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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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JUTE RESEARCH AND DEVELOPMENT

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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 G.A. Gordon
Packaging expert

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

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

ABSTRACT

The report covers the final phase of the packaging related part of project DP/IND/86/037/11-14/j13102, Development and Promotion of Diversified End-Uses of Jute at the Indian Jute Industries Research Association (IJIRA).

Costs of both woven and non woven (felt) reinforced plastic sheet (JRP) have been reduced by over 30% through reduction in the plastic resin content and by substituting recycled LDPE for vigin material but are still higher than plywood. A full scale production plant has been commissioned. The interest shown by various companies in prototype printed sheet material, subject to costs being acceptable, can now be followed up.

A few trial sheets have been produced of a jute composite made from the whole of the jute plant above ground (jute fibre plus stick). These indicate that the material has potential as a rigid or semirigid material in thicknesses above 3-4 mm. It should be substantially lower in cost than JRP and could be a competitor to timber and plywood in packaging.

The identification, outside the project, of naturally occuring organic resins which are biodegradable and potentially of much lower cost than the resins used so far, could lead to substanial lowering of costs, particularly of the jute composite.

The development of the jute composite material in the next phase of the project is recommended, and with the naturally occuring organic resin when available.

Consideration should also be given to developing jute based packaging materials through pulping processes.

C O N T E N T S

INTRODUCTION

This report covers the work carried out and the progress made at IJIRA in developing diversified uses for jute products for packaging under the project referenced above. My split mission, of which this is the second part, following the first in September 1991, (ref.1), had the job description in Annex 1

Both parts of the mission came late in the UNDP assisted project which covered a range of products besides those for packaging. In the first part a 6 month extension of the packaging related part of the project was proposed and this was implemented. The main purpose was to complete field trials on tea chests and apple boxes using woven jute reinforced plastic sheet material developed under the project, as a substitute for plywood.

The first report recommended that future development work should seek to reduce the cost of the materials to make them more competitive by developing ground jute composites which would have a lower jute material cost than either woven or non woven jute.

The report also recommended a survey of the packaging market in India related to costs of competitive materials and the functional and decorative requirements. In particular, information on the costs of competitive materials was lacking.

I. ACTIVITIES

I arrived at IJIRA on 23 March 1992 and left India on 14 April 1992. Most of the early part was spent at Birds Jute Exports Ltd. (BJEL) factory site where the development work on the materials and packages was being carried out,using the pilot plant equipment. This was principally a 76 cm x 51 cm hydraulic press with time and temperature programming. The full size production press, which has now been commissioned, is on the same site.

Developments in reducing the cost of both woven and nonwoven jute reinforced plastics were seen and discussed with Mr. P. K Pal and Mr. A Biswas of IJIRA (Annex 2) and also development in improving the surface appearence and the quality of print. Discussions were also held with Dr. D Gupta, Deputy Jute Commissioner, Govt. of India, Ministry of Textiles, and Executive Director of the National Centre for Jute Diversification and with Mr. D. K. Sarkar, Industrial Adviser to the same Ministry who has just been appointed Director and Chief Executive of BJEL. This company is now responsible for the commercial production of the woven and non woven jute reinforced plastics. Discussions were held with several others in the jute and packaging industries.(Annex 3).

This report is being written part way through the mission due in particular to the need to have it available as early as possible before the Tripartite Meeting. A visit is planned to the apple growing areas where a delayed field trial is likely to take place later in the year. (See Annex 6 for a report on this visit.)

II. PROGRESS

Since the first visit in September 1991, the following progress has been made:

1. Reducing the cost of woven and non woven thermoplastic JRP by around 33% and 35% respectively. This has been done by reducing the percentage of resin by using recycled resin (LDPE) in place of all, or most, of the virgin material.

2. Developing better surface finish and print quality for retail pack material, through coloured surface laminations and pre-printed laminations.

3. Demonstrating prototype packs to potential users. In many instances interest was expressed (dependent on the final cost) but this cannot be progressed until full scale production facilities are available to produce sheets in quantity and to convert sheet material into packages.

4. Making some preliminary samples of ground jute composites using the whole jute plant (fibre plus stick)

5. Assisting in the commissioning and trial run of the full scale production plant at BJEL for the production of the sheet material, with the assistance of Govt. of India. Full scale production by BJEL is due to start in early April.

6. Results from the two field trials are not available, for different reasons.

   One company (Tata Tea Limited), following successful handling trials on one tea chest, is carrying out taint tests lasting 6 months which end in June. If the results are satisfactory BJEL will, if costs are acceptable, carry out an extended trial. No response has been made by the other two companies which received samples, but other companies have shown some interest in the trial.

   Although full arrangement, were made, including instruction in box making with JRP sheets and score sheets for recording box damage (ref.2), no results have been received from the apple growers. The reasons for this may be

clarified on the visit to the Apple Growers. This has been organised with the help of Mrs. N. Saggi of the Jute Manufacturers Development Council, which sponsored the earlier trials.

7. Made a few prototype sheets using a potentially low cost chemically modified naturally occuring organic resin developed by the outside the project (see VI Alternative Materials)

III. ORGANISATIONAL CHANGES RELATED TO THE PROJECT

The Government of India, Ministry of Textiles, is involved in several activities which impinge on the implementation of this project.

A National Centre for Jute Diversification (NCJD) has recently been formed with the objective of encouraging entrepreneurial development of jute products by businesses. Dr. D. Gupta is the Executive Director.

In discussion with Dr. D Gupta he was very keen to get competitive products on to the market, including the packaging materials developed in the project.

A further close involvement between BJEL and the Ministry has occured through the appointment of Mr.D K Sarkar, Industrial Adviser to the Ministry to be also Director and Chief Executive of BJEL. He too is keen to develop the uses of jute materials, particularly for tea chests.

The production has now been transferred to BJEL which has chemical processing plant, the technology for bleaching and dyeing of jute textiles and also screen printing equipment which is capable of high quality graphics.

The ten opening press can produce upto 120 8'x4'(2.44 x1.02mm) sheets per hour.

IV. COST OF JUTE REINFORCED PLASTICS

Except in those instances where a material has markedly superior properties which are needed, or where it can confer added value, the cost of a packaging material is the main factor in determining whether it can displace another one.

The cost of jute based material is principally the cost of the jute and resin components. The cost reduction has been achieved -

- by replacing all or most of the virgin high molecular weight LDPE costing 55 Rs./kg* by recycled LDPE costing 35 Rs./kg.

- by reducing the resin content of woven fabric JRP from 45% to 30% and of non woven JRP from 40% to 25-28%.

With woven jute at 18 Rs./kg. this reduces the material cost of woven JRP from 35 Rs./kg to 23 Rs./kg or by 33%. Non-woven jute costs 15 Rs./Kg and the JRP material cost reduces from 31 Rs./kg. to 20 Rs./kg. or by 35%.

Processing costs have not been included in the figures above. IJIRA estimate this cost to be 2 Rs./sq.m for 2 mm thick and 3 Rs./sq.m for 4 mm thick.

The costs of competitive materials, particularly plywood, has not been clearly established, but some approximate figures are given in Table 1

* At the time of writing 29 Rs.= 1 US Dollar approximately

Current figures for 3 ply woven JRP is 42 Rs./sq.m

TABLE I

COST IN Rs/SQ.M FOR JRP AND OTHER PACKAGING MATERIALS(INCLUDING PROCESSING)

	Thickness	Rs./sq.m
3 ply woven JRP (30% recycled LDPE)	1.4 mm	42
2 ply woven JRP (30% recycled LDPE)	1.0 mm	34
Non woven JRP (27% recycled LDPE)	1.4 mm	37
Non woven JRP (27% recycled LDPE)	1.0 mm	32
High quality plywood	4 mm	36
Low grade plywood	4 mm	17
7 ply corrugated fibreboard		21
5 ply corrugated fibreboard		15

Comparisons are not exact : 1.4 mm JRP is thinner, denser tougher and more flexible than the corresponding 4 mm plywood. For example 1.4 mm JRP was substituted for 4 mm ply in the tea chest trials.

On these cost figures the JRP materials are approaching the cost of good quality plywood, but not that of the low grade ply used in many tea chests and apple boxes. They may, however, be cost effective for tea chests used to export quality teas and which meet Indian Standard IS:10 (Ref.3).

Even if a relatively small percentage of the total number of tea chests used JRP panels this would still represent substantial usage, given the large number of tea chests (about 14 million - Ref.4). used every year.

Costs for carton board are not available. Carton board costs more than corrugated fibreboard on a weight basis, but no real comparison can be made at present and these costs are needed.

V. ALTERNATIVE RESINS

At the meeting with Dr. Gupta, we discussed a recent development outside the project which could have considerable potential in further reducing the cost of jute based materials, particularly of the jute composites. A low cost chemically modified naturally based organic resin which is biodegradable and would cost no more on a weight basis than woven felt and might cost considerably less has been iden tified.

The main application would appear to be outside packaging but the reduced cost would widen market opportunities in packaging fieldsif it could replace the synthetic resins used in JRP.

It is understood that the resin is, to some extent, moisture sensitive. This might be counteracted by using LDPE in the surface layers of the sheet.

Several prototype sample sheets from both woven and non woven jute fabric were examined briefly at the meeting. They appeared to have comparable rigidity and strength to similar materials made with LDPE.

In the limited time for discussion it was not possible to determine the availability of the resin for more extended evaluation.

.VI. DISCUSSION

WOVEN AND NON WOVEN JRP

The development of these materials is now complete within the present project. BJEL now have the full scale production equipment and the silk screen printing equipment needed to provide high quality print.

What is now needed to produce retail packages, and to a lesser extent industrial and transit packages, is the ability to convert sheet material into packages. For retail packages this involves cutting out blanks of the appropriate size and shape from the sheet and creasing the material so that the blank may be folded to form the box. IJIRA has demonstrated that both cutting and creasing of thinner sheets of JRP can be done satisfactorily.

BJEL has a cutting press, but will need either to acquire a creasing press (thought to cost around 50,000 Rs.) or subcontract this to a carton making company. The latter option might cause problems of commercial competition.

Packaging is a bespoke trade, where every pack is unique and has to meet a unique set of requirement and development of this market by BJEL will need staff dedicated to this if substantial market penetration is to occur.

For industrial and transit packaging the material is still more costly relative to plywood but is more durable. Compared to metal packaging it should be highly competitive, particularly in cylindrical packages where the shape increases the rigidity. Here rivetting or heat sealing combined with die cutting should cover many applications. JRP is also at 1.2g/cc, denser than most packaging materials (except metals) and thinner material must be used if package weight is to be the same.

The market for the thinner non woven JRP is smaller in tonnage but should have a higher added value.

JUTE COMPOSITES

The ground jute composite from the preliminary tests, is likely to cover thicknesses from 4 mm upwards, providing rigid panel type material. Dependent on cost and strength it could

have potential as a timber substitute in applications such as packing cases and crates particularly where large panels are required. Other possible areas would be in multitrip use in pallets and tote bins. Uses outside packaging would be as a lower cost substitute for the thicker JRP materials, or penetrating markets where JRP is too costly.

Some possible cost estimates are given in Table 2 where the cost of currently available JRP is compared with ground whole jute fibre composite at 6 Rs./kg, thermoset resin at 25 Rs./kg, organic resin at 15 Rs./kg (which is probably conservative) and recycled LDPE at 35 Rs./kg.

TABLE 2

POTENTIAL COST OF JUTE COMPOSITE FROM WHOLE PLANT
(PROCESSING COST EXCLUDED)

	Rs./kg.	Rs./sq.m*
With 30% thermoset	12	58
With 20% thermoset	10	48
With 30% recycled LDPE	15	72
With 20% recycled LDPE	12	58
With 30% organic resin	9	43
With 20% organic resin	8	38
Good quality plywood	13	36

* For 4 mm thick sheet

The composite material could be competitive with plywood of similar thickness although the density at 1.2 gm/cc is higher Alternatively, where thicker timber is used (as in packing cases), thinner composite could be used if strength and rigidity are adequate,as with JRP.

It is considered by IJIRA that a lower percentage of resin would be needed for the composite than the 30% in the woven and nonwoven JRP, due to lower absorption by the material. The cost of the organic resin could well be lower than the 15 Rs/kg. used in Table 2. If it reached 6 Rs./kg of the whole jute plant, the cost of the composite would be 6 Rs./kg. independent of the resin content. At this stage the eventual cost of the organic resin is of course,speculative.

With the development of the JRP material effectively complete, the potential for large reductions in cost makes the development of ground jute composites a priority.

Progress in marketing the JRP materials was hampered by the inability to provide packages in sufficient numbers. Now

JRP is in full production the marketing opportunities for a composite material can largely be assessed from the experience with JRP. This should enable the development of the composite to be divorced, in the first stage, from the marketing.

In order to produce uniform jute fibre and uniform composite sheet, the following equipment would be needed.

(a) A small grinding machine
(b) A mixer
(c) A vibratory table
(d) A hopper

These could be used in conjunction with the present pilot plant press. Some may be available within IJIRA and BJEL or could be fabricated.

Once satisfactory processes and formulations have been developed the requirements for full scale production can be established. At this stage it is not clear whether the composite would cover both flexible and rigid material of 3 mm-4 mm upwards.

Development of the formulation and processing of the jute composites is estimated to take no more than a year provided that the equipment mentioned above can be installed 4-6 months.

A similar development period is estimated for the incorporation of the organic resin in JRP, provided no modifications to the resin are found necessary.

The conclusions above apply specifically to packaging materials and not necessarily to other areas; there may be similar requirements in other areas which modify the machinery required.

PULPED JUTE BASED MATERIALS FOR PACKAGING

Jute has, in the past, been used in the manufacture of corrugated board by pulping, with the introduction of resin in the beater, or by subsequent impregnation. Addition in the beater could lead to a lower density product with lower resin content and lower cost. It is understood from Dr. Mukherjee that pulping has been included in the proposals for the next UNDP project.

No detailed assessment of the equipment needed has been made.

CONCLUSIONS

1. JRP MATERIALS

Full scale production facilities are now available at BJEL for the production of JRP sheets, including chemical processing of the fibre and silk screen printing. It can now develop the marketing potential for industrial applications in packaging and, with the addition of a creasing press, in the retail and gift pack area. It will also need an additional staff member to develop the marketing capability and liaise on development of specific packages. It is still a high cost material.

2. JUTE COMPOSITES

Initial test sheets hold out the promise of a much lower cost mateial than JRP , which could be made in thickness from 3 mm upwards, suitable for crates and cases using timber or plywood at present. The material is denser than timber or plywood, so thinner, possibly less rigid, sheets of composite would be needed when using it as a replacement.

3. LOWER COST RESIN

The development, outside the project, of chemically modified naturally occurring resins could result, on the basis of some initial test sheets in considerable cost reduction in both JRP and jute composites. When available, the use of this resin in both materials should be investigated.

4. MATERIAL DENSITY

JRP and Jute composite at present are both denser than paper and wood based packaging. Lower density materials are desirable, to enable thicker material to be used without increasing weight or cost and to provide rigidity without brittleness.

5. PULP BASED JUTE MATERIALS

These could provide lower density and lower resin content, particularly if the resin is added in the beater. A different range of applications could become available, both in transit and retail packages. It is understood that pulping has been included in the proposal for the next stage of the UNDP assisted project.

RECOMMENDATIONS

1. JUTE COMPOSITES

IJIRA should proceed with developing this using the prototype laboratory at BJEL. Additional equipment will be needed some of which may be fabricated. All is commercially available in India. It is recommended that assistance be provided by UNDP towards the purchase (See Annnex 5). Attention should be given to the development of lower density materials.

2. LOWER COST RESIN

IJIRA should, when they become available, develop jute composites based on the chemically modified naturally occuring organic resins.

3. JUTE PULP

Development should proceed, with one objective being to develop suitable packaging materials. The equipment needed for this has not been assessed and needs further consideration. The minimum size which would be suitable for package development would be a sheet size of 750 x 500 mm Expertise in pulping is needed, and it is recommended that UNDP provide assistance in its provision.

4. JRP

This material is now at the stage of market development and assistance should be given to enable BJEL to develop the market potential in packaging. Support should be considered for provision of a creasing press, and also for marketing staff (probably one) to both market and develop individual packs in conjunction with the technical and production staff.

5. GENERAL

In all development work attention must be paid to ways in which the sheet material can be formed or converted into a package and how the package will be closed. Designs for collapsible transit packs need developing.

In future field trials it is important for trained observers to follow through all stages from package making, through filling, distribution and the markets and statistical comparisons of damage are made with existing packages.

6. MARKET RESEARCH

Market research to identify requirements and costs of comparative packaging materials in current use is essential, to provide targets for both cost and properties in any future development.

ANNEX 1

JOB DESCRIPTION
DP/IND/86/037/11-14/J13102

Post Title :	Packaging expert
Duration:	2.0 man-months (in split missions of 1.0 m/m each)
Date required:	As soon as possible
Duty station:	Calcutta
Purpose of the project:	Strengthening the capability of the Indian Jute Industries Research Association (IJIRA) to develop new packaging products
Duties:	The expert shall - advise the project staff on appropriate methods and designs for rigid or semi-rigid packaging products using jute based materials developed in IJIRA; - arrange and evaluate tests relevant to such products; - assist in field trials and in the commercial exploitation of these nsew products; - suggest future lines of development work for IJIRA in this field.
Qualification:	A university degree with several years of practical experience in the development of materials and new packaging products and bringing them up to the performance requirements of the market.
Language:	English

ANNEX 2

STAFF OF IJIRA

1.	Dr. A K Mukherjee	Director of IJIRA and National Project Director
2.	Mr. P K Pal	Project Leader, JRP Group
3.	Mr. A K Rana	Scientist JRP Group
4.	Mr. A K Biswas	Textile Engineer, JRP Group

Annex 3

PEOPLE MET

1. Dr. D Gupta	Deputy Jute Commissioner, Govt. of of India, Ministry of Textiles and and Executive Diretor of the National Centre for Jute Development 20B Abdul Hamid Street (6th Floor) Calcutta - 700069
2. Mr. D K Sarkar	Industrial Adviser to the Jute Commissioner, Director and Chief Executive, Birds Jute Exports Limited. 20B Abdul Hamid Street (6th Floor) Calcutta - 700 069
3. Mr. S C Sarkar	Jute Expert 118 Regent Estate, Calcutta -700092
4. Mr. V J Shah	Proprietor, International Exports, 2nd Floor, 6 Khaltu Place, Calcutta - 700072 Inter alia exports jute based Christmas packs
5. Mr. A C Biswas	Chief Mill Manager Birds Jute Exports Ltd.
6. Mrs. N Saggi	Secretary, Jute Manufacturers Development Council, Ministry of Textiles, Govt. of India, 71 Park Street, Park Plaza, Calcutta - 700 016

ANNEX 4

REFERENCES

1.	G A Gordon	Technical Report : First Mission 1 - 30 September 1991
2.	P K Pal	Report on initiation of trial on JRP boxes at KMVN and GMVN - IJIRA July 1991
3.	Indian Standard IS:10	Specification for Plywood Tea Chests Part 2 (Plywood)
4.	Technical Core Group JMDC	Project Profile of Jute Chest (Apple & Tea),April 1989

ANNEX 5

EQUIPMENT TO BE PROVIDED BY UNDP

1. Equipment for the production of jute composites (Recommendation 1) Specification and sizes have not been developed.

   Needs are : A small grinding machine
   Vibratory table
   Mixer

   IJIRA estimate that cost in India would not exceed 35,000 US Dollars

2. Equipment for Creasing (Recommendation 4) a creasing press - available in India at cost of less than 2000 US Dollars

   1 US dollar = 29 Rs.

ANNEX 6

VISIT TO THE APPLE GROWING AREA AT NAINITAL

This visit had as its objectives the study of the environment in which packs for apples, both the traditional wooden box and the experimental JRP box, had to perform and any problems that had been found with the latter.

Discussions were held with Mr R K Verma and Mr K N Khanna, respectively Managing Director and Manager (Marketing) of Kumaun Mandal Vikas Nigam Ltd (KMVN)*. The company is a Government of India, Ministry of Textiles, undertaking with wide interests in tourism, woollen mills, carpet making, besides fruit. Visits were made to some apple orchards and to the factory which made up the experimental JRP cases and also makes the timber boards for the traditional box: this factory, sited on the plain, then sends the timber up to the packing stations made up into sets, each for one box. The box is then made up at the packing station.

Both the orchards and the packing stations are in mountainous areas with terraced slopes which have gradients up to and exceeding 60°. There are few roads and such is the difficulty of transport that KMVN have built several rope ways (steel cable) to transport packing materials to, and fruit from, the packing stations across valleys. Many private orchards, unlike some Government ones, are not near a packing station and fruit is then transported by foot or animal with the fruit in bamboo baskets or in sacks. Much damage occurs.

The JRP box is more complex than the traditional box and has to be assembled at the factory, so that, not being collapsible, transport costs to the pack house are high. Also the JRP boxes took longer to make. Thus the high cost of JRP and the added labour and transport costs made the box too costly. An added factor in the private sector is that much of the timber comes from illegally felled trees and costs less than the Government standard price.

There seems little point in continuing with trials of this type of jute based box for apples until the problems of complexity and cost of a jute based box have been addressed. A collapsible box is essential if it is to be assembled away from the packing stations. Future trials need to be supervised through from case making to the markets by staff from IJIRA and/or the Indian Institute of Packaging.

* KMVN Ltd, Secretariat Building, Nainital-263001, UP