



Design of an On-Farm Cacao Processing System for Kyya Chocolate

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Introduction

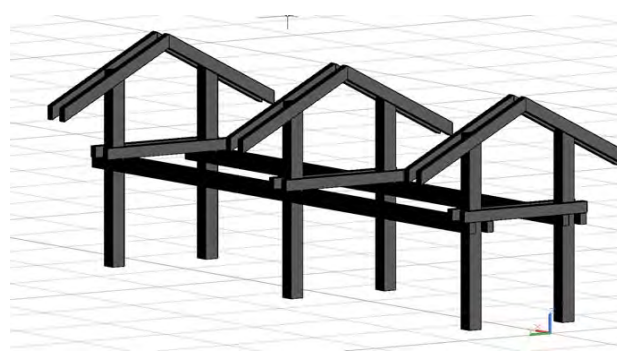
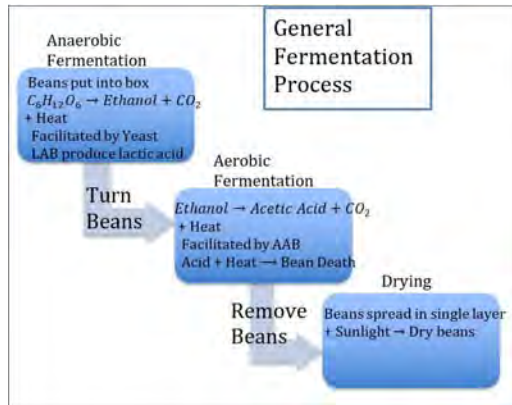
Cacao beans, the main ingredient of chocolate, are a commodity crop that must undergo several important processes in order to become the chocolate products we are familiar with. One of the most important processes, with regard to flavor, is the fermentation and drying of the beans. If the beans are not fermented completely they will not taste very good, and if the beans are not dried enough they will spoil and be completely ruined. The issue at hand is that most cacao farmers have never had to worry about the quality of their beans and thus the beans are often substandard or spoiled when they reach the chocolate manufacturers. Our client, Kyya Chocolate, pays the farmers significantly more for their beans than most buyers do, but the poor and inconsistent quality of his beans is hurting profit margins. The company has tasked us with rectifying this issue.

Objectives

- Design system that can ferment beans to ideal level consistently and the procedure to operate it
- Design drying system to ensure beans are dry enough to be imported and the procedure to operate it
- Devise monitoring system for both drying and fermenting processes that is easy to use
- Educate the client on how and why the system works so that it can be reliably replicated

Constraints

- Must be able to run without power
- Must be viable in any cacao-growing region
- Must be relatively inexpensive
- Must be easy enough to use that farmers can learn how to use it
- Materials used must be commonly available
- End product bean must be dry enough to pass through customs



Top Left: Process flow diagram of Cacao Bean Production, Top Right: Cacao beans exposed inside husk (from Kyya Chocolate), Bottom Left: Fermentation box, Bottom Right: Solar Dryer Frame

SUSTAINABILITY

The current system for purchasing cacao follows the Fair Trade guidelines for pricing the beans in order to insure that the price does not fall to unsustainable levels. This however does little to help the farmer as the increased profits for the beans goes to the middlemen at port instead of to the communities that produce the cacao. Farmers make, on average, \$0.28 per pound of cacao bean which leaves them below the poverty line. Kyya Chocolate pays the farmers \$1.50 per pound of bean directly which dramatically increases their economic situation. The system we designed will allow the farmers to get paid significantly more for their crops. Additionally the increase in profits for Kyya will allow them to meet their goal of investing into the communities that supply their cacao in order to improve the local infrastructure and economy. Between the increase in cash flow from their crops, and the investment of capital from Kyya into the community the economic and social situations in those communities should become increasingly sustainable. Furthermore, as our system allows for the fermentation and drying of the beans with no additional power inputs our system virtually eliminates the carbon emissions released by the current processing methods.

Acknowledgements:

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Proposed System

Our system was designed with cost and lack of guaranteed power supply in mind, and consists of a fermentation box and a solar drying table detailed below.

Fermentation Box:

- Wooden cube constructed of 2x4s
- Lined with banana leaves during anaerobic fermentation to insulate and limit oxygen infiltration
- Banana leaves removed during anaerobic stage to allow oxygen infiltration
- Removable side to allow the beans to be easily removed and turned
- Box wrapped with straps or cordage to hold removable side shut
- Box will be raised off the ground to prevent contaminants from entering box
- Bottom of the box consists of wooden slats to allow proper drainage of effluent

Solar Dryer Table:

- Table measures 3 feet by 15 feet
- Constructed of wood 2x4s for the frame, 4x4s for the vertical posts, plywood for the table surface, and plastic sheeting for the roof
- The table surface is three feet off the ground
- The roof connects to the vertical posts three feet above the table surface
- The peak of the roof is four feet above the table
- The roof sticks out two feet from the side of the table
- Beans will be spread evenly over the surface of the table to dry