Starch production techniques help cassava processors protect their profits

RIU

Validated RNRRS Output.

Some 60% of the water used in producing starch from cassava can be recycled using a hydrocyclone (a device that separates particles in a liquid suspension). The savings from water extraction offset production costs, and the technology can prove especially useful in areas with growing water shortages. Low concentrations of acetic acid (2%) can also help cassava processors to protect their profits, preventing the growth of micro-organisms in stored starch and thereby helping to maintain its quality. This knowledge addresses two of the major constraints to the cassava starch industry in India, and can be applied in other cassava-producing countries.

Project Ref: **CPH39:**
Topic: **5. Rural Development Boosters: Improved Marketing, Processing & Storage**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Crop Post Harvest Programme**

Document Contents:

Description

CPH39

A. Description of the research output(s)

Research into Use
NR International
Park House
Bradbourne Lane
Aylesford
Kent
ME20 6SN
UK

Geographical regions included:

India,

Target Audiences for this content:

Processors,

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.

Small-scale starch extraction and storage to improve process efficiency

Working title:.Improving water use starch extraction and storage

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.

R6316, but preliminary work done as part of R5080 and R5082

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SAGOSERVE "Salem Starch and Sago Manufacturers' Service Industrial Co-operative Society Ltd.

Private Sector Starch and Sago Industries.

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 research work that generated the research outputs were generated between 1990 and 1996.

There are over 1000 small scale starch extraction factories in south India providing a significant market for poor cassava farmers. Two major sets of constraints to the industry, established through process audits were: (a) low efficiency of starch extraction; high water consumption during the processing; and, the adverse environmental problems created from the discharge of effluent from processing units; and (b) quality problems associated with wet starch storage. Approaches to overcome these constraints were developed and validated.

The use of hydrocyclones were investigated for their application within the process to reduce water consumption and minimise effluent generation. Trials showed that over 60% of the water used could be re-cycled, which led to a reduction of the total water consumption and the volume and loading of effluent by over 50%. Whilst there is no financial benefit to be obtained by operating the hydrocyclone, it is recognised that the cost of operation maybe offset by the savings made from extracting water.

The inability to dry all the starch (and sago prepared from the starch) extracted from cassava at the height of the season in India means that up to 40% of annual starch production is stored for 4-5 months. There is a loss of quality during storage that results in a 20% loss in income. Field trials have shown that low concentrations of acetic acid (2%) can be used to prevent the growth of microorganisms. The treatment of starch with 2% acetic acid during storage resulted in a product with viscosity 32% higher than the minimum value specified in the Indian standard for textile starch whereas conventionally stored starch had a viscosity value 14% below the minimum value. The technology was validated in full scale factory trials and reduced levels of starch quality loss were demonstrated.

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		

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 starch extraction and storage could apply to any tropical roots crop.

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.

Although there are many RNRRS outputs relevant to cassava, few concern cassava in Asia and so in many cases, it will be an issue of picking out key principles from these other projects and looking how they can be applied in an Indian situation. Diseases, markets, varieties etc will all be different. 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 two specific outputs. The hydrocyclone water-saving and reuse technology and the acidified wet starch storage technology.

Validation of the **hydrocyclone technology** and water recycling (termed "hydrocyclone technology in the remainder of this dossier)" was done by a NRI engineer and a NRI economist and was undertaken in India and Brazil (as part of a joint collaboration under EC DGXII Programme Cassava Processing in Latin America). Extended factory based field trials were completed during the period October 1994 to March 1995 in Salem District of Tamil Nadu, India, to evaluate the effect on water consumption, effluent generation and product quality by re-cycling water during the processing. Highly successful, long term confirmatory trials have been completed in India under commercial factory operating conditions for the production of *sago* and starch. Whilst it has been shown that there is no financial benefit to be obtained by operating the hydrocyclone, it is recognised that the cost of operation maybe offset by the savings made from extracting water and consideration of the broader socio-economic issues have established there is a case for the wider-scale promotion and adoption of the technology.

During the period November 1994 to March 1995, the technical and economic potential of acetic acid (2% v/v) as an acidulant for acidification of cassava starch prior to **wet storage** were assessed on a pilot-scale at a cassava *sago* factory in Salem District, Tamil Nadu, India by a microbiologist and an economist from NRI. The work built upon applied research carried out at the factory level to understand why storage of starch caused a reduction in quality. The results of the pilot-scale trial showed that acetic acid (2% v/v) prevents reductions in paste viscosity during wet storage which result in a 20-25% loss of income for the Indian cassava starch industry. A preliminary economic evaluation of acidified wet storage indicated that the technique would have positive economic benefits as long as the price of acetic acid could be kept below certain limits.

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)****.*

Preliminary fields trials of the hydrocyclone technology were completed during January 1994 in the Indian *sago* and starch industries, and during October 1994 in the Colombian sour starch industry. Extended trials were completed during the period October 1994 to March 1995 in India, to evaluate the effect on water consumption, effluent generation and product quality by re-cycling water during the processing.

During the period November 1994 to March 1995, the technical and economic potential of acetic acid (2% v/v) as an acidulant for acidification of cassava starch prior to wet storage were assessed on a pilot-scale at a cassava *sago* factory in Salem District, Tamil Nadu, India.

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 current (November 2006) situation is that:

The hydrocyclone technology was little used after its validation, but water shortages in ca. 2000 forced a number of factories to start adoption. It was estimated by SAGOSERVE's technical representative that can 20-25 factories now use the technology which represents ca. 5-10% of the industry. The equipment is currently locally fabricated with imported cyclones. SAGOSERVE currently pays 50% of the costs of the hydrocyclones. This supports is mandated role to support the industry.

We understand that the starch storage technology is currently not being used. Interest in the technology still however exists.

*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).***

To the best of our knowledge the hydrocyclone technology is being used by 20-25 commercial starch/sago producing factories in the Salem District of Tamil Nadu in India.

We understand that the starch storage technology is currently not being used in Salem.

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

For the hydrocyclone technology, the scale of use is currently 20-25 factories out of a total industry of ca. 400 hundred factories covered by SAGOSERVE producing ca.0.3 million tons of starch and sago. Although a couple of factories established the use of the hydrocyclone technology in 1996, their use did not really increase until there were water shortages in 2000. Use is currently still increasing and this being supported by the industry cooperative associated SAGOSERVE which is currently funding 50% of the costs of purchase.

The acidification-based starch storage technology has not yet been adopted although it was interesting that when speaking with the Convenor of the SAGOSERVE Technical Advisory Committee, the technology was known and it was considered that it would be useful as there was an increased emphasis on quality to meet challenge posed by international competition.

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).***

The starch and sago industry is concentrated in specific regions where drying conditions are good and labour costs are low. The largest area is Salam District of Tamil Nadu and in this district. The starch industry is supported by Sagoserve. The sago/starch manufacturers formed "Salem Starch and Sago Manufacturers' Service Industrial Co-operative Society Ltd." Salem in 1981 under the Tamil Nadu Co-operative Society Act 1961. It was Registered on 21 July 1981 and commenced business on 27 February 1982. The society functions under the administrative control of the Director of Industries and Commerce, Govt. of Tamil Nadu. It is said that due to successive efforts of the society, sago/starch units have now become the backbone of Salem District's Rural Economy.

SAGOSERVE has been instrumental in promoting the hydrocyclone technology.

The key to the success of SAGOSERVE is that it wants to see the sustained growth of the starch and sago sector. Although supported by local government, SAGOSERVE works closely with the industry to ensure its sustained growth.

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 hydocyclone technology was developed and tested because of its environmental benefits. Factory studies indicated that: effluent generation is reduced by the same quantity as the saving in water. The characteristics of the effluent produced, in terms of their polluting potential as measured by the Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and solids concentrations, are similar to that of the effluent produced during regular processing. Indicating the overall pollution load emanating from factories can be **reduced by over 50 %**.

The impact of starch and sago processing **without the hydrocyclone technology** was assessed as part of the DFID project 'Alleviation of Water Pollution from Agro-Industry, Project R6525), as:

- Groundwater quality - pollution of open wells and borewells due to seepage of untreated effluents are also likely to be significant in localised areas, 17 complaints against the starch/*sago* industries were received during the 1994/5 season.
- Air pollution and adverse social impacts - these are self evident from odours emitted from stagnating seepage ponds, which increase in intensity as the season progresses.

A groundwater sampling and analysis programme, looking at key physical and chemical water quality parameters (with particular reference to drinking water quality standards), highlighted that groundwater pollution of deep and shallow aquifers in the region can, in places, be attributed to the industry. Out of 40 samples taken from open wells and bore wells within the immediate vacinity of factories, seven were found to differ significantly from 'control' sites of which three exceeded US Public Health Department drinking water standards for BOD (5 mg/l) and two exceeded WHO drinking water standards for BOD (6 mg/l). This confirms the belief that in some cases discriminate discharge of effluents to land and ditches surrounding factory sites, which rapidly seeps away into groundwater, particularly in areas of porous surface geology and fissured or cracked sub-surface geology, has contaminated groundwater aquifer recharge areas.

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

The adoption of the hydrocyclone technology has a positive environmental benefit.

The adoption of the acidic storage method will result in the release of a weak organic acid to the environment. This can be easily neutralised and is totally biodegradable, but some precautions would be necessary.

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)***

The only impact relates to water shortages. Water shortages as a consequence of climate change and climate variability can be mitigated against by the more efficient use of water. The adoption of hydrocyclones by the starch industry in India and elsewhere contributes to this. The impact on poor people is however indirect since they benefit by improved access to market.
