DEVELOPMENT OF A PROCESS PLANT FOR PLANTAIN FLOUR PRODUCTION

BY

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END POVERTY

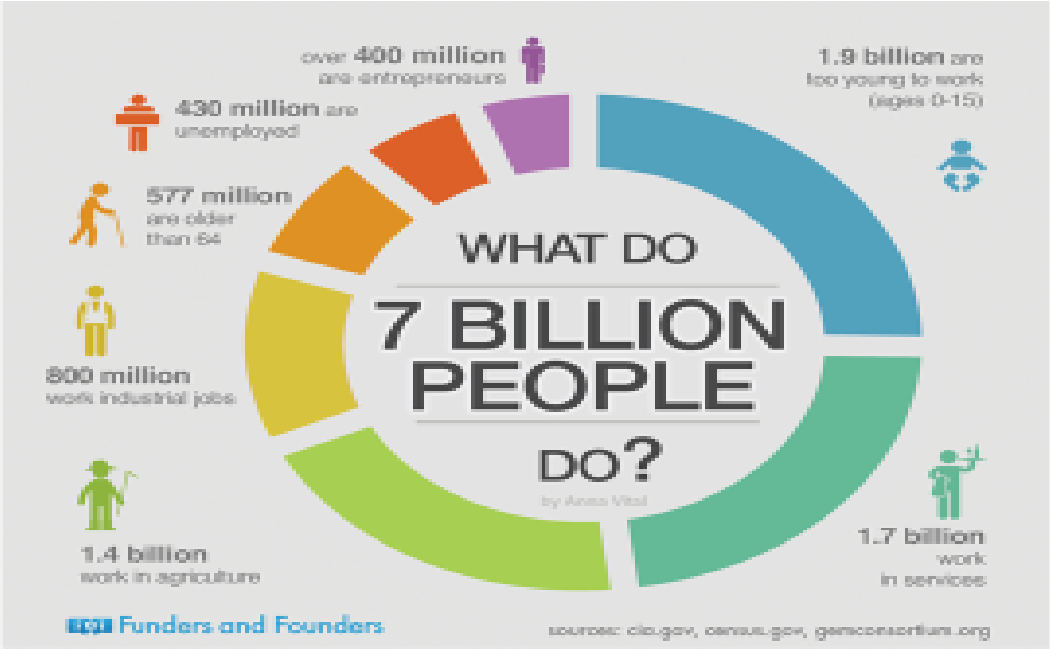
2.47 billion people

around the world live on

less than $2 per day

STOP HUNGER

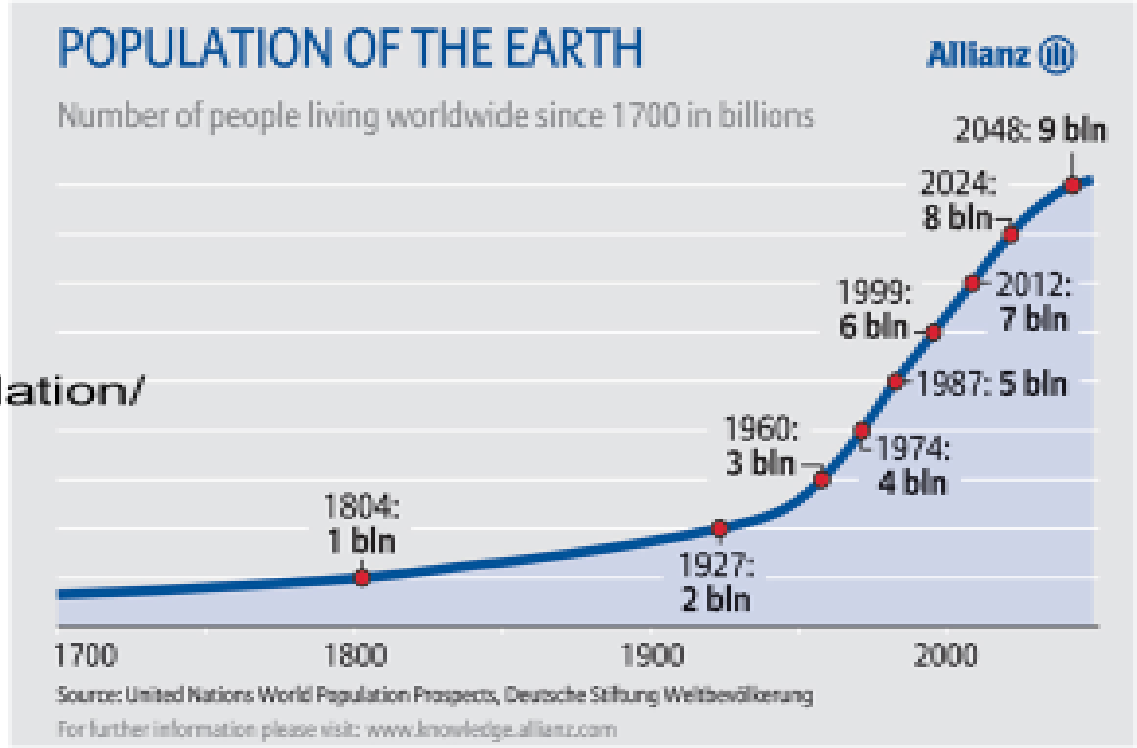
Every 3.6 seconds a person
dies of hunger
75%
of them are children



Increasing population…

Global population as of August is estimated to be 7.7 billion people and counting

http://www.worldometers.info/world-population/



Of these global population....

The World Poverty Clock reported that 86.9 million of its estimated 180 million (representing nearly 50%) Nigerians now living in extreme poverty.

The report further stated that the United Nations' Sustainable Development Goal (SDG) to end extreme poverty by 2030 is unlikely to be met—especially in Nigeria

And that Nigeria has overtaken India as the country with the most extreme poor people in the world. India has a population seven times larger than Nigeria's population.

And since Nigeria faces a major population boom, it will become the world's third largest country by 2050! And the problem will likely worsen.

- How do we ensure food security?
- What do we do to entrench self-sufficiency in food production?
- Food-Water-Energy Nexus: what about it?

CAN I DO SOMETHING WITH PLANTAIN?

- Plantain is 4th most important crop on earth,
- Plantain is crucial to the food security and livelihoods of many people in Nigeria.
- Nigeria is the fifth leading plantain producer in the world.
- Demand for plantain flour is rapidly increasing due to its health/nutritional benefits and industrial/commercial use; hence, the need for a processing plant

Motivation for the Work

- Management of type 2 diabetes
- Flour quality and quantity improvement
- Mitigation of plantain postharvest losses
- Food security enhancement
- Curbing of gluts/price instability
- Value addition
- Economy diversification
- Job creation/improvement of livelihoods
- ***Since Nigeria is one of the leading producer of plantain in the world****, we need to develop technology for processing it into flour and other storable products to ensure its availability and quality all the year round.*
- ***To promote local-content initiative***…… made in Nigeria, used/eaten in Nigeria/by Nigerians & other Nations of the world…

❑ Causes of Post-harvest Food Losses

-limited food preservation capacity;

-poor food preservation techniques;

-poor food processing techniques.

Side Effects: *food & nutritional insecurity in Nigeria.*

❑ Food processing techniques have to be improved upon, mechanized and automated…….

Why mechanization & automation in food processing techniques?

-to meet the demand from ever increasing human population;

-Reduction of post-harvest losses of farm produce;

Need to:

-reduce drudgery,

-improve food quality,

-improve production capacity,

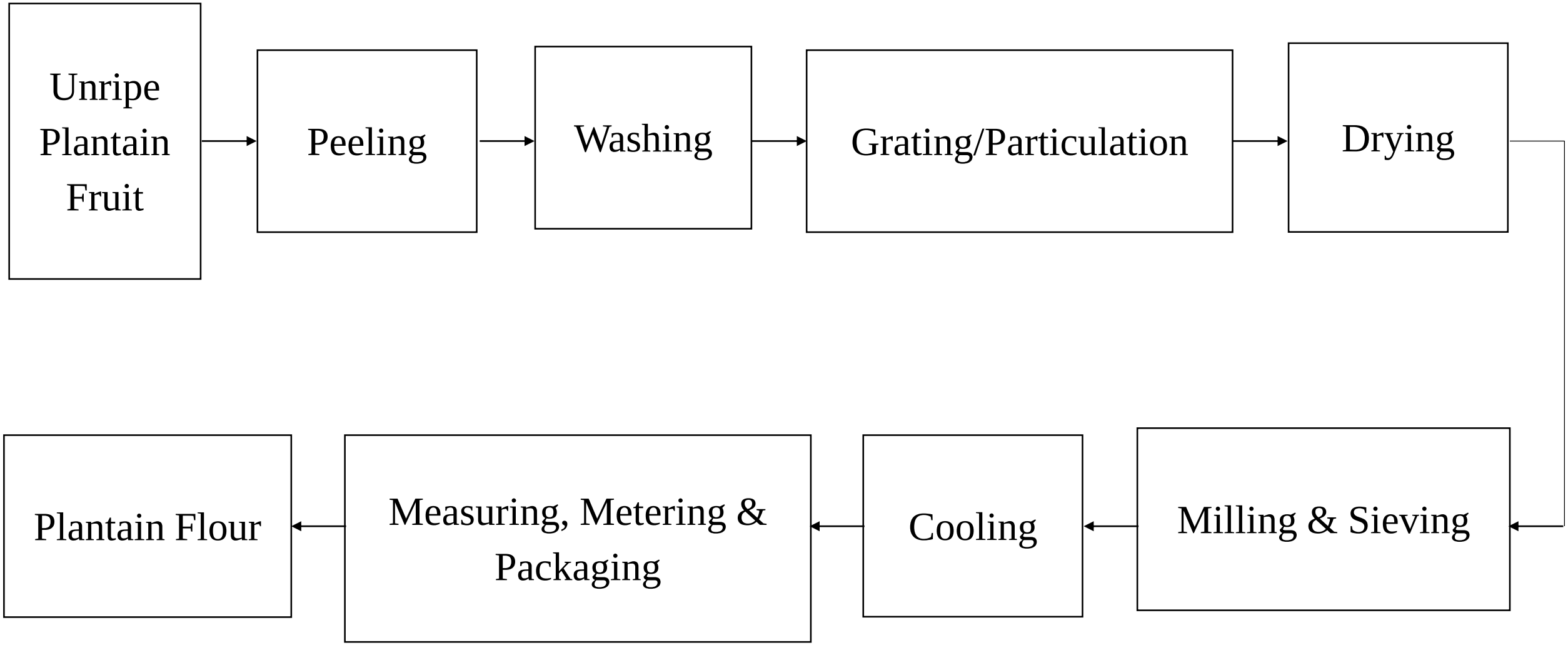
-save time and minimize cost

-comply with food safety regulation,

Our Aim/Goal

To develop a plant for continuous processing of unripe plantain into flour.

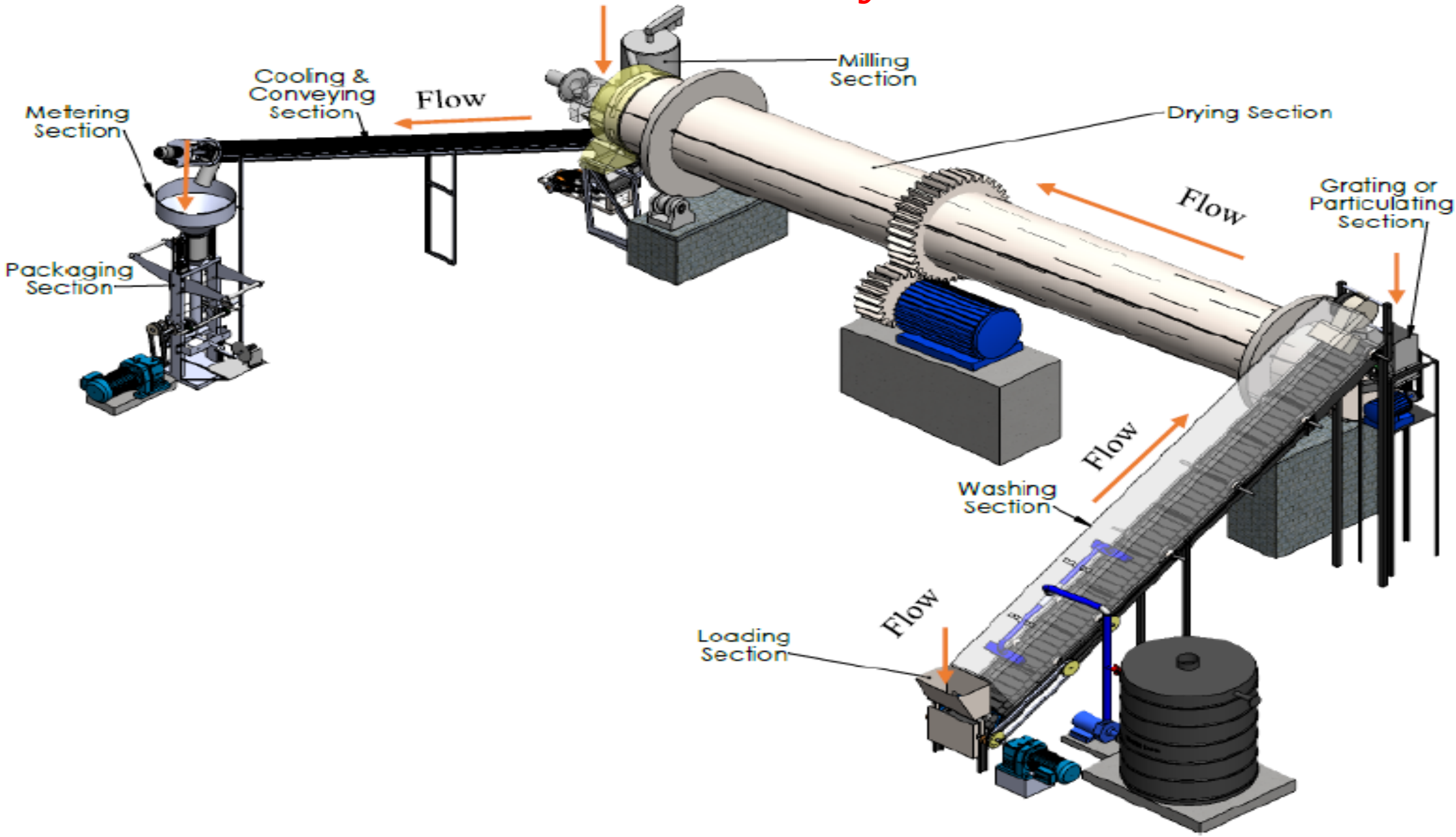
Process Flow for Plantain Flour Production



DESIGN CONSIDERATIONS

- The traditional processing of plantain into flour.
- Retaining the original nutritional value, flavour & colour of plantain.
- Hygiene
- After washing, plantain pulp surface must thoroughly drain before grating.
- There must be continuous material/production flow.
- Production capacity of 1000 kg of plantain flour per day
- Optimal processing time & plant is to operate for 8hrs/day.
- Negligible plantain loss.
- Plantain case-hardening effect
- Drying chamber temperature ≤ 70^{o}C.
- Plantain average moisture content (60%) – to reduce to ≤ 10%.
- *Drying rate: plantain size, temperature, humidity & velocity of drying air*.
- Drying mechanism - by conduction & forced convection .
- Heat source
- Ergonomics & automation
- Local-content initiative
- Material selection: not corrode or react with plantain pulp.

Process Plant Assembly CAD Model



DEVELOPED PLANTAIN PROCESSING PLANT

Plate 1: Assembly of the Fabricated Sections of the Plantain Processing Plant

CONCLUSION

- ✓The plant has capacity to produce 1,000 kg of plantain floor within 8 hours which can be scaled up on request.
- ✓The cost of production of the processing plant is approximately sixty million naira (₦60,000,000) only (approximately $40,300) excluding installation and logistics to factory.
- ✓The whole plant will require 20 kVA power supply
- ✓The total of 12 m x 6 m (72 m^2) space will be required for the Process plant

Academic Outputs

Degrees produced:

- One (1) Doctor of Philosophy (Ph.D.) in Mechanical Engineering.
- Eight (8) Master’s degree (M.Eng.) holders in Mechanical Engineering.

Research Output: Patent & Publications

One patent and Over fourteen (14) publications (12 journals and 2 conference papers).

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2. Olutomilola E. O., Ayodeji S. P., Fagbemi T. N., Mogaji P. B. and Adeyeri M. K. (2016). Conceptual Design of Dryer for Plantain Flour Process Plant. Proceedings of Annual Conference of the *School of Engineering and Engineering Technology*, The Federal University of Technology, Akure, Nigeria, 221-228.
3. Olutomilola E.O. and Omoaka A. (2018). Theoretical design of a plantain peeling machine. FUTA Journal of Engineering and Engineering Technology, 12(2), 229-237.
4. Olutomilola E. O., Ayodeji S. P. and Adeyeri M. K. (2019). Finite Element Analysis of a Washing and Preheating Unit Designed for Plantain Flour Process Plant. *International Journal of Engineering Technologies*, Vol. 5(4): 117-127.
5. Magaji P. B., Ayodeji S. P., Adeyeri M. K., Beremoye A. S. and Olutomilola E. O. (2019). Design, Fabrication and Evaluation of a Metering System for Flour Packaging in a Plantain Process Plant, in 1st International Mechatronics Engineering Conference, Oye Ekiti, Ekiti State, Nigeria, 52-65.
6. Olutomilola E. O., Ayodeji S. P. and Adeyeri M. K. (2020). Design and Structural Analysis of a Particulating Machine for Plantain Flour Process Plant. *ARPN Journal of Engineering and Applied Sciences*, Vol. 15(17): 1816-1824.

Research Output: Patent & Publications Cont'd

7. Adeyeri M. K., Ayodeji S. P., Olutomilola E. O. and J. O. Bako (2020). Design of a Screw Conveyor for Transporting and Cooling Plantain Flour in a Process Plant. *Jordan Journal of Mechanical and Industrial Engineering*, Vol. 14(4): 425-436.
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11. Olutomilola E. O., Ayodeji S. P., Adeyeri M. K. and Fagbemi T. N. (2021). Development and Performance Evaluation of a Pulverizer for Plantain Flour Process Plant. *Production Engineering Archives*, Vol. 27(3): 223-231. https://doi.org/10.30657/pea.2021.27.30
12. Adeyeri M. K. and Ayodeji S. P. (2022). Comparative Analysis of Static and Dynamic Facility Layouts Design Using the Modeling of Plantain Flour as Case Study. *Production Engineering Archives*, Vol. 28(1): 12-20. https://doi.org/10.30657/pea.2022.28.02
13. Adeyeri M. K., Ayodeji S. P., Olutomilola E. O. and Abayomi O. J. (2022). The Automated Process Control Model for Energy Consumption Optimization within Plantain Flour Processing Facility. *International Journal of Industrial Engineering and Management*, Vol. 13(3): 206-214.
14. Olutomilola E. O., Ayodeji S. P., Adeyeri M. K., Fagbemi T. N. and Mogaji P. B. (2022). Development and Preliminary Testing of Rotary Dryer for Plantain Flour Processing Plant. *Mindanao Journal of Science and Technology*, Vol. 20(2): 50-70.

Research Output: Patent & Publications Cont'd

15. Ayodeji S. P., Olutomilola E. O., Adeyeri M. K. and Fagbemi T. N. (2023). Development of a Plant for Processing Unripe Plantain into Bagged Flour. NG/PT/NC/2023/9211

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Thank you