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USE OF UNCONVENTIONAL FIBRES FOR THE MANUFACTURE OF FABRICS, SITRA COIMBATORE

DP/IND/86/038/11-01 and 11-02

INDIA

Technical report: Second mission*

Prepared for the Government of India
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of
Cyril Jarman, Fibre extraction expert and
Finn Terkelsen, Expert in spinning + weaving
of unconventional fibres

Backstopping officer: J.P. Moll, Agro-based Industries Branch

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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1. ACKNOWLEDGEMENTS

Special thanks are due to Miss Indra Doraiswamy, Deputy Director, for her concern for our well-being and the high professionalism in executing the work.

ABBREVIATIONS used

PALF - Pineapple leaf fibre

PES - Polyester fibre

CMC - Carboxy methyl cellulose

CCRI - Central Coir Research Institute

IJIRA - Indian Jute Industry Research Association

PPM - Picks per minute

CMERI - Central Mechanical Engineering Research Institute

MERADO - Mechanical Engineering Research and Development Organization

JTRL - Jute Technological Research Laboratory

CSIR - Council for Scientific and Industrial Research

SEM - Scanning Electron Microscope

ODNRI - Overseas Development Natural Resources Institute

2. TERMS OF REFERENCE

These are set out in the Special Service Agreements as follows:

Fibre Extraction Expert

1. Assist in preparing the research work programme to be conducted at SITRA on fibre extraction.
2. Advise on the type of machinery required, on the overseas training programme for SITRA staff.
3. Supervise the research work at SITRA and identify potential industrial units where pilot experimentation can be conducted.
4. Prepare final report setting out findings and recommendations.

Expert in Spinning and Weaving

1. Assist in the research work programme to be conducted at SITRA on the spinning and weaving of unconventional fibres.
2. Assist in identifying the machinery required for the spinning and weaving of the fibres.
3. Start the research and testing facilities in the spinning and weaving of the fibres using SITRA's or other available facilities.
4. Prepare final report setting out findings and recommendations.

SUPPLEMENTARY TERMS OF REFERENCE

During the experts' briefing in Vienna and New Delhi they were requested to:

- review progress of the project;
- establish what further work remains to be done and to draw up a programme, aiming at writing of terminal report by November 1990;
- assist in filling out project performance evaluation report (PPER);
- assist in writing of new job descriptions;
- make recommendations in consultation with SITRA for expert posts 11-03 and 11-04;
- update fibre prices and to arrange for cost estimates in order to identify most economic processes.

SITRA requested that priority to be given to initiating a programme of R and D on the SEM and to investigating the possibilities of radical improvements in raspador design, in order to boost output.

3. MAIN CONCLUSIONS AND RECOMMENDATIONS

3.1 Using the KVIC decorticator a fibre production of 625 g./hr. has been achieved. This is considerably less than was achieved during the 1st mission (1.25 kg./hr.). A higher rate must be achieved if the process is to be economic.

3.2 Attempts at retting met with only limited success.

3.3 Chemical treatments produced a substantial improvement in fibre fineness from 3.0 -4.0 Tex to 2.0 Tex.

3.4 Spinning trials on the jute system with 100% PALF and in blends were successful.

3.5 Spinning trials on the worsted system were successful but a maximum of 10% PALF only could be spun.

3.6 OE spinning with 100% PALF produced good yarn with reduced hairiness but the sliver had to be rolled by hand.

3.7 Yarns were also spun on coir spinning [2-fold] systems. Spinning of 100% PALF fibre was possible; however coir/PALF blends could not be spun.

3.8 Banana fibre in 25% blend with jute was spun on jute system giving slightly higher strength than jute alone but C.V. percentage was much higher.

3.9 Similarly sisal fibre in 25% blends were processed and showed the same C.V. but much reduced strength.

3.10 A wide range of fabrics was woven without difficulty on both hand and power looms except that warp hairiness created problems in some fabrics.

3.11 Three major outlets are suggested:

3.11.1 On jute system - spinning 100% PALF or in blends with jute

3.11.2 Fibres and yarns to be directed mainly towards handicraft industry and KVIC, both PALF and banana

3.11.3 .Fibres [both PALF and banana] to be pulped for production of high quality papers.

RECOMMENDATIONS

FIBRE EXTRACTION

Decortication

3.12. The collaboration with Measureall Engineering be intensified with a view to developing a radically new method of fibre extraction.

3.13 An expert on the automation of fibre extraction to be recruited [see para 13.5]

3.14 Developments with CMERI and KVIC decorticators to be closely monitored.

3.15. Developments to existing SITRA decorticator to be explored - Dr Iype to provide details for installing his microprocessor.

3.16 Existing manufacturers of fibre extraction machinery to be contacted to ascertain their interest in developing a decorticator for PALF.

Retting

3.17 Retting trials of decorticated fibre to be resumed . Collaboration to be sought with the CCRI to draw upon their extensive experience of techniques of retting and to apply this to PALF.

Chemical extraction

3.18 In view of promising results with chemical treatments further trials be carried out with advice from expert in fibre chemistry.

SPINNING

Cotton system

3.19 Expert advice be sought on the feasibility of making radical changes to existing cotton card to enable 100% PALF and blends to be spun.

3.20 Trials of 100% PALF and PALF/cotton blends on O-E spinning system to be continued together with trials with PALF as core.

3.21 Detailed economic assessment to be made on feasibility of using PALF or PALF blends on re-designed cotton system

Woollen system

3.22 No further trials to be carried out.

Worsted system

3.23 Trials to be discontinued.

Jute system

3.24 TNO's offer to carry out spinning trials at no cost to be accepted.

3.25 SIRO spinning to be investigated.

3.26 OE spinning trials to be carried out using PALF drawing sliver.

3.27 DREF-2 spinning trials to be carried out by Fehrer [free of charge] using PALF carded sliver.

3.28 Wet spinning to be invistigated.

3.29 Only fine counts were attempted [6-8 lb (Tex). Trials with PALF/jute blends should also be made with traditional jute counts for warp or weft for use in hessian, sacking and carpet backing cloth. These could

be a major outlet for PALF.

3.30 A detailed economic assessment assessment should be made of using PALF and PALF blends on jute system

Flax system

3.31 IKWN, Poznan, should be approached with a view to establishing cooperative programme on flax spinning

3.32 Make detailed economic assessment of using PALF and PALF blends on the flax system

Coir system

3.33 Proceed with further large scale trials on pedal operated system to produce single yarns

3.34 Modify feed-in funnels to spin blends

3.35 Investigate possibility of using Okime 2-step machine for spinning coir/PALF blends

3.36 Attempt to eliminate lead-thread in Okime machine

3.37 Make detailed economic assessment of using PALF and PALF blends on the coir system

Ambar Charka

3.38 Obtain estimate for rebuilding charka for PALF if transport cost of sliver or roving does not prove prohibitive.

KNITTING

3.39 Obtain information on small-scale knitting machines

3.40 Make trials on small scale knitting machine.

3.41 Make detailed economic assessment of using knitting for fabric formation with PALF and PALF blends

DYEING

3.42 Use ODNRI reports G176 and G177 as basis for choosing dyes suitable for PALF.

3.43 Make exploratory trials for dye-uptake and fastness.

PRODUCT DEVELOPMENT

Paper-making

3.44 Sample should be sent for evaluation to speciality paper-maker eg Cromptons, Dexters and also Indian Paper Industry Research Association.

Geotextiles

3.45 Contact should be made with Silsoe College to ascertain type of fabric suitable for evaluation as geo-textile. The Indian Institute of Technology, Powai, Bombay [Dr J N Mandal, Dept of Civil Engineering] should also be contacted.

GENERAL

3.46 Tables of physical properties [ref p 12 and 13 Sec B 1st Mission report] to be updated.

3.47 List of references to be updated

SCANNING ELECTRON MICROSCOPE

3.48 A stand-by system should be installed to prevent disruption of work during power failures

3.49 The water cooling unit for the s e m should be modified so that waste heat is discharged to outside the preparation room

3.50 Photographic facilities should be provided so

that processing can be carried out at SITRA. This will necessitate;-

3.50.1 Purchase of photographic equipment

3.50.2 Improvements to existing dark-room

3.50.3 Training in photographic techniques

SPECIAL NOTE

The team did not have sufficient time to carry out an audit of results, machine parameters, yarn tests and costs but concentrated on deciding which activities to continue and which to abandon due to there being less likelihood of success. Emphasis was put on advising on the s e m programme and on suggesting improvements in fibre extraction to increase output.

The raspador output was lower than expected. As much of the project success hinges on cheap fibre extraction radical changes in design are being tested.

FIBRE EXTRACTION AND PROCESSING

4.1 Raw Material

The variety "Kew" was chosen for trials. Full details of all the varieties investigated are given in the SITRA report entitled "Studies on physical and properties of PALF" As yet no studies have been carried out into the economics of harvesting and transportation of leaves although a figure of Rs 0.25 per kg was quoted by Dr Doraiswamy [Measureall Engineering]

4.2 Decortication

Trials had continued in the field since the first mission of the experts. The outputs obtained by unskilled workers were on average substantially below those obtained in the laboratory. A possible cause of

this could have been an attempt to obtain a higher throughput by inserting as many as six leaves into the decorticator feed at one time.

A report was published of promising results obtained with a new design of decorticator on which trials had been carried out at MERDO Cochin. Unfortunately a discussion with the scientists involved revealed that the report had been over optimistic.

A visit took place to an organization [Measureall Engineering] where trials are in progress with a radically new design of decorticator which works on the "squeeze and scratch" principle. Unfortunately all attempts to obtain even a few leaves for trials were unsuccessful. This project could lead to a breakthrough in automated fibre extraction.

The experts were shown a microprocessor board designed by Dr Iype of Leeds University. Unfortunately full details of its method of operation were not available.

4.3 Retting

The results of retting trials were given in a report prepared by SITRA entitled "Studies on physical and chemical properties of PALF. Fibre samples were immersed in water for up to 5 days. In one experiment the water was changed daily. There was a slight loss in bundle strength in both cases but also an improvement in fineness - greater in the case of the trial in which the water was not changed. Another experiment was carried out in which fibre samples were stored for up to one year before retting. It was found that storing for longer that 6 months produced a strength loss.

Research being carried out at the CCRI on the use of pure cultures for the accelerated retting of coir was discussed with the scientists involved.

Whilst water shortage in Tamil Nadu imposes restrictions on the use of retting as a means of fibre extraction this is not the case in other parts of India [eg West Bengal]

4.4 Chemical extraction

Some preliminary degumming trials were carried out at SITRA in an attempt to make the decorticated fibres soft and fine. Concentration of NaOH was at 3 levels 4%, 6% and 8%, time of treatment was at 4h, 6h and 8h whilst

the temperature of the degumming bath was at 3 levels - 30 C, 60 C and 90 C. The optimum conditions were a concentration of 4% NaOH at 30% C for 4h. After degumming the mean Tex was 1.9.
It is recommended that prior to the mission of the fibre extraction expert the likely cost of the chemical extraction process be calculated in order to assess the economic feasibility.

5. SPINNING

5.1. Cotton System (Trials at SITRA)

A conclusion of the first mission was confirmed namely that the cotton system (even when modified) is unsuitable for 100% PALF and blends with cotton, polyester etc. This is further confirmed by a study carried out at JTRL which concluded that the PALF content could be a maximum of 50%. However even with a much lower PALF percentage , results were not acceptable; yarns suitable for only special purposes (novelty) being spun. Never-the-less in view of the importance of the cotton system to SITRA's members and the good results obtained by O-E system, we would support SITRA's suggestion that attempts for radical changes to the cotton card should be attempted and expert advice on machine building be sought. In the context of the present project, all that can be expected is to establish the technical possibilities,and the actual re-building would, no doubt take longer than the run of this project.

5.2. Woollen System (Trials at Bombay)

This was not done for want of facilities. However the University of Leeds [in similar experiments] found a very high rate of droppings and were unable to form a web.

5.3. Worsted System (Trials at Bombay)

Spinning trials proved that PALF content exceeding 10% created excessive end breaks. A suiting fabric was woven with 45 wool/45 polyester/10 PALF spun to Nm. 24 (42 Tex), with few difficulties. However, the PALF content of the spun yarn, was reduced to 8% due to fibre losses in spinning. The suiting fabric was also found to be noticeably harsher in handle, even with as

little as 8% PALF content.

The PALF sliver was not combed [so in fact following the semi-worsted route] and blending was done at third draw frame.

5.4. Jute System (Trials at IJIRA, Calcutta)

These tests showed that the jute system is very suitable for PALF, both 100% and in blends with jute. Provided that the fibre price can be reduced to that of jute, then the jute industry should be very interested in using PALF as a blend partner, say 15-20%. However it would be necessary to ascertain a steady supply through out the year at a minimum quantity of 4-5000 kgs. per week, before jute mills would get seriously involved. PALF and PALF/jute blends can be spun finer than 100% jute, with stronger and more even yarn. Wet spinning can further improve strength and regularity.

Minimal changes or modifications are necessary. For example the breaker card causes many neps, so a double passage of the finisher card is needed, by-passing the breaker card, the optimum staple length was found to be 6".

5.5 Flax System (Trials at Calcutta)

The flax system was not included in the SITRA trials for want of facilities. However JTRL has done trials on the flax system, claiming good results, both dry and wet spun, so in view of the high price of flax, [about Rs.45/kg. compared to expected PALF price of less than Rs.10/kg.] it is suggested that, if flax machines could be found, trials and tests should be carried out to prove the claims of JTRL, and to generate data and information for the industry.

It is recommended that IKWN (Institute for natural fibres) in Poznan, Poland, which has flax spinning machinery, be approached. The IKWN are interested in doing research on natural fibres other than flax and hemp, both of which are grown in Poland. PALF may be of interest to IKWN.

5.6 Coir System [Trials at Kalavoor]

Small scale trials were done on the pedal-operated machine, in which PALF is hand fed into two spindles and simultaneously twisted to a two fold yarn. This machine produced promising results with PALF, and additional larger samples should be made.

Trials with PALF/coir blends proved unsuccessful as all PALF dropped out. The use of blends is however interesting and attempts to modify the feed-in, using a funnel type instead of a narrow hole, should be tried. Even for 100% PALF this machine would prove of interest to the cottage industry. CCRI also has a more automated spinning machine (OKIMI/CECOCO), this a two step process, with carding and sliver forming in one, followed by drafting, spinning and twisting in the other using a cotton core thread. The need for the core thread makes this machine less interesting, however the system deserves investigation with PALF or PALF/coir blends. As the main purpose of the core thread is to transport the fibres from drafting to the spindle, it should be possible to construct a conveyer system where the cotton yarn need not form part of the yarn spun.

5.7. Ambar Charka spinning

The ambar charkha is developed by Measureall Engineering, and is a 12 spindle pedal operated machine. The ring diameter is very small and so is the lift. The drafting consists of cotton roller drafting and cotton roving is fed into the machine.

Trials with PALF have not been made, as the machine in its present form is unsuitable. The ambar charkha would only be interesting, if sliver or roving of PALF could be made on the re-built cotton card. Even though the possibility exists of utilizing finisher draw sliver or roving from the jute system, the transport cost from West Bengal may prohibit this. In both cases, the ambar charkha machine must be completely re-built. Roller drafting changed to slip drafting and flyer used instead of rings.

6. WEAVING

PALF is very suitable for weaving fabrics. eg. cotton warp and PALF weft.

6.1. Pedal Loom

This pedal operated loom is developed by Measureall Engineering Industries and is suitable for light to medium weight fabrics. The loom is simple in design and weaves well at speeds up to 90 ppm. with an average rate of 60 ppm. attainable over longer periods.

PALF samples were woven with no difficulty on this loom. also in warp if density is low, [ie few ends per cm.]

6.2. Powerloom

Samples woven on powerlooms created no difficulties. Some powerloom installations have sizing machines and they should be able to weave PALF warp with few problems, even with denser warps. As mentioned earlier, attempts will be made to reduce the hairiness of PALF yarns and PALF blends.

7. KNITTING

As set out in the original objectives of this project, fabric production by knitting was envisaged, however trials on both circular and flat machines were unsuccessful. There is however a knitting machine which could prove effective in knitting some PALF fabrics. The machine, which is claimed to be very versatile, is developed by John Carr Doughty* and SITRA has mentioned their intention to acquire such a unit to complement their present range of knitting machines.

Mop cloth (Floor Cloth) was successfully woven, and it would be interesting to compare quality and performance of machines, between weaving and knitting.

* It is understood that the Italian Company Cappodoni produce a similar machine. This also should be

investigated.

8. DYEING

Ligno-cellulosic fibres such as PALF have a similar behaviour towards dyes as other ligno-cellulosic fibres such as sisal. The main differences compared with sisal affecting dyeing behaviour are the greater fineness of pineapple fibre resulting in better penetration and the presence of gums which could lead to less even dyeing. A comprehensive study of the dyeing of sisal was carried out at ODNRI and published as G 176 1983. "Dyeing of sisal and other plant fibres- a handbook for craft instructors". G 177 1983 "Properties of selected dyes on sisal" is a supplement which lists the fastness properties of a wide range of dyes selected for their suitability for sisal. The use of reactive dyes for the cold pad-batch dyeing of plant fibres is described in ODNRI's "Rural Technology Guide No.2".

Initially dyes should be selected on the basis of their fastness properties measured on sisal and if necessary confirmatory tests carried out on PALF.

9.0 END PRODUCTS

12 different products were produced and presented during the 2nd mission and are as follows :

9. 1. TOWEL/TABLE CLOTH

Woven on powerloom (Dobby) at SITRA
Warp : Tex 30 (Ne 20) Cotton
Weft : Tex 210 (6.1b) PALF 100% - Jute spun.

Pirn winding and weaving presented no problems.

Selvedge was uneven, but with a little attention could easily be corrected.

9.2. MAT (RUBPERIZED)

Top Fabric - plain weave

Wp - Tex 210 (6 lb) 100% PALF - Jute spun
Wf - Tex 210 (6 lb) 100% PALF Rubberized by Coir Research Institute.

9.3. MOPCLOTH (FLOOR CLOTH)

2/2 Twill - Striped - Reactive Dye used
Wp : Tex 2/30 (Ne 2/20) Cotton
Wf : Tex 210 (6lb) - 100% PALF-Jute system
Woven on Pedal Loom with no problems
Product is being market tested, price not yet known

9.4. MOP CLOTH (FLOOR CLOTH)

As 3 But Grey

9.5. MATTING (FLOOR COVERING)

Wp : Tex 2/30 (Ne 2/20) Cotton
Wf : Tex 210 (6lb) 100% PALF - Dyed black with reactive dye
Woven on handloom without problems.

9.6. THICK MAT

Hand made on 'Treadle Rods' without problems
Wp & Wf Tex 3/210 (3/6 lbs) 100% PALF

9.7. SUITING

Wp. Tex 2/25 (Ne 2/24) 45 wool/45 PES/10 PALF
We : Tex 2/25 (Ne 2/24) 45 W/45 PES/10 PALF
Woven on SITRA Powerloom, without problems.
Fabric was found to have abrasive touch, due to PALF content.

9.8. SWEEPING MOP

Made of Tex 5/210 (5/6 lb.) - 100% PALF

9.9 CURTAIN CLOTH

Plain Weave
Wp. Tex 1/30 (Ne 1/20) Cotton
Wf. Tex 210 (6lb) 100% PALF - Jute spun
Woven on pedal loom with no problems
Printing, in a series of colours, presented no problems.

9.10. COMPOSITE

Resins was reinforced with loose fibre.
No tests done to determine advantage of using PALF

9.11. FANCY YARNS

Spun at LEEDS UNIVERSITY (4 samples)
Less than 25% PALF content and 2 cotton threads and outside yarn of Acrylic fibre.
PALF sliver produced on SITRA Lap converter and "HAND ROLLED" .

9.12. DYED PALF FIBRE

Dyed in SITRA Lab without problems. Dyestuff was Napthol, which is expensive.

9.13. NON WOVENS

PALF Fibre has been forwarded to FEHRER A.G. in LINZ, AUSTRIA for trials. This could offer an interesting way of using PALF for fabrics, but no doubt through the thermal bonding process, where about 15% of Polypropylene Bi-component Fibre could give good results.

9.14. GEO TEXTILES

Fabrics suitable for this application have not yet been produced. However with the possibility of PALF being more slowly bio-degradable than Jute, it could have considerable potential, particularly as a reinforcement. Woven or Nonwoven can be used.

9.15. PAPER PULP

This project is primarily concerned with the use of unconventional fibres for fabrics, but chemical analysis indicates another, possibly very important, outlet for PALF and also banana fibres. PALF has long ultimate fibres with a mean length of 6 mm - similar to abaca and much longer than hardwood pulps.

10.0 COMMENTS ON UNCONVENTIONAL FIBRES

The project document and 1st Mission report refers to several different fibres under the heading of "unconventional".

PALF

The main emphasis was placed on this fibre, and at the beginning most work concentrated on this because of the greatest probability of success was expected.

BANANA

Some exploratory work has been done at SITRA. While JTRL is fairly optimistic about the use of banana fibres,

James Mackie of Belfast has unsuccessfully tried to process banana fibres for many years. Also several West German Firms have carried out trials with banana fibre extraction machines but without any commercial success so far. If any fibre extraction method being developed shows promising results, work should resume at SITRA.

SISAL

Sisal has been spun in blends with jute on the jute spinning system, with poor results. Sisal is well established in Africa and Brazil. Yarn spun on the long fibre spinning system [Goods machines] is used either by itself or with jute yarn to produce heavy weight sacks. There does not seem to be any justification for including sisal in the project.

RAMIE

This fibre is well established outside India, even though much research work still remains, particularly in the area of degumming, it is perhaps outside the scope of this project.

SUNNHEMP

Sunn hemp is commonly called Indian Hemp since it is cultivated in practically every state in India. The fibre which is extracted by retting [or sometimes by decortication] is used for rope,string and high quality papers. It would not therefore be appropriate to include sunn fibre within this project

NETTLE

The stinging nettle [Urtica dioica] contains a fibre which was utilized during the Second World War in Germany as a substitute for flax.
Another plant belonging to the nettle family [Urticacea] is used as a fibre source in Nepal. This is known as "allo" and is obtained from a species of Girardinia. An improved method of extraction has been developed at ODNRI in the UK. However the process is still highly labour intensive and would not be likely to prove economic in India.

11. ORGANIZATION OF LARGE SCALE PRODUCTION OF FIBRES

With the project nearing completion it is an appropriate

time to consider how to proceed to large scale production. Previous attempts to use PALF, etc. have failed to arouse interest by industry. This was perhaps due to a lack of availability of fibres. Even though this subject is slightly outside the main scope of this project, it is important to bear in mind that a successful technical completion, will not assure industrial and handicraft application, unless thoughts are given to the generation of bulk supply of fibres. During the 1st Mission this problem was underscored by Mr.K.Sreenivasan, who suggested that co-operatives may be a good way to organize a continuous production and marketing for the farmers.

12 EQUIPMENT PURCHASED FOR THE PROJECT

12.1. Scanning Electron Microscope

12.1.1 Operation and Maintenance : The instrument gives its optimum performance if it is left running so that the high vacuum is maintained continuously. Furthermore the need to wait for the instrument to be pumped down before use is avoided. A standby system to provide power during loss of mains supply should be installed. A modification to the water cooling unit should be made so that the waste heat is discharged outside.

12.1.2 Photographic Recording. Film Processing and Printing should routinely be carried out "in house" (Errors in exposure/focus can then be corrected within an hour rather than having to wait 2 days). The existing LEITZ 35 mm. enlarger has been reconditioned but the 6 x 7 cm enlarger will probably not be repairable economically. A new 6 x 7 enlarger should be purchased.

12.1.3 Negative storage. Provision should be made now for the safe storage (ie. in an air conditioned room) and rapid retrieval of negatives. If required UNIDO will advise on suitable system.

12.1.4 Data Storage : A data base should be designed for the storage of information in specimens examined in the SEM. (dbase or similar might need to be

purchased?).

12.1.5 Training in Photographic Techniques. If suitably qualified staff are not available it will be necessary to provide training locally if possible.

12.2. Instron Tensile Tester

12.2.1 The model purchased has the minimum of mechanical parts thus reducing the maintenance requirements The experts were given a demonstration of the operation of the instrument. Unlike previous models operation is largely automatic the test conditions being computer controlled.

13 APPENDICES

13.1 EXTRACTS FROM : STUDY TOUR BY MR RATNAM AND MISS DORAISWAMY

Offers of Cooperation

Were received from **E.Fehrer** who offered to carry out spinning trials on the Dref 2 system - 3kg of sliver has been sent. 100 kg. will be sent for bulk trials if 3 kg. trial promising.

TNO has offered to carry out a trial production of twistless yarns using 3 kg of sliver.

Central School of Art. Study on development of new products from PALF (free). Training in use of computer controlled handlooms (duration and cost to be ascertained).

Suggestions

Fischer Dotticon PALF may be good source of raw material for the production of fine paper.
If PALF fibres were made finer and softer they might possibly be used in high quality fabrics blended with silk etc.

TNO PALF has good potential in Upholstery and carpets [rugs and mats] if dye absorption and fastness properties are superior to those of jute. Twistless yarns should be investigated - such yarns have high durability and strength.

Leeds University Crimping should be tried; it might make the fibres softer. Use enzymes to soften fibre and keep amount of sodium hydroxide at low levels. Softening longer fibres before cutting might be advantageous. Use of wet spinning could be investigated to give finer counts.

Potential for Geo-textile use should be investigated. Benefits to the soil derive from the use of cellulosic fibres but not from polypropylene and other synthetics.

Fancy yarns could open good avenues. PALF can be spun to fine counts and fancy yarns with wrapping on hollow spindles. Possibility of producing low priced blankets from blends of PALF and acrylic fibres be investigated. (80% dyed jute blanket with 20% acrylic had good feel and wear comfort - PALF is superior to jute in all properties).

SRRL - New Orleans PALF/ cotton sweaters should have good potential- roughness will not be much of a handicap. Novelty will enhance appeal.

13.2 FELLOWSHIP TRAINING

One fellowship remains with a remaining budget of about $8500 (As of 1/1-90). A list of suggested visits was discussed with SITRA. We are not able to comment on the usefulness of the visits to USA Institutes, as they are not known to us.

The following institutions were identified for Fellowship Training.

Scottish College of Textiles - Has full range of sophisticated test equipment. Can offer training of short duration (3 months) in Chemical Processing Fibre, colour matching, blending with wool and SEM application

and interpretation.

University of Leeds - Well equipped to offer Fellowship training in chemical processing. Has current experience in processing of PALF fibre.

SRRC + TNO also have excellent facilities.

13.3 EXPERTS

The following experts were identified as able to assist SITRA.

Dr.I.S.Knox	Product Development	Leeds
Dr Ian Holme	Chemical Processing	Leeds
Dr R C van Essen	Industrial Products	T N O
Dr D L Brydon	General Textiles	Leeds
Dr Cherian Iype	Textile Machinery	Leeds

13.4 NOTES ON VISITS

13.4.1 Note of visit to Central Coir Research Institute, Kalavoor 6.2.1990

We were welcomed by Mr. Nataraj, the Senior Scientific Officer. Mr. Nataraj who is a Microbiologist by Training described the current work of the institute particularly that on microbiology. The pioneer work of Prof. Bhat had clearly demonstrated the role ofspecific bacteria such as Pseudomonas,Clostridium and Bacillus spp. in retting. These bacteria were responsible for the breakdown of polyphenolic compounds and pectins. (Moulds and yeasts although present in the retting liquor do not contribute to the retting.)

The objective of the current research was to extend this basic research and apply it to the improvement of retting as carried out in practice. To this end pure cultures of the 3 main micro- organisms were being produced in bulk and these cultures were then added to the husks which were being retted. The quantity was not specified but the addition took place at fortnightly intervals.

We were shown samples of fibre from husks one of which had been retted normally whilst the other had cultures of bacteria added. The latter was detectably lighter in colour and also brighter (we were supplied with photographs) and we were told that the lighter sample was cleaner. The difference in colour between yarns made from the two samples was not very striking.

The trials are still in the early stages and so it was not possible to obtain data on the cost of producing + adding the cultures to set against the extra value of the yarn produced. Progress is not likely to be rapid though as the microbiologist with whom we later discussed the project told us that she was the only scientist working on it.

Apart from the improvement in colour obtained, it was claimed that the period of retting was substantially reduced from 8 - 12 months to 3 - 6 months. The use of a crusher (as is already well established in Sri Lanka) also reduces the retting time.

It should be noted that pure cultures can only be added to husks retting in pits - it is not possible where husks are retted in rets immersed in lagoons. The use of concrete retting tanks is not contemplated although some are being constructed at the institute. It appears that no work has been carried out on the use of a pre-soak to leach out some of the polyphenolic substances (which are bactericidal) before commencing the main ret. Neither has any work been done on the use of aeration to produce an aerobic ret. (Anaerobic rets produces very unpleasant smells contributing to the unpleasant nature of the process.)

Mr. Nyaranan, the institute's designer, showed us samples of matting designed both by Birgit Ullhammer (a Swedish designer commissioned by the International Trade Centre) and by himself. Whilst all

of Ms Ullhammer's designs would be acceptable to the European buyer there was also one of his which might also be acceptable. Mr. Nyaranan had not heard the results of the test marketing of the new designs.

We saw both treadle operated and power looms in operation.

13.4.2 Note of visit to Bishop Peter Chenerparampil 6 February 1990

One of the many activities developed by the Bishop to provide employment to the women in the area is the making of craft goods from local fibres. During our visit we saw Korai grass being first plaited, then sewn into decorative squares and finally the squares being stitched together to form mats of various sizes.

Handicrafts were also being made out of sisal and banana fibres. These were purchased from suppliers as far away as Cape Comorin. The handicrafts unit would be glad of an additional source of fibre since there was a shortage which restricted production of goods.

13.4.3 Visit to MERADO, Cochin by Mr. R. Gunasekaran, SITRA, 5.2.1990

In a paper by R. K. Verma and G.K. Verma entitled "Decorticator for extraction of fibres from pine apple leaves", it is claimed that a machine designed by CMERI produces 6 to 10 kg. of ibre per hour. These figures are substantially higher than the output (0.625 Kg/h) obtained with the KVIC decorticator currently in use at SITRA. Since the low output of the KVIC machine is a major obstacle to developing an economic process for the utilisation of pine apple leaf fibre it was decided to investigate the claims made for the CMERI machine.

It was arranged for Mr. Gunasekaran to first locate the MERADO unit in Cochin and then attempt to arrange a demonstration of the decorticator.

On arriving at MERADO, Mr. Gunasekaran was informed that the machine was no longer at MERADO. During transportation from CMERI the main shaft had been bent and it had been returned for repairs.

Mr. Gunasekaran spoke to Mr. Menon (the other scientist working on the project was Mr. Sankaran). Mr. Menon informed Mr. Gunasekaran that CMERI, Durgapur was a CSIR unit. He stated that preliminary trials had produced a very harsh beating effect and he did not accept the output figures claimed by Verma and Verma-6 - 10 Kg/h fibre was quite unrealistic. He also expressed the opinion that the machine had proved a failure and CMERI were hoping that MERADO might be able to suggest means of modifying it to greatly increase output.

Mr. Menon suggested that the Cottage and Small Scale Industries Department in West Bengal be contacted for details of their results. The KVIC in Bombay had developed a commercial machine for pineapple fibre. KVIC, Trichur was using the machine with banana leaves.

13.4.4 Visit to IRIS (Measureall Engineering Industries)
2 February 1990

Dr.Doraiswamy (Nuclear Physicist)
Mr.Ramachandran

This company produces O-E units, pedal operated Ambar charkhas and pedal looms.

FIBRE EXTRACTION

Dr.Doraiswamy, together with Mr.Chellamani, has constructed a new design of raspador, the principle being "Squeeze and Scratch".

DIAGRAM

This is a proto-type, much further development is needed.

A major problem is roller lap round the studded roller since small take-off rollers do not grip properly. Otherwise the results with PALF were satisfactory.

During the visit trials were carried out with sisal leaves which are much tougher than pineapple leaves. However results were good. The PALF extracted earlier on behalf of SITRA, was carried out after one week's storage, when the leaves changed colour to yellow/brown, this was thought to give a better result than using fresh/green leaves.

O-E SPINNING

Trials were successfully carried out with SITRA PALF sliver, rolled by hand from lap converter (sliver could not be formed with 100% PALF). The yarn was less hairy than jute spun PALF. Comparison of properties between yarn spun on O-E system vs. jute system will be made. Dr.Doraiswamy stated that O-E has drafting power up to 100.

AMBAR CHARKHA SPINNING

The Ambar Charkha is a pedal driven 12 spindle machine with drafting rollers (as on the cotton system) and small size rings. The machine is fed by rovings and works well with cotton, but in its present form is not suitable for PALF or banana fibres. The machine must be modified with another drafting system for long fibres and flyer spindles, to be fed by sliver or roving.

PEDAL OPERATED LOOM

This loom ran very well with average 60 ppm, and maximum up to 80-90. Pirn winding was done on a primitive ratt. It was suggested that Ambar Charkha ring tubes be used direct in shuttle. The loom had been used to weave PALF in weft and cotton in warp and ran

with no difficulties.

Normal handlooms installed have fly shuttles, operate at 3 m. fabric/hr compared to pedal loom with 12 m/hr. Several thousand looms are said to have been sold and the pedal loom is a very good next generation to the fly shuttle handloom.

Dr.Doraiswamy estimated that a modified Raspador would cost to construct:

Banana	:	Rs.50,000
PALF	:	Rs.20,000 - 25,000

13.4.5 Visit to Meenakshi Printers

12 February 1990

Mr.S.K.Mano (Part Owner)

This is a small screen printing operation with 4 tables, pad-mangle and drying/curing machine. They also have designing and screen making facilities. The capacity is 250 m/Table x 4 = 1000 m per day.

They have printed SITRA PALF fabric without problems. However the print was not set/cured as there was not sufficient time available. The design was printed on loom state PALF cloth with pigment dyes. The rather open mesh fabric was thick and several extra strokes of the squeegee were needed together with increased pressure. A more "flat" fabric would give better design definition.

13.4.5 Visit to Universal Dyeing House Erode 14 2 90
Mr R Thangavelu

The company is about 40 years old, now run by 3rd generation. Cotton and a small amount of silk is dyed. There are 6 jiggers and 2 winches, all hand-operated and wood fired. However a new buildings with better machines are being built- these are still hand operated since taxes have to be paid on motorized equipment. The laboratory was very poorly equipped with only a sample dying jigger, winch and pad mangle.

Labour cost Rs20/8h. 40 persons were employed, only about 10 were seen. The total wages bill per week was Rs 3000. Production per day is 6 jigs x 440 m = 2400 m.

Effluent [20,000 l per day] went straight into a ditch. The new dyehouse will have some provision for effluent treatment with collection in tanks after evaporation by sun, the residue will be buried.

Work on pineapple fibre was limited to 10g samples of yarn in a beaker. The dyer had been given information on the chemical composition by SITRA. Having found that wax content was higher than cotton and so the concentration of scouring agents had to be increased:-

	Cotton	PALF
NaOH	3%	6%
Na_2CO_3	2%	4%

The absorbency rate was slightly higher in the bleached state compared to the grey state [grey = 9.83 sec bleached = 9.37 sec]

Approximate prices of dyeing were:
Direct dye 10-15 Rs/kg
Reactive dye 20-25 Rs/kg

The firm has given some thought to giving chemical treatment to improve the fineness of PALF but they had not done any work so far. It is hard to see what assistance this company can give to SITRA in view of the poor facilities [there is no apparatus for fastness testing]. SITRA is better equipped to do this work.

13.5 JOB DESCRIPTIONS FOR ADDITIONAL EXPERTS

11.03 (Revised). The original 11.03 which is titled : "Expert in Yarn and Fabric Manufacture for unconventional fibres" appears to be covered by 11.02, and SITRA's own staff, instead there is a greater need for advice on automation of raspador and rebuilding of cotton card.

11.04 (Revised) The original 11.04 which is titled " Yarn and Fibre Processing Expert "appears to be

covered by 11.02, and SITRA's own staff. It is now clear that advice is needed on the chemical modification of PALF, and even though few difficulties are expected on dyeing and finishing of PALF blends, the textile chemist needed should also be of assistance in this area.

The original job descriptions 11.03 and 11.04 of 13/3-87, to be cancelled. Revised job descriptions have been agreed with SITRA.

SITRA has suggested two candidates for these posts [Dr Ian Holme and Dr Iype ; their cvs have been handed over to UNIDO] to be considered together with other qualified experts on the UNIDO roster

13.6 DRAFT LETTER ON FLAX SPINNING

Dear Dr.Kozlowski,

SITRA is presently engaged in a project to utilize unconventional fibres, such as pineapple and banana for the production of fabrics.

We have been very successful using pineapple fibres on the jute system, both in 100% and in blends with jute, and we are now interested in making trials on the Flax system dry and wet spinning, and are wondering if it would be possible for one of our staff members, in connection with a European tour, to visit Poznan to make some spinning trials on your Flax spinning machinery with pineapple fibres.

We would be grateful to receive your views on the possibility of cooperation between our institutes on the mentioned subject.

With kind regards

Yours sincerely

Doc. Dr R Kozlowski

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