UTILISATION OF SISAL FIBRE (AGAVE SISALANA L.) - A REVIEW

Laxmikanta Nayak, D. Nag, S. Das, Deb Prasad Ray
and Lakshamanan Ammayappan

National Institute of Research on Jute & Allied Fibre Technology
12, Regent Park, Kolkata –700 040, India.

Received : 24-12-2010 Accepted : 21-05-2011

ABSTRACT

Sisal is a perennial plant identified by its 50 – 150 thick, spiky, long and rigid spirally arranged leaves. Upon maturation, pale yellow/shiny white fibre can be extracted from leaves by retting followed by washing and drying. Easy to raise on wastelands in a wide range of agro-climates, sustained fibre yield for a considerable long duration and versatility of the fibre as a potential input material for various applications makes it a viable option for employment generation and rural development thus leading to sustainable development.

Key words : Sisal fibre, Cordage, Rope, Yarn, Paper.

Sisal fibre occupies 6th place among plant fibres, which represent 2% of the world’s production of plant fibres (Rehm and Espig, 1991). A good sisal plant yields about 200 commercial used leaves with each leaf having a mass composition of 4% fibre, 0.75% cuticle, 8% other dry matter and 87.25% moisture. Thus a normal sisal leaf weighing about 600g yields about 3% by weight of fibre with each leaf containing about 1000 fibres. The fibre can be potentially used for making Cordage (rope, twine and yarn), Composite materials (automobile components, construction roofing and paneling materials), woven materials (carpets, bags and buffing cloth etc.), organic fertilizer, animal feedstock, industrial alcohol (ethanol), pharmaceutical products (Inulin), pulp and paper (specialty paper, reinforcement) and energy generation (biogas, electricity). Apart from fibre processing, allied activities like cultivation and fibre extraction are proven means of employment generation due to its labour intensive and low tech nature.

Production scenario

Sisal is mainly grown in arid and semi-arid regions of Andhra Pradesh, Bihar, Orissa, Karnataka, Maharashtra and West Bengal. About 275 species are distributed in tropical regions of India. The major sisal cultivation districts of different states in India are given below.

<table>
<thead>
<tr>
<th>State Name</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karnataka</td>
<td>Chamraj Nagar</td>
</tr>
<tr>
<td>Tamilnadu</td>
<td>Vellore</td>
</tr>
<tr>
<td>Uttarakhand</td>
<td>Kumaon, Kotdwar, Kolhupani, Dehradun</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>Durg, Bhopal</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>Ahmednagar</td>
</tr>
<tr>
<td>West Bengal</td>
<td>Midnapur (E)</td>
</tr>
<tr>
<td>Jammu &amp; Kasmir</td>
<td>Bhalwal, Jammu, Ratnapur Sarara, Kathuwa, Kathua</td>
</tr>
</tbody>
</table>

Source: List of potential hubs – Ministry of Textiles, www.indianhandicrafts.nic.in

Sisal is currently found on embankments, bunds and roadsides serving the purpose of soil conservation and protection as hedge plantation.

* Corresponding Author E-mail: laxmikanta8495@rediffmail.com.
Presently, sisal fibre is collected and utilized for conventional purposes like ropes, anchors, cordages and handicrafts. They are not optimally utilized and commercially exploited with respect to the abundant availability, superior characteristics/quality and wide applicability.

**Extraction of Fibre**

Sisal fibre is extracted by the process of Decortication. Leaves are crushed and beaten by a rotating wheel set with blunt knives, so that only fibres remain. The other parts of the leaf are washed away by water. Decorticated fibres are washed before drying under the sun or by hot air. The fibre quality depends upon moisture content, so proper drying is important. To get better grades of fibre artificial drying has been found in place of sun drying and the optimum moisture content for best quality fibre is 13.5%. Dry fibres are machine combed and sorted into various grades, largely on the basis of the previous in-field separation of leaves into size groups.

**Properties of sisal fibre**

Sisal fibre consists of 66–72% cellulose, 12% hemicellulose and 10–14% lignin. The superior engineering properties (Ultimate Tensile Strength 468–640 Mpa, Modulus of 9.40–15.80 Gpa and elongation of 3-7%) makes it as an excellent material for manufacturing high strength textile and reinforcement composites for various applications. (Chand and Rohatgi, 1994, Soumitra Biswas et. al. 2005).

**Sisal fibre Uses**

**Building materials**

Sisal fibre has been proved to be very suitable reinforcement in various polymeric matrices. The Central Building Research Institute, Roorkee and Regional Research Laboratory, Bhopal has investigated several techniques for sisal fibre surface modification for its use in the production of roofing sheets. BMTPC, New Delhi and TIFAC (DST) has also sponsored a number of schemes/projects for natural fibre reinforced composite building materials. Sisal fibers used with natural or synthetic resins can be better in technical terms, more economic and environment friendly. For example: to produce furniture, by using fiber grass, the chairs become more durable, less weighted, less expensive and a lot better when compared with the synthetic fibres.

**Rope making unit**

Sisal fibre is widely used in rope making and also manufacture of sacks and paper. Ropes are extensively used in agricultural operations and is handy on bullock cart while transportation of goods. The market for the product is expected to grow in the rural market in the near future.

**Organic fertilizer and electricity**

The sisal waste, which otherwise degrade in a landfill, and produce methane, a major greenhouse gas was successfully utilized in Tanzania, one of the world's leading producer of sisal fibre to produce organic fertilizer and green electricity. The project was launched with the technical support of UNIDO. The endeavour helped in both the ways of increasing the productivity and reducing the pollution level. Farmers are using the locally produced organic fertilizer sold at very affordable price to increase the productivity of the land while conserving the soil.

**Animal Feed**

The project started in East Africa aims at achieving the integral use of sisal plant and has performed trials using fresh and ensilaged sisal wastes (biogas) for feeding beef and dairy cattle, sheep and goats. The International Livestock Research Institute of Nairobi is co-operating the project by preparing the statistical analysis of the achieved results and defines the strategy to be followed.

**Blended yarn**

In a recent pioneering effort, Central Research Institute on Jute & Allied Fibres, Barrackpore and National Institute of Research on Jute & Allied Fibre Technology, Kolkata in collaboration with Baranogore Jute Mills have developed Jute – sisal blended technical and
industrial yarns using traditional jute spinning technology running in the jute industries. In these yarns, the physical properties of Jute fibre, like high tenacity and low extensibility have been advantageous used through compatible blend of sisal that has more flexible/durable in comparison with the jute fibre.

**Diversified products**

Technical yarn produced from jute and sisal fibre blends possess the desired quality characteristics for being used in the manufacture of high valued technical and industrial fabrics such as geo-textiles, carpets, sewing threads for jute sacks and other uses. Wrappers have been developed from jute- sisal blended yarn (80:20) having shiny and warm characteristics to be used in the cold areas as warm clothes.

**Handicraft unit**

Decorative handicrafts and utility items are prepared using sisal fibre as the only raw material and that in combination with other natural fibres with identical characteristics. In Uttaranchal, several NGOs have been working with sisal fiber for the past several years, such as Women’s Development Organisation, WDO, Dehra Dun, Girish Griha Resha Udyog, Kotdwar, and HOPE, Pilkholi Ranikhet. They have demonstrated successfully the commercial potential of Sisal fiber handicrafts.

**CONCLUSIONS**

The sisal fibre and its allied activities like cultivation, fibre extraction, processing and making value added products are proven sources of employment opportunities and income generation. The extent of research and development activities on sisal plant, coupled with engineering applications like composites, automotives etc. indicates that, trained artisan and women are able to sustain with the income generation through the sisal related activities thus making it as a viable option for rural empowerment.

**REFERENCES**


http://www.crijaf.org/about/aicrp.html.

http://www.indianhandicrafts.nic.in

http://www.sisal.ws/page5/page5.html
