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The moderating effect of farming contracts on the relationship between responsive supply chain elements and supply chain resilience

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C H R O N I C L E

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A B S T R A C T

Food supply chain disruptions have of recent increased in terms of severity and frequency leading to viability problems for most businesses in related supply chain networks and hunger among millions of human beings. In the extant supply chain literature elements of responsive supply chain such as velocity, versatility, and visibility have been suggested as some of the possible strategies to build supply chain resilience. It has therefore been suggested in this study that these elements' influence on supply chain resilience is moderated by contract farming as a special form of supplier development. Farming contracts are either production or marketing contracts. Data was collected from a conveniently selected sample of 200 restaurants that use supplier development in the form of contract farming for acquiring critical resources for their operations. A structural equation modelling was used to analyse data related to the direct effects and multi group structural equation modelling was used to assess the moderating effects. The results revealed that there is a statistically significant relationship between the three selected elements of responsive supply chain management and supply chain resilience, and all the hypothesised relationships were moderated by type of farming contracts, with the relationships being stronger under marketing contracts for supply chain velocity, and under production contracts than under marketing contracts for relationships involving versatility and visibility. Therefore, the study recommended that production contracts be used in the fast-food restaurant industry in order to reduce supply chain vulnerabilities, and marketing contracts to build supply chain capabilities. This is the first study that has sought to assess the differential utility of different farming contracts through assessing their moderating effects as a build-up on previous research that has already established that supplier development in the form of contract farming leads to supplier development.

1. Introduction

Poultry meat has become the leading source of protein for most citizens in Zimbabwe as evidenced by it being a major ingredient in most menus (Mukucha & Jaravaza, 2021). The consumption of poultry by far exceeds that of beef, pork, mutton, chevon, and game meat combined. This has been attributed to the popularisation of poultry meat as healthier, affordable, easily accessible, and associated with less complicated breeding and rearing methods (Taylor & Field, 2014). Moreover, poultry has a shorter breeding cycle than most of the other meat sources (Banaszak, Biesek, Kuźniacka, Grabowicz, & Adamski, 2021) making its supply to the market faster. However, the poultry meat supply chain has been severely affected by disruptions of varying frequencies and severities. The sources of disruptions ranged from COVID 19 pandemic that restricted the flow of input material, rise in input costs, shortages of breeding stock, poor quality chicks that resulted in higher mortality rates, and outbreaks of poultry diseases like New Castle. This resulted in 2.45% decline in the output of the poultry industry in 2020.

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Recently the poultry industry in Zimbabwe recovered from the disruptions it has been facing as a result of a multi-pronged approach involving the Government of Zimbabwe (GOZ) and the private sector. As a way of resuscitating the industry the GOZ invoked the Statutory Instrument SI124 of 2017 which suspended duty on fertilised eggs and broiler chicken breeding stock. Moreover, the above normal rainfall received during the year led to the abundance of stock feeds at affordable prices. However, despite the availability of the necessary inputs for poultry farming the farmers still lacked the necessary capital to reinvest in their businesses after having experienced some set-backs. The restaurant industry intervened through implementing contract farming initiatives involving either production contracts or marketing contracts. Contract farming is a special type of supplier development that is unique to the agro processing industry (Mukucha & Chari, 2021). Farmers under the production contracts were provided with day-old chicks, vaccines, disinfectants, stock feeds, extension services, and a guaranteed market for their produce, and the buyers would then deduct the cost of the provided support from the farmers' sales proceeds. Those under marketing contracts self-financed themselves, but had a guaranteed market also.

The frequency and severity of the poultry meat supply chain disruptions has necessitated the need to come up with strategies to reduce or recover from future disruptions through building resilient supply chains. A recent empirical study by Mukucha and Chari (2022) has revealed that supplier development in the form of contract farming leads to supply chain resilience. However, although that study revealed some great insights, it did not distinguish the effects of various forms of contract farming. The most dominant variants of contract farming are production contracts and marketing contracts (Ruml & Qaim, 2020). There is a possibility that these two types of farming contracts have differential effects on building supply chain resilience. However, a search in literature did not reveal any study that had sought to assess how contract farming strengthens the influence of responsive supply chain elements on supply chain resilience. Therefore, this study seeks to determine the moderating effects of farming contracts on the link between selected supply chain responsive elements and supply chain resilience.

The rest of the study is organised as follows: Immediately after this section is literature review and hypotheses development. The literature shall discuss how responsive supply chain elements such as velocity, velocity, and visibility act as the enablers of supply chain resilience. Literature review shall also include the mechanisms through which various types of farming contracts buffer or strengthen the relationship between responsive supply chain elements and supply chain resilience through grounding in the Resource Based View (RBV) theory. Literature review shall be followed by the operationalization of the hypotheses developed in the preceding sections, and then the presentation and discussion of the results. Lastly, the study shall lay out the managerial implications of the study, limitations and the future research agenda.

2. Literature review

2.1 Supply chain resilience

Supply chain resilience is defined in the extant supply chain management literature by Ponomarov and Holcomb (2009:131) as "*the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function*". This definition suggests that resilient supply chains' first line of defence is to resist any form of disruption (Panomarov & Holcomb, 2009). In the event of being overcome by a disruption resilient supply chains quickly recover to their pre-disruption levels (Singh, Soni & Badhotiya, 2019; Kamalahmadi, & Parast, 2016) or even perform better than before within a reasonable timeframe and at an affordable cost outlay (Golgeci & Kuivalainen, 2020). Furthermore, the insights distilled from this definition are that resilient supply chain networks are associated with vulnerability and capability elements (Kaviani, Tavana, Kowsari & Rezapour, 2020; Ribeiro & Barbosa-Povoa, 2018; Elleuch, Dafaoui, Elmhamedi & Chabchoub, 2016; Mandal, Sarathy, Korasiga, Bhattacharya & Dastidar, 2016). The vulnerability dimension is made up of elements that can potentially cause a disruption along the supply chain network (Kaviani *et al*., 2020). These elements range from internal factors such as industrial actions, fuel shortages, and machinery breakdown (Singh *et al*., 2019; Scholten & Schilder, 2015) to external factors such as armed conflicts, and natural disasters (Christopher, 2016; Christopher & Peck, 2004). These vulnerabilities can be mitigated by the application of the responsive supply chain elements such as versatility and visibility (Singh *et al*., 2019). Furthermore, effective responses to vulnerabilities requires members of a supply chain network to possess some capabilities (Kaviani *et al*., 2020).

Capabilities are the strengths at the disposal of a firm (Jafari, Eslami & Paulraj, 2022) which can be used to respond to a disruption (Munir, Jajja & Chatha, 2022; Kaviani *et al*., 2020). For effective recovery resources need to be at the disposal of all the supply chain network members (Singh *et al*., 2019). This is grounded in the RBV theory which posits that firms use assets at their disposal to attain some competitive advantage (Barney, Ketchen & Wright, 2011). These assets can either be tangible or intangible (Barney, 1991). Tangible resources can be financial or materials such as plants and machinery. Intangible resources include, but not limited to collaborations (Scholten & Schilder, 2015). However, resources are not evenly distributed among supply chain members. This is particularly true in the agro processing industry where farmers as suppliers are mostly poorly resourced (Minot & Sawyer, 2016). Therefore, the concept of contract farming comes in hand to capacitate tier 1 suppliers in the agro processing supply chains who in this case are farmers. Most of the farmers in developed countries like Zimbabwe simply possess land and nothing else above that (Mazwi, Chambati & Mutodi, 2018). This is a result of the elimination of large scale commercial farmers through the fast track land reform programme (FTLRP) at the turn of this century which has left the agro processing firms with contract farming as the only alternative way of

sourcing for critical raw materials (Mazwi, Chemura, Mudimu & Chambati, 2019). It is therefore suggested in this study that contract farming as part of the capabilities contributes towards the attaining of resilient supply chains. However, contract farming is a product of either production contracts or marketing contracts. Therefore, in building resilient supply chains contract farming is proposed to play a moderating role between responsive supply chain elements and supply chain resilience where the strength of the relationship is expected to vary depending on the type of farming contract adopted.

Supply chain resilience has gained prominence in the recent years as result of recurrent supply chain disruptions that has affected many businesses and millions of human beings across the globe (Katsaliaki, Galetsi & Kumar, 2020; Singh *et al*., 2019; Brusset & Teller, 2017). A growing body of literature has revealed various antecedents of supply chain resilience such as flexibility (Kamalahmadi, Shekarian & Parast, 2021), redundancy (Kamalahmadi, & Parast, 2016), social capital (Golgeci & Kuivalainen, 2020), and postponement (Al-Hakimi, Borade, Saleh, Nasr, 2022; Carbonara, & Pellegrino, 2018). Several conceptual frameworks have also suggested that responsive supply chain elements such as supply chain velocity, versatility, and visibility are enablers of supply chain resilience (.e.g. Mandal, Sarathy, Korasiga, Bhattacharya & Dastidar, 2016). More recently, in a study by Mukucha and Chari (2022) supplier development in the form of contract farming was also found to be another predictor of supply chain resilience. However, what is missing in the extant literature is how contract farming interacts with responsive supply chain elements to enhance supply chain resilience.

2.2 Responsive supply chain management

Supply chain responsiveness is of paramount importance in many markets (Lysons & Farrington, 2020) in that it helps to maintain higher levels of order fill rate leveraging on resilience supply chains (Christopher, 2016; Christopher & Towill, 2000). The responsive supply chains result from carefully focusing on velocity, versatility, and visibility (Coyle, Langley Jr, Novack & Gibson, 2021; Wisner, Tan & Leong, 2016; Scholten & Schilder, 2015). These elements synergistically combine to build resilient supply chains since visibility works well for developing capabilities while velocity works well for speedy recovery (Juan, Li. & Hung, 2022; Mandal *et al*., 2016).

2.2.1 Supply chain velocity

Supply chain velocity is the pace of the movement of materials along the supply chain network (Scholten & Schilder, 2015). It can also be regarded as the speed with which market changes are reacted to in the supply chain (Juttner & Maklan, 2011). The speed required ranges from the procurement of production inputs, production processes, and order fulfilment processes (Lysons & Farrington, 2016). The importance of supply chain velocity in supply chain management is that it increases customer satisfaction, reduces shipping time and costs, and prevents production stoppages (Ahimbisibwe *et al*., 2016). Supply chain velocity further reduces damages and spoilage of the inventory in transit and inventory holding costs (Christopher & Perk, 2004). The reduction in shipping time leads to reduced supply chain costs (Chopra, Meindl & Kalra, 2018). Supply chain velocity is accelerated through eliminating non value adding activities, and speeding up the order processing routines (Christopher & Perk, 2004). In the event of a disruption taking place the recovery efforts depend on the pace with which materials flow along the supply chain network (Singh *et al*., 2019). Thus, the supply chain networks are restored to their usual states when the velocity for the movement of materials within the supply chain network is accelerated (Scholten & Schilder, 2015). It is therefore suggested that;

H_1: *Supply chain velocity leads to supply chain resilience.*

2.2.2 Supply chain versatility

Supply chain versatility which is described as the adaptation to the volatility (Singh *et al*., 2019) or adaptation to the inconsistency in the materials flow along the supply chain network (Campuzano-Bolarín, Mula, Díaz-Madroñero & Legaz-Aparicio, 2020) is also known as agile supply chain management (Lysons & Farrington, 2020). Supply chain versatility is necessitated by supply and demand variability. Supply and demand variability refers to the discrepancies in demand and planning (Germain, Claycomb & Droge, 2008). The sources of variability are either predictable or unpredictable (Chopra *et al*., 2018). Predictable variability emanates from seasonal production. Unpredictable variability arose from unexpected equipment failure. Reduced variability leads to better planning (Lysons & Farrington, 2020). Traditionally demand variability is offset by having safety inventory while supplier variability can be reduced through information sharing with strategic partners who can be suppliers or customers (Tai, Anderson, Hien Duc, Thai & Yuan, 2022) preferably through a single portal that caters for forecasts, placement of purchase orders, and administering of shipping activities for all the suppliers. Versatility deals well with attaining a quick recovery from a disruption (Singh *et al*., 2019). It is therefore anticipated that;

H_2: *Supply chain versatility leads to supply chain resilience*

2.2.3 Supply chain visibility

Supply chain visibility (SCV) refers to the ability to view vital information throughout the entire supply chain network (Şahin, & Topal, 2018) through creating an efficient inventory tracking system (Wisner *et al*., 2016; Scholten & Schilder, 2015). An efficient tracking system makes the operations more cost effective through being lean and agile (Singh, Soni & Badhotiya, 2019). SCV further makes the handling of exceptions more efficient (Somapa, Cools & Dullaert, 2018). The exceptions include late shipments, late customer requests, and missed forecasts (Wisner *et al*., 2016). Visibility to tier one

suppliers only is not enough to deal with supply chain disruption (Schilten & Schilder, 2015). Therefore, appropriate visibility should extend beyond tier one suppliers (Moshood, Nawanir, Sorooshian & Okfalisa, 2012). The provision of relevant information that has an impact on the smooth flow of material along the supply chain network makes it easier to anticipate any potential disruptions (Singh *et al*., 2019). The foreseeing of potential disruptions create room for supply chain practitioners to devise mitigatory measures and contingency plans that will make the supply chain network more resilient (Ahimbisibwe, Ssebulime, Tumuhairwe & Tusiime, 2016). Thus, through a clear visibility the system can plan for appropriate alternative sources of supply (Baah, Agyeman, Acquah, Agyabeng-Mensah, Afum, Issau, Ofori & Faibil, 2020). It therefore prudent to suggest that;

H_3: *Supply chain visibility leads to a supply chain resilience*

2.3 Contract farming

Contract farming is increasingly becoming the dominant method of financing agricultural activities (Minot & Sawyer, 2016) on the background of the efforts from its proponents such as multilateral development agencies, donors, and governments (Bellemare & Bloem, 2018; Ragasa *et al*., 2018). Contract farming has been found to be an institutional response to alleviate market failures through reducing marketing and production risks (Ruml & Qaim, 2020). This is usually achieved through investing in smallholder farmers (Mazwi *et al*., 2019). In fact most of the cash crops such as cotton and tobacco are produced under contract farming arrangements (Mazwi *et al*., 2018). Contract farming is a special form of supplier development and is one of the key dimensions of agricultural supply chains (Ruml & Qaim, 2020). The increasing popularity of contact farming at the expense of open market sourcing is based on the fact that farming contracts enable a stable and continuous supply of raw materials for agro processing firms. Furthermore, contract farming reduces supply risks and transaction costs (Ruml and Qaim, 2020) especially where the contracted suppliers are fewer than the suppliers in open market transactions (Mazwi, Chambati & Mudimu, 2020).

Extant literature revealed that there are two main types of farming contracts: production contracts, and marketing contracts (Veettil, Yoshoda. & Johny, 2021; Ruml & Qaim, 2020). In production contracts a buyer owns the product and a farmer is compensated for his services, while marketing contracts are limited to the forward agreement on quantity, price, quality, and delivery timing with a farmer maintaining ownership over the produce (Ruml, Ragasa & Qaim, 2020). A farmer only guarantees the buyer a specified quantity at an agreed unit price (Mazwi *et al*., 2018). Farmers under marketing contracts use their own resources to invest in farming equipment and input resources (Ruml, Ragasa & Qaim, 2021).

The resources provided to the farmers through the production contracts enables them to make necessary investments in assets that enables them to speedily conduct their production and logistics services (Mazwi *et al*., 2018). The logistics infrastructure necessary for farmers include, but not limited to delivery trucks. These investments enable timely responses to irregular customer requests and speed delivery of the requested items at a very short notice (Wisner *et al*., 2016). This may not be case in marketing contracts where the farmers usually have inadequate resources to respond timeously to unplanned customer requests especially during supply chain disruptions. It is therefore anticipated that;

H_4: *The positive effect supply chain velocity on supply chain resilience is stronger under production contracts than marketing contracts*

The versatility in supply chain is likely to be attained through contract farming arrangements since contract farming has been identified as a special form of vertical integration (Mukucha & Chari, 2021). Through that kind of integration there is room for coordinating activities with the upstream members of the supply chain (Lysons & Farrington, 2016). It is through this coordination that adaptability to turbulence is achieved. Versatility in supply chain operations has an effect of enhancing resilience during supply chain disruptions. Moreover, having contracts reduces market failure and procurement risks through stabilising the input and output processes (Anbarassan, Chandrasekaran, Raman & Karthick, 2016; Otsuka, Nakano & Takahashi, 2016). However, the possibility of contract farming acting as a moderating variable between the relationship between supply chain versatility and supply chain resilience is stronger under the conditions of production contracts than marketing contracts. Production contracts are associated with the provision of resources which capacitates upstream supply chain members in order to integrate their operations with those of a buyer (Ruml and Qaim, 2020). This integration may not be fully realised under the marketing contracts. Thus, it is anticipated that;

H_5: *The positive effect supply chain versatility on supply chain resilience is stronger under production contracts than marketing contracts*

It has already been explained that production contracts involve the provision of resources (Bellemare & Novak, 2017). The provision of resources is well explained in the RBV theory (Barney *et al*., 2011) where farmers are provided with necessary resources (Mazwi, Chambati, & Mudimu, 2020) to invest in information and communication technology among other investments. It is through investments of similar nature that suppliers are able to link their systems with those of the buying firms (Christopher & Peck, 2004). The linkage provides visibility in terms of stock levels and any other pertinent information that may be necessary in smoothening the production processes of the buyer and the supplier (Wisner *et al*., 2016). Visibility also provides access to vital information for assessing the vulnerability levels and developing capabilities to deal with the turbulence. It is therefore anticipated that;

H_6: *The positive effect of supply chain visibility on supply chain resilience is stronger under production contracts than marketing contracts*

3. Methodology

3.1 Population and sampling

The population of this study were fast food restaurants in Zimbabwe that specialise in chicken based menus and relied on contract farming for securing the supply of live or dressed chickens. Most of the businesses in Zimbabwe in general and restaurants in particular are usually reluctant to participate in surveys probably due to scepticism surrounding the intended use of the data collected. Moreover, some of them fear entertaining regulatory authorities disguised as researchers. As a result the researchers could not establish a complete sampling frame. The absence of a complete sampling frame necessitated the use of convenience sampling (Saunders, Lewis & Thornhill, 2018; Struwig & Stead, 2013). The study yielded a convenience sample of 200 participating restaurants. The surveyed sample was represented by either branch managers in the case of chain restaurants or operations managers in case of stand-alone restaurants. These respondents were all either middle level or top managers. They were chosen on the basis that they have a conceptual and strategic view of their firms' operations (Golgeci & Kuivalainen, 2020).

3.2 Instrumentation

The data collection was made up of previously validated measurement scales in order to ensure content validity and comparability of the current study with previous studies. Supply chain velocity and supply chain visibility were operationalized using items from Mandal *et al*. (2016), supply chain versatility using items from Brusset (2016), and supply chain resilience using items from Gogeci and Ponomarov (2015). All the latent variables were measured on a 7 point Likert scale with anchor values ranging from 1 to 7. Type of farming contract was operationalized as a binary variable with marketing contracts coded 0, and production contracts coded 1.

3.3 Data collection procedures

Data was collected over a period of three weeks. The researchers visited the participating restaurants using the drop and pick strategy where the respondents were given a self-administered questionnaire. A drop and pick strategy has the advantage of giving the respondents ample time to carefully go through the data collection instrument and give carefully thought responses (Malhotra 2019). Before the respondents became part of the study they were requested to fill in the consent forms. Their anonymity was preserved through having no portions in the data collection instrument that requested them to indicate their names or the names of the organisations they represented.

4. Results

4.1 Sample characteristics

The sample characteristics presented in this section covers the demographics of the respondents who represented their firms, and the firmographics of the fast-food restaurants studied.

Table 1
Demographics

Variable	Category	N	%
Age	18-30	85	42.5
	31-40	60	30.0
	41-50	25	12.5
	51-60	25	12.5
	61+	05	02.5
Gender	Male	115	57.5
	Female	85	42.5
Qualifications	Certificate	50	25.0
	Diploma	102	51.0
	Bachelor's degree	42	21.0
	Postgraduate degree	06	03.0
Experience	0-4	48	24.0
	5-9	109	54.5
	10-14	23	11.5
	15+	20	10.0

The majority of the respondents were in the category of 18-30 years with the subsequent categories having decreasing frequencies as we approach the retirement age. The males dominated the industry (57.5%). Most of the respondents had a diploma qualification (51%), and an experience of between 5 to 9 years (54.5%).

Table 2
Firmographics

Variable	Category	N	%
Structure	Independent	146	73
	Chain	54	27
Location	CBD	120	60
	Industrial	50	25
	Residential	20	10
	Along highways	10	05
Years in operation	0-4 years	40	20
	5-9 years	55	25
	10+ years	110	55

The firmographics of the studied restaurants were made up of mostly independent restaurant businesses (73%). The majority of the restaurants were located in central business districts (60%), and had more than 10 years in existence (55%).

4.2 Timing and Common method bias

Testing the association between variables measured from a single source is susceptible to common method bias (CMB) (Podsakoff, Mackenzie, Lee & Podsakoff, 2003). CMB was assessed using Herman's one-factor test. The results indicated that no single factor explained more than 50% of the variance which is a sign that their study was free from CMB. Timing biases was assessed through comparing early and late responses (Armstrong & Overton, 1997). The results indicate that there were no statistically significant differences between the responses of the two groups ($P > .05$).

4.3 Construct validity

Construct validity refers to the extent to which the items measure a theoretical construct (Churchill, 1987). A confirmatory factor analysis was run testing a measurement model for estimating construct validity. The results indicated a good model fit, NFI = .916, CFI = .930, TLI = .910 as shown in Table 3.

Table 3
Descriptive, Fit indices, AVE, and SV

Construct	Mean	SD	CR	1	2	3	4	Model fit		
								CFI	NFI	TLI
1.Supply chain velocity	4.35	.976	.924	**.802**				.930	.916	.910
2.Supply chain versatility	4.02	1.435	.980	.651	**.944**					
3. Supply chain visibility	3.90	1.567	.971	.423	.692	**.917**				
4. Supply chain resilience	4.30	1.352	.980	.617	.748	.726	**.980**			

Notes: AVE is shown is shown in bold; SV is shown off the diagonal

Having attained a good model fit convergent validity was assessed. Convergent validity assesses the convergence of items used to operationalize a construct. Convergent validity was tested using Average Variance Extracted (AVE) following the Fornell and Larker (1981) procedures. The AVE for all the constructs was above the recommended threshold of .5 and this provided sufficient evidence for convergent validity (Bagozzi & Yi, 2012). Furthermore, convergent validity was assessed through checking whether each individual item's coefficient was greater than twice its standard error (Anderson & Gerbing, 1988). For all the cases the items had coefficients greater than twice their standard errors. Discriminant validity was estimated through comparing individual AVE to shared variance for random pairs of constructs. For all cases the individual AVEs were above the shared variances thereby providing sufficient evidence of discriminant validity. Composite reliability (CR) coefficients were estimated using the classical Fornell-Larker (1981) criterion and the coefficients obtained were above .7 for all the constructs which signifies sufficient composite reliability (Bagozzi & Yi, 2012).

4.4 Hypotheses testing

Having satisfied psychometric issues related to the constructs the study proceeded to hypothesis testing. H1-H3 stated that responsive supply chain elements such as velocity, versatility, and visibility lead to supply chain resilience. A Structural Equation Modelling (SEM) using AMOS 25 was run to test these hypotheses. The results from hypothesis testing are shown in Table 4.

Table 4
Direct effects results

Hypotheses		B value	T value	P value	Decision
H1	Supply chain velocity-supply chain resilience	.314	6.467	.000	Supported
H2	Supply chain versatility- supply chain resilience	.217	3.173	.002	Supported
H3	Supply chain visibility – supply chain resilience	.475	9.192	.000	Supported

H4-H6 predicted that farming contract types moderates the relationships between responsive supply chain elements and supply chain resilience. A Multi Group-SEM (MG-SEM) was run to test these relationships and the results are shown in Table 5.

Table 5
The moderating effects results

Type of contracts		Production contracts			Marketing contracts			Moderation			
Hypotheses		B	T	P	B	T	P	X^2	Df	P	
H4	SCVEL-SCRE	-.021	-.197	.844	.816	17.788	.000				
H5	SCVEL-SCRE	.437	3.845	.000	.220	4.192	.000	120.342	3	.000	Supported
H6	SCVIS-SCRE	.541	8.419	.000	-.353	-8.399	.000				

Hypotheses testing revealed that supply chain velocity leads to supply chain resilience, B = .314, T = 64.67, p < .001. This provided evidence to support H1. Furthermore, the results from hypothesis testing indicated that types of farming contract moderates the relationship between supply chain versatility and supply chain resilience, $X^2(3) = 120.342$, p < .001. The relationship was strong under the marketing contracts, B=.816, T=17.788, P < .001, then under the production contracts, B= -.021, T= -.197, P = .844. This led to the support of H4 although in the opposite direction.

Hypotheses testing also revealed that supply chain versatility leads to supply chain resilience, B = .217, T = 31.73, p = .002. This provided evidence to support H2. Furthermore, the results from hypothesis testing indicated that types of farming contract moderate the relationship between supply chain versatility and supply chain resilience, $X^2(3) = 120.342$, p < .001. The relationship was strong under the production contracts, B=.437, T=3.845, P < .001, then under the marketing contracts, B= .220, T= 4.192, P < .001. This led to the support of H5.

Finally, hypothesis testing revealed that supply chain visibility leads to supply chain resilience, B = .475, T = 9.192, p < .001. This provided evidence to support H3. Furthermore, the results from hypothesis testing indicated that types of farming contract moderates the relationship between supply chain visibility and supply chain resilience, $X^2(3) = 120.342$, p < .001. The relationship was strong under the production contracts, B=.541, T=3.059, P = .002, then under the marketing contracts, B= -.353, T= -8.399, P < .001. This led to the support of H6.

5. Discussion

The food supply chains have recently been faced with numerous types of disruptions that ranged from armed conflicts (Vutula, & Mlangeni, 2022), natural disasters (Katsaliaki, Galetsi & Kumar, 2020; Christopher, 2016), pandemics (Munir, Jajja & Chatha, 2022), to economic meltdowns (Kaviani, Tavana, Kowsari & Rezapour, 2020). This has been particularly true in the poultry meat supply chains. Therefore, this study was conducted as a build-up on previous research that had advocated for contract farming as a way of enhancing resilience in the food supply chains (e.g. Mukucha and Chari, 2022). This study further investigated the type of farming contracts that create a strong relationship between responsive supply chain elements and supply chain resilience. Contract farming has become the most viable way of financing agricultural activities after the commercial banks withdrew from the agricultural markets as a result of the chaotic FTLRP programme that disposed commercial farmers of their arable land (Mazwi *et al*., 2018). The FTLRP left most of the arable land in the hands of poorly resourced and inexperienced smallholder farmers who previously were peasant farmers (Mazwi *et al*., 2019). These farmers that dominated the new agrarian structure could not optimally supply the agro processing industry's needs for raw materials. This accelerated the adoption of contract farming as the new order in financing and capacitating agro based value chains.

It was demonstrated in this study that supply chain velocity leads to supply chain resilience. The speed in carrying out transactions ranging from order cycle fulfilment process to logistics makes the movement of materials swift such that the full effects of a disruption may not be felt in the market (Mandal *et al*., 2016). The relationship was also found to be moderated by the farming contract type as has already been hypothesised. The relationship was found to be stronger under marketing contracts than under production contracts. This was contrary to the initial expectations, It was expected that the resources provided to the farmers under production contracts make them swiftly attend to any possible disruptions. For

instance in the event of a bird flu outbreak resourced farmers can quickly vaccinate their birds (Ravikumar, Chan & Prabakaran, 2022), and where there is a breakdown of the regular mode of transport farmers under production contracts have got resources to find alternative mode of transport that would enable them to reach the market or the place of consumption before the buyers' production systems are interrupted.

However, there is a possibility that farmers under marketing contracts may not opt for production contracts because they already possess their own resources either financed from accumulated ploughed back profits over the years (Mazwi *et al*., 2018) from other capital providing institutions such as banks. Therefore, farmers under marketing contracts are able to invest in appropriate infrastructure that enable them to respond to a disruption with an accelerated velocity. Furthermore, marketing contracts make farmers track the changes in the market places as they constantly seek for more lucrative business avenues. This is necessitated by the fact that marketing contracts usually have a shorter tenure than production contracts (Ruml & Qaim, 2020). This increases the vigilance of marketing contract farmers as they regularly search for lucrative markets. This is unlike the scenario with production contract farmers who are burdened with long contracts that leaves little room to manoeuvre in the event of a disruption. Usually long tenure contracts under the production system stifles the responsiveness of the whole system to respond to a disruption with the well measured acceleration.

The results of the study also indicated that supply chain versatility is positively associated with supply chain resilience. This means that as the versatility capabilities of firms increase supply chain resilience also increases. This relationship was also moderated by the type of farming contracts. The relationship was found to be stronger under production contracts than under marketing contracts. This has already been suggested to be a function of adequate resources that makes adjusting to the turbulent environment more possible (Mazwi *et al*., 2019). Accurate forecasts make it possible to make necessary adjustments to the supply chain plans so that the foreseen disruptions are catered for (Christopher, 2016).

Finally, the relationship between supply chain visibility and supply chain resilience was also found to be strong. In cases where visibility was high, resilience too was found to be high. High visibility enables supply chain participants to accurately anticipate the risks with the supply chain (Juan *et al*., 2022) and come up with mitigation measures (Mandal *et al*., 2016). This relationship was also found to be moderated by the type of farming contracts. The relationship was stronger under production contracts than under marketing contracts. This can be attributed to the availability of the resources that makes a close integration of the buyers' operations with those of the suppliers (Mandal *et al*., 2016). Such a linkage enables sharing of vital information such as demand changes in the market, and possible bottleneck in the supply market (Juan *et al*., 2022). This visibility enables appropriate contingency plans to be formulated in advance such that when the disruption eventually happens the movement of materials can flexibly be channelled through alternative routes and kept the flow of operations constant (Mandal *et al*., 2016).

6. Implications

The results of this study have both theoretical and practical implications. Theoretically, the results from this study validated the relevancy of the RBV theory in predicting the competitiveness of the supply chains. In this study it was demonstrated that a supply chain with tailored made resources and well measured applications tend to become resilient. Such supply chains can withstand or quickly recover from disruptions of varying nature and severity. Therefore, although previous research has already demonstrated that supplier development in the form of contract farming leads to resilient supply chains, this study further refined that proposition through suggesting and empirically testing the nature of contract farming that has a bearing on supply chain resilience. Therefore, this study grounded on the RBV theory revealed that resources provided under production contracts are some of the contributors to resilient supply chains in the agro processing industry, although in limited cases resources acquired through marketing contracts can also contribute to supply chain resilience.

Practically, the results of this study implies that in a stable economy managers in the agro processing industry can rely on marketing contracts. With marketing contracts managers are assured of a smooth flow of input materials without committing substantial resources to the operations of their suppliers' businesses. Such resources can be invested in other business functions that can pose some bottlenecks along the entire supply chains such as logistics. However, during turbulent times agro processing firms must invest in production contracts so that they capacitate their suppliers. This has particularly become imperative in this contemporary world where successive disruptions of varying nature have become the order of the day. Moreover, the use of marketing contracts have become limited due to the absence of well-resourced commercial farmers post FTLRP in the year 2000. Most of the existing farmers who possess arable land but are poorly resourced hence the need for production contracts.

7. Conclusions, recommendations, and future research agenda

The study concluded that the elements of responsive supply chain such as velocity, versatility, and visibility have got a statistically significant influence on supply chain resilience. However, the relationships were all moderated by the types of farming contracts with the relationships involving versatility and visibility stronger under production contracts than under

marketing contracts, while the one involving velocity was stronger under marketing contracts than under production contracts. The variability emanating from different types of farming contracts were attributed to the quantity and quality of the resources under each variant of contract farming. However, the study was limited to the food supply chains only. Future studies need to assess other types of agro processing industries.

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Appendix

Table 6
Data collection instrument

Construct	Items
Supply chain versatility	Our firm quickly detect and adapt to changes, threats and opportunities
	Our firm frequently modify tactics and operations when needed
	Our firm is able to implement decisions quickly in response to market changes
Supply chain visibility	Our supply chain members have the information for monitoring and changing operations strategy
	Our supply chain members have access to inventory, order status information for forecasting
	Our supply chain members have the necessary information system for tracking goods
Supply chain velocity	Our firm's supply chain can rapidly deal with threats in our environment
	Our firm's supply chain quickly respond to changes in the business environment
	Our firm's supply chain can rapidly address opportunities in our environment
Supply chain resilience	Our firm's supply chain is able to adequately respond to unexpected disruptions by quickly restoring its product flow
	Our firm's supply chain can quickly return to its original state after being disrupted
	Our firm's supply chain can move to a new, more desirable state after being disrupted
	Our firm's supply chain is well prepared to deal with financial outcomes of potential supply chain disruptions
	Our firm's supply chain has the ability to maintain a desired level of control over structure and function at the time of disruption