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# Increasing Performance of the Cassava Industry in West and Central Africa Region (IPCI)

Technical Review of Cassava Processing Equipment Fabricated in  
Nigeria

By

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Large Grant Agreement:  
2000000473

March 2017



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of  
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IFAD - WEST AND CENTRAL AFRICA DIVISION

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## Acknowledgement

The Natural Resources Institute, United Kingdom, is appreciated for the opportunity given to me in undertaking this assignment. I also appreciate Prof. Ben Bennett, Prof. Lateef Sanni, and Prof. Kolawole Adebayo for their advice.

During the field trips, the doggedness and collaborative efforts of Jan Priebe (Information Systems for Development Specialist, Natural Resources Institute, UK) and Hakeem Oyedele (Department of Food Science and Technology, FUNAAB) are also valued.

The cooperation of the fabricators (Deban Faith Agro Allied Ventures, Adebash Manufacturing Company, Fataroy Steel Industry Ltd, S Adiss Agricultural Engineering Ltd., Tropical Engineers Ltd, Niji Lukas Nigeria Ltd, Nobex Tech Company Ltd and Starron Nigeria Ltd.) during the field trips is highly appreciated.

Engineer Kolawale Adegoke of FUNAAB and Dr Louise Abayomi of NRI-UoG are thanked for their contributions in reviewing the report's technical details.

I equally appreciate Dr. Bola Asiru of the Federal Institute of Industrial Research, Oshodi (FIIRO) for providing contact information about the fabricators.



## Executive Summary

This document summarises a technical review of common cassava processing equipment fabricated in Nigeria. The purpose of this review was twofold: firstly, to provide expert advice on the technical parameters of different cassava equipment suppliers to the Value Chain Development Programme (VCDP); and, secondly, to populate the cassava equipment application 'CassavaTech' being developed by the 'Improving Cassava Production in West and Central Africa Project' (IPCI), funded by the International Fund for Agricultural Development (IFAD). The review supports the project work package 3, "Support to private sector creating demand for small-holder produced cassava", the aim of which is to establish mechanisms to regularly complete and update the Phase I technology database, increase users and promote sustainability.

The review covered eight fabricators and three cassava processors in three states, namely, Lagos, Ogun, and Oyo States of Nigeria. The review used oral interviews with fabricators and processors, and on-the-spot (including visual) assessment of finished equipment, aided by structured and pre-tested questionnaire, photographic and video coverage.

Cassava processing equipment fabrication businesses that were contacted had been in the businesses for 25 to 40 years. Findings indicated that apart from cassava processing machines, most fabricators have diversified fabrication business to meet up other agro-allied and chemical industries processing needs. Sophistication of manufacturing technology varied. Most fabricators claimed expertise of different categories of the cassava processing equipment that were reviewed. However, it was observed that peelers and chippers are less commonly fabricated. Peelers are only recently being increasingly adopted to replace manual peeling operations across a number of cassava processing businesses. Whilst chippers have in the most part have been replaced by graters-particularly where gari and High Quality Cassava Flour processing is concerned. Chippers are mainly adopted **where** sun drying is employed.

Most fabricators are aware of the general requirements of food processing equipment in terms of materials of construction. However, quality grades and surface finish of construction materials adopted for construction, varied. Design and fabrication quality also varied widely. Manufacturers' submissions on some technical specifications and operational parameters of many processing machines at several instances appeared fictitious as no records of previous test runs were shown. Once delivered, equipment testing and performance evaluation is often left for users. Some fabricators rely solely on feedback from users for performance assessment (i.e., they do not test themselves). The fabricators' idea of maintenance requirements also differed. Documented specifications, operation and maintenance guidelines, were, in the large, absent.

There is an urgent need to increase the knowledge and skills of fabricators on basic machine design, fabrication quality (welding precision, accurate clearances between surface, joints and surface finish, dampening of equipment vibration etc.) and finishing, basic performance evaluation procedure, record keeping and the development of manuals.

Further, warranties (or guarantee as the case may be) for equipment purchased are not common. In the event of equipment **breakdown**, users sometimes resort to using other artisans for repair, which sometimes leads to total breakdown or drastic loss of operational efficiency.

Most of the fabricators are aware of need to provide safety guards on moving parts but do not consider it imperative once the machine is technically functional. Long-term noise exposure generated from operated equipment such as peelers and grater is also an area for design improvements.

For the benefit of potential equipment buyers, ascertaining the price of some fabricators' equipment is often challenging. Many fabricators are reluctant to give immediate quotes, and a large variation in price for the same equipment is often found. The features of various cassava processing equipment are summarized below. From the summary, what is apparent is the absence of information on significant features that would facilitate a more informed purchase by those wanting to procure such machines. It is advisable therefore to carry out due diligence before the procurement of some of these equipment. Potential users can visit existing cassava processing factories to ascertain performance. Nevertheless, it is expected that once the cassava equipment database application '**CassavaTechAdvisor**' is launched, fabricators will see the benefits of updating their equipment information with accurate data. The interaction on this App with existing end-users (cassava processors), and their feedback via the platform will also encourage best practice and better inform those aiming to enter the business of cassava processing.

Peeling machine features across two fabricators

Fabricator name	History of peelers	No. units sold	Customer list	Quality of fabrication	Specifications/operating manual	Robustness	Design	Safety
*Fataroy Ltd., Oyo				Satisfactory- mild steel casing, frame, pulley system	No	Good	Stainless steel abrasive component, Mild steel hopper	High noise level
	Ease of operation	Ease of maintenance	Fuel type	Fuel consumption (units/h)	Quality of product output	Output capacity (Kg/hr)	**Cost (\$)	Dimensions (height/width)
	Easy Good separation of waste	Moderate	Diesel	5Hp, 2600rpm	About 90% peeling efficiency		1382	
Fabricator name	History of peelers	No. units sold	Customer list	Quality of fabrication	Specifications/operating manual	Robustness	Design	Safety
Nobex Ltd., Lagos							Stainless steel abrasive component, Mild steel hopper	
	Ease of operation	Ease of maintenance	Fuel type	Fuel consumption (units/h)	Quality of product output	Output capacity (Kg/hr)	**Cost (\$)	Dimensions (height/width)
			Electricity	10 Hp, 3 Phase electric motor			4934	

Comparison of sift features from three fabricators

Fabricator name	History of sifters	No. units sold	Customer list	Quality of fabrication	Specifications/operating manual	Robustness	Design	Safety
*Fataroy Ltd., Oyo				Good	No	Good	Stainless steel mesh, Rectangular wooden frame Angled exit chute for easy discharge	Moderate- drive belt unguarded  Physical contamination from wooden frame
	Ease of operation	Ease of maintenance	Fuel type	Fuel consumption (units/h)	Quality of product output	Output capacity (Kg/hr)	**Cost (\$)	Dimensions (height/width)
	Easy	Easy	Electricity, diesel			1000	625	
*Adiss Ltd., Lagos	History of sifters	No. units sold	Customer list	Quality of fabrication	Specifications/operating manual	Robustness	Design	Safety
				Satisfactory		Satisfactory	Stainless steel mesh, Rectangular stainless steel frame	Good- no exposed parts
	Ease of operation	Ease of maintenance	Fuel type	Fuel consumption (units/h)	Quality of product output	Output capacity (Kg/hr)	**Cost (\$)	Dimensions (height/width)
	Easy	Easy	Electricity, diesel			1000	724	
*Starron Ltd., Oyo	History of sifters	No. units sold	Customer list	Quality of fabrication	Specifications/operating manual	Robustness	Design	Safety
				Good	No?	Good	Stainless steel mesh Mild steel circular frame	Moderate- drive belt unguarded

							Simple screen-mesh clamp assembly/removal	
	<b>Ease of operation</b>	<b>Ease of maintenance</b>	<b>Fuel type</b>	<b>Fuel consumption (units/h)</b>	<b>Quality of product output</b>	<b>Output capacity (Kg/hr)</b>	<b>**Cost (\$)</b>	<b>Dimensions (height/width)</b>
	Easy	Easy	Electricity			125	1233	

\*indicates no previous independent assessment; \*\*exchange rate ₦304:\$

**Comparison of dewatering press features from four fabricators**

<b>Fabricator name</b>	<b>History of dewatering machines</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Specifications/operating manual</b>	<b>Robustness</b>	<b>Design</b>	<b>Safety</b>	<b>Dimensions (height/width)</b>
<b>*Adebash Ltd., Oyo</b>				Good Stainless steel press late	No	Good	Cage not fully enclosed (walled)- Uneven dewatering expected Must always load full	High	
	<b>Ease of operation</b>	<b>Ease of maintenance</b>	<b>Pressure source</b>	<b>Fuel consumption (L/h)</b>	<b>Quality of product output</b>	<b>Input capacity (Kg)</b>	<b>***Cost (\$)</b>		
	Easy	Easy	40t hydraulic ram	n/a		500	986		
<b>**Nobex Ltd., Lagos</b>	<b>History of dewatering machines</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Specifications/operating manual</b>	<b>Robustness</b>	<b>Design</b>	<b>Safety</b>	<b>Dimensions (height/width)</b>
				Good	No	Good	Common- 3 walled cast iron cage Wooden press plate	High	

	<b>Ease of operation</b>	<b>Ease of maintenance</b>	<b>Pressure source</b>	<b>Fuel consumption (L/h)</b>	<b>Quality of product output</b>	<b>Input capacity (Kg)</b>	<b>***Cost (\$)</b>		
	Easy	Easy	32t hydraulic jack	n/a	Good- when loaded correctly	600	659		
<b>Starron Ltd., Oyo</b>	<b>History of dewatering machines</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Specifications/operating manual</b>	<b>Robustness</b>	<b>Design</b>	<b>Safety</b>	<b>Dimensions (height/width)</b>
				Good	No	Good	2-walled cage Uneven dewatering expected Wooden press plate	High	?
	<b>Ease of operation</b>	<b>Ease of maintenance</b>	<b>Pressure source</b>	<b>Fuel consumption (L/h)</b>	<b>Quality of product output</b>	<b>Input capacity (Kg)</b>	<b>***Cost (\$)</b>		
	Good	none	10t screw press	n/a		50	1612		
<b>Niji Lukas Ltd</b>	<b>History of dewatering machines</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Specifications/operating manual</b>	<b>Robustness</b>	<b>Design</b>	<b>Safety</b>	<b>Dimensions (height/width)</b>
	Yes	Easy		Very good	None	Very robust	Pneumatic tank compression		
<b>Ease of operation</b>	<b>Ease of maintenance</b>	<b>Pressure source</b>	<b>Fuel consumption (L/h)</b>	<b>Quality of product output</b>	<b>Input capacity (Kg)</b>	<b>***Cost (\$)</b>			
		Pneumatic compression	Electricity			4934			

\*indicates no previous independent assessment; \*\* indicates previous independent assessment (manufacturer or user feedback); \*\*\*exchange rate ₦304:\$

Comparison of flash dryer features across four fabricators

Fabricator name	History of flash dryers	No. units sold	Customer list	Quality of fabrication	Ease of maintenance	Installation	Specifications/operating manual	Input feed system	Control panel	Dimensions (height/width)	Ease of operation
Nobex Technical Co. Ltd., Lagos	Yes		Yes	Satisfactory-welded joints	Easy	Modular	Yes- both	Semi- auto	Yes		Easy
	Ease of maintenance	Safety	Exhaust	Energy type	Fuel consumption (L/h)	Power (KWh)	Material (food contact components)	Model type	Quality of product output	Output (Kg/h)*	Cost (\$) **
	Easy	Moving parts covered, no exposed wires	No soot	Electricity/kerosine	17.5	15	Stainless steel	6 cyclone separator	Good	333	~33,000
Fataroy Ltd., Oyo	History of flash dryers	No. units sold	Customer list	Quality of fabrication	Ease of maintenance	Installation	Specifications/operating manual	Input feed	Control panel	Dimensions (height/width)	Ease of operation
	Since 2016		No	Satisfactory-welded joints	Easy		No		Yes		Easy
	Ease of maintenance	Safety	Exhaust	Energy type	Fuel consumption (L/h)	Power (KWh)	Material (food contact components)	Model type	Quality of product output	Output (Kg/h)	Cost (\$) **
	Easy	Chain belt uncovered, no exposed wires		Diesel	15		Stainless steel	6 cyclone separator		375	28,000
Niji Lukas Lt., Oyo	History of flash dryers	No. units sold	Customer list	Quality of fabrication	Ease of maintenance	Installation	Specifications/operating manual	Input feed	Control panel	Dimensions (height/width)	Ease of operation
	Yes			Good-welded or bolted joints	Easy				Yes		Easy
	Ease of	Safety	Exhaust	Energy type	Fuel	Power (KWh)	Material (food contact)	Model type	Quality of	Output (Kg/h)	Cost (\$)

	<b>maintenance</b>				<b>consumption (L/h)</b>		<b>components)</b>		<b>product output</b>		
	Moving parts covered, no exposed wires	Moving parts covered, no exposed wires		Electricity/ kerosine/ diesel	15	10hp 1400 rpm	Stainless steel	Single cyclone separator	Good	5 ton/day (~312 kg//h @16 working hour per day)	34,540
<b>*Deban Faith Ltd., Ogun</b>	<b>History of flash dryers</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Ease of maintenance</b>	<b>Installation</b>	<b>Specifications/operating manual</b>	<b>Input feed</b>	<b>Control panel</b>	<b>Dimensions (height/width)</b>	<b>Ease of operation</b>
	No			Poor	Easy				Yes		Easy
	<b>Ease of maintenance</b>	<b>Safety</b>	<b>Exhaust</b>	<b>Energy type</b>	<b>Fuel consumption (L/h)</b>	<b>Power (KWh)</b>	<b>Material (food contact components)</b>	<b>Model type</b>	<b>Quality of product output</b>	<b>Output (Kg/h)</b>	<b>Cost (\$)</b>
	Moving parts covered, no exposed wires	Moving parts covered, no exposed wires		Electricity/ kerosene/ diesel	15	15	Stainless steel	Single cyclone separator			

\*indicates previous independent assessment; \*\* exchange rate ₦304:\$

#### Comparison of gari fryer/roaster features from three fabricators

<b>Fabricator name</b>	<b>History of milling machines</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Ease of maintenance</b>	<b>Spare parts required</b>	<b>Specifications/operating manual</b>	<b>Robustness</b>	<b>Dimensions (height/width)</b>	<b>Ease of operation</b>
<b>*Niji Lucas Ltd., Oyo</b>				Satisfactory-welded or bolted	Moderate	Listed	No	Very		Easy
	<b>Safety</b>	<b>Exhaust</b>	<b>Energy type</b>	<b>Fuel consumption (L/h)</b>	<b>Power (KWh)</b>	<b>Material (food contact components)</b>	<b>Quality of product output</b>	<b>Output (Kg/h)*</b>	<b>Portable</b>	<b>***Cost (\$)</b>
	Good-Good no exposed parts	Fumes directed externally	wood		2Hp 1400	Stainless steel frying pan, aluminium paddle	Good	62.5	Low-bulky	10,526



	Low noise level					blades				
<b>**Adiss Ltd., Oyo</b>	<b>History of milling machines</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Ease of maintenance</b>	<b>Spare parts required</b>	<b>Specifications/operating manual</b>	<b>Robustness</b>	<b>Dimensions (height/width)</b>	<b>Ease of operation</b>
				Satisfactory-welded or bolted	Moderate	Listed	No	Very		Easy
	<b>Safety</b>	<b>Exhaust</b>	<b>Energy type</b>	<b>Fuel consumption (L/h)</b>	<b>Power (KWh)</b>	<b>Material (food contact components)</b>	<b>Quality of product output</b>	<b>Output (Kg/h)*</b>	<b>Portable</b>	<b>***Cost (\$)</b>
	Low- one moving part Exhaust fume inhalation	Not directed externally	Electricity 1 phase and charcoal		1Hp 1480	Stainless steel frying pan, aluminium paddle blades	Satisfactory	62.5	Low-bulky	5,921
<b>**Adebash Ltd., Oyo</b>	<b>History of milling machines</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Ease of maintenance</b>	<b>Spare parts required</b>	<b>Specifications/operating manual</b>	<b>Robustness</b>	<b>Dimensions (height/width)</b>	<b>Ease of operation</b>
				High	Easy	Listed	No	Very	1ft height, 3x6ft width	Easy
	<b>Safety</b>	<b>Exhaust</b>	<b>Energy type</b>	<b>Fuel consumption (L/h)</b>	<b>Power (KWh)</b>	<b>Material (food contact components)</b>	<b>Quality of product output</b>	<b>Output (Kg/h)*</b>	<b>Portable</b>	<b>***Cost (\$)</b>
	Good	Fumes directed eternally	Wood and charcoal	n/a	n/a	Stainless steel frying pan			High	296

\*indicates previous independent assessment; \*\* indicates no previous independent assessment; \*\*\*exchange rate ₦304:₹

Comparison of grating machine features from three fabricators

Fabricator name	History of grating machines	No. units sold	Customer list	Quality of fabrication	Ease of maintenance	Spare parts required	Specifications/operating manual	Robustness	Dimensions (height/width)	Ease of operation
*Nobex Technical Co. Ltd., Lagos			Yes	Good- welded, bolted, riveted	Easy	Listed	No?	Good		Easy
	Safety	Exhaust	Energy type	Fuel consumption (L/h)	Power (KWh)	Material (food contact components)	Quality of product output	Output (Kg/h)*	***Cost (\$)	
	Satisfactory	none	Electricity 3-phase	n/a		Stainless steel hopper, drum and cover	Good	3000		
<b>Starron Ltd., Lagos</b>	<b>History of grating machine</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Ease of maintenance</b>	<b>Spare parts required</b>	<b>Specifications/operating manual</b>	<b>Robustness</b>	<b>Dimensions (height/width)</b>	<b>Ease of operation</b>
				Good- welded, bolted, riveted	Moderate- owing to grating drum design	Listed	No	Good		Easy
	Safety	Exhaust	Energy type	Fuel consumption (L/h)	Power (KWh)	Material (food contact components)	Quality of product output	Output (Kg/h)*	***Cost (\$)	
	Moderate	none	Electricity 3-phase		1.23 2Hp 1460rpm	Stainless steel hopper, grating drum	Good	1200	954	
<b>Niji Lucas Ltd., Oyo</b>	<b>History of grating machine</b>	<b>No. units sold</b>	<b>Customer list</b>	<b>Quality of fabrication</b>	<b>Ease of maintenance</b>	<b>Spare parts required</b>	<b>Specifications/operating manual</b>	<b>Robustness</b>	<b>Dimensions (height/width)</b>	<b>Ease of operation</b>
	Yes		Yes	Satisfactory- welded, bolted, riveted	Moderate	Listed	No	Satisfactory		Moderate- Very large hopper

	Safety	Exhaust	Energy type	Fuel consumption (L/h)	Power (KWh)	Material (food contact components)	Quality of product output	Output (Kg/h)*	***Cost (\$)	
	Moderate-owing to dust inhalation No exposed parts	Excessive dust during operation	Electricity 3-phase	Electricity	5Hp 1400rpm	Stainless steel hopper, cyclone and casing		3000	3948	

\*indicates previous independent assessment; \*\* indicates no previous independent assessment (manufacturer or user feedback); \*\*\*exchange rate ₦304:\$

#### Comparison of milling machine features from three fabricators

Fabricator name	History of milling machines	No. units sold	Customer list	Quality of fabrication	Ease of maintenance	Spare parts required	Specifications/operating manual	Robustness	Dimensions (height/width)	Ease of operation
<b>*Nobex Technical Co. Ltd., Lagos</b>	Yes		Yes	Good- welded, bolted, riveted	Easy	Listed	Some	Satisfactory-tripod structure		Easy
	Safety	Exhaust	Energy type	Fuel consumption (L/h)	Power (KWh)	Material (food contact components)	Quality of product output	Output (Kg/h)*	***Cost (\$)	
	Moderate-owing to dust inhalation No exposed parts	Excessive dust during operation	Electricity 3-phase		20hp 2380rpm	Stainless steel hopper, cyclone and casing	Good	1000	4,275	
<b>*Niji Lucas Ltd., Oyo</b>	History of milling machines	No. units sold	Customer list	Quality of fabrication	Ease of maintenance	Spare parts required	Specifications/operating manual	Robustness	Dimensions (height/width)	Ease of operation
	Yes		Yes	Good- welded, bolted, riveted	Easy	Listed	No?	Good		Easy

	Safety	Exhaust	Energy type	Fuel consumption (L/h)	Power (KWh)	Material (food contact components)	Quality of product output	Output (Kg/h)*	***Cost (\$)	
	Moderate-owing to dust inhalation No exposed parts		Electricity 3-phase, Petrol		15Hp 1460rpm	Stainless steel hopper, cyclone and casing	Good	1200	?	
**Adiss Ltd., Oyo	History of milling machines	No. units sold	Customer list	Quality of fabrication	Ease of maintenance	Spare parts required	Specifications/operating manual	Robustness	Dimensions (height/width)	Ease of operation
	20XX??		Yes	Satisfactory-welded, bolted, riveted	Easy	Listed	No	Satisfactory		Easy
	Safety	Exhaust	Energy type	Fuel consumption (L/h)	Power (KWh)	Material (food contact components)	Quality of product output	Output (Kg/h)*	***Cost (\$)	
	Moderate-owing to dust inhalation No exposed parts	Excessive dust during operation	Electricity 3-phase	n/a	15 2380rpm	Stainless steel hopper, cyclone and casing	**	1000	987	

\*indicates previous independent assessment; \*\* indicates no previous independent assessment (manufacturer or user feedback); \*\*\*exchange rate ₦304:\$

## Introduction

This report is summary of activity conducted to fulfil the terms of contract B0144x3 awarded by the Natural Resources Institute to achieve the following specific tasks:

1. Contribute to the design of a standard format and criteria for 'expert' cassava equipment as necessary
2. Conduct at least 20 individual equipment reviews for a range of different equipment categories, scales and manufacturing companies, focusing initially on the companies list provided by VCDP and on a basic range of equipment that might be provided to typical small scale producing/processing groups in their target regions
3. Visit at least four different cassava equipment suppliers
4. Provide initial draft reviews for VCDP and IPCI to consider and comment on before proceeding to complete all the reviews
5. Submit the finished reviews for comment and then complete as necessary
6. Take suitable photographs of the equipment reviewed and supply these with notes so that they can be identified

The activity was completed under the IPCI grant with funding from IFAD in support of the VCDP.

## Methodology

The task was conducted in three states of the in the Southwest part of Nigeria, namely, Oyo, Ogun and Lagos States. Scheduled visits were made to equipment manufacturing companies whose physical addresses were obtained from the Secretariat of Nigerian Cassava Processors and Manufacturer Association (NICPMA), Lagos. In addition, physical addresses of some other manufacturers were obtained through personal contacts. An email and/or text messages were sent to first introduce the IPCI project, the benefit, and to seek the manufacturers' approvals to visit their factories. Similarly, some cassava processing factories were also contacted for information and advice about their fabricators/suppliers.

In addition to oral interviews, review tasks were also conducted using a pretested questionnaire (Appendix 1) prepared for evaluating different categories of cassava processing equipment, namely,

- Category A: Dryers
- Category B: Presses
- Category C: Hammer mills
- Category D: Graters, Chippers, Wet hammer mills
- Category E: Peeling machines
- Category F: Sifters

Video and audio recordings were also made to accompany the interview, when necessary. During the interview, manufacturers were asked for details of any equipment available on site. When possible, some machines were operated to conduct on-the-spot evaluations of operational efficiency.

## Dryers

Artificial dryers come in many designs. They are generally used to reduce the moisture contents of liquid, semi-solid, or solid materials. Typically, dryers used for cassava are classified as either hot air or heated surface dryers. Due to the high moisture content, starchy, and non-sticky nature of most products from cassava tissue, hot air dryers such as solar, cabinet, conveyor, tunnel, rotary, flash dryers etc. are used. They all operate based on the ability of heated air to release its sensible heat energy when in contact with food, causing moisture release from within the food matrix, which drift away the diffused water from the food surface. The design of each type of dryer differs based on the following factors among others:

- Nature of product handled
- Economics of the process
- Desired product quality
- Throughput
- Environmental consideration
- Ease of maintenance
- Safety of operation
- Cost of equipment

As a rule of thumb, dryers with surfaces in contact with food product must be constructed of stainless, non-toxic and easily cleaned (or sanitized) materials for food safety reasons.

To handle food products with a large particle size (such as cassava chips), solar, cabinet, conveyor, and tunnel dryer are recommended. However, for small particulates (cassava flour and starch), rotary and flash dryers are recommended. The choice of the dryer may further be screened by throughput. For example, most flash dryers have higher throughputs than rotary dryers.

Flash dryers are more commonly used in Nigeria for the production of High Quality Cassava Flour (HQCF). A flash dryer is a pneumatic drying system for converting wet cassava meal (<50% moisture content) to dry meal (<12% moisture). It has six basic components: the heat exchange unit, the feeder, the drying duct, the separator (cyclone), blower (fan), and dried product receptor.

## Nobex Ltd. Flash dryer

<b>Manufacturer:</b>	Nobex Technical Company Limited
<b>Review Location:</b>	Idimu Lagos
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	1333 kg/h
<b>Output capacity:</b>	333 kg/h
<b>Fuel Type:</b>	Electricity and Kerosene
<b>Fuel consumption:</b>	17.5 L/h
<b>Electricity:</b>	15 kWh

### Material Used:

Stainless steel is used for all the units from feeder to product collector except the heat exchange unit built predominantly from mild steel.

### Spare Part:

Electric cut-out, belt



### Maintenance Required:

1. Cleaning of contactor (control panel) with air pressure blower
2. Cleaning of drying duct of product residue by running of dryer empty for 20 min after the product has been completely discharged

### Design and fabrication:

It has six cyclone units for separating dried product from hot air. The fabrication quality is very high. Most joints are welded.

### Quality of Product:

Not covered during review



### Safety:

Well lagged heat exchanger to reduce heat pollution of environment. Moving parts covered and electrical wires were not exposed. According to manufacturer, combustion is highly efficient thereby producing clean non-sooty air.

### Concluding Remarks:

According to manufacturer, the flash dryer is nearly maintenance-free. If there is wear-and-tear of any moving part it could be easily replaced. Its design is unique. However, on-the-spot evaluation will be necessary to determine its product quality and process efficiency.

### Fataroy Ltd. Flash dryer

<b>Manufacturer:</b>	Fataroy Steel Industry Limited
<b>Review Location:</b>	Fataroy Steel Company Factory, Elizabeth Road, Ibadan
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	-
<b>Output capacity:</b>	375 kg/h
<b>Fuel Type:</b>	Diesel
<b>Fuel consumption:</b>	15.0 L/h
<b>Electricity:</b>	15 kWh



### Material Used:

Stainless steel (drying tunnel), mild steel (heat exchanger)

#### Spare Part:

Electric cut-out, belt

#### Maintenance Required:

**It is easily maintained.** It requires no dismantling after operation for cleaning; Cleaning of contactor (control panel) with air pressure/blower; Cleaning of drying duct of product residue by running of dryer empty for 20 min after the product has been completely discharged.

#### Design and fabrication:

The dryer has six cyclone separators. Most joints are welded.

#### Quality of Product:

Not covered during the review period

#### Safety:

The chain belt driving the feed conveyance not covered. None of the electrical parts was exposed.

#### Concluding Remarks:

According to manufacturer, the machine operates with minimal noise and vibration. Technical information provided was based on information from manufacturer. On-the-spot evaluation will be necessary to determine its product quality and process efficiency.

### Niji Lucas Ltd. Flash dryer

<b>Manufacturer:</b>	Niji Lucas Nigeria Limited
<b>Review Location:</b>	Niji Farms Factory, Ilero, Oyo State
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	-
<b>Output capacity:</b>	500 kg/h
<b>Fuel Type:</b>	Electricity, Diesel, Kerosene
<b>Fuel consumption:</b>	15.0 L/h
<b>Electricity use:</b>	-



**Materials Used:**

Stainless steel for all the units except the burner/heater and blower unit which are built from cast iron

**Spare Parts:**

Bearing, electric motor, belt

**Maintenance Required:**

Cleaning of burner; running of dryer for extra minutes after each operation to clean duct; cleaning of control panel.

**Design and fabrication:**

Fabrication quality is high; joints are mostly welded; some joints were also bolted.

**Quality of Output:**

Well dried and uncontaminated; moisture content and particle size not determined.

**Safety:**

Safe operation; moving parts not exposed; heat exchange unit well lagged to prevent heat pollution in the processing area; exhaust fumes from burner well directed away from processing area.

### Concluding Remarks:

Information was provided by manufacturer as well as on-the-spot observation of operation. However, operational efficiency was not assessed during review. Output capacity was based on manufacturer's stipulation of 8 hour day operation.

### Deban Faith Ltd. flash dryer

<b>Manufacturer:</b>	Deban Faith Agro Allied Ventures
<b>Review Location:</b>	Deban Faith factory, Abeokuta
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	-
<b>Output capacity:</b>	1000 kg/h
<b>Fuel Type:</b>	Electricity, Diesel
<b>Fuel consumption:</b>	15.0 L/h
<b>Electricity use:</b>	15 kWh



### Material Used:

Stainless steel for drying duct, hopper/feeder, and cyclone; mild steel for hanger/frame and heat exchange unit

### Spare Parts:

Bearing, electric motor, meshes

### Maintenance Required:

Lubrication of bearing, cleaning of burner, running of dryer for extra minutes after each operation to clean duct.

#### **Design and Fabrication:**

Fabrication quality is low; Burner well lagged with fibre and aluminium foil cover.

#### **Quality of Output:**

Not assessed during review

#### **Safety:**

Moving parts encased; exhaust fumes located away from the user area; electrical cables not exposed.

#### **Concluding Remarks:**

Technical specifications were as provided by manufacturer/user, power consumption/rating is in addition to other ancillary use in the factory; fabrication quality needs to be improved.

#### **Key findings on Nigerian made flash dryers**

- Flash drying equipment is common amongst fabricators
- The technology requires larger investments relative to, say , rotary dryers
- Design and fabrication quality differ considerably
- Multi cyclone designs are replacing single cyclone models
- Manufacturers do not have limited data on the performance characteristics and the maintenance requirements of their equipment
- Fabricators do not have documented operating or maintenance guidelines

#### **Recommendations**

- Fabricators need to be enlightened on the need to generate and save technical specifications and performance data
- Training of fabricators on how to improve on design and fabrication quality is required

## Grinder/Milling Machines

Grinding or milling machines generally collectively perform the function of size reduction of materials. They are classified based on the type of force and configuration of milling zone as:

- |                          |                     |
|--------------------------|---------------------|
| 1. Impact milling:       | Ball mill           |
| 2. Shear milling:        | Disc/Attrition mill |
| 3. Compression milling:  | Roller mill         |
| 4. Impact/shear milling: | Hammer mill         |

Products presented for milling could either be in the wet or dry forms as found for cassava products. The choice of a milling machine for a product depends on the following:

1. Nature of product (fibrous/non-fibrous, wet/dry, oily/non-oily, sticky/non-sticky etc.)
2. Particle size of the feed (coarse, fine)
3. Desired final product quality (particle size)
4. Economics of process
5. Ease of maintenance
6. Safety of operation
7. Energy use, efficiency and availability of supply

Construction material for milling machine used in food processing is usually stainless steel (wall) and mild steel for the rough moving parts of the milling zone e.g. hammer head, disc, etc. In order to take advantage of heaviness of cast iron and non-reactive nature of high carbon (stainless) steel, hammer head made with cast iron may be galvanized with high carbon steel.

Due to high fibre content of most cassava products, either disc/attrition or hammer mill is recommended. The latter is better for wet feed and gives wider particle size distribution while the former is better for dry feed and product with finer and more uniform particles.

### **Nobex Ltd. hammer mill**

The hammer mill is used to convert dry cassava meal or chips into fine particulate (flour). It consists of three main units: receptacle/hopper, mill, and cyclone dust suppressor. It operates on impact principle. It is supplied with different breaker plates or grates with varying aperture sizes to give product of desired particle sizes. It operates using a 3-phase electric motor rotating at 2380 rpm.

**Manufacturer:** Nobex Technical Company Limited  
**Review Location:** Open Door System Industry Factory Site, Ota, Ogun State  
**Process Type:** Continuous  
**Input Capacity:** 1000 kg/h  
**Output Capacity:** -  
**Fuel Type:** Electricity  
**Fuel consumption:** 15.0 L/h  
**Electricity use:** 15 kWh



**Materials Used:**

Stainless steel for hopper, cyclone and miller casing, hammerhead was built with cast iron

**Spare Parts:**

Screen, bearings and belt

**Maintenance required:**

Dry cleaning of milling by operating milling machine for some time after each milling Operation to completely empty machine. Change of hammerhead and screen.

**Design and Fabrication:**

Joints in the machine were welded, bolted or riveted. The hopper is slanted at angle to allow for free flow of feed into the milling zone.

**Quality of Output:**

Not covered during review

### Safety:

It has very safe operation. Electric wire cable is not exposed. The driving belt not covered. Dust abatement during product delivery not adequate

### Concluding Remarks:

The technical specifications given were provided by manufacturer. The machine was fabricated with high precision. The output capacity stated was given by user during review visit. Operational efficiency still needs to be tested. Dust abatement and safety feature may require some improvement.

### Niji Ltd. hammer mill

The mill is driven by a 3-phase 10 hp electric motor rotating at 2000 rpm.

<b>Review Location:</b>	Niji Farms, Ilero, Oyo State
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	-
<b>Output Capacity:</b>	1200 kg/h
<b>Fuel Type:</b>	Electricity, petrol
<b>Fuel consumption:</b>	-
<b>Electricity use:</b>	-



### Materials Used:

Stainless steel (hopper, cyclone), cast iron (hammer head)

### Spare Parts:

Bearing, gear plate, screen plate, belt



#### Maintenance Required:

Dry cleaning of milling **is done** by operating milling machine for about 2-3 **min** after each milling operation to completely empty machine. Change of hammerhead and screen.

#### Design and Fabrication:

Dust abatement mechanism is unique by directing and absorbing dust into a water reservoir

#### Quality of Output:

Flour particle size is very with no obvious contamination

#### Safety:

**It has** very safe operation. Moving parts and cables not exposed.

#### Concluding Remarks:

Review was based on information provided by manufacturer and on-the-spot observation. The information on throughput is accurately based on cursory evaluation of the machine on site whereas information on fuel consumption was supplied by manufacturer/user (Niji Ltd).

#### Adiss Ltd. hammer mill

Equipment is driven by 15 hp, 3-phase electric motor at speed of 1460 rpm.

<b>Review Location:</b>	S Adiss Factory, Olodo, Ibadan
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	-
<b>Output Capacity:</b>	1000 kg/h
<b>Fuel Type:</b>	Electricity
<b>Fuel consumption:</b>	-
<b>Electricity use:</b>	-



**Materials Used:**

Stainless steel for hopper, cyclone and miller casing, hammerhead was built with cast iron

**Spare Parts:**

Sieves, hammerhead, belt, and bearing

**Maintenance Required:**

Dry cleaning of the milling machine is by operating milling machine for some time after each milling operation to completely empty machine. Change of hammerhead and screen.

**Design and Fabrication:**

Joints in the machine were welded, bolted or riveted. The hopper is slanted at angle to allow for free flow of feed into the milling zone. Provision is made for dust abatement with a cyclone unit

**Quality of Output:**

Not covered during review

**Safety:**

No electricity cable exposed, belt guard absent

**Concluding Remarks:**

The technical specifications given are as provided by manufacturer. Operational efficiency still needs to be tested.

**Key Findings on Nigerian Made Hammer Mills**

- The hammer mills fabricated vary in capacity
- Fabrication and finishing quality are at large variance
- Manufacturers do not have adequate data on the performance efficiency and maintenance requirements of their equipment

**Recommendations**

- Fabricators needs to be enlightened on the need to generate and save technical specifications and performance data
- Training of fabricators on how to improve on fabrication quality

## Gari Fryers/Roasters

Gari frying/roasting is a process that helps to convert wet cassava mash to pre-gelatinized dry meal (gari), which is often soaked in cold or ordinary water for drinking or it may be cooked in boiled water to make thick paste for swallow.

The manual roasting operation done by women in gari frying is tedious, time consuming and has low throughput. Automatic and improved manual gari fryers have been invented to eliminate the disadvantages of the manual operation. Improved manual gari fryers helps to reduce the hazard of operator to heat and smoke, increase throughput slightly, as well as improve operational ergonomics. An automatic gari fryer helps to reduce human involvement to the minimum and further improve throughput.

To date, there are wide variations in gari fryer designs, many of which are still being developed or improved. There are pan, drum and auger types of gari fryer. The most popularly researched and used models in Nigeria are the pan types believed to perform and closely mimic the traditional gari fryers. A pan fryer consists of four units (the roasting pan, heat source, stirrer/paddle, and motor drive units); the pan, stirrer blades and emptying hopper are made from stainless steel.

### Niji Ltd. Gari fryer

The equipment converts pressed wet cassava mash (40-50% moisture) to pre-gelatinized dry meal or gari (<12% moisture). It mimics manual operation but produces gari of lesser contamination with faster throughput. The stirrer, which makes planetary motion during operation, is driven by a 2 hp motor at 1400 rpm. The frying pan wall is lagged (insulated) with fibre glass.

**Review Location:** Niji Farms, Ilero, Oyo State  
**Process Type:** Batch  
**Input Capacity:** -  
**Output Capacity:** 62.5 kg/h  
**Fuel Type:** Electricity, Diesel, Wood, Charcoal



**Materials used:**

Stainless steel (frying pan, product receptacle), paddle blade (aluminium), stirrer hanger (cast iron)

**Spare Parts:**

Bearings and gear plates

**Maintenance Required:**

Simple, lubrication of drive mechanism, cleaning of pan after each operation

**Design and Fabrication:**

Fryer is portable and easily dismantled

**Quality of Output:**

It produces well dried gari with no obvious contamination

**Safety:**

No exposed wire and moving part that can wound operator. There is provision of exhaust smoke fumes if wood, charcoal or diesel fuel is used.

**Concluding Remarks:**

The information provided here is based on on-the-spot observation and as provided by manufacturer. Detailed evaluation of the machine's operational efficiency is required.

**Adis Ltd. Gari fryer**

The equipment is driven by a 1-phase 5 hp motor at 1480 rpm.

<b>Manufacturer:</b>	S Adiss Agricultural Engineering Limited
<b>Review Location:</b>	S Adiss Factory, Olodo, Ibadan
<b>Process Type:</b>	Batch
<b>Input Capacity:</b>	50 kg
<b>Duration per Batch:</b>	45 min
<b>Fuel Type:</b>	Electricity, charcoal



**Material Used:**

Cast iron for hanger and frame; mild steel for gear wheel; aluminium for paddle blade; stainless steel for the frying pan

**Spare Parts:**

Bearing, belt

**Maintenance Required:**

Cleaning of frying pan after use; emptying and cleaning of combustion chamber from ashes

**Design and Fabrication:**

The machine was yet to be finished during review. Based on physical assessment, it is not too compact in terms of space management; the primary drive unit is separated outside from the paddle; Most joints are either welded or bolted; fabrication quality is average as the machines was yet to be finished

**Quality of Output:**

Not covered during review

**Safety:**

Moving part exposed; electricity cable not visibly exposed

**Concluding Remarks:**

The technical specification is as provided by manufacturer. Operational efficiency still needs to be established.

## Adebash Ltd. gari fryer

A manually operated gari roaster with improved ergonomics and operational convenience; could be operated both at sitting (small stirrer) and standing positions (with elongated stirrer); consists of two major parts the pan (3 x 6 ft) and the support frame (1 ft high).

<b>Manufacturer:</b>	Adebash Manufacturing
<b>Review Location:</b>	Adebash Company Site, Old Oyo Road, Ibadan
<b>Process Type:</b>	Batch
<b>Input capacity per Batch:</b>	50 kg
<b>Fuel Type:</b>	Wood, Charcoal



### Material used:

Stainless steel for frying pan; mild steel for frame; and clay as frame filler

### Spare Parts:

Stirrer

### Maintenance Required:

Clean pan after use, remove wood ash after each operation

### Design and Fabrication:

Design is unique as its support frame is made hollow. The hollow space is filled with clay as laminating material to reduce heat radiation to the processor and loss to the environment. Chimney is also provided to direct smoke away from processor.

### Quality of Output:

Not covered during review

**Safety:**

Operation is very safe. Heat hazard is reduced to minimum; provision of smoke abatement helps to secure processor from smoke

**Concluding Remarks:**

Technical specification was provided by manufacturer. Input capacity represents maximum capacity at a time. Throughput depends on individual processor's skill. Technical efficiency need to be assessed.

**Key Findings on Nigerian Made Gari Fryers/Roasters**

- Pan types of gari fryers are the most commonly fabricated for commercial use
- Fabrication and finishing quality of gari fryers are at large variance
- Inaccurate technical specification were submitted by manufacturers
- Manufacturers do not have adequate data on the performance efficiency and maintenance requirements of their equipment

**Recommendations**

- Fabricators needs to be enlightened on the need to generate and save technical specifications and performance
- Training of fabricators on how to improve on fabrication quality, operational efficiency, durability is required

## Graters

Graters are used for shredding of cassava root into wet meal; it is sometimes used to pulverize pressed cassava cakes. It consists of three major units (hopper, frame and drive units); hopper unit, which also holds roots during grating, shelters a motor-driven abrasive grating drum for shredding root; frame is made of mild steel; provision of stainless steel or ceramic receptacle to contain grated mass helps to prevent contamination and makes bagging easy; It could be run on electricity or diesel/petrol engine; for safety reason, the belt drive area should be shielded to prevent accidental contact by operator causing injury following sudden belt cut.

### Nobex Ltd. grater

The machine is driven by 3-phase electric motor rotating at 1200 rpm.

<b>Manufacturer:</b>	Nobex technical Company Ltd.
<b>Review Location:</b>	Open Door Factory, Ota, Ogun State
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	-
<b>Output capacity:</b>	3000 kg/h
<b>Fuel Type:</b>	Electricity
<b>Electricity Use:</b>	-



### Materials Used:

Mild steel for Frame, belt sheath; stainless steel for hopper, grating (rasper) plate

### Spare Parts:

Rasper, belt, bearing



### **Maintenance Required:**

Change of rasper after wearing, lubrication of bearing, cleaning of hopper by brushing and water flushing

### **Design and Fabrication:**

Machine fabrication quality is high; Simple and compact design; most joints in an element are welded; units are either riveted or bolted; hinged cover is provided on hopper to prevent root escape during grating; Hopper configuration allow for self feeding; stable operation with no vibration

### **Quality of Output:**

The machine made large and non-uniform particulate grates. No obvious contamination of product

### **Safety:**

Electrical cables are not exposed; belt guard not provided

### **Concluding Remarks:**

Comments on performance was given by user (Open door) and confirmed by on-the-spot test of the grater. Provision of belt guard is also necessary to prevent accidental touch by operator.

### **Starron Ltd. grater**

He unit is driven at 1440 rpm by a 2 hp motor.

<b>Manufacturer:</b>	Starron Nigeria Ltd
<b>Review Location:</b>	Starron Nigeria Fabrication workshop. Mushin, Lagos
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	-
<b>Output capacity:</b>	-
<b>Fuel Type:</b>	Electricity
<b>Electricity Use:</b>	1.23 kWh



#### **Materials Used:**

Mild steel for the frame, stainless steel for the hopper (grating zone), mild steel portion gloss-painted for protection but may require additional layer to optimize parts against corrosion due to wet operation.

#### **Spare Parts:**

Belts and bearings

#### **Maintenance Required:**

Cleaning of grating drum is by brushing and flushing with water. Changing of belt and bearings easy; Changing of grating drum could be difficult since it requires removal of axle.

#### **Design and Fabrication:**

Stainless steel cylindrical grating plate guarded with wood in the grating zone to avoid root escape. It has slanted stainless steel feeding hopper to regulate root sliding to the grating zone. Motor fixed to counter balance the hopper/milling zone weight, frame well balanced. Inaccurate and varied clearance between grating surface and wooden guard means output will be inconsistent

#### **Quality of Output:**

Not covered during review. It is likely to give inconsistent quality due to varying clearance between grating surface and wooden guard.

#### **Safety:**

Absence of belt guard against sudden cut or accidental touch by operator

#### **Concluding Remarks:**

The safety design and quality of machining need to be improved upon. Operational efficiency also needs to be determined

## Niji Ltd. grater

The machine is driven a -phase 5 hp motor rotating at 1400 rpm.

<b>Manufacturer:</b>	Niji Lukas Nigeria Ltd
<b>Review Location:</b>	Niji Farms Factory, Ilero, Oyo State
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	300 kg/h
<b>Fuel Type:</b>	Electricity
<b>Electricity Use:</b>	-



### Materials Used:

Stainless steel for the hopper, the hanging frame mild steel

### Spare Parts:

Belt and bearings

### Maintenance required:

Thorough cleaning with water and brushing off the remnant cassava mash from grating drum surface.

**Design and fabrication:** The machine has self-feeding mechanism. Fabrication quality is high; Joints are either welded or bolted.

### Quality of Output:

Not covered during review

### **Concluding Remarks:**

Technical information was provided by manufacturer. On-the-spot evaluation of the machine is necessary.

### **Key Findings on Nigerian Made Cassava Graters**

- Information on the input and output capacities of the graters is lacking.
- Fabrication quality of graters are, most of the times, low especially concerning the clearance between grating drum and hopper walls
- Manufacturers do not have adequate data on the performance efficiency and maintenance requirements of their equipment.

### **Recommendations**

- Fabricators needs to be enlightened on the need to generate and save technical specifications and performance data
- Training of fabricators on the design of safety features
- There is need to improve fabricators skill and technical capacity to make high quality grating drums. Specifically with the use of more durable guards

## Mechanical dewatering press

Mechanical presses are device used to remove excess water from grated or retted cassava meal in preparation for dry processing; they consist of two major units (frame & mechanical press units); to enhance even pressure distribution frame is matted internally preferably with stainless steel or non-corrosive metal gauze or hard wood sheets.

A major feature of mechanical press is that its frame (rectangular or cylindrical) should be constructed from materials capable of withstanding heavy working pressure without failure. That informs why cast iron or mild steel is sometimes used. In addition, mechanical pressing in cassava processing factory is an entirely wet operation. Material of construction should have strong corrosion resistance. Due to the low corrosion resistance to acidic solution as in cassava liquor, coating/painting of surface with paint is recommended to improve corrosion resistance.

Packing of bagged wet cassava mash for pressing is another cause for varying designs of mechanical presser. Ease of loading and offloading has made rectangular caging of packed mash more common than cylindrical meshed containers.

The source of pressure in mechanical presses is either from screw jack or hydraulic jack. The latter is known to have greater lifting power and more durable than the former. Screw jack requires more manual effort than hydraulic. Hydraulic jacks operation may be easily automated than screw jack.

## Adebash Ltd. press

<b>Manufacturer:</b>	Adebash Manufacturing Company
<b>Review Location:</b>	Adebash Company Site, Old Oyo Road, Ibadan
<b>Process Type:</b>	Batch
<b>Input Capacity per Batch:</b>	500 kg
<b>Output capacity per Batch:</b>	-
<b>Duration per Batch:</b>	-
<b>Pressure Source:</b>	Hydraulic ram
<b>Jack Tonnage:</b>	40 ton



**Materials Used:**

Mild steel (frame and hanger), stainless steel (press plate)

**Spare parts:**

None

**Maintenance Required:**

Replacement of fluid when necessary, clean frame after each operation; repaint frames to avoid rusting

**Design and fabrication:**

The design is unique as the cage is guarded in all direction; joints are welded, fabrication quality is high

**Quality of Output:**

Not assessed during review

**Safety:**

Safe operation; no moving part apart from lever; remote possibility of hydraulic fluid spillage as the source of oil is outside the cage

**Concluding Remarks:**

Operational efficiency was dictated by manufacturer. The actual operational performance needs to be established

**Nobex Ltd. press**

The unit consists of two major units, namely, the frame (for receiving the product) and the mechanical press unit for transferring load on to the product.

<b>Manufacturer:</b>	Nobex Technical Company
<b>Review Location:</b>	Open Door Factory, Ota, Ogun State
<b>Process Type:</b>	Batch
<b>Input capacity per Batch:</b>	600 kg
<b>Output Capacity per Batch:</b>	180 kg
<b>Duration per Batch:</b>	45 min
<b>Fuel Type:</b>	None
<b>Pressure Source:</b>	Hydraulic ram
<b>Jack tonnage:</b>	32 ton



#### **Material Used:**

Cast iron (frame) and wood (press plate as accessory)

#### **Spare Parts:**

Woody press plate, hydraulic jack

#### **Maintenance Required:**

Cleaning of frame **is done** after each use. Periodic coating of frame is needed to prevent rust, due to wet operations

#### **Design and fabrication:**

**Design is** simple. Unguarded front side for easy uploading and offloading of product; Design of frame is fixed for hydraulic jacking only. The press has removable wooden press plate for distributing pressure on wet product during de-watering

#### **Quality of Output:**

Not quantitatively covered during review. Visual assessment of pressed cake showed that it is dry enough for subsequent drying. No obvious contamination of pressed cake

#### **Safety:**

Operation is entirely safe

### Concluding Remarks:

Due to woody nature of the press plate, it may require more frequent replacement. Data on equipment performance needs to be generated

### Starron Ltd. screw press

The equipment has a frame with base dimension of 40 by 40 cm and height of 120 cm.

<b>Manufacturer:</b>	Starron Nigeria Ltd.
<b>Review Location:</b>	Starron Nigeria fabrication workshop. Mushin, Lagos
<b>Process Type:</b>	Batch
<b>Input Capacity per Batch:</b>	-
<b>Output Capacity per Batch:</b>	-
<b>Fuel Type:</b>	None
<b>Pressure Source:</b>	Screw
<b>Jack Tonnage:</b>	10 ton



### Materials Used:

Mild steel, aluminium, wood

### Spare Parts:

None

### Maintenance Required:

It is easy to maintain. Cleaning of frame is required after each use. Grease should be applied to lubricate screw



### **Design and Fabrication:**

**Design** is simple. Joints in the frame are welded. The design is expected to make pressure become evenly transferred to product by means of a flat plate attached to the screw that easily fits into frame. Basement of frame is not perforated to allow collection drained fluid from product through an outlet pipe. The frame is guarded only on two sides to hold product firmly during pressing. According to manufacturer, the design of the frame makes it flexible to use hydraulic jack as source of pressure.

### **Quality of Output:**

Not assessed

### **Concluding Remarks:**

The technical information here was provided by manufacturer. According to manufacturer, the presser has maximum capacity of 1 ton/24-h day. The operational condition and efficiency of the press is yet to be established. The guard may require some modifications to enhance better pressure distribution.

### **Key Findings on presses**

- Manufacturers do not have accurate information on the loading requirements, input and output capacities, as well as the **pressed cake's final** moisture contents
- Manufacturers lack data on the performance efficiency and maintenance requirements

### **Recommendations**

- Fabricators needs to be enlightened on the need to generate operating guidelines and performance data
- Training of fabricators on the above required
- Design of caged presses should be improved upon to maximise pressing efficiency and reduce contamination of product

## Sifters

Cassava sifters are mechanical devices meant to facilitate bringing cassava cake (moisture content less than 40%) to a more uniform particle size, screening out unwanted lumps and fiber, and enhance subsequent processing operations such as drying and roasting. They help to increase throughput and eliminate the drudgery of using manual rafter sieves.

The equipment has four main parts: the frame, feed receptacle (sieve), vibrating mechanism and product receptacle. The frame holds the receptacle and serves as basement for transfer of vibratory motion from an eccentrically loading electric motor to the sieve. Sifted product is delivered into a receptacle at the bottom by gravity. The efficiency of sifting affects the particulate qualities of final product (gari).

### Fataroy Ltd. sifter

<b>Manufacturer:</b>	Fataroy Steel Industry Ltd
<b>Review Location:</b>	Fataroy Steel Industry factory site at Ibadan
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	1000 kg/h
<b>Fuel Type:</b>	Electricity, Diesel



#### Materials Used:

Wood and stainless steel for sieve frame, mild steel for support frame

#### Spare Parts:

Belt, Screen, and bearing

#### Maintenance Required:

Cleaning of screen after use, replacement of sieve and belt

### **Design and Fabrication:**

Simple design, easily mountable and removable sieve; product exit chute is slanted, most parts of the machine are joined by welding, fabrication quality is high

### **Quality of Output:**

Not covered during review

### **Safety:**

Drive belt is exposed and could cause injury, electric cables are enclosed

### **Concluding Remarks:**

The technical Information was provided by manufacturer only. Evaluation of machine for process efficiency is necessary.

### **Adiss Ltd. gari sifter**

The screen is about 2.5 x 1.5 x 0.4 ft

<b>Manufacturer:</b>	S Adiss Agricultural Engineering Ltd.
<b>Review Location:</b>	S Adiss Factory, Olodo, Ibadan
<b>Input Capacity:</b>	-
<b>Output Capacity:</b>	1000 kg/h
<b>Fuel Type:</b>	Electricity, Diesel
<b>Fuel Consumption:</b>	-
<b>Electricity Use:</b>	-



### **Material used:**

Stainless steel for the sieve frame and screen; mild steel and wood for the frame

**Spare parts:**

Belt, screen

**Maintenance Required:**

Cleaning of mesh screen and product exit chute after use

**Design and fabrication:**

Parts of machine units welded, fabrication quality is average

**Quality of Output:**

Not assessed during review

**Safety:**

Electric cable not exposed, moving part covered from accidental touch by operator

**Concluding Remarks:**

Quality of fabrication needs to be improved upon. Moreover, operational efficiency needs to be assessed.

**Starron Ltd. gari sifter**

The frame holds the receptacle and serves as basement for transfer of vibratory motion from an eccentrically loading electric motor (1200 rpm) to the sieve. The cylindrical sieve built from stainless steel is furnished at the bottom with mesh that sifts the product to a typical particle size. Sifted product is delivered into a receptacle at the bottom.

<b>Manufacturer:</b>	Starron Nigeria Ltd
<b>Review Location:</b>	Starron Nigeria fabrication workshop. Mushin, Lagos
<b>Process Type:</b>	Continuous
<b>Input Capacity per Batch:</b>	125 kg/h
<b>Fuel Type:</b>	Electricity

**Materials used:**

Mild steel for frame and stainless steel for receptacles

**Spare Parts:**

Screen, belt

**Maintenance Required:**

Cleaning of receptacle after each operation

**Design and fabrication:**

The sieve is replaceable simply by use of clamping system

**Safety:**

No exposed wire and moving part that could obviously cause operational harm

**Concluding Remarks:**

Appropriate operational condition and efficiency needs to be established.

**Key Findings on Nigerian gari sifters**

- The sieves of gari sifters commonly found were either cylindrical or rectangular sieves
- Fabrication quality of sifters are at large variance
- Technical specification submitted by manufacturers are also at variance
- Manufacturers do not have adequate data on the performance efficiency and maintenance requirements of their equipment

**Recommendations**

- Fabricators needs to be enlightened on the need to generate and save technical specifications and performance data

- Training of fabricator on how to improve on fabrication quality and on the above required

## Motor driven cassava peeler

Peeling is the most significant but tedious stage of cassava processing. It is also perhaps the most difficult stage to mechanize till date. The difficulty lies in the large variation in root weight, shape and size as well as difference in the peel texture, and thickness among cassava varieties. Mechanical peelers have been developed and are still being researched and developed to replace manual peeling. Despite the concerted R&D efforts, there is yet to become available, a peeling technology that gives peeling quality on par with manually peeled cassava roots. However, time constraints are often a trade-off from peeling quality.

Most mechanical peelers designed so far use abrasive or cutting mechanism to peel cassava roots. What differ mainly are the configuration of the peeling zone and the size of equipment. Peeling efficiencies reported so far has not been greater than 90%. Some mechanical peelers combine subsequent unit operations like washing and grating alongside.

Most of the reported mechanical peelers were constructed of two major materials, namely, cast iron (for cutting knife), stainless steel (for abrasive surface) and mild steel (for peeler casing).

### Fataroy Ltd. Mechanical peeler

The unit is driven by an electric motor of 5 hp at 2600 rpm. Driving is actuated by double belt pulley system at fixed speed. The top loading peeling zone is encased in a mild steel box (150.9 by 50 by 38.5 cm). Peeling is achieved by an abrasive mechanism. Root conveyance is enabled via a spiral shaft which helps to push roots against abrasive walls along the peeling zone, which is also slanted to further enhance root movement by gravity.

<b>Manufacturer:</b>	Fataroy Steel Industry Ltd.
<b>Review Location:</b>	Fataroy Steel Industry workshop at Ibadan
<b>Process Type:</b>	Continuous
<b>Input Capacity:</b>	-
<b>Output Capacity:</b>	-
<b>Fuel Type:</b>	Diesel
<b>Fuel Consumption:</b>	-



**Materials Used:**

Mild steel for the shaft, pulley system, casing and frames; stainless steel for the abrasive surfaces

**Spare Parts:**

Belts and bearing

**Maintenance Required:**

Lubrication of moving parts; changing of belt; changing of abrasive plate

**Design and Fabrication:**

Simple design; enables separation of waste stream from product clearly; fabrication work is good; there is need for optimization of slant angle and noise level; welding and riveting were used for joining parts; strong frame, loading is apparently evenly distributed, suspension frame adequately coated to prevent corrosion due to wet operation

**Quality of Output:**

According to manufacturer it gives above 90% peeling efficiency; by visual inspection of output on site, it seems feasible

**Safety:**

No exposed wires; pulley/belt assembly encased to prevent accident due to sudden cut or touch by operator; the exhaust point from the diesel engine is low and requires channeling during installation to avoid air pollution during operation

**Concluding Remarks:**

The peeler is one of the few designed and fabricated in Nigeria. The performance of the machine was tested with small batch quantity and output appears good; however, it may require further testing to establish optimal operational conditions and peeling efficiency and capacity

**Key Findings on Nigerian motor driven peelers**

- Only one model was found during the review visits
- Only three out of eight fabricators visited mentioned their involvement in mechanical peeler manufacture
- Fataroy Steel industry has once been involved in partnership with IITA and NCAM on the fabrication of mechanical peelers



## Recommendations

- More fabricators need to be encouraged to pick up interest in the cassava peeler manufacture
- Training of fabricators on how to improve on fabrication quality is necessary

## Appendix 1: Templates

### Review Template: Heating Equipment

<i>Item</i>	<i>Comment</i>	<i>Unit (if applicable)</i>
<b>General information</b>		
Equipment name		
Short description		
Manufacturer		
Pictures attached?		
<b>Process efficiency</b>		
Input capacity		wet, kg/h (continuous); kg/batch (batch) @ moisture content
Output capacity		dry, kg/h (continuous); kg/batch (batch) @ moisture content
Process duration		h/batch; how to measure for continuous process?
<b>Energy use</b>		
Fuel type	diesel, petrol, wood, coal etc..	
Fuel consumption		per hour (L, kg), per tonne output
Electricity consumption		kWh
<b>Quality</b>		
Metal used is appropriate (mild steel, stainless steel ... )		
Strength (visual signs of stress)		
Method of fixing (welded vs flanged)		
Maintenance (ability to service parts; clean, replace, sharpen etc)		
Spares (spares are available and easy to exchange)		
Quality of output (visual inspection)		
<b>Safety</b>		
Exposed wires		
Guards (heat sources, blades, graters, screws..)		
Safety valves (pressure)		
Fumes (exhaust facilities)		
<b>Comment</b>		
Pros		
Cons		
Additional remarks		

## Review Template: Presses

<i>Item</i>	<i>Comment</i>	<i>Unit (if applicable)</i>
<b>General information</b>		
Equipment name		
Short description		
Manufacturer		
Pictures attached?		
<b>Process efficiency</b>		
Input capacity		wet, kg/batch (batch) @ moisture content
Output capacity		dry, kg/batch (batch) @ moisture content
Process duration		h/batch
<b>Energy use</b>		
Pressure source	Screw, jack press, hydraulic rams...	
Pressure size		tonnage (for jack presses)
<b>Quality</b>		
Metal used is appropriate (mild steel, stainless steel ... )		
Strength (visual signs of stress; integrity of frame under pressure)		
Method of fixing (welded vs flanged)		
Maintenance (ability to service parts; clean, replace, sharpen etc)		
Spares (spares are available and easy to exchange)		
Quality of output (visual inspection)		
<b>Safety</b>		
Exposed wires		
Guards (heat sources, blades, graters, screws..)		
Safety valves (pressure)		
Fumes (exhaust facilities)		
<b>Comment</b>		
Pros		
Cons		
Additional remarks		

## Review Template: Graters, Chippers, Wet Hammer Mills

<i>Item</i>	<i>Comment</i>	<i>Unit (if applicable)</i>
<b>General information</b>		
Equipment name	Grater	
Short description		
Manufacturer	Starron Nig Ltd, Lagos	
Pictures attached?	Yes	
<b>Process efficiency</b>		
Input capacity	1000	kg/h
Output capacity	-	kg/h
Process duration	-	
<b>Energy use</b>		
Electricity	1.25	kWh
<b>Quality</b>		
Metal used is appropriate (mild steel, stainless steel..)		
Strength (visual signs of stress; integrity of frame under pressure)		
Method of fixing (welded vs flanged)	Welding,	
Maintenance (ability to service parts; clean, replace, sharpen etc)	Cleaning of drum by brushing and flushing with water;	
Spares (spares are available and easy to exchange)	Changing of belt and bearings easy; Changing of grating drum could be difficult	
Quality of output (visual inspection of output)	-	
<b>Safety</b>		
Exposed wires	None	
Guards (heat sources, blades, graters, screws..)	Absence of belt guard against sudden cut or accidental touch by operator	
Safety valves (pressure)	No pressurized operation.	
Fumes (exhaust facilities)	None	
<b>Comment</b>		
Pros		
Cons		
Additional remarks		

## Review Template: Hammer Mills

<i>Item</i>	<i>Comment</i>	<i>Unit (if applicable)</i>
<b>General information</b>		
Equipment name		
Short description		
Manufacturer		
Pictures attached?		
<b>Process efficiency</b>		
Input capacity		kg/h
Output capacity		kg/h
Process duration		
<b>Energy use</b>		
Electricity		kWh
<b>Quality</b>		
Metal used is appropriate (mild steel, stainless steel..)		
Strength (visual signs of stress; integrity of frame under pressure)		
Method of fixing (welded vs flanged)		
Maintenance (ability to service parts; clean, replace, sharpen etc)	possibility to change screens?	
Spares (spares are available and easy to exchange)	spare screens available?	
Quality of output (visual inspection of grated/chipped material)		
<b>Safety</b>		
Exposed wires		
Guards (heat sources, blades, graters, screws..)		
Safety valves (pressure)		
Fumes (exhaust facilities)		
<b>Comment</b>		
Pros		
Cons		
Additional remarks		

## Review Template: Sifters

<i>Item</i>	<i>Comment</i>	<i>Unit (if applicable)</i>
<b>General information</b>		
Equipment name		
Short description		
Manufacturer		
Pictures attached?		
<b>Process efficiency</b>		
Input capacity		kg/h
Output capacity		kg/h
Process duration		
<b>Energy use</b>		
Electricity		kWh
<b>Quality</b>		
Metal used is appropriate (mild steel, stainless steel ... )		
Strength (visual signs of stress; integrity of frame under pressure)		
Method of fixing (welded vs flanged)		
Maintenance (ability to service parts; clean, replace, sharpen etc)	possibility to replace mesh?	
Spares (spares are available and easy to exchange)	spare mesh available?	
Quality of output (visual inspection of grated/chipped material)	inspect size & consistency of size of flour	
<b>Safety</b>		
Exposed wires		
Guards (heat sources, blades, graters, screws..)		
Safety valves (pressure)		
Fumes (exhaust facilities)		
<b>Comment</b>		
Pros		
Cons		
Additional remarks		

## Review Template: Peeling machines

<b>Item</b>	<b>Comment</b>	<b>Unit (if applicable)</b>
<b>General information</b>		
Equipment name		
Short description		
Manufacturer		
Pictures attached?		
<b>Process efficiency</b>		
Input capacity		kg/h
Output capacity		kg/h
Process duration		
<b>Energy use</b>		
Electricity		kWh
<b>Quality</b>		
Metal used is appropriate (mild steel, stainless steel ... )		
Strength (visual signs of stress; integrity of frame under pressure)		
Method of fixing (welded vs flanged)		
Maintenance (ability to service parts; clean, replace, sharpen etc)	possibility to replace blades?	
Spares (spares are available and easy to exchange)	spare blades available?	
Quality of output (visual inspection of grated/chipped material)	inspect peeled roots and peel	
<b>Safety</b>		
Exposed wires		
Guards (heat sources, blades, graters, screws..)		
Safety valves (pressure)		
Fumes (exhaust facilities)		
<b>Comment</b>		
Pros		
Cons		
Additional remarks		