# Fermentation helps meet growing urban demand for cassava products

RIU

**Validated RNRRS Output.**

Cassava producers are meeting growing urban demand for processed products thanks to new technologies for the manufacture of convenient, high-quality and environmentally safe foods. Private-sector partnerships are providing linkages between rural producers and urban markets, and a series of best practices and technologies are helping to match consumer preferences with the needs of rural processors, the private sector and market traders. The innovations include new specially developed dryers and fermentation vats, training centres for local businesses, professionals and post-graduate students, and a food safety manual that brings cassava processors up to speed on the new techniques. Processors and consumers validated the techniques and products in Nigeria and Ghana, where they are currently in use.

Project Ref: **CPH41:**
Topic: **5. Rural Development Boosters: Improved Marketing, Processing & Storage**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Crop Post Harvest Programme**

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**Document Contents:**



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**Description**

***CHP41***

**Research into Use**
NR International
Park House
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**Geographical regions included:**

**Ghana, Nigeria,**

**Target Audiences for this content:**

**Crop farmers, Processors, Traders,**

## *A. Description of the research output(s)*

*1. Working title of output or cluster of outputs.*
*In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.*

**Commercialisation of traditional processed cassava products to maximise benefits and sustain rural livelihoods**

Working title: Commercialisation of traditional processed cassava products.

*2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.*

Crop Post Harvest Programme

Subsequent work was supported by the EC via the CASSAVA-SMES project and the Integrated Cassava Project in Nigeria.

*3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.*

R7495/EC CASSAVA-SMES project, but also R7580

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*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced?* ***(max. 400 words)****. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

The cluster of outputs on the **commercialisation** of **traditional processed cassava products** was produced between 1999 and 2006 with funding from the CPHP and European Commission. Cassava is a **food security** and **income generation** crop for many millions of people in the developing world and is now increasingly being processed to meet the demands of rapid **urbanisation**. These projects sought to develop cassava-based foods to meet the changing and growing urban demand through the **manufacture** of products that are convenient, of high quality and are **safe**. This was achieved through the development of **private sector partnerships** which were central to providing linkages between rural producers and the **urban market**. This project developed "**best practice**" tools and technologies to develop the **value-chain** from **production** to **consumption** and considered market demand and **consumer preferences**, the needs of **rural processors**, the private sector and **market traders**. This was achieved by developing an understanding of the changes that different approaches to commercialisation are likely to have on case study producers and processors.

This was achieved by:

- Developing **partnerships** between researchers in Europe and Africa, the private sector and rural processors;
- Working with **small-medium scale enterprises** to bridge the gap between primary local processing and urban demand.
- Developing specific processed products to meet identified markets (such as: dried fermented odourless fufu, instant unfermented fufu, high quality cassava flour)
- Developing, in partnership with a local fabricator, two dryers appropriate for producers in West Africa. Through partnership linkages, 34 have been manufactured or are on order;
- Establishing private sector **training centres** for cassava processing for training of local businesses, professionals and post-graduate students:
- Developing a **food safety** training manual for **SME** cassava processors;
- Developing improved processes for fermented cassava products that reduced the cost, increased throughput and reduced **environmental pollution**;

- Establishing the **consumer acceptability** in major urban locations in West Africa so that products are developed to meet their needs;
- Established factors critical to the success for small-scale cassava processors such as the scale of production, use of water, fuel and economic/financial and social factors.

Cassava is widely grown in many of the DFID PSA Countries in **Africa** and **Asia**. These technologies can be promoted through a **partnership approach** in selected countries. The partners should be selected from throughout the cassava processing value chain from **farmer to consumer**.

*5. What is the type of output(s) being described here?*
*Please tick one or more of the following options.*

| ***Product*** | ***Technology*** | ***Service*** | ***Process or Methodology*** | ***Policy*** | ***Other Please specify*** |
|---|---|---|---|---|---|
| X | X | X | X | | |

*6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment*

The main commodity the outputs focused on is cassava and its products. The principals of the approach that supports commercialisation could apply to any tropical roots crop and other food products that have commercial potential through processing.

*7. What production system(s) does/could the output(s) focus upon?*
*Please tick one or more of the following options. Leave blank if not applicable*

| ***Semi-Arid*** | ***High potential*** | ***Hillsides*** | ***Forest-Agriculture*** | ***Peri-urban*** | ***Land water*** | ***Tropical moist forest*** | ***Cross-cutting*** |
|---|---|---|---|---|---|---|---|
| | | | X | X | | | X |

*8. What farming system(s) does the output(s) focus upon?*
*Please tick one or more of the following options (see Annex B for definitions).*
*Leave blank if not applicable*

| ***Smallholder rainfed humid*** | ***Irrigated*** | ***Wetland rice based*** | ***Smallholder rainfed highland*** | ***Smallholder rainfed dry/cold*** | ***Dualistic*** | ***Coastal artisanal fishing*** |
|---|---|---|---|---|---|---|
| X | | | | | | |

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*

*Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.*

Outputs for improving the livelihoods of rural poor and providing more choice for urban consumers can potentially come from any processing that adds to the value chain (farmer to consumer). This can be through interventions in policy, knowledge management, food safety and quality management, training, livelihoods, institutional linkages, dissemination and promotion and financial support.

Elements of RNRRS outputs that could potentially add value include the following:

- Participatory Market Chain Analysis (PMCA) - R8182 R8418 – the livelihoods of those working in the market chain that supplies the cassava traditional processing value chain require support but rural processors may be highly vulnerable;
- Knowledge management - R8402 –information and ideas need to be effectively shared and discussed;
- Farmer access to markets - R8275, R8274, R8498 – the size and value of the cassava sector can be significant. Support for this sector will provide secure and sustainable incomes for farmers, rural processors and market traders;
- Market information tools - R7151, R8250, R7494, R8422 - Improved information and access to it will help support and sustain livelihoods;
- Decision tools for institutional change in public and private sectors -R7502, R6306 – these projects have involved key institutions (public and private) in the traditional processing sector. These tools may support this process;
- Cyanogen removal from cassava - R6332, R6339 – processed cassava products need to meet specified food safety and quality standards;
- Promotion of control for cassava brown streak disease - R8227, R8404 – farmers need to be able to meet the demand for cassava by processors;
- PPT breeding disease resistant cassava - R8405, R8302, R7565 - farmers need to be able to meet the demand for cassava by processors;
- Extending the control of cassava mosaic disease - R8456, R8303 - farmers need to be able to meet the demand for cassava by processors;
- Cassava as an industrial commodity High Quality Cassava Flour, Paperboard adhesives from cassava flour, Glucose syrup from cassava flour - R 6504, R7418, R8268 – components of these technologies can be transferred to rural processors;
- Improved storage for wet cassava starch & Small to medium scale cassava starch - R6316 - components of these technologies can be transferred to rural processors.

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## Validation

### *B. Validation of the research output(s)*

*10. **How** were the output(s) validated and **who** validated them?*

*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which*

*group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation* ***(max. 500 words)****.*

There are three main types of output and each was validated in slightly different ways. They were:
**Processes** such as approaches for developing sustainable linkages between different levels of processors and end users, approaches to developing specific products. Initial validation of the approaches in Nigeria was done UNAAB's Cassava Processing Plant. The manager and workers at the Plant adopted the recommended process of purchasing wet *fufu* paste from trained, small rural-based processors as opposed to purchasing cassava roots directly from farmers. In the same way, an SME in Ghana (Food and Flour Ghana Limited) acted as an intermediary in the purchase of cassava grits for production of high quality cassava flour. Subsequently, 6 SMEs processing cassava in southwest and southeast Nigeria validated the processes for fermented Nigerian fufu processing.

**Technologies,** such as drying equipment and fermentation vats. The equipment required for producing shelf stable, dry and large quantities of cassava products developed in collaboration with local fabricators were validated both at UNAAB's Processing Plant and the 6 SMEs processing cassava in southwest and southeast Nigeria. These processing plants acquired the technologies under various arrangements and ran the processing plants for a 12 month period during which input-output and profitability analyses were carried out.

**Specific products**, such as: dried fermented odourless *fufu* (Nigeria), instant unfermented *fufu* (Ghana), high quality cassava flour (Ghana)). The validation of these products was done at two levels. First, among small and medium scale cassava processors using focus group discussions and participant observations and later among potential end users using consumer acceptability test and willingness to pay analyses.

In the case of Nigeria, cassava processors were engaged in an information-sharing process where feedback of overall findings of the project and potential future activities were discussed with cassava processors and end users of the cassava products. At the cassava processors' level the validation was applied mainly in female-dominated enterprises, where children often playing an active role in some activities, such as, collecting water and peeling cassava roots. While some of the cassava processing units are dominated by family labour, many of the entrepreneurs employed labourers to assist them. In some locations, men were involved in the validation exercise, and these were on a larger scale. The active involvement of men in cassava processing was considered an indicator of the emerging commercial potential of this activity in locations with established market links. To facilitate uptake of the output of the research during the validation stage, some female processors received support from their husbands and male relatives, through the supply of credit and assistance in activities aimed at increasing output, such as the construction of surface tanks. This reflected the nature of the livelihood partnerships that may be important in a wider scale promotion of the cassava processing technologies as well as enhance processors' ability to maximise market opportunities.

In Ghana, validation of technologies were carried out through commercial operation of processing systems (e.g. FFGL) and the production and sale of high quality products from the FRI Pilot Plant Facility.

11. ***Where and when*** *have the output(s) been validated?*

*Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above* ***(max 300 words)****.*

Although various outputs have been validated in both Ghana and Nigeria, the most progress on validation and adoption of outputs has been in Nigeria and hence the majority of the text concentrates on this country.

The village level validation exercise among rural-based cassava took place in the three cassava processing locations which were emerging as the main focus of the project: Ereji, Ode Remo and Ilaro in Nigeria in April, 2002. In Ghana, it took place at FFGL's operations between 2003 and 2006. Other outputs were validated over the same period It was targeted at cassava processors and end users of the cassava products in rural and peri-urban locations production systems and smallholder rainfed humid farming systems of southwest Nigeria

At the SMEs level, the validation took place at the University of Agriculture, Abeokuta, Nigeria Cassava Processing Plant between 2002 and 2003 and the 6 SMEs processing cassava processors in southwest and southeast Nigeria 2004 and 2005.

At the end users level, consumer acceptability test and willingness to pay analysis were done in Nigeria (Abeokuta, Ibadan and Lagos) between 2001 and 2002.

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## Current Situation

### *C. Current situation*

*12.* ***How and by whom*** *are the outputs currently being used? Please give a brief description* ***(max. 250 words****).*

The outputs of the project are being used at various levels and by various actors. Some of these are:

1. **Commercialisation of cassava production at UNAAB**: The dried fufu flour has been commercialised at UNAAB cassava processing plant. UNAAB is working closely with six local processors by providing a starter fund for processing equipment by advancing payments for semi-processed fufu. **Training Centre**: Facilities at UNAAB in Nigeria are being used as a cassava processing training centre for local businesses and post-graduate students (currently three PhD and three MSc students)

**1b**. **Commercialiation of cassava flour/fufu in Ghana.** Production of instant Ghanaian fufu is now a commercial product in Ghana that is expanding in production. This is mainly due to the adoption by a new SME that used information and staff from one of the project partners (FRI)

2. **Support to local industry**: Addis Engineering/Starron Nigeria Limited, Lagos and Peak Products, Abeokuta, Nigeria are local fabricators of the rotary and the flash dryers who collaborated extensively with the project. They are now leading fabricators for cassava processing equipment in Nigeria.
3. **Collaboration between CASSAVA-SMES and Integrated Cassava Project (ICP) at IITA:** In training of local processors, regulatory agencies, and research institutions in quality training (Hazard Analysis Critical Control Points). One member of UNAAB staff and two PhD students associated with the EU have been actively recruited by IITA to support initiatives in this sector. The participants at these sessions were drawn

from regulatory agencies (SON and NAFDAC), local processors, research Institutes, and private investors.

**4. Dryer technology**: The early development of production of high quality fufu flour using locally fabricated rotary and flash dryers, has been successfully fed into the current Integrated Cassava Project being hosted by IITA. The opportunities for widespread adoption of the dryer technology across the cassava growing regions of Africa are immense.

*13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used **(max. 250 words).***

This question is complex in nature because of the multiple outputs of the projects.

In Nigeria, the technical outputs are currently being used at the following locations:

1. University of Agriculture, Abeokuta Cassava Processing Plant, Nigeria
2. Two Private Cassava Processors in Abeokuta, Nigeria
3. Two Private Cassava Processors in Ibadan, Nigeria
4. Six Integrated Cassava Processing groups supported by the Niger Development Commission in the Niger Delta area of Nigeria

The project team in Ghana worked with six food producing companies and three artisanal cassava processing groups in the rural areas of Ghana. These enterprises will be used elements of the technologies developed.

The process outputs are the key ones for future impact and a framework for cassava commercialisation for the development of the traditional food sector based on cassava has just been prepared at the final project workshop of the CASSAVA-SMES project (December 2006)

*14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading **(max 250 words).***

Compared to the potentials of the outputs, the scale of current use is significant, but still limited. For example at the UNAAB Cassava Processing Plant, commercial production of a shelf stable cassava *fufu* has being in progress since the end of the validation exercise in 2002. The Plant currently works with six trained, rural-based cassava processing groups who supply wet cassava pastes for drying at the plant. The plant also provides employment for four cassava processing assistants. The level of production is only about one-sixth of installed capacity due mainly to problems of inadequate supply of electricity, inconsistency in raw material supply and business enterprise skill. The plant has supplied an average of about 5MT of dried products per month since 2002 and achieves 100% sales record. The scale of operation at this cassava processing plant is typical of the other 10 plants that currently use the project outputs in Nigeria. The only exception is of the other two plants in Abeokuta which produces dried cassava starch in addition to cassava fufu.

In Ghana the scale is limited by the number of factories with which contact has so far been made. This only six, but with a large potential market for the products there is potential for further expansion.

*15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as*

*the key facts of success?* ***(max 350 words).***

*For this question, the best experience is in Nigeria.*

The technology and approach developed is being expanded by Integrated Cassava Project hosted by IITA in South-South and South-east Nigeria with funding from USAID and Shell Petroleum Development Company, Nigerian Federal Government Presidential Initiative on Cassava, Niger Delta Development Commission, Nigerian National Petroleum Corporation and 12 State Governments.

In addition the promulgation of a law in Nigeria that compels the flour industry to include 10% cassava flour in bread from January 2005 had stimulated the demand for locally fabricated drying equipment and high quality, locally produced unfermented cassava flour. Many awareness platforms on investment opportunities in Nigerian cassava organized by Office of the President on Food Security, Federal Ministry of Agriculture, Federal Ministry of Science and Technology, Federal Ministry of Commerce and Industry etc. have also facilitated awareness and adoption of project outputs.

Other success factors are the current approach (public-private sector driven) being adopted by the ICP in transferring cassava post harvest technologies, which is based on the DFID/EC-funded cassava projects in Nigeria and Ghana.

A significant factor in the success of the initiatives has been the involvement of product personnel/former personnel in the initiatives/enterprises that have used the technologies and approaches developed.

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## Environmental Impact

### *H. Environmental impact*

*24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)?* ***(max 300 words)***

*This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.*

The major environmental issues arising from cassava processing are erosion, cyanagenic content of cassava, volumes of waste water and deforestation. The production of cassava into various products on a micro, small and medium scale generates very little liquid effluent containing significant concentrations cyanogenic compounds. Also, the current processing activities are scattered in various locations, thus minimising the environmental impact of processing at any given location.

The modified techniques proposed for fufu processing use considerably less water than the techniques traditionally used meaning there is less environmental impact of the processing operations.

Understanding the need to reduce to the practicable minimum the environmental damage associated with cassava processing by taking the following measures:

- Cassava processing sites should not be sited very close to mechanic workshops as this will reduce/remove the incidence of lead in water sources.
- There is need for a proper plant design which addresses, not only the problems of chemical toxicants but also, the peels, the starch and other components of the effluents.
- Strict hygiene and sanitary condition should be enforced within and around the cassava plant, particularly with respect to the problem caused by fly infestation resulting from indiscriminate dumping of cassava peels around the plant.
- Processors should be trained on how best to make use of firewood, charcoal and gas as energy source during processing so as to reduce smoke and fire incidents in the environment.

Specifically, cassava processors can add value to cassava waste and generate more income with the following enterprises:

- Well dried cassava peel could be compounded and mixed for poultry while peels (wet or dried) could be used for feeding pigs.
- Cassava peel could also be used for mushroom production.
- For a long tem strategy, cassava waste can be treated in an integrated system. The peels are treated as animal feed, most waste from the peels are converted to biogas production, the effluent and sludge as fertilizers for the cassava plant.

*25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)?* ***(max 100 words)***

There are few adverse environmental impacts.

Clearly artificial drying where adopted as part of a modification to traditional processing requires that there is a need for firewood or other source of heat. These materials need to obtained from renewable, sustainable sources to reduce environmental impact.

However, under poor management processors, factory workers and neighbourhood might be exposed to offensive odour if proper environmental mitigations are lacking. Problems may arise from solid waste management if not properly tapped to generate more income.

*26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience?* ***(max 200 words)***

These outputs improve the utilization of already released cassava drought, disease resistant and high yielding cassava varieties thereby reducing the extent of environmental attacks by various climatic changes like drought, virulent attacks, erosion, etc.

Also, income from sales of cassava products could be used as part of coping strategies to deal with the effects of

climate change (rainy & harmattan periods), natural disasters (drought, fire accidents, etc) and increase the resilience of rural poor people to survive in the rural environments.