

Scaling flash drying of cassava starch and flour at small scale

Luis Taborda A. (latabordaa@unal.edu.co), Arnaud Chapuis, Adebayo Abass, Simon Lukombo, Suraju Adegbite, Makuachukwu Ojide, Edmond Totin, Murat Sartas, Marc Schut, Luis Augusto Becerra Lopez-Lavalle, Dominique Dufour, Thierry Tran











History of the RTB flash drying project



- **2013-2014:** Survey applied to processors in different countries to understand the flash dryer's ideal design.
- 2014-2015: Computer model
- **2015-2016:** Design and construction of prototype at CIAT
- **2017-2018:** Testing and validation of high energy efficiency
- → 2019-2020: Transfer to private sector (scaling out)
- Scaling readiness project's Outcomes:
 - Reduction in energy consumption and operating costs
 - Two or three improved flash dryers in commercial use by end 2020



Cassava processing at small and large scale



Drying represents 70-80% of energy use for cassava starch or flour



production in Thailand, Vietnam and Colombia

Energy represents 7-20% of production

costs



2012: Problems with small-scale drying Drying is expensive

Nigeria

Peak 1FD Black oil 2013



Peak 1FD + Nobex HE Palm Kernel Shells 2013



OPERATIONAL COUNTRIES



Scaling Project Delivers



- Core innovation:

Efficient Small Scale Flash Dryer Design for Cassava Starch and Flour Production with:

- Improved feed system
- Improved dewatering equipment
- Improved hot air generator
- Improved fan

- Complementary innovation

-Theoretical and practical training on the basics of flash drying equipment.

-Training on preparing business plans on cassava drying using flash dryer equipment.

-On demand technical support for building and using cassava flash dryer equipment.

Core innovation: Efficient Flash Dryer





Adjustable temperature: 120 - 200°C LPG gas consumption: 3-4 kg/h at 180°C Cost: 4 USD/h or 0.04 USD/kg starch

Energy: 1500-2000 MJ/t starch similar to large scale dryers





Source of the images: Chapuis, 2018



PROGRAM ON Roots, Tubers and Bananas

The pilot flash dryer developed at CIAT





Critical size to avoid clogging and bridging: 5 – 10 cm

→ Downscaling limit

Hot air generator improved

Designs adapted to the requirements and conditions of each country to optimize energy consumption and production costs. Depends on type of fuel available (e.g. diesel, gas, agricultural residues/biomass, etc.) and type of burner technology and heat exchanger technology available









(a) Cut view of the counter-current, shell-and-tube improved air-air heat exchanger developed by RTB; (b) Photo of one of the six heat exchangers built during the scaling-out phase of the project (source: Authors and Agrimac Ltd, DR Congo).

Core innovation: Dewatering

Technological proposal of mechanical pretreatment of the raw material to reach +/- 35% humidity prior flash drying. Options considered are press and/or centrifuge to remove water





Theoretical and practical training on the basics of flash drying equipment.

2019 Oct. Nov. Dec. March April Sept. July May June August Flash Dryer Workshop https://youtu.be/FpeM1zdwoSs

And training on preparing business plans on cassava drying using flash dryer equipment.

And training on preparing business plans on cassava drying using flash dryer equipment.

Cassava Flour investment project feasibility

This tool uses predetermined information based on averages of business plans of multiple cassava flour processors from D.R. Congo, Nigeria and Colombia. This study was conducted during the development of the **Scaling Readiness Flash Dryer project** during 2019 and 2020. Although the information used could be significantly different with respect to other countries, this exercise could be used as a rough estimate to a pre-feasibility study of investment in cassava flour processing using flash drying technology. However, it is recommended that before making an investment, a complete study and business plan with updated data in your specific locality should be carried out. For inquiries and further information please contact us at latabordaa@unal.edu.co

Please select your location (more approximate)	Considering that the dryer will be operating for 6 days/week and 8 hours/day, the required capacity of the flash dryer (in	
DR. Congo (intermediate investment cost)	Kg/hr) is:	
If you have conducted a previous market survey, do you know what is the demand (estimated or projected) for cassava flour in your target market? (in Ton/week)	300 The price <i>(in US Dollars)</i> of the Flash Dryer that you need is:	
5 35		
Approximately how many tons of cassava roots would be available weekly for processing at your location	Flash Dryer Price	
48.90	US\$ 34716 Name: DRC_Price, dtype: int64	
16.30 114.10		
The quantity of roots available in your locality is enough to process the quantity of flour demanded	Cassava roots required (Ton/week)	
Will you also invest in complementary technology for cassava flour processing? (Press, Granulator, Gas burner (or Diesel heatexchanger), PID control system, Note:The costs of the complementary technology may vary from country to country, however, the information collected indicates that of the total investment costs, the flash dryer corresponds on average to 70%. For practical purposes of the analysis, we will use this approximate value to estimate the total investment costs)	Ton 48.9 Name: Roots_demand, dtype: float64	
	Complementary technology Price	
yes -	US\$ 14878 Name: DRC_complementary, dtype: int64	
What is the cost of one(1) Ton of cassava roots in a locality (in \$USD)?		
	The total investment (in USD) is:	
10 350	Θ	
What is the selling price per 1 Ton of HQCF (at factory gate) (in \$USD)? 350	US\$ 49594	
	Data collected in the countries under study allow us to conclude that the price of roots is on average 75% of flour	



_

On demand technical support for building and using cassava flash dryer equipment.





On demand technical support for building and using cassava flash dryer equipment.





Navigate: 2019









2 2









 Investment decisions by 4 more processors between January and May 2020:

- 3 dryers under construction; (DRC 2; Nigeria 1)

2 under planning (business plan, quotation by a manufacturer). (Dominican Republic 1; Colombia 1).

Strategize



Main bottleneck Strategy Strategy

Outputs



July 2019

December 2019

Two cassava processors (out of seven) adopted innovations and increased their processing capacity by 23% and 50%, and profitability by 8% and 10%, corresponding to extra income of about \$10,000/year/processor.

Outputs





December 2019

July 2019

Two cassava processors (out of seven) adopted innovations and increased their processing capacity by 23% and 50%, and profitability by 8% and 10%, corresponding to extra income of about \$10,000/year/processor.

Levels of innovation readiness

(Adapted from Sartas et al. 2020a) applied to flash drying

Stage	Innovation Readiness Level	Flash dryer example
1	Idea	Flash drying can increase the energy efficiency of drying HQCF and starch
2	Basic Model (testing)	An energy-efficient flash dryer has five key components (hot air generator, feed system, flash drying pipe, blower, cyclone collector)
3	Basic Model (proven)	An updated version of the basic model increased the efficiency of cassava flash drying, as validated with numerical simulations covering multiple scenarios
4	Application Model (testing)	A prototype based on the proven basic model and numerical model findings was designed
5	Application Model (proven)	Multiple versions of the prototype designs were assessed by RTB researchers and finalized by technical drawings with specifications
6	Application (testing)	CIAT prototype was built based on the technical drawings in Colombia
7	Application (proven)	CIAT prototype assessment showed to improve the efficiency of flash drying significantly
8	Innovation (testing)	Commercial small-scale energy-efficient flash dryer was built in Ghana by RTB and CAVA-II, Figure 4.7
9	Innovation (proven)	Testing of flash dryers in commercial setups is ongoing

Scaling Readiness Diagnosis



Scaling Readiness Diagnosis



Please visit our web site

https://flashdryer.cirad.fr/





This website provides a collection of tools to design energy-efficient small-scale flash-dryers for production of cassava starch or flour. These tools were developed by the CGIAR RTB program since 2013 to improve current designs and thus improve the efficiency of rural and peri-urban cassava processing industries. Here you will find:

- Tools to calculate the optimum dimensions of each component of a flash dryer, based on the target production capacity and local availability of cassava.
- Tool to assess the financial viability of a cassava starch/flour processing investment project, based on costs of raw materials and selling price of the product (flour or starch).
- Diagnosis tool to assess the energy efficiency of existing flash dryers, and identify options to upgrade the equipment. (Read more)

We want to invite you to our virtual workshop!!!

VIRTUAL Workshop: Low-cost flash drying of cassava starch and flour at small scale October 20 and 21 of 2021 14:00 WAT Time

During this workshop, you will learn:

- -About the key components of the flash dryer system
- -To assess the financial feasibility of a cassava starch/flour processing investment project
- -To assess the energy efficiency of existing flash dryers and identify options to upgrade the equipment.

You can access the event using the following link https://meet.google.com/vhm-nxzy-pfx









email: scalingflashdryer@gmail.com tweeter: <u>@ScaleFlash</u>