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Unravelling Risk Structures in Nigeria's Rice Supply Chain: A Review of the Literature

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Abstract
Agriculture generally is faced with a lot of risks that are beyond the control of actors and stakeholders in the sector. This paper unravels the susceptible risks present in the rice supply chain, management and coping strategies in Nigeria. Just-Critical reviews of the past works done on risk in agriculture were examined by a desk study. Production, processing and storage risks are important in describing output variation for different actors and national output over the years. Knowledge of these risks will go a long way in helping them to subdue. The channel in which the rice flows was reviewed. Different sources of risk in rice supply chain such as production risk, processing risk and storage risk were reviewed. To manage these risks, risk management strategies and coping strategies were reviewed. This review identified the risk, risk prevention strategies and coping strategies applied at different points of the chains. It was found out that risks were not only present in production stage but also in processing and storage. The prevention strategies recommended include crop rotation, mulching, water harvesting, and irrigation. While the coping strategies recommended are income diversification activities such as engaging in off-farm work to complement the income from farming and mixed farming system such as rearing animal to compliment income.
Keywords: risk structure, rice supply chain, coping strategies, risk management, Nigeria.

1. Introduction

Rice is one of the major crops grown and also form a major part of Nigeria's staple foods. Food grains constitute an important aspect of Nigeria's food regime, supplying 46% calories and 52% proteins of national food consumption per annum (Dévelopment 2010; Famine Early Warning Systems Network (FEWSNET) 2008). A large part of the rice grains produced is retained on the farm for home consumption due to risks in rice chain (Ukeje 2006). Local farmers are the major producers of rice in Nigeria. Their participation in market chain contributes significantly to rural economic growth and poverty reduction in developing nations (Dorward et al. 2008; Greig 2009; Kostov & Davidova 2013; Zanello 2012). Yet several risks limit the full optimization of market participants' economic potentials in the fast-paced market environment. This raises a pertinent puzzle regarding what risk management and coping strategies may be required to spark increase investment in rice market chain? (Barret, 2008; Dorward et al, 2008; Gabre-Madhin, 2006). Several studies associated constraints to risks in technological characteristics especially in relation to production, processing and storage limitations of food grains in developing countries (Gabre-Madhin 2006; Baltenweck & Stall 2007). This orientation suggests that critical intervention assistance aimed to ensure risk management and coping strategies that will enable broad-based, low cost access to competitive, well functioning markets will require significant investment by public sector (Barret 2008). Despite the growing interests along this line, much less attention has been paid to understanding the susceptible risks present in the rice supply chain, management and coping strategies in Nigeria. There is need to address this under-researched area given the peculiarity of rice supply chain in shaping the food security and investment by private sectors in emerging economies.

Here we draw insight from rice supply chain and ask: what contextual risks (production, processing and storage risks) are important in describing output variation for different actors and national output over the years? What risk prevention and coping strategies should be applied at different points of the chains?

The choice for risks in rice supply channel in this study is related to its role in the economy. Local farmers get their seeds mostly from past harvests, or they buy them from markets or sometimes from government agencies/cooperatives, especially the improved seeds. Rural assemblers get the grains from farmers for further processing and storage, and for onwards movement to the wholesalers who eventually store the grain in large quantities (Oguoma et al. 2010). The grain moves from wholesalers to industries, retailers or directly to the consumers. Although, Nigeria is one of the major producers of rice globally, what is currently produced locally is not enough to meet local consumption needs, a situation that has made Nigeria a net importer of rice (Daramola 2005). This may be as a result of risk factors and low production technologies. Rice commodity flow is the movement of rice volume from one stage to another such as production to consumption. This flow can be disrupted by certain factors such as erratic rainfall, high humidity, droughts, pests and disease epidemics along any rice chain (Lire et al. 2000). These factors reduce the volume of the rice as they flow from one stage to another, thereby causing shortages in terms of quantity. Risk in agricultural food production is defined as an uncertainty (i.e. imperfect knowledge or predictability) because of randomness (Aker 2010). It is regarded as the probability of losses resulting from incomplete control over the processes with which farmers are concerned

(Organization for Economic Cooperation and Development (OECD) 2000). Weather factors are essential in rice production. Rice production in Nigeria is still predominantly rain-fed (International Food Policy Research Institute (IFPRI), 2009a). Rainfall which increases grain moisture content is a key issue during and after harvest. Smallholder farmers rely on sun drying to ensure that grains are well dried before storage. If unfavourable weather conditions prevent grains from drying sufficiently, then losses will be high. Also, pest and disease affect the grain during storage if they are not stored properly. According to (Dupriez & Leener 1988), farmers are faced with many food production uncertainties in rural areas. These prevent them from acting freely in accordance with their food production wishes. In such circumstances, they have to take some innumerable and highly diversified risks and uncertainties into consideration. In order to cope with various production and post-harvest risks, farmers and wholesalers in developing countries usually engage in informal risk management mechanisms. These range from income diversification activities, production strategies such as crop rotation, crop diversification, water harvesting, irrigation, improved water use efficiency, breeding for heat or drought tolerance, mixed cropping and use of improved seeds (Antonaci et al. 2014). These local means of risk management methods tend to fail in the presence of larger shocks affecting large areas of the farm. Rice availability is low in Nigeria due to a combination of low productivity and postharvest losses (Agwu et al, 2012; Babalola, 2003; Liverpol, Ayoola, & Oyeleke, 2009). Climate factors such as rainfall, temperature and humidity are key determinants of grain production and grain losses (Peel et al. 2007). Climate variability is likely to increase post-harvest losses due to the combination of changes in various climatic variables, which may increase in the number of pests and diseases which attack stored grain, as well as it creating an environment for new insect pests to flourish (Paterson & Lima 2010; Deffenbaugh et al. 2008) Weather instability exposes rice production to uncertainty, such that it may bring output fluctuations. For instance, if rainfall is inadequate or untimely, plants dry up and yields are in jeopardy. If rainfall is inadequate at the beginning of the rainy season, seeds dry up and the harvest is likely to be poor (IITA (International Institutes of Tropical Agriculture) 2007).

Risk in the grain chain is not only associated with production stage alone but is also present in other stages in the chain such as processing, storage and government policy. This negatively affects farmers, processors, and wholesalers decision's on their production activities, processing and the volume of storage. This may reduce the quantity supplied, thereby reducing the revenue of each actor in the chain. Similar studies have been conducted in Ghana on agricultural supply chain risk identification by (Yeboah et al. 2014) and in Thailand on uncertainty factors affecting the sustainable supply of rice production by (Thongrattana 2012). The broad objective of this review is to identify risk structure in Nigeria's rice supply chain. Critical in depth was done on the following specific objective: describe typical rice supply chain channel in Nigeria, identify different risk sources present in rice supply stages and identify risk prevention strategies and coping strategies are applied.

2. Methodology

The review consists of desk study done to unravel risk structure in rice supply chain. Critical outlook was done on the existing literature on risk structure and management. This was harmonized together in the context of Nigeria situation. Literature was reviewed from articles on risk available at the Wageningen University, Netherlands library, online articles accessible from the University. Also, articles were accessed through websites such as Google Scholar, Science direct, jstor.org, Science web etc.

3. Literature review and discussions

i. The following headings were reviewed and discussed:
ii. Rice supply chain stages in Nigeria
iii. Risk in rice supply chain in Nigeria
iv. Risk prevention (Ex ante) management different points of rice chain in Nigeria
v. Coping strategies at different points of rice chain in Nigeria
vi. Government risk management strategies (ex post) in Nigeria
vii. Grain reserve in Nigeria

3.1 Rice supply chain stages in Nigeria

A supply chain has been described as a system whose constituent parts include material suppliers, production facilities, distribution services and customers, linked together via the feed-forward flow of materials and the feedback flow of information (Stevens 1989). The major producers of grain in Nigeria are local farmers. They obtain their seed from the previous harvest, bought at the market, or via government agencies or farmer's cooperatives. The quantity of grain after harvest moves to rural assemblers for semi-processing. The grain is collected by a wholesaler or grain reserve in large quantities for storage. Due to insufficient rice production, imports of milled rice amounting to 48% are needed to complement the current supplied (Olajide & Oyelade 2002). The figure below shows the typical overview of a grain chain in which the Nigeria situation is captured.

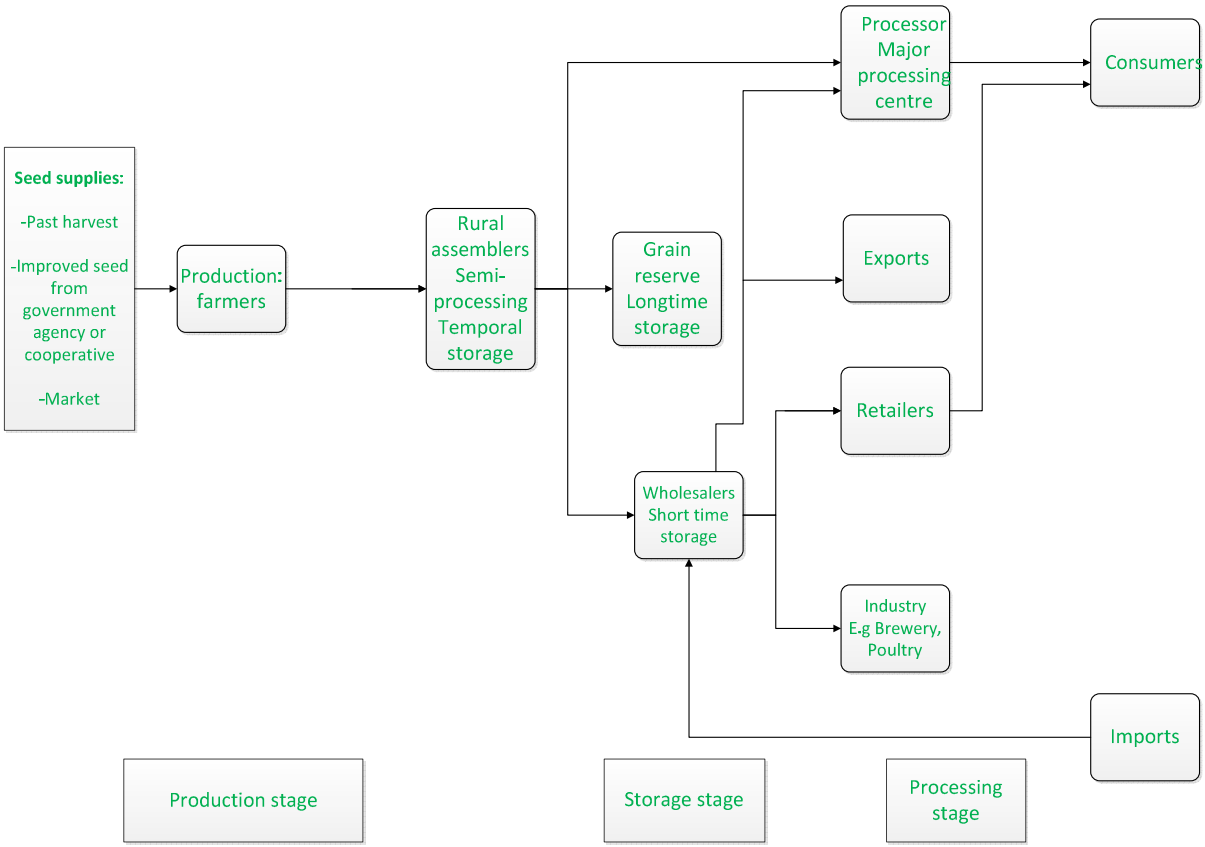

Figure 1; Schematic highlight of a typical rice supply chain

Figure 1 is adapted to Nigerian situation

Agricultural supply chains encompass all of the input supply, production, postharvest, storage, processing, marketing and distribution, food service, and consumption functions along the farm-to-consumer. This is applicable for all forms of the given product (either consumed as fresh, processed, and/or food-service-provided), including the external enabling environment (Lalonde & Masters 1994). Agricultural supply chains are networks that include flows of physical product and information. It begins from input suppliers to producers, in which the commodity proceeds to buyers and to final customers. The importance of agricultural supply chain management is in providing the right products (quantity), in the right amounts, to the right place, at the right time. Governments may get especially interested when such a supply chain has a particular strategic commodity of importance such as food sufficiency, food security or trade (import and export) and critical in the domestic food system. Agricultural supply chain risk management should be structured in such a way as to include the risks involved in other to leverage shortages and achieve performance objectives by farms, and supply chain as a whole. Some participants and services are specialized, whereas others are involved in several different supply chain functions (Jaffee et al. 2010). The agri-food system includes farmers and a diverse range of firms, including backward-linked input suppliers and forward-linked intermediaries, processors, exporters, wholesalers, and retailers. The main activities for direct supply chain entities are as follows:

3.1.1 Input supply*:* This involves production and distribution of inputs such as fertilizer, seeds, packaging, and other things needed in the primary production, processing, and/or trade of the local commodity.

3.1.2 Farm production: This involves primary agricultural production particularly on the farm, sale of a raw commodity at the farm gate or at some other point where the farmer hands over ownership of the product to the next supply chain participant (depending on the crop, some type of primary processing such as the shelling or bagging of dry grain may take place at the farm level by rural assemblers). The common risks that have direct effect on this stage are risks regarding: weather, humans, biological, institutional and technical aspect. These risks can make the quantity of produce to fluctuate year to year and the farmer has limited or no control over it.

3.1.3 Processing*:* This is the transformation of agricultural raw materials into one or more finished goods through drying, canning, per-boiling freezing and many other methods. In this stage, the associated risks are weather, infrastructure, technical (such as machinery) and human risk.

3.1.4 Storage*:* This involves storage of farm produce temporarily at farm level or the next actor in the chain. The processed product can be store by wholesalers and retailers for onward movement to last actor in the chain. There also can be a long storage time by the government through grain reserves. The risks associated with this

stage are weather, biological, infrastructure (storage facilities) and institutional risk.

3.1.5 Import and stock reserve: These are strategy measures employed in case there is shortage. This may be as a result of disruption activities when the quantity of rice is below the critical threshold.

3.1.6 Consumption: This is final output that is available for consumption.

3.2 Risk in rice supply chain in Nigeria

Risk in agricultural food production is defined as an uncertainty (i.e. imperfect knowledge or predictability) because of randomness. It is regarded as the probability of losses resulting from incomplete control over the processes with which farmers are concerned (Organization for Economic Cooperation and Development (OECD) 2000). There are a number of risks that are accompanied with food production. This greatly impedes the effort of farmers in terms of their agricultural production and productivity. This risk mainly derives from extreme weather shocks, such as drought, floods and erratic rainfall. Other risk such as biological factors, which include insect pests, and crop diseases, are recurrent events affecting agricultural production. Indeed, climatic and biological events may hit the overall farming system of a certain area in the country and this may have serious implications on how to deal with agricultural risks (Antonaci et al. 2014). Agricultural production as observed in Nigeria is affected by weather and climate which dictate outputs. We usually observe long spells of drought; torrential rainfall and flooding could seriously disrupt production and lead to fall in supply of agricultural commodities (Oguoma et al. 2010). According to (Lire et al. 2000), the major risks in the grain chain comprised failure of farming methods, storage and processing. The natural causes of risk include losses due to pests and diseases, and perishing of products. It also includes those losses due to adverse or unfavourable weather conditions such as highly erratic rainfall, high humidity, drought and flood. Other risk factors that constitute risk to rural farmers are commodity price fluctuations, poorly functioning or missing markets for inputs and outputs, unexpected changes in policies, and unstable government (Horace 1959). Farming is a risky occupation because, to some extent, it faces a lot of risks. It is risky because results depend relatively on certain factors over which the farmer has no control. Agriculture operates under uncertain conditions and factors which the farmer can only influence to a minimal degree. For instance, they have no control on frequent rainfall, face difficulties managing certain sudden attack of locusts and they cannot stop the outbreak of serious diseases fatal to crops. With respect to this, farmers need to develop strategies that could help minimize the effects of such risks in the event of their occurrence.

3.2.1 Weather risks and natural disaster

This comprises of weather factors such as erratic rainfall, high humidity, wind storm, flood and drought. Weather hazards subject farming to uncertain effects. For instance, if rainfall is inadequate, untimely, or fluctuates, plants dry up and yields are in jeopardy. At times, sudden hurricanes flatten plants to the ground, which can cause enormous losses in crop yield. A spell of exceptionally cold weather destroys flowers and young fruits. In fact, there are many varied ways of combating weather risks, but there is no adequate or full proof way of protecting crops from bad weather (Donye & Ani 2012). Recently in 2012, two major flood events took place between the months of September and October in Nigeria. These were due to Cameroon releasing waters from their Ladgo dam. This water flooded a major river in Nigeria. These events made most of the country's rivers overflow their banks and submerged hundreds of kilometres of urban and rural lands. It had a serious negative effect on crop production as many crop farms were eroded. The main attribute of the severity of the flood disasters in Nigeria that year lies in the fact that they were sudden and unexpected. Most of the central states of Nigeria and other surroundings states along the rivers Niger and Benue were seriously destroyed. This caused huge destruction to the rural and urban infrastructures (farmlands/crops, roads, buildings, drainages, bridges, power-lines, etc.) and socio-economic lives of the areas (Ojigi et al. 2013).

Rainfall and humidity, which affect moisture content, is a key issue during and after harvest. In Nigeria, farmers rely mostly on sun drying to ensure that grains are well dried before storage. If unfavourable weather conditions prevent grains from drying sufficiently, this may lead to an increase in the number of pests and diseases which attack stored grain, as well as create the environment for new insect pests to flourish (Paterson & Lima 2010; Deffenbaugh et al. 2008).

3.2.2 Biological and environmental-relater risks

According to (Meuwissen et al. 2001), attributed production and disease risk as major biological and environmental problems farmers faced within their production activities. The speed with which they multiply is influenced by the prevailing environmental conditions (Nukenine 2010). This decreases the monetary value of the crops (Lewis et al. 2005). There may be attacked by microorganisms carrying diseases. They may also be eaten by caterpillars, slugs, insects, and rodents, monkeys and loose animals which devastate crops. Other biological risks include pest attacks, rotting and fermentation, or damage caused by wandering animals. Other biological factors that cause uncertainties in food production are the diseases in crops, diseases in cattle, the quality of the implements used by farmers, and so on (Donye & Ani 2012).

It may happen that a farmer or processor is ill or dies. For instance, the ongoing humanitarian crisis in

North Nigeria has forced some of the crop farmers and pastoralists to abandon their farms, homes and migrate to the neighbouring countries of Niger, Chad and Cameroon for the safety of lives. This has drastically affected agricultural production in the region. In March 2008, the National Emergency Management Agency (NEMA) recorded about 65 per cent of northern farmers had migrated to the southern part of Nigeria because of the insecurity they faced (Obioha 2009). Most of these farmers who produce beans, onions, pepper, maize, rice, livestock and catfish in the Lake Chad area for the southern states, have been forced to migrate to another part of the country in which they cannot continue the farming process (Eme et al. 2014).

3.2.3 Technical risks

Technical risks are those which comprise of failure of farming methods, storage and processing techniques, and imperfections in the transport systems. There can be a risk of theft, fire, and damage of equipment, buildings and other working implements for agriculture and processing. These implements complement one another to make effective use possible. Production and processing will be limited by the unavailability of one particular input. In addition, the response in output to a change in the level of a single input will depend on the level and variation in the level of all other inputs. However, mechanical breakdown may occur at a critical time of food production (Jaffee et al. 2010). For example, when a plough develops a fault, it may take sometimes for the farmer or processor to get repair parts and this can result to setback in production and processing activities. Farmers can also be confronted with a lack of the technical knowledge about the existence of these production implements. Also, there can be untimely delivery of these inputs which might constitute a great measure of uncertain in food production.

3.2.4 Political and institutional risks

This is a very serious issue when it comes to agriculture in Africa and Nigeria is not an exception. Policies instability is one major problem that limits farmer's production in Nigeria. The policy about import and export keep on changing without long periods of stability. This has made farmers sceptical about producing large quantities, because this may result in price uncertainties. This eroded the competitiveness of domestically produced grains, a situation that acted as a major disincentive to farmers through ultimately creating a state of uncertainty for farmers in rural societies. They would not produce such crops on large scale for fear of losses of produce due to lack of good storage facilities and also the possible sales at lower prices (Azih 2008).

3.2.5 Infra-structure risks

This refers to the problem of machinery breakdown, which leads to a shortage of volume supplied from processing. This may lead to significant losses if is not fixed in time. In addition, infrastructure risk also refers to the absence of the necessary equipment in storage houses. Most of storage facilities by farmers in Nigeria are locally made such as mud rhombus, thatched rhombus, in-hut storage such as earthen pot and warehouse storage. This may be inefficient to store grain for long time. Also, inadequate capacity may be detrimental (Echiegu 2013).

Table 1. **Summary of disruption risk factors and their examples**

Type of risk	Country	Examples	Sources
Weather-related risk	Nigeria and Thailand	Erratic rainfall, high humidity, excess temperature, rainfall untimely	(Donye & Ani 2012; Peel et al. 2007; Thongrattana 2012)
Natural disasters	Nigeria	Flooding, drought, fire, wind storm	(Banmeke et al. 2012; Ojigi et al. 2013)
Biological and environmental-related risk	Nigeria	Pest and disease, animal attack, illness, death rotten and fermentation	(Adejuwon 2005; Lewis et al. 2005)
Political and Institutional risk	Ghana and Nigeria	Policy instability, failure of policy implementation, distribution inefficiency of government incentives, governance-related risk and uncertainty (e.g, corruption), Security-related risk and uncertainty, terrorism, war	Political and Institutional risk
Infrastructure risk	Nigeria	Facility breakdown, inadequate equipment, degraded and undependable transport system, energy supply failure, yield of rice (e.g milling and packaging) can vary	(Olajide & Oyelade 2002),
Technical risk	Nigeria	Machinery breakdown, unavailable of spear parts, technical know-how, untimely delivery of input	(Adekunle et al. 2009; Jaffee et al. 2010)

3.3 Risk prevention (Ex ante) management and coping strategies at different points of rice chain in Nigeria

3.3.1 Prevention strategies

According to (Dupriez & Leener 1988), farmers are faced with many food production uncertainties in rural areas. The most common risk prevention strategies identified in Nigeria range from production strategies such crop rotation, mulching, water harvesting, irrigation, improved water use efficiency, breeding for heat or drought tolerance, use of improved seeds, dry season farming, early harvesting, planting of trees to serve as wind break against incidence of storm, and use of disease resistant seeds, (Antonaci et al. 2014). These local means of risk prevention methods tend to fail in the presence of larger shocks affecting large areas of the farm (Akpan, 2012). The processors make sure that spare parts are available, or are at their disposal where they can easily access it in case of machinery breakdown. Also, farmers seek information from extension agents on weather forecasts.

3.3.2 Coping strategies

These strategies involve measures taken by actors in the chain to manage risk. This includes income diversification activities (such as engaging in off-farm work to complement the income from farming), mixed farming system (such as rearing animals to compliment income), and use of agrochemicals against diseases and pest infestation, crop diversification, insure farm, mixed cropping, and income reserve. The processors take contracts and insurance of their processing facilities. In order to reduce post-harvest grain losses there is a need to maintain grain moisture content at acceptable levels. To minimize the risk of mould growth and mycotoxin contamination, rice grain should have moisture content between 12 % and 13 % for storage in bags, or below 12.5 % for bulk storage in bins or silos deterioration(Pixton & Warburton 1971).

3.5 Government risk management strategies (ex post) in Nigeria

The post-harvest storage systems in Africa need considerable investment in order to improve their performance to a point where PHLs can be substantially reduced. For grains, it may include inventory credit schemes and warehouse receipt systems to accelerate the efficient removal of the grain from the farmer into safe centralized storage (Coulter & Shepherd 1995). Public and private sectors need to develop, invest, and manage, the introduction of interventions and prevention strategies. The following are the coping strategies develop by Nigerian government:

3.6 Grain reserve in Nigeria

The Strategic Grain Reserve Storage Programme (SGRSP) was established in 1989 in anticipation to increase levels of grain production. This was as a result of the government's determination to fulfil the FAO declaration that member countries must hold a minimum food reserve sufficient to sustain its population for 90 days in case of famine, national disaster or war. In order to realise the above mentioned objectives and to provide adequate food for the Nigerian populace, the Federal Government through the Ministry of Agriculture started the construction of 33 metal silo complexes with 25000t capacity for grain storage (Adejumo & Raji 2007). For the purpose of this ten (10) hectares of land were acquired for each of the complexes all over the country. However, only four (4) ha were developed, leaving six (6) ha for future expansion. The complexes were built on well drained, firm land and connected to the national grid (PHCN) to supply electricity. They were also located near major trunk roads for easy accessibility. The following service buildings and facilities were provided at all the food reserve location: (a) control room; (b) bagging plant; (c) warehouse; (d) spare parts store; (e) weighing room (30 t capacity); (f) quality control laboratory; (g) administrative block; (h) standby generator (380KVA); (i) fuel station; (j) borehole with reserve capacity of 2500 gallons per day for water supply; (k) two 250 t/h cleaners to remove foreign bodies which could damage conveying machinery; and, (l) two dryers (batch type) with capacity of 30 t/h for drying incoming grain with about 18% (w.b) moisture on arrival (Babalola 2003).

Food grain storage policy in Nigeria requires 5%, 10% and 85% storage of total annual grain output at the federal, state and on-farm levels, respectively. At the federal level is the strategic grain reserve held for the Nation's food security. At the state level is the buffer stock for both price stabilization and planting materials for the upcoming season (Umeh et al. 1996) Government interventions in commodity storage are mainly designed to stabilize prices, ensure food security in time of disasters, and to support producers. The strategy used to achieve these is management of grain reserves. Strategic stocks may be publicly-owned and managed, or could be privately held commercial stocks governed by national rules set by national governments (Organization for Economic Cooperation and Development (OECD) 2012)

4. Conclusion

The review focuses on various sources of risks that are prevalent in rice supply chain in Nigeria. Different risk prevention strategies and coping strategies applied at different points of the chain were identified. For instance government ex post risk management strategies include import of milled rice, increase in rice production, strategic grain reserve, support for the farmers by providing incentives in form of subsidies and vital information

with regard production techniques and weather forecast. Although, some risks may be beyond the control of the actors or stakeholders in rice's supply chain, it is interesting that, identification of risks prominent in the supply chain will go a long way to provide theoretical evidence for further research. The review has been able to do to show the direction. If these risks can be eventually reduced, avoided and prevented the effect it would have on output will be minimal thereby ensure sustenance of food security. Also these expositions will help government policies that can help stakeholders to curb output fluctuation. The spill-over effect from this can translate into improve the standard of living of smallholders and consumers alike. Research and investment in rice supply chain should be encouraged by government to reduce the incidence of risks and to alleviate poverty. Our results are similar to past studies on marketing constraints (Gabre-Madhin, 2006; Barret, 2008; Dorward et al. 2008), particularly on the need to get institutional capacities right in order to manage risks in commodity supply chain. Our study shows that post-harvest storage systems in Africa need considerable investment in order to improve their performance to a point where post harvest losses (PHLs) can be substantially reduced. Public and private sectors need to develop, invest, and manage, the introduction of interventions and prevention strategies.

5. References

Adejumo, B.A. & Raji, A.O., 2007. Technical Appraisal of Grain Storage Systems in the Nigerian Sudan Savannah. *Agricultural Engineering International: the CIGR Ejournal.*, ix(11), p.12.

Adejuwon, J.O., 2005. Food crop production in Nigeria. I. Present effects of climate variability. *Climate Research*, 30(1), pp.53–60.

Adekunle, O.A. et al., 2009. Constraints to Youth's involvement in agricultural production in kwara state, Nigeria. *Journal of agricultural extension*, 13, pp.102–108.

Agwu, N.M., I.N., N. & C.I., A., 2012. Climate Variability: Relative Effect on Nigeria's Cassava Productive Capacity. *Report and Opinion*, 15(12), pp.11–14.

Aker, J.C., 2010. *Rainfall Shocks, Markets and Food Crises: The Effect of Drought on Grain Markets in Niger.* University and Centre for Global Development, Washington.

Antonaci, L., Demeke, M. & Vezzani, A., 2014. *The challenges of managing agricultural price and production risks in sub-Saharan Africa.*, Rome.

Azih, I., 2008. *A background analysis of the Nigerian agricultural sector (1998 to 2007).*,

Babalola, O.Y., 2003. *Economics of commercial storage of grains: A case study of selected markets in Ogun state.* University of Agriculture, Abeokuta.

Baltenweck, I. & Stall, S., 2007. Beyond one size-fits-All. Measures for commodity system in Kenyan Highlands. *Journal of Agricultural Economics*, Vol 58 pp(3), pp.536 – 548.

Banmeke, T.O.., Akinbile, L.. & Eshare gharan, O.V., 2012. Farmers' awareness of the effects of climate change on agriculture in Delta State, Nigeria. . . In *Agricultural extension strategies for climate change adaptation*. pp. 11 – 14.

Barret, C., 2008. Smallholder market participation: concept and evidence from Eastern and Southern Africa. *food policy*, vol 33, pp.pp. 299–317.

Coulter, J. & Shepherd, A.W., 1995. Inventory credit—an approach to developing agricultural markets. *FAO Agricultural Services Bulletin 120*, p.174. Available at: D:/cd3wddvd/NoExe/…/meister10.htm.

Daramola, B., 2005. Government policies and competitiveness of Nigerian rice economy. In *Rice policy and food security in Sub-Saharan Africa*. Cotonou, Republic of Benin: WARDA.

Deffenbaugh, N.S. et al., 2008. Global warming presents new challenges for maize pest management. *Journal of Environmental Research Letters*, 3, p.9.

Dévelopment, R., 2010. *A Look at the Agricultural Giant of West Africa: Special Issue: Nigeria Grain De Sel.*,

Donye, A.O. & Ani, A.O., 2012. Risks and uncertainties in food production and their implications for extension work in Nigeria. *Agriculture and Biology Journal of North America*, pp.2151–7517.

Dorward, A., Kydd, J. & C., P., 2008. *Traditional domestic markets and marketing systems for agricultural products*,

Dupriez, H. & Leener, P.D., 1988. *Agriculture in African Rural communities*, London: Macmillan Publishers Ltd.

Echiegu, E.A., 2013. Grading and Packaging of Nigerian rice for export: issues, challenges and prospects. *Journal of Agricultural Engineering and Technology (JAET)*, 21(1), p.126.

Eme, O.I. et al., 2014. Challenges of food security in nigeria: options before government. *Arabian journal of business and management review.*, 4(15-25).

Famine Early Warning Systems Network (FEWSNET), 2008. Nigeria Food Security Outlook. , p.8.

Gabre-Madhin, E.Z., 2006. *Building institutions for markets – the challenge in the age of globalization*, Addis Ababa, Ethiopia.: Ethiopia strategy support program, International food policy research institute.

Greig, L., 2009. An analysis of the key factors influencing farmer's choice of crop, Kibamba ward, Tanzania. *Journal of Agricultural Economics*, 60(3), pp.699 – 715.

Horace, B., 1959. *Agricultural Credit in Economically Underdeveloped Countries. A Review of Economic*

Studies, Rome, Italy.
IITA (International Institutes of Tropical Agriculture), 2007. *Doubling maize production in Nigeria in two years: Project description.*, Ibadan, Nigeria.
International Food Policy Research Institute (IFPRI), 2009. *Constraints to increasing Agricultural productivity in Nigeria*,
Jaffee, S., Siegel, P. & Andrews, C., 2010. *Rapid Agricultural Supply Chain Risk Assessment: A Conceptual Framework. . The World Bank.*,
Kostov, P. & Davidova, S., 2013. A quantile regression analysis of the effect of farmers' attitude and perceptions on market participation. *Journal of Agricultural Economics*, 64(1), pp.112–132.
Lalonde, B. & Masters, J., 1994. Emerging logistics strategies. Blueprints for the next Century . *International Journal of Physical Distribution & Logistics Management*, 24, pp.35–47.
Lewis, L. et al., 2005. Aflatoxin contamination of commercial maize products during an outbreak of acute aflatoxicosis in Eastern and Central Kenya. *Environmental Health Perspectives*, 113, pp.1763–1766.
Lire, E., Jeffery, A. & Harrold, A., 2000. Changing in Consumption and Saving behaviour before and after Economic Shocks: Evidence from Zimbabwe. In *International Food and Agribusiness Management Association*. Chicago, pp. 1–39.
Liverpol, L, S, O., Ayoola, G.B. & Oyeleke, R.O., 2009. *Enhancing the Competitiveness of Agricultural Commodity Chains in Nigeria: Identifying Opportunities with Cassava, Rice, and Maize using a Policy Analysis Matrix (PAM) Framework*, Rome.
Meuwissen, M.P.., Huirne, R.B.. & Hardaker, J.B., 2001. Risks and risk management strategies; an analysis of Dutch livestock Farmers. *Livestock Production Science*, 69, pp.43–53.
Nukenine, E.N., 2010. Stored product protection in Africa: Past, present and future. . , 425, pp.26–40.
Obioha, E.E., 2009. Climate Variability, Environment Change and Food Security Nexus in Nigeria. *Journal of Human Ecology*, 26, pp.107–121.
Oguoma, O.., Nkwocha, V.. & Ibeawuchi, I.I., 2010. Implications of middlemen in the supply chain of agricultural products. *Journal of Agriculture and Social Research (JASR)*, 10(2).
Ojigi, M.L., Abdulkadir, F.I. & Aderoju, M.O., 2013. Geospatial Mapping and Analysis of the 2012 Flood Disaster in Central Parts of Nigeria. In *8th National GIS Symposium*. Saudi Arabia.
Olajide, J.O. & Oyelade, O.J., 2002. Performance evaluation of the Strategic Grain Reserve Storage Programme (SGRSP) in Nigeria. *Journal Technovation*, 22, pp.463–468.
Organization for Economic Cooperation and Development (OECD), 2000. *Stabilisation Policies in Developing Countries after the 2007-08 Food Crisis* In Jonatha. A. P. for P. Reduction, ed., Paris.
Organization for Economic Cooperation and Development (OECD), 2012. *Stabilisation Policies in Developing Countries after the 2007-08 Food Crisis.* O. In Jonathan Books (Eds), Agricultural Policies for Poverty Reduction, ed., Paris.
Paterson, R.R.M. & Lima, N., 2010. How will climate change affect mycotoxins in food? *Journal of Food Research International Institute for Biotechnology and Bioengineering, Centre of Biological Engineering, Universidade do Minho, Braga, Portugal.*, 43(1), pp.1902–1914.
Peel, M.C., Finlayson, B.L. & McMahon, 2007. Updated world map of the Köppen-Geiger climate classification. *Hydrology and Earth Systems Science*, 4(1), pp.439–473.
Pixton, S.W. & Warburton, S., 1971. Moisture content/relative humidity equilibrium of some grains at different temperature. *Journal of Stored Products Research*, 6, pp.283–293.
Stevens, J., 1989. Integrating the supply chain. *International Journal of physical Distribution and Materials Management*, 19, pp.3–8.
Thongrattana, P.T., 2012. *Analysis of the uncertainty factors affecting the sustainable supply of rice production in Thailand.* University of Wollongong.
Ukeje, E., 2006. Modernizing Small Holder Agriculture to Ensure Food Security and Gender Empowerment: Issues and Policy.
Umeh, J.C., Agunwambab, C.. & Agada, O.A.D., 1996. Grain stocking and storing in Benue State: An appraisal of the Federal Government of Nigeria's food grain storage policy. *International Journal of Production Economics.*, 45(1-3), pp.261–270.
Yeboah, N.. et al., 2014. Agricultural Supply Chain Risk Identification- A Case Finding from Ghana. *Journal of Management and Strategy.*, 5(2), pp.31–48.
Zanello, G., 2012. Mobile phone and radios: effects on transactions osts and market participation for households in Northern Ghana. *Journal of Agricultural Economics*, 63(3), pp.694–714.

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