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INDIA

Technical report: Utilization of jute for geo-textiles*

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 J. Thomson,
expert in geo-textiles

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United Nations Industrial Development Organization
Vienna

* This document has not been edited

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PART 1

PURPOSE

Strengthening the capability of the Indian Jute Industries Research Association (IJIRA) so that it can undertake development work on jute as a geo-textile material. In doing so IJIRA will be in a position to offer technical assistance to jute mills which are in this market or propose to enter it.

DUTIES

1, Reviewing the work done at IJIRA and visit trial sites

2. Make a tour of potential end users

3. Hold discussions with jute mill executives.

4. Prepare a report with recommendations for future work.

PART 2

VISIT TO INDIA

2.1. Introduction

Departure was from London on 16th. July for Delhi and Calcutta and return was from Bombay on 2nd. August for London. Apart from a two day private visit the whole of the period was working or travelling in connection with the contract.

The program for the visit had been organised by IJIRA and covered an initial review of work done, visits to sites, meetings with potential end users and manufacturers.

IJIRA had planned the program over a three week period as they did not seem to be aware of the two week period envisaged in the job description. It was possible by some re-arrangement , working long hours and weekends to cover the whole of the original program in the two weeks.

2.2 Review

The initial period was spent in Calcutta reviewing the work done to date and the potential role of jute as a geotextile.

The extensive periods of travel and the evenings in hotels together with IJIRA people provided additional review and discussion time.

Discussions and meetings were taken with a number of IJIRA officials including Dr. Ranganathan, S.Palit, S.N. Ghosh, P.K. Chatterjee.

Work by IJIRA to date has been directed towards four possible applications.

a. Existing form of jute mesh for mitigation of soil erosion
b. Revetment filter
c. Mulch for high value crops
d. Pre-seeded fabric for turf production

The work undertaken to date was jointly reviewed.

a. Soil Erosion

The problem of soil erosion is one of great concern in India and has according to some reports reached a crisis situation. The loss of valuable top soil and the siltation of rivers and reservoirs are major drains on the economy. The problem is particularly acute in that India naturally has large areas covered in erodible soils and has a high and heavy rainfall which is very erosive.

An open mesh woven material known as "Soil Saver", "Anti-Wash" and Geojute has been exported by the jute producing countries to USA and Europe for a number of years. This material has been the subject of trials and investigations and the fibre has been shown to have a number of natural advantages although the structure has some shortcomings.

The writer in a Jason Consultants report to IJO in 1987 suggested that there could be a potentialy large domestic market for jute erosion control materials.

IJIRA as part of their present task of promoting jute geotextiles has organised a series of trials using "Soil Saver". These trials have been in conjunction with various Government bodies. The trials are at various stages with some started about two years ago and others installed this year.

In most cases the major role in instal'ing the material and monitoring the tests has been with the user organisation.

In West Bengal trials were currently underway with the Forestry organisation at Siliguria in the hills and at Digha on the sea shore sand dunes. The Central Soil and Water Conservation Institute at Dehradun were also undertaking trials on residual minestone tailings in the foothills.

In addition IJIRA contacts with Railways Research, Design and Standards Organisation had established that they had independantly undertaken their own tests which had been favourable, In a similar way Central Road Research Institute at Delhi was found to

have undertaken independant trials for road embankments and cuttings in the latter part of the seventies. Again with a favourable report.

The information available within IJIRA on these trials was limited or in the case of railways and roads almost non-existent. Subsequently visits to sites added considerably to the level of knowledge.

b. Revetment Filter

River and sea shore bank erosion is counteracted by protection of the surface to resist the forces generated by flow and waves. This is a civil engineering problem requiring substantial protection measures. One method widely used is to install a layer of stone pitching on the shore line to stop the loss of soil. The rise and fall of the tide and wave action causes water to flow into the pitched bank and then drain away. This two way flow is known as Dynamic Flow. This flow is capable of dislodging and carrying away the soil which lies below the stone protection and ultimately causing the revetment to fail. To protect against this action traditionally a granular filter is installed between the stone and the soil which theoretically allows the water to pass through freely but not the soil particles. The design and choice of suitable granular material for this filter is not an easy task. The use of geotextile filters in such cases has proven to be an attractive alternative.

The Calcutta Port Trust in their development work at Haldia Port were suffering serious erosion to an island in the river. A program of bank protection based on stone pitching is underway. As part of their development program they were investigating the use of geotextile filters and had invited synthetic and jute manufactures to provide suitable materials for trials.

The authority had specified what they required in terms of technical specification including the porosity, which is critical in a filter layer. A woven jute sub-strate coated with bitumen had been developed and supplied by a jute manufacturer for this application. The authority had been responsible for installing. An initial 200 sq.m. had been supplied in February 1989 and a further 3000 sq.m. in March 1990.

It is also understood that a jute fabric had been used by Calcutta Port Trust in the Hoogly river bank revetment work. In this case the application had been varied by using the fabric as part of a mattress that was sunk on to the slope to be protected. A D.W. Twill 800gm.sq.m. coated in bitumen was laid over bamboo splits. The block and boulder pitching being placed after sinking the prefabricated mattress. The work was undertaken in 1988 and was reported to be very succesful in that bank erosion had been stopped and silt deposition was in the order of 60cm in 12 months.

One other local use of jute in erosion control was suspending jute sacking cloth in the water close to the bank which is being protected. The objective is to check the flow velocity and encourage deposition of silts.

Agro-Products

Although not strictly geotextiles there has been a great increase in the use of materials of a geotextile type in the agro business. Such uses and products are very closely allied to soil erosion matters.

c. Blanket Mulches

With high value crops using expensive seed high rates of germination are of great importance. It is practice to protect the seedlings using mulches. Providing protection against rain splash, sun , cold and bird attack a variety of mulch materials are used. There are drawbacks with existing forms. Plastic sheeting can lead to build up of soluble salts in the soil. In some cases growers find it is necessary to remove and then replace a conventional straw mulch each day.

A trial was carried out in 1988 in association with CTRI (Tobacco Research Institute) at Hunsur to protect seedlings in nursery beds. The jute material used was standard "Soil Saver".

The results from conventional mulches- paddy straw and paddy straw cum husk - were compared to jute "Soil Saver".Jute mulch showed significant advantages in height, weight and survival rates of seedlings.

A further trial for mulches was in aiding germination of tomato plants. This was caried out in 1989 with the State Horticultural Research Station, Krishnagore, West Bengal using

a control based on growers practice,
a straw mulch
plain 6 x 7 jute cover
open mesh Soil Saver

Based on the results for
Seedlings per.sq.ft.
Av. number of leaves
av. leaf surface area
the trials showed that plants germinated and grew better under mulch and that under the "Soil Saver" the best results were obtained.

These trials have been reported in technical papers and the measurements and monitoring of comparitive results add credibility to the work.

d. SuperSod

This work is associated with Clemson University. A non-jute product is being marketed in USA which is a pre-seeded non-woven for growing carpet like turf for instant lawns. A number of products of this type exist in USA and Europe.

It was decided to put in hand some experiments based on using a jute non-woven. Difficulty was experienced in obtaining grass seed which is not normally used in India. Laboratory trials were

undertaken based on mustard seed. Very poor germination and the trials were adjudged a failure.

2.3 Visits to Trial Sites
Visits were paid to a wide variety of sites.

2.3.1 Erosion Control Sites
a. Darjeeling Area - The trip involved a flight to Bagdogri and travel by car to Siliguri and the trial sites. This is a restricted area and it was necessary to obtain a permit to visit the immediate region. To visit Darjeeling area as planned was abandoned because of the problems in getting a further permit.

A visit was made to Sukhna Range Office and contacted Beat Officer responsible for trials.

The following day was spent in visiting trials area which lay some way up the hillside from Siliguri on the roads to Darjeeling and Ghanktok.

The extensive hill areas above Siliguri are heavily covered in vegetation and trees. There are also extensive areas under terraced cultivation for tea plantations.

The area is of recent geological age and the rock is relatively unstable and schists and slates are commonly found.

The slopes are steep sided and in the wet season (June to September) are prone to instability and land slips are common. From observation it appeared that in some cases slips were of the slab type where soil cover had slid off the underlying dipping rock. More commonly slides were of the circular slip type. The rise in the phreatic surface appears to be the trigger for the slide.

A considerable number of old and new slips could be seen.

Chunabah Site. The area being treated at Chunabah was the site of a substantial circular slip where earth and rocks had slumped down the slope and blocked the road and railway track. The road had been cleared and the surplus material spread down the slope to the lower side of the road. A toe wall had been constructed with rock gabions and the next stage objective was to try and stabilise the slipped material above the road with vegetation.

An area of several thousand square metres was being covered in "Soil Saver" jute. The site was extremely steep and rugged with many rocks and boulders. The only access was by a steep climb.

The way in which the jute was being used was not entirely satisfactory. In some cases it was being laid along the slope rather than down it. The jute was in many cases suspended over rocks, boulders, hummocks and vegetation. The securing of the jute to the surface with burial trenches top and bottom and pinning at frequent intervals was not in line with good practice. Insufficient overlap was allowed between adjacent rolls.

Sacharum grass species were being planted through the jute mesh.

Khalijhorn Trial This site was about an hour from Siliguri and was also the scene of a substantial landslip from a steep slope down towards the river in the valley bottom. The slip had come to rest in a large mass above the river. The material was a mixture of rocks, stones and silty clay and was probably close to further movement. Again the Forestry people wished to vegetate the area as quickly as possible to reduce the loss of soil and risk of slippage.

About 3000sq.m. were being placed and here the material was correctly laid down the slope. The problem of lack of contact of the jute with the soil where it is held up on rocks and vegetation was still a problem. Anchoring by burial at top and bottom of slope was not being done and the wooden pegs being used appeared to offer little anchorage and could be easily dislodged. There was insufficient overlap between adjacent rolls of the "SoilSaver"

Sacharum grasses and other species were being planted through the mesh .

The opportunity was taken to see the Forestry traditional method of re-vegetating with live staking and mulching . This was on an adjacent area.

Comment
The Forestry people appeared to be well informed about the overall problems of erosion control, soil conservation and slope stability.

It was established that re-vegetation work would normally be done in the period March/April to provide maximum opportunity for establishment before the rainy season. Laying the material in the rainy season was difficult and there was a high risk of further slips.

There was a lack of understanding on how jute functioned and its role in erosion control. There was an absence of any guidance from the suppliers on how to use the material and how it works. Also of concern (in that these were supposed to be proving trials) was the lack of understanding by the jute people of the nature of the erosion problem being tackled and their lack of participation in the designing and monitoring of trials.

It is of the greatest importance that surface soil erosion and instability problems are not confused. Where in the longer term vegetation will function as the protection and surface stabiliser then jute has a role. As an erosion control blanket it has no role in stabilising soil mass which is unstable.

The work seen was at the limit of erosion control practice of this type and the jute material being used was not really appropriate to meet the needs of this work.

In reality these were not trials in the accepted sense but demonstrations. No control plots were being used, no program of monitoring or measurement. As a result of my visit the method of laying was modified and a control plot left. A regular program of

monitoring was to be established.

It will be difficult to draw any lessons or be able to base any development or further work on the results at these sites although they are of great interest. There is a danger that for a variety of reasons, some of which are entirely outside the role of jute, this work will not be successful. The reaction will be to assume that jute does not work and dismiss it for future schemes.

b. Digha

Digha is a small town lying on the Bay of Bengal and some 5 or 6 hours by car from Calcutta. The Forestry Beat Officer who accompanied us was Roy Chaudhury.

The site visited in Digha was also under the Forestry Authority but the problems were of an entirely different kind to the work previously seen. Here the erosion force is wind rather than rain and surface flow.

Stabilisation of the sand dune area adjacent to the shore was needed and again the long term solution lay in establishing vegetation cover. 10 000sq.m. of "SoilSaver" had been supplied for trials and part was being laid during our visit. In this case the conditions were not very onerous and the SoilSaver should perform a useful function in establishing vegetation.

The sand hills were not high and were gently sloping with a number of established trees. The jute blanket was reasonably well laid but insufficient overlap was provided and the burial at top and bottom of slopes was needed to stop wind dislodging the jute. The ground cover plants being planted through the jute were Iponea Biloba and other suitable hardy shoreline species.

An extensive area of sand hills had been successfully stabilised by planting of this type but without use of any short term protetion such as "SoilSaver".

Again this is a demonstration site rather than a trial and again it was suggested that some control areas be installed and the job monitored to compare performance.

c. Deradhun Trials

The town of Dehradun was visited by car- a 6 hour journey north from Delhi. The trials were being undertaken through The Central Soil and Water Conservation Research and Training Institute who are centered in Dehradun.

The trial area was located at Sahashadora a few kilometres outside Dehradun in a steep sided valley. The particular problem in this area arose from the effects of limestone mining. Over some years uncontrolled mining of the high quality limestone had been widely practised. Considerable environmental problems had arisen and the government had managed over a period to close down all these mines. A major residual problem was the tailing's heaps left over the workings. Substantial dumps of material had been tipped and were unstable. Considerable problems had occurred with

these materials slipping doen the hill side and blocking roads and water courses. At one point we passed through one river channel area of many hectares which was covered to a depth of a couple of metres with these tailings.

The Institute were trying to stabilise these tailings by a variety of methods including channel forming with gabion walls, live staking and slope vegetation. Slopes were steep and rather barren consisting of small granular limestone with little soil. They were experimenting with variety of methods including the use of jute- "SoilSaver". Some initial trials had been made using "SoilSaver" in combination with mulch material. These were not succesful and it is suspected that possibly too greater thickness of mulch had been used which cut out too much light and hindered germination. It was noted the climatic conditions had caused jute to degrade very rapidly - within 6 months. This early degrading had been a problem in that vegetation is slow to establish in these conditions. A life of 12 months is probably needed for this type of work. Overall the control methods being used had resulted in a considerable improvement in stabilisation of these tailings and nearly eliminated slips of the material on to the roads.

Comment
The people from the Institute had a good understanding of soil conservation problems and solutions. There was a lack of understanding by the Institute of how "SoilSaver" functions which probably arose from lack of communication between the supplier and user. Again an almost total absence of any understanding, liasion or participation by IJIRA in this work.

It was possible to put forward a series of suggestions on how best to use the material for their particular needs. Suggestions included some simple comparitive trials using various combinations of jute and mulch. Although seeding is by far the commonest way of revegetating in Europe and USA it was agreed it is is probably not appropriate for India. Seed is not readily available and is expensive. The alternative of planting seedlings and other developed plants is more appropriate and is likely to be more effective. The jute mesh structure is ideal for the planting work and should provide good protection during plant establishment.

It is hoped that further monitored trials will be mounted.

2.3.2 Revetment Filter Site

a. Haldia Port Trust

The port of Haldia lies on the Hoogly River some 4 hours by car from Calcutta. The Trust has its own engineering group including a section responsible for river training and bank protection. We met engineers A.Bose and P.Roy from the group.

The river at Haldia is divided into two arms by a low lying island Nayachar and because of siltation problems in the shipping channel a training arm had been installed on the northern end of the island. The objective being to divert an increased flow through the western shipping channel and reduce siltation. This training arm had been constructed using Dutch expertise. Advice

on the design, construction and installation had been provided by Delmas, a consultant from Holland. A series of preformed mattresses were constructed on land and floated out and sunk at the site. Stone pitching up to 1500mm thick was then dumped on to the mattresses. The mattresses were formed from bamboo frames and used imported Dutch geotextiles from Robusta as the filter layer. This was a 185gm extruded tape polypropylene in combination with a heat bonded non-woven. These geotextiles and the consultancy was provided by the Dutch Government under an aid scheme.

As a result of this work the western shore of the island was subject to increased erosion forces and protective measures were put in hand. Protective revetments and a series of training fingers or moles had been installed at intervals.

A revetment type protection was used which consists of a protective stone layer overlying a filter. The 600mm protective layer is designed to absorb the energy from the water and to allow water to pass freely, both in and out, through the structure. The purpose of the filter which is in contact with the soil is to allow the water to pass but to retain the soil particles. This filter traditionally was a designed granular layer but geotextiles have found to be an economic alternative.

The Haldia Port Trust in carrying out the revetment work had used a number of materials on a trials basis to form the filter layer.

> Needle punched non-woven polypropylene supplied by Hitkari of Bombay and Supreme India Ltd. Approx 250 sq.m. from each supplier.
>
> Two layers of Nylon filter cloth purchased locally
>
> A woven jute sub-strate coated with bitumen.

The authority had specified that the filter should have a 150 micron pore size.

These trials were undertaken in the early part of 1989 and subsequently a further 3000 sq.m. of the jute filter had been supplied for installation work in 1990.

The original trials and the later section were inspected. A sample was taken from the bituminised jute material for further examination and testing . Unfortunately this sample was misplaced.

The revetment work appeared to be controlling the bank erosion and there was visual evidence of silt deposition. On the original trial site problems were noted on one section (not a jute section) where there appeared to be a failure through undercutting of the toe. The installation of the training arm and the subsequent protective measures had set up a series of eddies and reverse currents which were causing the undercutting.

In discussion with the designers a number of points were made.

It was suggested that in line with normal practice an initial layer of smaller size stone should be first laid on the geotextile. This would act as a cushion and reduce the risk of damage to the geotextile.

The initial revetment design had been for the full length of the slope. To save money it had been shortened and the lower part permanently under water left unprotected. The revetment is probably now inadequate as underwater erosion of the toe will undermine the structure and cause slippage and failure.

One point made by the authority was the need to attach to the lower end of the geotextile some form of end weighting such as sandbags. This keeps the lower end in close contact with the bank even when the material is exposed. The jute material was not strong enough to carry this type of loading.

Comment
There are serious reservations about the use of a bituminised jute in this context. It has to be pointed out that it was the authority who specified the material and chose to use jute rather than them being sold the material.

The reservations arise from the following:

- A revetment filter is a permanent structure and needs to perform over a number of years.

- A filter is quite a sophisticated application involving dynamic flow.

- Failure of the filter can lead to failure of the system.

- During construction the filter is subject to rough handling and needs to be durable and tough.

- The consistency of the material and in particular the pore size are important for it to function correctly.

My doubts arise from:

- The relatively short life ofjute

- The lack of serviceability of a bituminised jute

- The difficulty in producing a material with a consistent 150 micron pore size.

- The likelihood of long term bitumen flow turning the filter into an impermeable membrane.

The sample taken appeared to be a completely impermeable membrane without any pores.

2.4 Potential End Users

During the visit a number of organisations were visited who could be potential users of jute geotextiles. Some of these organisations were already involved with the trials described in the previous section.

2.4.1 Forestry Offices -

Siliguru, West Bengal
Representatives met : K.N.Singh, Conservator of Forest- Research and Planning, S.Patel,District Forest Officer, P.K. Datta Range Officer Sukhna and A.Chanda Range Officer Kalijnora
Digha, West Bengal
Representatives met: P. Gupta Administrator and A.Roychaudhury Beat Officer

Comment
A wide ranging discussion of the problems in the foothills showed that soil conservation and revegetation are areas of great concern. There are a wide variety of problems.

The main area of interest rehabilitation of landslip areas. These were a frequent occurrence and some were extensive. Some of the slip areas seen were still unstable and needed more permanent civil engineering treatment.

The main concern lay in stabilising slipped areas by revegetating quickly and limiting loss of soil.

A large number of small localised slips were noted. Such exposed areas could lead to surrounding area being destabilised. The possibility of a program of early remedial work was proposed.

A river erosion site was visited in Mahananda Wild Life Sanctuary where due to river changing course the river bank adjacent to the access road was in danger. Vegetation alone would be insufficient to stablise the bank.

Another problem raised was the vegetation of deposition areas in rivers. Again to give some stability the aim is to vegetate these islands and banks of granular material. The problem lies in lack of finer silt material which will provide a basis for plant growth.

Digha Forest Office - West Bengal
Representatives met: P. Gupta, Administrator, A. Roy Chaudhury Beat officer.

Comment
The problem for this area was wind erosion causing movement of coastal sand dunes. The conventional solution lies in establishing vegetation which will protect and bind the surface.

2.4.2 Central Soil and Water Conservation - Research and Training Institute, Dehradun.

Representatives met: R.K. Gupta Acting Director, D.N. Puri Forest Officer and G.Juyal Engineering Division

Comment
The extent of erosion problems was extremely extensive and some of the problems that the Institute were interested in included; high Altitude (around 12000 ft) revegetation in the Himalayas, desert area revegetation and "bad land" rehabilitation.

2.4.3 Calcutta Port Trust Haldia
Representatives met : A. Bose and P.Roy

Comment
Although the majority of the protection work being undertaken required engineering solutions there were a number of potential situations where jute in various forms could be used to assist in revegetation and silt deposition.

2.4.4 Research, Design and Standards Organisation (RDSO) Lucknow - Ministry of Railways, Govt. of India.
Representatives met: O.P. Jain, Director General, Dr. N. Ananthanarayana, Additional D.G. and Parmod Kumar, Geotechnical Engineer

Comment
The railways have a extensive length of track which requires regular maintenance and upgrading. They are currently undertaking a 1200km. program of extension. They have a substantial office of 30 or more people in the geotechnical section and use of geotextiles is of great interest. They have an internal document "State of the Art- Use of Geotextiles in Railways"

The main problem lies in finding a suitable geotextile to lay under the ballast layer and over the natural soil. The problem for all railways is the loading imposed by passing trains sets up a pumping action which causes migration of water and soil particles upwards into the ballast. This soil migration and the weakening of the ballast causes track settlement and the need for maintenance gang to lift track by adding and packing ballast and also at intervals removing all the ballast for cleaning and replacement. Sections of track subject to this problem usually have to be speed restricted and the cost of track maintenance is high.

A geotextile which can act as a separator layer and as a filter will greatly reduce the problem. P. Kumar also felt that he needed a geotextile which had sufficient strength to act as a reinforcement.

The problem for jute geotextiles in this context lies in producing a material that is durable and will work for 20 to 25 years and that is sufficiently robust for the application.

In addition railways have extensive cut slope erosion problems and the normal solution lies in permanent vegetation. For short term protection and to aid vegetation establishment the railways have undertaken trials using jute "SoilSaver" and found it to be effective. This is a good application for jute using existing products. To date despite the approval the railway operating regions have not used "SoilSaver" for this purpose.

2.4.5 Central Road Research Institute - New Delhi

A meeting arranged with CRRA had to be postponed due to flight delays from Lucknow . A meeting was being attended by Mr. Palit and Mr. Chatterjee of IJIRA on the day of my departure. A report of this meeting is awaited.

It was established that CRRA had also undertaken trials using jute as an erosion control blanket and found it to be effective. It did not appear that in practice much if any material had been used for protection of cut slopes on road works.

Road Authorities are potentially a major user of geotextiles and it is important that in any development program a close liasion is formed with bodies such as CRRA. There is a need to identify the main areas of interest and difficulty.

2.4.6 Central Water Commission - New Delhi

The meeeting arranged with this organisation had to be postponed due to the flight delay in Lucknow. Again a report of the meeting is awaited.

This organisation is another potentially large user of geotextiles and particularly erosion control materials for watercourse embankments.

2.4.7 State Building Company -Delhi
Representative met: Susanta Sengupta Technical Director
(Also a meember of the Standing Conference of Indian Public Enterprises)

The opportunity was taken by Mr. Palit to introduce me to Mr. Sengupta who showed considerable interest in the potential use of geotextiles in construction work. He was able to appreciate the benefits that could be available both technically and financially. He explained the steps that would have to be taken by any enterprise wishing to penetrate the market with new concepts. The need to demonstrate on real work the methods and materials and provide proof of benefit was paramount. The need to support the product with sound technical information and support was also emphasised.

2.4.8 Dr. Dattye - Bombay

Dr. Dattye is a well known Civil Enginering Consultant based on Bombay.

For many years he was the senior partner in a firm employing about 60 staff. Recently he appears to have taken partial retirement in order to pursue some of his own ideas. He has considerable interest in Bio-Technical engineering. This is the use of natural materials alone or in combination with more traditional engineering materials to provide solutions to geotechnical problems. He has also taken a considerable interest in geotextiles.

We discussed the potential for geotextiles and he provided information on about 10 Indian textile companies who were trying to establish in this field. He also felt that the very high cost of geosynthetics, due to tax on basic polymers, would limit the use in India. He was a strong advocate of the use of indigenous materials such as coir and bamboo for such work. He also felt that jute could play an important role but his experience with the industry to date had given him a very negative attitude. He was interested and encouraged to learn of the IJIRA work.

He was of the opinion that for erosion control in India there were immense problems and extensive opportunities for developing solutions based on jute materials.

2.5 Jute Industry Executives

Ludlow Jute Mills

Representatives met: General Manager and Production Manager.

A visit was paid to Ludlow Jute Mill, Chengail, Howrah. Ludlow are the leading Indian manufacturer of "SoilSaver" with virtually all their production going to one distributor, Belton, in the USA. The current level of production is around 800/900 tonnes (Around 1.8 million sq.ms.) annually but this has dropped from a peak of 1500 tonnes.

It was quite obvious that although they had made the product for years they had no understanding of how it worked or its application.

The management professed an interest in making geotextiles and suggested that if I would send them samples they would make copies.

They seemed unable to grasp that in the geotextile business you sold clients answers to problems not rolls of cloth.

The opportunity was taken to inspect the non-woven plant and to determine the possibility of making a suitable non-woven for geotextile use. Also a number of other forms of jute were considered.

It was arranged that the mill through IJIRA would arrange to send me samples of various materials. These are now awaited so that further consideration can be given to their potential use.

PART 3
POTENTIAL FOR USE OF GEOTEXTILES IN INDIA

The site visits and discussions held with authorities confirmed that there was a potentially very large market in India for a whole range of geotextiles.

To tap the demand this demand will have to be done by developing products (solutions) to meet the specific needs of users in India. Products will need to have a whole range of characteristics and qualities according to their application. From experience of the development of geotextiles in the rest of the world there will be demands for both general purpose volume products and relatively small quantity high value specialist products.

The role of jute in the geotextile picture is determined by its natural characteristics. In particular its lack of durability effectively bars its use in long term applications. Time and effort should not be wasted on trying to imitate synthetics in these applications.

A detailed analysis of applications will determine where long term durability is a key factor. There are a wide range of applications where the geotextile only requires a relatively short life.

3.1 Erosion Control

By far and away the most important role for jute in geotextiles lies in the field of erosion control. The natural characteristics of absorbancy, drapeability and bio-degradation are all positive factors compared to synthetics.

India is noted for the extent of its soil erosion loss and a wide range of problems were identified during the visit. Erosion problems vary widely and include:

- Road embankment and cutting slopes
- Rail embankment and cutting slopes
- River, canal and stream bank erosion
- Forestry revegetation
- Slip material revegetation
- Mining waste revegetation
- Sea shore sand dune revegetation
- Desert dune revegetation
- "Bad land" rehabilitation
- High Altitude revegetation

We encountered a number of organisations who highlighted the large potential demand and the need to find effective erosion control methods.

Within the visit brief no proper market study was to be undertaken but it is possible to envisage that with proper development an annual demand of millions of square metres can be created in India for erosion control materials.

The current form of jute erosion control material -Geojute, Soil-Saver etc - no doubt can be used for some applications. It is not a properly designed material and has shortcomings.

In some of the trials where it was being used it was likely to prove inadequate. To properly exploit the market will require a range of products designed to meet specific needs.

Mulch Blankets (See Section 3.2.4)
I would couple with erosion control materials the development of mulch type products for the agro industry . There is a great deal of similarity in the nature of the problems and the forms of the solutions.

Some of the agro businesses have soil conservation problems. During my visit to the Darjeeling area we saw a number of tea plantations where areas of soil had slipped and their was a need for re-establishing cover and tea planting.

3.2 Other Applications

The market for erosion control products is so potentially large that it may well be a diversion of limited resources to enter into other geotextile applications at this time.

A number of other potential geotextile applications came to light during the visit and perhaps could be developed in due course. For the following applications virtually no detailed research has been carried out into the technical and market demands. Until there is a clear understanding of the needs and the economics it is foolhardy to start any form of development.

3.2.1 Three Dimensional Honeyccmb Product
See sketch on attached sheet.

A three dimensional product which is formed from strips and sewn to form a honeycomb type configuration when pulled out could find application in a number of ways. Products of this type were originally developed by the US Corps of Engineers as a substitute for sandbag construction. Such structures are used to build walls and to form foundations. When filled with granular material through the cellular construction are able to carry quite heavy loads as a road or airfield foundation. Another application is to contain material on slopes and prevent surface loss and slip. The military use is for building emplacements and bunkers by using these 3 dimensional grids filled with granular material on top of another to form walls.

The use would be for short term applications to provide temporary roads, parking, emplacements. They also can be used for slope containment prior to establishing more permanent protection.

3.2.2 Unpaved Roads
Unpaved roads of which there are many thousands of kilometres in India suffer from failure by rutting. The use of reinforcement geotextiles has been shown to extend the life of such roads. It should be possible to develop a suitable form of jute fabric which would provide both a separation and reinforcement function. The life of such roads before they have to be remade is quite short so that the lack of durability of jute is not a factor. it may be an advantage to use some form of protection on the jute, such as bitumen to extend the life.

3.2.3 Paved Roads
It was noted that in the 1930's Calcutta Highway Authority had carried out trials using a layer of jute when resurfacing. The report states that the performance of the jute treated roads was superior to the control sections left untreated.

In USA there is a very widespread use of geotextiles in road repaving. More than 50 million sq.ms. annually.

This is a complex subject but a simplistic explanation is that a suitably treated geotextile layer acts as a seal and prevents the ingress of water through the top layer into the foundations below. It is always the failure of the foundations, often due to water ingress, that causes the problems seen at the surface of roads.

3.2.4 Agri- Mulch
Reference has already been made in this report to the work undertaken in trying to use existing products for this purpose. There is potentially a large demand in India in high value crop cultivation for some form of mulch protection product. The need is to identify clearly what are the funcuons that the mulch has to perform and then design and develop an appropriate product, or series of products, based on jute.

I have already suggested that such developments should be closely coupled with erosion control product development.

3.2.5 Fabric Formwork
A rather specialised but possibly interesting and appropriate application for jute would be for use as temporary formwork in certain types of concrete injection work.

For example geotextiles are used for underwater formwork for repairs to concrete structures such as quay walls, piles, foundations. A fabric form is tailored and fitted with closure means such as zips. This form is taken by divers and fitted to the structure to be repaired and then concrete is injected into the space formed between the old structure and the fabric formwork. For example a corroded pile under water will be renovated in this way. See sketch on attached sheet.

One particular fabric formwork is used to form a revetment protection on river banks. A specially developed two skin quilted fabric form is laid over the area to be protected and then filled by injection with a concrete mortar. The formwork is only required to impart the form and give short term protection while the mortar gains strength. See sketch on attached sheet.

CemIndia who operate such a process has already made an approach to IJIRA about possibly substituting jute for the synthetic materials currently used. Although there needs to be a careful evaluation of the functions and the characteristics required in theory it should be viable.

3.2.6 Other
There are a large number of other applications where it may well be possible to develop jute geotextiles to meet Indian market needs.

As stated, at the start of this section, until the proper preliminary analysis has been carried out for a potential application the jute industry should be discouraged from trying to copy existing products.

PART 4
ON-GOING DEVELOPMENT

To exploit this market will require a substantial change of philosphy and commercial direction by the jute industry.

It was very encouraging to see that the IJIRA people, through exposure, had come to better recognise and understand the nature and demands of the business.

IJIRA is well positioned to open the door for the jute industry onto this large potential domestic market. This is only the first stage and unless there is an understanding and commitment from the jute industry to continue to service the market on an enginnering oriented basis the initial investment and effort will be wasted. It was noted that although both railway and road authorities had given approval to use of Geojute materials for erosion control some years ago no follow up had been made by the industry.

4.1 Expertise Required
The in-depth understanding of jute production has little value in this market. There is a need for people who can identify and understand users problems and then apply a knowledge of jute to the problem. Currently these people are not generally available in the industry. It was interesting to note that certain individuals within IJIRA grasped this point and oriented the thinking towards client needs rather than jute products.

4.2 Jute Manufacturers
The industry to exploit this market on a commercial basis will have to change in a number of ways.

First the jute industry must see jute fibre/fabric as engineering materials and not as commodity textiles.

Second it has to organise itself to produce solutions to clients problems not sell products. To do this will require people who can directly understand the client's problems and interpret these into a specification. Most of the time the client will not provide a traditional textile type specification. At best he may provide a performance specification i.e what he expects the product to do.

Thirdly the industry will have to understand the need to produce products which are made to a consistent engineering standard.

This change of attitude to being market oriented rather than product oriented is an evolution that has had to take place in all the leading geotextile manufacturers.

4.3. Tests and Trials

With regard to the development and trial work undertaken to date this has only a limited value in that trials on the whole have not been conducted in such a manner to yield any positive information that can be used for technically proving performance or for interpolating in further developments.

It is important that we differentiate between laboratory tests, field trials and demonstrations. In laboratory tests all inputs and outputs can be controlled, measured and analysed. Field trials are usually a second stage to prove findings from laboratory tests. The opportunity for measurement is much less and the variables much greater. It is still important to maximise the information return by means of regular observation and control plots. A third stage is demonstrations to potential users of the benefits of a product on their work. Apart from ensuring the material is used correctly monitoring is limited. Demonstrations are essentially a promotional exercise.

A new series of trials should be undertaken but this time it is important that prior to entering into any such trials a procedure should be developed and followed.

The first task would be to work closely with the user to understand the technical and economic needs and what he is trying to achieve. The importance of working with the end user cannot be over emphasised. He has an excellent understanding of his own problems. He is able to offer experience and expertise in developing solutions. By working together he proves that the solution works for him.

From this initial understanding it will be possible to determine if existing forms of jute could be used or if it will be necessary to develop alternative forms. The present approach of handing out free samples and having no knowledge of where or how it is going to be used is dangerous. Failure through misuse will give the product a bad name.

The trials need to be properly mounted, controlled and monitored so that useful information can be obtained on performance.

Where appropriate it may be prudent to put new forms of material through laboratory controlled tests where conditions can be controlled and accurate measurements can be taken.

The results of these kinds of trials and tests can form the basis for developing improved products, technical papers and promotional literature to support the product.

Generally on this trip we encountered well informed and co-operative potential users who would welcome the kind of approach suggested.

PART 5
RECOMMENDATIONS

I would suggest that what now needs to be done is:

1. To re-define a strategy for developing jute geotextiles in India with clear goals and time frame.

2. To draw up a detailed implementation plan with regard to the work to be carried out by IJIRA. This plan should be based on initial development concentrating on erosion control and mulch products with other applications being considered at a second stage

3. Determine the additional resources that are going to be required to implement the plan. (Stages 1 and 2)

It can be foreseen that some specific actions will need to be taken:

a. The current visit has clearly indicated the need for extensive specialist assistance and inputs in the future work. Experience and understanding of geotextiles and their application and the ability to interface effectively with potential users is just not currently in IJIRA. In the short term there is a need for more input and visits by myself (or other experts) to help IJIRA formulate and implement a program.

b. In the medium to longer term there is a need for IJIRA to build up their own resource and expertise and rely less heavily on external inputs. It is suggested that IJIRA recruit a suitable young civil engineer with probably a Master Degree in "Geotechnical Engineering"

It is unlikely that he will have either the background or the experience to make an immediate contribution and he will need to become fully acquainted with the problems of soil conservation and erosion control. To this end it is suggested that he attends the course offered by Central Soil and Water at Dehradun.

He also needs to gain expertise and experience in geotextiles. It will be possible to arrange for European and North American experience. Close liasion with myself on the proposed work and developments will both assist in the education progress and ensure that the ongoing development is economically and technically effective.

c. As a textile based organisation IJIRA need to become much more involved in and familiar with the geotextile and erosion field. A cheap and quite effective way is to become a member and participate in the activities of the International societies concerned with these subjects. The International Geotextile Society and The International Erosion Control Association are relatively inexpensive to join and offer a grear deal of information and contact.

d. There is a considerable need for extensive education of the potential clients and the jute industry itself. Both clients and the industry need to be informed on the benefits, application and economics of geotextiles.

It is suggested that a series of technical courses and workshops be presented.

e. Their will be a need to produce "Good Practice" guides to help field workers and installers use jute geotextiles in appropriate applications and to install the material correctly.

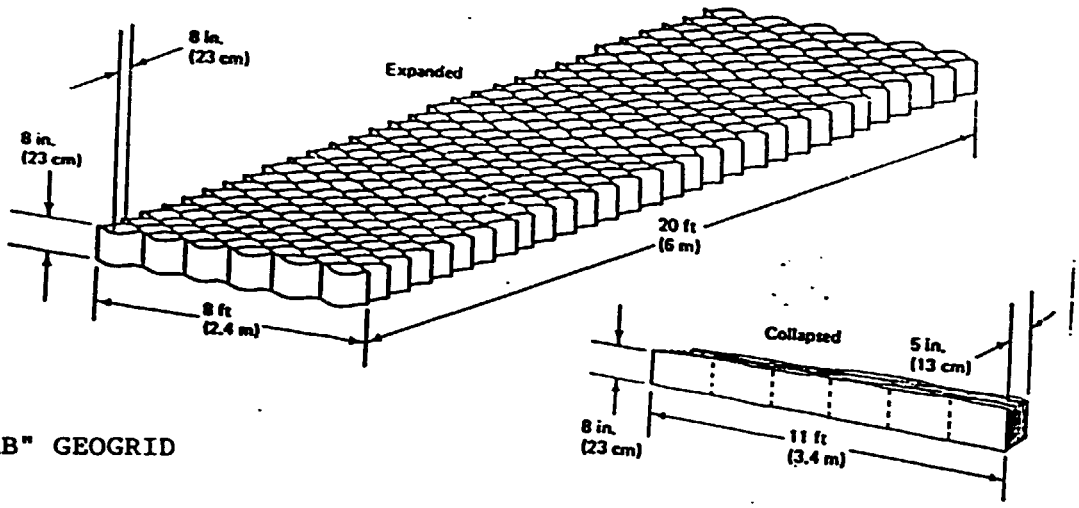
f. A considerable part of the proposed program requires good quality report writing and a high level of communication. The quality of verbal and written communication from IJIRA needs improving to meet the future demands.

g.Consideration should be given to IJIRA devloping its own basic test facilities for geotextiles. This facility would be valuable in determining the engineering properties of various materials for trials.

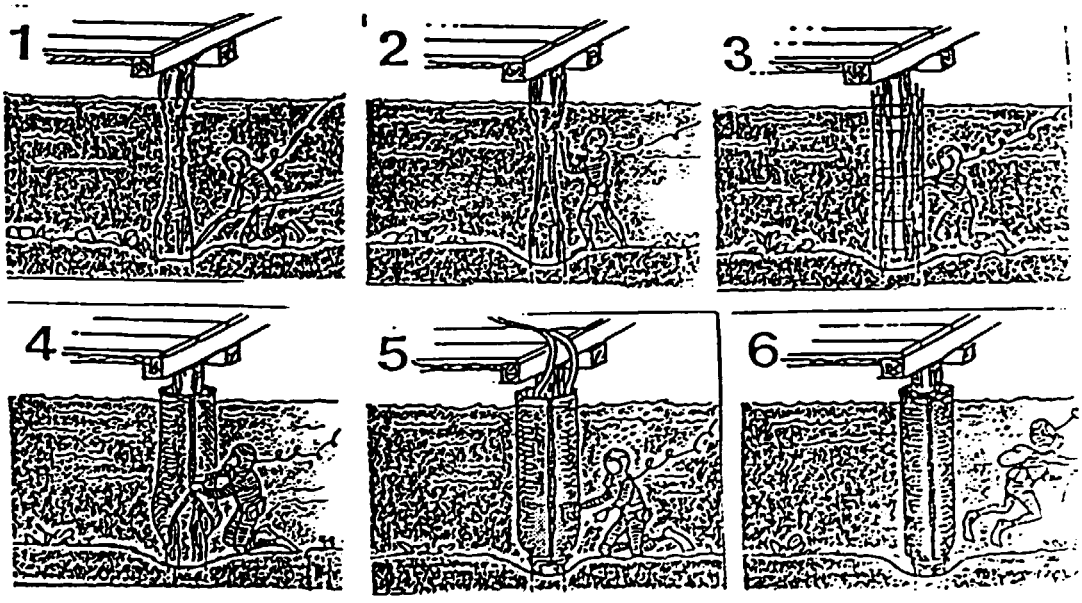
It would also have an important role in providing a quality control function when commercial production is underway.

A simple test facility in the form of a rainfall simulator for testing erosion control products should also be installed.

It is quite posible that these facilities could be offered on a commercial basis to all users and manufacturers of geotextiles in India.



"HONEYCOMB" GEOGRID



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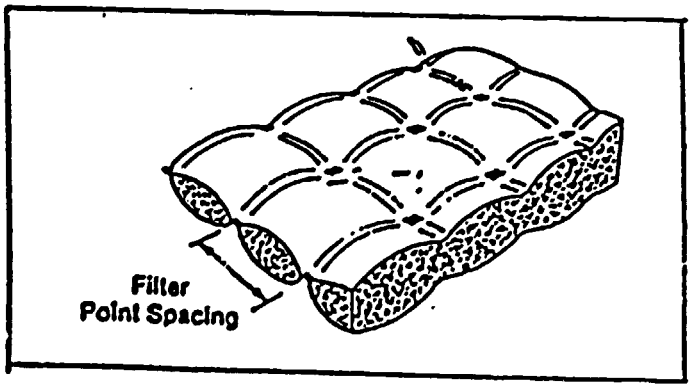

Fabriform Revetment Mattress