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Assessing the Influence of Bullwhip Effect on Price Fluctuation of Agricultural Products at Mbalizi Market in Mbeya, Tanzania

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ABSTRACT
The trends and causes of fluctuation in the price of agricultural products have been viewed and reported from different perspectives. Along the supply chain of agricultural products, the influence of bullwhip effect on price fluctuation has not been addressed. This study employed a cross-sectional research design and stratified random sampling technique to assess the influence of bullwhip effect on fluctuation in the price of agricultural products. Data was collected from 296 agricultural supply chain actors at Mbalizi market in Mbeya, Tanzania using a questionnaire survey and supplemented by a document review. The influence of bullwhip effect on fluctuation in the price of agricultural products was established by using descriptive statistics (frequencies and percentages). The study revealed that lead time, aspiration to achieve economies of scale, batch ordering system, inflated orders, government policies, fear of price increases and shortage gaming influence fluctuation in the price of agricultural products. The study concludes that bullwhip effect amplifies the phenomenon of price fluctuation along the supply chain of agricultural products due to increased or decreased demand expectations among traders and farmers. The authors recommend centralising demand information and adopting supply chain computer-based systems through proper coordination, collaboration and strategic partnerships among traders and farmers. This will enhance better information sharing, thus minimising the domino effect of bullwhip.

Keywords: *Bullwhip effect, agricultural products, agricultural SC, price fluctuation, trends.*

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INTRODUCTION
Price fluctuation is a global and multifaced phenomenon which affects almost all sectors of the economy in many countries. Empirical evidence reveals that the agriculture sector experiences and reports higher rates of fluctuation in the price of agricultural products than any other sector.[1] A global price index shows that the price for agricultural products fluctuates to an average of 9% to 68.5% in a year, compared to 7.7% to 31.6% in non-agricultural products.[2] In the agricultural sector, this

[1] NBS, *The national accounts statistics publication*, (National Bureau of Statistics: Dodoma, Tanzania, 2021): 1-67
[2] EC, *Price dashboard no 122-July 2022 edition*, (European Union: Brussels, Belgium, 2022): 1-8.

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phenomenon can be traced back to the early 20th century which was highly attributed to the impact of the Second World War. To date, the trends of price fluctuation in agricultural products have gained much momentum with different perspectives on the root causes. Its ultimate impacts on the public and the economy have also been given due weight by scholars and policymakers. Substantial increases in the price of agricultural products lead to inflation, thus affecting purchasing power and economic stability.[3] Moreover, an increase in price creates eagerness among farmers to cultivate and produce more for the subsequent year, leading to a high supply of agricultural products. High supply on the other hand results in ultimate decreases in the price. A decrease in price makes farmers lose interest in production resulting in a shortage of food in the market, causing more fluctuation in the price of agricultural products.

Along the supply chain of agricultural products, the trends and the root causes of price fluctuation have been viewed and reported from different perspectives. The global market report indicates that fluctuation in the price of agricultural products is caused by changes in demand, supply and climatic conditions.[4] Studies by Zhang et al.[5] in China and Steven[6] in Uganda showed that government interventions, agricultural policies and changes in climatic conditions contribute significantly to the fluctuation in the price of agricultural products. Nevertheless, the nature of the season, geographical locations, depleted soil and low responses to overcharging customers' requirements are contributing factors to fluctuation in the price of agricultural products.[7] The other major issue that signifies the phenomenon of price fluctuation of agricultural products from the supply chain management perspective is the problem of the bullwhip effect. This phenomenon is described as the variations in demand downstream of the supply chain caused by the distortion of information among supply chain actors.

Adnan and Ozelkan[8] connected the causes of the bullwhip effect along the supply chain to a lack of centralised and coordinated market information, the desire to achieve economies of scale in purchasing through batch ordering system, fear of future shortages and price increases, errors in demand and supply forecasting and long lead time in the delivery of requirements. Overreaction to demand (extra or fewer purchases) both have domino effects on the level of price. However, no empirical literature specifically in Tanzania's context that examines the influences of the bullwhip effect on the trend and fluctuation in the price of agricultural products. Previous studies have focused on the socio-economic[9] and climatic factors[10] and agricultural supply chain challenges.[11] It is from this background; that this study aims to examine the influences of the bullwhip effect on the trend and causes of fluctuation in the price of agricultural products. The study is governed by two specific

[3] J. Wang, Y. Huo, X. Guo and Y. Xu, "The pricing strategy of the agricultural product supply chain with farmer cooperatives as the core enterprise" *Agriculture,* 12, (732), (2022): 1-17.

[4] FAO, *The state of agriculture commodity markets, (*Food and Agriculture Organization of the United Nations: Rome, Italy, 2022): 1-128.

[5] X. Zhang, P. Qing and X. Yu, "Short supply chain participation and market performance for vegetable farmers in China." *Australian Journal of Agricultural and Resource Economics*,.63, (2), (2019): 282–306.

[6] M. Steven, *Agricultural production and price fluctuation in Uganda. A case study of Namungo sub county, Mityana district*, (Kampala International University: Kampala, Uganda, 2018): 1-49.

[7] E. Misaki, M. Apiola, S. Gaiani and M. Tedre, "Challenges facing sub-Saharan small-scale farmers in accessing farming information through mobile phones: A systematic literature review." *Electronic journal of information systems in developing countries,* 84, (4), (2018):1-12.

[8] Z. Adnan, and E. Ozelkan, "Bullwhip effect in pricing under different supply chain game structures." *Journal of revenue and pricing management,* 18, (5), (2019): 393-404.

[9] A. Mchopa, J. Jeckoniah, B. Israel and I. Changalima, "Socio-economic determinants of participation in sunflower value chain among smallholder farmers in Iramba District Tanzania." *East African Journal of Social and Applied Sciences,* 2, (2), (2020): 105–114.

[10] H. Huka, C. Ruoja and A. Mchopa, "Price fluctuation of agricultural products and its impact on small scale farmers development: Case analysis from Kilimanjaro Tanzania." *European journal of business and management,* 6, (36), (2014):155-160.

[11] I. Changalima and I. Ismail, "Agriculture supply chain challenges and smallholder maize farmers' market participation decisions in Tanzania." *Tanzania Journal of Agricultural Sciences,* 21, (1), (2022): 104-120.

questions. (1) What is the trend of the price of agricultural products for the last 12 months: October 2021-September 2022? (2) Does the bullwhip effect account for fluctuation in the price of agricultural products?

LITERATURE REVIEW

Theoretical Perspective

The concept of bullwhip effect stems from the theoretical perspective of information asymmetry. The theory was developed by Akerlof in the 1970s when advocating the root causes of market and business failure. Market failure means inefficient distribution of goods and services which is coupled with price instability.[12] Information asymmetry theory asserts that the imbalance of information between the buyers and sellers is the root cause of market and business failure.[13] It assumes that one part possesses more or better information which is not communicated and shared correctly with the other side, causing information imbalance which in turn affects distribution, demand and the price of the goods or services. Information is a power and key competency for market success among traders since it serves as a tool for competitive advantages.

The theory further holds that business actors can perform better and sustain when they develop a sense of balanced information sharing among themselves. In this study, the information asymmetry theory was employed to explore how the phenomenon of the bullwhip effect contributes to the market failure (price fluctuation) of agricultural products. As defined in this study, bullwhip effect refers to the distortion of demand and market information along the supply chain. Keeping into account that market and demand information is a prime driver of the level of price, therefore distortion of the demand and market information has an ultimate impact on the level of price.[14] From the theoretical perspective of information asymmetry, this study assesses how the bullwhip effect (the distortion of demand information) creates information imbalances among the supply chain actors and its ultimate impact on fluctuation in the price of agricultural products.

The bullwhip effect in the supply chain of agricultural products

The bullwhip effect is the supply chain phenomenon which describes how small fluctuations in demand at the retail level can cause progressively larger fluctuations in demand at the wholesaler, distributor and manufacturer or producers. This phenomenon is described as the distortion of demand information downstream of the supply chain.[15] It occurs at a point when retailers overreact to the demand by ordering too little or too many requirements due to one or more reasons of supply chain practices, causing domino effects along the supply chain. The order tends to increase at each node of the supply chain as we go up in the supply chain. Figure 1 presents a sample fluctuation in demand along the supply chain (actual versus distorted demand) caused by the bullwhip effect.

With the bullwhip effect, small changes in the actual demand at a retail level amplify the expectations of wholesalers, distributors and producers, thus resulting in extra or fewer purchases (distorted demand). Supply chain on the other hand is a set of activities linked upstream and downstream that facilitate the flow of goods, funds and information from the supplier of inputs or raw materials to the ultimate customer.[16] In this study, the supply chain refers to the network and interconnected activities and parties involved to facilitate the efficient flow of agricultural products from the farmers to the customers. The agricultural supply chain is linked by a network of inputs suppliers, farmers, distributors, retailers and the ultimate customers. One of the critical issues that impede the efficient operation of supply chains is the phenomenon of the bullwhip effect.

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[12] Adnan and Ozelkan, "Bullwhip effect in pricing under different Supply Chain," 399.
[13] G. Akerlof, "The Market for Lemons." *Quarterly Journal of Economics,* 84, (1970): 488-500.
[14] H. Rahman, A. Rahman and I. Talapatra, "The bullwhip effect: causes, intensity, and mitigation. Production and manufacturing research, 8, (1), (2020):406-426.
[15] M. Udenio, E. Vatamidou, J. Fransoo and N. Dellaert, "Behavioural causes of the Bullwhip Effect: An analysis using linear control theory. *IISE Transactions*, 49, (10), (2017): 980-1000.
[16] Zhang et al., Short supply chain participation and market performance, 289.

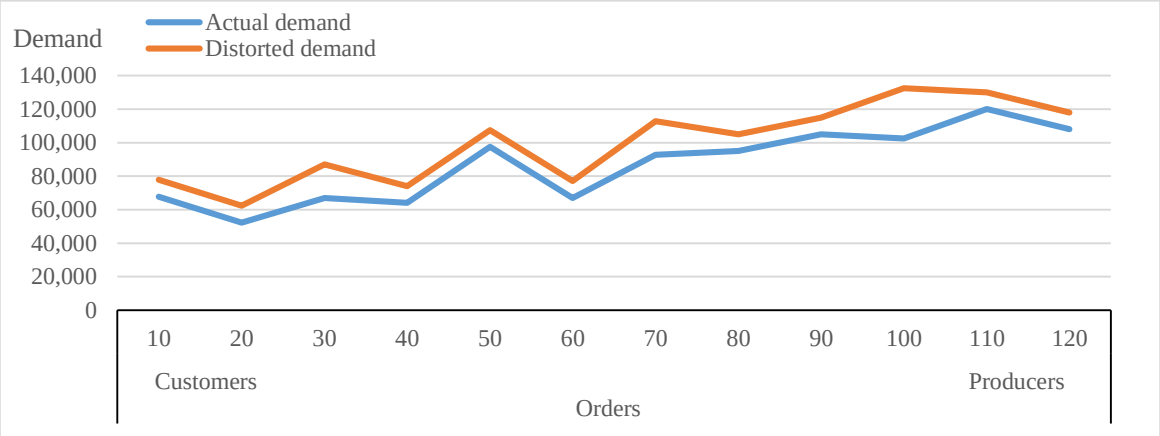

Figure 1: Fluctuation in demand caused by the bullwhip effect (Authors, 2022).

Literature connects the root causes of the bullwhip effect from two perspectives,that is the operational causes and behavioural causes.[17] The operational causes of the bullwhip effect include the supply chain practices which stem from the institutional and physical structure of the supply chain. It is influenced by how the supply chain is structured, how it works and coordinates its activities among its actors. It includes supply chain practices such as coordination, demand and supply forecasting updates, availability, and sharing of information among supply chain actors. Coordination of transportation, delivery lead time, inventory management and order replenishment also form an integral part of the operational causes of the bullwhip.[18] The inefficient organisation, coordination and structure of supply chain activities amplify the problems of the bullwhip effect.

The behavioural causes of bullwhip effect are rooted in how supply chain managers and other supply chain actors make and base their decisions pertaining to supply chain operations. It encompasses the attributes, routines and attitudes of supply chain actors they use in analysing information for decision-making and planning. Behavioural causes of bullwhip effect are sub-optimal supply chain practices enriched through decision-making, which in turn result in an adverse impact on supply chain performance. It includes responses and reactions to demand and supply, fear of future shortage, neglecting the impact of delays and lead time, free return policies and batch ordering system.[19] From the literature, this study summarises the operational and behavioural causes of the bullwhip effect along the supply chain that might have significant influences on fluctuation in the price of agricultural products (see table 1).

[17] K. Dahlin and S. Oscar, *"Causes of the bullwhip effect: A study of the bullwhip effect in the Volvo Group, (*Master's thesis at Linköping University. Linköping University: Linköping, Sweden, 2021):1-24.
[18] X. Yuan, X. Zhang, M. Wang and D. Zhang, "Quantifying the bullwhip effect in a reverse supply chain: The impact of different forecasting methods. Mathematical problems in engineering, https://doi.org/10.1155/2022/2701530
[19] Rahman, et.al., "The bullwhip effect: causes, intensity, and mitigation," 411.

Table 1: The root causes bullwhip effect in the agricultural supply chain

Issues	Meaning	References
Price fluctuation	Increases or decreases in the price level of agricultural products influenced by holding or hoarding of products with anticipation of future price increases	Pena et al.[20]
Free return policies	The practices where customers intentionally overstate the demand due to shortages and then cancel the order when the supply becomes adequate.	Nienhaus et al.[21]
Batch ordering	The practice in which buyers accumulate their orders and buy in large quantities from the retailer, distributors and producers to minimise transactional costs	Coppini et al.[22]
Poor communication	Information asymmetry and lack of transparency in information sharing among the supply chain actors	Ozelkan, et al.[23]
Inflated orders	The practice in which customers, retailers or distributors currently buy in large quantities with fear of future shortages in supply of products	Rahman et al.[24]
Government policies	Government interventions, policies and by-laws that were enacted to monitor the transportation, distribution and marketing of agricultural products	Udenio et al.[25]
Inaccurate forecasts	Errors in estimating the future demand, supply and price of related agricultural supply chain products	Yuan et al.[26]
Impact of economies of scale	Transactional motives and aspire among the supply chain actors who buy in large quantities to achieve quantity discounts and minimise transport cost	Khan et al.[27]
Shortage gaming	The practice in which supply chain actors over-purchase or under-purchase the requirements due to anticipation of future shortage or plentifully supply	Pena et al.[28]
Lead time	The time interval in purchasing estimated from a point an order is placed to the delivery point	Udenio et al.[29]

Causes of fluctuation in the price of agricultural products

The root causes of fluctuation in the price of agricultural products have been viewed and reported from different perspectives. Its ultimate socio-economic impact overly affects producers, distributors, retailers and consumers.[30] Fluctuation in the price of agricultural products adds uncertainties to farmers' income as well as production decisions. Empirical literature reveals that fluctuation in the price of agricultural products is caused by several factors. The causes stem from technological-related issues,

[20] D. Pena, A. Bas and R. Maldonado, "Impact of bullwhip effect in quality and waste in perishable supply chain." *Processes,* 9, (7), (2021):1-18.
[21] J. Nienhaus, A. Ziegenbein and P. Schoensleben, "How human behaviour amplifies the bullwhip effect. A study based on the beer distribution game online." *Production planning and control,* 17, (6), (2006): 547-557.
[22] M. Coppini, C. Rossignoli, T. Rossi and F. Strozzi, "Bullwhip effect and inventory oscillations analysis using the beer game model. *International journal of production research,* 48, (13), (2010): 3943-3956.
[23] E. Ozelkan, C. Lim and Z. Adnan, "Conditions of reverse bullwhip effect in pricing under joint decision of replenishment and pricing. *International Journal of Production Economics,* 200, (2018):207–223.
[24] Rahman, et.al., "The bullwhip effect: causes, intensity, and mitigation," 421.
[25] Udenio et al., "Behavioural causes of the bullwhip effect," 986.
[26] Yuan et al., "Quantifying the bullwhip effect in a reverse supply chain," 6.
[27] M. Khan, S. Ahmed and D. Hussain, "Analysis of bullwhip effect: A behavioural approach. *Supply Chain Forum: An International Journal,* 20, (4), (2019): 310-331.
[28] Pena, et. al., Impact of bullwhip effect, 9.
[29] Udenio et al., "Behavioural causes of the bullwhip effect," 987.
[30] Huka et al., "Price fluctuation of agricultural products," 156.

climatic, economic and operational related factors. A study by Xie and Wang[31] revealed that the use of poor and outdated technology in farming results in price increases while advanced technology does the opposite. Advanced technology fosters production thus increasing the supply of agricultural products at a low price compared to when poor and outdated technology is applied. From a climatic condition perspective, literature shows that the seasonality nature of agricultural products leads to price fluctuation. With seasonal products, producers tend to increase the price during the shortage but when the product is plenty enough the price tends to decrease.[32] Changes in climatic conditions such as drought and floods adversely affect agricultural production which results in shortages and price increases.[33] On the other hand, good climatic condition with adequate rainfall favours agricultural production and a plentiful supply of agricultural products, thus price decreases.

Furthermore, changes in exchange rates lead to price fluctuations since some prices of products increase like fuel gears up transportation costs which evenly affects the price of the product when moved from the farm to the markets.[34] Moreover, the number of firms involved in the production of a certain product influences price fluctuation. Having a large number of firms creates intense competition among producers, eventually leading to price decreases while fewer firms may produce less, which results in higher prices. Changalima and Ismail[35] connected the prevailing level of price for agricultural products at a particular market with the distance from the farm to a market, the efficiency of transport facilities and infrastructure. Their findings assert that long-distance and ineffective transport facilities and infrastructure attract high prices while short-distance and effective transport facilities and infrastructure account for low prices.

A compressive assessment of the influences of the bullwhip effect on fluctuation in the price of agricultural products has not developed yet. Discussions from the previous studies are centred on the socio-economic and climatic factors that influence fluctuation in the price of agricultural products[36], agricultural supply chain challenges and the socio-economic impact of price fluctuation[37] and the causes of bullwhip effect along the supply chains.[38] Discussion on the influences of bullwhip effect on fluctuation in the price of agricultural products has been neglected, especially in Tanzania's context. As discussed, there are numerous causes of bullwhip effect that are believed to have a significant influence on the price of agricultural products. However, it is not possible to ascertain the influence of each cause available in the literature. In this regard, this study enhances the general knowledge of scholars, supply chain managers and practitioners on the influences of bullwhip effect on fluctuation in the price of agricultural products.

METHODOLOGY

There are pieces of literature which examine the causes of fluctuation in the price of agricultural products by using different designs and approaches in different perspectives and scopes. This study employed a cross-sectional research design to assess and establish the influence of the bullwhip effect on fluctuation in the price of agricultural products. The study aimed at assessing and describing the phenomenon of the bullwhip effect and fluctuation in the price of agricultural products at a single point in time (one year), from October 2021 to September 2022, thus tied well with the focus of the study's design.[39] The target population for this study were 386 agricultural supply chain actors, comprising customers, retailers, distributors and farmers who were proportionally divided into four strata of 96

[31] H. Xie and B. Wang, "An empirical analysis of the impact of agricultural product price fluctuations on China's grain yield. Sustainability, 9, (2017):1-14.
[32] Wang et al., "The pricing strategy of the agricultural product," 11.
[33] Huka et al., "Price fluctuation of agricultural products," 157.
[34] Zhang et al., "Short supply chain participation and market performance," 293.
[35] Changalima and Ismail, "Agriculture supply chain challenges," 107.
[36] Huka et al., "Price fluctuation of agricultural products," 154.
[37] Xie and Wang, "An empirical analysis of the impact of agricultural product price fluctuations," 11.
[38] Rahman, et.al., "The bullwhip effect: causes, intensity, and mitigation," 411.
[39] U. Flick, *Introducing Research Methodology: Thinking Your Way Through Your Research Project*, (SAGE Publications: London, Britain, 2020).

respondents. It is believed that these actors are the sources of the bullwhip effect in any supply chain.[40] Israel's formula for infinite population (1992), $n = Z^2pq/e^2$ was used to determine the specified sample size with 0.05 tolerance error. Stratified random sampling was used to select the unit of analysis from each stratum. Only agricultural supply chain actors with an average of more than one year in dealing with agricultural products were sampled for analysis. This helped the researchers to collect and analyse valid data from respondents with a wider understanding and experience of the variables under investigation.

The study was conducted at the Mbalizi market in the Mbeya region. Mbalizi market is the leading and central market for agricultural products in the Southern Highland of Tanzania which brings together and integrates farmers, distributors, retailers and customers from the neighbouring regions and the country at large. Moreover, the Mbeya region is one of the leading regions that produce and distribute to other regions almost all types of products. Nevertheless, the Mbeya region is one of the regions that have been regularly sampled by the Ministry of Investment, Industry and Trade (MIIT) to establish the weekly and monthly trends in the price of agricultural products in Tanzania. It is from the aforementioned criteria, Mbalizi markets in the Mbeya region were selected for observations of the variables under the study. Seven (7) agricultural products were selected: maize, rice, beans, sorghum, bulrush millet, finger millet and round potatoes whose data on the trend of price have been regularly monitored and published by the MIIT. The study collected both primary and secondary quantitative data. Secondary quantitative data related to the trends of agricultural products were collected through documentary review. Mainly, a weekly and monthly market bulletin on the trends of the price of agricultural products for the previous 12 months (October 2021-September 2022) were retrieved from the MIIT and reviewed.

Primary quantitative data were collected from customers, retailers, distributors and farmers using a questionnaire survey to assess the implications of information asymmetry theory on fluctuation in the price of agricultural products. Information asymmetry theory assumes that market and business failure is the result of the imbalance of information between buyers and sellers. Therefore, information asymmetry theory was used to ascertain whether the bullwhip effect influences fluctuation in the price of agricultural products using a set of multiple-response questionnaires. Data pertaining to the causes of the bullwhip effect (practices) along the supply chain of agricultural products such as batch ordering system, reaction to future demand and price, inflation of orders, government intervention, lead time and demand information asymmetry were sought from the target respondents. A set of self-administered questionnaires containing multiple response questions were issued to 384 respondents through the drop-and-pick later method. However, only 77.1% (n=296; 71 customers, 76 retailers, 68 wholesalers and 81 farmers) of questionnaires were successfully filled and returned. The influence of the bullwhip effect on fluctuation in the price of agricultural products was ascertained by using descriptive statistics (frequencies and percentages) which were generated through multiple responses.

RESULTS AND DISCUSSION

Trends in the fluctuation of the price of agricultural products

The trends of price fluctuation for the selected agricultural products in the last 12 months are depicted in table 2 and figure 2. The price of beans was significantly higher compared to the price of other products followed by the price of rice and finger millet. The minimum price for 100kgs of maize was Tsh. 47,800/= in October 2021 and turned out to Tsh. 120,000/= as the maximum price in August 2022. In October 2021, the price for 100kgs of beans was Tsh. 202,500/= as the minimum price and turned out to Tsh. 260,000/= in December 2021 before falling back to Tsh. 213,300/= in February 2022. The maximum price for 100kg of beans was Tsh. 267,500/=. The minimum price for 100kgs of rice was 152,500/= in November 2021 and kept fluctuating up to a maximum of Tsh. 235,000/= in September 2022. Round potatoes revealed the lowest level of price than other products followed by maize and bulrush millet. The price for 100kgs of round potatoes stood at Tsh. 56,500/= as the minimum price in

[40] Yuan, et al., "Quantifying the bullwhip effect in a reverse supply chain," 9.

October 2021 and Tsh. 101,000/= in September 2022 as the maximum price. The analysis further revealed rapid fluctuations in the price of sorghum from the minimum price of Tsh. 65,000/= in January 2022, Tsh. 90,000/= in October 2021, Tsh. 75,000/= in December 2021 to a maximum of Tsh. 145,000/= in May 2022.

Table 2: Fluctuation in the price of selected agricultural products: October 2021-September 2022

Types of agricultural products	Level of price (Tsh/100kgs)		
	Minimum	**Maximum**	**Average**
Maize	47,800	120,000	84,075
Rice	152,500	235,000	198,475
Beans	202,500	267,500	227,775
Sorghum	65,000	145,000	104,792
Bulrush millet	70,000	115,000	93,025
Finger millet	157,500	185,000	168,683
Round potatoes	56,500	101,000	74,533

The price for 100kgs of finger millet fluctuated from Tsh. 170,000/= in October 2021 to a minimum price of Tsh. 157,500/= in November 2021 before rising up to Tsh. 185,000/= in April 2022. For bulrush millet, the minimum price of 100kgs was Tsh. 70,000/= while the maximum price was Tsh. 115,000/=. Generally, it is revealed that the price of the seven (7) examined agricultural products have been fluctuating (decreasing or increasing) for the last 12 months (see figure 1). This is an indication that the price of agricultural products never stabilises, it keeps fluctuating on a daily, weekly or monthly basis due to one or more seasons. In their studies, Huka et al.,[41] Steven[42] and Xie and Wang[43] spotted the changes in climatic conditions, poor infrastructure, low production, poor storage facilities, government regulations and seasonal production as the prime contributing factors to fluctuation in the price of agricultural products.

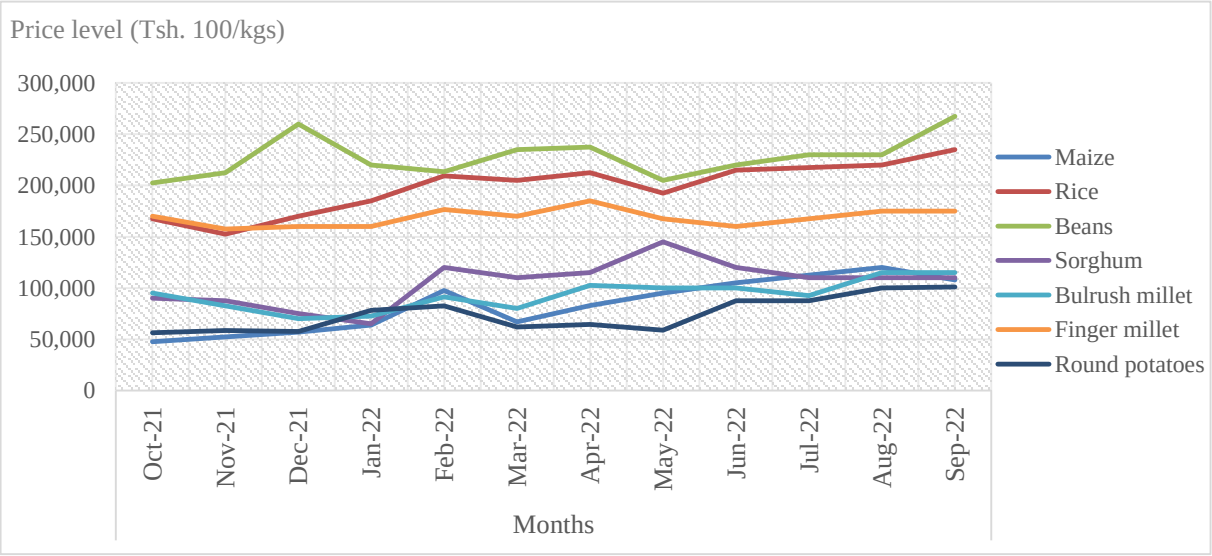

Figure 2: Trends in the fluctuation of the price of agricultural products
Source: Extracted from the National Bureau of Statistics (2022)

[41] Huka et al., "Price fluctuation of agricultural products," 157.
[42] Steven, "Agricultural production and price fluctuation in Uganda," 46.
[43] Xie and Wang, "An empirical analysis of the impact of agricultural product price fluctuations," 13.

Influences of bullwhip effect on price fluctuation of agricultural products

This section of the discussion presents and discusses the results of the influences of the bullwhip effect on fluctuation in the price of agricultural products as one of the contemporary issues in supply chain management. The results of the influences of the bullwhip effect on price fluctuation are summarised in table 3. Holding and hoarding agricultural products with anticipation of future price increases was mentioned by 88.17% (n=261) of the respondents. This implies that hoarding of agricultural products influences fluctuation in the price of agricultural products. Specifically, farmers and distributors tend to hold agricultural products with anticipation of selling them in the future when the price is relatively high. This practice creates deficit and scarcity in the market, thus causing price increases.[44] Contrary to their anticipation at the point of selling, price decreases due to the plentiful supply of agricultural products.[45] Accumulation of order under the batch ordering system was spotted by 87.16% (n=258) of respondents and ranked 2nd among the bullwhip effect which influences fluctuation in the price of agricultural products. Customers and retailers mostly prefer accumulating their requirements and buying in large quantities with an intention and aspiration to achieve economies of scale in transportation. This practice alerts wholesalers and farmers as the indicator of increased demand, thus increasing the price of agricultural products.[46] However, in the short-run or long-run distributors and farmers experience limited demand which results in price decreases.[47]

Table 3: Multiple response results: bullwhip effect and agricultural products price fluctuation

Root causes of the bullwhip effect	Count	Per cents (%)	Ranking
Holding of products with anticipation of future price increases	261	88.17	1
Accumulation of order under batch ordering system	258	87.16	2
Purchasing lead time in the delivery of agricultural products	255	86.15	3
Inflated orders due to fear of future shortages in supply of products	232	78.38	4
Transactional motives and aspiration to achieve quantity discount	224	75.68	5
Government interventions, policies and by-laws	218	73.64	6
Wrong demand and supply forecasts	209	70.61	7
Demand and supply information asymmetry among actors	197	66.55	8
Over-purchasing and under-purchasing of requirements	175	59.12	9
Intentionally overstating and cancelling the demand	147	49.66	10

Order processing time (lead time) was mentioned by 86.15% (n=255) of respondents as one of the practices pertained to the bullwhip effect which plays a significant role in altering the price of agricultural products. The longer the order processing time, the more it creates scarcity particularly at the retailers causing price increases.[48] Moreover, a long lead time results in more quantities ordered and safety stock while a short lead time results in the opposite, thus more fluctuations in price.[49] It was established by 78.38% (n=232) of respondents that inflated orders due to fear of future shortage in the

[44] Wang et al., "The pricing strategy of the agricultural product," 11.
[45] Ozelkan et al., "Conditions of reverse bullwhip effect in pricing," 218.
[46] Pena, et. al., "Impact of bullwhip effect," 8.
[47] B. Israel, D. Majaliwa and M. Kinala, "Contribution of Agricultural Marketing Co-operatives in Commercialisation Among Smallholder Maize Farmers in Mbozi District, Tanzania." *Journal of Studies in Social Sciences and Humanities*, 8, (1), (2022): 98–111.
[48] Yuan, et al., "Quantifying the bullwhip effect in a reverse supply chain," 9.
[49] Adnan and Ozelkan, "Bullwhip effect in pricing under different supply chain game structures," 398.

supply of agricultural products causes price fluctuation. This implies that over-reaction and under-reaction to supply and demand expectations by ordering too many or too few products contribute to price fluctuation which was ranked 9th in this study and spotted by 59.12% (n=175) of respondents. This finding support Adnan and Ozelkan's[50] findings that over-reacting to demand due to fear of future shortage results in over-purchasing which leads to scarcity and ultimate increases in price. On the other hand, when the shortage seasons never came, customers and retailers go back to their normal orders, causing more fluctuations in price. About 75.68% (n=224) of respondents further mentioned that transactional motive with aspires to achieve quantity discount among the traders is also a causative agent to fluctuation in the price of agricultural products. Quantity discounts enable traders to buy and hold agricultural products in large quantities, the practice which results in limited demand in the future thus causing more variability in price.[51]

Government interventions, policies and by-laws also result in price fluctuation of agricultural products (73.64%, n=218). Government policies and interventions, particularly on the import and export of agricultural products, impact agriculture's price fluctuation. Regulations that restrict the export of agricultural products result in plenty of supply and decreased demand for agricultural products within a country causing decreases in price.[52] On the other hand, policies toward export enable farmers to exploit the global market, resulting in increased demand and the price of agricultural products.[53] Furthermore, 70.61% (n=209) of respondents argued that wrong forecasts in demand and supply of agricultural products are one of the bullwhip effect-related issues that influence price fluctuation. A better forecast is needed to balance the production, demand and price of agricultural products at each node of the agricultural supply chain. Like Adnan and Ozelkan's[54] and Pena et al's[55] findings, this study asserts that poor forecasting results in a mismatch between the demand and supply of agricultural products, causing variability in the price. Demand and supply information asymmetry among agricultural supply chain actors was mentioned and spotted by 66.55% (n=197) of respondents. This implies that market demand and supply information is not correctly shared along the agricultural supply chain actors. This makes it difficult in setting and stabilising the price of agricultural products. This finding concurs with Xie et al's[56] and Wang et al's[57] and Rahman et al's[58] findings that wrong demand and forecasting tend to create more variations in the price at different nodes of the agricultural supply chain.

Contributions, limitations and theoretical implications

Despite several pieces of literature which address the factors that influence fluctuation in the price of agricultural products, none of them examines the influences of the bullwhip effect. Previous studies focus on the causes from socioeconomic, climatic conditions and supply chain challenges perspectives. Using asymmetry information theory, this study enriches the literature by assessing the influences of the bullwhip effect on fluctuation in the price of agricultural products. However, the findings are limited to trends and fluctuations in the price of selected agricultural products in Tanzania's context. The trends in the price of agricultural products other than the selected ones were not accounted for. Moreover, the assessment is limited to a single production season (October 2021 – September 2022). Therefore, the findings of this study should not be generalised to other products and seasons other than the specified. Information asymmetry theory prescribes the consequences of the imbalance of information among the supply chain actors as the root cause of market and business failure. The

[50] Wang et al., "The pricing strategy of the agricultural product," 11.
[51] Xie and Wang, "An empirical analysis of the impact of agricultural product price fluctuations," 13.
[52] Zhang et al., "Short supply chain participation and market performance," 293.
[53] Pena, et. al., "Impact of bullwhip effect," 8.
[54] Adnan and Ozelkan, "Bullwhip effect in pricing under different supply chain game structures," 401.
[55] Yuan, et al., "Quantifying the bullwhip effect in a reverse supply chain," 9.
[56] Xie and Wang, "An empirical analysis of the impact of agricultural product price fluctuations," 13.
[57] Wang et al., "The pricing strategy of the agricultural product," 11.
[58] Rahman, et.al., "The bullwhip effect: causes, intensity, and mitigation," 421.

findings presented and discussed in this study ascertain how information asymmetry among the supply chain actors causes market failure (price fluctuation) for agricultural products. Apart from the climatic condition and socio-economic factors, it was revealed that fluctuation in the price of agricultural products is also influenced by information asymmetry (the bullwhip effect) among the supply chain actors. Issues like shortage gaming, fear of future shortage and price increases, inaccurate forecasting, delayed lead time, inflated orders and batch ordering system are the root causes of the bullwhip effect or otherwise information asymmetry which in turn affect the price of agricultural products.

CONCLUSION AND MANAGERIAL IMPLICATIONS

The study identified and ranked the prime causes of the bullwhip effect and their influence on fluctuation in the price of agricultural products by a means of frequencies and percentages. The findings of the study are that batch ordering system, shortage gaming practices, inflating orders, agricultural demand and supply information asymmetry, order processing lead time, wrong demand and supply forecasts, over and under-reaction to demand, transactional and precautionary motives and government interventions are the root causes of the bullwhip effect which play an imperative role on fluctuation in the price agricultural products. The bullwhip effect results in distortion of demand and supply information, which in turn result in price fluctuation.

To minimise the problem of the bullwhip effect and price fluctuation, the authors recommend toward centralised demand and supply information-sharing system through coordination, collaboration and strategic partnerships among farmers, distributors, retailers and customers. Moreover, supply chain managers and practitioners should adopt computer-based systems that integrate and connect supply chain actors such as vendor-managed inventory (VMI), enterprise resources planning (ERP) and electronic data interchange (EDI). This will enhance better information-sharing systems for agricultural products (demand, supply and price) among agricultural supply chain actors. Since the price of agricultural products fluctuates over time, the authors suggest that a longitudinal case study be conducted. Among others, the study should include climatic and socio-economic factors as the explanatory variable with a mediating role of the bullwhip effect. This will enrich the literature on the causes of fluctuation in the price of agricultural products from climatic, socio-economic and supply chain perspectives.

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