Oiling the wheels of coconut processing

RIU

Validated RNRRS Output.

New knowledge is helping small, domestic coconut processors to improve their techniques. The innovations include a rotary grater, hot oil immersion drying, the use of a ram press, a technique for recovery of waste heat and use of carefully controlled moisture. While household-level processing of coconuts for milk and oil is an important women's activity in many countries, traditional extraction methods are arduous, time-consuming and inefficient. Tanzania, Côte d'Ivoire, Ghana, Indonesia, Sri Lanka and India participated in the field trials. The findings, which improve efficiency and output, are summarized in a series of processing manuals.

Project Ref: **CPH32:**
Topic: **5. Rural Development Boosters: Improved Marketing, Processing & Storage**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Crop Post Harvest Programme**

Document Contents:

Description

CPH32

A. Description of the research output(s)

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

Geographical regions included:

Cote d'Ivoire, Ghana, India, Indonesia, Sri Lanka, Tanzania,

Target Audiences for this content:

Crop farmers, Processors, Traders,

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.

Improving small-scale extraction of coconut oil

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

Crop Post-Harvest Programme
Common Fund for Commodities

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.

R6087
The project was led by Natural Resources Institute, University of Greenwich, United Kingdom (Contact: J Orchard. Tel. 44 1634 883741. email: j.e.orchard@gre.ac.uk)

Country collaborators were:

- **Tanzania** - National Coconut Development Programme, (now the Mikocheni Agricultural Research Institute), Dar es Salaam.
- **Côte d'Ivoire** - Marc Delorme Coconut Research Station (DPO/IDEFOR), Port Bouët.
- **Ghana** - Technology Consultancy Centre, University of Kumasi.
- **India** - Coconut Development Board, Kochi.
- **Sri Lanka** - Coconut Development Authority, Colombo.
- **Indonesia** - Institute for Research and Development of Agro-based Industry, Bogor.

Dissemination was provided by both the African Oil Palm Development Association (AFOPDA) and the **Asian and Pacific Coconut Community (APCC).**

*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.*

This CPHP project provided co-financing from 1994 - 1997 for a Common Fund for Commodities (CFC) project aimed at developing, field testing, and promoting improved techniques for extracting coconut oil at the small rural and domestic scale, for which traditional methods are arduous, time consuming and inefficient. Household-level processing of coconuts for milk and oil is an important women's activity in some countries.

Five **coconut** processes were investigated, often in collaboration with SMEs and NGOs, in **Tanzania**, **Côte**

d'Ivoire, Ghana, Indonesia, Sri Lanka and India. Pilot-scale processes were installed under normal field conditions and validated both by in-country collaborators, NRI staff and CFC-appointed independent monitoring personnel. The validations were carried out from financial, technical and socio-economic perspectives.

The research produced improved technical and economic knowledge of five coconut processing systems. The main findings were

- **aqueous processing** – introduction of a **rotary grater** provided an increase in **oil yield** in excess of 30% over that given by the traditional grater, with improved nutritional value over milk obtained from coarse gratings;
- **hot oil immersion drying** – a more efficient process producing a better quality of oil;
- **ram press** – a suitable extraction process only for small-scale throughput but produced a high quality oil with 70% extraction efficiency
- **waste heat recovery** technology – found to be a financially viable system for providing heat for processing;
- **intermediate moisture method** – showed that processing at a moisture content of 12% improved the quality and extraction of oil by traditional low pressure systems.

The findings were used to produce **country processing manuals** (produced by each country collaborator) for each method as applied in that collaborating country. Additional processing manuals were produced amalgamating all country processing approaches for each process.

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

Coconut. This project used five separate methodologies for processing coconut. Two could be applicable to other oilseeds (the intermediate moisture method of oil extraction using a bridge press; oil extraction using a ram press). The third technology (harnessing waste energy for drying purposes) is applicable to other crops where energy-rich shell or other biomass is associated. The drying technology itself is applicable to drying processes generally.

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.

The project to control coconut lethal yellowing (R8309) should be included in a cluster as this disease has the potential to damage the palm, reducing coconut yield, and even kill the palm completely. It is applicable to all coconut producer-countries.

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)**.*

In all cases the pilot-scale processes were validated under normal field conditions both by in-country collaborators, by NRI staff and by CFC-appointed independent monitoring personnel. The validations were carried out from financial, technical and socio-economic perspectives. Over 110 reports were published, most involving monitoring and evaluation of the separate technologies.

Aqueous Processing of Coconuts (applicable to rural farmers and householders)
Household-level processing of coconuts for milk and oil is an important women's activity in coastal Tanzania and Zanzibar, involving virtually all women in this area (estimated at one million) in daily grating of coconuts. Extraction efficiency of the technology was evaluated with collaborators in Tanzania, Côte d'Ivoire, Ghana, India, Brazil and Guyana assessing different parts of the process.

Hot oil immersion drying (HOID) – SME development
Hot oil immersion drying (HOID) is an indigenous method of producing coconut oil by drying the chopped meat (kernel) of the coconut in a pan of hot coconut oil producing "fry-dried" oil, known locally as *kilang oil*. Improvements to the process were researched by Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement (CIRAD) and validated under operational conditions in two factories - at Gorontalo, N. Sulawesi and Padan Pariaman, West Sumatra. Further validation was undertaken in Pontianak, West Kalimantan, with the Institute for Research and Development of Agro-based Industry. Technical data as well as financial data on costs and sales were recorded for a period of four months, when the factory was running at full capacity.

Waste Heat Recovery Technology - SME development
Charcoal produced from coconut shell is traditionally made using the pit or drum methods which produces large volumes of noxious smoke and variable quality charcoal often contaminated with extraneous matter. The traditional systems are inefficient and pollute the surrounding areas. A coconut shell carbonization with waste heat recovery unit was developed to virtually eliminate the evolution of noxious smoke evolved during the charcoal-making operation and simultaneously enable the heat generated during the process to be used in the production of copra.

The system was installed, commissioned and assessed for financial viability at a site in Palembang, Sumatera.

Ram press (rural or urban: applicable to individual operators, householders, farmers or groups)
Experimental programmes were undertaken by collaborators in Tanzania, Côte d'Ivoire, and Ghana to examine the performance of the ram press on copra, dried coconut gratings, and the residue from the traditional aqueous process. Financial and technical appraisals were undertaken with women's groups in Tanzania, Ghana and Côte d'Ivoire.

Intermediate moisture content (rural or urban: applicable to individuals and groups)
Experimental programmes were undertaken by collaborators with women's groups in Tanzania, Côte d'Ivoire, Ghana, and Sri Lanka to validate the basic concept that at a moisture content of 12%, between 60% and 70% of the available oil can be extracted from coconut kernel using an inexpensive manual low pressure system. Financial appraisals of the method produced a range of outcomes depending on the assumptions, but ventures were found to be viable under certain circumstances in all collaborating countries.

*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)**.*

All technologies were studied between 1994 and 1997. The production systems applicable to all the technologies were the same for each country: High Potential, Land-water interface and tropical moist forest. The farming system considered was smallholder rain-fed humid. The target groups were generally smallholder farmers of moderate poverty, particularly regarding the use of the three manual technologies being assessed: aqueous processing, ram press, and the intermediate moisture method.

Hot Oil Immersion Drying System (HOID)
Two factories were selected: at Gorontalo, N. Sulawesi and Padan Pariaman, West Sumatra, Indonesia.

Waste-Heat Recovery system (WHU)
The WHU system was installed, commissioned and monitored at a site in Palembang, Sumatra, Indonesia.

The Aqueous Process was assessed in several villages in the three countries taking part:

- Côte D'Ivoire: President Cooperative, situated within the Marc Delorme Research Station near Abidjan;
- Ghana: assessed at the village of Nsein about 60 km from the Ghana-Côte d'Ivoire border;
- Tanzania: The grater being used was portable and was loaned between householders;
- India: at Cochi, with Coconut Development Board.

Ram Press
Ghana: tested at the Technology Consultancy Centre, University of Science And Technology, Kumasi.

Côte d'Ivoire: This press was tested at the Marc Delorme Research Station near Abidjan

Tanzania: in Zanzibar with the Riziki Kwa Mungu Group at Mkadini village, the Kiduni Women's Group, Kwahani Youth group, Mzuri Village, Vuga Mkadini and Kajengwa, Tuaminiane Group.

Intermediate Moisture Content
Ghana: This bridge press was tested at the Women's Group in Duakyimase, c/o Methodist Mission, Komenda – Dominase, Central Region.

Côte d'Ivoire: The assessment was made at the Marc Delorme Research Station.

Tanzania: Trials were carried out at Kicheba Village and Machui Village.

Current Situation

C. Current situation

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

Manuals were produced for each separate technology as well as over 110 reports. The project concluded with an international workshop in 1997 which provided details of all project outputs. Dissemination was provided by both the African Oil Palm Development Association (AFOPDA) and the Asian and Pacific Coconut Community (APCC). Copies of all reports were copied to DFID through NRIL, to the CFC and to the APCC and AFOPDA. The final project workshop provided the opportunity for each country to consider which technologies were considered suitable for them.

The results of this dialogue resulted in several countries aiming to seek funds for project proposals. It is unknown to what extent these countries were successful in their searches. It is also unknown whether the APCC, CFC, DFID or AFOPDA received requests for any of the project documents produced by this project.

Reports and manuals on the technologies are available on the Asian and Pacific Coconut Community website.

Given the long passage of time since the end of this project, it is difficult to attribute current activities to this project. Technology adaptation is occurring all the time responding to new market opportunities, and changes in financial and trading regimes.

*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 is unknown since no monitoring of whether the outputs were taken up has been carried out according to the author's knowledge.

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

No monitoring of the extent or scale of the use of the outputs from this project has been carried out according to the author's knowledge.

*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 project, in aiming to validate processing technologies, developed a partnership of research and technology innovation institutes, large-, medium- and small-scale processing companies, NGOs, and rural and urban individual operators, householders, farmers or groups. Because of the global nature of the coconut processing sector, most of the technologies and processes were assessed in more than one country, often taking out of local needs and customs to vary the process accordingly. This approach resulted in between country variation in acceptance of the technology, often based on local practices, capabilities and opportunities.

An important feature in this approach was to co-ordinate outputs through the regional bodies: the Asian and Pacific Coconut Community and the African Oil Palm Development Organisation. Processing manuals, as well as individual country manuals outlining the technologies, were disseminated to coconut producer countries by both

the Asian and Pacific Coconut Community and the African Oil Palm Development Organisation.

Despite intentions by several interested countries to carry out projects after exposure to the outputs it is unclear whether these countries have managed to gain the funding required. This implies a gap in the research into technology-transfer process. The project outputs exist and are well-documented. The extent to which interested parties have been exposed to the outputs needs appropriate investment. A more intensive promotion of such outputs coupled with a monitoring system for evaluating interest would allow development agencies to assess the potential for further interventions.

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.

Waste-Heat Unit
Charcoal produced from coconut shell is traditionally made using the pit or drum methods produce large volumes of noxious smoke and variable quality charcoal often contaminated with extraneous matter such as earth, leaves and twigs. The traditional systems can be inefficient and in view of the nature of the operation pollute the surrounding areas. Consequently charcoal-making is banned in urban areas and near to village residences. This project provided a system of coconut shell carbonization with waste heat recovery whereby noxious smoke evolved during the charcoal- making operation was virtually eliminated. Simultaneously, the heat generated during the process - heat normally lost to the surroundings – was used to make copra.

Hot oil immersion drying
Copra itself is frequently made by drying coconut over open fires using husk as fuel. The system produces a large amount of smoke. The Hot oil immersion drying (HOID) is a method of producing coconut oil by drying the chopped meat (kernel) of the coconut in a pan of hot coconut oil. Such a system, if used instead of traditional copra manufacture, has the potential to reduce smoke pollution.

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

No adverse environmental impacts are associated with any of the technologies developed in this project.

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)***