

An Assessment of Supply Chain Risks in the Cocoa Industry in the Ashanti Region, Ghana

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Abstract

The cocoa industry represents a major source of income for most economies including Ghana. Despite huge investments made by Ghana government, the sector still faces various forms of risks. This study examines the various categories of risks within the cocoa supply chain in the Ashanti Region of Ghana. Quantitative method was adopted using Primary data. The study revealed that cocoa related diseases were the major production related risks. Again, high inflation rate and instability of the local currency were found as the key causal factors of commercial related risks whilst ineffective information sharing among the parties and partners accounted for the environmental related risks, negatively affecting productivity. It is recommended that farmers be given training on cocoa related disease to be able to deal with these risks whilst information sharing and trust building among the supply chain players should also be improved to enhance coordination and integration of the supply chain.

Key Words: Supply Chain Risk, Risk management, Cocoa production, Ashanti Region, Ghana

1. Introduction

Today's business environment is not only becoming increasingly competitive and turbulent in nature but also full of uncertainties. This reality of the current business environment has led to the emergence of supply chain (SC) that consists of complex network of suppliers, partners and customers to deal with the dynamism and uncertainties with their associated risk (Otchere, Annan & Anin, 2013a; Otchere, Annan & Quansah, 2013b; Lambert 2008, Fantazy et al 2010). Supply Chain Management (SCM) is increasingly being recognized as the integration of key business processes across the network of organisations. In fact, one of the most significant changes in the paradigm of modern business management is that individual businesses no longer compete as solely autonomous entities, but rather as supply chains. SCM seeks to enhance competitive performance by closely integrating all functions within an organisation and external stakeholders to be successful (Otchere et al., 2013b; Lambert, 2008, Fantazy et al., 2010; Otchere et al., 2013a; Baharanchi, 2009).

SCM, according to the Council of Supply Chain Management Professionals (CSCMP) cited in Otchere et al. (2013a), is "the Integration of key business processes from end user through original suppliers that provides product, services, and information that add value for customers and stakeholders". As a business process, the benefits of supply chain can be attained through efficient linkage between various supply chain activities. Therefore SC is aimed at improving business processes through effective coordination of business activities along the chain in order to increase competitive advantage and productivity (Fabbe-Costes and Jahre, 2008; Otchere et al., 2013a; Van der Vaart and van Donk, 2008; Singh and Power, 2009; Ouet al., 2010; Wiengarten et al., 2010).

Cocoa is Ghana's primary cash crop and typically provides about one-third of all export revenues. The industry represents a major source of income for farmers and many others engaged in trade, transportation, and processing of cocoa. The cocoa production has recorded significant growth rate since the first shipment of cocoa from the then Gold Coast in 1885. The volume of cocoa export grew rapidly to 20,000 metric tonnes in 1908, and by 1911 Ghana was the world's leading cocoa producer, with 41,000 metric tonnes. In the early 1920's, Ghana produced between 165,000 – 213,000 metric tonnes, representing about 40% of the total world output. In 2009, the volume was 711, 000, about 14% of the total world output (Tutu, 2009). Recent report indicates that Ghana has recorded an unprecedented volume of production of over one million metric tonnes in 2011 (Ghana Cocobod, 2011). Even so, there is the need for continuous improvement in the sector and the government of Ghana (GoG) is committed to securing the future profitability and sustainability of the cocoa supply chain. In pursuance of that, GoG has made reasonable investments in restructuring the industry, improving productivity (World Bank, 2012).

Despite these investments, the sector is still being challenged by various forms of risks. Risk is any incident or event that could disrupt the movement and flow of raw materials across the chain (Christopher & Lee 2004). Even though SC risks vary by the nature of industry and the level of complexity of the SC network, in the cocoa sector, risk may be grouped under three main categories. These are: pre-harvest risks, harvesting risks and post-harvest risks. A lot of studies have been conducted in the cocoa supply chain in Ghana. References of such studies include Otchereet *al.* (2013a); World Bank, (2012); Fantazyet *al.* (2010) and Tutu (2009). However, it appears that the problem of risks still persists in the industry and gives justification for further studies in the sector. This study aims at evaluating the various categories of risks within the cocoa supply chain in the Ashanti Region of Ghana.

2.0 Literature Review

2.1 Supply Chain Management

The term supply chain is defined in this research as the network of organisations, which are involved through upstream and downstream linkages in different processes and activities that create value in the form of products and services in the hands of customers (Christopher, 1998 cited in Peck, 2005). SCM seeks to enhance competitive performance by closely integrating the internal cross-functions within a company and effectively linking them with the external operations of suppliers, customers, and other channel members to be successful (Otchereet *al.*, 2013a; Lambert, James and Elram, 1998; Kim, 2006; Tan, Kannan, and Hadfield, 1998). The basis of SCM is characterised by cooperation, collaboration, information sharing, trust building, partnerships, shared technology, and a fundamental shift from managing individual functional processes to managing integrated chains of processes (Otchereet *al.*, 2013a; Vickery, Jayaram, Droge and Calantone, 2003; Kahn 1998; Pagell, 2004).

The global market environment, including the cocoa industry is becoming increasingly competitive. This has huge influence on business activities. Apparently, SC has become a key business process model for organizations to be able to compete favourably in the market place, both locally and internationally. Given the turbulent nature of the international business environment as well as trade restrictions and barriers imposed on organizations in various countries such as strict regulation on export, SC then becomes one of the effective drivers for firms to compete and improve performance (Ouet *al.*, 2010; Baharanchi, 2009).

In the cocoa sector, the roles SC plays include coordination in the supply network, alignment with customer satisfaction and sustainability of the overall competency throughout the supply chain (Faisal and Banwat, 2006, Chopra and Sodhi, 2004). This requires close and seamless coordination among all the members of the supply chain. Thus, effective cocoa SC requires the coordination of the farmers, regulators (such as Cocobod in Ghana), the Licensed Buying Companies (LBCs), local and international processors and other stakeholders.

2.2 The Concept of Risk

The concept of risk has been studied in several business contexts. There are numerous definitions of risk propounded by various authors. Some of them are Sitkin and Pablo (1992), who define risk as uncertainty about potential outcome, whether it is momentous and/or insignificant in the decision that occurred. On the other hand, Faisal *et al.* (2006) define risk as consumer's perceptions of the insecurity and undesirable consequences for buying products or services. In another development, Mitchell (1999) describes risk as "the likelihood of loss and the implication of that loss for the individual or organisation". He formulated a principle of risk to assess the probability of loss (P) and the significance (I) of that loss as; **Risk = P (loss) X I (loss)**. This concept has been advanced by further studies. For example Zsidsin (2003) suggests that risk contains three dimensions which are outcome uncertainty, outcome expectations, and outcome potential.

Ritchie and Brindley (2007) also indicate that there are three dimensions of risk: (1) Likelihood /probability of occurrence of certain outcomes; (2) consequences/severity from the occurrence of particular events; (3) causal pathways leading to the events. Ritchie and Brindley (2007) and PMBOK (2009) also consider risk as the multiplication of likelihood of a risk event, the severity of a risk event, and the ability to detect the risk. It is formulated in the notation as **Risk = Likelihood X severity X Detection**. Risk management always relates to those three dimensions of risk (Rithie and Brindley, 2007). There are different types of risks, ranging from market associated risks including demand, cash flow, technical or operational related risks to institutional risks such as regulation related risks, customer acceptance risk, and independent risk (Miller, 1992).

2.3 Supply Chain Risks in the Cocoa industry

SC risk is defined as any incident or event that could disrupt the movement and flow of raw materials across the chain (Christopher & Lee 2004). In the cocoa sector, risk factors such as demand forecasting, market price fluctuations, environmental risks and the cocoa bean safety and regulations are prevalent. Furthermore, costs of transactions, investments in business transactions, information asymmetries between parties (leading to bullwhip effect), are also militating against the industry (Otchereet *et al.*, 2013b; Vickery, Jayaram, Droge and Calantome, 2003; Khan and Burnes, 2007). According to the World Bank report (2012), the major risk of the cocoa supply chain of can be grouped into three main categories: Production risk, Commercial or Market risk and Environmental risk.

2.3.1 Production Risk

Under the production risk, crop diseases and insect pests appear to be the major threat to the supply chain of the cocoa sector. Drought and bush fires are also risks but they do not pose major threat to the supply chain as they rarely occur. Again, cocoa acreage loss and other pests, diseases, and weeds are other production related risks that threaten cocoa production on long- term basis. The causes of these risks are attributable to competition for land with other sectors and decrease in economic gain from the cocoa sector which invariably causes shift from cocoa cultivation (Hainmueller *et al.*, 2011; World Bank Report, 2012).

2.3.2 Commercial/Market Risk

Market risk is usually driven by market dynamics such as the inability of the local currency to compete with the major trading ones. According to Hainmueller *et al.* (2011) and World Bank Report (2012), commercial risk is concerned with, among others, cocoa price volatility, exchange rate volatility, counterparty risk (risk that is concerned with the probability that the other party in an agreement will default), input price and interest rate volatility that impact on the cocoa supply chain. These risks mostly emanate from both macro and micro economic instability. (Lee *et al.*, 2000; World Bank Report, 2012). Cocoa price on the world market, for example, has been unstable over the years. The instability of cocoa prices on the market poses great challenge to farmers as well as the producing countries. According to the International Cocoa Organisation (ICO) report, cited in Otchere *et al.* (2013a), cocoa price in 2000 was \$714 per ton. This price somewhat increased to \$1,280 per ton in 2002. In 2003/04 prices went high at an average of around \$1,600. The report however stated that the second and third quarters of the 2005/06 cocoa season were characterized by high volatility in cocoa prices (Lee *et al.*, 2000).

2.3.3 Environmental Risk

Environmental risks are difficult to predict and require careful measures. Major risks identified as environmental which militate against cocoa supply chain include cocoa smuggling, market regulation risks, policy risks, logistics breakdown and misappropriation of funds along the supply chain (Hainmueller *et al.*, 2011; World Bank Report, 2012). They continue to describe logistics breakdown to be chronic congestion at COCOBOD, shortage in marketing materials such as jute sacks, strained capacity and transport breakdowns. These cause undue delays and raise cost of financing to about 1.8% Freight/Free on Board (FOB) prices.

Misappropriation of funds includes financial management risk arising from poor decision and prioritization, theft or embezzlement. Policy related risks include uncertainty over future Government of Ghana's (GOG) support to domestic cocoa industry and lack of material policy on land use. GOG support policy may include supply of light cocoa beans at a subsidized or discount price to local processors. For instance, cocoa producers as well as suppliers in Ghana are less exposed to natural disasters, flooding and crop failures and are recognized for its natural quality (Pegge, 2003).

2.4 Supply Chain Risk Management

Large number of links that need to be created between members of the SC has increased the possibility of risks being transmitted along the chain, so that a small incident in one distant area can grow into adverse consequences for other associates within the SC (Christopher *et al.*, 2006, Otchere *et al.*, 2013a; Faisal & Banwat, 2006; Chopra and Sodhi, 2004). Because of Supply chain's vulnerability and exposure to many internal and external risks, most businesses have started to realize the need for mechanism to identify and assess those risks in early stages and then manage them in the most effective way to survive the adverse consequences that may come about especially when introducing new products to the market. The ultimate results that arise from effective risk management is to ensure improved productivity within the cocoa supply chain (Hainmueller *et al.*, 2011; Anim-Kwapong *et al.*, 2004). SC risks vary based on the type of industry and the level of complexity of the SC network, however, it could be seen that most of the SC related risks are common in most industries. The frequent occurrence of natural disasters, labour disputes, uncertain supply and demand, supplier bankruptcy, political changes, war and terrorism have led to deeper concerns about risk management for the supply chain (Ritchie and Brindley, 2007; Mallman, 1996; Giannakis *et al.*, 2004; Ellegard, 2008; Christopher and Lee, 2004).

It is important to develop a framework of risk mitigation strategies for supply chains, in order to create a sustainable cocoa industry so that the target set by the Ghana government will be reached. Risk management strategies may be categorized into what is termed the four 'Ts':

1. Tolerate or accept the risk
2. Transfer or spread the risk
3. Terminate or avoid and,
4. Treat, mitigate, minimize or control (Chartered Institute of Purchasing and Supply (CIPS), 2012).

Tolerating risk has to do with a situation where no further action (or deliberate action) needs to be taken to deal with the risks if the assessed likelihood or impact of the risk is negligible or within acceptable level. Transfer or spread of risk has to do with sharing the risks impact with other parties or partners. This could be by taking insurance cover or engaging in contract terms where risk is borne by the partner. For example using defect liability clauses in contracts. Terminating also has to do with avoiding the risk completely when the likelihood of impact is costly than the returns. For example, backing off from a project that has high risks with low reward; Treating risks is where a deliberate mitigation process is undertaken to minimize or control the impact According to CIPS (2012), risk mitigation could be explained in terms of control application. Control application could take any of the following forms:

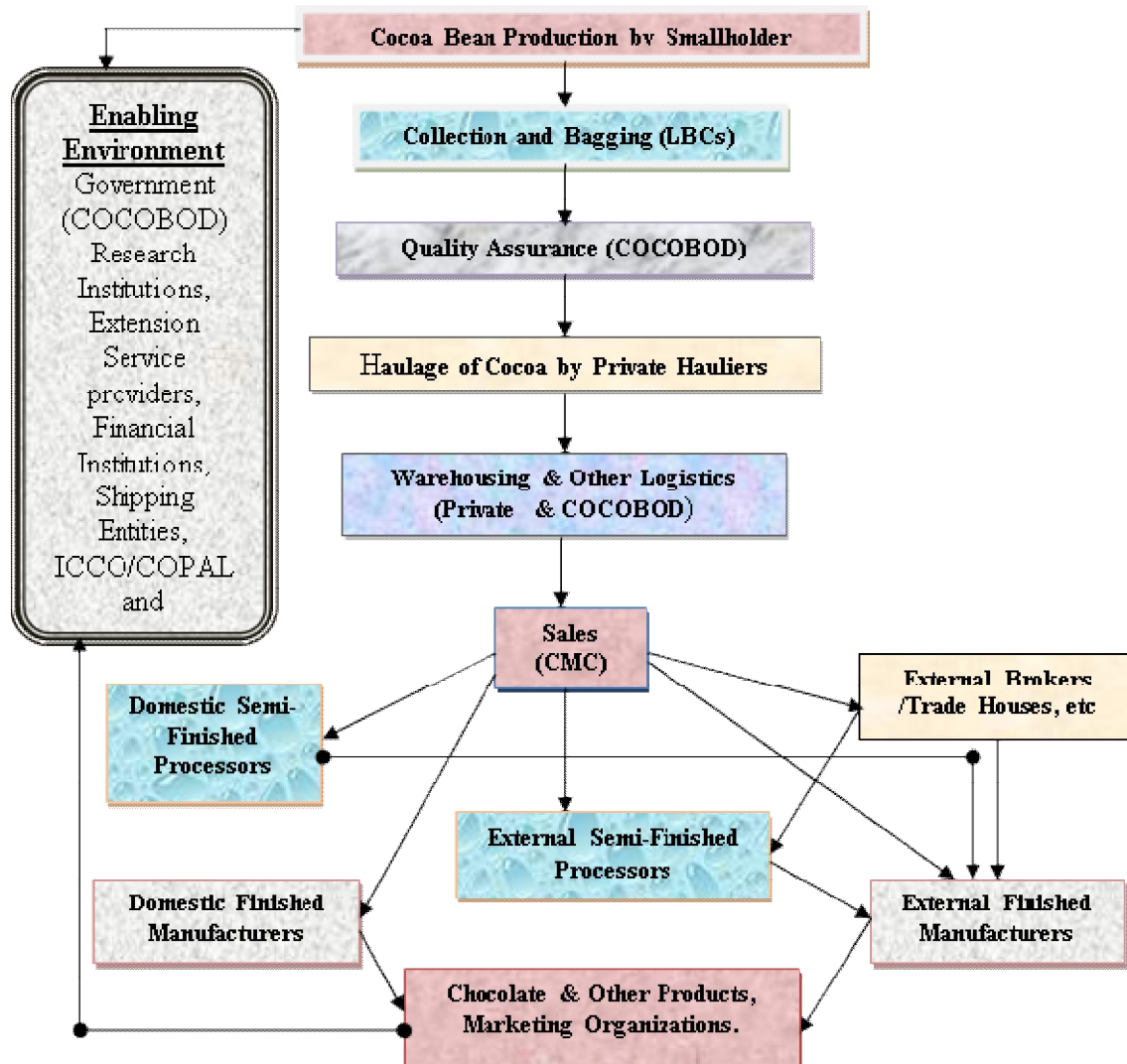
- Preventive control which is designed to limit the negative impact;
- Directive control which is designed to ensure desired outcome;
- Detective control which is also used to identify whether an undesired risk event has occurred and
- Corrective control designed to mitigate the impact of undesired outcome when it has already happened.

The assertion concludes that risk analysis could be undertaken by quantitative technique which is subject to or based on people's perception, and quantitative technique which is objective and uses statistical analysis such as Failure Modes and Effects Analysis. A qualitative technique could take the form of scenario analysis which involves the use of "what if" questions or brainstorming to stimulate the identification of possibilities in the supply chain (CIPS, 2012).

2.5 Cocoa Production

Cocoa provides livelihoods for millions of people in over 50 countries in Africa, Latin America, the Caribbean and Asia (Kaplinksky, 2004). Philipset *al.* (2006) observe that cocoa plays an important role in most economies as a source of foreign exchange. It provides jobs for an estimated fourteen million people (ICCO, 2006, cited Otchere *et al.*, 2013a). Ghana is one of the major producers of cocoa in the world. Cocoa has been Ghana's primary cash crop and backbone of its economy for more than six decades. Cocoa provides about one-third of all export revenues. It accounts for between 25-30 percent of total export earnings and contributes about 10% to GDP (Tutu, 2009; Ghana Cocoa Board, 2011). Ghana cocoa value chain is unique from the global cocoa value chain due to the partial liberalization of the sector, which is different from the other producing nations. Figure 2.1 shows Ghana cocoa value (supply) chain map. Figure 2.1 depicts Ghana cocoa value (supply) chain map.

Figure 2.1: Cocoa Supply Chain Map



Source (Osei, COCOBOD 2007, Cited in Otchereet *et al.* 2013)

The Cocoa Service Division (CSD) and Cocoa Research Institute of Ghana (CRIG), two wholly owned subsidiaries of Ghana Cocoa Board, are key providers of support to the country's cocoa farmers. CSD gives support directly through extension services and provision of planting material while CRIG, with an international reputation, provides research and development services for the sector (Ghana Cocoa Board, 2009).

3. Methodology

The study adopted quantitative method with deductive approach. The study targeted the management and staff of three cocoa purchasing companies (names withheld for ethical reasons). Given the technicalities and relevance of information required to meet the research objectives, a sample size of one hundred and forty-one(141) respondents, forty-seven (47) each from the case companies was used in the study. These comprised twelve(12) management members and thirty-five (35) staff from each case company who were selected purposively. Table 3.1 gives the categories of respondents.

Table 3.1 Category of Respondents

Respondents	Sample Size
Management Members	36
Staff	105
Grand Totals	147

Source (Author's construct, 2013).

Primary data was used in the study. The data collected was based on three categories of risk, i.e. Production Related risk, Commercial / Market Related risk and Environmental Related Risk adopted from the World Bank(2012) report on risks in the cocoa industry in Ghana. Both self-administered and interviewer-administered questionnaires were used for the study. This allowed for responses from the respondents with varying characteristics, some of whom required guidelines and further explanations to some of the questions. The questionnaires used were closed type with five point likert scale, ranging from 1= Very Low to 5=Very High in three sections. The first section sought to solicit responses from respondents on the likelihood of occurrence of certain pre-determined risks factors based on the World Bank(2012) report. The second section also sought to find out the perception of the respondents on the level of exposure or impact of the various risks on cocoa supply chain whilst the third section focused on detection (the need for urgent attention). Respondents were given the chance to tick the most appropriate response(s). The questionnaires were delivered to the respondents by the researchers.

The study adopted the Failure Mode and Effect Analysis (FMEA) model as the techniques to identify and assess risks in supply chain used by Crow, (2002) and Carbone and Tippett, (2004) cited in Anggara (*Implementation of Risk Management Framework in Supply Chain: A Tale from a Biofuel Company in Indonesia*, 2008). The risk assessment process was done in phases. The first phase focused on determining the various risks that is inherent in the cocoa supply chain of the various cocoa purchasing companies. This stage ensured that all the recognizable risks were identified. Each risk was scored for its likelihood of occurrence, severity of impact, and Detection (need for urgent mitigation) based on FMEA model scaling guidelines for scoring each risk. This phase was followed by the calculation of Risk Score Value (RSV) and Risk Priority Number (RPN) for each risk.

The standard of FMEA evaluation is based on the likelihood of occurrence, severity of impact and detection for each risk event. The multiplication of these values gives a Risk Priority Number (RPN) i.e., $RPN = \text{Likelihood of Occurrence} \times \text{Severity of Impact} \times \text{Detection}$. That of $RSV = \text{Likelihood of Occurrence} \times \text{Severity of Impact}$. After the RSV and RPN values were obtained for each identified risk, Pareto analysis (80/20 rule) and risk clustering were then developed using a Scatter plot. From the Pareto analysis and the scatter plot, the risks profiling and its mitigation strategy matrix was developed and analysed.

4. Results and Discussions

Table 4.1 Type of Risk inherent in the cocoa SC

RISK FACTORS	Risk Score Vale(RSV) (Likelihood x Impact)	Risk Priority Number (RSV × Detection)
Black pod disease	20	125
Mirids/ capsids	9	27
Swollen shoot virus	16	100
Other pests, diseases and weeds	25	75
Drought/ dry spell	12	48
Bushfires	16	32
Loss of cocoa acreage	9	36
Cocoa price volatility	20	100
Exchange rate volatility	25	100
Counterparty risk	12	36
Input price volatility	25	125
Interest rate volatility	15	100
Market regulatory risk	12	36
Policy risk	8	32
Logistics breakdown	25	100
Mismanagement of funds	20	80
Smuggling	25	125

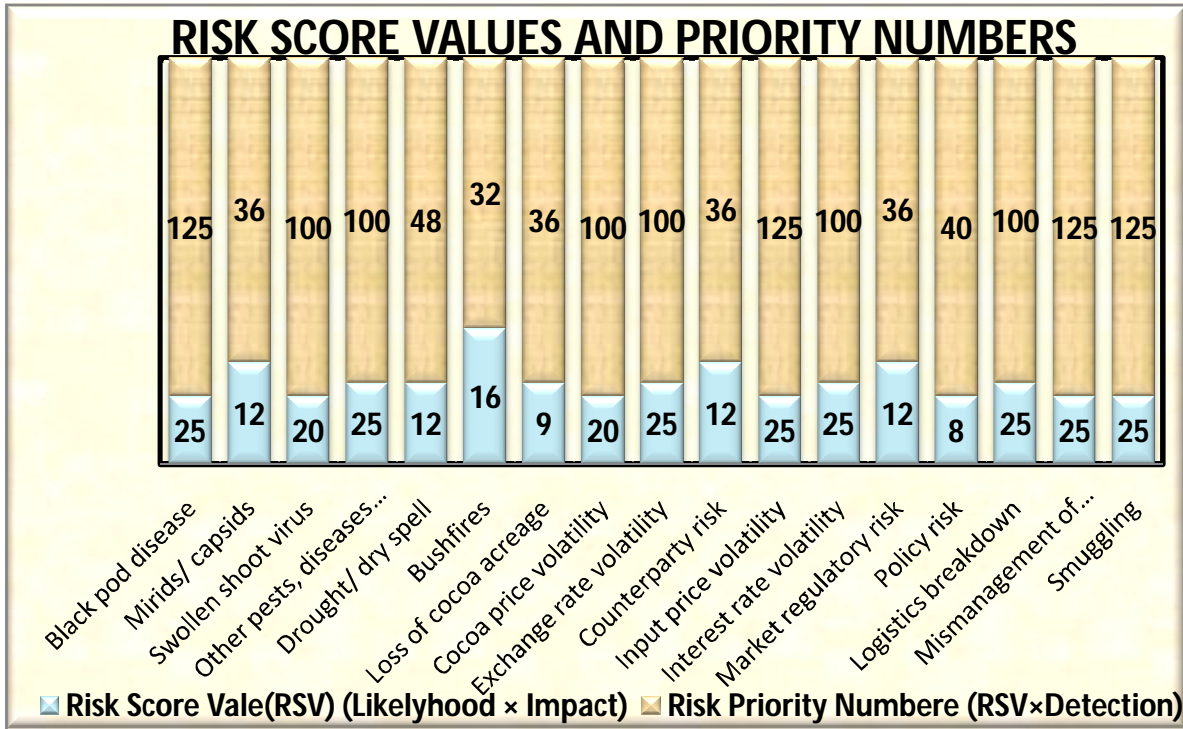
***Likelihood, Impact, Detection, each ranging from a scale of 1- 5**

(Source: Author's own computation based on the field survey, 2013)

Table 4.1 gives the perception of the respondents in respect of the various risks inherent in the cocoa supply chain of various cocoa purchasing companies in the Ashanti Region of Ghana and their various RSVs and RPNs.

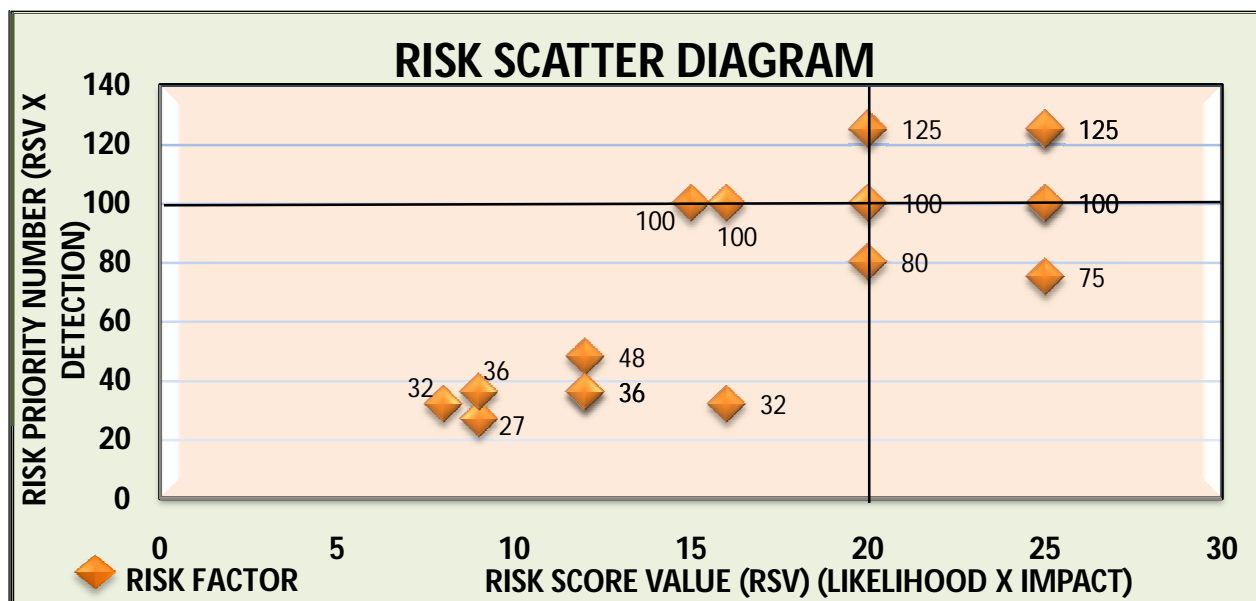
It is discernable from the table that seventeen (17) types of risks were perceived to be inherent in the cocoa Supply Chain with their RSV and RPN values. These risks were classified as production, commercial/market and environmental related. Figure 4.2 gives graphical illustration of the risk profile of the cocoa supply chain of the selected cocoa purchasing companies operating in the Ashanti Region.

Figure 4.1 RSV and RPN Values



(Source: Author’s own construct based on the field survey, 2013)

Figure 4.1 Risk Scatter Diagram

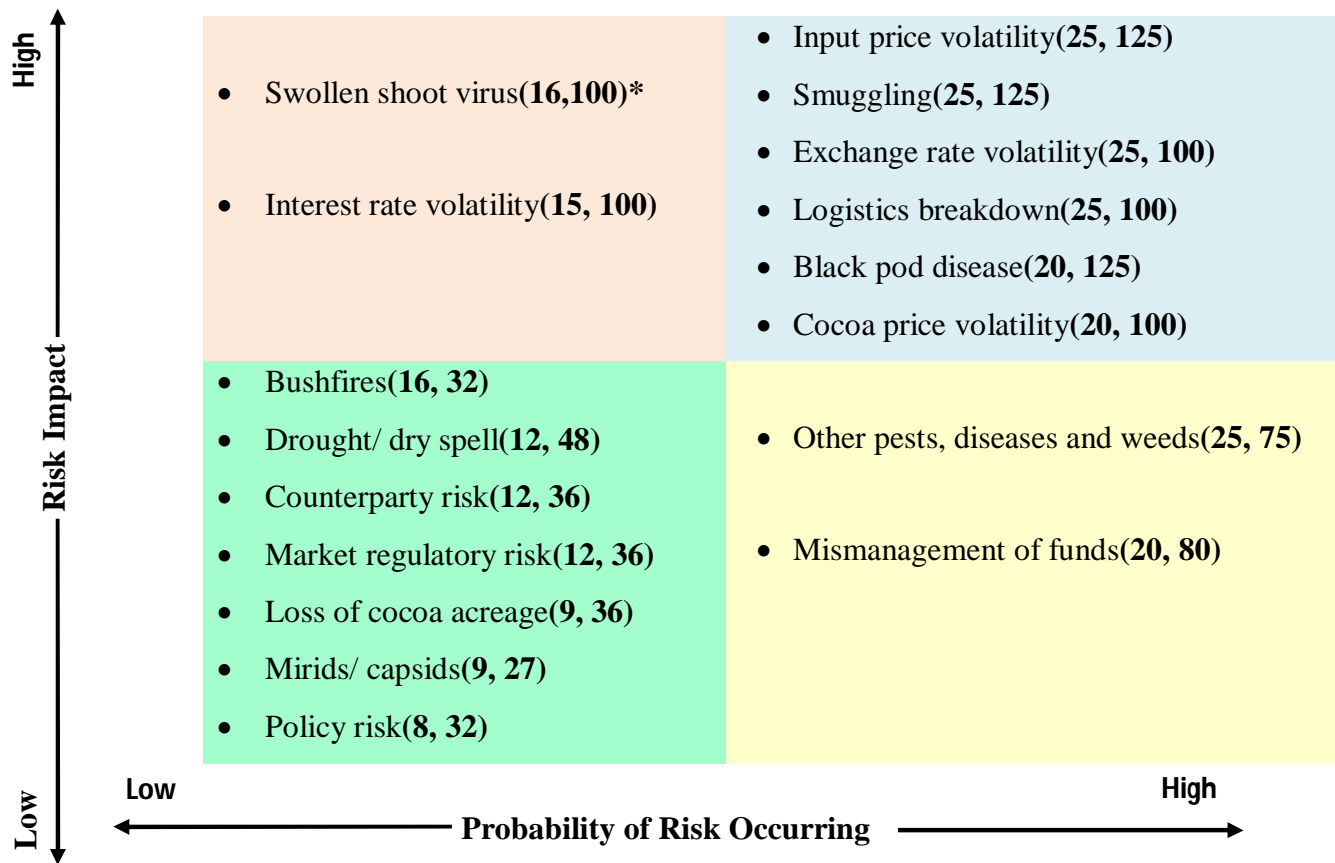


(Source: Author’s own construct based on the field survey, 2013)

4.4 Risk Mitigation Strategies

Figure 4.3 and table 4.3 show the scatter diagram and risk mitigation strategy matrix perceived to be measures to deal with the various risks identified in the supply chain of the cocoa industry.

Figure 4.3 Risk Mitigation Matrix



(Source: Author’s ownconstruct based on the field survey, 2013)

Figure 4.2 and Table 4.3 shows the level of exposure/ impact of various risks in the cocoa supply chain. Using Parato Rule of 80/20, the critical value for RPN was 100 (80% of 125) and falls on the 100 mark (reading upwards on the Y axis). For the RSV the critical value was 5 (20% of 25) and falls on the 20th mark (reading from right to left on the X axis). This gives RPN threshold point at 100 and RSV at 20. The upper-right area of the scatter diagram contains the most critical risks with high level of exposure. These risks are beyond the level of acceptability and therefore need immediate attention. It is evident from the diagram that Input price volatility (25, 125), Smuggling (25, 125), Exchange rate volatility (25, 100), Logistics breakdown (25, 100), Black pod disease (20, 125) and Cocoa price volatility (20, 100) are the risks that fall within that quadrant. These risks have the highest level of exposure amongst the entire risk profile of the cocoa supply chain as their likelihood of occurrence and impact on the operations are very high and require critical attention.

In the lower-right area of the scatter diagram and the risk profile matrix, the risks have high likelihood of occurrence, however, their impact or level of exposure is not very high. It is discernable from the figures 4.2 and 4.3 that other pests, diseases and weeds (25, 75) and mismanagement of funds (20, 80) are the risks that fall within that quadrant with their respective RSV and RPN values. Even though the results indicate that their level of exposure or impact is not too high since they have high likelihood of occurrence, their impact can easily escalate and get out hand. Therefore they require close monitoring as they can lead to high production vulnerabilities. Risks in the left top corner of the scatter diagram have high level of exposure or impact on the supply chain activities but the likelihood of their occurrence is low.

From the figures 4.2 and 4.3, swollen shoot virus (**16,100**) and Interest rate volatility (**15, 100**) were the risks that fall within the quadrant with their respective RSV and RPN. Although the likelihood of occurrence of these risks is low, they still need to be closely monitored and managed since their level of exposure is high and the SC susceptibility to adverse event could escalate.

The last category of risks falls in the bottom-left corner of the scatter diagram. These risks have both low likelihood of occurrence and low level of exposure or impacts on the supply chain activities. From the figures 4.2 and 4.3, Bushfires (**16, 32**), Drought/ dry spell (**12, 48**), Counterparty risk (**12, 36**), Market regulatory risk (**12, 36**), Loss of cocoa acreage (**9, 36**), Mirids/ capsids (**9, 27**) and Policy risk (**8, 32**) are type of risks that fall within that quadrant with their various RSVs and RPNs. Too much resource should not be expended on these risks since their levels of exposure or impacts on the supply chain activities and likelihood of occurrence are very low. They should be managed as and when necessary.

4.2 Risk Mitigation Strategies

The identified risks could be managed through diligent operational activities and contractual arrangements. Mismanagement of funds could be dealt with through close monitoring of individuals responsible in managing funds at all stages of the supply chain. Auditing and internal control mechanisms could also be intensified to reduce, if not prevent, the incidence of funds mismanagement. The use of ICT could again be used to reduce the human interface to strengthen internal controls.

The issue of smuggling risk could be managed operationally by close monitoring of the activities of members of the supply chain, especially those close to the farm gate and boarder areas. The supply chain may collaborate with government to offer competitive price of the cocoa produce to discourage farmers and dealers from taking their produce to the neighboring countries. Again effective co-ordination through information sharing could be an effective mitigation tool to dealing with smuggling. Logistics breakdown risk could be managed by outsourcing the non-core activities such as transportation with effective and appropriate contractual arrangements in place to discourage non-performance of parties and to ensure effective relationship management.

Exchange rate, input price and interest rate volatility risks could be managed through the use of hedging or derivatives (example, hedging against exchange rate, input price and interest rate volatilities) and other forms of insurance. For the production related risks, possible mitigation strategy could be by providing training to the farmers to improve their knowledge in managing crop related diseases. The supply chain could also provide support to farmers to ensure that farmers get access to quality farm inputs such as fertilizers and other chemicals. The supply chain may also embark on continuous research that will help develop new and improved approaches to managing crop related diseases and ensure that there is effective knowledge sharing on risk mitigation to reduce the likelihood of production related risk events occurring.

5. Conclusion

This study was set out to evaluate the various categories of risks within the cocoa supply chain in the Ashanti Region of Ghana. The study revealed that Swollen shoot virus, Black Pod disease and other Pests related diseases are the major production related risks facing the cocoa SC. Major commercial/market risks found included Exchange rate volatility, Cocoa price volatility and interest rate volatility whilst smuggling, mismanagement of funds and logistics breakdown were found to be the major environmental related risks facing the sector. These identified risks could be managed through diligent operational activities, the involvement of third party and contractual arrangements as well as effective SC co-ordination and integration.

5. Recommendation

Based on the above findings, it is recommended that farmers be given training on cocoa related disease to be able to deal with these risks at the farm level. It is also recommended that farmers be assisted financially and technically by the various cocoa purchasing companies in acquisition of various farm inputs and application of chemicals on the cocoa plants. Perhaps, the mass spraying exercise initiative should be given serious attention by the cocoa purchasing companies.

It is again recommended that government and cocoa purchasing companies should offer competitive pricing and incentives as well as prompt payments to discourage farmers and other parties smuggling cocoa products to other countries.

Further, trust building and information sharing among the supply chain players should be improved as it is one of the drivers of building effective supply chain resilience. This will also improve coordination and integration of the supply chain and consequently reduce the negative impact of these risks. Finally government should improve upon the road networks, especially among the cocoa growing areas in order to reduce transportation related cost.

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