

Summary

The Netherlands is one of the largest chocolate producing countries therefore a lot of handling of cocoa beans takes place in Amsterdam. It is imported as well in bulk as in jute sacks to be processed. The handling of the jute sacks is mainly done manual which is labor intensive and a heavy job. In this report an overview of the supply chain of cocoa beans is made in which the following questions will be answered: what amounts of cocoa beans are produced and has to be transported? How are they transported and what type of equipment is needed? What is allowed and prohibited? And what programs develop a more sustainable supply chain? This research will focus on the supply chain of cocoa beans from the farm till the warehouses of the processing industries or traders.

A cocoa tree only grows within 15 degrees above and below the equator. It takes 6 to 7 years to let the tree produce beans which are harvested in the main crop and mid-crop. The main crop is yielded from September to March and account for about 80% of the total production. The tree produces about 35 pods a year containing 20 to 60 cocoa beans each. After the beans are extracted they are directly subjected to fermentation which takes about 6 days and develops the real chocolate flavor. Next the beans are dried, bagged and transported to a collection center where the farmers get paid for the beans. From there larger quantities are transported at once to the ports where it is made ready for shipment and sold again. Cocoa beans are directly traded to processing industries or at the futures market. Beans for futures market is traded at the LIFFE or NYBOT mainly in jute sacks.

An average bean measures: 22 x 12.5 x 7.5 mm and are not that spherical. The lowest surface area is measured for 13% moisture content, 410 and 480 mm² depending on the formula which is used. The density at storage conditions of a particle is 940 and for bulk 560 kg/m³. The angle of repose is 27°. The coefficient of static friction at storage conditions amounts 0.55 for plywood, 0.48 for galvanized steel and 0.22 for rubber.

The total cocoa bean production amounts nearly 4.2 million metric ton in 2007 from which 70% is produced by Africa and 20% by Asia. Cocoa beans are exported to be processed but slowly more processing of cocoa beans is done in the country of origin. The total exports in 2005 amounts 3 million metric ton from which 67% originates from Africa. In total Europe is importing 1.7, North America and Asia both 0.6 million ton. Between the importing continents is almost no transportation of cocoa beans. Within Europe, Belgium, France, Germany, the Netherlands and the United Kingdom dominate the market. These countries imports respectively 0.3, 0.2, 0.4, 0.6 and 0.2 million ton. Europe is the main importer of cocoa beans but also the main consumer, 42% of in total 3.2 million metric ton.

Methods used for shipping cocoa beans depend on facilities in the port of origin, the quantity to be shipped and future use. Currently sacks of 65 kg are mainly used for futures markets and shipped loose, in slings, on bolsters or in containers. Sacks are manual loaded and unloaded. Containers are also unloaded automatic by tilting it and sacks are stacked on pallets with machines. Bulk is shipped in ventilated containers, dry bulk carriers and sometimes in lighters. It is loaded by belt conveyors, big

bags and sometimes sacks are cut open in the hold of a ship to process as bulk. It is unloaded by grabs and sometimes pneumatic. Conveyor belts transport it to the warehouse where it is stored in heaps made by a hall filler. Bulk unloading has an average capacity of 300 metric ton beans per hour. Bulk reduces the handling time of the ship and fewer workers are needed. Beans are shipped in two weeks from Africa to the Netherlands in general cargo ships, container ships, LASH, ro-ro and dry bulk carriers. A lot of ships are self supporting to be less dependent of the port.

The value of cocoa beans is quite high and is very vulnerable to decay. To maintain the quality its moisture content should be lower than 8% and depending on its origin the humidity of the air must be below 66 to 76% therefore good ventilation is required. Cocoa beans are stored in warehouses where sacks are stacked on pallets and bulk in bays. Less use is made of silos which are more expensive but safes space by storing more than 10 ton and results in less breakage of beans. Cocoa beans are mainly shipped during the winter months towards the northern hemisphere. Due to the cold the humidity of the air increases and probably condensation occurs. For break-bulk paper is used to prevent contact between sack and the cold metal surfaces and water dripping on the floor and off the walls. In containers paper, a special plastic sheet or cloth is used to keep the sacks dry and in good condition. If the container is used for bulk mostly a liner bag is used. For bulk in a hold only good ventilation is applied.

For pesticides the European Commission has set up maximum residue levels what cocoa beans may contain. Often containers are fumigated in which the concentrations are too high. The Dutch ministry for social affairs has set up laws which forbid a worker to lift more than 25 kg on its own and two workers together not more than 50 kg. Legislation in warehouses for fire hazards differs per region. In Rotterdam the regulation is stricter than it is in Amsterdam what makes storage of cocoa beans less financial interesting and will lead to bigger concurrence from other ports.

Programs are set up like CATIE and the Accra Agenda to make cocoa farming more sustainable. Low cost methods raise the total earnings of farmers and improve the ecology. CATIE teaches farmers to be sustainable and manage their production. The Accra Agenda promotes sustainable cocoa production and use of cocoa through dialogue and cooperation with all stakeholders along the supply chain. Such a program has a lot of impact and can realize a big change in this business.

It is recommended to do research on bulk specifications because literature on the physical properties of cocoa beans is limited available and there is almost no data for cocoa beans at storage conditions. Currently the working conditions do not meet the regulation set by the ministry for social affairs. For the handling of sacks with cocoa beans it is advisable to change the unloading process. A research should be done to make the work less physically demanding or to make a change in the entire unloading process.