You name it, cassava can do it

RIU

Validated RNRRS Output.

Faced with the need to find solutions for a 30-40% surplus in cassava production in Ghana, researchers decided to get creative. They discovered that cassava-based products could provide substitutes for expensive imported raw materials in industries covering pastries to plywood. They developed processing techniques to convert fresh cassava into high-quality cassava flour, plywood and paperboard adhesive, glucose syrup and industrial and potable alcohol. Commercial processors acted as market intermediaries between farmers and end-users and a system for conflict-resolution with independent arbitration was developed to maintain good relations throughout the supply chain. Processing industries in Ghana and Nigeria are using the techniques to supply national, regional and international markets. This work meets the needs of countries with a relatively low level of development where expensive imported enzymes, adhesives and wheat flour are not affordable.

Project Ref: **CPH21:**
Topic: **5. Rural Development Boosters: Improved Marketing, Processing & Storage**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Crop Post Harvest Programme**

Document Contents:

Description

Research into Use
NR International
Park House
Bradbourne Lane
Aylesford
Kent
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UK

Geographical regions included:

Ghana,

Target Audiences for this content:

Crop farmers, Processors, Traders,

CPH21

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.

Cassava as a commercial / industrial commodity

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

Crop Post Harvest Programme

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.

Please note the Managing Partners should be the first points of contact.

Natural Resources Institute, Enterprise Trade & Food Management Group, Central Avenue, Chatham Maritime, Kent, ME4 4TB, United Kingdom. Contact: Dr A. J. Graffham (**Managing Partner** R6504, R7418, R8268 & R8432), Tel (Dir): 00 44 1634 88 3239, Fax: 00 44 1634 88 3567, Email: a.j.graffham@gre.ac.uk & Andrew.graffham@btopenworld.com

Food Research Institute, PO Box M20, Accra, Ghana. Contact: Dr Nanam T. Dziedzoave (**Managing Partner** R6504, R7418, R8268 & R8432), Tel (Dir): 00 233 21 761209, 777330 & 500470, Fax: 00 233 21 777647 & 500331, Email: nanamtay@yahoo.com

Afrimart Global Enterprise, PO Box AH150, Achimota, Accra, Ghana. Contact: Mr B. Asare-Bediako (R8268 & R8432), Tel (Mob): 00 233 20 8138332, 233 244 639059, Email: basafare@hotmail.com & bafasare2003@yahoo.co.uk

Amasa Agro-Processing Company, PO Box 6302, Accra-North, Ghana. Contact: Mr K. Oware (R8268 & R8432), Tel (Dir): 00 233 21 300083, Fax: 00 233 21 306546, Email: amasaagro@yahoo.com

Feed and Flour Ghana Limited, PO Box CT1334, Cantonments, Accra, Ghana. Contact: Mr K. Kassim Shardow (R8268 & R8432), Tel 00 233 21 514644, (Mob): 00 233 24 254590, Email: depessey@yahoo.com

Forestry Research Institute of Ghana, University PO Box 63, Kumasi, Ghana. Contact: Dr D. Sekyere (R7418, R8268 & R8432), Tel 00 233 51 60123/60373, Fax: 00 233 51 60121, Email: dsekyere@forig.org

Ministry of Food and Agriculture (Brong-Ahafo Region), PO Box 86, Sunyani, Ghana. Contact: Mr L. K. Krampa (R7418, R8268 & R8432), Tel: 00 233 61 27193 & 23614, Fax: 00 233 61 27194 Email: kralaw@yahoo.com

National Board for Small-Scale Industries, PO Box M85, Accra, Ghana. Contact: Mr E. O. Boateng (R7418, R8268 & R8432), Tel (Dir): 00 233 21 668641/2, & 665693, Fax: 00 233 21 669707 & 661393, Email: nbssided@ghana.com

University of Ghana, Department of Nutrition & Food Science, PO Box LG134, Legon, Accra, Ghana. Contact: Prof. G. S. Ayernor, (R6504, R7418, R8268 & R8432), Tel (Dir): 00 233 21 513187, & 500381 (ext 3392), Email: nfs@ug.gh

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 outputs from projects R6504, R7418, R8268 and R8432 were produced in Ghana between 1996 and 2006. PRA's and value chain analyses identified a 30-40% in-ground **surplus of cassava** and **lack of market** for farmers produce. Various **industrial sectors** (**plywood, paperboard**, **bakery**, **confectionary** and **industrial & potable alcohol**) were identified that relied on expensive imported raw materials where a locally produced cassava based alternative had potential to substitute for the imported material (**import substitution**) and create a market for the farmers cassava. A range of processing options was developed to convert fresh cassava into **high quality cassava flour** (**HQCF**), **paperboard adhesive**, **glucose syrup** (mixed **sugar syrup**) and industrial and potable alcohol. The HQCF was used at levels of 10-35% in a range of bakery products and proved popular in rural areas where consumers preferred the heavy cake like texture created by the HQCF. HQCF was used for complete **substitution of wheat flour** as an **extender in urea and phenol formaldehyde resin plywood adhesives**. HQCF was blended with soluble borax and caustic soda to produce **Bauer type paperboard adhesive** that could completely replace imported starch based materials. A controlled process was developed for conversion of HQCF into sugar syrups with a range of **dextrose equivalents** to meet different end-user requirements **using enzymes from plant seedlings**. A system was developed for conversion of sugar syrup into **ethyl alcohol** for industrial or potable use. The system for conversion of sugar syrups was derived from mathematical models but these were converted into simple sets of instructions for use by rural processors. Three commercial processors took on the role of **market intermediary** between the farmers and the end-users and a system for **conflict resolution** was developed with independent arbitration to maintain good relations throughout the supply chain. At the end of project, the three processing industries were engaged with 5,000 farmers at 15 geographically diverse locations, and supplying 12 plywood mills and 6 food industries in Ghana, and 9 regional and international export markets. Since the end of the project a fourth Ghanaian processor has become involved on the plywood side and the glucose syrup work is being taken up commercially in Nigeria. The work in Ghana was designed to meet the needs of countries with a relatively low level of development where expensive imported enzymes, adhesives and wheat flour are not affordable. The output would **NOT** suit countries with sophisticated enzyme and starch industries.

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		

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

Cassava

This group of outputs focuses on technologies, processes and products specific to cassava and could **not** be applied to other commodities without extensive fundamental / strategic research.

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	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	X			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.

The outputs from projects R6504, R7418, R8268 and R8432 represent a stand alone set of processing options and approaches for product marketing. However, successful development of rural production requires effective business management and to achieve this it is highly desirable to cluster these outputs with the output dealing with the management model designed to combine Community Ownership with Professional Management (COProM) which was also developed under project R8432. In countries where cassava production is being expanded to meet industrial demand and agronomic problems associated with disease are occurring it would be useful to cluster the post-harvest processing and marketing outputs with those dealing with disease control strategies. These would include: R8227/R8404 (Promotion of control for cassava brown streak disease), R8405/ R8302/R7565 (PPT breeding of disease resistant cassava) & R8456/R8303 (Extending the control of cassava

mosaic disease).

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)**.*

The outputs were validated by practical adoption by processing industries and small-scale cassava farmers, successful adoption was assessed by monitoring increasing levels of demand for cassava-based products from industrial users and the changing livelihoods of the farmers (rising incomes, access to bak accounts and successful use of micro-finance). Data was collected from the end users of the inputs on a regular basis by the managing partners aided by the Ministry of Food and Agriculture.

*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)**.*

The outputs were validated in Ghana between 1998 and 2006, working with three commercial processing industries and some 5,000 small-scale growers of cassava in the forest transition zone of the country (forest agriculture interface). These farmers typically produce ~6 tonnes of cassava per annum of which ~1.7 tonnes has no market outlet via conventional routes and normally goes to waste as an in-ground surplus. Production conditions are primitive with no access to irrigation and no agricultural inputs of any kind. Cassava is considered a low value crop when compared to maize and African white yam. The majority of small cassava farmers and processors are female with a few male participants. Per capita Incomes prior to involvement in processing activities were £44-£46 per annum in most cases which is well below the national threshold of £58 for extreme poverty.

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 have been taken up by 4 processing industries in Ghana, and a fifth Ghanaian company and one Nigerian company are in process of adopting the technology for conversion of high quality cassava flour to glucose syrup.

*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).***

In Ghana, two of the processing industries are located close to Accra in the Greater Accra Region and the third is more rurally situated in the Central Region ~100km from Accra. The latest processor to adopt production of HQCF is located 3km north of Sunyani (on the Techiman Road) in Brong Ahafo and supplies plywood mills in Sunyani and Techiman. The fifth industry in Ghana is a maize grit processor at Takoradi who is being forced to adopt glucose syrup manufacture as the his major customer the brewing industry is changing from maize grits to glucose syrup as a brewing adjunct. The farmers processing for these industries are located mainly in Brong Ahafo, Volta, Central, Eastern and Greater Accra Regions of the country. The Nigerian entrepreneur is located in Lagos but has identified markets for glucose syrup in Lagos, Ibadan, Abeokuta & Port Harcourt.

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

Strategic and adaptive research under these outputs was mostly conducted between 1996 and 1998 at which point the research activities became more adaptive and a group of 22 farmers in Brong Ahafo started to produce HQCF for sale to local bakeries ~9km from the processing area. By 2002 this group had grown to 60 and a second group of 60 farmers had started sugar syrup production for sale to local distillers and bakeries. In 2002 three commercial food processors became involved and expanded production and marketing operations rapidly over the course of 1 year, within 3 years these companies were involved with 5,000 farmers at 15 geographically distinct locations and were supplying 12 plywood industries and 6 food industries in Ghana and had fulfilled export orders for 6 food and 3 plywood industries regionally and internationally. This business continues and a fourth processor has started operations close to Sunyani in Brong Ahafo. This processor has orders for 700 tonnes of cassava flour per annum and is sourcing cassava from 3,000 local farms. However, he has a potential market for 1,400 tonnes of cassava locally and this could involve ~10,000 farms to ensure a reliable supply of cassava roots. A maize grit processor is moving into the glucose syrup business but this work is at the trial stage and a Nigerian entrepreneur is in the process of establishing a glucose syrup plant near Lagos with potential to supply 1,000 tonnes of syrup per annum to local food and pharmaceutical industries.

*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).***

In commercial systems such as processing for industrial use, the private sector is clearly the driver for change and key players and owners of the research outcomes. Public and non-governmental institutions have a valuable role in providing support to the market chain in the form of training, extension support, system development and

independent arbitration for conflict resolution in the case of disputes. Experience has shown that farmers require strong commitment from a commercial partner such as a market intermediary (commercial processor). Donor, NGO or public sector driven initiatives almost always fail due to the lack of commercial drive and sustained input.

There is a need for a wide ranging skill-base, to cover all the issues related to production, processing, marketing of products and industrial support for adoption of cassava-based products, and thus players may include national & international research institutions, extension services (public or private), training institutes, commercial partners, farmers, and farmer organisations. The national supporting institutional framework must have the capacity to understand the requirements of the buyer and have the ability to provide the necessary level of support during the early stages of market development.

In primary production farmers need to be organised into groupings such as primary cooperatives with definite management structure and operating rules. Business management is a proven weakness of farmer processing groups and it essential to establish a system for business management with external support and mediation such as the Community Ownership with Professional Management (COProM) system developed for cassava processors under R8432. This avoids problems with erratic production, poor quality control and lack of commercial drive that so often hamper rural processing operations.

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.

Production of native cassava starch on a medium to large-scale can have a negative impact on the environment due to the production of large amounts of liquid effluent containing cyanogenic glucosides and having a high biological and chemical oxygen demand due to the level of suspended solids and high levels of readily digested carbohydrates. This problem was eliminated in the system developed under projects R6504, R7418, R8268 & R8432 by concentrating on conversion of raw cassava into high quality cassava flour, a process that generates very little liquid effluent. Furthermore processing was spread over 15 geographically dispersed locations across Ghana, thus minimising the environmental impact of processing at any given location.

The operations of the cassava processing plants generate an abundant supply of cassava peels for animal (goats and sheep) feed; and this has a positively affects the environment in two ways:

- The preservation of natural vegetation which would otherwise have been fed on by sheep and goats, and

- An increased opportunity to pen domestic animals like sheep and goats, with a consequent reduction in pollution from animal excrements and attendant improvement in environmental sanitation.

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

There are no significant adverse environmental impacts because processing of cassava into high quality cassava flour is not a water intensive process and rural processing is dispersed to many small to medium scale processing units at geographically dispersed locations rather than a few large-scale factories.

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)***

This output improves the incomes of poor people and with improved incomes their ability to cope with the effects of climate change (dryness in the harmmatan season, erosion during rainy seasons etc), and those of natural disasters (rain storms ripping off roofs, bush fires destroying crops etc) is enhanced as they funds with which to purchase alternative sources of food or pay for repair or replacement of property damaged by climatic problems.
