemes is that, in case of a loan default, the guarantee is paid out directly from the government budget, resulting in higher credibility within the banking sector (OECD, 2011). Such schemes can foster the development of financial markets as a valuable risk management tool provided care is taken to minimize distortions in the incentive of banks to exert sufficient effort in the collection of guaranteed loans.

In Nigeria, the Agricultural Credit Guarantee Scheme (ACGS) has been in place since 1997, and in 2001 the capital base of the scheme increased to N3 billion. The fund is set up to provide guarantees to loans granted by any bank for agricultural activities. The fund guarantees credit facilities by banks up to 75 percent of the amount in default net of any security realized. The fund is managed by the Central Bank of Nigeria, which handles the day-to-day operations of the scheme (Olaitan, 2006). In 2008, the African Development Bank, USAID and CRDB launched a partial CGS in the United Republic of Tanzania to finance private sector participation in agriculture using US\$10 million to set up a 50 percent partial credit guarantee facility. The aim is to help expanding access to medium- and long-term financing for 450 small and medium enterprises (SMEs), especially in the agricultural and eco-tourism sector.¹⁶ FAO is currently providing technical assistance for the implementation of a credit guarantee fund for national producer organizations in Niger. In particular, FAO selects eligible producer organizations and provides the guarantee fund then deposited into a formal bank selected by each organization. Once the fund is transferred, the bank releases a credit guarantee letter which enables the organization to claim a credit for specific investment

¹⁶ Tanzania: Launch of Historic AfDB-USAID Partnership to Finance Private Sector Participation in Tanzania's Agricultural Development. Available at : <http://www.afdb.org/en/news-and-events/article/tanzania-launch-of-historic-afdb-usaid-partnership-to-finance-private-sector-participation-in-tanzania-agricultural-development-2442/>

proposal to a local financial institution. The CGS guarantees up to 50 percent of any loan requested; the remaining 50 percent of default risk is shared between the lending institution and the producer organization. This provides an incentive to both parties involved to carefully plan investment and credit requests, and to analyse and monitor them. One major goal of the CGS is to build solid commercial relationships between lenders and borrowers by creating a solid credit history, reducing the perception of risk of the financial institution. As suggested by the country experiences reported, credit guarantee schemes are becoming an increasingly popular tool to increase access to credit, especially for constrained groups such as small or new enterprises.

Another financial tool gaining momentum is the inventory credit. It refers to the use of stock (or inventory) as collateral to access finance. As already discussed above, with reference to the *Warrantage System* in Niger, this risk management tool can foster micro-finance diffusion in rural areas where farmers and traders are generally under-capitalized, and hardly engage in inter-seasonal storage to take advantage of seasonal price movements. Clearly this system requires banks' involvement and their confidence on availability of the stored product if they need to call on the collateral. Moreover, given banks' difficulty in valuing the inventory, linking this scheme with CGS can lower the perceived risk from banks in engaging with small farmers and traders.

The financial system in most African countries is underdeveloped and not yet able to reach rural population and sustain the agricultural sector. Moreover, given that African agriculture is mainly made off small-medium actors, it appears unlikely that complex financial services could have a real impact in improving agricultural activities. Instead, it appears that major problems come from the small market size, where financial institutions should develop innovative financial products to enlarge their portfolio of clients and offer alternative strategies to support producers to cope with risks.

3.2 Insurance

Agricultural insurance has been one of the agriculture risk management tools which attracted more attention in the recent years. Insurance is an instrument that pools risks from a large population in order to cover pay-outs encountered by a small portion of that population.

The most traditional agricultural insurance is crop insurance, which covers farmers from threats by paying them on the basis of the losses assessed by observing yields at harvest time. Despite definite benefits, traditional insurance faces a series of challenges. First of all, operational and administrative costs become higher when the client base is more dispersed, the farm production system is more heterogeneous and the insured value is smaller. In fact, in order to define losses encountered by individual subscribers, insurance companies have to undertake specific assessments which are very costly particularly when farmers are small and scattered. Secondly, these assessment practices could stretch over a long timeframe, resulting in delayed repayments which hamper farmers' capacity to invest for the next planting season. Finally, traditional insurances have been targeted by theoretical criticism: adverse selection and moral hazard limit their efficient functioning. Moral hazards occur when individuals who are insured against risks change their behaviour by taking riskier decisions or reducing their efforts; for example, insured farmers have no incentives to reduce losses deriving from adverse situations. On the other hand, adverse selection derives from asymmetric information

between the provider and the client. The insurance company calculates the premium based on the average probability and amount of losses over a given population; this in turn results in low incentives to ensure on the part of farmers less exposed to risks than others.

In the last few decades, such problems have been addressed through new insurance products with the aim of making insurances more affordable and less prone to various distortions. The most promising 'new' insurance mechanisms are Index-Based Insurances. These are financial products written against specific risks linked to an index highly correlated with the production of a commodity, but not based on specific losses that a farmer may encounter. The most common index insurances are the Area-Yield Index and the Weather-Based Index.

The first offers compensation based on the expected losses when the average yield of a geographically-defined group falls below a specified threshold. However, payment is normally made six months after the harvesting period. Moreover, in order to properly calculate premiums and pay-outs, long and reliable series of area yield data are required; this limits their applicability to developing countries which usually lack good historical data.

The second provides a pay-out to farmers when an index (normally rainfall) falls below a certain threshold level; the pay-out will compensate farmers from the reduced production. In order to construct a weather-index insurance system, the financial impact of adverse weather events for a farmer has to be estimated. The objective is to minimize the mismatch between pay-outs triggered by the rainfall index and the actual yield. The first step is to estimate the crop yield fluctuation per mm of rainfall. The yield fluctuation per mm of rainfall can then be converted into a monetary value by either assessing farmers' input costs or the expected sales margin.

Both types of index-based insurances try to overcome the moral hazard and adverse selection problems by setting an average observable trigger defined on a certain area. When the index falls below a certain level, farmers are automatically compensated without the need of crop assessment. This approach dramatically reduces operational and administrative costs. Moreover, since all farmers pay the same premium and receive the same pay-out, they have incentives to minimize production losses. As a consequence, the moral hazard and adverse selection problems are tackled. Finally, the nature of the verifiable index on which the insurance is calculated, could favour its reinsurance on international markets, allowing insurance companies to transfer part of their risk. This last feature is essential for a well-functioning insurance market. In fact, insurance is an appropriate instrument for risk management when risks are independent. However, events that typically hit agriculture are spatially correlated, hence insurance companies operating at regional- or country-level are not able to pool risk efficiently and protect against systemic risks, such as droughts, floods, earthquakes, etc., thus failing to reduce the risk. When a local company reinsures the excess of the overall pool risk, the reinsurance premium could be very high. This will require government support to guarantee such contracts (eventually reinsuring local companies at affordable premium prices).

It is widely recognized that another challenge is the basis risk. Such insurance products do not offer an optimal risk edging strategy for insured farmers who face above-average losses which are not covered by the insurance. This implies that the design of the index contracts is

very important for their success and some training is needed for farmers to fully understand the terms of contracts.

Index-based insurances have not yet gained popularity for application in African countries. This could be due to the high initial costs associated with the launch of such programmes. In fact, a large amount of resources is needed to build technical expertise among local insurance companies, infrastructure to collect data, and capabilities to design index products. Most country experiences in Africa are still at pilot level and are supported by international organizations and global insurance companies. For example, Ethiopia, Kenya, Malawi and the United Republic of Tanzania are piloting different types of weather-based index insurance, particularly against the risk of drought. In Kenya, a consortium comprising Financial Sector Deepening (FSD) Kenya, the Rockefeller Foundation and the World Bank is piloting a project with the primary objective of developing and testing the market viability of index-based insurance products to reduce the impact of weather risk on smallholder farmers and pastoralists. The success of this scheme depends strongly on the support of the Kenya Meteorological Department (KMD), which has historical record of climate data, essential to design market valuable indices. The programme provides cover for the value of the inputs provided on credit to farmers. This will enable farmers to increase their productivity safely, knowing that their loans will be repaid in the event of a drought. In Ethiopia, since 2009, the Nyala Insurance Company, supported by different agencies, has introduced different weather index-based insurances. These were targeted at smallholder farmers who grow haricot beans, teff and other cereals. However, due to a lack of historical data, problems were encountered in calculating price index insurance to scale up the projects. Since 2005, in Malawi, different pilot schemes have been launched for maize, tobacco and groundnut farmers, with the support of some global reinsurers. However, the major challenges were the non-homogeneity in rainfall patterns, the limited number of automated weather stations and a lack of historical data. A major lesson, derived from the implementation of these pilots was that weather insurance is best sold when bundled with credit and not as a standalone product. The *Ethiopian Project on Interlinking Insurance & Credit in Agriculture* (EPIICA) is trying to address this issue by simultaneously providing credit and insurance, creating state-contingent loans. Also in the United Republic of Tanzania, a pool of international agencies and global reinsurers has recently launched a programme which provides cover for the value of the inputs provided on credit to farmers. The aim is to enable farmers to increase their productivity thanks to loans that are secured against drought.

To sum up, country experiences suggest that weather-based index insurance is a promising tool for agricultural production risk management when linked to other rural financial instruments. However, this requires reliable historical data to define accurate pricing and secure weather stations to increase insurance providers' confidence. What is more, farmers operating in different microclimatic zones may face rainfall at plot level which is not highly correlated to those at the station level (basis risk).

A general lack of historical data, coupled with a low capacity of local insurance company, has constrained the successful large scale implementation of insurance products. Efforts in capacity-building to support an efficient design and distribution of insurance products are crucial for the success of such a risk management tool.

In developed countries, such as the USA, the governments support crop insurance policies which cover farmers' crop revenue from price risks. Indeed, these schemes combine price and yield features to assure producers minimum revenue. Moreover, some experiences also combine yield guarantees and indemnity payments based on area yields rather than on individual farm yields, which can reduce premium payments. The premiums for these crop insurance policies are generally subsidized by governments, which makes insurance affordable for producers and supports the insurance sector by expanding their client portfolio. In the context of agricultural markets, which are experiencing high price volatility, these revenue insurance products may represent a valuable alternative to price risk management.

3.3 Technology development and adoption

The role of technology in African agriculture is very limited; however, it can be of great potential to enhance productivity, incomes, and food security. Resource poor farmers face huge variability in agricultural yields and production due to the high incidence and likelihood of climatic shocks which also exacerbate the pressure on high food prices. In turn, this increases the vulnerability and strengthens the importance of keeping up supply to enable the markets to absorb price movements. The adoption of farm technology is claimed to be critical in overcoming production risks. Indeed, the increase in climate variability in Africa, which in the past two decades has registered decreases in annual rainfall and an increase in temperatures, is detrimental to agricultural productivity. In turn, factors such as yield variability and the risk of crop failures affect technology adoption decisions, particularly in low-income, rain-fed agriculture. Therefore, the constraints to African agriculture which is characterized by dry area conditions due to acute water scarcity, frequent drought, salinity, desertification and other forms of land degradation, as well as pest and diseases, cannot be overcome without innovative approaches; hence higher investments in agricultural research, and strong political commitment to strengthen policies and institutions. Moreover, successful technologies are needed to enhance adaptation to climate change, mitigation of shocks, and resilience of productive systems. For instance, according to the International Centre for Agricultural Research in the Dry Areas (ICARDA), improved varieties offer higher and more stable yields resistant to multiple stresses and new technology packages: drought tolerant wheat and barley, together with integrated pest management, have increased output and productivity and lowered production costs. Modern technology tools, such as remote sensing and Global Information System (GIS), are improving traditional practices, such as rainwater harvesting, thus increasing water productivity. Conservation agricultural technologies can also increase yields while intensification and diversification of production systems generate new income and livelihood strategies. Several research centres are developing crop varieties and production technologies that can achieve sustainable increases in agricultural productivity and income to contribute to the improvement of livelihoods of the resource-poor farmers.

Given the high variability of returns, (average) productivity gains are not a sufficient condition to attract farmers to adopt new technologies and agricultural innovations. New technologies need to yield adequate and stable returns from one year to the next. There is no rationale for adopting new technologies if farmers are exposed to price uncertainty due to the high volatility of food prices and to frequent shifts in agricultural policy which heightens the uncertainty. The main challenge in Africa is ensuring adequate investments in agricultural research, supportive policy and institutional environment and strong political commitment to

support technology adoption by small farmers. In Mali a comprehensive reform of the irrigation system, which included new legislation providing tenure security, full cost recovery and joint management of the scheme by farmers and government staff, triggered an increase in production and productivity: paddy yields increased from 1.5 to 5.5 tons/ha and production more than tripled to about 300,000 tons (Reij and Steeds, 2003).

3.4 Farm safety nets

Safety net interventions that protect producers aim to increase their productivity by enhancing their use of inputs and technologies, and increasing farm and off-farm incomes. In particular, in the context of agriculture, safety nets might alleviate liquidity constraints of producers, foster income-generating strategies and boost demand for farm products, thus creating multiplier effects throughout the local economy (Devereux *et al.*, 2008).

In Africa, safety net schemes in support of poor producers are limited and not properly institutionalized. Most widely adopted programmes to assist agricultural production are input distribution schemes, which mainly focus on targeted fertilizer distributions, but such interventions are mostly designed and implemented as ad-hoc policies without proper planning, resulting in temporary and scattered interventions. The efficiency of these schemes is mainly hampered by two common constraints: namely, the failure in properly target intervention (which requires studies) and the likely delay of input distributions. Proper targeting of input distributions is key to limiting the costs associated with the scheme, and to avoid the crowding out of commercial sales. The delays in fertilizer availability lower the effectiveness of the fertilizer due to their late application.

An example of this problem is provided in a study which assessed the 2008 fertilizers' subsidy programme in Ghana. Yawson *et al* (2010) reported that the programme was initiated during the sowing period. Combined with bureaucratic difficulties relating to the distribution of vouchers and/or fertilizers at different administrative levels, the distribution of the fertilisers was greatly delayed. The study highlights that farmers who used the fertilizer in 2008 did not experience any significant increase in yield due to late application. An evaluation of the Agricultural Input Subsidy Programme (AISP), implemented by the Malawi Government in 2006-2007, highlighted that it resulted in large increases in maize production which contributed to lower market prices. However, the large share of fertilizer purchased by Government for direct sales through parastatal outlets, together with the delay in signing contracts with private distributors, displaced private activities, reducing incentives to import beyond the needs of the subsidy programme. The report highlights how increasing volume of subsidized fertilizers may lead to higher displacement rates in the input market unless it is not effectively targeted at farmers who cannot afford purchases. High rates of displacement reduce the overall effectiveness of the programme.

Unlike African countries, most developed countries include regular safety net schemes in their national budget plans to support producers. These programmes may take different forms and often progressively improve thanks to monitoring and evaluation of previous plans. They may also evolve according to agricultural production structures and major changes to the international markets. For example, in the USA the government provides mandatory funding for many farm bill programmes, including farm safety nets (commodity programmes and crop insurance), some nutrition, conservation, research, bioenergy, and rural development

programmes.¹⁷ Through the Farm Safety Net Programs the Federal government supports farm income and helps farmers to manage risks associated with variability in crop yields and prices although a large proportion of the farm support payments are received by a few large farms and payments are made even in an environment of high prices and high farm income (Mercier, 2011). A few countries in Africa have disaster risk management programs but these are often focused on ‘bail-out’ mentality, despite calls for better risk management options. There is little concern to institutionalizing risk management tools and ensuring that farming households are better prepared for future disasters (Vogel, *et al.*, 2010).

In summary, it appears that there is a huge gap between producer protection in African countries and most developed ones. African experiences show weakness of designing and implementation of such schemes which hinder their efficacy. Therefore, in order to improve their performance, governments should take an approach which utilises safety nets and is not only confined to input subsidies, but which includes supporting policies that help to maintain incentives for producers, foster technology adoption and promote overall agricultural growth. Moreover, such schemes are normally conceived to cover a certain number of people. However, in case of adverse systemic shocks, when most of the market-based risk management tools tend to fail, the number of people requiring social protection dramatically increases. Therefore, additional resources are needed to scale-up social protection interventions to ensure full coverage. Due to the limited resources of the existing safety nets, alternative responses to emergencies need to be considered.

4. Consumer protection

Consumer protection policies are interventions that enable governments to meet the immediate needs of vulnerable households. These schemes are critical in minimizing the negative effects of large shocks representing valuable measures to respond to production and price risks. Moreover, they contribute to building the long-term resilience of people and ensuring sustainable food security. Safety net programmes not only guarantee an adequate level of food consumption in distressing situations, but also prevent people from adopting coping strategies which result in depletion of assets.

Consumer support schemes are mainly designed as food and cash transfer programmes that can be distributed through food vouchers or in-kind distributions. It has been widely debated whether cash or food was the better alternative to base safety nets transfers. In the 1990s, food aid was increasingly criticized on the basis of the high costs implied (shipment, storage, and distribution) and because it could distort normal ‘market functioning’. Conversely, cash transfers were perceived as more cost-efficient and viewed as more encouraging for agricultural production and market activities. However, in recent years, the disadvantages of cash-based transfers have been highlighted while arguments in favour of food transfers have emerged. In fact, among other shortages, cash transfers are vulnerable to inflation. Cash injections might increase inflation, particularly where commodity markets are weak and supply is constrained. A comprehensive discussion on the advantages and

¹⁷ Total budgetary authority for all mandatory farm bill programs under current law is about 995 USD billion during 2013-2022 financial years. Of this amount, the budget for farm safety net programs is about 15 USD billion a year (Shields and Schnepf, 2012).

disadvantages of food and cash transfers can be found in Devereux (2002); and Sabates-Wheeler and Devereux (2010). The following table summarizes the main features of both safety nets approaches.

Table 2: Cash versus food transfers

	Advantages	Disadvantages
Food Transfers	<ul style="list-style-type: none"> Immediately increases food availability Directly addresses nutritional deficits Usage favours women, children, elderly Can be self-targeting Lower security risk Donor food surpluses are available 	<ul style="list-style-type: none"> High transport and storage cost Losses from spoilage and theft Less easily exchanged than cash Disincentive effects on production Competes with local markets and trade
Cash Transfers	<ul style="list-style-type: none"> More cost efficient Allows more beneficiary choice More fungible than food Encourages production Stimulates the market 	<ul style="list-style-type: none"> Losses from inflation Can be used for non-food consumption Usage favours men More difficult to target Heightened security risk Limited donor resources available

Source: Devereux, 2002.

The inflationary risk was highlighted during the commodity price surge of 2007-2008 (Benson *et al.*, 2008), when the purchasing power of low income people was undermined. Thus employment-based safety nets based on a combination of food and cash transfers have gained momentum in popularity. Public works and employment-guaranteed schemes are the most common employment-based safety nets. These public programmes particularly address negative impacts of seasonality and shocks by offering short-term employment opportunities. Indeed, they have a high potential to mitigate the impacts of crisis in agriculture by offering off-farm revenues to contrast production losses, but also creating productive assets.

In 2005, the Government of Ethiopia launched the Productive Safety Net Programme (PSNP), the largest social transfer programme in Africa outside South Africa. The scheme is based on two major components, a 'Public Work Programme', which provides temporary employment on rural infrastructure projects, and 'Direct Support' which provides unconditional transfers to a minority of participants. In addition, a series of complementary programmes are implemented. The possibility that cash transfers could contribute to price inflation has proved to be true in the case of Meket Woreda (Amara region). This is explained by two factors: first, traders did not respond punctually to the increased demand following cash injections; second, cash disbursement arrived in erratic lump-sums instead of a consistent, flowing delivery, and this resulted in price spikes due to demand surges. Another pitfall of the PSNP (and of many safety nets programmes) is that it did not take into account price seasonality and price differentials between regions. Moreover, the spectacular increase in food prices experienced in Ethiopia since mid-2007, eroded purchasing power of the cash transfer distributed by the PSNP. In fact, the PSNP cash transfer level had increased by 33 percent between January 2005 and mid-2008, whereas the average price of staple grains almost tripled over the same period (Sabate-Wheeler and Devereux, 2010).

The Ethiopian experience highlights that there are several challenges that need to be considered when designing and implementing optimal safety net schemes. African countries must carefully select from among various alternatives, taking into account their specific conditions. Many countries are also unlikely to be able to afford and operate multiple programs, hence they must select the most appropriate schemes depending on their administrative capacity, political environment, and the nature of target groups, among others (IFPRI, 2004).

5. Conclusions

It is well known that agricultural production is prone to several risks which affect both producers and consumers; the former lose out when prices are low; the latter when prices are high. Variability in production results in high food price instability; this means that an increase in productivity and a more stable supply help to mitigate price risks. However, the uncertainty surrounding agricultural production, especially in less-developed environments, hampers investment decisions, reducing technology adoption and hindering the adoption of improved farming systems. The high correlation between production, price, and market risks pinpoints the necessity of an integrated and comprehensive approach to risk management and building resilience of African producers.

This work has investigated possible tools and instruments to deal with such risks. While specific social safety net schemes could aid consumer protection by improving their access to markets and guaranteeing minimum living standards, the majority of risk management tools analysed in this paper are better suited to supporting producers. This is because it is critically important to maintain incentives for producers in order to guarantee a long-term increase in agricultural productivity and increase food supply. This, in turn, will trickle down to benefit the overall population.

Grain stock management strategies, trade policies, commodity and futures exchanges, and agricultural information systems deal to a greater extent with price risk, whereas modern forms of insurance, well-functioning financial markets and farmer safety nets primarily address production risks.

This review has shown that market-based approaches are very important for dealing with these issues, but their implementation requires a series of preconditions and an enabling policy environment. The country experiences examined highlighted that these tools are not in place or are not fully developed in most African countries. Farmers are not sufficiently protected and this emphasizes the critical role that governments should play in agricultural risk management. Governments should create a supportive institutional environment where modern risk management tools can thrive. Investments in basic services, such as definition of grades and standards, contract enforcement and market information, will help to sustain long-term market development. An effective legal framework and conducive business and economic environment would facilitate the development of solutions for risk-pooling/sharing. Policy makers need to adopt an integrated and holistic approach in support of risk management interventions through incentives and by strengthening agricultural markets and financial institutions.

Most African governments have yet to include agricultural risk management policies in their national development plans. Risk management tools need to be mainstreamed into agricultural policies and programmes in order to promote a paradigm shift towards an integrated approach of managing ‘development’ and ‘emergencies’. Enabling an efficient response to systemic risks, components of disaster risk management should be incorporated into national strategic plans. Besides large-scale emergency operations, they can improve farmers’ capacities to adapt to changing environmental pressures. For instance, providing training to extension officers and farmers in hazard-affected communities is critical to encourage crop diversification, counter-season production, water harvesting and water conservation, the adoption of resistant seeds (against drought or floods) and generally to improve existing production techniques. The recent move by the New Partnership for Africa’s Development (NEPAD) Planning and Coordination Agency (NPCA) to mainstream risk management policies and resilience building programmes into the Comprehensive Africa Agriculture Development Program (CAADP) investment plans is a step in the right direction.¹⁸

There is a dearth of information in modern risk management strategies in Africa and governments generally lack the capacity to manage agricultural risks. These factors combined with high levels of price and production risks in Africa provide a good case for comprehensive studies into risk profiles, assessment of risk management tools, legal framework and policy environment, the role of social protection, and risk management policies and strategies which best suit the different political and economic contexts of African countries. No developing country has successfully reduced poverty without first increasing agricultural productivity, which in turn depends on effective management of price and production risks.

¹⁸ <http://www.nepad.org/foodsecurity/knowledge/doc/3168/integrating-risk-management-tools-and-policies-caadp-options-and-cha>

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