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Embracing Risk Mitigation Strategies in Pineapple Supply Chain and Its Impact on Supply Chains Performance

Nyamah Edmond Yeboah[1*], Yi Feng[1] and Enchill Evelyn[1]

[1]School of Management and Economics, University of Electronic Science and Technology of China, Chengdu 610054, China.

Authors' contributions

This work was carried out in collaboration between all authors. Author NEY designed the study, managed the literature searches, performed the statistical analysis and drafted of the manuscript. Author YF supervised the work. Author EE helped with data collection and edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This paper empirically investigated the impact of major risk mitigation strategies employed in the pineapple supply chain on the chains' performance.
Study design: A survey method involving the random sampling technique was used in selecting respondents for the study.
Place and Duration of Study: The survey was conducted in Ghana between 13th April 2014–18th August 2014.
Methodology: The ordinary least squareregression model was employed to analyze the primary data were collected through a survey with a sample of 303 top executives and participants operating in the pineapple supply chain.
Results: The analytical results revealed that, not all the five (5) major mitigation strategies, mostly employed in pineapple supply chain significantly improved the performance of the chain. Risk

**Corresponding author: E-mail: eddynaa@yahoo.com;*

acceptance, as a strategy to mitigate any of the risks studied undermined the performance of the chain. With the exception of acceptance as mitigation strategy, all studied strategies employed to mitigate demand related risk, significantly improved the chains' performance. The adoption of control and coordination as strategies to mitigate supply and logistics related risk, significantly enhanced the chain's performance respectively. Even though, none of the strategies embraced to mitigate political and weather related risks, significantly improved the chain's performance, the used of coordination as a strategy to mitigate policy and regulatory risks, yielded significant improvement of the chain's performance. With the exemption of avoidance and control mitigation strategies, none of the studied strategies employed to mitigate biological and environmental related risks significantly improved the performance of the chain. Also, the adoption of strategies such as avoidance, control and coordination to mitigate management and operation related risks significantly improved the performance of the chain. By mitigating finance related risk, with strategies such as control and coordination, the performance of the chain significantly improved.

Conclusion: Therefore, to improve the pineapple supply chain performance, this study advocates the use of mitigating strategies such as avoidance, control and coordination to mitigate all the risk studied with the exception of political and weather related risk.

Keywords: Pineapple; performance; supply chain risk; mitigation; Ghana.

1. INTRODUCTION

Risk mitigation is becoming more important in the global agricultural supply chains due to the inevitable of risk in the environment the firms in the chain operate. Mitigating risks could be expensive and any attempt to reverse failed mitigation strategies could be cumbersome and even aggravate the cost of mitigating the risk in question. When risk mitigation strategies failed, disruptions set in the supply chain operation and consequently affect the performance of the firms in the chain. According to Hendricks and Singhal [1], stock prices dropped by nearly 10% when disruptions in firms were publicly announced. Several studies have revealed that, the mismatch between demand and supply is an indicator of supply chain disruption and influence revenue, cost and asset utilization [2-4]. The pineapple industry continues to contribute appreciably to the Gross Domestic Product (GDP) in Ghana [5]. According to Webber & Labaste [6], numerous companies operate in the Ghana pineapple sector. The firms in the pineapple industry in begun to export to European Union countries before the 1980's and later captured the greater part of the European Union market [7]. However, the industry surrendered this golden opportunity to other countries due to some major risk its supply chain encountered which arguably were related to market risks and managerial and operational related risk. Numerous sources of supply chain risks exist in the agricultural supply chain in Ghana [8]. Among these risks are weather related [9-11]. Demand related [11,12], Supply related [13,14], Logistic and infrastructure [11,15-17], Political related risk [18]. In addition, Policy and institutional related [1,19-21], Financial related risk [19,22-24]; Biological and Environmental related risk [25-27] are also occurring to some extend in the agricultural supply chain in Ghana. These sources of risk in their various forms could make the supply chain fragile and are vulnerable and consequently undermined the chain performance [19,28-32]. Due to the negative consequences of risks on supply chain performance, firms in the supply chain could employ diverse risk mitigation strategies to curb these risks. Among the principal risk mitigation strategies being used in supply chains are avoidance, acceptance, control, flexibility and coordination/cooperation [33-57]. According to Miller [39] avoidance occurs when the risks associated with operating in a given product market or geographical area are considered to be unacceptable. From a supply chain viewpoint, a company could drop specific products, suppliers or geographical markets if supply is seen to be unreliable. According to Sodhi [42], avoiding risks entails efforts to prevent the occurrence of undesirable incidents. Lee & Wolfe [43] illustrate how certain technologies, like biometric systems for positive identification of personnel and smart container systems for monitoring internal temperature and pressure of each container, can be used to prevent containers being tampered with throughout the shipping process. According to Wernerfelt & Karnani [44] firms can adopt avoidance by delaying the entrance in the market until the risks decrease at a suitable level in the industry. The uses of supply chain cooperation/collaboration could be used as a potential risk mitigation tool. Cooperative risk

mitigation strategies were useful by a number of organizations and, it is mainly limited with key suppliers [33]. Supply chain cooperation/ collaboration improves; customer services by reducing inventory, delivery and cycle [45,46]. According to Stecke & Kumar [47] clear visibility between the supply chain nodes, firms could foresee a problem at chain participants that could influence the rest of the chain. Cooperation could improve the supply chain reaction to the market [48]. Cooperation within the company to minimize the inventory management, risk; demand forecasting, operational cost and logistics performance measures would be extensively enhanced by prevalent collaboration [49,50]. Coordination could aid to avoid a disturbance from disrupting multiple supply chain nodes and could facilitate organizations to forecast disorder [40]. Coordination removes risks by lowering costs and ensuring a stable supply of critical components [51,52]. According to Tsay & Lovejoy, [41], flexible contracts can be used to mitigate demand related risks. Flexibility strategies could mitigate supply side risk with the adoption of multiple suppliers. Supply chain flexibility acts as facilitator in coordination process and helps to overcome or manage supply chain uncertainties. The Companies with high flexibility, perform better than those with low flexibility [53] since they have more option of risk management [54]. Other research has proposed redundancy buildup such as extra inventory or back up supplier [17] but Sheffi, [55] indicated that redundancy could be expensive. Firms seek to control contingencies from the various risk sources, rather than to passively treat uncertainties as constraints within which they must operate to mitigate risks [39]. Jüttner et al [33] indicates that control strategies are widely used in organizations to mitigate supply chain risks. According to Cyert & March [56] firms could control the environment to reduce the uncertainties. To control weather related risk agricultural industries at the production node of the chain, Heymann et al, [57] suggested the use of irrigation strategies to control drought risks in short term measures. However, they indicated that long term control measures by the uses of irrigations can have a detrimental effect. Risk acceptance is the process of actively deciding that you will accept the impact of risk if it occurs. If the risk is low enough, then accept it as a cost of doing business acknowledging that little to no action is being taken to mitigate that risk. According to Sodhi [42] accepting the risk does not require doing anything other than the company bearing the entire consequence in case there is a risk incident or the company transferring part of the consequences to its insurance company or its supply chain partner. However, transferring risk through insurance or through financial instruments like swaps does not actually reduce the likelihood of the risk. Even if it reduces the impact of the risk to a certain extent, it may result in moral hazard whereby the company can become more risk-prone knowing that it can transfer some or all of the financial consequences [42]. Likewise, liability insurance may offer financial compensations to customers who suffer from using unsafe products, but it does not reduce the damage to the reputation of the company nor the suffering of the people who used these products [42]. According to Van der Vorst [58] supply chain performance is the degree to which a chain meets the expectations of the consumer and the parties involved. There are numerous benefits and importance of performance measurements to firms [59,60]. A performance measurement system is an important tool for managing a supply chain and can facilitate the understanding and integration among its participants, to compare competing systems or provide insights for better decisions that bring competitive advantages to the chain [61,62]. In Supply chain management, the models for evaluating the performance of supply chains have been highlighted as a tool of great importance [63-65]. It is difficult to establish what, how and when to measure performance of the firm. Gunasekaran et al. [66], classified supply chain performance and competitiveness in strategic, tactical and operational levels of management. Supply chain performance measures have been associated with the total cost, customer responsiveness, flexibility [67,68]. Aramyan et al. [63-64] pointed the importance of food quality and safety to propose and test as a performance measure in agricultural supply chains. Risk has negative impact on chain risks and performance [1,19,20,29,69-71]. However, the impacts of firms' mitigation strategies on the pineapple supply chain performance are rare in the literature. Therefore, this current study seeks to close such gap. The main research objective of this study is to investigate the influence of different major risk mitigation strategies adopted in Ghana pineapple supple chain on the chains' performance. Specifically, this study seeks to address the following. What set of mitigation strategies improve or undermine the performance of the pineapple supply chain in Ghana? To achieve this objective, the following hypotheses (H1 & H2) were form based on literature review and tested; H1; The use of

appropriate strategies to mitigate risks in the pineapple supply chain would significantly improve the performance of the chain. H2: The choice of unfitting strategies to mitigate risks in the pineapple supply chain would significantly undermine the performance of the chain. The contributions of risk mitigation research to the pineapple supply chain are numerous. First an intensive review of recent research studies has shown no extensive research studied on risk mitigations in pineapple supple chain in Ghana and its impact on the performance of the chain. Thus, this research will heavily contribute to the literature in the pineapple industry in Ghana. Secondly, this paper will edify the chains' policies/decision makers to understand the impact of the various risk mitigation strategies on pineapple supply chain performance in Ghana. Thirdly, by probing into pineapple supply chain risk mitigations, this research could assist the chain's participant to manage risk effectively to improve the performance of the chain. In addition, this research could serve as a guide for new investors venturing into the pineapple industries to have pre - knowledge of risk mitigations and its impact on the pineapple supply chain in Ghana. The rest of this paper is organized as follows, section 2 reviews the literature and the methodology/ approaches of data collection are addressed in section 3. The results of the study are presented in section 4. Section 5 discusses the findings. Finally, section 6 concludes the study with managerial implications and highlight on the future research.

2. RESEARCH METHODS AND APPROACHES

First, we based the agriculture supply chain risk measures and risk mitigation strategies on an initial pool of scale items that had been generated through an extensive review of the academic and practitioner literature on risk management and agriculture supply chain management to establish the content validity of the survey instrument. This paper adopted nine (9) major supply chain risk drivers (Weather related, Demand related, Supply related, Logistics & infrastructure related, Biological and Environmental related, Political related, Policy & Regulation related, Operation & Management related and Financial related) which could undermine the chains' performance. The major potential supply chain risks were sub-categorized into thirty six (36) minor risks in the survey questionnaire [11,17,19,70,72-75] (Appendix 1). In addition, based on literature review and the views of expects in the field of risk management five risk mitigation strategies (acceptance, avoidance, control, coordination & flexibility) frequently used in supply chain/industries irrespective of its business nature were adopted [17,33,39,41,42,45,50,53,55,57]. This paper considered supply chain performance as the degree to which the pineapple chain meets the expectations of the consumer and the parties involved [58]. After definitions for the risk measures, risk mitigation strategies and supply chain performance were derived, a preliminary questionnaire was drafted. Next, the scale items included in the questionnaire, their relevance, their wording and directions, and the format of the questionnaire were refined on the basis of comments from practitioners and researchers. Thirdly, to further refine the survey instrument, it was pre-tested through interviews with a small number of executives in the pineapple supply chain. The executives' comments were incorporated into the final version of the questionnaire. Respondents were asked to indicate most preferred risk mitigation and how these various risk mitigation strategies influence the general performance (the degree to which a chain meets the expectations of the consumer and the parties involved) using five-point Likert-type items. All items were scored so that higher numbers reflect increases in the underlying constructs. The descriptive statistics of major agricultural risk mitigation are in Table 1.

2.1 Sampling and Data Collection

The pineapple industry engages several households and ranks first in non-traditional horticultural produce and operates a global supply chain. Primary data were collected through a survey to a sample of 303 top executives and participants in the pineapple supply chain who were briefed the motivations of this research. Out of 303 supply chain participants contacted, the follow-ups generated 145 usable responses, yielding a relatively high response rate of about 47.85%. The business types of the informants in the supply chain consist of input supply (13.1%), production (15.5%), intermediaries (13.1), processing (9.0%), retail (15.2%), export (9.7) purchasing/procurement (6.2%), logistics/transport (9.0%), finance (5.5%), information (3.4). The majority (73.1%) of the respondents' firms employed between 20-1000 staffs (Table 2).

2.2 Scale Assessment

The scales were tested for normality and outliers by the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett test of sphericity. The result, which showed KMO value of 0.713 with the significance of Bartlett's test at the 1% level, indicates the data fitting for factor analysis. A factor analysis for each construct was conducted to ensure the unidimensionality of the scales [76]. All constructs had strong factor loadings (>0.65) thereby indicating unidimensionality. The indicator items are deleted if their factor loadings are smaller than 0.5 [77]. Next Cronbach's alpha was used to evaluate each construct's reliability, with the threshold value of 0.60 [78]. Cronbach's alphas in this study are higher than the recommended threshold value, and reliability of these constructs is ensured. The evidence suggests that the measures included in this study possess a sufficient reliability and validity.

3. RESULTS AND DISCUSSION

3.1 Impact of Demand and Supply Related Risk Mitigation Strategies on Pineapple Supply Chain Performance

Demand and supply uncertainties are major concerns of many firms operating in the global pineapple supply chain. Demand (F=5.88; *df*=144) and supply (F=4.50; *df*=144) related risk mitigation strategies, explains about 58.3% of pineapple supply chain performance in Ghana. The use of avoidance (*t*=4.364, *p*=.05), control (*t*=9.346, *p*=.05), coordination (*t*=9.466, *p*=0.05), flexibility (*t*=6.652, *p*=0.012) as mitigation strategies significantly improves the performance of the pineapple supply chain in Ghana. However, the adoption of acceptance (*t*=-13.695, *p*=0.000) as a strategy to mitigate demand related risks, significantly undermined the supply chain performance (p>0.05) (Table 3). From the analysis, the use of avoidance (t = 0.517, p = 0.606) or flexibility (t = -0.721, p = 0.047) as strategies to mitigate supply related risk insignificantly influenced the performance of the pineapple supply chain in Ghana. However, the adoption of control (t = 2.767, p = 0.006) and coordination (t = 1.721, p = 0.047) as mitigation strategies against supply related risk significantly improve the performance of the pineapple supply chain. Contrariwise, the adoption of acceptance (t = -2.094, p = 0.006) as a mitigation strategy to curtail supply related risk significantly weakened the performance of the pineapple supply chain (p>0.05) (Table 3).

3.2 Impact of Logistics/infrastructure and Policies/Regulations Related Risk Mitigation Strategies on Pineapple Supply Chain Performance

Logistics/infrastructure and policy/regulatory issues are essential in the agricultural supply chain. The analysis revealed that, the employment of avoidance (*t*=1.868, *p*=0.064) as logistics and infrastructures related risk mitigation strategy results in positive and insignificant impact on the performance of the chain (Table 4). However, the adoption of control (*t*=2.794, *p*=0.006) or coordination (*t*=2.686, *p*=0.008) as strategies to mitigate logistics and infrastructures related risks, revealed the positive and insignificant impact on the performance of the chain (Table 4). The employment of avoidance (*t*=0.638, *p*=0.525), control (*t*=0.178, *p*=0.859), flexibility (*t*=1.396, *p*=0.165) or acceptance (*t*=-1.255, *p*=0.212) as strategies to mitigate pineapple supply chain risks related to policies and regulatory issues, insignificantly influence the pineapple supply chain performance in Ghana. However, the adoption of coordination (*t*=2.147, *p*=0.034) as a mitigation strategy significantly improve the supply chain performance in Ghana (Table 4).

Table 1. The descriptive statistics of major pineapple supply chain risk mitigation strategies

	Range	Min	Max	Mean	Std. error	Std. dev.	Varia-nce	Skew-ness	Skew error	Kurt-osis	Kurt-error
Acceptance	2	3	5	3.73	0.54	0.50	0.29	0.27	0.20	-0.92	0.39
Avoidance	2	2	4	3.30	0.53	0.43	0.28	-0.46	0.20	0.48	0.39
Control	3	3	5	4.26	0.58	0.57	0.35	-0.24	0.20	0.16	0.39
Coordination	2	3	5	4.57	0.33	0.55	0.11	-0.06	0.20	1.27	0.39
Flexibility	2	3	4	3.79	0.41	0.51	0.17	-0.18	0.20	0.64	0.39

Sample size (N) = 145

Table 2. Profile of respondents in pineapple supply chain (total = 145)

a) Business nature	Frequency (percent)	b) Business nature	Frequency (percentage)
Input Supply	19 (13.1%)	Export/import	14 (9.7%)
Production	22 (15.2%)	Purchasing/procurement	9 (6.2%)
Intermediaries	19 (13.1)	Logistics/infrastructure	13 (9.0%)
Processing	13 (9.0%)	Finance	8 (5.5%)
Retail	23 (15.8%)	Information Service	5 (3.4%)
c) Number of employees			
< 20	66 (45.5%)	301 – 1000	28 (19.3%)
20 – 300	40 (27.6%)	>1000	11 (7.6%)

Sample size (N) = 145

Table 3. The impact of demand and supply risk mitigation on pineapple supply chain performance

Mitigating demand risks	Standardized estimate	*t -statistic*	*P*	95% conf. interval	
				Lower limit	Upper limit
Control variable					
Firm size	0.456	3.111*	0.004	-0.103	0.025
Predictor variable					
Avoidance	0.168	4.364*	0.004	0.039	0.152
Control	0.450	9.346*	0.000	0.028	0.112
Coordination	0.462	9.466*	0.000	0.010	0.092
Flexibility	0.345	6.652*	0.012	0.239	0.020
Acceptance	-0.512	-13.695*	0.000	-0.047	0.029
Model summary					
Mitigation; supply risks					
Avoidance	0.017	0.517	0.606	-0.082	0.042
Control	0.093	2.767*	0.006	-0.012	0.061
Coordination	0.059	1.721*	0.047	-0.047	0.029
Flexibility	-0.012	-0.358	0.721	-0.044	0.036
Acceptance	-0.012	-2.094*	0.006	0.023	0.121
Model summary	F (144) = 4.50; R^2 = 0.584				

**Significant at 0.05 level*

Table 4. The impact of logistics/infrastructure and policies and regulations related mitigation to pineapple supply chain performance

Logistic and infrastructure	Standardized estimate	*t -Statistic*	P	95% conf. interval	
				Lower limit	Upper imit
Control variable					
Firm size	0.456	3.111*	0.004	-0.103	0.025
Predictor variable					
Avoidance	0.297	1.868	0.064	-0.044	0.038
Control	0.364	2.794*	0.006	-0.058	0.073
Coordination	0.528	2.686*	0.008	-0.071	0.079
Flexibility	0.177	1.429	0.155	-0.022	0.155
Acceptance	-0.077	-0.007*	0.019	-0.032	0.124
Model summary	F (144)=3.026;	R^2 =0.584			
Mitigating Policies/Regulatory					
Avoidance	0.057	0.638	0.525	-0.121	0.155
Control	0.022	-0.178	0.859	-0.073	0.006
Coordination	0.228	2.147*	0.034	-0.042	0.083
Flexibility	0.141	1.396	0.165	-0.029	0.045
Acceptance	-0.183	-1.255	0.212	-0.079	0.022
Model summary	F (144)=2.149; R^2=0.585				

**Significant at 0.05 level*

3.3 Effect of Political and Biological/environment Related Risk Mitigation Strategies on Supply Chain Performance

Arguably, political issues and outbreak of diseases are among the top unpredictable risk in many regions in the globe. Therefore, there could high signals that, most firms allocate huge resources to mitigate risk related to political and biological/environmental issues. From our analysis, all the mitigation strategies studied (avoidance, control, coordination, flexibility or acceptance) to mitigate political related risk in pineapple supply chain insignificantly improved the performance of the supply chain (Table 5). However, the analysis also revealed that, the adoption of avoidance (*t*=1.768, *p*=0.046) or control (*t*=1.781, *p*=0.007) as strategies to mitigate biological and environmental related risks in pineapple supply chain brought about significant (p=0.05) improvement in the chains' performance. Although, the employment of coordination (*t*=0.102, *p*=0.526) and flexibility (*t*=0.410, *p*=0. 410) as an appropriate strategy brought about the positive and insignificant impact on the chains' performance. However, the choice of acceptance (*t*=-1.960, *p*=0.026) as a mitigation strategy negatively and significantly influence the performance of the pineapple supply chain in Ghana (Table 5).

3.4 Effect of Management/Operational and Weather Related Risk Mitigation Strategies on Pineapple Supply Chain Performance

Managerial and operational related risks are closely associated with human judgment and response. The outcome of the analysis indicated, with the exception of the adoption of flexibility as a mitigation strategy (*t*=0.163, *p*=0.096) all the strategies studied to mitigate management and operational risk, significantly influenced the performance of the agricultural supply chain in Ghana (Table 6). Whiles the adoption of avoidance (*t*=2.496, *p*=0.046), control (*t*=1.833, *p*=0.019), coordination (*t*=1.708, *p*=0.048) as risk mitigation strategies positively influence the performance of the chain, the adoption of acceptance (*t*=-1.769, *p*=0.007) as a mitigation strategy undermined the performance of the supply chain (Table 6). Weather related risk issues have been a canker to a variety of major agricultural supply chain in the globe. However, the employment of risk mitigation strategies such as acceptance, avoidance, coordination, control and flexibility insignificantly influenced the performance of the chain (p>0.05) (Table 6).

Table 5. Effect of political and biological/environmentrelated risk mitigations on supply chain performance

Political Related risk	Standardized estimate	*t -statistic*	*P*	95% conf. interval	
				Lower limit	Upper limit
Control variable					
Firm size	0.456	3.111*	0.004	-0.103	0.025
Predictor variable					
Avoidance	0.038	1.059	0.292	-0.051	0.160
Control	0.028	0.781	0.437	-0.001	0.172
Coordination	0.049	0.102	0.919	-0.045	0.061
Flexibility	0.018	0.490	0.189	-0.034	0.072
Acceptance	-0.003	-0.102	0.919	-0.039	0.177
Model summary	F (144) =1.73;	R^2 =0.584			
Biological and environment risk					
Avoidance	0.002	1.768*	0.046	-0.039	0.177
Control	0.097	1.781*	0.007	-0.039	0.161
Coordination	0.023	0.102	0.526	-0.042	0.130
Flexibility	0.031	0.490	0.410	-0.004	0.071
Acceptance	-0.044	-1.960	0.026	-0.062	0.022
Model summary	F (144) = 1.43; R^2 = 0.585				

**Significant at 0.05 level*

Table 6. Impact of management/operation and weather related risk mitigations on pineapple supply chain performance

Weather related risk	Standardized estimate	*t -statistic*	*P*	95% conf. interval	
				Lower limit	Upper limit
Control variable					
Firm size	0.456	3.111*	0.004	-0.103	0.025
Predictor variable					
Avoidance	-0.047	-1.330	0.186	-0.111	0.121
Control	0.054l	1.433	0.155	-0.084	0.045
Coordination	-0.053	-1.453	0.149	-0.016	0.049
Flexibility	-0.051	-1.457	0.148	-0.020	0.119
Acceptance	-0.060	-1.627	0.107	0.044	0.191
Model summary	F (144)=1.43;	R^2= 0.586			
Management and operational					
Avoidance	0.023	2.496*	0.046	-0.071	0.024
Control	0.054	1.833*	0.019	-0.071	0.193
Coordination	0.026	1.708*	0.048	-0.021	0.039
Flexibility	-0.006	0.163	0.096	-0.108	0.059
Acceptance	-0.028	-1.769*	0.007	0.185	0.066
Model summary	F (144) = 1.34;	R^2 =0.586			

**Significant at 0.05 level*

3.5 Impact of Financial Related Risk Mitigations on Pineapple Supply Chain Performance

Finance could be of great importance in operating any supply chain. Therefore, it is essential for firms in the pineapple supply chain planned against financial related risk. The employment of avoidance (*t*=0.491, *p*=0.062) or flexibility (*t*=1.083, *p*=0.281) as mitigation strategies to curb financial related risks insignificantly affect the performance of the supply chain (Table 7). However, the analysis of this study also revealed that, the adoption of control (*t*=2.012, *p*=0.047) or coordination (*t*=1.544, *p*=0.050) as mitigation strategies significantly improved the performance of the chain. In addition, acceptance (*t*=0.496, *p*=0.011) financial related risks in the supply chain significantly undermined the performance of the chain (Table 7).

3.6 Discussions

Since the pineapple supply chain is inevitable of risks, it's laudable to identifying risk mitigations and their impact on the supply chain performance. In general, risk mitigation strategies studied explains more than 50% of the pineapple supply chain in Ghana. There are strong indications that the participants in the pineapple supply chain have effectively adopted and implemented the appropriate risk mitigation strategies to mitigate demand related risk issues in the pineapple supply chain. These effective mitigation strategies might have positively and significantly influenced the performance of the pineapple supply chain. The positive and significant impact of the risk avoidance as a mitigation strategy on pineapple supply chain performance could be that, the participants in the chain have pragmatic preventive measures to demand, management and operation as well as biological and environmental related risks which could cause a detrimental effect on the performance of the chain. Sodhi [42] stated that, avoiding risks entail efforts to prevent the occurrence of undesirable incidents. Also, there could some likelihood that, the participants in the pineapple supply chain adopt high technologies to avoid some major risks in the chain. Earlier, Lee & Wolfe [43] exemplify how certain technologies are being used as an avoidance strategy for monitoring internal temperature and pressure of containers and to prevent containers being tampered with throughout the shipping process. According to Jüttner et al. [33], control strategies are widely embraced by organizations to mitigate supply chain risks. There is a high probability that, the participants in the pineapple supply chain in Ghana are constantly aware and could isolate the potential risks that could have a negative effect on the performance of the chain. Hence, they are able to formulate an effective mitigation strategy to control demand, supply, finance, logistics and infrastructure, management and operation as well as biological and

environmental related risks to significantly improve the performance of the supply chain in Ghana. The complexity, globalization and riskiness of modern supply chain have made the use of coordination as mitigation strategically more important. The use of coordination measures as a mitigation strategy to mitigate portions of demand, supply, logistics and infrastructure, policy and regulatory laws, management and operational as well as financial related risks in pineapple supply chain significantly improve the performance of the chain. The adoptions of coordination mitigation strategies could probably aid the participants to avoid a disturbance from one node of the chain to ripple itself through the entire chain or to foretell chaos in the chain. Heish and Wu [40] indicate that vertical and horizontal coordination/integration could aid to avoid a disturbance from disrupting multiple supply chain nodes and could facilitate organizations to forecast disorder respectively. Also, the adoption of coordination as pineapple supply chain risk mitigation strategy in Ghana could enhance the ability to visualize the activities of the chain. According to Stecke & Kumar [47], with clear visibility between the supply chain nodes, firms could foresee a problem at individual chain nodes that could influence the rest of the chain. This could also improve the supply chain reaction to the market [48]. Characteristics of good coordination or coordinating strategy such as avoiding the disturbance, foretelling chaos, improving visibility in supply chains could lead to improve performance of the pineapple supply chain in Ghana significantly. Supply chain flexibility acts as facilitator in coordination process and helps to overcome or manage supply chain uncertainties. The adoption of flexibility in pineapple supply chain may be due to the importance attached to flexibility as a mitigation strategy in global supply chain. From the empirical analysis, the employment of flexibility mitigation strategy to mitigate demand related risk significantly improves on the performance of the pineapple supply chain in Ghana. For instance Tsay & Lovejoy [41] indicated that flexibility in contracts has been revealed to be used in mitigating demand related risks. In addition flexibility gives more option of risk management [54]. Other studies have indicated that, the higher the flexibility of a firm the higher its performance and vice versa [53]. Acceptance has been a best mitigation strategy for most supply chains in the globe. However, in the case of firms in the pineapple supply chain in Ghana, risk acceptance as a mitigation strategy has been revealed to deteriorate the performance of the chain significantly in this current research. The use of acceptance as a strategy to mitigate demand, supply, logistics, and infrastructure, management and operational as well as finance related risks negatively and significantly affect the performance of the chain. The participant in the pineapple chain could accept as any risk due to their inability (i.e. Lack of technical know-how or beyond their available resources, abilities) to mitigate those risks in questions. However, the accumulation of this supposed low impact than expected risks along the inability of firms to mitigate some other major risks could affect the overall performance of the chain.

Table 7. Impact of financial related riskmitigations on pineapple supply chain performance

Variables	Standardized estimate	*t statistic*	*P*	95% conf. interval	
				Lower limit	Upper limit
Control variable					
Firm size	0.456	3.111*	0.004	-0.103	0.025
Predictor variable					
Avoidance	0.018	0.491	0.062	0.030	0.107
Control	0.072	2.012*	0.047	0.103	0.195
Coordination	0.020	1.544*	0.050	0.121	0.190
Flexibility	0.037	1.083	0.281	0.088	0.154
Acceptance	-0.062	-1.604*	0.011	-0.095	0.058
Model summary	F (144) = 1.11; R^2 = 0.586				

**Significant at 0.05 level*

4. CONCLUSION

This research empirically contributes to the literature on agricultural supply chain risk management by providing a comprehensive risk mitigation strategies and their potential impact on pineapple supply chain performance. The results reveal that, not all risk mitigating strategies significantly improve the performance of the pineapple supply chain. The adoption of avoidance, control, coordination and flexibility as mitigation strategies for market related risks could improve the performance of the pineapple supply chain. Whiles the adoption of control and coordination as mitigation strategies for financial and logistic/infrastructure related risks, improve the performance of the chain respectively; the pineapple supply chain performance could be improved by the adopting of avoidance and control as strategies to mitigate biological and environmental related risks. In addition, by avoiding, coordinating and controlling most of management and operational related risks, the performance of the pineapple supply chain in Ghana could be improved. Even though, risk occurrence in the supply chain could cause panic and losses to the firms involved, the choice of mitigation strategies should be done with precaution. From the results, it would prudent for managers to note that, their choice of risk mitigation strategies in their operation could either undermine or improve the performance of the chain. Hence, managers should thoroughly select and scrutinize risk mitigation strategies before implementation. This study also advocates that, participants in the pineapple supply chain in Ghana could adopt coordination to mitigate policy and regulations related risk to improve performance of the supply chain. Further empirical research to identify other supply chain risk mitigation strategies excluding those in this paper and their impact on pineapple supply chain performance could broaden the scope of the study area. Also, further research to reveal the extent of risk level to which a particular mitigation strategy is adopted could further enrich literature.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX 1

Questionnaire

Your Personal
Position: _____ working department: _____

Section 1. Enterprise profile (please use the mark "√"in the grid)

The number of employees in your company is:	less than 20 □ 20-300 □ 300-1000 □ more than 1000 □
The supply chain position of your company (Business nature)is:	Input supply□ Production □ Processing □ Procurement/purchasing□ Logistics/transport□ Exporter/Importer□ Information □ Finance □intermediaries □Retailers □Other kinds (please indicate): _____

Section 2. Q1 a. What best mitigation strategy do you employ to mitigate the following supply chain risks?

A. 1= avoidance 2=control, 3= coordination 4= flexibility 5= acceptance.
B. What's the impact of your choice strategy on the Supply Chain performance

Demand side risks	Mitigation strategies	Mitigation impact
Unanticipated or very volatile customer demand.	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Unanticipated or very volatile customer Supply.	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Insufficient or distorted information from your customers about orders or demand quantities.	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
changes in food safety requirements	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Supply side risks		
Supplier quality problems.	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Sudden default of a supplier (e.g., due to bankruptcy).	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Poor logistics performance of logistics service providers.	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Capacity fluctuations or shortages on the supply markets.	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Logistical & Infrastructural Risks		
Changes in transportation and energy cost	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Undependable transport	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Conflicts, labor disputes affecting transport,	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Lack of infrastructure and services unit	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Policy and Regulatory Risks	A. Mitigation strategies	B Impact
Changing and/or uncertain monetary, fiscal and tax policies,	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Changing and/or uncertain regulatory and legal policies, and enforcement (e.g. subsidies, regulations for food safety and environmental regulations)	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Changing and/or uncertain trade and market policies	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Changing and/or uncertain land policies and tenure system	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Political Risks		
Political instability, war, civil unrest or other socio- political crises.	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Interruption of trade due to disputes with other countries.	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Nationalization/confiscation of assets, especially for foreign investors.	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Changes in the political environment due to the introduction of new laws, stipulations	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Biology and Environmental Risks	Mitigation strategies	
Crop yield, pests and diseases	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Contamination related to poor sanitation and illnesses	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Contamination affecting food safety	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Contamination and degradation of production and processing processes	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □

Weather Related Risks	Mitigation strategies	
Periodic deficit rainfall	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Period excess rainfall	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Extreme drought	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Flooding	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Management and Operational Risks	Mitigation strategies	
Poor management decisions in asset allocation	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Poor quality control/	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Forecast and planning errors,	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Use of outdated seeds/Input	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Financial Risk		
Inadequate financial support	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Delays in accessing financial support	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Uncertain financial support (credit)	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □
Period change/ uncertain interest and exchange rate policies	1□ 2□ 3 □ 4 □5 □	1□ 2□ 3 □ 4 □5 □

Section 3. Evaluate the following supply chain performance indicators compared to your major competitor

Supply chain performance	(5 point scale: worse - Best)
Dependability: Meeting quoted or anticipated delivery dates and quantities on a consistent basis.	1□ 2□ 3 □ 4 □5 □
Speed: Time between order receipt and customer delivery.	1□ 2□ 3 □ 4 □5 □
Qualities: Number of faultless delivery	1□ 2□ 3 □ 4 □5 □
Information: Information richness in carrying out the delivery	1□ 2□ 3 □ 4 □5 □
Response: Response to number of urgent deliveries	1□ 2□ 3 □ 4 □5 □

Section 4. Indicate how the following statements apply to your firm

Firm size	(5point scale: does not apply at all – applies very much)
In collaboration with our customers and suppliers, we are working on transparent supply chains and an open sharing of information.	1□ 2□ 3□ 4 □5 □
Our firm has elaborated business continuity or contingency plans addressing several risk mitigation.	1□ 2□ 3 □ 4 □5 □
We regularly monitor our suppliers for possible supply chain risk mitigation strategies.	1□ 2□ 3 □ 4 □5 □
In our firm, an employee or a team is dedicated to supply chain risk mitigation strategies.	1□ 2□ 3 □ 4 □5 □

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