

Planning and Implementing Solutions to Overcome Storage Challenges in Cocoa Bean Warehousing: A Case Study

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Abstract: *This paper addresses the significant problem of storage challenges in cocoa bean warehousing, particularly the infestation of cocoa beans by insects during cultivation, storage, and transportation. These challenges lead to spoilage, rejection of cargo, and financial losses. The study aims to identify the challenges faced by warehouses in the cocoa bean company, investigate the critical factors contributing to these challenges, and provide solutions to overcome them. The research is conducted at XYZ Company, involving employees from the logistic departments. The qualitative method is used to collect data through interviews with the company's employees. The study is crucial for XYZ Company as it helps identify and address warehouse challenges, ultimately improving the storage of cocoa beans. Furthermore, it contributes to educating stakeholders, including clients, about the industry's responsibility to the community. The findings of this research will have practical implications for the cocoa processing industry, aiding in the design of effective drying systems, the selection of suitable drying conditions, and the prediction of heat and mass transfer during the drying process of cocoa. Moreover, the study will help in enhancing the quality of cocoa beans, reducing the cost of the drying process, and improving the overall efficiency of the industry.*

Keywords: Cocoa Beans, Challenges, Warehouse

1. Introduction

Cocoa, the dried and fully fermented fatty seed of the cacao tree, known as the food of the gods, is highly desired, appreciated, and a source of great passion for people all over the world due to some unique characteristics (Montagna et al., 2019; Rusconi and Conti, 2010). The main purpose of cocoa harvesting is to extract the purplish beans used to make cocoa liquor, butter, and powder—the main components of chocolate. In the past, Malaysia has relied heavily on cocoa as a crop, which has helped the nation's agricultural industry expand and flourish. According to recent data, cocoa cultivation is still an important industry, despite its relatively small GDP contribution compared to other industries like rubber and palm oil (Khazanah Research Institute, 2018).

Cocoa production contributes to Malaysia's GDP via influencing the agriculture sector and allied industries such as food processing and manufacturing. A total of about 104,000 metric tons of cocoa beans were exported by Malaysia in 2023—a small down from the approximately 108,000 metric tons exported the year before. In 2018, the nation shipped about 155,000 metric tons of cocoa beans, the most ever (Statista Research Department, 2024). The strong position of the nation in the international cocoa market is reflected in this figure. The Malaysian Cocoa Board states that the country is one of the top producers and exporters of cocoa goods worldwide, which stimulates the economy both at home and abroad. The Malaysian Cocoa Board offers comprehensive data and reports on the success of the cocoa sector, including information on exports, production levels, and economic contributions. The MCB's annual publications provide in-depth analysis on the GDP impact of cocoa on Malaysia.

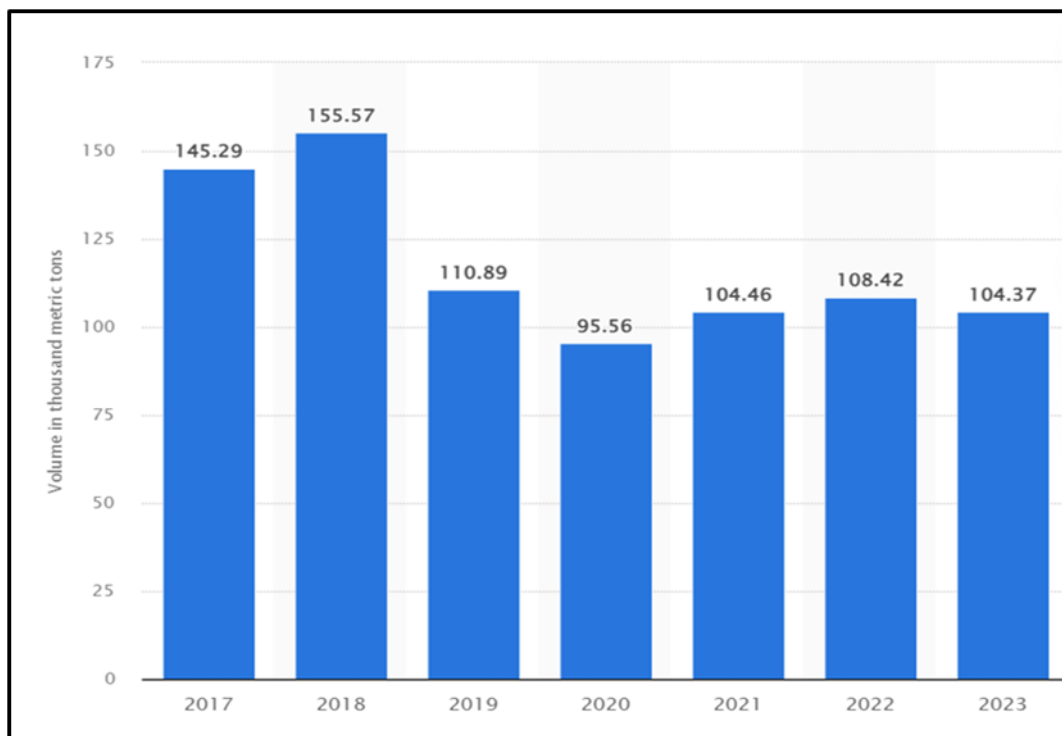


Figure 1: Export volume of cocoa beans from Malaysia from 2017 to 2023
 (Statista Research Department, 2024)

Apart from this beautiful contribution, the cocoa industry was faced with several challenges, one of which was cocoa bean storage in the warehouse. This cocoa bean can be easily infected by the temperature in the warehouse, moisture level, duration of storage, fungal infection, insects, and other pests like mice, ants, and roaches during storage (Delgado-Ospina et al., 2021). Addressing these challenges requires a combination of good warehouse design, regular maintenance, and effective management practices to ensure that cocoa beans remain in optimal condition from storage through processing. Therefore, a suitable warehouse is important to ensure that the cocoa is well protected so that the cocoa beans will not be infected by those factors in the warehouse. If the quality of the cocoa beans is well protected, it can reduce the risk of the cocoa being rejected by the customer and reduce the loss.

Rejecting a customer can have a lot of repercussions, including expensive fees, difficult paperwork, disputes, and losses. Typically, the infection can occur in the warehouse due to the presence of insects, rats, and even birds that might harm the cocoa bean bags. Thus, the purpose

of this study is to identify the problems that the cocoa bean business faces with warehouses and to propose solutions for improving cocoa bean warehouses.

2. Literature Review

According to Panlibuton and Lusby (2006) in their report to the U.S. Agency for International Development and also the latest study by Zulfiandri (2023), Indonesia is the third largest producer of cocoa in the world after Ghana and the Ivory Coast and the most significant cocoa bean supplier in East Asia. This case examines how the value chain can influence industry upgrading and the adoption of improved practices by smallholder farmers. Although the cocoa value chain in Indonesia has experienced phenomenal growth over the past few decades, its continued competitiveness is threatened by inconsistent and poor-quality production. Widespread pest infestation, especially from the cocoa pod borer (CPB), is a primary cause of poor cocoa bean quality. To cope with the problem, Indonesia had implemented some methods to improve the quality of the cocoa beans. One of the methods is by improving the infrastructure and logistics of their production. Efficiency and availability of transportation and infrastructure to move beans from producers to the global buyer. Besides, this also includes the efficiency of port operations, inspection services, and other logistical export services.

Besides, by referring to the Asante (2014) research, his study aimed at assessing the various challenges associated with the storage and transportation of cocoa by the LBCs in the Western Region of Ghana and how these challenges affected cocoa quality and losses. Storage, primary and secondary evacuation of cocoa have been a source of concern to LBCs especially during peak seasons of the year. There have been many instances where originally graded and sealed cocoa failed to meet quality standards at the takeover centers (TOCs) and therefore was rejected. According to Shepherd and Farolfi (1999), the liberalization of markets has brought in its wake new challenges, including how to maintain produce quality during storage and transportation in a competitive market environment. Since problems are inevitable along the supply chain, revealing the warehousing and transportation problems experienced by LBCs particularly during peak seasons, would be of paramount importance in the country's effort to further increase sales and exports (Asante, 2014).

The Quality Control Company (QCC) of COCOBOD monitors the quality of the beans along the cocoa value chain from production to export (Artavia Oreamuno & Croppenstedt, 2023). QCC provides all the inspection, grading, and certification services. The flow of the process has been showed in the Asante (2014) study, the first inspection takes place at the society or village level before the purchase is done by the LBC's marketing clerks (MC). A second inspection is carried out at the district depots by QCC before movement to take-over points at Kaase in Kumasi, Tema and Takoradi ports. A third inspection is carried out at the port before the cocoa is taken over by CMC and a final inspection is done before shipment or export. All such quality checks are done to ensure that the quality, as seen during the original inspection and certification, is maintained and consistent.

The insects attract rodents that also attack the bags that hold the cocoa. With fewer means for pest control on the one hand and growing insect and rodent populations on the other, the problem is becoming difficult to manage (IS Department (2024); Jack Steijn, Sept 2010). Some of the methods used are, firstly, the procedure. In coffee warehousing, the rules of HACCP have already been applied and HACCP concerns food hazards and critical control points. It describes the entire process that the warehouse keeper is responsible for including identifying

the risks to food safety and security and the critical points in the process where these risks can be controlled, and finally, developing and executing a policy to contain the hazards. The second method is registration. One of the tools in HACCP that can also be used as a stand-alone measure is the warehouse logbook, in which every action in the warehouse is recorded: landing of goods, sweeping, fumigating, delivery, etc. Thirdly is packaging. Analysis of samples of jute bags has shown that there seems to be no indication that the type of bag, finishing or origin has any influence on the appearance of insects. Lastly, there is RFID technology. Pilots have been carried out with the use of RFID technology for tracking and tracing cocoa beans. With readers attached to shovels and transmitters to the fences between heaps of cocoa beans in bulk, mistakes are avoided as to which cocoa should be delivered to a certain customer, thereby contributing to the guarantee of the origin of the cocoa that is being transported (Steijn, 2010).

Another journal that can support this research is Jonfia-Essien (2012), in his research on Recent Developments in the Storage of Dry Cocoa Beans in Ghana. Ghana has successfully used hermetic control with phosphine fumigation of dry cocoa beans in storage. Hermetic storage of cocoa beans in Ghana has led to a 50% reduction in the use of agricultural chemicals. Ghana has also preserved its premium grade cocoa with 100% insect mortality with hermetic storage facilities. The parameters of the quality of dried cocoa beans as well as the degree of insect mortality of stored cocoa beans under hermetic storage were carefully monitored together with those under phosphine fumigation by the Research Department, Quality Control Company Limited (Jonfia-Essien, 2012). Cocoa, like other tropical crops, is often destroyed by insects, diseases and other pests that must be effectively and safely controlled. Their control involves the intensive use of agricultural chemicals that currently face several international challenges in terms of rigid international standards on Maximum Residue Levels (MRL) (Jonfia-Essien, 2012). There are several methods introduced by Ayeduvor, Obeng and Adomanko (2020), in their research, namely, the first is the determination of pre-storage quality. When cocoa beans graded, sealed and certified by QCC arrive from overseas depots, they are placed and samples of cocoa beans are taken from each bag for re-inspection. The samples were rounded and quartered and the process was repeated until the final sample was obtained for thorough physical quality analysis. The quality parameters determined are moisture content, nut count, nut size uniformity, and grade. The second is pre-shipment quality determination. The physical quality parameters of cocoa beans stored under both hermetic and gas-tight sheet conditions were determined in the same way as for pre-storage.

Based on Sandra's research (2012), it determined the level of pesticide residues in cocoa beans from the Ashanti and Brong Ahafo regions in Ghana using gas chromatography with electron capture detection (GC-ECD). Ghana packs about 850,000 tons of cocoa in a year and stores it in warehouses but there are many constraints or losses due to its storage. One of the main constraints is pest infestation. The literature shows that the development of relatively inexpensive and highly effective methods such as pesticides and fumigants is becoming the most preferred option in insect management (NASDA Research Foundation, 2014). The method introduced based on the study is, sampling. Dried cocoa beans were sampled from the main warehouse where cocoa beans were from different districts of Ashanti and Brong Ahafo. The consignment is divided into smaller lots of about 30 bags and split wire is used as widely as possible to detect foreign matter. The split wire is made of copper metal and has dimensions of 50 mm long by 30 mm wide (Sandra, 2012).

In addition to that to overcome the problem, they provide solutions in terms of warehouses. In the case of COCOBOD, warehousing starts in the sheds of companies buying licenses until the

beans are moved to the procurement centers in Tema, Takoradi and Kumasi. On reaching these centers, the beans are received by the warehouse manager and counted into the warehouse shed to see if the quantity matches the bill on the way. The received grains are then arranged in a warehouse separated from other grains to be fumigated for four nights, after these days they are ready for delivery. Although public warehouses rent space to individuals or firms that need storage for their goods, most of these firms do not need large spaces so there is no commitment to capital investment to build them and firms are exploring new markets where sales are unpredictable (Nbabuine, 2012).

The Cocoa Merchants' Association of America, concerning the warehouse inspection program is another journal that has relevance to this study. The journal's goal is to support participating warehouses in their attempts to uphold a suitable standard of storage in compliance with all relevant federal, state, and local regulations as well as the Federal Food, Drugs, and Cosmetics Act. In order to ensure that there are no live insects, rodents, or other infestations, the warehouse must physically verify the exterior condition of every cocoa that is tendered for delivery into a warehouse. It is advised that complete building fumigation be performed at least once a year on all cocoa bean storage facilities with CMAA certification. There shall be eleven inspections for beans and six for the product warehouse each year (The Cocoa Merchant's Association of America, 2015).

The effects of infection on stored purple cocoa beans are described in a study paper by Tettey, Jonfia-Essien and Obeng-Ofori (2014). Cocoa beans are vulnerable to moth and beetle attacks from several species. Though they mainly begin on the drying mats, insect infestations can occur elsewhere on the farm. The mats are typically rolled up and stored at the end of the season, but they frequently contain insect eggs and pupae that could emerge to infest the following crop. Likewise, the area near artificial dryers can serve as a breeding ground for bugs. Insect infestations can also happen while a product is being transported to a warehouse for shipment or storage (Tettey, et al., 2014). Insect feeding causes a loss of weight in the cocoa beans, thus reducing their commercial and nutritional value.

Inventory Control

The minimum and maximum values are not adequately maintained. Commonplace every day consumables, like cocoa in our case, are often out of stock. Cocoa may occasionally run out of stock when a client rejects the item because it takes a while for the replacement stock to arrive. Basically, the stock is imported from Ivory Coast, Ghana, or Cameroon. Because all cocoa is imported from outside of Malaysia and takes time to replenish, material replenishment is not done efficiently. The non-moving and slowly moving objects are beyond of your control (Prah & Fanam, 2019; Dianawati et al., 2021).

Record Keeping

Materials deteriorate when they are not stored correctly. Open yards are used to store valuable and expensive commodities. Certain objects can be discovered in two distinct places. There is no connection between items kept at many stores (Prah & Fanam, 2019; Dianawati et al., 2021). The warehouse operators occasionally fail to provide us with the warehouse summary that we need to record. In addition, there exist certain discrepancies about the data used in the summary, specifically the weight figure that differs between the warehouse operator's report and the CWT report. There will be miscommunication between the customer and the warehouse operator as a result.

Infrastructure

To maintain the quality of the cocoa, the warehouse must have the right infrastructure for cocoa beans. As is well known, insects may readily infect cocoa beans. In addition, any rats or birds that get into the warehouse may harm the cocoa. For this reason, it's critical that the warehouse be secure in order to safeguard the cocoa beans. For instance, PEST controls are typically employed by a large number of cocoa bean warehouses. The purpose of this control is to keep the rats out of the warehouse. To stop any rats from accessing the warehouse, it contains a detection system. Regretfully, warehouse owners are unwilling to implement this control at their facilities due to the expense (Prah & Fanam, 2019; Dianawati et al., 2021).

The researchers created the conceptual framework for this study based on the review and the scenario from the previous study. It is an essential tool that directs the research process and offers an organized method for comprehending and examining the research problem. Since the warehouse sector is the subject of this study, inventory control, report keeping, and infrastructure have been chosen as the three independent variables. Figure 2 illustrates this framework's specifics.

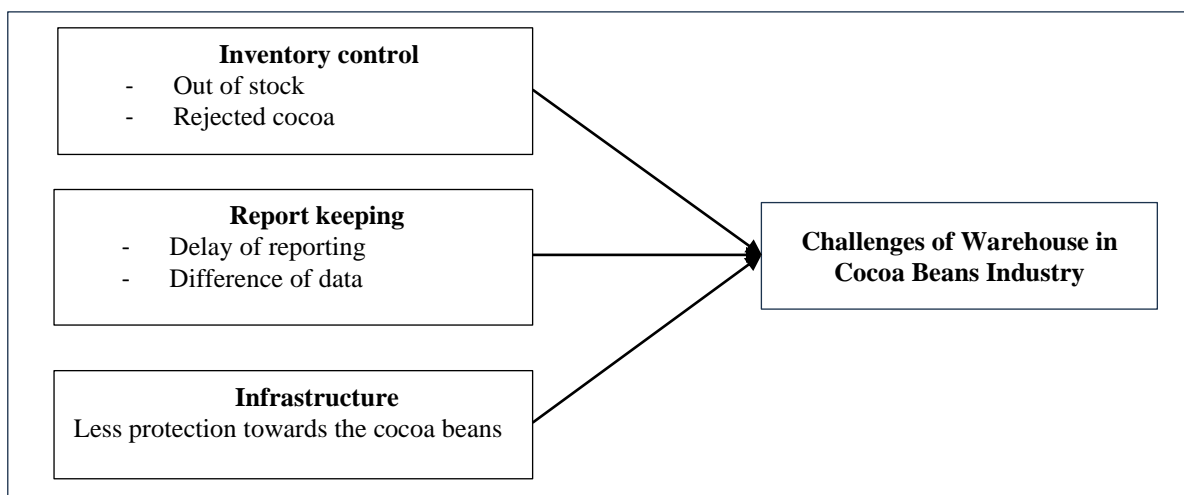


Figure 2: Conceptual Framework

3. Research Methodology

The intended respondent for this study is an employee of XYZ Company. The XYZ Company employs seven individuals in total. Six questions about the difficulties facing warehouses in the cocoa bean sector will be asked of each respondent during the interview process in order to collect information. Three personnel from XYZ Company's logistics department will be questioned about the difficulties facing warehouses serving the cocoa bean sector in order to gather a sample. Qualitative research is the method employed in this study to gather data. The interviewee, who will be made up of XYZ Company employees, will be given a total of six questions. There will be a direct question about the challenges that the company faced in keeping the cocoa beans inside the warehouse and the factors that contributed to the challenges. The interview will be asked the same question for everyone, so the most accurate answer will be collected.

Since no numerical data are needed, the sort of inquiry is a qualitative one. The XYZ Company conducted research that evaluates the difficulties faced by conventional warehouses in the cocoa bean sector. Information that the researcher has personally collected on the variables of

relevance for the particular goal of the study is referred to as primary data. The researcher conducted an interview session as a means of data collection to obtain the respondent's standardized data. After the interview answers were gathered, the data was examined using the NVivo program to determine the elements that lead to the difficulties faced by warehouses in the cocoa bean sector. Each person will be interviewed with at least five questions, and the questions will be the same for each person so that the answer will be more accurate.

In addition, the secondary data were utilized in this study as supporting data. The researcher used particular statistical reports and periodicals for this investigation. In order to have some data for reference, the researcher sorted and examined some of the data. At the end, a good summary of all the information gathered from the desktop research and interview was produced.

4. Analysis and Discussion

This research employs a qualitative technique, with six questions posed to three respondents at XYZ Company, which includes all employees in charge of the Logistics department. Following the interview and data collection, the researchers transcribed the interview's raw data into Microsoft Words before converting it into the NVivo program to extract the findings and obtain supporting data from the earlier study.

Table 1: The challenges to implement the better warehouse for cocoa beans

Q1: What are the challenges to implement the better warehouse for cocoa beans?	
Respondent	Statement
1	The challenges that usually happen in make sure the warehouse in good condition is of course the maintenance. For example, there is equipment on how to prevent the rodents from entering the warehouse. It called Pest control. The Pest Control must be inspecting to ensure that all the equipment is working.
2	Cost. Every cargo that arrived and infected must do the fumigation. Fumigation will be done by the Pest control. The cost of fumigation is per metric tonne. 1 metric tonne will cost RM7.50.
3	Right now, the record keeping and delay in reporting are the most challenges because our warehouse operators frequently giving us different data between their report and place of loading report. It makes us cannot have an accurate data for our record keeping.
Q2: Are there any challenges from inventory control when you want to setup the warehouse?	
Respondent	Statement
1	Yes, is it. Customer will reject the cocoa if the quality of the cocoa is in a bad condition. For example, the moisture, insect damage and also the waste. The quality must not exceed the percentage that had been stated.
2	There is some problem relating the inventory control but it is not usually happening especially for out of stock. Rejected cocoa only happen if the cocoa is really bad to sell to customer. But, Sucess Paris will make sure that the cocoa is good before export it to Malaysia by having the CWT report that show the quality of the cocoa.
3	Between out of stock and rejected cocoa, the most challenges for inventory control will be rejected cocoa. It is because the rejected cocoa required many documents, claims and also costs. The cost that need to bear including the unsold cocoa, the claims to the customer and also the cost for warehouse rental.
Q3: Are there any challenges from report keeping when you want to setup the warehouse?	
Respondent	Statement
1	Once the cocoa is bought from Paris, they will send the CWT report that stated the quality of the cocoa beans, the gross/nett weight of the cocoa beans and also the total no of bags of cocoa beans for each shipment to Malaysia. But, sometimes, when the warehouse operators give the stock report to us, there is difference in terms of the data between the report from Paris and report from warehouse operator in Malaysia. It will create confusion in our record.
2	Yes. We have three warehouse operator which is Bullion Trading, Pacaroni Access World (PMA) and Steinweg. But only two from the three warehouses that actively use by us to store the cocoa

Q1: What are the challenges to implement the better warehouse for cocoa beans?	
Respondent	Statement
	which is Bullion and PMA. The warehouse operators need to send us the stock report once a week so that we can monitor the cocoa easily. But, sometime warehouse operator delayed in giving us the stock report and it causes us to push the warehouse operator to give us the stock report. If they delay in giving us the stock report, we cannot detect any shipment or cocoa that already arrives at Malaysia and also giving us some problem in our record keeping.
3	Basically, report keeping problem always come from warehouse operator side. If they do their job nicely then there will be no problem in our side.
Q4: Are there any challenges from infrastructure when you want to setup the warehouse?	
Respondent	Statement
1	As we know, cocoa is perishable goods and it can easily be affected. So, the challenges that occur in order to setup the standard of warehouse is how to make sure that the cocoa is well protected by the insect or rodents inside the warehouse. For example, to make sure that the equipment in the warehouse is following the standard of warehouse like other warehouse operators.
2	Cost for maintenance. In order to make sure the warehouse is in a good standard, many costs required to maintain the maintenance of the warehouse. For example, to prevent the birds from entering the warehouse, there will need the plastic curtains at every door of the warehouse. Price of one piece of plastic curtain is RM400 but it also depends on the length of the curtainl.
3	I think, as long as the equipment used at the warehouse is suitable and follow the procedure for the cocoa, there will be no challenges in make sure the standard of warehouse for cocoa beans.

According to the comments received during the interview session, the barriers to implementing the standard in cocoa bean warehouses include maintenance, expense, and record keeping. To keep the cocoa safe from insects and rodents, the warehouses must be outfitted with high-quality technology, which will come at a price. The costs associated with fumigation and pest control, for instance. Management and warehouse operators will become confused as a result of record keeping.

Besides that, the challenges of inventory control will affect the standard of the warehouse for cocoa beans because of the rejected cocoa. If the cocoa is in bad condition, it will be rejected, and if the cocoa is rejected, it will need to be stored inside the warehouse for quite some time. The rejected cocoa will take up the space for new cocoa, and the cocoa will move slowly. Based on the respondent statement, delay in reporting and differences in data will be challenges in report keeping when they want to set up the standard of the warehouse. It is because differences in data and delayed reporting will make it a bit complicated for XYZ Company to allocate the location of cocoa, whether it is still in the warehouse or not. It is also difficult to know the actual weight of the cocoa if there are differences in the data.

Aside from these situations, infrastructure issues arise while attempting to establish warehouse standards. The responder concurs that regular maintenance is necessary to keep the machinery operating at peak efficiency. The reason for this is because building infrastructure to safeguard cocoa beans is expensive.

Table 2: The most challenging factor and the recommendation

Q5: Based on these 3 factors, which one that you think the most challenging factor to implement the good warehouse for cocoa bean industry?	
Respondent	Statement
1	I think the most challenges factor is infrastructure. It is because infrastructure plays big roles for the warehouse to be able meet the standard and to keep the cocoa in a good quality because warehouse can also damage the cocoa by stored it for a long time.
2	The most challenges factor implements the standard of warehouse for cocoa bean industry are the maintenance. To maintain the maintenance is quite difficult because of the cost.

Q5: Based on these 3 factors, which one that you think the most challenging factor to implement the good warehouse for cocoa bean industry?	
Respondent	Statement
3	Based on that factor, the major challenges are inventory control. Because rejected control will cause the flow in warehouse become slow and effect the new cocoa that will come inl
Q6: As cocoa bean is perishable goods; how can you control this problem? Recommendation	
Respondent	Statement
1	To make sure that cocoa is well protected, the warehouse must also well protect. That’s why we have the inspection for warehouse that will be held to make sure that the warehouse is following all the standard that needed to ensure the quality of the cocoa.
2	Basically, the cocoa will be infected because of the insect and the insect occur when the raw cocoa has been stored for an extended period. Fumigation process can help to kill the insect that occur at the cocoa.
3	Make sure that the packaging and container is suitable for the cocoa. The container must be carefully inspected and confirm their cleanness to ensure that the air is suitable for the cocoa and will not damage the cocoal.

Based on the respondent's remark, it is possible to deduce that infrastructure is the most challenging issue in implementing warehouse standards for cocoa bean sector. The reason for this is that, in comparison to inventory control and record keeping, it will have the biggest impact on the warehouse. Because cocoa beans need to be housed in certain warehouses, a well-designed infrastructure can match the standards of those warehouses. In order to guarantee that the cocoa would be safeguarded throughout storage or transportation, the respondent says that warehouse inspections, fumigation procedures, and container types are crucial. This is due to the fact that cocoa is a perishable commodity that is easily contaminated, therefore controlling these approaches can lessen the amount of damaged or infected cocoa.

For best practices to overcome the challenges based on the results that have been analysed, the major factor or first priority that needs to be improved is the facility and infrastructure for the warehouse. It includes doing more inspections of the warehouse. By having enough facilities, the cocoa bean can be protected from any rodents or birds that may damage it. The inspection of the warehouse must be held frequently and as scheduled. By having enough facilities, the cocoa bean can be protected from any rodents or birds that may damage it. For example, bird curtains and bird devices can help prevent birds from entering the warehouse, while an insect light trap can help kill the insects inside the warehouse. The ventilation is needed to lower the temperature of the warehouse.

5. Conclusion

In addition to conducting interviews with XYZ Company employees, the researcher used an onboard observation technique to document the current state of the warehouse at Pasir Gudang, Johor as it is often known. The data that has been analyzed indicates that there is just one variable that affects the normal warehousing issues for the cocoa bean sector. Infrastructure is the independent variable. The data analysis indicates that the warehouse for the cocoa bean sector is more likely to fail than the infrastructure needed to secure the cocoa.

In order to find the key elements that go into finding a solution to overcome the difficulties and meet the standards of a warehouse for the cocoa bean industry, this paper will examine the challenges faced by the warehouse from the perspective of three improvements factors: inventory control, report keeping, and infrastructure. From tiny insects to large rodents, cocoa requires excellent protection, and a warehouse must offer adequate facilities for this purpose. The process for setting up a typical warehouse for the cocoa bean sector may be the same for

all warehouse operators. While some warehouse owners would want to have the most basic equipment in their warehouse, others would consider very good equipment to safeguard the cocoa.

The results of this study will assist in the understanding by planners and local authorities of the significance of implementing standard warehouse procedures for cocoa beans in order to preserve the quality of the cocoa. The quality of cocoa will be enhanced when the best facilities are offered, which can boost revenue and prevent issues from arising in the warehouse. In conclusion, the researcher has determined the primary cause of the standard warehouse's difficulties in the cocoa bean sector. Infrastructure is therefore the primary factor in this study. Subsequently, the warehouse operator and the organization can implement guidelines to address the issues facing the warehouse and ensure that it adheres to industry standards.

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