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19102

5 August 1991

R E P O R T

ON THE 28th COCOTECH MEETING OF THE
ASIAN AND PACIFIC COCONUT COMMUNITY
ON SMALL SCALE PROCESSING OF COCONUT PRODUCTS,
SUVA, FIJI, JULY 22-26 1991.

prepared by

↗ Horst R. Koenig
UNIDO Consultant and Resource Speaker

Backstop off: Mr Leguina, 10/11/ AGRO

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Etherington of the Australian National
University dated 26 April 1991

1. General remarks.

The COCOTECH is a conference annually organized by the Asian and Pacific Coconut Community (APCC) for the purpose of the presentation by national and international experts of relevant information on all issues of coconut production, processing and marketing. The COCOTECH is normally attended by representatives of all fourteen APCC member countries and invited resource speakers (experts). The meeting is open for observers showing interest in the issues presented and discussed. Each COCOTECH meeting deals with one specific substantive issue. The issue of the meeting in Suva was small scale processing of coconut products.

A COCOTECH meeting report is prepared by the APCC-Secretariat for submission, discussion and approval for action by the APCC Annual Meeting of policy making bodies (Government officials) of all APCC member countries.

The consultant (H.Koenig) wishes to recommend that close contacts be held by UNIDO with the APCC-Secretariat in order to be currently informed about the official development policy of the fourteen APCC member states. Close contacts between UNIDO and the APCC will facilitate UNIDO project operations in the coconut industry development sector.

2. The COCOTECH meeting held in Suva, Fiji, from 22-26 July 1991.

The meeting was hosted by the Government of Fiji through the Ministry of Primary Industries and took place in the conference room of the Travelodge Hotel in Suva.

The meeting was attended by representatives of the fourteen APCC member countries which are the Federated States of Micronesia (FSM), Fiji, India, Indonesia, Malaysia, Papua and New Guinea, the Philippines, Solomon Islands, Sri Lanka, Thailand, Vanuatu, Vietnam, Western Samoa and Palau.

In addition representatives of the following countries and organizations attended the meeting as observers: Cook Islands, French Polynesia, Kiribati, New Caledonia, Nieu, Tonga, Tuvalu and Tansania (!) as well as the South Pacific Commission (SPC), IRHO/Paris, the Natural Resources Institute (NRI)/London, Appropriate Technology International (ATI)/- Washington, UNIDO and a number of observers from the coconut trade and industry. The complete List of Participants is shown in ANNEX 3.

The total of twenty resource speakers took the floor in order to present papers on issues of special interest for review and discussion. The representatives of all the fourteen APCC member countries made statements on small scale coconut processing activities in their respective countries. The meeting agenda is shown in ANNEX 2.

The UNIDO consultant (H. Koenig) presented his paper on the UNIDO Model Scheme for the Improvement of Rural, Small capacity Coconut Processing Operations.

Mr. Koenig outlined the basic philosophy and the UNIDO approach to small capacity coconut processing operations which led to the formulation and successful implementation of a UNIDO project on the setting-up of a rural, small capacity coconut processing model scheme in Padang-Pariaman, West Sumatra, Indonesia. The work carried out was described and the results obtained were highlighted. The entire processing operations were improved technically, economically, financially and otherwise. The improvements reflected in some thirty percent higher sales and caused a different approach to up-to date processing by the factory owners. Mr. Koenig reported on the very favourable conclusions drawn at the end of the project by the seven participating local processors and expressed hopes that the UNIDO model scheme may become the starting point for widely spread small scale coconut processing industry development in Asia and the Pacific. The paper presented by Mr. Koenig is attached as ANNEX 1.

3. Follow-up discussions.

The paper presented by Mr. Koenig was well received and was followed by lively discussions on the various issues of rural, small scale processing operations presented. Points of special interest were overall improvement of unit operations which was considered most important although no new technology was introduced. The introduction of new technologies is usually most difficult in traditional small scale processing activities. The main question was "How did UNIDO succeed in obtaining the cooperation of the local processors?" It was agreed that the cooperation of the local factory owners and their confidence in development work are essential elements of small scale industry development assistance to be provided by national authorities and/or international organizations.

From the general discussion the following points made by the participants from Indonesia, Papua and New Guinea, Western Samoa and the observer from the South Pacific Commission may be of special interest to UNIDO Headquarters.

Indonesia.

Indonesia highly appreciated the work done by UNIDO in Padang-Pariaman, West Sumatra. The representative of Indonesia (Mr. Maryono, Department of Trade, Government of Indonesia), however, expressed his concern about not having received so far any UNIDO reaction on the official Government request for UNIDO assistance submitted approximately one year ago. The Government of Indonesia formally had requested UNIDO assistance for the setting-up of a similar small scale, rural coconut processing programme in North Sulawesi. The required funds in local currency have since long been reserved for this purpose. UNIDO was asked to forward to the Government of Indonesia its detailed view on the requested assistance which is considered important for the small scale coconut processing sector of the country. UNIDO action, please! Substantive details - if required - may be obtained from Ms. T. Uhl, IO/T/AGRO, Ext. 3833.

Papua and New Guinea.

An official delegation of Papua and New Guinea visited the Unido project area in Padang-Pariaman where the coconut processing model scheme was implemented. Mr. Koenig was informed that the delegation was very favourably impressed about the project results and similar projects are expected to be implemented also in Papua and New Guinea. A formal request for UNIDO assistance may be forthcoming to this effect.

Western Samoa.

Also Western Samoa showed great interest in receiving UNIDO assistance in the small capacity coconut processing development sector. The relevant formalities and proceedings with regard to obtaining UNIDO assistance were explained to the Western Samoan delegation and the various financing possibilities were outlined which UNIDO might consider. A request for UNIDO assistance in the small scale coconut processing sector might be forthcoming from the Government of Western Samoa.

South Pacific Commission.

The chairman of the South Pacific Commission showed great interest in the UNIDO model scheme. He, however, had so far not been informed about UNIDO project operations in this field and would like to know more about UNIDO activities which he considered of special interest to the South Pacific countries of which only some are members of the Asian and Pacific Coconut Community. UNIDO action, please! Relevant information material on UNIDO activities may be forwarded to Dr. S. Malcolm Hazelman. Please see List of Participants, Observers 13, page 19.

4. Requests for UNIDO publications.

UNIDO action, please! One copy each of the UNIDG publication No. IO.47(SPEC) be forwarded to the following COCO-TECH meeting participants:

- Mr. Luke Raturvuki (List of Part. Fiji 2, page 1)
- Mr. Ahmed Zubeir Haji Noordin (List of Part. Malaysia 1, page 7)
- Mr. Eruel Passingan (List of Part. P+G 1, page 8)
- Mr. Fred Fono (List of Part. Solomon Islands 1, page 9)
- Mr. Cao Qui Phuoc (List of Part. Vietnam 1, page 11)
- Mr. Opetaiia Liu (List of Part. Western Samoa 1, page 12)
- Mr. S. M. Hazelman (List of Part. Observers 13, page 19)

One copy of the UNIDO publication No UNIDO/IO 528 be forwarded to the following persons:

- Mr. Opetaiia Liu (List of Part. Western Samoa 1, page 12)
- Ms. Janak Juneja (List of Part. India 1, page 7)
- Mr. Cao Qui Phuoc (List of Part. Vietnam 1, page 11)
- Ms.N. Ediriweera (List of Part. Res. Speaker 7, page 13)
- Mr. Dan M. Etherington (List of Part. Res. Speaker 10, page 14)
- Mr. George Y. Uy (401, Sunrise Condominium, Green Hills, San Juan, Metro Manila, The Philippines.

5. Other business.

A. Joint UNIDO/ATI (Appropriate Technology International) coconut industry development projects in Kenya.

During his stay in Suva on the occasion of the 28th COCOTECH meeting the consultant (H. Koenig) had detailed discussions with Mr. Glenn Patterson, Director, Technical Resources Group, ATI, Washington/USA. Reference is made in this context to Mr. Patterson's letter to UNIDO dated 16 May 1991 seeking UNIDO's cooperation in connexion with a coconut industry development project in Kenya. A copy

of this letter is attached to this report as ANNEX 4 for easy reference.

The information provided by ATI in this context is valuable but not specific enough to become the basis for the setting-up in Kenya of a wet coconut processing pilot/-demonstration plant. Agreement was reached between Mr. Patterson and Mr. Koenig on the need for further technical and economic study work the results of which may or may not justify the overall feasibility of wet coconut processing operations in Africa (Kenya). The agreement was reached based on the following facts known to and accepted by Mr. Patterson.

a. It is an established fact that large and medium scale wet coconut processing operations are not economically feasible. For this reason no wet coconut processing plants have so far become commercially operational world wide.

b. Small capacity wet coconut processing operations may become economically feasible if established in coconut growing areas thereby reducing the transport costs of the whole nut raw material. This assumption has, however, to be verified.

c. For this purpose the technical design of the smallest possible wet coconut processing plant has to be prepared along with investment and production cost estimates. Based thereon a detailed economic feasibility study will have to be made in Kenya and/or other countries/areas.

d. A small capacity wet coconut processing plant may only be established by UNIDO/ATI for demonstration purposes if no doubts are left on its economic feasibility and viability.

The first step in joint UNIDO/ATI project operations in Kenya with regard to wet coconut processing has to be the work as mentioned under c) above.

UNIDO action, please! The above mentioned views may be submitted by UNIDO to ATI in reply to Mr. Patterson's letter dated 16 May 1991 with reference to the above mentioned discussions and agreement reached in Suva between Mr. Patterson and Mr. Koenig.

B. Cooperation between UNIDO and the Australian National University in the coconut development sector.

During his stay in Suva on the occasion of the 28th COCOTECH meeting the consultant (H. Koenig) further had the opportunity to discuss possible very interesting project activities to be undertaken by UNIDO in close cooperation with the Australian National University in Canberra. The discussions were held with Dr. Dan Etherington and Dr. David Hagen. In this context Dr. Etherington's letter dated 26 April 1991 refers. A copy of this letter is attached to this report as ANNEX 5. The cogeneration energy system for medium and small scale coconut plants outlined therein is of special interest for coconut processing activities as well as other industrial uses. The consultant (H. Koenig) therefore wishes to strongly recommend that the project idea be taken up by UNIDO and a project be designed for implementation by UNIDO in cooperation with the Australian National University (Dr. Etherington and Dr. Hagen). The project in principle would be the setting-up and demonstration of a prototype cogeneration energy system for the production of steam for electricity generation primarily using coir dust and coir fibre as fuel. In this context attention is drawn to the fact that coconut fibre material is abundantly available in most of the coconut producing countries and remains unused to a very large extent. Coconut dust is increasingly causing a serious environment problem. It is a waste product from the coir industry for which only very limited outlets exist and which is rotting away in many country areas thereby becoming the breeding spot for

insects and other pests. The proposed cogeneration energy system would therefore serve two purposes namely the very economic production of energy from waste material (Coconut fibre) sources and the useful disposal of a waste product causing serious damage to the environment and human health.

Mr. Koenig was informed that the Government of Australia may soon (August/September 1991) decide to rejoin UNIDO membership. All preparations to this effect have been made and a final favourable Parliament decision is expected to this effect. Depending on this decision two possible ways of financing may be open for UNIDO project operations in this case.

a. If Australia becomes a UNIDO member state again the respective Project Document prepared by UNIDO may be forwarded to the Government of Australia for financing considerations. Good chances may exist for approval. In this case the project may best be designed for implementation by UNIDO in close cooperation with the Australian National University.

b. In case the Australian Government should finally decide to stay out of UNIDO the project may best be globally based and the Project Document may be presented to other donor Governments (Germany?) for financing considerations. In this case the Australian National University would have to participate in international bidding in order to become the UNIDO contractor engaged in the implementation work.

UNIDO action, please! A Project Document be prepared by the relevant UNIDO office (global) covering the establishment and demonstration of the cogeneration energy system using coir dust and/or coir fibre as fuel. Dr. Etherington and Dr. Hagen will be glad to answer any questions which may arise during the PRODOC formulation work.

6. Final remarks.

By presentation of this report the consultant (H.Koenig) considers his assignment (S.S.A. No. CLT 91/106) completed. He shall, however, be glad to be available for discussions on the reported issues if required.

ANNEX 1

A MODEL SCHEME FOR THE IMPROVEMENT OF RURAL
SMALL CAPACITY COCONUT PROCESSING OPERATIONS *)

prepared by

Horst R. Koenig
UNIDO Consultant

*) A paper to be presented by the author for discussions
at the XXVIII COCOTECH MEETING of the Asian and Pacific
Coconut Community

1. The approach to small scale industry development.

A lot is being written, read and otherwise lectured about rural small and village scale industries and their development. A number of national and international organizations and institutes as well as individual experts - one way or the other - are stressing the need for small scale industry development. The views presented are manifold depending on the background, interests and policies of the sponsors and promoters. There may be dominating political interests, social considerations, technology development issues combined with equipment production and sales as well as business development speculations and other motivations, among them admittedly also honest engagements and good will to jointly sail a common ship.

But questions certainly arise, such as: What has so far been achieved? Has there been real development at all? What are the results of the development work carried out so far? How do we have to proceed from now on and what partnerships have to be created as an essential element of small scale industry development?

Real small scale industry development - and this is my well considered view based on experience - cannot be brought about without the very close cooperation of the small scale processors themselves. There is a great difference between well meant theories and the realities of the life of those people who live in remote rural areas. These people have considerable knowledge and experience which has been transferred through generations from grandfather to father and to son and this knowledge still is the heart of the small scale business in which the whole family is presently engaged. The problem only is that time has passed them by.

The business conditions very familiar to them over

generations have changed to their disadvantage and those actually very skilled people have not yet realized the different world in which they are now living or simply refuse to accept changes hoping it may turn out to be just a crisis which will be over soon like many of them in the past. And now, Ladies and Gentlemen, we are already discussing the particular situation faced by small scale coconut processing enterprises in Asia.

2. Small and village scale coconut processing operations.

Coconut oil production in Asia traditionally was and in principle still is a small scale operation and so necessarily are related activities such as the production of toddy or certain coconut based food items. Also the production of copra basically is a small scale operation and the many different copra dryers have been designed as such and are still being operated this way. The "Tree of Life" namely the coconut tree always was of great importance if not essential for the life of numerous village communities in Asia and during history considerable knowledge was developed by the Asian population in this field. I would like to pay respect to those people who actually have created very efficient coconut processing technologies over centuries in the past. We in our time have profited from it and so has the modern large scale industry.

But has the modern large scale industry not outdated and superceeded the small scale sector in our world today? It in fact has not outdated it but it has made it dependent on it to a considerable extent. Numerous small scale copra drying operations, for example, are supplying the raw material copra to the large scale industry which is using economically efficient solvent extraction technologies and automatic expeller presses for the production of coconut oil for international marketing. Copra has become a commodity depen-

ding on price fluctuations reflecting market demands and supplies. The result was a still comparatively low living standard for copra driers at the best and unemployment combined with serious starvation periods at the worst.

But one should be fair. The large scale industry to quite some extent also supported the predominantly small scale coconut production sector (small holders) which got the opportunity to supply it with fresh coconuts for example for the production of desiccated coconut for which actually the large scale industry developed an export market.

In the national and international coconut markets there is certainly room for both the small scale and the large scale industry but the private small scale sector always was and will remain the backbone of life for millions of people if - and this is of vital importance - the small scale sector is willing and able to adjust itself to changing market demands and consumer priorities which have to be brought in line with production economies. Governments, international organizations, experts, sponsors and promoters alone cannot develop the small scale coconut processing sector. All what they can do is to offer their services in a partnership with the small scale processors themselves and to try to convince their partners about the need for improvements and to actively assist them in appropriate action to be taken the earlier the better.

3. The model scheme.

Realizing the situation as mentioned above a rural small capacity coconut processing model scheme was outlined, formulated and implemented by UNIDO in cooperation with the Asian and Pacific Coconut Community secretariat and the relevant authorities of the Government of the Republic of Indonesia. The implementation work was carried out in Padang-Pariaman, West Sumatra, Indonesia. The scheme certain-

ly was action oriented small scale industry development work and I am glad to state that the model character was confirmed at the end of the project which now stands for repetition and expansion.

During a preparatory phase which in fact was the most difficult part of the project a number of small capacity enterprises were visited and discussions were held with the owners and their families and staff. The UNIDO personnel was only very reluctantly received and the dialogs were slow and problematic. The discussions were held with great reservations on the part of the factory owners. "We know our business, we have done it over many years, what do you, UNIDO, know about our problems?" The discussions continued until one of the factory owners finally agreed to cooperate under the condition that no losses what-so-ever will occur to him and his business. After the cooperation agreement was concluded with one producer others followed and the model scheme was started in cooperation with seven small scale enterprises, all of them producing coconut oil (Klentik oil) from fresh coconuts.

The work carried out over two years covered all aspects of small scale coconut processing operations. There was the improvement of equipment and technology, product quality control, repairs and maintenance, book keeping and finance, marketing and training in all sectors inclusive study tours and seminars. The details of the project operations have been laid down in the UNIDO document IO.47(SPEC) entitled "A MODEL SCHEME FOR THE IMPROVEMENT OF RURAL SMALL CAPACITY COCONUT PROCESSING OPERATIONS". This document is available to you here in this conference and can be obtained from UNIDO Headquarters in Vienna free of charge.

4. The principle criteria of the model scheme.

a. No new technology was introduced. The existing technology practiced over a long time by the factory owners was improved through modifications and simple mechanisation of the equipment already in use. The results of the improvements were clearly visible and measurable and were therefore accepted by the local partners.

b. The optimum product (Klentik oil) quality was defined and so was the lowest acceptable product quality. The quality of the oil produced and ready for sales had to be within these limits with the aim to always reach the optimum.

c. One small quality control laboratory was established and equipped with the essential glass ware and chemicals. Selected personnel was trained in the use of simple but effective quality control methods. The laboratory was made available to all the seven cooperating producers for joint financing and operation.

d. The technological parameters were outlined and their influence on the product quality was explained to the factory operators and written down in manuals which were handed over to the factory owners.

e. The importance of good housekeeping was stressed and relevant methods introduced. A medal was awarded to the best housekeeper and the problems of hygiene and health were made the points for discussions in seminars and individually.

f. A small mechanical workshop was established and equipped with appropriate tools for repair and maintenance purposes and technicians were trained to operate it. The workshop services were made available to all the seven participants who certainly used it to their benefit. Also the mechanical workshop operations were meant for joint financing by the users.

g. Study tours were arranged in order to give the participants an opportunity to see similar operations in other countries and areas. The study tours were followed by critical evaluations of all important aspects and relevant discussions.

5. The conclusions.

The participants of the model scheme happily and proudly acknowledged some thirty percent higher sales of coconut oil and a steadily rising demand due to better oil quality. The production costs were reduced and the income increased without product price increases. The seven participating small scale coconut processors themselves concluded at the end of the project operations that they really had profited from it and were lead to different thinking resulting in different more efficient approaches to production, processing and marketing.

6. The follow-up.

A small capacity coconut processing model scheme was formulated and successfully implementd along the lines as mentioned above. It was a model scheme meant to be the starting point and the framework for similar operations to follow in as many as possible areas in as many as possible coconut producing countries. The principle framework criteria of the model scheme will remain valid although some of the details will have to be adjusted to the prevailing conditions of the implementation area.

UNIDO shall be very pleased to further assist the Asian and Pacific Coconut Community in the implementation of similar small scale industry development programmes. I shall be very glad to be available for discussions in this context.

ANNEX 2

The Agenda
of the 28th COCOTECH meeting
of the Asian and Pacific Coconut Community



Asian and Pacific Coconut Community

Jakarta - Indonesia

XXVIII COCOTECH MEETING

22-26 July, 1991

Theme : "Small Scale Processing of Coconut Products"

Schedule of Activities

July 22, 1991

8:30 - 9:30 hrs - Opening Session

9:30 - 9.45 hrs - Coffee Break

Introductory Session

9:45 - 10:30 hrs - The Economics of Modern Small Scale Coconut Processing - Dr. Dan Eltherington, Australia National University.

10:30 - 11:15 hrs - Potential for Application of Small Scale Processing Techniques for Coconuts - Mr. Roland Fox, Head of Soils and Plant Chemistry Department, Natural Resources Institute (NRI).

11.15 - 12:00 hrs - New Approaches for Developing Small and Medium Scale Coconut Processing Enterprises: Experience in the Philippines and the South Pacific - Mr. Glenn Patterson, Director, Technical Resources Group, AT International, U.S.A.

12:00 - 12.45 hrs - Open forum and remarks by the session chairman.

12:45 - 14.00 hrs - L u n c h

Session on Country Status

14:00 - 17:30 hrs - Country Statements

17:30 - 18:15 hrs - Open forum and remarks by the session chairman.

July 23, 1991

Session on Technologies

Food Sector - Part I

8:15 - 9:00 hrs - Coconut-based Technologies for the Edible Sector - Dr. (Mrs) P.C. Sanchez, Institute of Food Science and Technology, UPLB, Philippines.



Asian and Pacific Coconut Community

Jakarta - Indonesia

July 23, 1991

Cont'd. Food Sector - Part I

- 9:00 - 9:45 hrs - Small Scale Coconut Food Processing - Dr. (Mrs) N. Ediriweera, Ceylon Institute of Science and Industrial Research, Sri Lanka.
- 9:45 - 10:00 hrs - Coffee Break
- 10:00 - 10:45 hrs - Manufacture of Coconut Sugar as a Cottage Industry - Ms. Atih Suryati, Head, Food Science Division, Institute of Research and Development in Agro-Based Industries (IRDABI), Indonesia.
- 10:45 - 11:30 hrs - Open forum and remarks by the session chairman.

Food Sector - Part II

- 11:30 - 12:15 hrs - Small Scale Processing of Copra and Coconut Oil in Sri Lanka - Mr. Henry A. Tillekeratne, Director, Processing Development, Coconut Development Authority, Sri Lanka.
- 12:30 - 14:00 hrs - L u n c h
- 14:00 - 14:45 hrs - Copra-Making and Village Level Cooking Oil Production System - Dr. E.P. Lozada, Professor, College of Engineering and Agro-Industrial Technology, University of the Philippines at Los Baños, Philippines.
- 14:45 - 15:30 hrs - Wet Coconut Processing - "Mini Cream" - Mr. Brian Fitzpatrick, Manager, South West Pacific Region, ALFA LAVAL Engineering Pty Limited, Australia.
- 15:30 - 16:15 hrs - Open forum and remarks by the session chairman.
- 16:15 - 16:30 hrs - Coffee Break

Non-Food Sector

- 16:30 - 17:15 hrs - Processing and Utilization of Coir Fibre - Mr. Mat Duham Mohd Daud, Director, Agricultural Engineer Division, Malaysian Agricultural Research and Development Institute (MARDI), Malaysia.
- 17:15 - 18:00 hrs - Manufacture of Charcoal - Metal Kijil - Mrs. Piyanoot Naka, Post-harvest and Processing Technologist, Chumphon Horticultural Research Centre, Thailand.
- 18:00 - 18:15 hrs - Activated Carbon Technology - Mr. Stuart Robertson, Managing Director, Coal and Carbon Industries Ltd., Australia.



Asian and Pacific Coconut Community

Jakarta - Indonesia

July 24, 1991

Cont'd. Non-Food Sector

- 8:00 - 8:15 hrs - Portable Sawmill - Our Guide to an Economic & Practical Approach to Forest Utilization - Mr. L.S.T. Griffith, Stan Griffith Engineering Ltd., New Zealand.
- 8:45 - 9:30 hrs - Open forum and remarks by the session chairman.
- 9:30 - 9:45 hrs - Coffee Break

Session on Country and Allied Experiences

- 9:45 - 10:30 hrs - Energy Systems for Small Scale Coconut Processing - Dr. David Hagen, Australia.
- 10:30 - 11:15 hrs - Establishing a National Energy Policy with the Use of Coco-Methyl Ester as Alternative Fuel - Ms. Marilon Jael, United Coconut Association of the Philippines.
- 11:15 - 12:00 hrs - Model Scheme for the Improvement of Rural Small - Capacity Coconut Processing Operations - Mr. Horst Koenig, Former UNIDO staff member, Austria.
- 12:00 - 13:30 hrs - Lunch
- 13:30 - 14:15 hrs - Small Scale Coconut Processing - Indian Experience - Mr. P.K. Thampan, Formerly of Coconut Development Board, India.
- 14:15 - 15:00 hrs - Development of Small Scale Coconut Processing - Federated States of Micronesia Experience - Mr. Catalino Sam, General Manager, Ponape Coconut Products.
- 15:00 - 15:45 hrs - Setting up a 10,000 Metric Ton Capacity Copra Oil Plant - Solomon Island Experience - Mr. D. Friend, Managing Director, Lever Solomon Limited.
- 15:45 - 16:00 hrs - Coffee Break
- 16:00 - 16:45 hrs - Open forum and remarks by the session chairman.

Session on Organizational Structure, Constraints and Reforms

- 16:45 - 17:30 hrs - Organizational Structure for Small Scale Coconut Processing - Mr. U.V.H. Perera, Director, Economic Research, Coconut Development Authority, Sri Lanka.
- 17:30 - 18:15 hrs - Small & Medium Scale Enterprise Development : Constraints and Reforms - Mr. Bonifacio B. Pangahas, Assistant Director, APCC.
- 18:15 - 19:00 hrs - Open forum and remarks by the session chairman.



Asian and Pacific Coconut Community

Jakarta - Indonesia

July 25, 1991

Field Trip

July 26, 1991

9:00 - 10:30 hrs - Other Matters

1. R & D in Coconut Programme
2. Statements by Observers
3. Any other matters.

10:30 - 14:30 hrs - Free Time

14:30 - 15:30 hrs - Adoption of Report

15.30 - 16:00 hrs - Closing Remarks

- Adjournment

ANNEX 3

List of the Participants
of the 28th COCOTECH meeting
of the Asian and Pacific Coconut Community

LIST OF PARTICIPANTS

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ACTION
22 MAY 1991

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INTERNATIONAL

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President

ACTION COMPLETED

- KNOWNLED
- NO ACTION REQUIRED

23 MAY 1991

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16 May 1991

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ENCLOSURE ATTACHED

Dear Mr. Koenig:

Please find attached an updated concept paper describing a small to medium coconut processing enterprise development project ATI would like to assist UNIDO with. Ms. Jamie Raile, who is no longer with ATI, has, before leaving, included additional information to make the concept more complete. I would appreciate you reviewing and sharing this with appropriate UNIDO staff.

On May 21, Dr. Jeanne Downing will be in Vienna on her way back from Africa. She will be meeting with Ms. Guigou in the Agro-based Industries Branch about the Zaire palm oil project, and with other UNIDO staff in the Unit for the Integration of Women into Industrial Development. She could discuss the coconut processing concept with you and UNIDO and determine UNIDO's interest in funding the project that would be planned and implemented by ATI. Plans for ATI to submit a formal proposal could be made at that meeting.

Information on several new and improved promising small to medium coconut processing technologies and products will be available to this project from continued collaborative work with leading Philippine coconut processing experts and organizations. In addition, ATI will make a presentation and otherwise participate in the Asian and Pacific Coconut Community's upcoming COCOTECH meeting in Fiji, July 22-26, 1991 which will focus on small scale coconut processing. These activities plus ATI's past experience in coconut processing will broaden opportunities for producing local and possibly exportable market-acceptable products from Kenya's coconuts.

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Mr. Horst Koenig
16 May 1991
Page Two

Jeanne Downing will call you when she arrives in Vienna. Thank you for your assistance and continued support for ATI to assist UNIDO in improving utilization of Kenya's coconut resources for enterprise development and job creation. Please contact me if additional information is necessary or other assistance is needed before your discussions.

Sincerely,

A handwritten signature in cursive script that reads "Glenn W. Patterson" followed by a stylized flourish or initials.

Glenn W. Patterson, Ph.D.
Director Technical Resources Group

Enclosure

COUNTRY CONTEXT:

Kenya's GNP per capita declined (in real terms) between 1980-87 and currently stands at \$340.00 per World Bank estimates. Unemployment is a serious problem with up to 40% of the work force out of work. Although the government has made some progress in controlling the rate of population growth (from 4.2% in 1979 to 3.6% currently) the present population of 22-23 million is expected to reach 37 million by the year 2000.

Tourism has overtaken both tea and coffee as the single largest foreign exchange earner for the country. However, agriculture provides the livelihood for approximately 80% of the population.

Kenya has a foreign exchange deficit (almost \$500 million in 1987) and a shortage of foreign currency. Yet they import annually close to \$50 million of vegetable oils and fats for domestic consumption. The demand for edible oils is estimated at 150,000 metric tons annually. 80% of that is being imported, mostly as refined and unrefined palm oil from Southeast Asia. The Government of Kenya has several major initiatives ongoing (Ministry of Agriculture/World Bank and Egerton University/IDRC) to increase oilseed production and processing in Kenya.

Sunflower, simsim, rapeseed, and coconut are grown in Kenya for producing vegetable oil; oil is also obtained from maize and cotton as a byproduct of other processing. However, the availability of low cost imported palm oil and low producer prices paid to farmers for oilseed crops has resulted in little incentive for farmers to increase their production of oilseed crops to date. On the other hand, it is becoming clear even to industry officials that in the long run promotion of local oilseed production is desirable both to reduce foreign exchange costs and to supply increased internal markets because of an increasing population.

PROJECT CONTEXT

UNIDO has had a long term involvement in providing assistance to the development of the coconut industry in Asia, Africa, and Latin America. It has worked closely with the Asian and Pacific Coconut Community as well as national governments in implementing coconut processing operations.

ATI has extensive experience in small-scale processing of vegetable oils in Africa (especially with sunflower and palm oils) as well as in coconut processing in the Philippines and South Pacific. In the context of this project ATI will collaborate with UNIDO to build upon previous experiences in these two areas and develop a replicable model for small-scale coconut processing in Africa.

Coconuts are a major crop in the coastal areas of Kenya; at least 35,000 hectares of coconut are under cultivation. In 1987,

Egerton's VOPS's (Vegetable Oil/Protein System Program) study estimated 42,000 hectares were planted with a yield of 1600 kg/ha. Although it is considered an important crop on the coast, little research or attention is paid to this crop. Unlike Tanzania, there is no organized plant improvement research or replanting scheme in place. (As explained at the Coast Agricultural Research Station, it is difficult to find a researcher interested in this sector because the research would take 20 or 30 years to come to fruition.)

The only commercial type of coconut tree planted is the Kenya Tall or East African Tall (a dwarf hybrid "Pemba" is planted mostly for decorative purposes and the yield is low). Portions of the coastal districts, where nearly all of Kenya's coconuts are grown, receive an annual rainfall of 1000 - 1250 mm, offering good yield potential. Well managed coconut trees in Kenya should yield 40-60 nuts a year. However, it is estimated that the average yield is 30 nuts per tree (due to lack of fertilization, weed control and maintenance). It is common practice in Kenya to intercrop coconut trees with annual crops and other trees (cashew, citrus, bixa).

It is probably not overstating the fact to say that most rural families along the coast grow at least a few coconut trees. Estimates range from a smallholder having approximately 4 acres of land with coconut grown on one to two acres to a smallholder having up to 2.5 acres devoted to coconut. Coconuts are a source of both cash and subsistence without a great deal of time spent on their cultivation and care. Both the amount of land devoted to coconut and yields of current plantations could be increased were there economic incentives for farmers' to do so. VOPS's study indicates that extension efforts are needed to disseminate successful agronomic practices as well as to improve the post-harvest treatment of coconuts.

In Kenya, coconuts are grown for both direct consumption and for sale. The coconut tree has many uses at the homestead level. A roofing material ("makuti") is made from the leaves; coconut milk ("tui la nazi") is made from grating and squeezing the meat and then used for cooking; and coconut water from immature coconuts is consumed for a drink ("madafu"). Palm wine (mnazi) is also consumed. Coconut trunks are used for building (houses, boats) as well as firewood.

Members of a women's group visited in the Chilulu area estimate that they use on average three coconuts a day to cook with. Most of this is in the form of coconut milk which they prepare and use in cooking. In addition, it is possible to make coconut oil for a hair and body lotion although it appears this is a lot of work and not done widely. The women estimated that it takes three coconuts to obtain one (7-up size) bottle of oil.

As a cash crop, farmers usually process the coconut meat to produce

and sell copra for industrial use (occasionally the whole coconut is sold). The women mentioned above were adamant that it was taking 8 coconuts to obtain 1 kg of copra; all other Kenya information sources said the average is 5 coconuts for 1 kg of copra. It takes approximately four days for the coconut meat to dry in the sun. The price a farmer receives for copra ranges from 3 Ksh to 5/50 Ksh/kg. At an average price of 5 shillings, a farmer is receiving 1 shilling (Ksh 22/ = \$1.00) per coconut.

It is common practice to wait for mature coconuts to fall to the ground for harvesting; when climbing trees to cut the coconuts, a laborer receives 2 Ksh per tree (regardless of whether there are 1 or 20 coconuts). Immature coconuts are harvested for a coconut drink which sells for 3 Ksh/coconut in Mombasa and 5-6 shillings in Nairobi.

Although copra drying at the homestead level was not seen, copra stocks inspected at several plants were badly infected with coconut borers and showed some previous spoilage (mold discolorations); some copra was also damaged by rats. To date, there appears to be no economic incentives to improve the quality of copra drying.

The VOPS study estimates that in 1987 67,200 metric tons of nuts were harvested (FAO estimates for 1987 are slightly higher at 72,000 metric tons) with the resulting breakdown:

- 14,000 MT were used for home consumption
- 7,000 MT were marketed as green nuts
- 46,200 MT were used for industrial purposes resulting in 8500 MT of copra yielding 5400 MT of coconut oil. 3000 MT of copra cake were obtained; 2000 MT were used in Kenya as animal feed with the remaining exported to the Netherlands.

Kilifi District produces the most copra on a commercial basis. Kwale District markets more green nuts (especially to Nairobi) and the copra produced is not believed to be as high of quality as in Kilifi. Mombasa supplies coconuts for the tourist industry.

Of the coconut oil being produced, up to 95% is for non-edible purposes. This includes industrial uses such as soap stock, hair tonics, and skin softeners. The tonics and softeners are often semi-refined products. Ufuta Ltd. is the only company producing coconut oil for human consumption. Other processors sell to refiners who neutralize, bleach and deodorize before retailing. Consumer access to coconut oil has been limited by the relatively high prices of coconut oil and the difficulty in extracting oil at the household level.

The price of cooking oils and fats in Kenya is controlled. As of May 1990, a local grocery store in Nairobi was selling 500 ml oil for Ksh 17; desiccated coconut was being sold for Ksh 13.50 for 200 grams.

Other coconut products and byproducts are not widely marketed on a commercial basis. These include:

Vinegar--Though several companies have built vinegar processing plants, none are in production on an industrial scale. Vinegar from pineapple juice, cashew apples, and molasses have been tried without success. Industry is using imported acetic acid (aqueous) and diluting it to 4.8% percent strength (Kenya Bureau of Standards requires a minimum of 4.5%). The product is sold to consumers as a "vinegar substitute" with a brown or clear color or used in the industrial preparation of other food commodities. The consumer price of the vinegar substitute is Ksh 12 for 700 ml.

Industry imports 95% acetic acid at about 26-27 Ksh/kg including a 30% duty. Vinegar and its substitutes can be imported for approximately 100 Ksh/kg including a 35% duty. In 1988, about 1,625 metric tons of acetic acid and its salts were imported. Two of the largest users of acetic acid are believed to be Trufoods and Premier Foods, each using about 150 metric tons of pure acetic acid per year. Although the cost of the vinegar makes up less than 3% of the retail cost of the products it goes in, neither company feel it is in their best interest to switch to a locally available, higher quality, more expensive product. Trufoods believes that products need to cater to a market with low incomes--food products need to be low cost--and there is only a limited market for high income foods. Although consumer preferences may change as a result of marketing efforts, it can be a long process.

Charcoal--All of Kenya's activated carbon is imported from Asia, Europe and the U.S. There is no known activated charcoal production in Kenya. Imports are between 800 and 900 metric tons per year in a variety of grades (particle size and quality) and have been increasing in volume by 3-4% p.a. The value of the imports is about 11-15 Ksh/kg and includes a 30% duty. Activated carbon is used in Kenya's edible oil processing industry (bleaching agent), in the petroleum industry (filtration agent), and in water purification (purification agent).

Coconut Flour--It appears that there is limited use of composite flours in Kenya. One company, House of Manji, uses some coconut flour in a limited number of confectionery biscuits. UNGA group has done some taste/process testing on composite flours, but not with any coconut mixtures. UNGA would be interested in coconut flour if it was competitive in price with wheat flour.

An industry representative stated that the importation of wheat flour (at the world market price) is being reduced from

500,000 tons per year to half of that. The local supply of wheat flour will not be sufficient to substitute for the imports. Wheat flour prices are controlled at Ksh 17 for a 2 kg sack, but shortages have created a parallel market at Ksh 25-30 kg for a 2 kg sack. It is believed that several large bakeries had failed or were in trouble due to increasingly narrow profit margins.

Coconut Cream--No one is presently making coconut cream or milk for industrial or retail consumption. Tourist hotels tend to make their own from fresh milk for use in specialty drinks and dishes. There has been a graduate thesis prepared by a student at the University of Nairobi on the technical viability of commercially producing coconut milk in Kenya. (In Tanzania, a plant for producing coconut cream should become operational in mid-1991; it is being assisted by UNIDO.)

Coconut Meal--There appears to be little commercial market for meal. Msamwini Oil Mills sells this by-product directly to farmers for Ksh 100 per 60 kg; farmers are required to collect the meal themselves. Ufuta Ltd. sells coconut cake for Ksh 3 per kg to UNGA (parent company); sesame cake is sold for Ksh 4 per kg.

Coir--Coir is produced in Kenya for the local market as a filler for mattresses and cushions; however, due to lower cost foam products available for the same purpose, the use of coir has been limited to higher quality/cost furniture. Rising oil prices would change the economics of the foam/coir economic trade-off, however.

Shell--It is reported that in Tanzania a company makes flour from the coconut shell which is then used in the manufacture of mosquito coils. No such use of the shell is known in Kenya.

The commercial and technical viability of small-scale coconut oil and by-product processing in Kenya will depend on several factors including consumer tastes and preferences, competing substitutes, and packaging/materials handling:

Food Products Development

--The Mombasa Polytechnic has a Food Science and Chemistry department that is fairly well equipped for most testing operations (drying, milling, pH testing, oil content, moisture content, refrigeration, etc.) but does not appear to have equipment for packaging/processing (retorts, industrial kitchen space, or jacketed kettles). They are understaffed (two full-time lecturers) but enthusiastic to work with industry.

--The University of Nairobi has a full Science and Technology department that is well equipped and staffed; they have produced processes for cultured milk production.

--The UNGA group has its own research facilities for both product/process development and quality control located in Nakuru.

Packaging

--Tetrapack: A few companies (primarily juice processors and the KCC) are using consumer size aseptic packaging. Equipment is imported from Sweden and maintained by a local service staff. Due to the high initial cost of the machinery (Ksh 80 million) most companies are leasing rather than purchasing. Special (foil or mylar linings) packaging materials are imported (foreign exchange required) and then locally laminated with the locally produced printed paper stock. These are rolled and provided for each customer. The cost of the small tetrapack container is about Ksh 1.40.

In the Mombasa area, the only retail oriented aseptic packaging operation is with Kenya Creameries Corporation (KCC). They are running at approximately 40% machine capacity. However, due to sanitation concerns among other constraints, they would probably not be interested in contract processing.

Also in the Mombasa area is Tropical Food Processors, an Asian owned firm making fruit juice concentrate and tomato products for export; they anticipate producing sauces as well. They package exclusively in bulk aseptic drums. They considered producing coconut milk/cream but became concerned about microbial contamination and milk/cream separation during shipment. They are also running well below capacity (lack of raw materials) and expressed interest in contract processing.

PROJECT IMPLEMENTATION

Project implementation will involve the following:

Technology: A pilot wet coconut processing plant in Kenya will be established. The initial focus will be on coconut products that can be easily manufactured. Environmental concerns of discarding coconut water and polluting water sources will also be addressed.

In addition, further experimentation with using the Bielenberg ram press for pressing copra will be conducted. Initial testing on the original prototype (Silsoe College, 1988) was promising with an estimated 55% extraction efficiency. Ufuta Ltd. has expressed interest in purchasing coconut oil versus copra from farmers.

Extension: The project will work in conjunction with government agricultural extension agents in promoting correct agronomic practices; in addition, project personnel need to promote improved post-harvest treatment of coconuts.

Marketing: A variety of value added products can be made from wet coconut processing and some, such as coconut flour, are not traditional products in Kenya. Market testing for acceptance will be conducted.

It is envisioned that the project will be phased as follows:

Phase I: Small-scale wet coconut processing will be initiated on a pilot basis utilizing mostly already available equipment in a research institution. Market testing of some possible coconut products will be conducted. The market testing will be on a commercial basis so as to actually test the willingness of purchasers to pay for the product (vs. just panel ratings).

During the same period, additional data will be gathered on local markets, competition, raw material supply, technology options, government support, etc.

Phase II (dependent on outcome of Phase I): A commercial small-scale coconut processing plant will be established, technology will be modified as needed, and extension work will commence to increase farmer outputs and returns using present plant stock and improved cultivation practices. The introduction of new plant stock may also be encouraged.

Implementing Organization

Ufuta Limited - Ufuta is part of the Unga Group - Kenya's largest human and animal food processors. Other companies making up the Unga Group include Unga Wheat Millers, Unga Maize Millers, Unga Feeds, Elliot's Bakeries, Elianto Kenya (producers of corn oil and livestock feed), and Proctor & Allen (manufacturers of food products).

Ufuta (ufuta = simsim) is an agro-industrial project established in 1984 to process simsim oil and animal feed cake. It has actively encouraged the growing of sesame in Kenya. It also processes a variety of other cooking oils, including coconut oil and imported, unrefined palm oil. Ufuta is the only company on the coast that is refining coconut oil for human consumption; the other companies are refining for sale to the soap industry or as a hair or skin lotion (requires less refining/equipment).

Other Organizations for Collaboration

TOTOTO Home Industries: TOTOTO is a non-profit regional organization based in the Coast Province of Kenya. It was established in 1963 by the National Christian Council of Kenya to assist women in the province to increase their standard of living; TOTOTO also runs income generating projects to support their development activities. TOTOTO operates in five districts - Mombasa, Kwale, Kilifi, Taita/Taveta, and Tana River. TOTOTO runs a tailoring course, a tie-die workshop, a handicraft shop, and a rural development program. Of a total staff of 43, 22 are in the rural development program. Through their rural development program they work with over 50 women's groups and 1500 women. The groups receive training and loans to establish small-scale enterprises including poultry production, farming, bakeries, and construction activities. TOTOTO has been described as one of the best grass roots development agencies in Kenya.

Msambweni Development Company Ltd. - Producers of fresh coconuts, desiccated coconut, coir fibre, coir dust, coconut shells, and thatching material. Their literature indicates that they process about 3 million coconuts a year with half converted into copra and the balance sold locally and abroad.

Mombasa Coir Factory (Hirani Family): Producers of approximately 100 tons/month or 3 1/2 tons a day. Coir is the outer coarse brown fibre of the coconut used for mats, stuffing furniture, etc. The factory has a limited market for their coir which is not of high enough quality for export due to poor equipment. Within Kenya foam for stuffing is cheaper than coir; coir is used for only high quality furniture. The company is planning to purchase additional equipment and land to expand their operations to export markets; as well as start making desiccated coconut, charcoal, etc.

ANTICIPATED BENEFITS/BENEFICIARIES:

Improved agronomic practices--the quality of copra being produced by farmers is poor; by improving the quality of the copra, more oil can be obtained and the value of coconuts increase

Ram press--by pressing copra at the village level, farmers can add value to their crop; unskilled laborer positions will be created

Wet coconut processing--a variety of high value coconut products are possible; to the extent coconuts increase in value, almost all households along the Kenyan coast will benefit; direct employment will be created through wet coconut processing plants

Nutrition---food products can be obtained from coconuts. In addition, Kenyans do not consume enough oil/fat in their diets (as recommended by FAO and WHO); the project could thus provide important consumer benefits

Foreign exchange---to the extent additional oil can be produced, less foreign exchange will have to be spent on importing oil and more animal feed will be available locally

RISKS and CHALLENGES:

--Although there are no controlled prices in Kenya on soaps, detergents, oilseeds and oilcake, there are price controls on vegetable oils and fats as well as animal feeds; this could adversely affect profitability of coconut processing.

--It will be verified that wet coconut processing has overcome many of the technical problems first encountered; another risk is consumer acceptance of coconut products not traditionally consumed.

INNOVATIVE ELEMENTS/REPLICATION POTENTIAL:

The technologies in question would both be innovative - using the ram press for pressing copra as well as transferring the wet coconut processing technology developed in Asia to Africa. Replication potential is large - there are over 80 countries where coconut is grown; in Africa the largest producers include Tanzania, Mozambique, Ivory Coast and Ghana.

BUDGET:

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1991 April 26th

Mr John C. Wigglesworth
United Nations Industrial Development Organization
P.O. Box 63
Belgrave, Victoria 3160

Dear Mr Wigglesworth,

I have pleasure in enclosing the set of documents that Professor Ross Garnaut refers to in his letter. The 'portfolio' consists of documents which should probably be read in the following order:

1. A paper (in the back pocket) entitled 'Should agro-industrial research be funded from the public purse? The case of integrated coconut processing for the South Pacific'.
2. Two initial project proposal documents:
 - 2.1. 'Integrated Coconut Processing for the Smallholder sector of the South Pacific.'
 - 2.2. 'An integrated cogeneration energy system for medium scale coconut processing plants.'

These two documents were initial applications to the Australian Centre for International Agricultural Research (ACIAR). Although the concepts were thought to be very important, ACIAR considered their "agro-industrial" nature excluded them from ACIAR's mandate.

3. A paper by Professor Stephen Kaneff et al entitled: 'A range of high performance inflow reciprocating steam engines powered by solar, biomass and other sources of steam.'

I have just received a totally unsolicited affirmative reaction to the first paper. It may interest you. Dr Alastair McIntosh, Centre for Human Ecology, Edinburgh University, in a letter (dated April 10) to the Australian Rainforest Information Centre, copied to me, says:

'I have now studied Dan Etherington's February 1990 paper and was deeply impressed by the case presented and also the flow chart understanding expressed in his letter to you of 5th March 1991.

Here at Edinburgh University's Centre for Human Ecology we are recognised as having considerable expertise in issues pertaining to sustainable development but I have to say that it is rare to come across a project proposal which so fully integrates the principles of appropriate village level industrial development with ecological imperatives, and this in the manner which displays a sound understanding of the economic practicalities involved.' Alastair McIntosh, Development Director.

Finally, let me say that I am well aware of the extensive interest that UNIDO has had in the coconut industry. I have a copy of the 7-volume Coconut processing technology information documents (UNIDO/IOD.377 1980/82) as well as a number of more recent studies. I corresponded with Mr H. Koenig, a Senior Industrial Development Officer in the Agro-based Industries Branch of UNIDO in the initial phase of my studies in 1987 and 1988. I was given to understand that UNIDO's funding crisis precluded funding any further work. The fact that Australia is no longer contributing to UNIDO has also made me reluctant to make any approaches to UNIDO for funding.

I look forward to hearing from you.

Yours sincerely,

A handwritten signature in cursive script, appearing to read 'Dan Etherington', with a horizontal line underneath the name.

A Project Proposal

for

An Integrated Cogeneration Energy System
for medium scale coconut processing plants

An initial submission

by

E.K. Inall
S. Kaneff

in association with

D.M. Etherington and D. Hagen

SUMMARY

Coconut is a tropical crop grown in over 80 countries. It is the most important nut crop in the world. Production is dominated by smallholders (>90% of output) with about 70% of the crop consumed locally. However, this long-lived renewable resource is currently poorly utilised as a significant biomass energy source. The substantial underused biomass energy provides a potential key to the manufacture of low-cost, hygienic, high-quality final products in medium scale processing plants.

This project addresses the critical need to use this existing, surplus, renewable, and sustainable energy source by building a 50 kW cogeneration system using a proven high efficiency monotube-boiler/steam engine technology using coir dust and 'cocogas' as fuel. The project will build a coir dust burner and a coconut shell charcoal kiln to test the use of the fuels separately and in conjunction with each other. By linking this system to equipment (which exist) that mechanically dehusk and deshell coconuts and equipment that separates coir fibre from coir dust, the parameters of the nut handling and cogeneration modules can be fully specified for subsequent incorporation into a full pilot processing plant producing final products.

The need for such technology is particularly acute in remote locations such as the islands of the South Pacific (which have among the highest per capita production of coconuts in the world) and Mozambique but would also have widespread application among many of the poorest coastal tropical communities in the world.

The total budget sought is US \$ 350,000. The project is to be completed over a 15 month period.

A. Research project title

**An Integrated Cogeneration Energy System
for medium scale coconut processing plants**

B. Research Staff and Institution

a) Principal Investigators:

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C. Project Administration

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D. The project

An Integrated Cogeneration Energy System for medium scale coconut processing plants

1. Objective

To build and test a prototype cogeneration system for producing steam for electricity generation and process heat using a coir dust combustor and cocogas from a coconut shell charcoal kiln using mature whole coconuts as the initial raw material.

2. Rationale

Economic analysis has shown that the use of currently wasted energy resources in coconuts could provide minimum-cost fuel for integrated plants processing coconuts into hygienic, high value-added, final products for domestic and export markets. Two particular coconut biomass components are, in general, waste products: the pith of the husk ('coir dust', this is about 70 per cent of the husk weight) and the heat generated from the production of coconut shell charcoal. The use of this existing, surplus, renewable and sustainable energy resource lowers the variable costs of coconut processing dramatically. It allows medium scale plants, suited to processing the nuts of small groups of smallholders in remote settings to be highly profitable - given the potential for such plants to operate throughout the year. There are also substantial external and environmental benefits to this development.

The overall system aims to develop small, robust, integrated fresh coconut processing plants, initially for remote Pacific Island communities, which will produce high value exportable (hygienic and/or aseptic) food products and incorporate power generation utilising the coconut biomass, supplying both electricity and process heat of appropriate quality to the manufacturing processes and for domestic and other industrial use. The system is directed to benefit smallholders, generate local employment, and to be a base for further development.

The cogeneration energy system for the first stage of the project would be built and tested in Canberra.

3. Background

The coconut is easily the most important nut crop in the world today. The coconut palm (*cocos nucifera* L.) is a tropical species that is able to grow in difficult environments, such as atolls, or under conditions of high salinity, drought, or poor soils. It plays an important role in maintaining the long-term stability of often fragile ecosystems in island and coastal communities. Coconut is primarily a smallholder crop with at least 90 per cent of production coming from land holdings of just a few hectares. Some 70 per cent of the crop is consumed locally either directly as a food or drink or indirectly as a cooking oil. The coconut palm is remarkable in the variety of its products. It is an important cash crop, a supplementary food, and a source of fuel and building materials. Coconut palms are relatively hardy, have a 60-70 year life span and produce their fruit monthly. The continuous production and long "shelf-life" of the unhusked nut (about three months) is of great significance to the economics of any processing plant.

This resource has far greater potential in the South Pacific than has been generally recognised. Per capita coconut production in the islands is among the highest in the world although the yields are only average. Coconut exports from most of the island nations currently consist almost entirely of copra.

In the South Pacific, the 'copra route' of conventional coconut processing starts with a smallholder collecting fallen coconuts. The whole nuts are manually split in two. The coconut water spills onto the ground. The kernel ('green copra') is gouged out with a knife in 'cup' form and stuffed into a sack. The husk and shell are discarded. The sack of green copra is then taken home and dried over 3 to 4 days in a wood burning kiln at the household, village or co-operative level. This 'copra' is traded, transported to a major port and exported. Final processing is done 'centrally' in Europe, or Japan. Copra processing technology is over a century old. The major purpose is preservation since coconut meat of high moisture content deteriorates rapidly in the tropics with the growth of fungi and bacteria. A consequence is that 85% (by weight) of the coconut is discarded: 40% with the husk, 15% with the shell, 15% with the loose water, and 15% from drying the flesh. Each metric ton of copra is made up of the flesh of about 5,000 whole nuts weighing about 6.5 tons.

The way copra, the dried flesh of the coconut is produced, stored and handled makes the resulting oil unfit for human consumption without substantial refining. Aflatoxin contamination is also introduced into the copra-meal by-product. This unhygienically processed oilseed is facing increasing competition in international markets.

A policy review (Etherington 1988) concluded that a 'demand pull' development strategy is required for the coconut industry. Much more valuable products can be obtained from fresh coconut flesh if it is processed under clean or hygienic conditions (depending on the final products). These products could be sold into significant niche markets. What the islands require then is a more efficient form of processing for export. Such improved efficiency is required in three areas: i) the quality of preservation; ii) the quality of the end products; iii) the use of the total resource.

The policy analysis was followed by an in-depth pre-feasibility study (Etherington & Hagen 1989) focusing on the processing requirements of the smallholder sector of the Solomon Islands. The very small, isolated, islands of the Solomons, and the South Pacific in general, suffer from the tyranny of distance. Their plight is compounded by poor internal communication and by the technological constraints of their resource base: small populations, high wage rates but low levels of mechanical skill. However they have an abundant, environmentally sound, renewable resource in the coconut palm. The authors concluded that the real requirement in the islands is for dispersed, relatively small-scale, robust, integrated processing activities producing pure or food quality products from mature whole coconuts. Effective integration would enable the efficient use of the whole coconut. Full use of the whole nut was the key to re-establishing the long run viability of the industry. The economic analysis showed that the use of the surplus, energy resource available in the whole nut would dramatically reduce the variable costs of coconut processing and allow such plants to be economic in spite of them often being located in relatively remote settings.

An overall conclusion was that relatively small plants (handling between 600 and 1,200 tons of copra-equivalent per year, or 1 - 2,000 nuts per hour) can provide remote communities with a core processing and cogeneration facility which is paid for with exportable products. High value food products and full use of shell and husk for by-products and energy should make the plants competitive in spite of their modest size and the high

inter-island transport costs. In addition, there are substantial external and environmental benefits to be gained from this development. The key component to such a plant is the cogeneration system using the "waste" biomass resources of coir dust and coconut shell producer gas (cocogas). This proposal thus focuses on the details of this core component but an economic analysis of the incorporation of the system into a pilot plant will be undertaken as part of the project.

4. The prototype facility

The test plant will consist of two major modules:

- 1) Nut preparation, and
- 2) The cogeneration plant.

These two modules are seen as being integrally related if a truly workable system is to be the outcome of this project. The cogeneration system could be built and tested using imported coir-dust and coconut shell but given the wide variability in the size and the relative proportions of husk, shell and the way in which nuts may have been transported (eg floated in sea water), it is important to design and test the system with a range in the quality of coir dust and whole nuts of different types. This requires the integrated use of a selected existing mechanical coconut dehusker, desheller and coir separator. Final processing of the lose water, flesh and coir baling are proven downstream technologies with known energy requirements so will NOT be a part of the proposed test facility. While it is recognised that mechanical nut handling may not suit countries with abundant 'surplus' labour, it is important for most of the South Pacific countries.

The essential features of the system are illustrated in Figure 1 and involve the following identifiable components:

4.1 Nut preparation module

Equipment purchased for this phase will be made available for inclusion in the pilot plant.

4.1.1 Dehusker, Desheller

The mechanical handling of whole coconuts is seen as critical in situations of relative labour shortage such as is typical in many parts of the South Pacific. A number of mechanical coconut dehuskers and deshellers are now being advertised. Two of these look particularly promising - one built in Japan and one in France. These would need to be checked in an actual operational situation before being ordered.

4.1.2 Coir fibre/dust separation

The separation of coir fibre from the pith or dust is a well developed technology in regular use in fibre plants in southern India and in Sri Lanka. This has been extensively reviewed by Jarman and Robbins (1986). Equipment suited to a possible pilot plant would be ordered for our purposes.

Figure 1

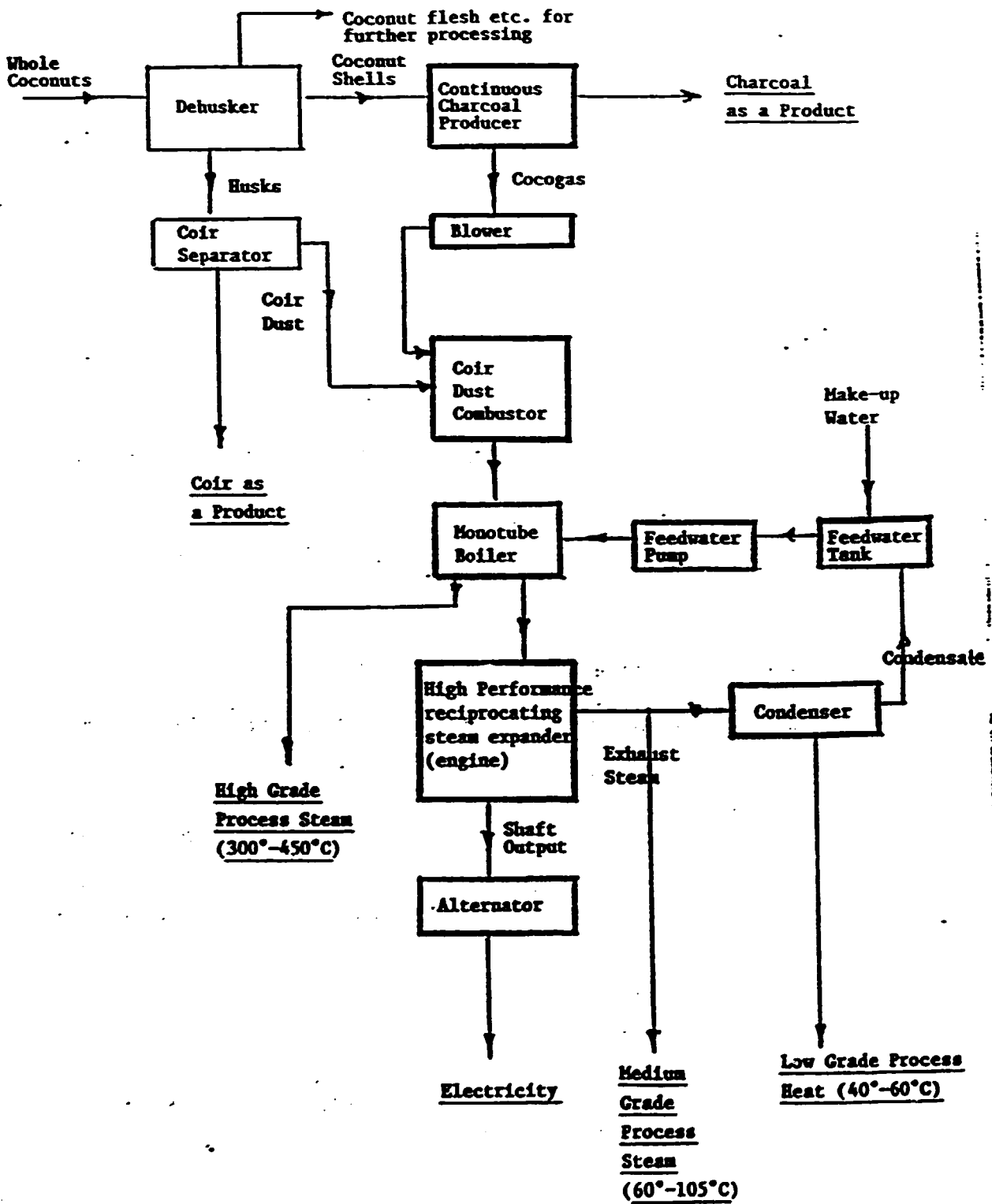


Figure 1: Basic Cogeneration System

4.2 The cogeneration plant

4.2.1 Coir Dust Combustor

Coir dust has a high ash content of 12–14%, a volatile content of 60–62% and a fixed carbon content of 26%. This contrasts with wood which has an ash content of only 1–2% and a fixed carbon content of 14–19%. Coir dust has a very low density of some 80 kg/m³ (for 10–15% moisture content). The ash is mainly potassium and sodium and has a low fusion temperature (around 800–900 degrees C) and density of 700–1200 kg/m³. The structure of coir dust is also different, with a much smaller cell size and a higher content of extractive material, mainly suberine. The nett calorific value of air-dried coir dust is around 14,000 kJ/kg as compared with wood of 16,600 kJ/kg.

The main problem that presents itself is the design of a combustor that can efficiently burn a very fine low density particulate fuel that has a high ash content and high moisture content. Coir dust has a similar composition to that of brown coal and rice hulls.

Special coir dust burners must be designed specifically for this fuel. Two manufacturers have had some experience with such burners and either could provide a prototype that would be a suitable basis for the final design. They are Biomass Energy Services and Technology Pty Ltd of Saratoga NSW 2250 and Maxitherm Boilers Pty Ltd of Milperra NSW. After consideration of the designs submitted by them, a choice would be made.

4.2.2 Charcoal Producer

Charcoal from coconut shells is a valuable product. The Natural Resources Institute (NRI, formally ODNRI) of the UK have recently released a coconut shell charcoal kiln designed specifically to recover waste heat in the form of 'cocogas' (producer gas). This Waste Heat Recovery Unit (WHRU) technology is now in commercial use in Sri Lanka (APCC 1989). Here the intention is to use the gas with the coir dust to assist combustion and increase the power of the system. A kiln of an appropriate size will be constructed using NRI plans.

4.2.3 Monotube Boiler

Our own experience with solar power generation and with both oil fired and biomass furnaces over the past 10 years has led to extremely robust, economical and safe boilers using tubes rather than boiler vessels. This inexpensive monotube boiler approach has advantages of safety and simplicity due to the presence of only a small quantity of steam and water within the high temperature/high pressure parts of the system and allows very fast start-up (usually only a few minutes).

4.2.4 Reciprocating Steam Expander

Heat engine research in the Research School of Physical Sciences ANU Energy Research Centre over the past 10 years has resulted in development of steam technology which, in the area of high quality heat application at high efficiency and low cost, has no counterpart elsewhere. This technology is ideal for the present project

since it is robust, simple and can be handled by those who have only moderate skills in automobile type engines [see separate information report].

To carry out the present project we need no engine development work (units have been running continuously for many thousands of hours in the field, including remote areas). We can supply a suitable engine for the project (commercial production would be supplied by licensees). However, the engine has to be matched to the overall system and attention must be directed to this purpose. In particular it needs to have appropriate auxiliaries and a cooling system, as well as being included in the overall system controller.

4.2.5 Pollution control

As a major overall operating objective, we aim at extremely low emission of pollutants; the technology is selected and designed with this in mind. Our previous experience and that of our associates has shown that pollution levels to meet the most stringent requirements are attainable cost-effectively.

4.2.6 Load Control, Energy Storage and Speed Control

During the first stage the plant will be tested in Canberra and the 50 kW of power produced will be supplied to the electricity mains. In the field the power will run the processing plant and supply the community with power and pumped water. These loads vary rapidly while the burners and engine operate at a relatively steady power which must be greater than the maximum load. The surplus power will be stored in a battery bank and used as required for starting the plant and supplying the load when the generator is stopped. A comprehensive control system will maintain the correct speed of the alternators by varying the power to the battery, as is done in the Solar Power Station at White Cliffs (a remote, community in western New South Wales) and in other similar or related systems built by the ANU Energy Research Centre. The controls will also ensure that the overall system operates in an effective manner.

5. The Engine Technology to be Used

5.1 Rationale

Over many years, attempts have been made to produce engine systems suitable for powering small to medium scale equipment which makes use of indigenous renewable resources — very largely without success. On the one hand, relatively long-standing steam technology has been employed to produce simple engines which are of low efficiency, allegedly require little attention, and provide some low quality steam and heat for crop drying (for example). Alternatively, high technology approaches have been attempted; these have turned out to be too expensive and too impractical to maintain in the field. Had either approach shown real prospects of success, some at least of these attempts (and several have been supported by large corporations) would have resulted in a proliferation of the technology; that this has not occurred is indicative of the difficulty of the problem and of the inappropriateness of the solutions. Only when steam turbines of greater than a few Megawatts in size have been used in association with relatively large furnace and boiler equipment and suitably backed up by technical support staff, have installations been successful from the viewpoint of energy production. But steam turbine technology is not suitable for smaller units because of serious

reduction in efficiency and increase in relative cost as units are made smaller --- and turbines are not usually tolerant of low quality steam from simple furnaces and boilers; consequently this approach has also not been successful.

Starting in 1979 we have developed engines for the Solar Power Station at White Cliffs and in the USA. These have work conversion efficiencies of over 20% (turbines of this size have some 10% efficiency). The engine systems have been proved to require far less maintenance than diesel engines and to require expertise only at the level of simple automotive mechanic skills which can be readily imparted.

These engines, which were initially directed to solar applications where robustness, low cost, high efficiency and ready maintainability are important requirements, are finding increasing relevance for biomass applications where the same qualities are vital.

We have already demonstrated a biomass system using steam generated from burning (wet) sawdust (Prasad 1988), which would be very suitable for any region where sawdust waste is available.

5.2 Assessment of the ANU Engine Technology

For an assessment of the technology we propose, please refer to the copy of the Review Report by a high level committee, Appendix A (penultimate paragraph).

5.3 Related Work in Australia and Overseas

Since the Department of Engineering Physics first undertook, in 1979, the design and construction of the Solar Power Station at White Cliffs, the staff of the department has constantly studied the development of modern heat engines to ensure the most cost-effective and practical engine is used for our projects. Many man-years of effort have been expended on these developments, which have ranged worldwide. For example, Dr Inall has spent 3 years (1986-1988) working in the USA on the prototype module for the Solar Power Station on Molokai, a project that was funded through the US Department of Energy. During this time he was continually in contact with people in the energy conversion field, attended conferences and took part in program planning meetings where information on projects that were under way in many parts of the world was available and assessed. On the base of this experience, our own research and other experience, we can say: "There is no steam powered prime mover, in the power range less than 0.5 MWe, with the efficiency and tolerance to steam conditions to equal those of the engine that the department has developed (known overseas as the ANU engine). This is confirmed by the study 'Central Heat Engine Cost and Availability Study' by Mechanical Technology Incorporated (SAND87-7020)."

6. Specific Tasks

The tasks to be carried out follow the prototype facility described in Section 4.

6.1 Obtain the necessary nut handling equipment

6.1.1 Visit, examine and purchase suitable dehusking/deshelling equipment and arrange for its shipping to Canberra.

6.1.2 Visit, examine and purchase suitable husk separator equipment and arrange for its shipping to Canberra.

6.2 Arrange purchase and shipping of coconuts

6.3 Coir Dust Combustor

Obtain from Biomass Energy Services and Technology, Saratoga NSW or Maxitherm, a 350 kW burner system, install and test near the ANU Engine Test Laboratory, Research School of Physical Sciences, and test operation with coir dust. The necessary steps are:

- * Obtain the basic coir dust combustor.
- * Add an ANU monotube boiler (see Section 4.2.3).
- * Instrument to allow measurement of all key parameters.
- * Run the combustor and assess performance.
- * Make necessary redesign or other modifications revealed as worthwhile, especially ensuring negligible pollution levels as measured by appropriate instruments.

6.4 Coconut Shell Charcoal Producer Provides Cocogas

- * Build kiln to design obtained from NRI (UK).
- * Instrument to allow measurement of appropriate parameters.
- * Connect cocogas outlet to the coir dust combustor/monotube boiler, together with a centrifugal blower able to run at a high temperature.
- * Run the charcoal kiln and assess performance.
- * Make any necessary redesign or other modifications revealed as worthwhile, especially ensuring simplicity, durability and negligible pollution levels as measured by appropriate instruments.

6.5 Monotube Boiler

Design and construct (by the ANU) from appropriate boiler tube and mount in the coir dust burner, with connections to the feedwater pump and output as illustrated in Figure 1. The monotube boiler is tested in conjunction with the coir dust combustor and/or the kiln to ascertain heat transfer performance, overall efficiency, achievable steam quality (temperatures and pressures) in relation to furnace inputs and other relevant aspects of operation.

6.6 Reciprocating Steam Expander

- * Assemble a 4-cylinder 50 kW output steam engine, auxiliaries, and generator.
- * Mount the engine, auxiliaries and alternator in a standard 6-metre shipping container and install near the coir dust combustor and kiln with instrumentation to allow performance and other measurements.
- * Run the engine with each fuel supply separately and together to ascertain behaviour and performance. The engine load in this case would be a generator.
- * Assess overall engine performance and make any necessary system adjustments. (These are not expected to be necessary for the engine itself).

6.6 Pollution Level Control

Select suitable technologies for burning coir dust and for the production of charcoal from coconut shells to ensure the minimum attainable pollution emission levels.

6.7 Economic analysis

As part of this project, an economic assessment will be made of the capital and running costs of the system. Together with quotes from down-stream coconut processing equipment manufacturers, an economic analysis will be undertaken of a fully operable pilot plant with and without this cogeneration system.

7. Timetable A fifteen month program.

E. SUMMARY BUDGET

COGENERATION ENERGY SYSTEM FOR COCONUT PROCESSING PLANTS

ITEM	FIRST YEAR (12 Months)	SECOND YEAR (3 Months)	TOTAL PROJECT (15 Months)
	(A\$)	(A\$)	(A\$)
TOTAL PERSONNEL	116,550.00	33,993.75	150,543.75
EQUIPMENT & SERVICES	233,300.00	3,000.00	236,300.00
TRAVEL etc	5,500.00	1,600.00	7,100.00
ADMINISTRATION	53,302.50	5,789.06	59,091.56
OVERALL TOTAL (A\$)	408,652.50	44,382.81	453,035.31
US \$ COST (@ 0.77:1)	314,662.43	34,174.77	348,837.19

UNIVERSITY RESOURCES not charged for

Time of Senior Departmental Academic, Professional and Technical Staff, Laboratory facilities and resources for hardware development testing, commissioning. Measuring instruments, mainline computer simulation studies. Economic analysis.

TOTAL ESTIMATED VALUE

A\$ 105,000.00

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Note: Some 60 publications on the ANU engine and related technologies are available; we would be pleased to provide any of these on your request.

Appendix

**BUDGET FOR
COGENERATION ENERGY SYSTEM FOR COCONUT PROCESSING PLANTS**

ITEM	FIRST YEAR (12 Months)	SECOND YEAR (3 Months)	TOTAL PROJECT (15 Months)
SALARIES			
	(A\$)	(A\$)	(A\$)
Senior Engineer	51,000.00	12,750.00	63,750.00
Senior Technical Officer	15,000.00	7,500.00	22,500.00
Technical Officer	24,000.00	6,000.00	30,000.00
SUB-TOTAL	90,000.00	26,250.00	116,250.00
Salary related costs			
Payroll tax (7%)	6,300.00	1,837.50	8,137.50
Workers Comp. (2%)	1,800.00	525.00	2,325.00
Leave loading (1.5%)	1,350.00	393.75	1,743.75
Superannuation (17%)	15,300.00	4,462.50	19,762.50
Professional indem. (1%)	900.00	262.50	1,162.50
Public liability (1%)	900.00	262.50	1,162.50
SUB-TOTAL	26,550.00	7,743.75	34,293.75
TOTAL PERSONNEL	116,550.00	33,993.75	150,543.75
EQUIPMENT SUPPLIES & SERVICES			
Nut handling equipment:	6,000.00	2,000.00	8,000.00
Dehusker/desheller	50,000.00		50,000.00
Coir separator	32,000.00		32,000.00
Whole nuts (2 containers)	4,000.00		4,000.00
Coir dust burner	30,000.00		30,000.00
Charcoal (NRI) Kiln	30,000.00		30,000.00
Engine & steam system (incl. all controls)	79,800.00		79,800.00
Publications		500.00	500.00
Software	1,000.00		1,000.00
Comm's & materials	500.00	500.00	1,000.00
SUB-TOTAL	233,300.00	3,000.00	236,300.00
TRAVEL etc			
Fares	3,500.00	.00	3,500.00
Subsistence	2,000.00	.00	2,000.00
Reporting	.00	1,600.00	1,600.00
SUB-TOTAL	5,500.00	1,600.00	7,100.00
ADMINISTRATION			
Contingencies (5%)	17,767.50	1,929.69	19,697.19
ANUTECH Pty Ltd (10%)	35,535.00	3,859.38	39,394.38
OVERALL TOTAL	408,652.50	44,382.81	453,035.31
US \$ COST (@ 0.77:1)	314,662.43	34,174.77	348,837.19