



## DEVELOPMENT AND TRANSFER OF INNOVATIVE TECHNOLOGIES FOR FARM LEVEL COCOA PROCESSING AND USE OF BY-PRODUCTS.



## DEVELOPMENT AND TRANSFER OF INNOVATIVE TECHNOLOGIES FOR FARM-LEVEL COCOA PROCESSING AND USE OF BY-PRODUCTS.

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Despite being Uganda's fourth revenue earner, cocoa at postharvest handling and by-product processing involves loss of revenue, environmental degradation and is not gender inclusive. A new study in Uganda looks at two strategies to address these issues –use of a single fermentation box that reduces fermentation time and is gender-inclusive, and developing value-added products from the cocoa waste generated during fermentation.

### CONTEXT

Cocoa is one of the ten strategic crops in Uganda, currently, ranking 4<sup>th</sup> in foreign revenue contributions. The crop is predominantly grown in the districts of Bundibugyo, Mukono, Buikwe, Hoima, Kibale, Mayuge and Jinja, and directly supports over 15,000 households. Production in Uganda has increased over the past 5 years with volumes reaching 29,761 tonnes and fetching US \$74.996m in the year 2016. Fermentation is one of the vital steps that ensures the development of chocolate flavour precursors determining the quality of resultant chocolate and price offered to farmers. In Uganda, cocoa is majorly fermented using storey boxes and heap; both methods being labour-intensive and requiring larger volumes (>800kg) to achieve the desired quality. This leaves small-scale farmers with no option but to sell their cocoa fresh at a low price. In addition, the tower fermentation boxes also limit the women from engaging in fermentation due to energy requirements.

During cocoa fermentation, a lot of waste is generated as sweating from fermentable juices that can be detrimental to the environment by especially affecting soil pH. 1kg of dried cocoa beans produces 0.59kg of cocoa sweating. This implies that of the 29,761 tonnes of cocoa beans Uganda

exported in 2016, 17,558 tonnes of that was cocoa sweating which is the equivalent of 1,545 tonnes of fermentable sugars; that could be potentially of higher economic importance if converted to value-added products like bio-ethanol, wine and vinegar. This implies that Uganda lost 717 tonnes of ethanol as sweating, yet importing volumes of alcohol amounting to USD 500,000 in 2015, a value that can be reduced substantially by employing innovative technologies to ferment cocoa pulp.

**Therefore, the current project which targeted Bundibugyo and Mukono as the study areas to tackle the above challenges designed a single cocoa fermentation box that handles smaller volumes (60kg to 100kg) and a stainless steel press for extraction of juice from cocoa pulp that can be fermented to generate value added products like wines and brandy. This is expected to boost income generating capacity of cocoa farmers and lessen the negative impact on the environment.**

## **A single-box fermentation method reduces fermentation time by 2 days**

Three prototypes of the single fermentation box have been developed and efficiency studies of one prototype conducted in Kasawo alongside a storey box fermentation method. Bean cut tests and olfactory tests, were performed to evaluate the degree of fermentation in the different methods. Full fermentation of cocoa beans was achieved after 96 hours for single box and 144 hours for



*Figure 1: Left hand is the single fermentation box showing the inside design and a filled box with cocoa; on the right hand is the storeyed fermentation box with steps for climbing while filling first box*

storey box fermentation method, the cocoa in the single fermentation box attained the chocolate flavour after 96 hours (4 days) unlike the cocoa from the tower boxes which attained its chocolate flavour after 144 hours (6 days). The ease of applicability, gender inclusiveness and efficiency have shown that the single fermentation box will be a better alternative cocoa fermentation method for small-scale farmers.

## **Stainless steel tank suited for cocoa pulp juice extraction**

A fabricated stainless cocoa juice extraction press with a capacity of 15 kg has been designed and used to hygienically extract 20% cocoa juice without compromising the fermentation process and quality of fermented cocoa bean. The press is fitted with a lever to allow for easy movement of the shaft to squeeze juice out of the fresh pulp with no damage to the cocoa beans.



*Figure 2: Demonstration of removing cocoa bean pulp from pods and extraction of juice using stainless juice extractor*

## Value-added beverages generated from cocoa waste

The project has developed 2 alcoholic beverages from purely cocoa sweating namely; the dry wine and brandy. Dry wine has been developed with a characteristic light colourless beverage, mild sweetness and sweet smell. The brandy is still under development now pending the distillation process. After distillation, it will be matured for a period of one year. The brandy is expected to be a high value product characterized with dryness, and sweet flavour.

## Conclusion

Fermentation box has shown the potential to reduce the fermentation time from 6 days to 4 days with 99% full fermentation of cocoa beans. This technology if adopted, will reduce the cost of fermentation, increase the quality of processed cocoa at farm-level, increase gender-inclusiveness and the overall market value of Uganda's cocoa. To create knowledgeable and more productive farmers/farmer groups with high cocoa on-

farm productivity by June 2020, sixty farmers and five extension workers in Kasawo and forty farmers and 5 extension workers in Bundibugyo have been trained on good postharvest handling of cocoa. During the trainings, a participatory approach was used with the use of visual aids like the fermentation boxes and cocoa beans. Demonstrations were done on-farm and farmers were given the opportunity to participate in the fermentation operations and data recording of bean colour change, temperature and pH changes.

The waste to the environment will also reduce if excess juice from the freshly harvested cocoa can be tapped and transformed into valuable products like ethanol, wines and other products. Trainings of extension workers in Bundibugyo, Kasawo and Kayunga on production of wine and brandy will be held on farmers' field. Trainings will be held in Kasawo during the months of February and March 2020. The developed technologies are being disseminated via the participating project partners especially the private sector (ICAM chocolate and Lwanga enterprises) and farmer groups from the cocoa growing regions. On the basis of our findings, we recommend that Uganda consider adopting a law, or high-level policy document, where it is engaging in promoting uptake and adoption of the developed cocoa and by-product processing technologies.



Figure 3: Project team disseminating the technology to one of the cocoa farmer group in Kasawo, Mukono district