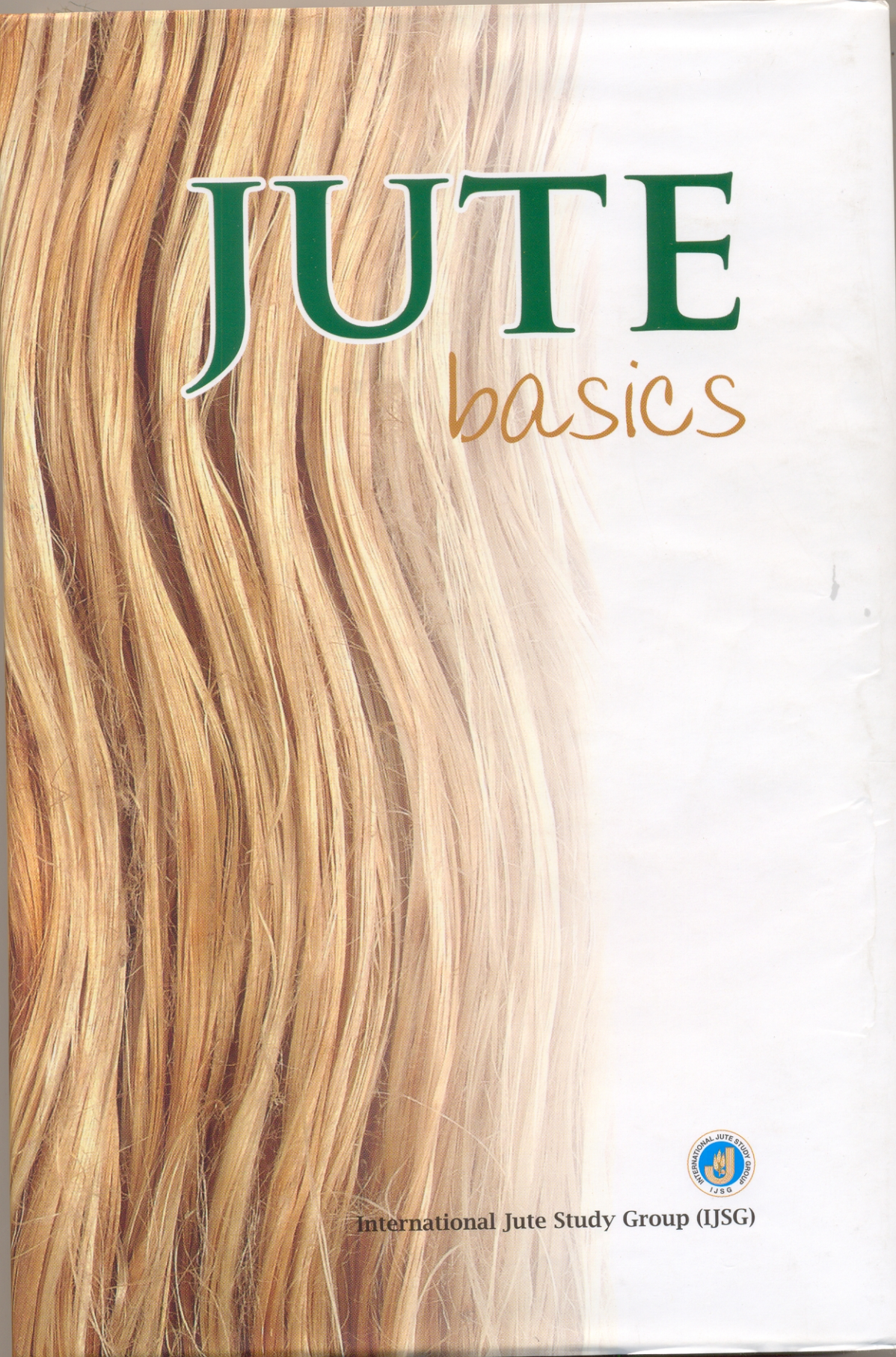


JUTE
basics

International Jute Study Group (IJSG)

JUTE
basics



International Jute Study Group (IJSG)

JUTE basics

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Foreword

This book is on one of the most widely grown fibres of economic importance i.e. 'Jute', obtained from the stems of the plants grown mainly in the South Asia.

The purpose of this publication is to introduce 'Jute' with its versatile attributes to the prospective consumers and the environmentally conscious people of the world especially those of the non-jute-growing countries. This book will hopefully increase awareness and thereby promote trade and marketing of jute and its various products in the global market.

The publication is intended to be treated as a hand book for jute. It aims at catering to the need of the users and dealers of jute and jute products. The book contains core information including technical and scientific descriptions to the extent necessary to enable interested readers from varied backgrounds to know and understand jute. Thus, it is hoped that this book will provide a better understanding of the more important aspects of jute as a raw material and the basic processes involved in converting this raw material into various products.

This book also attempts to fill the knowledge gap in the sector and bring together comprehensive information in respect of agricultural production, structure and properties, mechanical and chemical processing, finishing processes and also various traditional and non-traditional and diversified uses of jute.

The vast scope of the subject needed some editing and the authors and the editors had to use their wisdom and judgement in making the topics pertinent to the objective of the publication. The authors are experts having specialised knowledge and experience, most of who are actively engaged in research/ industry/ trade/ business and other fields of jute.

Some of the information might have appeared earlier in different forms such as technical articles, study reports, statistics etc. in various publications in different countries. But this book is expected to have all the updated information collected, collated, correlated and brought together in a single volume.

Dearth of printed material on jute in a compiled form and in a systematic way has prompted the International Jute Study Group to take up this work. Easy to understand mode of writing along with adequate illustrations,

photographs, data etc. is expected to make this book a unique piece of handy reference publication and would satisfy a large number of people who have taken up career/ business/ trade and interest on this eco-friendly and versatile natural fibre jute.

I take this opportunity to thank all the chapter authors for their lucid articles on various aspects of jute. I also express my gratitude to the members of the editorial board, especially Dr. Debanjan Sur, who has taken great pains to moderate the transcripts and give them uniformity without diluting the substance. I would like to mention that the concept of preparing this book came from our former Secretary General Mr. T Nanda Kumar whose vision is now becoming a reality. I also recall the efforts of my immediate predecessor, Mr. AFM Sarwar Kamal in this regard. I shall be failing in my task if I do not mention Dr. Latifa Binte Lutfar, my colleague in the Study Group who worked relentlessly in assimilating the drafts and also politely reminding all the authors, including me to adhere to the time schedule in submitting their transcripts. It is the cumulative effort of all these persons that has enabled this book to see the light of the day.

Sudripta Roy
Secretary General
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Acknowledgement

The book, Jute Basics, has dealt with various available information and data, considered to be the basic foundation of jute. For the purpose, we needed to consult a lot of published literature. Since the list is too long, mention of all these publications has not been felt judicious. Only the important ones have been quoted at the end of several Chapters. We take this opportunity to express our deep sense of gratitude to all the experts who authored these publications.

We are indebted to all the authors who had accepted our invitation to contribute towards this book by providing their valued write-ups and also gracefully accepted the modifications of the same made by the Editorial Board in keeping with the objective of this book. We also deeply acknowledge the support of some important jute organisations in terms of supply of several photographs, diagrams, tables/charts, etc.

We are thankful to all who have helped us in different ways in publication of this book and also my predecessors who initiated this attempt and continued till I joined this organisation and provided me with the opportunity to complete the task in my humble and best possible way.

Chief Editor

Abbreviation

ASTM	–	American Standards for Textile Materials
BADC	–	Bangladesh Agricultural Development Corporation
BEF	–	Bangladesh Employers Federation
BIS	–	Bureau of Indian Standards
BJA	–	Bangladesh Jute Association
BJGA	–	Bangladesh Jute Goods Association
BJMA	–	Bangladesh Jute Mills Association
BJMC	–	Bangladesh Jute Mills Corporation
BJRI	–	Bangladesh Jute Research Institute
BJSA	–	Bangladesh Jute Spinners Association
BJTRA	–	British Jute Trade Research Association
BTRA	–	Bombay Textile Research Association
CAFTA	–	Central American Free Trade Agreement
CAOBISCO	–	Association des Industries de la Chocolaterie, Biscuiterie et Confiserie de l'UE (Association of the Chocolate, Biscuit and Confectionery Industries of the European Union)
CFC	–	Common Fund for Commodities
CGR	–	Centralized Germplasm Repository
CSIR	–	Council of Scientific & Industrial Research
CRIJAF	–	Central Research Institute for Jute & Allied Fibres
CZJRI	–	China Zhejiang Jute Research Institute
DCCI	–	Dhaka Chamber of Commerce & Industry
ECF	–	European Coffee Federation
EMA	–	External Market Assistance
EPB	–	Export Promotion Bureau
EPIDC	–	East Pakistan Industrial Development Corporation
EUROJUTE	–	European Association for the Trade in Jute and related Products
FBCCI	–	Federation of Bangladesh Chamber of Commerce & Industry
FAO	–	Food and Agricultural Organisation
GDP	–	Gross Domestic Product
GOB	–	Government of Bangladesh
GOI	–	Government of India
GSP	–	Generalised System Preferences
HRD	–	Human Resource Development
IBPGR	–	International Board for Plant Genetic Resources (formerly, IPGRI)
ICAR	–	Indian Council of Agricultural Research
ICB	–	International Commodity Body
ICCO	–	International Cocoa Organisation
ICO	–	International Coffee Organisation
ICJC	–	Indian Central Jute Committee
IJIRA	–	Indian Jute Industries' Research Association
IJMA	–	Indian Jute Mills Association
IJO	–	International Jute Organisation
IJSG	–	International Jute Study Group
IJT	–	Institute of Jute Technology
ILO	–	International Labour Organisation
IOCCC	–	International Office of Cocoa, Chocolate & Sugar Confectionary
ISO	–	International Standards Organisation
ITC	–	International Trade Centre
JAF	–	Jute and Allied Fibre
JARI	–	Jute Agricultural Research Institute
JARL	–	Jute Agriculture Research Laboratory
JBA	–	The Jute Balers' Association
JCI	–	Jute Corporation of India Ltd.
JDPC	–	Jute Diversification Promotion Centre
JDPs	–	Jute Diversified Products
JMDC	–	Jute Manufactures Development Council
JRC	–	Jute Research Council
JRI	–	Jute Research Institute
JSI	–	Jute Seed Inspector
JTM	–	Jute Technology Mission
JTRL	–	Jute Technological Research Laboratories
LAFTA	–	Latin American Free Trade Association
MCCI	–	Metropolitan Chamber of Commerce & Industry
MDG	–	Millennium Development Goals
MJI	–	Myanma Jute Industries

MSP	–	Minimum Support Price
NBPGR	–	National Board for Plant Genetic Resource
NCJD	–	National Centre for Jute Diversification
NGOs	–	Non-Governmental Organisations
NIRJAFT	–	National Institute of Research for Jute & Allied Fibres Technology
PCJC	–	Pakistan Central Jute Committee
PEA	–	Project Executing Agency
PJMA	–	Pakistan Jute Mills Association
PP	–	Polypropylene
ppm	–	parts per million
PSCB	–	Private Sector Consultative Board
RBO	–	Rice Bran Oil
R&D	–	Research and Development
SAFTA	–	South Asian Free Trade Area
SCA	–	Seed Certification Agency
SMEs	–	Small and Medium Enterprises
STMS	–	Sequence Tagged Micro-satellite Site
SYI	–	Sustainable Yield Index
TIC	–	Textile Industries Corporation
TIV	–	Thermal Insulation Value
TKP	–	Tamarind Kernel Powder
UMIST	–	University of Manchester Institute of Science and Technology
UNCTAD	–	United Nations Conference on Trade and Development
UNDP	–	United Nations Development Programme
USD	–	United States Dollar
USP	–	Unique Selling Points
WTO	–	World Trade Organisation

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Glossary

JUTE basics

The Story of Jute – Past, Present and Future

Sudripta Roy

Chapter 01



Sudripta Roy

Secretary General, International Jute Study Group; A senior member of the Indian Administrative Service, worked as Joint Secretary, Ministry of Textiles, Government of India (GOI) just before joining IJSG and held a number of important administrative positions during his 32 years in the Civil Service of GOI; MPhil in Public Administration.

Jute is the most versatile natural fibre gifted to man by nature. Grown in the eastern part of the Indian subcontinent (in India, mainly West Bengal and Bangladesh), it is the second largest natural fibre produced after cotton. It is a bast fibre produced from the plant family *Tiliaceae* and genus *Corchorus*. It is a relatively cheap natural fibre with multiple uses. However, till recent times it was principally used as a packaging material. Today Jute, after passing through difficult times, is gradually emerging as a versatile, multipurpose, biodegradable, environment friendly inexpensive natural fibre.

Jute fibre is a mix of cellulose, hemi-cellulose and lignin (as found in wood). It is recovered from the skin of the plant, thereby falling in the category of the bast fibre along with kenaf, mesta, hemp, flax, and ramie.

Today two major types of jute grown are White Jute *(Corchorus capsularis)* and Tossa Jute *(Corchorus olitorius)*. The former variety is more than four hundred years old and has been used for spinning and manufacturing ropes, twines and cloth. The golden coloured tossa was developed by the British as an individual fibre for the manufacture of cheap reusable packaging material. Jute cloth is known as 'hessian cloth' and jute bags are called 'gunny bags' (derived from Hindi word meaning cheap). In North America 'hessian cloth' is commonly known as 'burlap'.

1.1 Jute Yesterday

It is not definitely known since when the jute plants were recognised as the source of fibre and utilised for making ropes and sacking mainly in the Indian subcontinent. References of sacking bags made of jute have been traced to the literary work of Mukunda Ram Chakraborty as far back as in 1575. In the *Ain-i-Akbari* (Jarret, 1590) there is mention of sack cloth, which was identified with jute from Rangpur, presently a northern district in Bangladesh. Sack cloth made of jute has been referred to as an article of trade in several Bengali literary works of 16th and 17th Century. Rumphius in 1743, one of the earliest workers on Bengal plants, gave an illustrated account of jute plants along with a figure of white jute mentioning therein that it was under cultivation in Bengal (India), the Arakans and South China. He even mentioned that the fine white thread made out of this fibre was stronger than that from cotton. Jute is believed

to have been traditionally in use in many other parts of Asia and Africa since ancient times to provide cordage and weaving fibres from the stem and vegetables from the leaves.

Though jute has been cultivated in the alluvial soil of the Gangetic Bengal for the last four hundred years, its acceptance as a popular natural textile fibre took place in the middle of the nineteenth century.

The first jute mill in the world was set up in 1830 at Dundee in Scotland, when the technology of spinning 100 per cent jute yarn with old flax machinery, after modifications, was established. Thereafter, a number of jute mills were set up in and around Dundee. The first power-driven jute weaving mill started functioning in 1838.

From 1830 to around 1855-60, the jute industry around Dundee had grown. The Scottish spinners, who were earlier depending on Russian flax (interrupted due to the Crimean War 1854-56), flourished too using jute as imported from India. However, other European entrepreneurs (apart from the Scottish jute spinners) realised that manufacturing units located thousand miles away from the raw material source point is not the best business strategy. Considering the growing profitability of the jute industry they realised that it would be prudent to have production units close to the raw material base.

To initiate manufacturing activities, the joint venture model with a local player emerged as the most sensible and strategic business structure. The first jute mill of India was set up in 1855 by G Auckland, a British, and Bysumber Sen, a Bengali. It was located at Rishra in West Bengal.

Jute thrived in the last half of the nineteenth century in spite of some inherent problems and the existence of a vibrant cotton industry. Nobel Laureate Amartya Sen stated that "it was a social ethos against cotton industry – but in favour of Jute that helped the sector as exporters contributed to Britain's settlement of dollar purchases. Between 1879 to 1920 the export of raw jute went up a number of times and the loomage went up by 500%."

In 1879 the factories in Bengal had 4946 looms which went up to 39,000 looms, 812,421 spindles and had 2,54,000 heads working in the jute sector in 1920. The growth was largely due to the increased requirement of jute for packaging during the First World War. All this made Wallace remark in his book *The Romance of Jute* "what a beautiful decade it was".

The great depression of late twenties did not affect the jute industry as it continued to thrive during the period. In 1930, the year of the great depression, the then Chairman, Indian Jute Mills Association, remarked "But when all the adverse conditions are prevailing, we must remember our unique position. We are the only textiles industry in the world which can control production to meet the world demand. Jute is only grown and harvested in Bengal and 60% of it is manufactured within a radius of 30 miles of this room (in Calcutta) at much less cost than anywhere in the world and we should not hesitate to take advantage of our fortunate portion to ensure that there should be no loss in manufacture" (IJMA Report, 1930).

Therefore, it is widely believed that all was well with the jute industry till the advent of the synthetics. This, however, is not correct, as the sector had to face major difficulties in the second quarter of the twentieth century. During the years leading to the Second World War the jute sector was confronted with two-fold problems. First was a major management problem and the second was the trade issue. Since the beginning of the twentieth century Scottish capital investment in jute industry was being replaced by Indian capital. By 1930, the Marwaris came to own 67% of the total investment in jute and only seven of the 65 jute mills were registered in England. The investors wanted a greater say in the day to day business transacted in the mills but management which was in the Scottish hands had their own agenda. Moreover, the British regulators created major obstacles for the jute suppliers and traders who were predominantly locals. Their raw jute was not certified and the entire material had to be sold through European firms. Meanwhile, the traders developed their own trading systems such as *fatka* (speculative forward trading), *bhitor bazaar* (inside trading) which upset the calculation of the industry managers. Ajit Dasgupta in his book *Jute Textile in India* remarked that during this period "profit dwindled seriously, though trade increased".

In the area of trade there were setbacks too. A number of countries shifted to paper from jute. Hessian was replaced by Sisal Kraft in Australia. Egypt banned jute for cotton baling. SG Barker in 1938 warned about the rise in the use of chemicals and the use of synthetics and regretted that no scientific research was taking place in the jute sector. The situation would have worsened but for the beginning of the Second World War which led to increased demand for commodities especially jute for carrying / storage of food grains and sugar for the soldiers.

The end of British rule and the partition of India created a piquant situation for the jute industry. The area under jute cultivation got located in erstwhile East Pakistan (now Bangladesh) whereas jute mills were mostly situated in the State of West Bengal in India. The Indian mills worked well below capacity due to the absence of raw jute. On the other hand the industrialists of East Pakistan set up new state-of-the-art jute factories besides modernising the existing ones. Very shortly Pakistan took over the world jute market bringing in a major portion of foreign currency earnings for the country.

Meanwhile India embarked upon large scale cultivation of jute. The government of India came ahead with proactive protectionist policies whereby jute was procured from farmers at minimum support price and the packaging of food grains, sugar, fertiliser and cement in jute bags was made compulsory. The policy continues even today in a slightly diluted form which has badly affected modernisation of the sector in India. With an assured market guaranteed in the form of government supplies, most jute mills continue to use old machinery and produce sacking materials in large quantity. There are, of course, certain exceptions as some export-oriented units have been modernised and are into manufacturing of some diversified products like shopping bags, special packaging materials such as food grade jute bags, etc. and conventional products of improved quality.

Jute industry was the life blood of the Bangladesh economy for several decades and still continues to be one of the mainstays of the rural economy of Bangladesh till today. About 15 million farmers in Bangladesh are involved in growing this cash crop and about an equal number are involved with its processing, conversion, transportation, marketing and trade etc.

Under the onslaught of polythene and other synthetic materials, jute started losing traditional market in East Pakistan and later in Bangladesh. For a few years farmers in Bangladesh either faced a severe problem in marketing raw jute or shifted to other crops as they did not get reasonable price. This adverse situation led to the closure of the Adamjee Jute Mills, the world's largest jute mill. The decade of eighties and nineties were difficult times for Bangladesh jute industries as the government refused doles and handouts to the ailing jute sectors. However, jute cultivation continued due to internal demand. The export of raw jute also increased significantly as the quality of Bangladesh jute continued to be better than that produced elsewhere. Between 2004 and 2008 the jute market

turned back again and the price of raw jute has doubled due to the increased demand of jute products all over the world.

1.2 Jute Today

Jute, the versatile natural fibre with its environment friendly quality is on the path of regaining its past glory. According to a report of Wigglesworth & Co. Ltd. "The closure of many jute spinning and weaving plants in many developed nations of the world, has resulted in the transfer of production of finished articles back to the point of origin of the fibre itself. This has reduced the costs of production and enabled jute to maintain a stable level of consumption for an extended period."

The specifications and standards of classic jute products have remained unchanged for decades. Sacking is used for making bearing bags for food grains and other commodities. Previously a sack weighed about one kilo and was used to transport and store one quintal of produce / production. The International Labour Organisation has now issued guidelines that head load of more than fifty kilos will not be permitted as it is torturous for the labour force. Hence, presently each sack weighs about two-third of a kilo and is able to store fifty kilos of consumables. Sacking itself represents about half of the industry's output. In the last decade an improved 'food grade' jute bag has been developed which is similar to the conventional one but does not contain any mineral oil. Instead vegetable oil of permissible quantity is used. The food grade jute bags are mostly exported to Africa and Latin America for packaging of cocoa, coffee beans and shelled nuts.

Next to sacks is hessian, which is a cloth made from fine yarns and weighs fifty percent less than sacking material. Some of the hessians are used for making finer sacks and bags, while the rest are used in a variety of applications right from wrapping plants to collecting grass cuttings and as a support cloth to linoleum flooring. Altogether hessian cloth accounts for around twenty percent of the total output of the world jute goods production. Yarn and twine are also major traditional products. The yarns are primarily exported to carpet weavers in Europe and Middle-East where they are woven into the back of the carpet in order to provide bulk and stability. This usage of jute yarns in carpet manufacturing accounts for twenty percent of the jute output. In fact the wide hessian cloth, known as carpet backing cloth (CBC) and used for both primary and secondary backing for tufted carpet, now occupies a very minor part of the market with primary backing altogether phased out due to inroads of synthetics in this area in recent years.

The remaining portion of jute output is taken up by a wide range of small amounts of specialised products. Geo-textile products form the bulk of those items of which 'soil saver' is the most prominent item. It is an open weave material using very heavy yarns. These are laid on the hill slopes to prevent soil erosion. Other jute geo-textiles can be used for river bank protection and road construction. Jute woven matting and carpets are used for floor covering. Jute shopping bags are made from better quality hessian cloth. Home furnishing fabrics, wall hanging, footwear, various gift items, handicraft products and toys made of jute are finding consumer's acceptance.

Considerable emphasis is being paid to the production of several non-traditional products, which are popularly called 'Diversified Jute Products'. The intention to introduce diversified products made wholly or partially from jute fibre has important ramification for the industry. The yarns used in such applications are generally finer in count and considerably better in quality than those used for the manufacture of traditional products. This means that there is a considerable shift towards Baxter flyer spinning and to some extent ring spinning and away from conventional two-legged flyer spinning. This has led to more capital investment, higher level of design, better marketing skills and a degree of entrepreneurship above and beyond the traditional industry. On top of that there has to be a considerable expenditure on R&D.

The real future of jute, however, lies in the area of technical textiles be it geo-textiles or agro-textiles. In spite of the domination in the fields of natural fibres and textiles, the Indian subcontinent's share in the global technical textiles is a meager 2%. Even within this miniscule share, man-made geo-textiles cater for over ninety percent of the total demand. Synthetic geo-textiles are imported though there is a tremendous scope of development and use of jute geo-textiles in the Indian subcontinent.

During the Textile Summit held in New Delhi in September 2007, Dr. Manmohan Singh, Hon'ble Prime Minister of India laid great emphasis on the growth and development of technical textiles. A subsequent study conducted by the Textile Commissioner's Office at Mumbai through PricewaterhouseCoopers revealed that natural geo-textiles such as jute geo-textiles (JGT) account for a tiny 1% of the total basket of geo-textiles. Yet, in view of the increasing global concerns for environment there is a palpable shift towards the use of environment friendly biodegradable materials.

Jute geo-textile too is one of the most important products of jute which has a wide range of potential applications and where both the scales

and volume are large. Soil erosion control, vegetation consolidation, soil-reinforcement, protection of riverbanks and hill slopes, land reclamation, road construction are some of the possible applications. The distinguishing features of jute such as high moisture absorption and retention capacity, drainage capacity, flexibility and biodegradability make jute more advantageous and suitable compared to its synthetic counterparts.

In the field of agro-textiles jute cloths are used for mulching and wrapping plants and saplings of trees so that it can be transplanted directly along with the cover without disturbing the roots. Jute is also used to cover the bark of trees to allow uniform growth.

One area of product development which is attracting attention is the use of jute fibres for manufacturing composites. The reinforcement of plastic materials by incorporating either non-woven mats or dispersed fibres in synthetic resin used for injection moulding or compression moulding is becoming increasingly popular. The potential seems considerable and in the next ten years with the growing concern for global warming, an expanded market between two to three hundred thousands of tons of jute would be required. Many of the major automobile manufacturers are using jute and allied fibers for making car components such as dashboards, door panels, etc. in composite form. It is expected that use of these fibres in composite manufacturing would increase in the days to come.

The pressure of synthetics has also forced the jute industry to seek new opportunities of diversification and alternative uses. With investment in R&D for the first time in a significant manner, major breakthrough has been made in the areas of jute geo-textiles and composites. The International Jute Organisation and its successor organisation, the International Jute Study Group has been playing a significant role in the development of these alternative technologies in the last two decades. Even the traditional uses of jute for making cloth for wrapping balls of raw cotton and packaging of food articles such as coffee, cocoa, soybeans etc. are being redeveloped to meet international standards. The use of rice bran vegetable oil in the manufacture of food grade jute bags removes any threat of contamination of mineral oil with the packed food items.

It would be relevant to mention that ever since jute was first mechanically spun in Dundee, a modified version of flax carding and spinning technology has been used. Now, however, jute requires processing machinery with various state-of-the-art features, like electronic auto-control for producing various types of new products as well as for manufacturing

better traditional products. It may be mentioned here that the last major technological change took place in the 1950s when the industries adopted sliver spinning instead of spinning from twisted roving. Since then sadly enough, unlike cotton and synthetic textiles, there has been very little effort to innovate and develop jute machinery with improved features.

The main thrust for mill modernisation has been made in the last decade through the import of second hand machinery, including textile machinery which could be modified for the jute sector. In today's jute sector large numbers of machines, such as carding machines, shuttle looms and winders are over thirty to forty years old and are being still run with the help of locally manufactured spare-parts, which need continued replacement.

1.2.1 R&D and Diversification Efforts

R&D efforts by reputed organisations all over the world have led to the strengthening of natural attributes of jute. Today jute has entered into a varied range of applications, generating employment and leading to a cleaner and healthier environment.

The recent breakthrough in product development has generated some significant results. The more prominent among them are:

- Hydrocarbon-free jute bags for packaging food grade products such as cocoa, coffee and shelled nuts.
- Major development in production of special jute-based yarns using DREF Spinning System.
- Production of blended yarns with jute (over fifty percent by weight) and viscose / acrylic / cotton / wool, which have been found suitable for manufacturing furnishing fabrics, blankets, shawls, pull over, etc.
- Production of fine blended yarns, using jute (around thirty to forty percent by weight) and cotton / silk / viscose / wool, which can be used for manufacturing lighter fabrics for use as home textiles and dress materials.
- Jute reinforced composites in the form of flexible, semi-rigid and rigid boards to substitute wood, timber and ply wood.
- Use of jute pulp to make paper.

Some on-going projects which have encouraged diversified use of jute and generated the hope of creativity, sustainable employment opportunities are the use of jute for paper production, manufacturing of jute-based needle-punched textiles, development of multi-component yarn from jute, wool, and other fibre for floor-coverings, blankets and knitwear. Besides the use of jute in manufacturing lighter and strong hessian fabrics and geo- / agro-textiles, another major prospect of use of large volumes of jute fibre is in the replacement of glass / synthetic fibre for plastic reinforcement. The openings exist both in the areas of compression moulding and injection moulding. The replacement of even ten percent of glass fibre used in plastic moulding by jute would open a potential market for several hundred thousand tons of jute fibre. This new technology would, however, need to adhere to capital investment which the existing mills are unwilling to incur.

1.3 Jute Tomorrow

Though jute's contribution to exports as a percentage of total global export of all commodities has remained constant, its contribution to agriculture and rural employment remains significant. It is also true that market share of traditional jute products has been lost to synthetics mainly due to the price factor. The relatively small size of the jute industry has contributed to its weakness in the market. This industry has been slow in developing consumer friendly specifications. The inability to compete with the synthetics is due to the fact that this sector is dominated by multinational and large companies with substantial investment in R&D. The government policies too have been by and large passive. In India a lopsided protection policy has led to the industry's apathy for modernisation and product diversification. Efforts on the part of international and bi-lateral donor agencies have also not been commensurate with the size of the problem.

Yet jute will not only survive but thrive in the days to come. Because, the growing global concern for environment and therefore increasing consumer preference for biodegradable natural fibre products have opened up a great opportunity for diversifying the usage of jute. Since the domain of technical textiles is being considered today as having the fastest growth rate in the global market, particularly in North America, Western Europe and Asia, this area has to be an important focus for

finding out new applications for jute. It is certainly expected that jute, being stronger and more dimensionally stable as compared to most of the textile fibres, can have greater usage potential in certain specific technical textile applications like packaging (packtech), geo-textiles (geotech), agro-textiles (agrotech) and composites (buildtech, mobiltech).

Today jute can therefore be defined as an eco-friendly natural fibre with versatile application prospects ranging from low value geo-textiles to high value products such as utility / fancy bags, carpets, home furnishings, composites, papers, particle boards, car components, fashion accessories and gift articles. Jute with its unique versatility thus deserves to be branded as the 'fibre for the future'.

It is presumed that in the coming decades a number of jute mills and miniature jute plants will be seen engaged in a big way in the production of high quality fine jute / blended yarns and lighter jute / blended fabrics, to be used for value added textile applications. Simultaneously, the world wide resentment towards synthetic materials would lead to a revival of traditional jute products such as sacks, hessian cloths and CBC.

New environmental considerations have prompted many countries to legislate in favour of environment-friendly products. In spite of this the cost of disposal of non-biodegradable products, cost of carbon foot prints, cost of emission of green house gases etc. are not reflected in the pricing of these products. This is bound to take place as the survival of the planet is in stake and as natural fibres like jute would have to be adopted for numerous environment-friendly applications. With the increasing awareness about positive attributes of natural fibres, the markets for jute products are definitely going to expand.

The concern now has to be on the supply chain. The production of jute has to be increased and farmers have to be motivated to grow more jute. This is only possible if the return on investment is higher than other alternatives. The Govt. of India has been buying back jute from the farmers at a minimum support price whenever there is a glut. Only assured returns can motivate a farmer to grow more jute. This has to be accompanied with modernisation of mills. New technology and new machinery are being developed but the pace is slow. This has to be hastened which is only possible through a quantum rise in demand for the finished product. The paradigm shift is truly in place, and the governments of the producing and manufacturing countries such as India, Bangladesh, Pakistan and Nepal have to provide meaningful policy activities.

One single area which needs urgent attention is the development of machinery and the modernisation of the jute industry.

A start has been made to develop more efficient and productive jute processing equipment in India firstly under an UNDP project in the 1990 and now under Jute Technology Mission (JTM) where a Centre is being set up to design and fabricate new machinery under public - private partnership.

In broad terms, the existing jute conversion process from raw materials to finished yarn or fabric requires around 40 man days per ton, which is highly inefficient and needs to be drastically reduced. It is indeed a daunting task which needs high capital investment as the entire chain of activities right from design of new machinery to its commercial development has to be undertaken. All eyes are now focused on the success of JTM in India. A machine manufacturing company in Ludhiana, India, has developed an integrated carding machine which is under test. It must therefore be kept in mind that new equipment will have to work in tandem with the old ones as no mill can afford to change all its machinery, lock, stock, and barrel in one go. Modernisation is inevitably going to be a step by step affair with few leaders and many laggards.

There is, unfortunately, a perception that jute is a 'dying' commodity. There are many who would like to believe that jute has no future. Their perception is probably based on the fact that the global market for jute products is more or less stagnant.

The jute products, being bio-degradable and hence eco-friendly, are poised for rapid growth in the world market provided this opportunity can gainfully be exploited with judicious plan of actions both on jute agricultural and industrial fronts. Under this plan of actions, while strategic campaign should be launched to promote jute products as eco-friendly materials, vigorous activities need also to be initiated for developing and commercialising a number of conventional and non-conventional jute-based products to offer as eco-friendly alternatives for synthetic products.

The success in accruing maximum benefit out of the emerging global market opportunity for eco-friendly products depends totally on industry's capability for meeting the challenge of producing the best in terms of technical attributes as well as consumer acceptability of the jute products, specially the diversified ones. Such capability can only be built up through initiatives by the jute industry for further investment, technological upgradation, and strategic market promotion.

It is certain that jute has a prosperous future. But, to ensure this, all the stakeholders, led by the jute industry, must strive hard to raise the jute sector to the desired height and thereby to substantially enhance its image before the consumers across the world. For achieving this, those concerned with the jute sector must have a vision on long-term basis and a mind-set that celebrates change.

JUTE
basics

Jute Agriculture

M A Sobhan

Chapter 02



JUTE basics

M A Sobhan

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2.1 Introduction

2.1.1 Background

Among the natural fibres, jute ranks next to cotton in terms of production. Jute is a bast fibre crop. There are a few other natural fibres which together with jute are generally called as 'Jute & Allied Fibres (JAF)'. They are mainly cultivated in the equatorial, the tropical and the sub-tropical zones. The main species of jute and kenaf, which are the major components of JAF, under cultivation include tossa jute (*Corchorus olitorius*), white jute (*Corchorus capsularis*), kenaf (*Hibiscus cannabinus*) and roselle / mesta (*Hibiscus sabdariffa*).

The preference for cultivation of one species or the other varies from country to country. Jute is preferred by Bangladesh, India and Nepal; and kenaf is mainly grown in China and Indonesia, while roselle / mesta is preferred in Thailand. The agricultural and other aspects of JAF crops are more or less the same while the fibre characteristics differ.

For a list of other important natural fibres please see Appendix B.

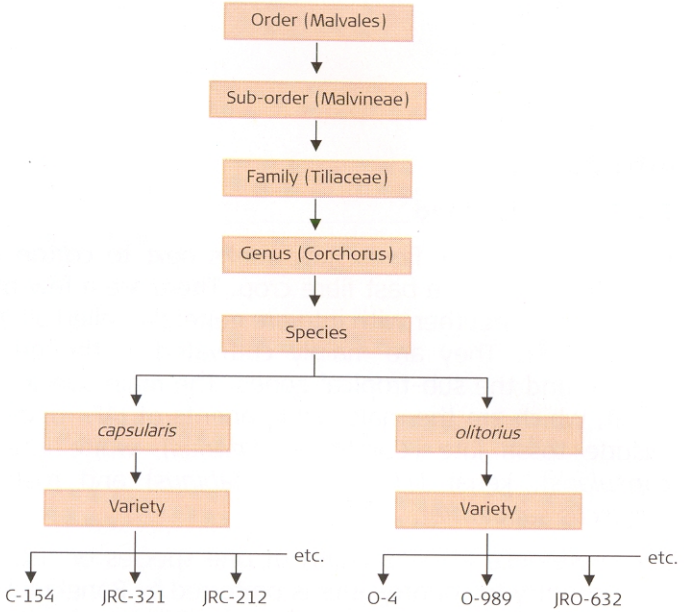
2.1.2 Taxonomy and Centres of Origin

The prominent genera in this group of JAF are *Corchorus* and *Hibiscus*. In fact, *Corchorus*, a genus of the family Tiliaceae and *Hibiscus* of Malvaceae, share more or less the same pattern of geographical distribution as they are related phylogenetically. Both belong to the same sub-order Malvineae of the order Malvales.

For understanding the taxonomic rank of JAF the general botanical ranking system of jute is shown in Fig. 2.1.

The number of *Corchorus* species is probably around 50–60, but over 170 *Corchorus* names are given in the *Index Kewensis*. The genus is extremely variable, but all species are apparently highly fibrous.

Fig. 2.1
Taxonomic Tree of Jute



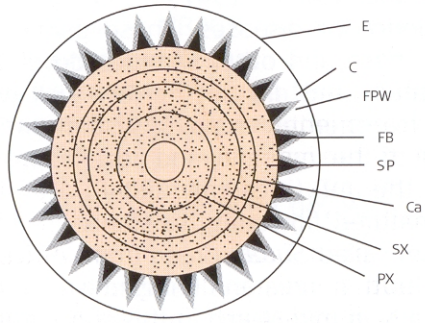
Corchorus species are found in warm regions throughout the world, on all continents and on numerous tropical and sub-tropical islands. However, the centre of diversity and origin of the genus appears to be Africa, where the largest number of *Corchorus* species, around 30 has been found with highest concentration reported from East and South Africa. Of the cultivated species *C. capsularis* is omnipresent in Indo-Myanmar and South China, from where it migrated into India and Bangladesh. In contrast, *C. olitorius* originated from North Australia and Africa. Though many workers earlier held the view about this species being native to Sri Lanka, India and Kenya, it is now generally agreed to have originated in Africa and migrated to India and China via Egypt and Syria.

2.1.3 Anatomy

Like all other bast fibres, jute fibres are arranged in the bast or phloem region of the plant consisting of pyramidal wedges which taper outwards; the fibre bundles in each wedge are arranged in 8-24 layers, alternating with groups of thin walled phloem (Fig. 2.2).

The bast fibre strands form a tubular mesh that encases the entire stem from top to bottom. This is looser towards the top of the stem becoming progressively more compact towards the basal region where again meshiness is looser towards the outside of the stem but much more compact towards the region near the cambium. It is well known that meshiness is an obstacle to carding process, and thus for spinning and finally for quality yarn preparation.

Fig. 2.2
Sketch of Cross-section of Jute at the base



E, Epidermis; C, Cortex; FPW, Fibre Pyramid Wedge; FB, Fibre Bundle; SP, Secondary Phloem; Ca, Cambium; SX, Secondary Xylem Px, Protoxylem

It is of significance to note that the genes controlling the formation of secondary phloem fibres are different from those controlling primary phloem or protophloem. Thus, as a bio-technological approach it may be envisaged that genetic manipulation for reducing meshiness is worth attempting for improving fibre quality.

2.1.4 Areas of Production

Favourable conditions for jute cultivation are found in the flood plains of the great rivers of the tropics and sub-tropics for example, the Ganges, the Irrawaddy, the Amazon, and the Yangtze, where irrigation, often characterised by extensive flooding, and alluvial soils combined with long day lengths. The crop traditionally thrives very well under rain-fed and hot humid and sub-tropical conditions in the Bengal Basin in India and in Bangladesh where more than 80% of the crop of the world is grown. Other major jute growing countries are Myanmar, Nepal, China, Taiwan, Brazil, Indonesia and Thailand.

2.2 Cultivation

2.2.1 Varietal Development

Systematic investigation on jute was initiated in the Burdwan district in Bengal (India) under the leadership of RS Finlow, a fibre expert, appointed by the Bengal Government as early as in 1904. They identified in due course 33 distinct white and tossa jutes in Bengal, Assam and Orissa. The centre of research activity was then shifted to Dhaka (now in Bangladesh) in 1910. The group developed a tossa variety *Chinsurah Green* in 1915 and a white variety Dhaka 154 (D-154) in 1919 based on plant height and low incidence of diseases. These gained popularity among the farmers. These and other varieties developed thereafter were of long duration and did not fit very well with the wetland (rainy season) rice-oriented cropping system until a paradigm shift took place due to the ingenuity and novel approach used by Prof. B Das Gupta at the JARI (presently CRIJAF). He introduced a novel gene for pre-matured flowering resistance in plants through an exotic germplasm called *Sudan Green* from Africa. Thereafter, a series of varieties both in India and Bangladesh were developed capable of sowing early in mid-March in this sub-continent with pre-matured flowering resistance character and the time for harvest reduced by at least 30 days. Jute thus fitted very well in the rice-oriented cropping system and the productivity also increased considerably. Although the fibre of white jute is, in general, characteristically finer than that of tossa jute, productivity of the latter being higher than that of the former, the earlier trend in areas under white : tossa in both India and Bangladesh as 80 : 20 was reversed to its present trend of 10 : 90, although the total area of production increased considerably until it reached a plateau in eighties throughout the sub-continent. The said reversal could be again offset if the farmers get appropriate premium for finer quality produced by white jute which will be in the overall interest of jute fibre use.

During recent times, jute breeding was duly strengthened under the patronisation of the IJO (now IJSG). Recognising that further research and development in jute should be largely dependent on the extent and nature of variability in the germplasm stock, an attempt was once made under the aegis of IJO for global collection of jute and allied fibres germplasm for conservation and maintenance at its Centralised Germplasm Repository (CGR)

located in the Gene Bank of BJRI, Dhaka. Germplasm resources are now available from the CGR for all the IJO member countries as successor of erstwhile IJO for an extensive genetic improvement effort. The Gene Bank at BJRI has a capacity of preserving 100,000 accessions with 200 g weight each. At present, it has a collection of total 5936 accessions preserved in two cells, one set at -20^{0}C and another set is under $+4^{0}$C. For *Corchorus*, 3344 accessions are from indigenous collection and 737 accessions have been collected by IJO. In India, CRIJAF, which was also benefited by IJO collection, has a gene pool of around 5000 accessions of jute and allied fibre crops maintained at $+4^{0}$C. A parallel set in India is maintained at the National Gene Bank at NBPGR, India. However, it should be admitted that the germplasm accession for jute, available in both the leading countries, India and Bangladesh, has still a very narrow genetic base, which is the basic obstacle for any attempt for further improvement in future.

A number of jute varieties have been developed and released in different countries.

Bangladesh

A number of white and tossa jute varieties have been released in Bangladesh since the beginning of research in the first decade of twentieth century. These include 21 white and 10 tossa jute varieties and are as follows:

White jute: Kakya Bombai, R-85, D-154, D-386, Funduk, C-212, C-13, C-321, C-412, C-1, C-2, C-3, C-4, C-5, C-6, CVE-3, CVL-1, CC-45, BJC-83, BJC-7370, & C-38.

Tossa jute: R-26, R-27, CG, O-2, O-3, O-4, O-5, O-9897, OM-1 & O-72

China

In China, jute is grown only in 10% area out of the total area under bast fibre crops. The major area under jute is covered by white jute and relatively smaller area is under tossa jute.

White jute: Yue Yuan No. 5, 71–10, Capsularis No. 2, Mei-Feng No. 4.

Tossa jute: Kuan Ye Xiang, Jute No. 1,2, Guangang, Guangfeng.

India

A number of varieties have been released in India for both the species. These include 13 tossa and 12 white jute varieties.

White jute: JRC-321, JRC-212, JRC-7447, JRC-4444, UPC-94, Padma, KTC-1, JRC-698, Bidhan Pat 1, Bidhan Pat 2, Bidhan Pat 3, JRC-80.

Tossa jute: JRO-632, JRO-878, JRO-7835, JRO-524, TJ-40, JRO-3690, KOM-62, JRO-66, JRO-8432, JRO-128, S-19 (Subala), Bidhan Rupali tossa, JRO-204 (Suren).

It is important to note that JRO-204 is recommended for sowing as early as in the first week of March in the Indian sub-continent.

Indonesia

In Indonesia, about 80% of the total area under bast fibre crop is sown to kenaf, 15% to roselle, while 5% is under white jute.

White jute: CC 15, CC 22.

Nepal

In Nepal, about 63 percent of the area under bast fibre crop is sown to tossa jute and 37 percent to white jute as per record up to the end of the last century. The major varieties in use are however of Indian origin. These are as follows.

White jute: JRC–321, JRC–212, JRC–7447.

Tossa jute: JRO–632, JRO–524, JRO–7835, JRO–878.

Thailand

In Thailand, about 80% of the area under bast fibre crop is sown to roselle, 10% to kenaf and 10% to tossa jute.

Tossa jute: Non Soong 1, Khon Kaen 1 (JRO-878).

2.2.2 Cropping System

Jute plant has a long effective taproot system and a rather deep and wide-ranging lateral root system. This may help the plant better withstand drought conditions, and at the same time fits in the rice-oriented cropping system. The continuous cultivation of wetland rice, with which jute is rotated in general, apparently tends to adversely affect the nutrient dynamics in soil during the subsequent dry periods because of deteriorating physical environment of soil caused by repeated puddling (in wet environment) over years, as

believed in some quarters, and also due to the formation of a hard pan for plough sole action just below the root zone during puddling. With the introduction of jute in the cropping system the taproots of jute break the pan and take up nutrients from lower profile of soil for growth and development. Further, the fallen leaves and the roots after harvest of jute enhance the soil fertility. Hence, conventionally jute has been a popular crop rotated with wetland rice.

Cropping patterns based on jute and allied fibre crops practised by different countries, both for rainfed and irrigated ecosystems, as reviewed by the IJO, are given as follows.

Bangladesh

(1) Jute-Fallow-Potato; (2) Jute+Sesame-T.Aman-Potato; (3) Jute-Mungbean-Potato; (4) Jute-Radish/Mustard; (5) Jute-T.Aman-Mustard.

China

Southern-China

(1) Jute / Kenaf-Rice-Vegetables; (2) Jute / Kenaf-Rice-Winter sweet potato; (3) Spring peanut-Kenaf (for seeds)-Fallow; (4) Sweet potato-Kenaf-Peanut-Late Maturity sweet potato; (5) Peanut-Kenaf (for seeds).

Yangtze River valley

(1) Rape-Kenaf; (2) Wheat-Kenaf; (3) Wheat-Vegetables-Corn-Kenaf; (4) Wheat-Vegetables-Kenaf; (5) Bean-Kenaf.

Huanghuihai

(1) Wheat-Kenaf; (2) Rape-Kenaf; (3) Vegetables-Kenaf; (4) Fallow-Kenaf; (5) Vegetables-Kenaf.

India

(1) Jute-Paddy-Wheat; (2) Jute-Paddy-Potato; (3) Jute-Paddy-Cabbage; (4) Jute-Paddy-Mustard; (5) Jute-Paddy-Pea.

Indonesia

East Java Province

(1) Flood/Fish-Paddy-Kenaf; (2) Flood/Fish-Paddy-Maize/Kenaf; (3) Flood/Fish-Paddy-Paddy; (4) Kenaf-Paddy-Paddy-Kenaf/Jute; (5) Paddy-Paddy-Maize/Kenaf.

Central Java Province

Paddy-Paddy-Jute

West Java Province

Fallow-Paddy-Kenaf

South Kalimantan Province

(1) Roselle-Maize-Paddy; (2) Roselle+Maize-Maize-Paddy-Roselle.

Nepal

(1) Jute-Paddy-Wheat; (2) Jute-Paddy-Potato; (3) Jute-Paddy-Lentil; (4) Jute-Vegetables; (5) Jute-Lentil; (6) Jute-Potato.

Thailand

(1) Roselle/Kenaf/Jute-Rice, (2) Kenaf-Supersweet Corn (3) Roselle-Sugarcane.

2.2.3 Soil

Jute is grown in wide range of soil types, mainly alluviums, laterite, and calcareous with soil texture varying from sandy loam to clay loam. Basically, the soil should be well-drained, and its pH should preferably be in the range of 5.5–6.5. White jute is relatively more tolerant to waterlogging especially at later stages of crop growth, therefore, this species may be preferred in areas prone to late flooding. Conversely, tossa jute does not tolerate waterlogging and is usually grown on higher lands. In general, both the species are more sensitive to waterlogging during early stage of crop growth. In India and Bangladesh, which are major jute growing countries, 0.913 and 0.450 million ha areas were cultivated for jute and allied fibres during 2004-05.

2.2.4 Land Preparation

Land is prepared carefully in order to make a fine seed bed for emergence and establishment of a good plant stand. Bullock- or tractor-driven ploughs are generally used (Fig. 2.3). It is necessary to plough 3 to 5 times for the fine tilth followed by removal of stubbles and weeds, and leveling the surface, using a leveler, in order to ensure uniform aeration and avoid water stagnation in pockets during the crop growth. This is also important to make the subsoil free of compact region in order to enable the taproot of jute to grow vertically downwards and also deep lateral roots to grow fast enough without hindrance.

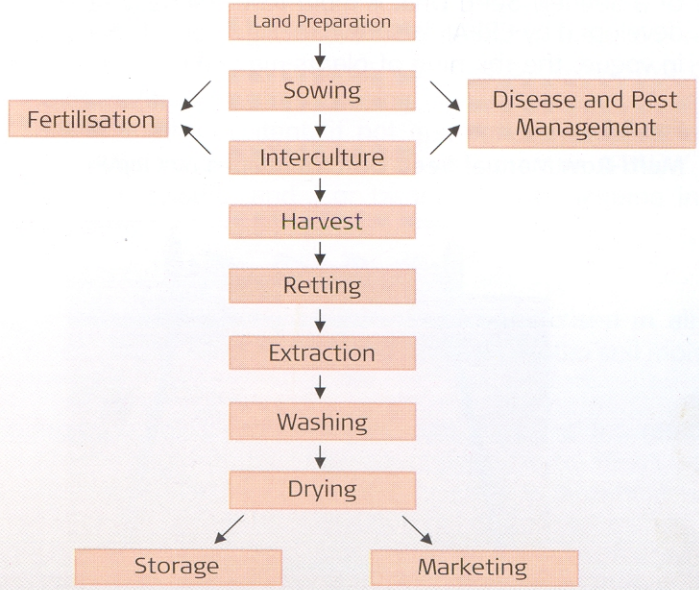
Figure 2.3
Land Preparation for Jute by Country Plough



2.2.5 Agricultural Practices

The sequence of agricultural practices being followed in raw jute production is illustrated in Fig. 2.4.

Fig. 2.4
Flow Chart for Raw Jute Production



2.2.6 Sowing vis-à-vis Photoperiod Characters

Jute is an annual herbaceous dicotyledonous plant that grows to a height of 1.5–4.5 m. The stems are about 1–2 cm in diameter with few branching habits. It is a short-day plant and in tropical areas flowers three to four months after sowing towards the end of the monsoon. It grows well in a hot and humid climate with temperature in the range of 24-37°C or even higher and day-length in excess of 12 hours. It requires a rainfall in the range of 1000 to 1500 mm, depending on soil characteristics and ground water status, spread evenly over four months of the growing season. Because of its thermosensitive property, it requires an appropriate time for sowing matching with the temperature and day-length required for optimum growth and development. Soil temperature needs to be 15°C or above for favourable seedling growth. Under favourable hydro-thermal condition of soils, emergence of seedlings may take place 3–6 days after sowing.

There is an optimum time of sowing for each location depending upon the onset of pre-monsoon rain and the varieties to be grown. Taking the major areas of production into account in Bangladesh, India, Myanmar and Nepal, sowing of jute ranges from late February to May. Sowing should be done preferably in lines with the help of a Seeder/ Seed Drill. A multi-row manually operated Seed Drill, developed by CRIJAF is shown in Fig. 2.5. If broadcast, which is still in vogue, the thinning of plants may be done at a later stage.

Fig. 2.5
Multi-Row Manual Seed Drill (Developed by CRIJAF)



2.2.7 Nutrients and Fertilisers

As with most high biomass crops, jute has a high demand for plant nutrients, especially of the macronutrients, like nitrogen (N), phosphorus (P) and potassium (K).

A good crop of tossa jute yielding 3.1 MT/ ha of dry fibre takes on an average of 65 kg N, 52 kg P_2O_5, 163 kg K_2O, 128 kg CaO, and 33 kg MgO per hectare.

White jute, on the other hand, yielding 2.0 MT/ ha of dry fibre takes on an average 84 kg nitrogen, 37 kg P_2O_5, 117 kg K_2O, 120 kg CaO, and 49 kg MgO per ha during growth period.

The critical limits for soil available P, Sulphur (S) and Zinc (Zn) were worked out as 24 kg P_2O_5 per ha, 8.5 ppm SO_4-S and 0.5 ppm Zn, respectively. Nitrogen, however, remains as the main contributing nutrient to boost fibre yield. Nearly 18-21 kg extra jute fibre may be obtained by the application of 1 kg / ha of S in S-deficient soils as worked out in India. It has been found that, on an average, 15 MT of green jute leaves per hectare are added to the soil enriching its fertility level during the growing period.

Integrated nutrient management is a strategy that incorporates both organic and inorganic sources to achieve higher yield, and what is more important, for sustainability in production for the entire cropping system. Jute is generally succeeded by exhaustive crops like rice and vegetables often causing gradual process of decline in soil organic matter content, if not appropriately supplemented through organics in the form of farm yard manure (FYM) / crop residues / biofertilisers, and / or by inclusion of legume in the cropping system.

2.2.8 Interculture

Raking, thinning and weeding are generally practised in all jute fields, which should be best practised under optimum soil moisture conditions (Fig. 2.6).

Raking helps uprooting the weeds and thinning for removing excess jute plants to bring down the population to 30-45 per sq m. Raking is followed by hand weeding. Small hand-held wheel hoes or scrappers may also be used for weeding. Usually one raking between two to three weeks following sowing followed by two to three weedings at an interval of fifteen to twenty days is done. With subsequent crop growth and canopy development

weed growth is checked. Large manpower is needed for manual weeding in jute field. The tender leaves of excess jute plants after thinning are popular as vegetables in the farmers' families.

Fig. 2.6
Manual Weeding in Jute Field



Irrigation

One pre-sowing irrigation (if necessary) and 2 to 3 additional irrigations at later stages are recommended for better crop growth and higher yield.

Drainage

Appropriate drainage facility may be arranged in order to avoid stagnation of water in the event of high rainfall during the crop growth period.

2.2.9 Disease and Pest Management

Jute is subjected to attack by a number of diseases and pests at different stages of growth and development. Losses of 10% by plant diseases and 12% by insects are on record in Bangladesh, India and Nepal.

Recommendations of pesticides and fungicides against diseases and pests are available. It is recommended to adopt need-based protection measures. Many farmers adopt crop rotation practices with a view to minimising crop losses due to diseases and insect pests.

2.2.10 Harvest

Jute is generally harvested when the plants are at early pod stage.

The harvest index remains more or less constant over 60–105 day period following sowing. However, it reaches its peak during 110-130 day period following sowing. The fibre, in general, remains weak if it is harvested before flowering. On the other hand, the fibre becomes coarse and lacks lustre if harvesting is delayed beyond 120-day age.

The plants are usually cut close to the ground by hand (Fig. 2.7). A curved, sickle type knife is used to cut the plants. The plants are then sorted out according to height and diameter. The assorted plants are tied into bundles. Each bundle weighs 8-10 kg. The bundles are kept standing in the field for 3–4 days for defoliation.

Fig. 2.7
Harvest of Jute



2.3 Post-Harvest Technologies

2.3.1 Retting

Conventionally the entire operations of retting followed by extraction of the fibres is done till date manually, which are time consuming and cost-ineffective for use of large human force. Besides, it requires large volume of clear water preferably slow flowing streams, which are ideal for retting. Finally, and most importantly, owing to several factors, some of them not controllable at a given time, quality of fibre extracted may not be always of good quality.

The bundles are carried to ponds, canals, ditches, or any other water bodies for retting. In some cases, the bundles are kept standing in knee deep water for 3–5 days. This is done for better retting of the bottom portion of jute plants. The bundles are then put into *jaks*

for steeping. The bundles are placed in 2–3 layers in a crosswise arrangement (Fig. 2.8). The *jak* is covered with water hyacinth, weeds or other available materials. Weighting down with wooden logs, earthen chunks, banana logs or bamboo frames submerges it, although use of earthen chunks or banana logs should be highly discouraged. Submersion is needed for uniform retting. Steeping to a depth of 15–20 cm in slow flowing clear water ensures better retting of jute.

Retting time varies from 15–20 days depending mainly on the maturity of plants, water temperature (optimum 31–36°C), pH, volume of water and height of water level above the *jak*.

Fig. 2.8
Submersion of Jute Plants for Retting



During retting bacteria break down the soft tissues around the fibre bundles and the fibres. Retting is complete when the bark separates out easily from the core. The end-point of retting is a critical stage that largely determines the quality of fibre. It is difficult to extract the fibre if the plants are taken from water too soon. On the other hand, the fibre is weakened if retting is continued for too long. Before extraction, the farmers make frequent checks to determine the end-point of retting.

Jute retting is associated with bio-chemical changes effected by a consortia of aerobic and anaerobic bacteria.

2.3.2 Extraction

After retting plants are taken out of water and the fibre is extracted by hand (Fig. 2.9). The two major methods of fibre extraction are:

Fig. 2.9
Extraction of Jute Fibres after Completion of Retting



i) Single reed method

In the single reed method fibre extraction is generally carried out in a dry place. The operator takes 4–5 retted plants in hand. Starting from the bottom, the fibre of each plant is stripped out separately from the stick up to 8–10 cm, then plants are held together and fibres are pulled out together slowly from the rest of the plants. The process continues until extraction is completed for all the plants in the bundle.

ii) Beat-break-jerk method

In the beat–break–jerk method, the fibre extraction is done in standing water. Only the bottom end of a plant is lifted above water, broken by a wooden mallet to loosen the fibre bundle, and the broken sticks are taken out. After that the loosened bottom portion of the fibre budle is twisted and vigorously shaken to and fro by hand in the water. The remaining broken sticks slip out and the wet fibre bundle (reed) is washed thoroughly.

2.3.3 Ribbon retting

Ribbons are the outer skins of the stem which can be obtained mechanically or manually. BJRI has developed a bamboo-hook ribboner. The ribbons are retted either in earthen pots or in the form of rings placed over vertical poles in water. CRIJAF developed a similar method for ribbon extraction followed by retting in a small pool of water by hanging the ribbons vertically downwards over the bamboo grill placed across the pool (Fig. 2.10 a, b) and finally washed in clean water. The ribbon extraction, which has been tested widely in farmers' fields, in the recent times has a capacity

Fig. 2.10
Ribbon Extraction & Retting



(a) CRIJAF Bast Fibre Extractor (b) Preparation for retting of the fibre ribbons in a small tank

of 25 kg dry fibre production per machine-hour as against 5 kg per man-hour by conventional method.

The complete protocol including retting requiring not more than 20% of water required under conventional method may be completed in less than 8 days with improvement in fibre quality than that produced under conventional method. Besides the mechanical approach there are other methods, like chemical, enzymatic / microbiological method of retting advocated by different R&D centres.

Ribbon retting is advantageous over the conventional retting method. It requires less water, less work force, and less time for retting. The fibre is almost free from cutting and quality is improved. But this technique has not yet been adopted by the farmers in large scale.

Efforts are going on to popularise other retting techniques in Bangladesh and India like the one, developed by JCI, an improved low cost retting technique, which is a slight modification of the conventional one and has proved to upgrade fibre quality at least by one grade.

2.3.4 Washing

The washing process consists of holding the extracted fibre bundle by the butt end and jerking it through the water (Fig. 2.11). Clean water is used for washing. The entire dirt, gum, extraneous plant materials and retting residues are removed thoroughly.

Figure 2.11
Washing of Jute Fibre



2.3.5 Drying

After extraction and washing, the fibre is spread over bamboo perch or bar for drying (Fig. 2.12). Drying under mild sun is recommended. Drying on bare ground is discouraged because it affects quality of fibre by contamination with dirt and other particles. Drying may require 4–7 days. This depends on intensity of sunlight and relative humidity. Fibre needs thorough drying before storage. The moisture

Fig. 2.12
Drying of Jute Fibre after Extraction



content of dried fibre ranges between 10–19 percent in the major jute growing countries. Lower the moisture content higher is the storage life, maintenance of colour and strength, and higher is the price, the farmer fetches.

2.3.6 Storage

The farmers generally store jute fibre in their dwelling houses. It is stored on the floor along with other crops. In most cases these floors are dampened grounds.

Sometimes split bamboos are spread on the floor so that the fibre does not come into contact with the dampened ground. Small and

Fig. 2.13
Jute Fibre ready for Storage and Marketing



marginal farmers generally grow jute and they sell fibre as soon as it is ready. The intermediate dealers or middlemen also do not store jute fibre for long time. However, the jute balers hold jute for longer time.

2.3.7 Fibre Yield

The yield of jute fibre depends on a diverse array of factors. These include the variety used, quality of seeds, time of sowing, soil fertility, season, incidence of diseases, insect pests, and method of retting. Productivity of jute in Bangladesh for 70 years since 1927 varied between 1.51–1.65 MT/ ha, although at the farmers' level much higher yield was obtained with proper adoption of cultivation practices. According to FAO, the national average yields (MT/ha) of jute in Bangladesh, India, Nepal and Myanmar in 2006-07 were 1.98, 1.93, 1.56 and 0.85, respectively.

2.4 Fibre Quality and Grading

The main parameters of fibre quality include strength, colour, lustre,

fineness, length and the extent of presence of defects and hard barky root portion in the fibre reeds.

2.4.1 Fibre Defects

Good quality jute is expected to be free from body defects. The occurence of body defects are dependent on various factors including production practices, diseases, pests and retting. Depending upon intensity, the defects may be major or minor. The major defects include hunka, runners, hard centre, dazed fibres, mossy fibres and entangled sticks. The minor defects are loose leaf, loose stick, gummy fibres, specks and croppy end. Since most of the defects are linked with retting, improvement of retting techniques and facility at farm level is urged in the interest of jute as well as jute farmers' survival.

2.4.2 Important Factors affecting Fibre Quality

The occurence of desired attributes or urdesired defects are dependent on various factors like cultivation practices, diseases, pests and retting. Agronomic manipulation in terms of balanced fertiliser, maintenance of desired plant population and yield, adoption of new cropping system approach, integreted pest management and improvement of retting facility have been suggested for quality improvement of jute.

2.4.3 Jute Grading System in Different Countries

Based on the major quality attributes fibres are graded for commercial purposes by two methods in Bangladesh. These are *Kutcha* grading method and *Pucca* grading method. In *Kutcha* grading method, the whole fibres as they come to village markets are categorized into five grades. These are: Top, Middle, B-Bottom, C-Bottom and X-Bottom in descending order of fibre quality (Appendix C). The fibre quality of Top grade is the best and has minimum cuttings, good strength, the natural colour of white or tossa jute, along with excellent lustre and texture.

In *Pucca* grading method the fibres whose basal parts have been cut away as cuttings are categorised into six grades (Appendix C). These are BW-special, BW-A, BW-B, BW-C, BW-D and BW-E for white jute and BT-special, BT-A, BT-B, BT-C, BT-D and BT-E for tossa jute. Special, A to E grades stand in the descending order of merit.

In India, the region-based grading system was changed in 1960s to

a scientific system by which the fibre grade (quality) is determined by assessing important fibre characteristics, viz. strength, defects, root contents, colour, fineness and bulk density, by subjective 'hand and eye' method. The present Indian grading system classifies white and tossa jute fibres into eight grades, as W1 to W8 and TD1 to TD8, respectively (Appendix C). Each grade is decided through a scoring system, giving different weightage to the above characteristics according to their importance in respect to quality and productivity of jute goods. W1 and TD1 represent the best qualities while W8 and TD8 represent the poorest qualities.

China has got a grading system with 4 grades.

Indonesia also has a very simple grading system. It classifies the fibres into three grades called Quality-A, Quality-B and Quality-C based on fibre cleanliness, colour, dryness, tensile strength and fibre length.

Nepal has got a grading system with 2 grades only.

Thailand classifies the fibres into three grades, called Grade-A, Grade-B and Grade-C.

2.5 Jute Seed Production

Quality jute seed production needs a typical agro-climatic situation different from the one suitable for fibre production. Bulk of the seed production is still met by India having the required agro-climatic situation far away from its own fibre producing areas, and used not only for its domestic needs but also to a large extent to meet the needs of other countries. India produces annually 5000 ton seeds through a large network of multi-tier retailers for commercial consumption by farmers. It has a seed regenation ratio of 1:80 and the seed replacement is also very high (> 80 %). However, farmers producing fibres, particularly in Bangladesh, normally retain a small portion (about 5 percent) of jute plants in the fields to produce seeds, which may not be of good quality. Seeds are sown during May / June each year and grown for about 160-180 days for seed production in India. The recent trend in Bangladesh is to sow later, i.e. during June-August. The production packages of the two countries are not exactly similar since the agro-climatic conditions under which jute seeds are grown are also not similar.

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JUTE
basics

Physics and Chemistry of Jute

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Chapter 03



JUTE basics

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3.1 Origin of Jute Fibre

The stem of a jute plant consists of a thick hollow woody core and the several interconnected fibre cell bundles, each having about 15-30 cells, in the peripheral sheath (Fig. 3.1). During retting, when the jute stems are kept immersed under water for 2-3 weeks, the micro-organisms act on the pectinous substances, being the bonding agent between the fibre cells and other non-fibrous tissues as well as thick woody core (stick), and thereby softens them which are thereafter dissolved out in water. As the pectinous substances are mostly removed on completion of retting, the fibre cell bundles, interlinked with each other, are separated manually by farmers from the stick, washed and dried to get the jute fibres suitable for commercial use. The fibre bundle so obtained is called 'reed' which is held together as a unit by the meshy or network structure of the fibre elements (Fig. 3.2) and represents only a very small proportion (4-6%) of the whole plant. Each fibre element of these meshes are actually bundles of fewer ultimate cells, resulted through break down of the each original bundle of 15-30 fibre cells due to random microbial attack all over the stem body during retting. The reeds may be 1.5 to 4.5 m long and are tapered from root to tip.

Fig. 3.1
Disintegration of a Jute Stem into a Jute Reed and a Stick after Retting

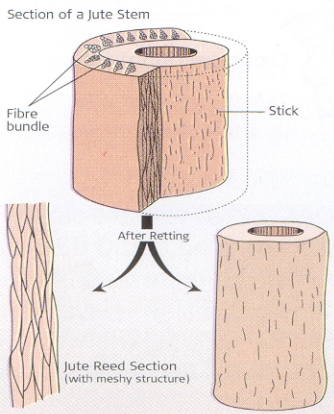


Fig. 3.2
Meshy Structure of Jute Reed

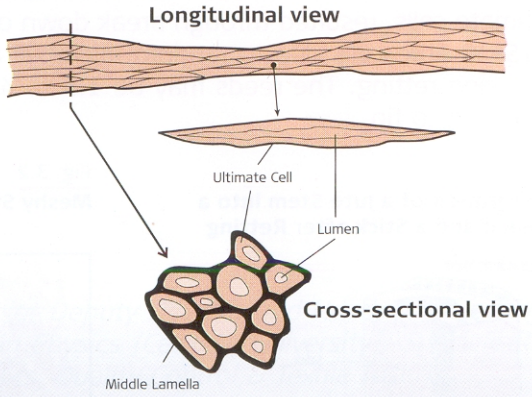


3.2 Structure of Jute Fibre

3.2.1 Macro - Structure

Each fibre element, as visible by naked eye, of a raw jute reed available commercially is basically a group of about 5 – 15 ultimate cells, cemented together laterally and longitudinally by means of inter-cellular materials being chiefly non-cellulosic in composition. Thus, jute fibre is multicellular (Fig. 3.3). For this, jute fibre is much coarser than cotton which is unicellular. Due to random disintegration of cell bundles caused by microbial attack during retting, the number of ultimate cells per cross-section of a jute filament varies much along its length. It is the inherent mechanism of jute retting which makes the commercially available fibres not only coarser but also highly irregular in diameter along the fibre length. These fibre features limit severely the use of jute in manufacturing fine yarns with good regularity and lighter fabrics, like apparel, with uniform texture.

Fig. 3.3
Jute Fibre Morphology : Micro-Structure

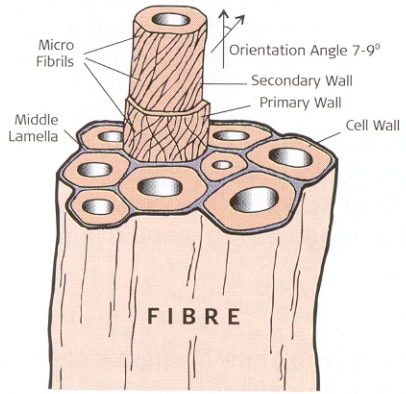


The ultimate cells are spindle-shaped and of variable size in length and width, being on an average 2.5 mm long and 0.02 mm width at the middle. The cross-section of the ultimate cells are found to be polygonal with rounded corners (Fig. 3.3). The layer of natural cement present between the ultimate cells is known as middle lamella. Each ultimate cell has thick cell wall and lumen, the central canal, with more or less oval cross-section.

3.2.2 Micro - Structure

The cell wall of each ultimate cell is composed of an outer thin primary wall and an inner thick secondary wall, differing from each other in the molecular architecture. Both these walls of a jute ultimate cell are composed of ultra-fine microfibrils (Fig. 3.4). While in the primary wall the fibrils are lying in criss-cross manner, the fibrils are almost parallelly arranged as right-hand spirals in the secondary wall.

Fig. 3.4
Jute Fibre Morphology : Micro-Structure



Within the ultimate cells of a jute fibre, the ultrafine fibrils, being purely cellulosic, are the highly ordered regions, while the inter-fibrillar locations are less ordered regions which can expectedly make room for the presence of short chain hemicellulose molecules to a larger extent and the bulky lignin molecules to a little extent. The formation of the walls of these cells and infiltration into them of hemicelluloses, lignin and other incrusting materials takes place in stages during plant growth.

The cell wall of a jute ultimate can be considered as having a 'fibre–reinforced–composite' like structure with ultrafine fibrils reinforcing the matrix of hemicellulose and lignin. The fibrils in jute cell wall are arranged in a right-handed spiral with angle of orientation of 7 - 9° in reference to the cell axis. The good strength, high initial modulus and very low extensibility of jute fibre owe much to such composite morphology of its ultimate cells as well as high degree of orientation of their microfibrils with respect to the fiber axis.

3.3 Physical Properties of Jute

3.3.1 Fibre Dimensions

a) Fineness

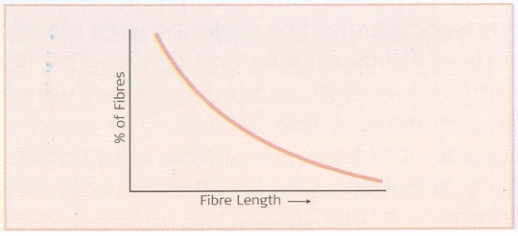
Fibre fineness is expressed by the linear density (i.e. mass per unit length) of filaments which at raw jute stage depends on the extent of retting, while at the yarn stage primarily on the degree of filamentation during carding. The average linear density of single jute filament at raw stage usually lies between 1.3-2.6 tex for white jute and 1.8-4.0 tex for tossa jute. Thus, white jute is usually finer than tossa jute. The width of jute filament varies roughly from 0.04 to 0.10 mm and therefore its average cross-sectional area becomes 0.002 sq. mm approximately. The strength of jute fibre depends to some extent on its coarseness; the coarser fibres are normally stronger.

The reeds may be 1.5 to 4.5 m long and are tapered from root to tip. Longer reeds usually have higher base diameters. Thicker reeds consist of coarser filaments. Finer filaments are found in long but thin reeds which should be used for producing good quality yarns.

b) Length

Unlike cotton or wool, jute filament does not have any finite length within the reeds. During mechanical processing, an initial operation at breaker cards is executed to break down the raw jute reeds into filaments of discrete lengths. The fibrous assembly (sliver) produced by the breaker card contains filaments showing an exponential distribution (inevitable due to random breakage of meshy jute network on carding) and ranging length-wise roughly from 2 cm to 50 cm with a bias towards the shorter lengths (Fig.3.5). During

Fig. 3.5
Fibre Length Distribution in Card Sliver of Jute



subsequent processing stages, the longer filaments suffer further breakages, but the exponential distribution of filament length is maintained. In a jute yarn, the average fibre length value is normally found to be 8-10 cm, while the maximum fibre length between 25 cm and 30 cm and length CV% of around 60%. Due to such fibre length distribution, with much larger amount of short fibres, the jute yarns, especially the finer ones, exhibit higher irregularity as compared to cotton or wool yarns.

3.3.2 Density

Density is the mass of the fibre per unit volume. Within the fibre structure, there are many void spaces. While the volume is measured considering these voids, we get the true density, and when they are not considered, we get the apparent density. True density for dry jute, when volume is measured by immersion in a non-swelling medium like benzene or mineral oil, is obtained as 1.46 g/cc. As the fibre absorbs moisture, density falls. The apparent density value of jute fibre has been found to vary from 1.10 to 1.34 g/cc. The porosity (amount of void spaces) of jute, as calculated from gravimetric fineness and cross-sectional geometry, can be found as 40%.

3.3.3 Mechanical Properties

a) Strength & Extensibility

Like other bast fibres, jute is a strong fibre with much low extensibility due to its 'composite-like' structure with highly oriented long chain molecules. When a single jute fibre is tested for strength at a test length of 1.0 cm, we get its tenacity value (breaking load divided by filament fineness) as 30-50 gf/tex. The jute fibre shows very poor extensibility, the breaking elongation ranging between 1.0 and 1.8 %. The initial modulus (stiffness) of jute fibre is 1700-3000 gf/tex. The tossa jute is found to be stronger than white jute. Tenacity-wise, the jute filament is comparable with steel. For the purpose of easy testing as well as larger sample size for obtaining reliable average, the fibre strength is mostly determined by testing jute fibres in bundles, for which the tenacity figure is less than half of that obtained with single filament. About a third of the single fibre tenacity is found to contribute towards the development of jute yarn strength, due to reasons like oblique fibre alignment (as a result of twist), higher irregularity and poor fibre packing in jute yarns.

b) Elastic – Plastic Nature

The load – elongation curve for a jute filament is linear which indicates that the breakage of fibres occurs within the elastic limit due to its 'composite-like' structure. The presence of numerous hydrogen bonds between the chain molecules does not allow the fibre to yield under external force. This unyielding characteristic of jute fibre is considered responsible for its good resiliency which is exhibited through elastic recovery to the extent of 75% from a high level of straining (1.5%) or loading (27 gf/tex), about 80 % of the respective values causing fibre breakage.

c) Flexural & Torsional Rigidities

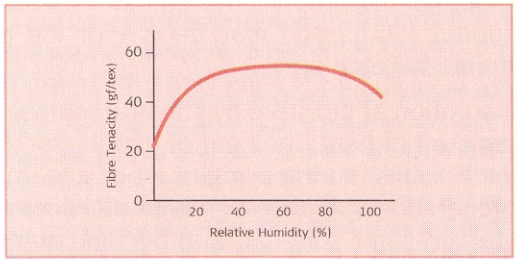
The flexural and torsional rigidities of jute fibre are quite high as compared to cotton or wool due to its coarseness and inelastic structure. On bending of a jute fibre, the chain molecules within the fibre structure get displaced due to breakage of many of the hydrogen bonds and subsequently locked in the new positions due to quick reformation of hydrogen bonds in some other places. For this, jute textile material develops wrinkles and creases easily.

3.3.4 Moisture Absorption

The jute fibre shows good moisture absorption capability owing to the presence, within its structure, of numerous polar -OH groups which attract polar water molecules. In an atmosphere with certain RH%, the amount of moisture absorbed by jute fibre is usually expressed as 'moisture regain' which is simply the amount of moisture within the fibre calculated as a percentage of its oven-dry weight. The moisture regain value of jute is 13.8% at 65% RH of the surrounding atmosphere and rises to 36.0% at 100% RH, which is higher than that of cotton and lower than that of wool. Higher hygroscopicity of jute has been attributed to the presence of hemicellulose in fair amount in it. On absorption of water molecules, jute fibres exhibit swelling as many of the inter-molecular hydrogen bonds are broken allowing the chain molecules to fall apart as water molecules penetrate the fibre matrix. Since the long chain molecules are almost aligned along the fibre axis, the swelling of jute fibre is found to be much more laterally than longitudinally. The diameter-wise and cross-sectional swelling of jute in water is about 20% and 45% respectively which are higher than cotton, while its longitudinal swelling is only about 0.4%.

With increased absorption of moisture, the strength of jute fibre increases first and then remains more or less unchanged but at much moist condition, the jute fibre shows lesser strength (Fig.3.6). On wetting, the tenacity of jute fibre goes down by about 14%. Such variation in fibre strength with increased moisture can be explained in terms of the action of water molecules on multicellular structure of jute filaments. With the increase of moisture absorption and thereby more and more breakage of transverse hydrogen bonds, the individual ultimate cells of a jute filament become stronger (as also observed in case of unicellular cotton fibre) due to increasing scope of uniform stress sharing by the chain molecules. But, on the other hand, the cementing layer (middle lamella) between the ultimate cells becomes gradually weaker due to plasticising effect of water molecules as they infiltrate more and more into the matrix of cementing layer, composed mainly of lignin and hemicellulose of shorter chain lengths.

Fig. 3.6
Effect of Moisture on Jute Fibre Strength



At low moisture level (say up to 30–35% RH), the jute filament shows increased strength with increase in moisture due to increased strengthening of its component ultimate cells without appreciable weakening of middle lamella. But, at higher moisture level (say beyond 75–80% RH), when the ultimate cells become much strong and the middle lamella is appreciably weakened, jute filament undergoes breakage due to shearing (not rupture) of the ultimate cells under the applied force. At the intermediate moisture level (between 35–75% RH), jute filament shows almost no change in strength as the beneficial effect of increasing strength of ultimate cells is being offset by the gradual weakening of middle lamella.

Both the flexural and torsional rigidities of jute decrease markedly

with increased moisture absorption due to increased mobility among chain molecules on breakage of the hydrogen bonds and thereby reduced resistance towards bending or torsion.

The hygroscopic nature of jute prevents accumulation of static electricity in any jute material since the water molecules help to dissipate quickly any static charge which might develop on friction.

3.3.5 Thermal Properties

On heating to high temperature, the jute fibre chars and burns without melting. Thus, jute is not thermoplastic like any other natural fibre. Even with supply of sufficient heat energy, the long chain molecules bound by numerous hydrogen bonds cannot flow past one another to exhibit plasticity. With increasing heat, the chain molecules vibrate more increasingly and ultimately disintegrate leading to violent chemical reactions observed as fibre combustion.

With a high specific heat value as 1360 J/kg/K, the jute fibre shows good thermal insulation. The ignition temperature of jute is not high, about 193°C, and may be one of the reasons making jute susceptible to catch fire.

The absorption of moisture by jute is accompanied by generation of large amount of heat, the heat of wetting for dry jute is about 18.2 calories. For this, during piling of moist jute under fabric cover, the heat generation facilitates growth of micro-organisms by which the jute fibres get softened and become amenable for good yarn spinning.

3.3.6 Electrical Properties

Dry jute exhibits high electrical resistance but in moist jute, the electrical resistance drops by about 10,000 times. Such variation of electrical resistance with moisture led to the development of an electronic moisture meter. The dielectric constant of jute at a frequency of 2 kHz is 1.8 in the dry state, 2.4 at 65% RH and 3.6 at 100% RH.

3.3.7 Optical Properties

The colour of jute fibres varies widely from pale yellow to dark brown. In general, the tossa variety tends to have a reddish tinge while the colour of white jute varies from from pale yellow to

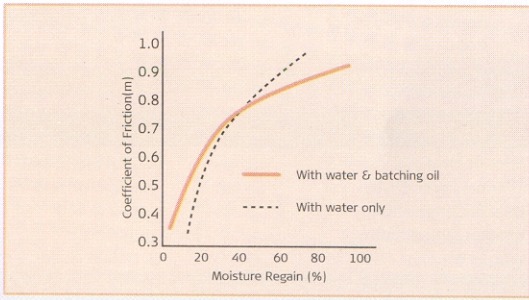
yellow. Good quality jute shows excellent lustre. Jute fibres with good molecular orientation show good amount of birefringence, +0.041, the difference between the refractive index along the fibre axis and that perpendicular to it, due to high orientation of chain molecules.

3.3.8 Frictional Properties

The coefficient of static friction (as measured by an Inclined-plane Friction Tester) is about 0.54 for white jute and 0.45 for tossa. The higher coefficient of friction in case of white jute may be attributed to its better fineness and higher meshiness as compared to tossa jute.

Jute fibre shows increasing friction with increase in moisture regain. The removal of fat and wax from the fibre surface also increases the friction. Batching oil, used for jute spinning, also increases friction up to a certain limit, but in batched fibres, the effect of moisture (upto 40% MR) is more pronounced towards the rise in friction (Fig.3.7). However, the batching oil helps to reduce the friction between jute fibres and metallic pins during carding and drawing stages undertaken for jute yarn spinning. It is worth mentioning here that while lower inter-fibre friction is desirable for reduced drafting-related irregularity, the higher inter-fibre friction helps to develop good yarn strength.

Fig. 3.7
Effect of Moisture on Inter-fibre Friction of Jute



3.3.9 Quantitative Values

In Table – 3.1, all the important physical characteristics of jute are given quantitatively, while in Table – 3.2, some of them have been compared with those of few important allied fibres and cotton.

Table – 3.1

Physical Properties of Jute

A. Macro & Micro Structure		
1. Ultimate Cell Length (L)	– Average	2.50 mm
	– Range	0.8 – 6.0 mm
2. Ultimate Cell Breadth (B)	– Average	18 µm
	– Range	10 – 25 µm
3. L / B Ratio (Average)		110
4. Fibre Fineness		1.3 – 4.0 tex
5. Fibre Length (after Carding)		2 – 50 cm
6. Density	– True	1.46 g / cc
	– Apparent	1.10 – 1.34 g / cc
7. Bulk Density		0.4 – 0.5 g / cc
8. Degree of Crystallinity (X-ray)		55 – 60 %
9. Angle of Orientation (X-ray)		7 – 9°
B. Moisture Absorption		
10. Moisture Regain	– at 65% RH	13.8 %
	– at 100% RH	36.0 %
11. Transverse Swelling in water	– Diameter-wise	20%
	– Cross-sectional area-wise	45%
12. Water holding Capacity		500 %
C. Mechanical Properties		
13. Tenacity : Single (gauge length – 1 cm)		30 – 50 gf / tex ; 0.29 – 0.48 N / tex
Bundle (gauge length – 5 cm)		12 – 35 gf / tex ; 0.18 – 0.34 N / tex
14. Elongation at Break		1.0 – 1.8%
15. Initial Modulus		1700 – 3000 gf / tex ; 17 – 30 N / tex ; 0.9 – 1.7 X 10^{11} dynes / cm^2
16. Specific Torsional Rigidity		0.4 – 0.5 mN. mm^2 / tex^2
17. Specific Flexural Rigidity		0.7 – 0.8 mN. mm^2 / tex^2
18. Elastic Recovery :		
from 3 g / den stress		75 %
from 1.5 % strain		75 %
19. Specific Work of Rupture		2.7 mN / tex
20. Work Factor		0.5
D. Thermal Properties		
21. Specific Heat		1.36 x 10^3 J kg^{-1} K^{-1}
22. Thermal Conductivity		427.3 mW m^{-1} K^{-1}
23. Heat of Combustion		17.5 J / g
24. Ignition Temperature		193° C
25. Heat of Wetting		18.2 calories
E. Electrical Properties		
26. Dielectric Constant (at 2 kHz) - dry		1.8
- 65% RH		2.4
- 100% RH		3.6
27. Insulation Resistance		10^{14} – 10^{17} Ohm depending strongly upon RH
28. Electric Strength		500 kV / cm

G. Frictional Properties		
31. Coefficient of Inter-Fibre Friction ;		
	Tossa Jute	0.45
	White Jute	0.54

Source : *Understanding Jute Yarn (Book), D. Sur, 2005*

Table – 3.2

Comparison between Jute, Important Allied Fibres & Cotton in terms of Physical Characteristics

A. Physical Properties

Fibre	Fineness (tex)	Tenacity (gf/tex)	Breaking Elongation (%)	Flexural Rigidity (dynes.cm^2)	Dia. Swelling (%)	Moisture Regain (%)	
						65 % RH	100 % RH
Jute & Allied Fibre							
Jute	1.25 - 4	30 - 45	1.0 - 1.8	3.0 - 5.5	20 - 22	13.8	36
Mesta/Roselle	3.5 - 5.5	30 - 45	1.0 - 2.0	3.5 - 6.5	20 - 22	13	38
Ramie	0.5 - 0.8	40 - 65	3.0 - 4.0	0.8 - 1.2	12 - 15	6.5	17.5
Flax	2.5 - 6	45 - 55	2.5 - 3.5	1.8 - 2.5	20 - 24	7	22
Hemp	5 - 15	35 - 45	1.5 - 2.5	25 - 80	18 - 20	11	33
Sisal	16 - 35	40 - 45	2.5 - 4.5	125 - 175	18 - 20	1	32
Pineapple	2.5 - 6	25 - 45	2.5 - 4.0	2.5 - 4.0	18 - 20	13	32
Coir	25 - 50	15 - 25	8 - 20	150 - 250	5 - 15	10.5	20
Cotton							
Cotton	0.1 - 0.3	20 - 45	6.5 - 7.5	0.3 - 1.0	20 - 22	7	24

Source : *Understanding Jute Yarn (Book), D. Sur, 2005*

B. Dimension of Ultimate Cells

Fibre	Length, L (mm)	Breadth, B (µm)	L / B Ratio
Jute	0.8 - 6	10 - 25	110
Mesta/Roselle	2 - 11	13 - 34	140
Ramie	50 - 280	15 - 80	3500
Flax	26 - 65	10 - 35	1700
Hemp	5 - 50	10 - 40	900
Sisal	0.5 - 6	5 - 40	150
Pineapple	3 - 9	4 - 8	450
Coir	0.5 - 4	7 - 30	95
Cotton	15 - 60	15 - 20	1300

Source : *Understanding Jute Yarn (Book), D. Sur, 2005*

3.4 Chemistry of Jute

Jute fibre is basically a compound of carbon. Chemically, it is totally a complex of organic molecules, which on ignition leave a little ash consisting of calcium, magnesium, aluminium, iron, etc. that are present either in the free state or bonded with functional groups of cellulosic chain. The major aspects related to chemistry of jute have been presented in the following paragraphs.

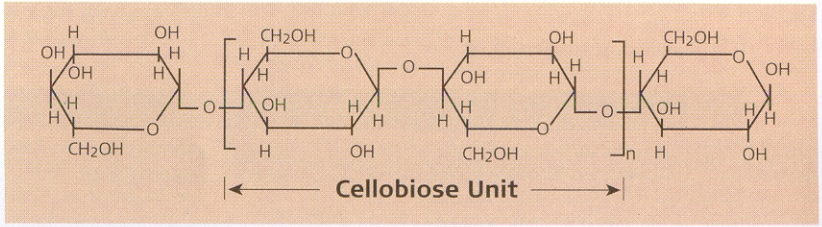
3.4.1 Chemical Structure of Jute

Chemically, jute fibre is mainly composed of polysaccharides (a polymer molecule made up of various units of sugar) and lignin. The fibre also contains smaller amounts of chemical compounds such as fats and waxes, pectin, nitrogenous, colouring, and inorganic matters. The polysaccharides are also called carbohydrates (or holocellulose), and are divided into two groups: alphacellulose and hemicellulose.

a) Alphacellulose

Alphacellulose is the major constituent of jute. It forms the skeletal structure of jute fibre and belongs to the family of the compounds of carbohydrates. It contains 44.4% carbon, 6.2% hydrogen and 49.4% oxygen. Its molecular formula is expressed as $(C_6H_{10}O_6)_n$. The chemical structure of alphacellulose is shown in Fig. 3.8.

Fig. 3.8
Chemical Structure of Alphacellulose



It appears that alphacellulose is a linear condensation polymer of β-d-anhydro glucose units. Each β-anhydro glucose unit contains a ring of five carbon atoms (C_1-C_5) and one oxygen atom. C_1 of one unit is linked to C_4 of another unit through an oxygen bridge, called as 1, 4 glucosidic link. The terminal carbonyl group alternates throughout the chains. All the glucose residues, except the terminal ones, contain three hydroxyl groups. The hydroxyl group

in C_6 position is known as primary hydroxyl group, and those at C_2 and C_3 positions are known as secondary hydroxyl groups.

The alphacellulose is a long chain polymer. The degree of polymerisation (DP) of aplphacellulose chain is about 10,000 if we consider 'glucose unit' as monomer or about 5,000 considering 'cellobiose unit' as monomer (Fig-3.8). The usual methods of isolation of alpahcellulose from raw jute fibre involve more or less degradative action on the cellulose molecule. As a result, the cellulose obtained from the raw jute fibre through different isolation techniques shows variable DP as well as molecular weight, which are less than those of the native cellulose. For this reason, these parameters (i.e. DP and mol. wt.) are found to vary depending upon the mode of isolations of alphacellulose from the raw jute fibre as shown in Table – 3.3.

Table – 3.3
Molecular Weight and DP of Alphacellulose

Mode of isolation	Molecular Weight *	D P
Alphacellulose from chlorite cellulose using 17.5% caustic soda	1,32,840	820
Alphacellulose from chlorite cellulose using 9.3% caustic soda	1,82,250	1125

** determined by viscometric method*

b) Hemicelluose

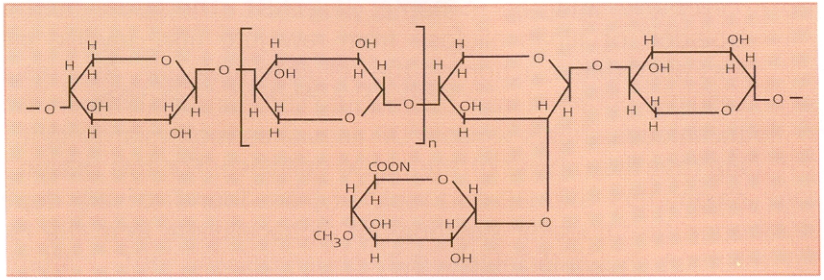
The hemicellulose in jute is a complex mixture of polysaccharides and polyuronides. It is formed by a number of comparatively low molecular weight polysaccharides of various sugar units, namely xylan in the pentosan, galactan in the hexosan, araban, rhamnosan, mannose, etc. These sugar units are actually present in anhydrous form. Polyuronide consists of 4-o-methyl glucuronic acid along with some acetyl groups. Polysaccharide hemicellulose contains a large number of hydroxyl groups and also carboxyl groups. The hemicelluloses are short chain linear polymers. The molecular weight of hemicellulose is 26,000 (determined osmometrically). The chemical structure of hemicellulose is shown in Fig. 3.9.

c) Lignin

The lignin is the third major constituent of jute with a DP of 60. Structurally, the molecule of lignin is a three dimensional polymer

of phenylpropane units consisting of phenolic hydroxyl group, methoxyl group, ether linkages and conjugated double bond in the alpha-position to the benzene ring.

Fig. 3.9
Chemical Structure of Hemicellulose



d) Pectin

A small quantity of pectin is present in the jute fibre. The pectin holds the fibre bundles together. Pectin is a large molecule built up of repeating units of hexuronic acid. It undergoes decomposition during retting to water soluble products by bacteria.

e) Mineral and Colouring matters

The jute fibres are found to be associated with small amounts of different inorganic metals such as calcium, potassium, magnesium aluminium, iron and silica in the forms of their salts. The fibre also contains some pigments and colouring matters. The colouring matters consist of xanthophyll, carotene and tannin. The tannin combines with the iron of retting water to form iron tannate which imparts dark grey colour on the fibre surface after retting. They are also present within the cortical cells and in the fibre bundle. The minerals and the colouring matters are removable from the fibre by chemical means such as treatments with dilute mineral acids, bleaching agents, etc.

3.4.2 Chemical Composition of Jute

The retted jute fibres consist of alphacellulose, hemicellulose and lignin along with some minor constituents. The chemical composition of jute fibres and sticks are given in Tables – 3.4 & 3.5.

The chemical compositions of some other allied fibres have been furnished in Table – 3.6.

Table – 3.4
Chemical Composition of Jute (in % of Bone Dry Weight of the Fibre)

Constituents	Jute	
	C. capsularis	*C. olitorius*
Alphacellulose	60.0 – 63.0	58.0 - 59.0
Hemicellulose	21.0 – 24.0	22.0 – 25.0
Lignin	12.0 – 13.0	13.0 – 14.0
Fats & Waxes	0.4 – 1.0	0.4 – 0.9
Pectin	0.2 – 1.5	0.2 – 0.5
Proteins or Nitrogenous matter , etc. ($\%\ N_2 \times 6.25$)	0.80 – 1.9	0.8 – 1.6
Ash	0.7 – 1.2	0.5 – 1.2

Table – 3.5
Chemical Composition of Jute Sticks (in % of Bone Dry Weight of the Stick)

Constituents	Jute Stick
Alphacellulose	40.8 - 47.5
Hemicellulose	23.0 - 23.6
Acetyl Content	3.6 - 4.7
Lignin	22.2 - 23.5
Fats & waxes	1.7 - 2.4
Pectin	0.5 - 0.7
Ash	0.6 - 0.8

Table – 3.6
Chemical Compositions of some Allied fibres (in % of Bone Dry Weight of the Fibre)

Constituents	Kenaf	Sisal	Sunhemp	Ramie	Banana	Pineapple	Roselle/Mesta
Alphacellulose	60	63.9	78.3	86.9	61.5	69.5	59.7
Hemicellulose	28.6	26.1	16.9	11.2	22.6	21.9	29.3
Lignin	10.1	8.6	4	0.5	9.7	4.4	9.9
Fats & Waxes	0.6	0.7	0.5	0.3	1.4	3.3	0.6
Ash	0.7	0.7	0.3	1.1	4.8	0.9	0.5

Source : *50 yrs of Research : 1939-89, JTRL, India*

3.5 Chemical Properties of Jute Fibre

Jute fibre is an acid fibre and contains fairly a large amount of hemicellulose (21-25%) having acidic group and lignin (12-14%). The fibre is susceptible to the action of alkali. Even a mild treatment with alkali reduces the wet strength of the fibre considerably. If the fibre is throughly scoured and bleached to white colour by which much hemicellulose has been removed from it, the fibre will not stand even mild laundering with soap and soda. The treatment weakens the intercellular cementing materials to hold together the short ultimate cells of the fibre. This behaviour towards

alkalis is related to the acidic constituents of the fibre. The acidity of the fibre is due to carboxylic group and phenolic hydroxyl group. By virtue of carboxylic acid, the fibre binds cationic ash minerals and possesses strong affinity for basic dyes such as methylene blue. It appears that more than 97% of jute constituents are due to alphacellulose, hemicelluloses, and lignin. As such the chemical properties of jute fibre, chiefly arise due to these three integral major constituents. The properties of the three components are categorically discussed below.

3.5.1 Properties of Alphacellulose

The alphacellulose of jute is the true cellulose and free from xylan. Each ß-anhydroglucose unit of the alphacellulose of jute fibre having secondary hydroxyl groups at C_2 and C_3 and primary hydroxyl group at C_6 position as already referred to shows chemical reactions under appropriate conditions.

a) Action with Alkali

It shows swelling properties with alkalis. It combines with NaOH to form sodacellulose, the degree of combination depends on the concentration of the alkali and the temperature of the reaction. Subsequent hydrolysis or washing of the sodacellulose with water makes the sodium ions loose and restores the cellulose and NaOH.

The degree of polymerisation (DP) is reduced to some extent and the molecular order of cellulose is decreased due to the action of alkali. The reduction in such order increases the absorption power, reactivity and dyeability. This is technically important for modifications of fibre by chemical reactions, as may be required for production of some diversified jute products.

b) Action with Acids

Swelling of fibres with mineral acid like sulphuric acid, fuming hydrochloric acid, nitric acid, phosphoric acid, etc. or their mixture is rather complicated. It takes place at higher acid concentration (60%) and it causes dissolution of the fibre structure. Even with dilute concentration of inorganic acid, the reduction of chain length occurs by hydrolysis of the 1,4 glucosidic linkages. So treatment with inorganic acid is very degrading. But such actions with organic acids are less degrading. Volatile organic acids (e.g. formic, acetic) are easily removable and the non-volatile acids (e.g. oxalic, tartaric) have no adverse effect on fibre.

c) Action with Oxidising Agents

Oxidising agents degrade cellulose producing oxycellulose. At low concentration, the fibre structure is not affected. Progressive oxidation decreases the fibre strength. When dilute solutions of oxidizing agents such as chlorine (in sodium or calcium hypochlorite) are used, no harmful influence is evident. In fact, they are used in whitening or bleaching the natural colouring matter. Potassium permanganates are found to be used for bleaching jute fibre, but it is not commercially done.

d) Action of Light and Moisture on Storage

The deterioration of alphacellulose upon ageing occurs due to the combined effect of oxidation and hydrolysis. But alphacellulose in the jute remains practically unchanged on storage, possibly non-celluolosic constituents protect the alphacellulose. Freshly prepared alphacellulose contains a small amount of carboxyl group as an artifact of the preparation treatment, which in the presence of a sensitizer (moisture, etc), tends to set up hydrogen-ion (auto) hydrolysis of the cellulose molecule at the neighbouring glucosidic linkages during ageing as with acidic oxycellulose of cotton.

e) Action of Microorganism on Storage

Microorganisms also degrade the fibre on storage. The cellulose can be hydrolyzed by the secreted enzymes of microorganisms, resulting in depolymerisation and reduction in fibre strength.

f) Action of Heat

Heat has some effects on alphacellulose. It brings decolouration, but it does not cause yellowing effects which are caused due to lignin chromophores in UV sunlight and is discussed later under the properties of lignin.

3.5.2 Properties of Hemicellulose

As hemicellulose belongs to the carbohydrate class consisting of pentosans and hexosans having uronic acid, the following properties are evident :

a) Due to the presence of uronic acid in hemicellulose, the jute fibre shows some acidic property as evidenced by its natural affinity for basic dyes such as methylene blue.

b) Hemicellulose also forms alkalicellulose like alphacellulose. It swells more than alphacellulose.

c) It is very much hygroscopic and susceptible to microbial attack.

d) It is soluble in 18% (w/w) NaOH solution.

e) It forms ester linkage between its uronic acid and phenolic hydroxyl group of lignin.

3.5.3 Properties of Lignin

There are evidences that there exists an ester linkage formed between the carboxyl group of hemicellulose (in uronic acid) and the hydroxyl group of lignin. Ether linkages between lignin and cellulose may be believed to exist. It is apparent that hemicellulose and cellulose are bonded by lignin and the three (alphacellulose, hemicellulose and lignin) are integrated. The following properties of lignin are particularly prominent:

a) It dissolves in chlorine dioxide solution.

b) It is resistant to hydrolysis by aqueous solution of inorganic acid.

c) Hydrolysis of lignin with concentrated solutions of mineral acids (64-72%) such as H_2SO_4, HCl fuming, HF or their mixture is accompanied with dissolution of the carbohydrate portion of fibre leaving behind the insoluble lignin portion.

d) The ester linkage between lignin and hemicellulose is resistant to the action of sodium chlorite. Caustic soda can only hydrolyze the ester linkage between uronic acid and lignin. So complete delignification without alkali treatment is not possible. A little lignin is tenaciously retained by the holocellulose during the delignification process with sodium chlorite.

e) Removal of surface lignin helps to increase light fastness.

f) Lignin has a pronounced tendency to develop yellowing on the bleached fibre upon exposure to light. The yellowing effect is the fastest during the initial hours of irradiation and it is more pronounced at higher humidity condition. Lignin in jute acts as a sensitizer for yellowing and absorbs radiation in the near UV region (290-4020nm with 330-370nm region playing the dominant role) when the lignin is in 'ionic' form. Delignified jute fibre does not show yellowing and it is concluded that lignin acts as a sensitiser towards yellowing of jute. Heat and oxygen cause discolouration of bleached jute, but do not cause yellowing.

Some remedial measures to check the yellowing problem upon bleached jute fibre due to lignin are :

- Modification of lignin chromophores to a form whose absorption lying in the far UV region may check yellowing.
- Post bleach in an acidic pH may remove some chromophores and retain lignin in a neutral and non-ionic form to check yellowing.
- Blocking of phenolic hydroxyl groups in lignin by acetylation or methylation may check yellowing.
- Application of suitable UV stabilizers and blending with man-made fibres which do not absorb in the near UV region may check the yellowing.
- Using UV sensitive dyes containing special chromophores may enable to achieve good light fastness grade on bleached jute fabrics.

3.5.4 Effect of Chemicals on Jute

a) Effect of Alkali

Jute fibres have poor resistance to alkali due to presence of hemicelluloses. Alkali treatment extracts out hemicellulose from the jute fibre structure making it weak. With treatment of strong (18%) alkali, jute fibres become much weak but develop crimp due to irregular swelling, a process popularly known as woollenisation of jute.

b) Effect of Acid

Jute fibres are weakened and destroyed by acids. The cellulose chains disintegrate due to hydrolysis of the glucoside oxygen atom (which joins glucose units to form cellulose chain). Mineral or inorganic acids have more adverse effect on jute than organic acids as they hydrolyse cellulose chains more rapidly.

c) Effect of Bleaching Agent

The most common bleaches used for jute are sodium chlorite and hypochlorite. Sodium chlorite / hypochlorite dissolves out lignin from jute making it more white as lignin is responsible for the natural yellow to reddish colour of jute. Due to partial removal of lignin, bleaching treatment makes jute weaker as the middle

lamella (major location of lignin) between the ultimate cells gets weakened. Due to this, jute fibres also become finer on partial disintegration of the multicellular structure.

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JUTE
basics

Mechanical Processing of Jute

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Chapter 04



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4.1 Introduction

Raw jute reeds after retting and drying are packed in the form of bales (180 kg) which are transported to the jute mills. In the jute mills, the raw jute fibre strands are converted to yarns and fabrics. The mills which produce yarns, fabrics and conventional bags of jute are known as 'Composite mills' and constitute the organised sector. In the organised sector, there are also 'Spinning mills' which produce only jute yarns or twines. In the decentralised sector, there are few production units which produce fabrics and finished goods with yarns produced by the mills of the organised sector; and another group of such units convert the fabrics, procured from the 'Composite mills', into finished products for varied end-uses. Thus, the basic functions of the jute product manufacturing units, in organised and decentralised sectors, are to convert jute fibres to yarns or finished fabrics or tailor-made products for different end uses.

A brief idea about the conventional processing of jute has been mentioned in the following paragraphs in three broad categories: (a) Conversion of Jute Fibre to Yarn, (b) Conversion of Jute Yarn to Fabric, and (c) Finishing and Bag Manufacturing. The flow chart for jute processing in all these categories has been mentioned in Fig. 4.1.

4.2 Conversion of Jute Fibre to Yarn

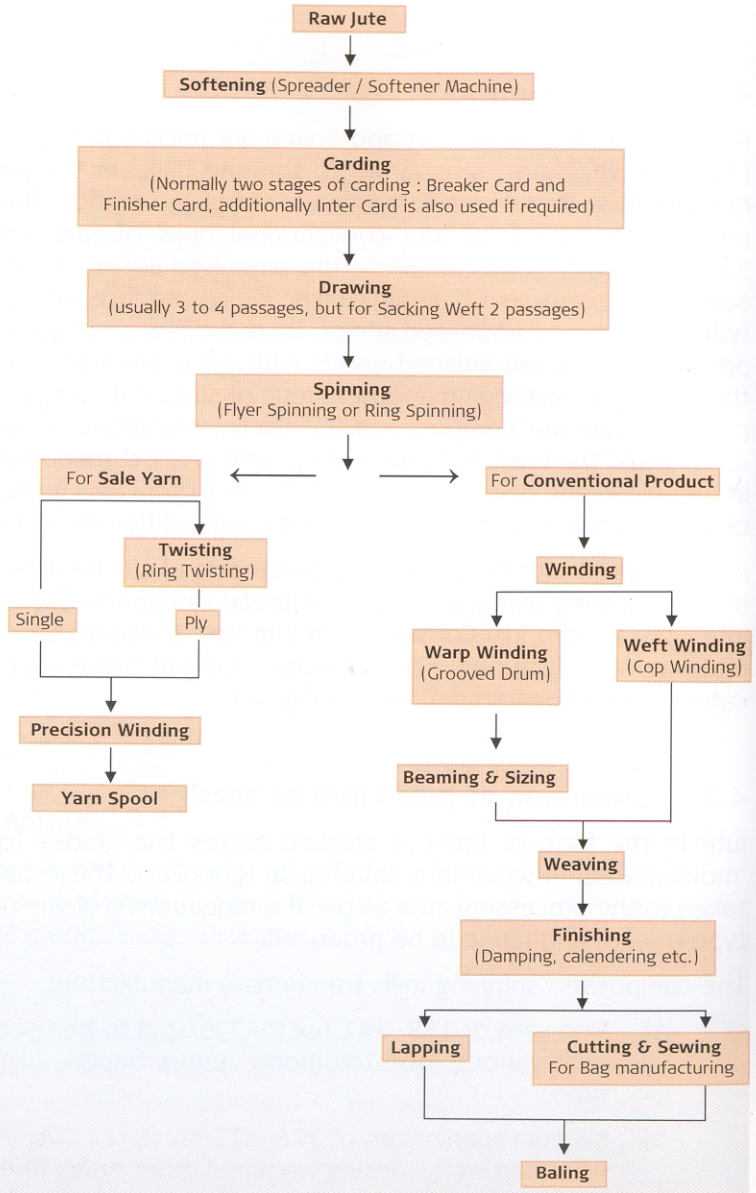
Jute in the form of bales is stacked as per the grades (quality), and 'mokam' (region-wise) in a warehouse (godown). These bales are then taken to the processing area as per the requirement of the quality or the type of yarn and fabric to be produced.

The composite / spinning mills traditionally manufacture:

a) Fine yarn of 138–241 tex (4–7 lb/spy) to be used for carpets and various non-traditional end-products like decorative fabric;

b) Medium coarse yarn of 276–413 tex (8–12 lb/spy) for hessian warp and weft, sacking warp and other types of end-products like canvas;

Fig. 4.1
Flow Chart for Traditional Jute Processing



c) Coarse yarn of 482 tex (14 lb/spy and above) for sacking weft and coarse end-products like matting;

d) Plied yarns or twines of different counts.

The conventional process of conversion of fibre to yarn consists of the following stages.

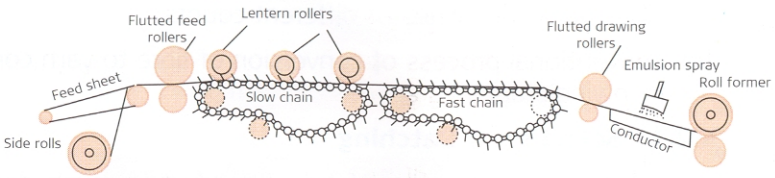
4.2.1 Selection & Batching

Since the quality of yarn / fabric / product is much dependent on the quality of the raw material i.e. raw jute fibre, any product manufacturing process starts with the judicious selection of raw jute bundles to be used for the purpose. The selection of raw jute for a particular product is done by 'selectors', through a 'hand-and-eye' (subjective) assessment. The selection is done by considering the basic fibre characteristics like strength, colour, entanglement, and defects affecting the spinnability, and also most importantly the cost of raw jute, being responsible for about 50% of the production cost. The selectors prepare the morah (jute reed bundle) of uniform weight from the assorted jute. The selection of a particular fibre batch for a particular type of yarn, such as hessian warp or weft, sacking warp & weft or sale yarn, depends on (a) price of raw jute; (b) grade of jute, (c) quality specification of yarn, (d) availability of jute, and (e) spinning performance.

Jute fibre cannot be processed successfully in the dry condition due to excessive generation of short fibres. For this reason, the jute fibres are subjected to moistening and lubrication so as to make them amenable to easy processing.

For making the jute fibre bundles suitable for next carding operation, the morah prepared in selection are passed through softener or spreader machine. During its passage through these machines, an oil-in-water emulsion is applied on jute for its softening or lubrication. In softener, the jute reeds are fed through a number of pairs of spirally flutted rollers and delivered in loose form. The jute fibres are repeatedly flexed between each pair of rollers and are made softer; and at the same time, some of the adhered materials like dust, dirt, bark and stick particles are either separated or loosened from the fibre body making their removal at later stages easier. During passage through the rollers, the emulsion is dripped on the jute fibres. In spreader (Fig. 4.2), the jute reeds pass between a pair of straight flutted feed roller and on to the pins of a

Fig. 4.2
Spreader Machine (Schematic diagram)



slow-moving lattice known as the slow chain; above the slow chain there are three lantern rollers to press the jute firmly down on to the pins. Half-way along the machine, the material is transferred from the pins of the slow chain to those of similar chain having a higher surface speed. Due to a greater surface speed of the fast chain, the jute reeds are combed and drawn out. The jute fibres come off the fast chain, pass between a pair of straight flutted delivery rollers and are guided down a channel where the emulsion is sprayed by a fish-tail nozzle. Finally the material is delivered as a continuous assembly of jute reeds in roll form.

An emulsion of oil-in-water is applied to jute to lubricate and soften it. The oil may be vegetable, or mineral. Vegetable oil is now used in manufacturing products like food grade jute bags. The water softens the fibre, improves its spinnability and prevents excessive fibre breakage during processing. The oil, residing on the fibre surface as a thin film, retards quick evaporation of water from the fibre body. Along with the oil, some jute mills are using different additives for ease of processing.

After softener / spreader, the emulsified jute fibre bundles are kept under a cover for certain period of time. By this, a certain amount of heat is generated within the covered jute mass which along with moisture causes microbes to grow. Due to this microbial action on jute fibres, the fibres become softened. This stage is called 'Piling'.

4.2.2 Carding

In the carding operation the long strands of jute are converted into a continuous ribbon of fibres. The ribbon is known as sliver. Different qualities of jute in the batch are also blended and much shorter fibres are removed too.

The primary objectives of jute carding are:

a) to generate discrete filaments, suitable for further mechanical processing, by longitudinal splitting and tranverse breakage of jute reeds having a mesh like structure of inter-linked filaments (Fig. 3.2), and

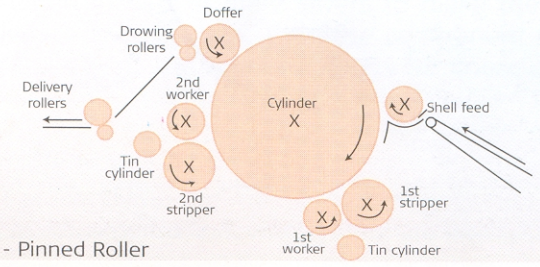
b) to produce a sliver with uniformity, as far as possible, in linear density along the sliver length.

The machines used in the carding process are generally two, Breaker and Finisher Cards.

The breaker card breaks the continuous mesh of fibres in jute reed into separate fragments, called spinners' fibres, which are akin to the single fibres of cotton or wool.

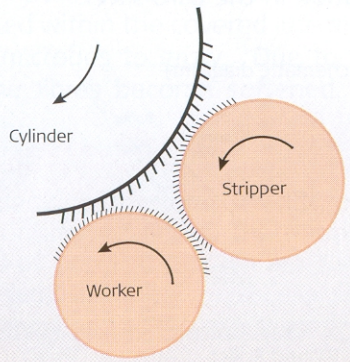
Breaker cards are usually half-circular, down-striker and have two pairs of worker and stripper rollers (Fig. 4.3). The long jute reeds are converted into fibrous fleece in the shell feeding arrangement of the breaker card. This consists of a pinned feed roller with backward-facing pins and a cast iron shell which is shaped to follow the circumference of both the feed roller and the cylinder and forms an edge between the two curvatures over which the jute reeds pass. The jute reeds enter the space between the pinned feed roller and the shell and gradually travel towards the pins of a heavy cylinder, moving down swiftly. These fast moving pins of the heavy cylinder exert substantial striking force on the jute reeds, for which the meshy structure of the reeds are broken into discrete filaments of widely varying lengths due to longitudinal splitting and transverse breakage and are converted into a continuous linear fibrous assembly on the cylinder surface. The clearances between the shell and the feed roller, the shell and the cylinder and the feed roller and the cylinder and also the rate of fibre feeding have a considerable influence on the average fibre length and the fibre length distribution in the card sliver.

Fig. 4.3
Breaker Card (Schematic diagram)



As the jute reeds are continuously fed to the breaker card, the carded fibres get deposited in layers on the cylinder surface and after certain amount of such deposition, the fibres are picked up by the doffer rollers to deliver a continuous ribbon of carded fibres, a card sliver. The feed of jute reeds to the breaker card is quite irregular in nature and as a result, the fibre mass accumulation along the cylinder circumference becomes also irregular for which the delivered sliver becomes irregular. Since the sliver at each pre-spinning stage is desired to be much regular for production of good quality yarn, the production of the breaker card sliver with less regularity is a matter of concern. For the purpose, in the breaker card, adjacent to the moving pinned cylinder, there are another two sets of smaller pinned cylinders, workers and strippers. Due to pin orientation and direction of rotation of the workers and strippers with respect to cylinder and each other (Fig. 4.4), the fibres from a thickly accumulated place are transferred first from the cylinder to the worker, then from the worker to the stripper and finally back from stripper to probably a place with lesser fibre mass on the cylinder. Thus, the fibre mass distribution over the cylinder surface becomes more even due to such randomisation. During each such transfer of fibre mass from cylinder to worker, worker to stripper, and back to cylinder, further combing, teasing and splitting of fibres take place. Finally, when the fibrous mass is developed to a sufficient thickness, the doffer strips the fibres off the cylinder and passes it to the nip of the drawing rollers. However, the doffer removes a major portion of the fibre mass on the cylinder, while the rest travels round with the cylinder. The presence of workers and strippers helps in reduction of irregularity

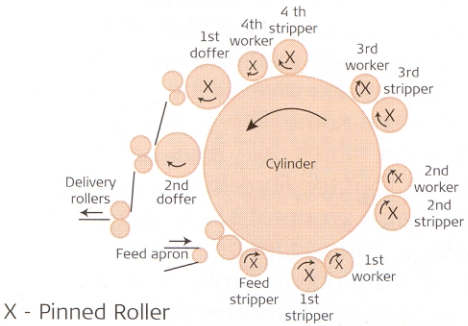
Fig. 4.4
Movement of Worker and Stripper rollers w.r.t. Cylinder



in the sliver delivered from the breaker card, while their absence would have caused much greater irregularity in thickness of the delivered sliver.

The carding operation is continued on a finer scale in the finisher card (Fig. 4.5). A number of slivers are fed on the feed side of the Finisher card to obtain a more uniform sliver from it and to mix different qualities of fibre. The finisher card has the ability to effect finer splitting of the fibres. Moreover, more number of pairs of workers and strippers, as compared to those in breaker card, help to improve further the regularity of the carded sliver. For coarser varieties of jute, one more carding passage, called 'Inter Card' is provided between breaker and finisher cards for better splitting and opening of jute.

Fig. 4.5
Finisher Card (Schematic diagram)



X - Pinned Roller

4.2.3 Drawing

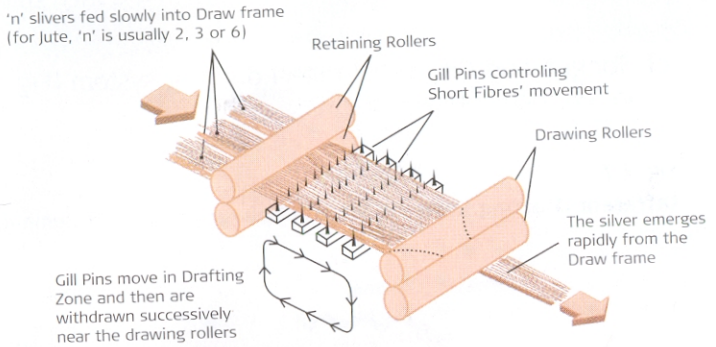
The sliver delivered from the finisher card is not so uniform in thickness and also the fibres within it are not sufficiently straightened. The subsequent drawing processes improve the sliver in these respects by means of drafting and doubling. Doubling is the combination of two or more slivers to make the resultant sliver more uniform in thickness, than the component slivers. By the process of drawing, the sliver thickness (or linear density) is reduced. A number of drawing machines are employed to achieve sufficient thinning down (attenuation) of the slivers as well as sliver regularity by way of doubling.

To examine the behaviour of the fibre during drafting, let the simplest case be considered first, where there are two sets of rollers

involved – a feed pair and a drawing pair. The jute sliver enters the machine through the nip of the feed or retaining rollers and then passes forward to the drawing rollers. Because of the greater linear speed of the latter, the material becomes drafted (elongated), the exact amount of drafting being determined by the ratio of surface speeds of the two sets of rollers. The distance between the two sets of rollers, the reach, is longer than the fibre being drafted; if it were not so then a number of fibres would be gripped by both sets of rollers at the same time and be broken. As a result of this comparatively long distance, there are always a large number of fibres, specially the shorter ones, which are gripped neither by the retaining rollers nor the drawing rollers. These are called 'floating' fibres. Whenever some fibres enter into the drafting zone through the slowly moving retaining rollers, they move with the speed of these rollers; and when their tips are gripped by the drawing rollers with higher speeds, their speeds become higher in comparison to other slowly moving fibres and thereby the relative distances between the two groups of fibres get increased, resulting in the increase in length of the sliver. Now, in case of such acceleration in the movement of some fibres, say few longer ones, many of the adjacent short fibres will also be dragged forward by the longer fibres due to inter-fibre frictional cohesion. This process is cumulative so that a group of short fibres simultaneously emerge from the drafting zone, generating thereby a thick place in the sliver delivered by the drawing rollers. Moreover, this action causes a temporary deficiency of shorter fibres in the drafting zone with the result that a thick place is followed by a thin place. Due to presence of large number of short fibres in jute slivers, not only the formation of thick and thin places takes place in higher magnitude as compared to that in cotton slivers, but also the extent of such thickness or thinness is also much higher, making the jute drawn slivers much more irregular as compared to those of cotton or similar fibres.

In jute drawing frames, the undesired dragging of short fibres by the longer ones are restrained by means of a set of moving pins which carry the sliver up to the nip of the drafting rollers (Fig. 4.6). The pins provide sufficient frictional resistance to restrain most of the short fibres from premature acceleration but at the same time do not interfere with the normal processes of drafting near the nip of the drawing rollers. These types of drawing frames are known as 'open-gill drawing' and the pins as 'gill-pins'. The linear speed

Fig. 4.6
Drawing of Jute Slivers in Open Gill Drawing Frame (Schematic diagram)



of the gill-pins is a few per cent higher than that of the retaining rollers so that when the sliver is held between the retaining rollers and the pins that have just struck into it, it is under slight tension and the next row of pins can penetrate the sliver more easily. It is essential that the sliver should remain embedded within the pins otherwise control over the short fibres will be lost; resulting in irregular sliver at the delivery.

For making the jute slivers much amenable to good spinning, usually three passages of drawing are employed with the help of three drawing frames, viz. first, second and finisher. After all these drawing passages, in the jute sliver, the fibre mass distribution along the sliver length becomes less irregular and also most of the fibres become oriented parallel to the direction of sliver length.

4.2.4 Spinning

At the delivery of the last (finisher) drawing frame, the jute sliver becomes sufficiently thin. In the spinning frame, this thin sliver is further elongated to the specified linear density of final yarn and twisted to form the yarn; and finally the yarn is wound on a bobbin so as to make a compact yarn package for easy handling for subsequent operations. So, the spinning machine performs three operations : drafting, twisting and winding. Due to such twisting, any textile yarn develops strength so as to withstand the tension developed in the yarn at subsequent processing stages.

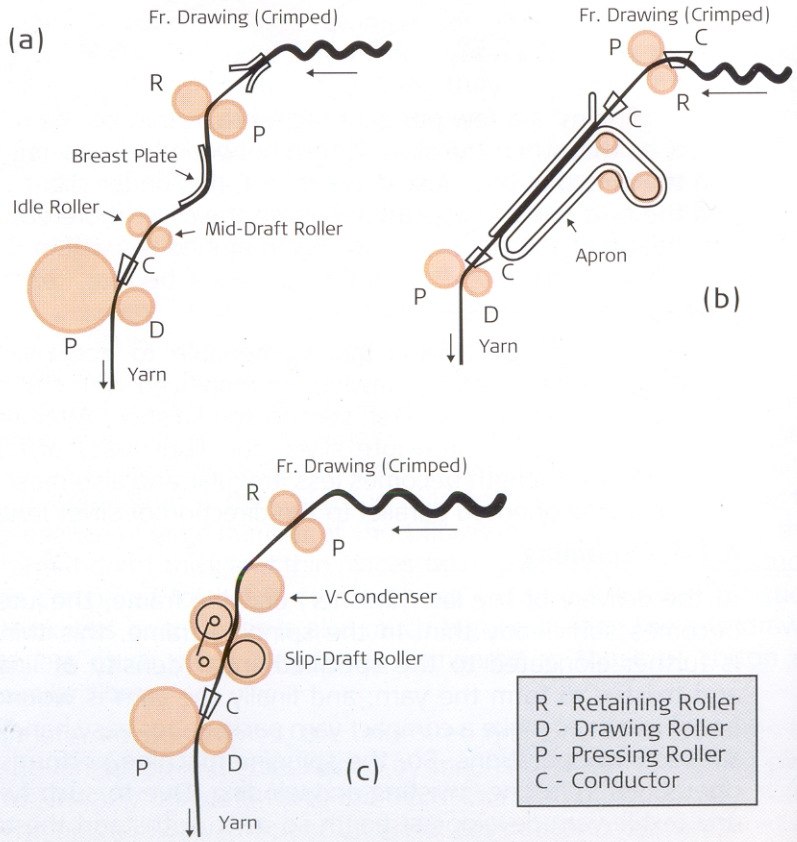
The drafting system used in jute spinning frames are of following types (Fig.4.7) :

a) Slip-draft system (Fig. 4.7a), used in 4¼ inch spinning frame;

b) Apron-draft system (Fig. 4.7b), used in 4¼ inch spinning frame; and

c) Tongue and Groove (V-roller) drafting system (Fig. 4.7c), used in 5½ inch spinning frame.

Fig. 4.7
Different Drafting Systems for Jute Spinning Frame (Schematic diagrams)



A comparison between the three drafting systems is given in Table-4.1.

Table – 4.1
Comparison between Different Drafting Systems for Jute Spinning

Drafting System	Draft Range	Use	Feature
Slip -draft	10-20	Mostly for spinning jute yarns, equal or above 241 tex (7lb/spy)	Medium control over the movement of short fibres in the spinning drafting zone and hence helps to produce medium quality yarns, equal or below 345 tex (10 lb/spy), and good quality yarns, above 345 tex (10 lb/spy).
Apron -draft	10-25	Mostly for spinning jute yarns, below 241 tex (7 lb/spy)	Good control over the movement of short fibres in the spinning drafting zone and hence helps to produce medium quality yarns, equal or below 207 tex (6 lb/spy), and good quality yarns, above 207 tex (6 lb/spy).
Tongue and Groove (V-roller)	4.5-10.8	Mostly for spinning sacking weft	Medium control over the movement of short fibres when present in large number in the spinning drafting zone as in case of sacking weft production.

The formation of a jute yarn can be achieved through various processes as described below:

Flyer Spinning

In this system, the twist is imparted in the yarn by revolution of a two-legged flyer or a cylindrical tube known as Baxter flyer. This is the popular system of spinning in the jute industry. By using the Baxter flyer, higher spinning speed can be attained as compared to two-legged flyer.

Jute spinning frames insert the twist by means of overhung flyers, either two legged or Baxter, suspended above the bobbins (Fig. 4.8). There is no positive drive to the bobbins and the bobbins are made to rotate by the yarn pull. The flyers are carried on ball-bearing wharves mounted on the front of the frame. The wharve is driven by a cotton or nylon tape from the main cylinder of the machine.

The yarn passes down from the nip of drawing rollers to the top of the wharve and continues to run down through the wharve. The flyers have a small 'eye' at the foot through which the yarn passes on to the bobbin.

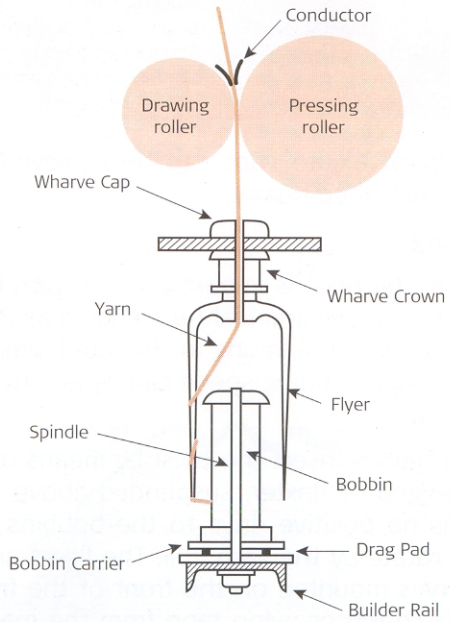
The simplest relationship between flyer speed, delivery speed, and twist is

$T = n / v$

where, T is the turns of twist per unit length, n the flyer speed, and v the delivery speed.

The bobbin rotates around a central dead spindle which is set vertically on the builder rail which in turn moves up and down. When the builder rail is at the top of its traverse, the yarn is wound at the bottom of the bobbin and vice versa. This reciprocating movement of the builder rail, combined with the rotation of the flyers about the bobbins, winds the yarn on the bobbin in a spiral path.

Fig. 4.8
Flyer Spinning System (Schematic diagram)



Ring Spinning

Here, the twist is imparted by a rotation of a traveller along the circumference of a metallic ring.

In ring spinning, the sliver, emerging from the drafting rollers and passing through a thread-guide, gets twisted by rotating movement of a traveller around a ring, and then wound onto a tube or bobbin, which is carried on a spindle, the axis of which passes through the

centre of the ring. The spindle is driven positively and the traveller is dragged around the ring by the loop of yarn passing round it. Each revolution of the traveller now inserts one turn of twist into the loop of yarn between the drawing rollers' nip and the traveller but, in equilibrium, the number of turns of twist in this loop of yarn remains constant as twisted yarn is passing through the traveller at a corresponding rate.

4.2.5 Twisting

Twisting is the operation of formation of ply yarn by twisting two or more single yarns. Single yarns are twisted in the direction opposite to the direction of twist in the single yarns. Both flyer and ring twisting machines are used for the purpose.

For production of ropes or cords, a number of plied yarns are twisted together by using suitable twisting machines.

4.3 Conversion of Jute Yarn to Fabric

In weaving, two types of yarns, known as warp and weft, are interlaced in loom to produce fabric (Fig. 4.9). While both warp and weft yarns are produced in spinning department using almost similar processing technology, their further processings for making them suitable for weaving are quite different. Warp yarn is converted ultimately into beam and weft yarn is converted into cop for the purpose of making interlacement in loom.

4.3.1 Winding

a) Warp Winding

Warp yarns coming from spinning department in the form of spinning bobbin are processed in winding machines (Fig. 4.10) for converting into spool/cone prior to beaming.

The objectives of warp winding are:

i) To produce bigger package (spool or cone) from comparatively smaller package (spinning bobbin),

ii) To remove objectionable faults (slub, thick and thin places etc.) from yarn, and

iii) To produce package with uniform tension and suitable for subsequent operation.

Fig. 4.9
Interlacement of Warp and Weft in a Fabric

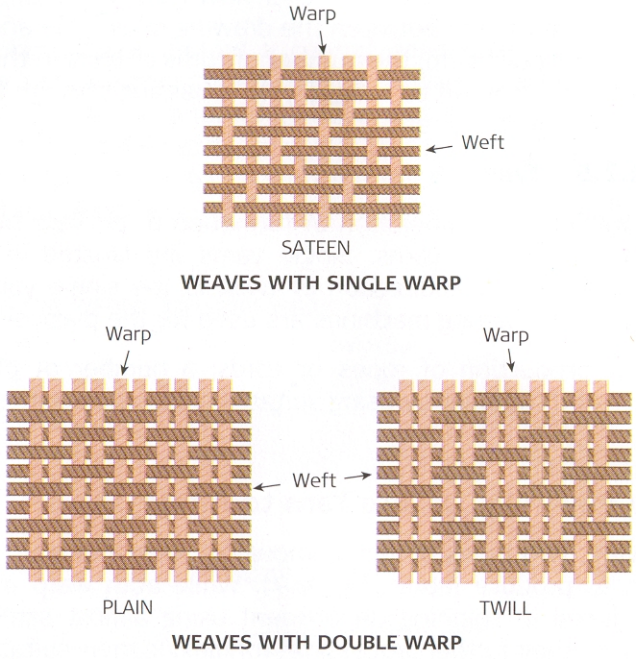
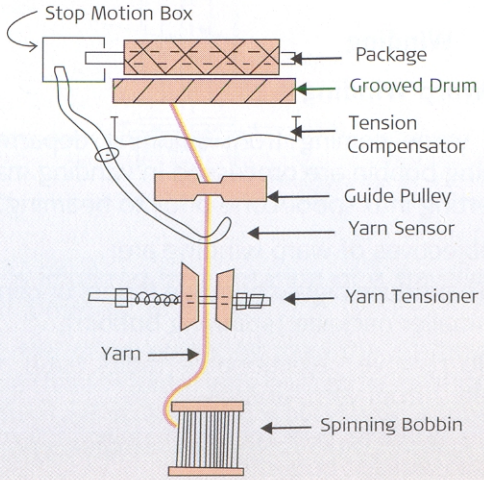


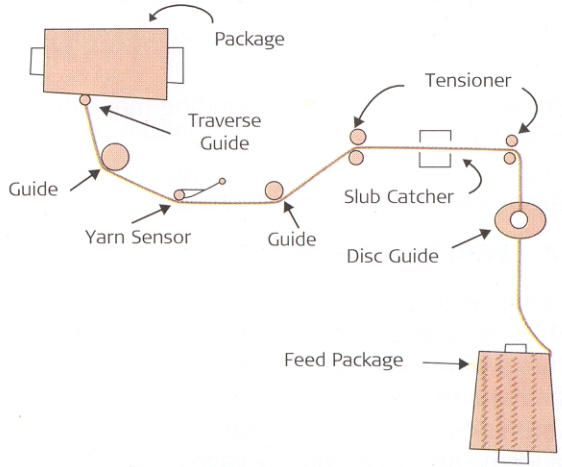
Fig. 4.10
Warp Winding Machine (Schematic diagram)



The warp winding machines are of following types:

- Drum or surface driven winding machine with separate Traverse Bar,
- Scroll type of Grooved drum winding machines, and
- Spindle or Precision Winding Machine (Fig. 4.11)

Fig. 4.11
Precision Winding Machine (Schematic diagram)



The objective of warp winding is being achieved by winding the spinning package (flanged bobbin) onto the wooden package or paper package known as spool, cheese or cone. These packages are either surface driven on a drum or directly driven from a spindle. The packages are made into a bigger diameter. The yarn, from the spinning bobbin, passes through a tensioner and a yarn clearer and then gets wound onto the package. The function of the tensioner is to provide uniform tension in the wound package and remove the weak places present in the yarn. The function of the yarn clearer is to remove objectionable faults present in the parent yarn. While the mechanical clearer removes objectionable slubs or thick places, the electronic clearer removes similar faults and also very thin places.

To form a wound package with large yarn content, several individual spinning packages (with smaller yarn content) are required to be

unwound and joined together by knots and hence the proper knotting is an essential part of this winding process. The wound package is then being transferred to beaming / warping section for further processing.

b) Weft Winding

The weft winding is a process to produce, from spinning bobbins, suitable yarn packages, known as cops, which are placed one after another within the shuttle during weaving so as to use such yarns as weft in the final fabric. For producing good quality cop, wound package should be used instead of spinning bobbin.

The cop winding machines are of following types:

- Conventional vertical cop winding machine (commonly found in mills), and
- Automatic cop winding machine.

4.3.2 Warping / Beaming & Sizing

The warp yarns are supplied to a loom in the form of a yarn sheet which is wrapped in a number of layers on a flanged beam, and this warp beam contains a required number of sized warp yarns, in parallel and placed side by side, according to the total number of warp ends in the total width of the ultimate fabric. These warp yarns come from wound packages (spool, cheese or cone). The preparation of the warp beam is a one stage process, called as Dressing and Sizing. But, when a fabric is produced with large number of warp threads using a broad loom, the beam preparation is carried out in two stages: Pre-beaming and Sizing. For the warp beam preparation, many jute mills are recently using the machinery similar to the textiles and the process comprises of two stages: warping / beaming and sizing.

In case of dressing and sizing (single stage process), the yarns from the wound packages, placed in the creels, are fed through the sizing bath, dried, and subsequently wound on a beam in layers. In the pre-beaming process, the yarns from the wound packages in creels are first wrapped onto beams with lower number of warp threads and then a number of beams taken together are subjected to the sizing operation.

a) Dressing or Beaming & Sizing

The warp yarns from the spools and are finally wound on to a beam. The warp yarns are sized ;

- to lay the loose fibres on the surface of the yarn in order to reduce frictional resistance during weaving, and
- to reduce wastage.

A sizing paste consists of adhesive substance such as tamarind kernel powder and a small quantity of antiseptic agent.

For jute yarns, the operations of sizing, drying and beaming are carried out simultaneously in a Dressing Machine. The warp yarns from the spools are impregnated with the dressing mixture contained in the size box and then, dried on drying cylinders and finally wound on to a beam.

In the following paragraphs, the pre-beaming / beaming / warping and sizing are discussed separately.

i) Pre-Beaming (or Beaming or Warping)

In this process, the wound packages (spool/cheese/cone), as obtained from winding section, are kept on a creel, a double-sided frame having a number of vertical and horizontal rods arranged in rows and columns. The yarns from the packages (150 – 500 in numbers), from all rows and columns of the creel, are drawn through individual guides and tensioners and finally through an expanding comb (deciding the beam width) towards the measuring roller (for fixing the required yarn length on the beam) and a flanged beam. The yarn beam so produced contains a fixed number of warp threads. Now, in case of pre-beaming / beaming / warping, a number of such beams are prepared and fed to the sizing machine.

ii) Sizing

Warp yarns are supplied to a weaving loom through a warp beam. These warp yarns undergo cyclic tensioning as well as repeated abrasion due to frictional contacts, between the adjacent yarns and also between yarns and loom parts, during weaving cycles. To reduce the incidence of warp yarn breakage (to achieve a satisfactory weaving efficiency) due to higher tensioning and/or abrasive damage during weaving, the yarns are coated or sized with paste of some gummy materials. Such coating helps in laying

down the protruding hairs on yarn surface and makes the yarn more resistive to abrasive damage. On the other hand, some penetration of sizing material into the yarn makes the yarn strong enough to withstand higher weaving tension. Thus, the sizing is meant for improving the weavability of warp yarns and thereby to obtain the desired level of weaving production.

Efficiency of the weaving shed is dependent on good quality warp beam. A good warp beam (preferably sized or dressed otherwise) ensures lower warp breakage, lower wastage, higher weaving efficiency, better fabric quality and lower weaver's fatigue.

The sheet of yarns passes through the size liquor kept in the sow box. Size liquor consists of adhesive along with antiseptic, softening, wetting agents etc. for various functions. Yarn sheet after passing through size liquor, passes through the nipping roller for removal of extra size solution. The sized yarn sheet then passes around a number of drying cylinders for evaporating water. The sheet of yarns is then wound on a weaver's beam as per width of beam. Heating and cooling assist binder to settle down in yarn. Moisture retention plays an important role. Too much drying or too less drying makes the yarn either brittle or sticky causing problems on loom. Moreover, stretching of yarns during its movement before sow box onto winding head also plays an important role in case of jute fibre due to its low elongation.

Sizing process therefore is an important process for better working in the loom shed. This is a major criterion for installing shuttleless loom.

4.3.3 Weaving

Weaving is the process of forming a cloth by the interlacement of two distinct sets of yarns : warps and wefts. The machine on which the operation of weaving is done is known as Loom (Fig. 4.12). The warp yarns are those yarns which run lengthwise (parallel to the selvedge) from end to end of the cloth, while the weft yarns, running from selvedge to selvedge, intersect the warps at right angles. For weaving a cloth, the warp yarns are supplied in the loom with the help of a beam and the weft yarns in the form of cops, anchored within the shuttle having a criss-cross movement in respect to warp sheet.

The important motions of a loom as required to weave a fabric are given in Table - 4.2.

Table – 4.2

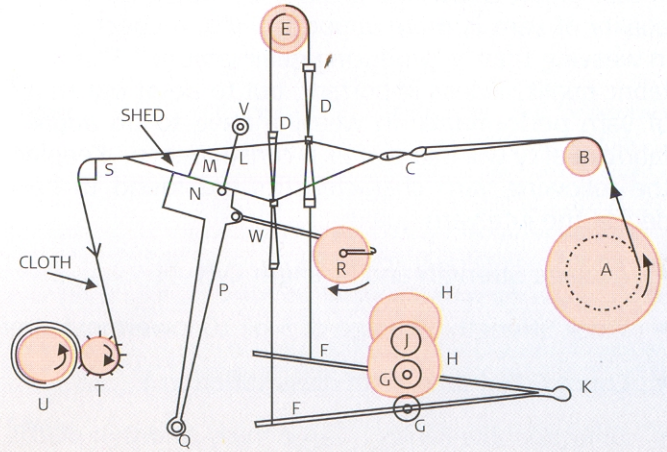
Important Motions of a Jute Loom

SN	Basic Action for Warp / Weft Yarns	Result of Action	Name of the Motion
1	Formation of two layers of warps	Shed formation	**Shedding motion**
2	Laying of weft yarns within the sheds formed by warp threads	Picking (propelling) of shuttle from one end to other	**Picking motion**
3	After laying the weft, the same has to be pushed towards the line of previously formed fabric	Beating up of the weft towards the fell of the cloth	**Beating motion**
4	Winding of the woven fabric onto a double-flanged roller	Taking up the fabric on a roller as per required weft density	**Take-up motion**
5	Release of the warp threads from weaver's beam as per the requirements of take-up	Slow unwinding of warps from the beam due to pull caused by take-up motion	**Let-off motion**

Apart from the above motions, weft stop motion and warp protecting device are also being incorporated on the loom to improve the quality of fabric.

Fig. 4.12

Passage of Warp in the Loom (Schematic diagram)



A – Warp Beam **B** – Back Test **C** – Lease Rods **D** – Camb **E** – Camb Roller **F** – Treadle Lever **G** – Treadle Bowl **H** – Shedding Wyper **J** – Bottom Shaft **K** – Heel Pin **L** – Reed **M** – Shuttle **N** – Sley **O** – Sley Sword **P** – Sword Shaft **Q** – Crank Shaft **S** – Front Rest **T** – Pin / Up-take Roller **U** – Cloth Roller **V** – Reed Cap **W** – Connecting Arm

4.4 Finishing and Bag Manufacturing

The jute fabrics, produced by the weaving process, are examined for the defects which are then repaired. Subsequently, these fabrics are subjected to mechanical finishing with the help of different machinery in the finishing department for achieving the following objectives for making them ready for conversion to bag or supply to customers:

- To remove or mend defects in the fabric,
- To remove the crease or fold in the fabric,
- To make the fabric surface smooth and bright,
- To improve the appearance and cover of the fabric, and
- To pack the fabric / bags in roll or bale form according to the requirements of the buyers.

The different finishing processes are mentioned along with the respective objectives in the following Table - 4.3 and Fig. 4.13.

4.5 Quality Assurance

4.5.1 Fibre to Yarn Conversion

In case of jute and at the present technological level of the industry, quality of yarn is more important with respect to its performance in weaving than in producing quality fabric. This is not to say that fabric quality is less important, but to point out that the problems of yarn performance in weaving have to be addressed first and fabric quality will improve as a consequence. Keeping this in view, the following yarn characteristics are found to be important to decide the jute yarn quality :

- Average Strength and Strength CV%
- Weak Strength (average of 5 or 10 lowermost strength values)
- Count CV% (long-term mass variation)
- Objectionable Faults : Large thick and thin places, and slubs
- Average Twist and Twist CV%
- Hairiness

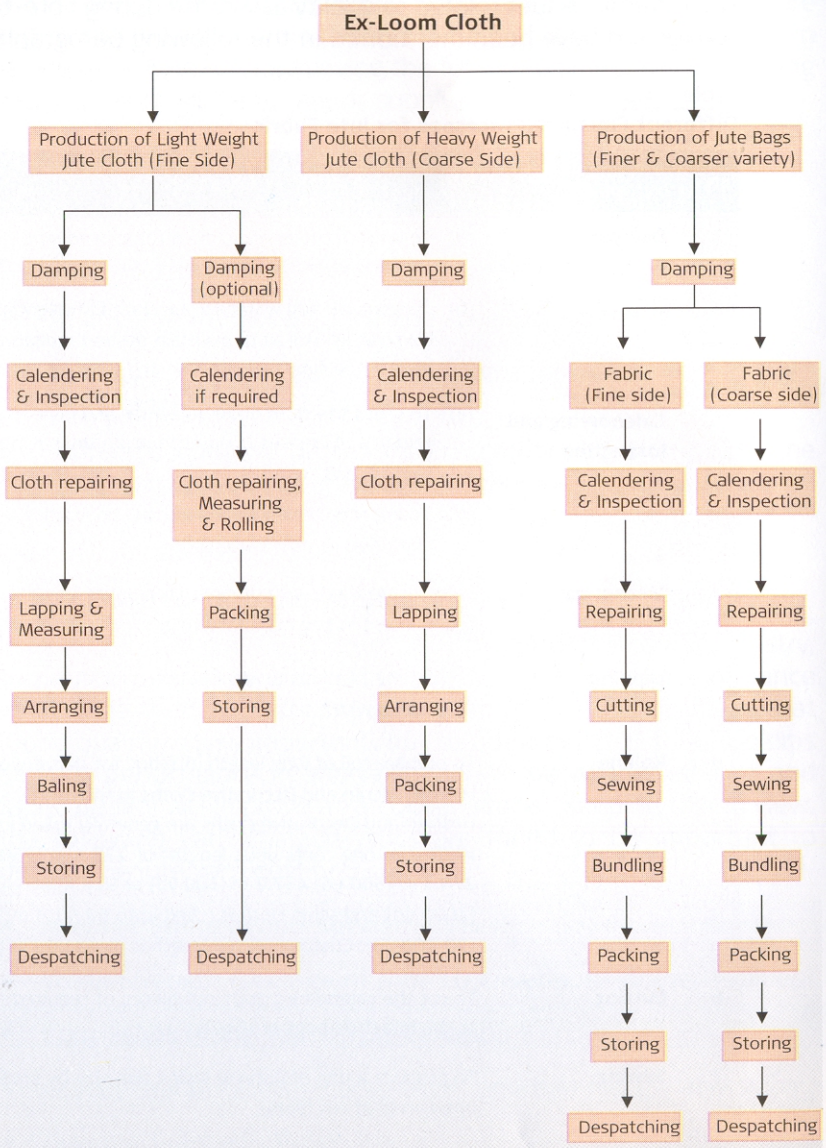
It must be noted that all these yarn quality characteristics are objectively measurable using suitable testing instruments.

The different issues related to quality assurance during fibre-to-yarn conversion have been mentioned in the following paragraphs.

Table – 4.3
Different Finishing Processes for Jute Fabric

SN	Name of the Process	Objectives
1	**Damping**	(a) To unwind the ex-loom cloth for subsequent finishing operation (b) To spray or add water on the cloth for calendaring purpose as well as to maintain desired moisture level in the final product.
2	**Calendering and Inspection**	(a) To press the cloth under moisture and heat for removal of creases in order to make the surface smooth and lustrous. (b) To improve the cover and glossy appearance of the cloth due to yarn flattening.
3	**Measuring**	To measure the length of cloth keeping in view the requirement in bag manufacturing.
4	**Lapping**	To fold the cloth continuously upon itself at required lap length and width.
5	**Rolling**	To prepare roll of long length of fabric for delivery of Hessian, Scrim and Decorative cloths in roll form. Hessian and Decorative cloths are generally rolled in full width into one continuous length of 228.6 m (250 yd), 274.3 m (300 yd),457.2 m (500 yd) or 914.4 m (1000 yd) and scrim cloth is rolled upto 64-91.4 m (70-100 yd). Customarily roll length is measured in yard.
6	**Cutting**	To cut the calendered cloth into pieces of required sizes to manufacture bags or sheets.
7	**Sewing**	To produce a bag of definite shape and size by sewing open ends of cut fabric.
8	**Baling**	To prepare a suitable package with cover of the final product for storing and dispatching.

Fig. 4.13
Flow Chart Finishing Processes for Jute Fabrics & Bags



a) Raw Jute & Softening

Right selection of raw jute, through objective assessment of raw fibre strength, and optimum softening play important roles in deciding the yarn quality. For this, some jute mills have already introduced the regular objective testing of raw jute strength by using usual strength testing instruments. The proper softening treatment for the raw jute fibres is essential to produce slivers of reasonable regularity.

b) Carding

The optimum operation of breaker and finisher cards helps to generate such distribution of fibre length and fineness as required to spin yarn with targeted quality.

The uneven feeding rate of raw jute at breaker card results in an appreciable irregularity in the breaker card sliver. For reducing such feed variations and also eliminating the dollop weighing system (for reducing labour cost), Sliver Grist Monitor (SGM), is being used in the breaker cards in many mills. Many mills are also using SGM in the spreaders.

To keep the long-term yarn count variation within the acceptable limit, it is imperative to produce a finisher card sliver with variation as low as possible from the targeted average linear density (count). For this purpose, some jute mills are using Autoleveller in the finisher cards.

c) Drawing

After carding, it is also desired to employ optimal use of drawing passages, through judicious choice of drafts and doublings in them, for achieving satisfactory sliver regularity as well as parallelisation – an essential requirement for spinning jute yarn with lower irregularity and higher strength. Many mills are employing four passages of drawing instead of conventional three passages to improve further the quality of jute yarn, particularly of finer counts.

d) Mechanical Defects

The mechanical defects in the carding and drawing machines do certainly affect the generation of sliver irregularity. The defects of

concern are usually found as : (i) eccentric rollers, (ii) improper gauging of the rollers, (iii) worn out bearings, (iv) groove formation in drawing rollers, and (v) broken, bent and missing pins of the card staves and gills. It can be found many times that in the same mill, the sliver irregularity varies appreciably from machine to machine and even in the same machine in different days due to inadequate attention to the above mentioned mechanical defects. Thus, it is imperative that to keep the unevenness of the sliver at a reasonably low level, the machine maintenance must be paid due attention. The system of 'machine auditing', already developed, may be adopted to identify the 'rogue' machines at different processing stages which cause higher than normal sliver irregularity and to implement corrective actions as deemed necessary.

e) Sliver Irregularity

Long-term mass variation seems to decrease appreciably from breaker card to finisher card due to higher amount of doubling (of 10 or 11) at the input of finisher card. From finisher card to finisher drawing, the long-term variation decreases slowly as the total amount of doubling increases slowly from the first drawing stage to finisher drawing stage.

Short-term mass variation decreases from breaker card to second drawing and increases again at finisher drawing (where doubling precedes drafting) due to higher draft and lower doubling combination at the finisher drawing stage where the open-gill system seems less effective for controlling drafting wave in the thin jute sliver. For this reason, intersecting-gill drawing frames may be used at finisher drawing stage (preferably along with second drawing stage) for their capability of exerting better control on large population of shorter 'floating' fibres in jute sliver.

f) Spinning

The drafting system and draft at the spinning stage are two important factors deciding the short-term irregularity and the overall quality of jute yarn. For this, these two factors are usually set on the basis of yarn count and targeted quality in most of the mills as per their technological understanding, being developed over the years. For achieving the targeted yarn quality, most of the mills are using humidifier and overhead cleaner, the former for helping easy twisting of coarse jute fibres while the latter one for

producing jute yarns with lesser number of objectionable defects.

4.5.2 Causes of Irregularity

In Table – 4.4, the primary causes of mass irregularity in slivers and yarns of jute, during commercial operations are mentioned. While some are uncontrollable due to inherent characteristics of jute fibre and its processing methodology, others are controllable and hence deserve serious attention for not only improving the yarn quality but also assuring the production of jute yarn as per targeted quality.

Table – 4.4

Primary Causes of Mass Irregularity in Sliver & Yarn of Jute

Factors Responsible	State of Control	Specific Causes
Fibre Factors	Uncontrollable	Unfavourable properties, inherent in fibre, like very low extensibility (brittle), coarseness with high diameter CV%, higher rigidity, etc.
		Wide Fibre length distribution, with high short fibre content, in slivers (after Carding)
		Presence of branches, of varying length, in almost each filament (after Carding)
Processing Factors	Uncontrollable	Random arrangement of fibres in slivers
	Controllable	Improper batch selection by subjective method with focus on cost reduction in most of the cases
		Irregular Feeding at the cards
		Inadequate or excessive carding action
		Moisture variations in fibre and sliver
Machine Factors	Controllable	Poor machine condition and inadequate machine maintenance in majority cases
	Uncontrollable	Non-availability of new machines with better process capability and electronic auto-control wherever needed
Quality Control	Controllable	Inadequate supervision and control of the process in most of the cases
		Over emphasis on production rather than product quality
		Less-equipped SQC Department in most of the cases

Source : *Understanding Jute Yarn (Book), D. Sur, 2005*

4.5.3 Yarn to Fabric Conversion

While assessing the quality of jute fabric either on or off the loom, the two aspects are usually considered: (i) Technical specification of the fabric, and (ii) Defects within the fabric.

Under the technical specification of a fabric, either all or a part of the following parameters are usually considered:

a) Count of warp and weft
b) Number of warp and weft threads / dm
c) Areal density
d) Width of fabric
e) Bag weight
f) Stitch density
g) Moisture content
h) Fabric Shrinkage

Under the fabric defects or faults, the following are usually considered as major ones, affecting adversely the quality of a fabric :

a) Reed mark
b) Missing warp or weft
c) Gaws
d) Broken pick
e) Biasness
f) Thick & thin places (bars)

If the faults are detected while weaving of the fabric on the loom, it should be rectified without any delay. The finishing stage is also meant for detection of the fabric faults and their removal to the extent possible.

4.6 Machinery Development

Though the jute industry for a long time are producing fabrics by using conventional orthodox machinery compared to the other fibre industry, the individual mills or machinery manufacturers tried to modify existing machinery or developing a new process or to develop a new machinery to improve the quality and production rate of the ultimate product. Over the years, maximum stress was given to the carding, drawing and

spinning machinery. Less importance was given for softener and spreader machines and hence no significant development has taken place in regard to softener or spreader machines. But the importance has been given to lubrication part, where jute batching oil (mineral oil) used over the years has been reduced to a very less quantity or replaced by other vegetable oil / polymeric materials / enzymes for odour-free product.

Over the years, the carding machines have undergone different modifications for improved functioning: full circular double doffer card, 5X single doffer card with draw head, high speed cards (JF series) with matalag staves, etc. Recently, high speed card with metallic card clothing is under development for improvement in the quality of jute sliver.

In case of drawing frame, even though mono-head or draftomatic has been used for long but screw-gill and rotary-gill drawing frames are considered as modernisation in the jute industry.

In case of spinning system, the two-legged flyer was replaced by Baxter flyer to increase the spinning speed with both apron and slip drafting system. For production of yarns of fine-to-medium counts, the ring spinning system with a larger package is being used by few mills. For plying single yarns, jute ring twister has been widely accepted. Recently, Two-for-One Twister (TFO), being used by other fibre industry, has been introduced in few of the jute mills for improving productivity.

In case of winding, the jute industry is running the same old Mackroll and Scroll Winder, since the automatic winding machine with splicer, as being used in textile industry, was not found suitable for the coarse and not-so-regular jute yarns. But precision winding machine has been accepted by the industry for a long time for larger package and specifically for ply yarn. In case of shuttleless weaving, single yarn wound on precision winding machine is being widely used. However, the precision winding machine in few cases are working with the electronic clearer and better tensioner device to remove not only the thick places and slubs but also thin places.

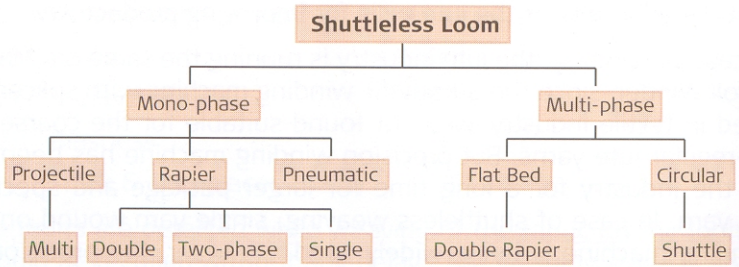
For weaving jute fabric, over-pick shuttle loom is being used by the jute industry for several decades and no new development has taken place in this regard. Under-pick shuttle loom has not been tried due to heavy mass of shuttle using larger cops.

Shuttleless looms are used widely in the cotton and synthetic industry. In the jute industry, the shuttleless looms, mainly Rapier and Gripper Looms (Projectile), are now slowly being introduced to produce good

quality jute fabrics, specially hessians. Since the preparation of good weaver's beam is essential for satisfactory operation of shuttleless looms, improved warping and sizing processes have become a necessity for beam preparation. For warping and sizing operations, the machines, being used by the cotton and synthetic industry, have been adopted by jute industry after some modifications. But, with coarser jute yarns, the speed of these machines has to be kept very low. The use of a square creel is preferred for coarse jute yarns in the warping machine with a positively driven warper's beam. In case of modern sizing machine, the sow box is slightly modified as the size content in jute is very low and used for coating purposes only. All the control mechanisms as exist in these machines meant for cotton / synthetic yarns are also available in machines for beam preparation with jute yarns.

The jute mills have started using shuttleless looms to produce jute fabrics, mainly hessian, of improved quality, in terms of firmness and appearance, as compared to the traditional jute fabrics. Classification of shuttleless loom is shown in Fig. 4.14.

Fig. 4.14
Classification of Shuttleless Loom



The first generation rapier loom is of multi-phase type, known as Onemac and Twomac models, and was initially used by the jute industry. In these models, the rapier (spear) is used to travel through two side-by-side separate sheds, opening and closing alternately, for weaving two fabrics at a time in a rectilinear weaving system. These types of looms were initially used by industry for making reversible sacking and hessian. Over the years, few mills continue to work with these machines but the development of rapier loom of rectilinear type with single phase concept, having single / double rapier of either flexible or rigid type, gained the popularity due to higher production with easier maintenance

and operation. In few mills, Russian ATPR Loom of pneumatic type is found to be in operation in spite of some operational and maintenance problems.

Overall picture of modernisation in the weaving section of a jute mill is not encouraging except that few mills have slowly started adopting various machines of textile industry, with some modifications, for precision winding, warping, sizing and weaving.

4.7 Nonwoven Technology

Nonwoven fabric is defined as a fabric structure made directly from fibres rather than yarns. In case of jute, needle-punched nonwoven fabric, known as felt fabric, was well known for long. This type of felt fabric was normally produced with jute caddis (waste material) using a teaser card, garneting machine (type of roller & clearer carding machine) and a needling machine wherein coarse needles penetrate the carded web, causing interlocking of fibrous mass and compactness. Generally, the jute caddis is used to be needle-punched on a scrim cloth. These needle-punched fabrics were mainly used for carpet backing, damping cloth, mulching etc.

The modern needle-punched nonwoven technology has been slowly adopted by the jute industry for meeting the demand of production of jute-based geo-textiles, agro-textiles, automotive textiles, filter fabric, insulation fabric etc. At present, jute nonwoven fabrics are manufactured either from cut-stapled jute or from breaker card roll. The jute fibre is being processed either individually or mixed with low melting point fibre through the nonwoven carding machine, cross lapper, and then the fibre assembly after needle punching or pre-needle punching is subjected to hot air bonding or thermal calendar bonding to produce different kinds of jute nonwoven fabrics. Again the air-lay principle is being used to manufacture jute nonwoven fabric for thick filtration, insulation and for manufacturing of composites. Resin impregnated nonwoven fabrics are also used to produce automotive textiles, shoe uppers and rigid boards.

4.8 Manufacturing of Diversified Products

4.8.1 Present jDP Manufacturing Base

The present overall scenario of manufacturing jute products and JDPs has been given in the Table-4.5.

Table – 4.5
Manufacturing Scenario for Jute Products and JDPs

Category	Description
	ORGANISED SECTOR
A	A very few jute mills manufacturing on regular basis both conventional and JDPs (to the extent of 5 – 20% of total production).
B	A good number of traditional jute mills occasionally producing some JDPs in their wet processing plant on a contractual basis or outsourced to the converters.
C	Another substantial number of jute mills engaged mainly in the production of sacking bags (to the extent of 80-100% of daily production) and without any capability of manufacturing JDPs due to inadequate machinery installation.
	DECENTRALISED SECTOR
A	A good number of units manufacturing a few JDP items by procuring yarns and fabrics from the organised jute mills or local jute traders / outlets and adopting, if necessary, suitable chemical processing such as bleaching, dyeing and printing or appropriate thermo-mechanical processing (for lamination or composite products).
B	Another good number of units, so called 'converters', engaged in producing JDPs using finished fabrics from external sources.
C	A large number of small units engaged mainly in production of various handicraft items using fibre / yarn / fabric or combinations.

4.8.2 Product Manufacturing

The fibre, yarn and fabric of jute are the basic raw materials that can be appropriately used by the entrepreneurs / craft-persons for manufacture of a number of JDPs.

The different jute diversified products are being manufactured by adopting any of the following routes :

a) Conversion of Fibre to Product

The raw jute fibres, in grey or dyed form, are converted to various products like dolls, jute blanket, etc. and jute composites, pulp and paper, absorbents, etc. In many cases, the fibres are braided and then converted to products like tea coaster, fruit basket, ornament, hammock, door mat, floor mat, telephone mat, door curtain, slipper/sandal, etc.

b) Conversion of Yarn to Product

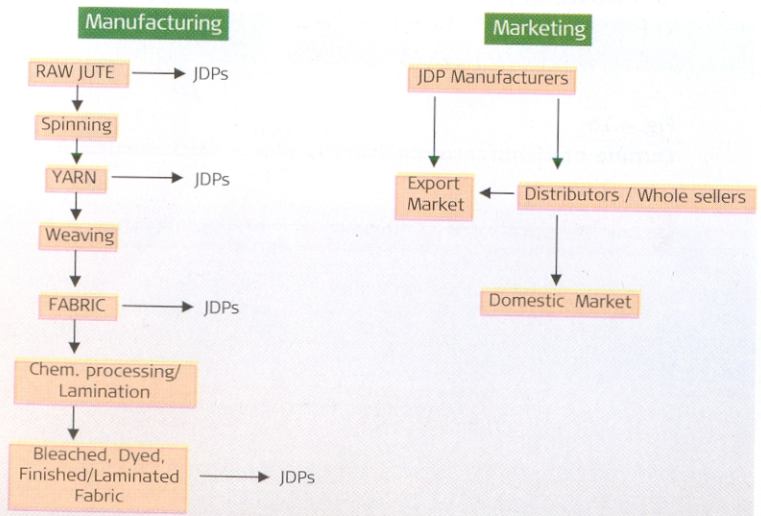
The jute yarns, in grey or bleached or dyed or woollenised form, are directly converted to products like pot holder *(sikka)*, knitted bag, hammock, lace, belt, sweater, sandal, shoe sole, doormat, floor mats, etc. The yarns in grey or bleached and / or dyed form are also used in handlooms to manufacture all-jute or union fabrics (mostly with jute yarn as weft and cotton yarn as warp) which are marketed as grey fabric, bleached fabric, dyed fabric, striped fabric, checked fabric, fabric for printing, lamination, etc. or converted to products like home textiles including furnishing fabric, wall hanging, buckram, floor covering, beach product etc.

c) Conversion of Fabric to Product

The jute fabrics, in grey or dyed form, are used to manufacture products like shopping bag, fancy bag for ladies, sling bag, brief case, folders and files, attaché case, suitcases, school bags, gift and jewellery boxes, Venetian blind, shoe upper, etc. In case of use for shopping bags and soft luggages, the jute fabrics are generally coated with thin low or high density polythene / polypropylene by extrusion technique or laminated with LDPE sheet for making them stiff and water proof.

The supply chain for manufacturing of JDPs and also for marketing has been shown in Fig. 4.15.

Fig. 4.15
Supply Chain for Manufacturing & Marketing of JDP



4.9 Jute Composite Manufacturing

4.9.1 Jute Reinforced Composite

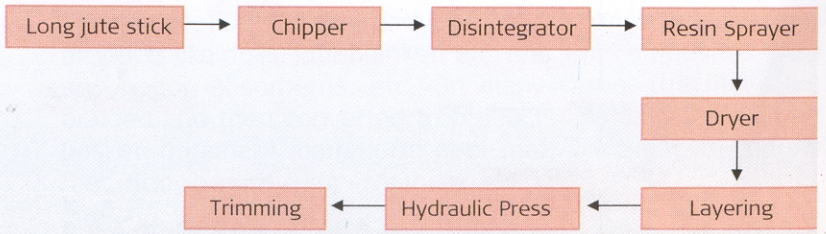
Jute fibre has the potential to substitute glass fibre in manufacturing fibre reinforced composites. Processing technologies have already been developed and established to incorporate jute fibre into polypropylene for converting jute into pellets / granules. The resultant jute composite granules can be converted into composite by injection moulding process. The use of jute fibres as filler, to the extent of 40%, for reinforcement results in cost benefit, renewability and low density in case of such composite materials. For these attributes, jute composite finds increasing application in the automobile industry, as alternative to popular glass-reinforced composite, in manufacturing of car door panels.

4.9.2 Jute Stick Particle Board

Jute stick particle board is a good example of utilisation of agro-wastes, i.e. jute sticks, for value addition. These boards are being manufactured by bonding the jute stick, disintegrated into particles / chips, with suitable synthetic binder under heat and pressure. While the low density boards are used for false ceiling and similar other non-load bearing applications, the medium density boards are used for structural applications.

An outline of particle board manufacturing process is shown below in Fig. 4.16.

Fig. 4.16
Outline of Manufacturing Process of Jute Stick Particle Board



4.10 Manufacturing of Technical Textiles with Jute

Technical textiles are defined as "textile materials and products meant primarily for certain technical performance and functional properties and with much less or no importance for aesthetic or decorative characteristics". It is certainly expected that jute, being stronger and more dimensionally stable as compared to most of the textile fibres, can have greater usage potential in certain specific technical textile applications like packaging (packtech), geo-textiles (geotech), agro-textiles (agrotech) and composites (buildtech, mobiltech). With growing global concern for environment, the potential of eco-friendly jute fibre is expected to be encouraging. To translate this potential into the real market growth, it is imperative to ensure that certain jute-based strong, dimensionally stable and flexible technical textile products with assured technical performance are regularly produced in bulk. This in turn demands a thorough understanding of the process and quality control as required for manufacturing each and every jute-based technical textile product with consistent quality.

The Table - 4.6 shows the requirements in terms of fabric type and fibre characteristic for different technical textiles wherein jute can effectively be used :

Table – 4.6
Requirements for Manufacturing of Technical Textiles with Jute

Product	Woven	Non - Woven	Fine Fibre	Coarse Fibre
Bags / Packaging	√		√	√
Soil Saver	√			√
Geo -textile	√	√	√	√
Automobiles - Dash board lining/door paneling/boot lining/insulation	√	√	√	√
Filter fabrics		√	√	
Scrim Fabric for Agricultural/Composites/Geo-textile	√		√	
Composites	√	√	√	√
Agricultural Nets and Mulching	√		√	√
Tapes / Webbing	√		√	√
Home furnishings	√		√	
Protective cloth	√	√	√	

Further Reading

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JUTE
basics

Chemical Processing of Jute

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Chapter 05



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5.1 Introduction

It has already been mentioned that there is an increased interest for jute-based products. To sustain this interest of the consumers by meeting their demands for jute products, specially the jute diversified products, it is being felt necessary to ensure the quality of the jute products in terms of functional and aesthetic characteristics, as desired for each such jute product in consideration of its specific end-use(s). For assurance of these desirable characteristics, the jute products must be subjected to appropriate chemical processing, which should be eco-friendly on one hand and on the other, economic as well as processor-friendly. While for jute diversified products to be used as decoratives / home textiles, the aesthetic properties are more important, for technical textile products of jute, the functional performances rather than aesthetics are of utmost importance. Hence, according to the end–use of the product, the whole sequence of required chemical processing has to be judiciously identified and then appropriately executed.

Although jute has some similarities with cotton in chemical processing for the presence of common constituent cellulose in both the fibres, it becomes essential to separately develop and standardise any type of chemical processing for jute due to its ligno-cellulosic nature, keeping in view of its end-uses and required functional property criteria. Hence, the methods and recipe of chemical processing for cotton are not directly applicable to jute.

In the subsequent paragraphs, a brief mention of the chemical processing of jute and its products has been made for understanding of the appropriate chemical processing as required for a jute product to make it fit for particular end-use.

The chemical processing of jute may be divided under the following categories:

a) Chemical and Bio-chemical treatments of jute fibres prior to spinning.

b) Chemical Texturing (woollenisation) of jute and jute-blended yarns.

c) Preparatory Chemical Processing of jute yarns and fabrics.

d) Dyeing of jute yarns and fabrics using synthetic and natural dyes.

e) Printing of jute fabrics with specific dyes or pigments.

f) Chemical Finishing of jute fabrics.

5.2 Chemical and Bio-chemical Treatments of Jute Fibres

5.2.1 Chemical Pre-treatments

Woollenisation (chemical texturing or bulking) of jute fibre is effected by treatment with 10-18 % aqueous caustic soda (Sodium hydroxide) solution in the cold or at room temperature for a minimum period of 30 min, followed by neutralization and washing and drying. By such treatment, significant change occurs in jute's physical structure like lateral swelling together with longitudinal shrinkage. As a result, the fibre becomes soft to the touch and develops crimps like wool. Due to close resemblance of the material with coarse wool in appearance and feel, the process is popularly known as 'Woollenisation'. This process is commercially used for blending woollenised jute fibres (crimpy) with wool, acrylic and other fibres for producing coarser variety of shoddy products in woollen or shoddy industry rather than jute industry.

5.2.2 Brightening of Colour

The jute fibre is usually brightened by treatment with reducing agent. Brightening of '*Shyamla*' (dark colour) of jute fibre is sometimes carried out with sodium bisulphite and di-ammonium phosphate at the fibre stage (batching) in the industry. Treatment of jute material with sodium bisulphite produces light cream to yellowish brown according to initial colour of jute.

5.2.3 Enzyme-aided Fibre Preparation

The enzymatic process is commercially carried out for softening the barky and hard root portions of the low quality long fibres, before piling prior to carding using pectinase enzymes (obtained from bran culture or other sources). For the purpose, the jute batching oil, along with appropriate proportions of non-ionic surfactant, enzyme and organomodified silicon compound as additive, is applied on raw fibres and then piled for required time span. Results of mill trials

revealed that enzymatic softening of root ends led to improved process performance, particularly during the spinning stage, even with higher proportion of root-ends in the batch.

5.2.4 Bleaching of Jute Fibre at Batching Stage

A simple and economic process for peroxide bleaching of jute at the fibre stage has been developed. Bleaching chemicals are applied with the jute batching oil. Equal volumes of a peroxide solution and the lubricant with emulsifier are combined in a hand sprinkler. Mill studies show that the spinning of bleached jute fibre, by using hydrogen peroxide (up to 6%), to yarns of 207 tex (grist 6 lb) and upwards can be satisfactorily done. The process is very economical as it dispenses with costly wet processing machinery. The process is extensively used for manufacture of bleached yarns for mats and matting as well as cheap or superior bleached fabric.

5.3 Chemical Texturing (Woollenisation) of Jute Yarns

Chemical texturisation or so called woollenisation at jute yarn stage develops much softer and bulkier yarns instead of woollenisation process being carried out at fibre stage, since the crimps developed in jute fibres by woollenisation are not permanent in nature and are lost to a considerable extent during mechanical processing for conversion of fibre to yarn.

Woollenisation of jute or its blended yarns is usually carried out by treatment with 15-18% aqueous caustic soda solution for minimum 30 min at room temperature at relaxed conditions, which is same as the procedure for woollenisation of jute fibres. By this process, despite considerable weight loss, jute or jute blended yarns develop bulk and become much softer, but develop surface browning as well, which is removable by H_2O_2 bleaching. Bulked or woollenised jute-based yarn, having superior stretchability and bulk properties, can be used as better weft yarns for making furnishing, upholstery, decorative fabrics and coarser material of jute i.e. blanket.

5.4 Preparatory Chemical Processing of Jute Yarns and Fabrics

Unlike cotton, jute has a golden yellow or brown colour and contains about 40% non-cellulosic matter, hemicellulose (21-24%) and lignin (12-14%). Besides, jute yarns or fabrics contain about 2-3% mineral oil and sizing material, etc. However, these non-cellulosic constituents are

highly reactive and susceptible to chemical reagents. Consequently, the properties and action of chemicals are somewhat different from that of cotton and wool.

For understanding chemical processing of jute textiles and its difference from that of cotton or wool textiles, it is worth considering a comparison of the properties of fibres of jute, cotton and wool as given in Table - 5.1.

Table - 5.1
Comparison of Fibre Properties of Jute, Cotton and Wool

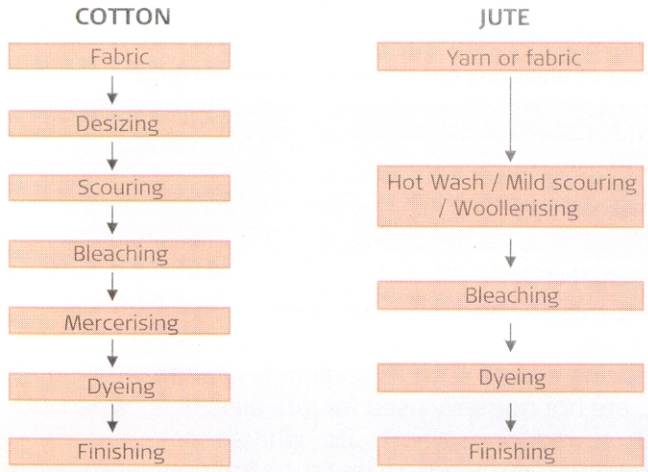
Fibre Properties	Jute	Cotton	Wool
Major Chemical constituent	Ligno-cellulose	Cellulose	Protein (Keratin)
Hygroscopicity	Good (12-13%)	Fair (6-8%)	Very Good (14-16%)
Strength on wetting	Dry > Wet	Wet > Dry	Dry > Wet
Effect of Acids	Little	Reduction in Strength	Nil
Effect of Alkalis	Adverse	Nil	Adverse
Resistance to Mildew	Good Mildew is formed on jute goods when stored in moist condition	Low	Good Mildew is formed on wool when stored in soiled condition
Effect of Sunlight	Colour rapidly changes to yellow or brown	Slight discolouration on prolonged exposure	Colour changes to yellowish white
Dyeability	Good All classes of dyestuff as used for cotton and wool, in addition to basic dyes.	Limited Selected classes of dyestuff only	Limited Selected classes of dyestuff only

The bleaching of cotton aims at removing as far as possible non-cellulosic and colouring matter and is generally accomplished by three steps: (i) Desizing with enzyme, (ii) Scouring or boiling with alkali under pressure for removal of natural wax, oil, impurities, etc., and (iii) Bleaching for removing the colouring matter.

In jute, non-cellulosic components are as important as cellulose and removal of these matters causes unacceptable high losses in strength and weight. For example, scouring of jute, like cotton, cannot be effected by boiling with 3-4% caustic soda solution under pressure. Scouring under such condition effects substantial removal of hemicellulose, resulting in reduction of weight and strength of jute materials. Despite the characteristic yellow-to-brown colour of jute materials and also the presence of mineral oil (used for spinning of jute yarn) as well as starch sizes in jute fabric, the jute fabrics are directly taken for bleaching after a hot water wash or mild scouring with detergent at about 70-80°C prior to bleaching or dyeing.

The presence of non-cellulosic constituents, therefore, complicates the processing of jute and demands a different chemical processing technology from that of cotton as shown in Fig. 5.1.

Fig. 5.1
Flow Chart for Chemical Processing of Cotton & Jute Textiles



5.4.1 Desizing

Tamarind Kernel Powder (TKP) is used as sizing materials on jute with or without some additives and this TKP is removable by hot water boiling. Hence desizing of jute fabric, if required, is effected by boiling in water for 30 min followed by normal washing.

5.4.2 Scouring

For producing super white jute fabric and for deeper shades of dyeing of jute yarns and fabrics, jute yarns and fabrics are scoured in mills before bleaching or dyeing operation. Mild scouring of jute yarns and fabrics is effected by either using 1-2 g/l detergent or along with a solution of 2 g/l soda ash at 70°C for 15-30 min. But an anionic surfactant cannot remove mineral oil or unsaponifiable oil and fats properly. Further, mineral oil, if present in jute goods, interferes not only with absorption of dyes and fastness properties, but also contributes additional yellowing on exposure to light. Addition of 2-3 g/l emulsified organic solvent, as scouring aid, is always advantageous in obtaining better and uniform scouring and substantial removal of jute batching oil.

5.4.3 Bleaching

Bleaching of jute materials can be performed by all common bleaching agents i.e. reducing and oxidising agents. The applicability of bleaching chemicals on cotton, wool and jute is presented in Table - 5.2.

Table – 5.2
Action of Bleaching Chemicals on Different Fibres

Fibre	Reducing Agent	Bleaching Powder or NaOCl	Hydrogen Peroxide
Cotton	++	++	++
Jute	+	(+)	++
Wool	++	--	++

++ = Process highly suitable -- = Process unsuitable
(+) = Process applicable only with special precautions
+ = Process applicable without fibre damage but without achieving a whitening effect

Reducing agents such as sodium bisulphite, sodium hydrosulphite, etc. are not normally used for jute bleaching. When jute is bleached with a reducing agent, its whitish colour does not become permanent and tends to revert to the original colour on storage.

Among the oxidising agents, use of sodium hypochlorite or bleaching powder Is being discouraged due to environmental implication.

Hydrogen peroxide (H_2O_2) is the most popular and the safest bleaching agent for jute. It can be judiciously applied to produce 'Creamish yellow' to 'Snow-white' bleach for a variety of end-uses. Conventional bleaching of jute fabric is extensively done in the jute

industry using H_2O_2, soluble sodium silicate, tri-sodium phosphate and non-ionic detergent or wetting agent in alkaline condition at 70–80°C. Bleaching of jute fabric is carried out in jigger in batch process.

Use of sodium meta-silicate in place of sodium silicate has been recommended to control pH, to achieve higher whiteness and to improve handle. Moreover, conversion of commercial soluble sodium silicate to sodium meta-silicate can easily be achieved by adding requisite amount of caustic soda.

5.4.4 Simultaneous Bleaching and De-hairing Process

The process comprises a preliminary treatment with buffered hypochlorite solution under weakly alkaline condition, followed by extraction with alkali and reducing agent, and final bleaching with alkaline hydrogen peroxide to a desired degree of whiteness. With this process, the surface hairs of the jute fabric are effectively removed to present a smooth handle, the photo-stability of bleached jute fabric is improved and fibre-shedding characteristics of the bleached fabric are also reduced.

The development of this process has opened up possibilities of jute for use in manufacturing value-added products.

5.4.5 Chemical De-hairing

The hairiness of jute yarns or fabrics is considered as one major problem affecting adversely their acceptance by consumers. This problem of jute fabrics is usually taken care of by the process of chemical de-hairing which is being carried out in industry by treatment with oxalic acid, followed by treatment with sodium or calcium hypochlorite and final wash.

5.4.6 Photo-stabilisation

Bleached jute yarns and fabrics are found to exhibit accelerated photo-yellowing under UV-light or sunlight which is not acceptable in case of any jute-based consumer products. Thus, for high value wall covering, decorative and furnishing fabrics, which usually receives sunlight exposure, photo-stabilisation of jute products is an essential market demand. An improved photo-stability for bleached and dyed jute fabrics may now be achieved by applying a 1-2% benztriazole (simple UV-absorber) following specific reaction conditions, to make it substantive to jute either in bleach-bath or dye-bath in presence of alkali, which is much effective for showing comparatively better photo-stabilisation.

5.5 Dyeing of Jute

5.5.1 Dyeing with Synthetic Dyestuffs

Jute has affinity for all classes of dyestuffs generally used for cotton and wool. It is attributed to the presence of both cellulose and non-cellulosic constituents (lignin and hemicellulose). In addition, jute has direct affinity for basic and acid dyes, which have practically no dyeing capacity for cotton (Table - 5.3).

Table - 5.3
General Dyeing Characteristics of Jute, Cotton & Wool

Class of Dyestuff	Jute	Cotton	Wool
Acid	√		√
Basic	√		
Pre -Metallised	√		√
Direct	√	√	√
Sulphur	√	√	
Reactive	√	√	√
Vat	√	√	
Pigment	√	√	√

√ - *Applicable*

Jute in either grey or bleached state can be dyed by conventional dyeing methods, but in some cases, certain modification to dyeing processes / recipes is necessary. However, dyes, which show excellent colour fastness to light on cotton and wool, will not show same high colour fastness on jute. This may be due to the following reasons:

a) Due to presence of non-cellulosic matter (about 40%), jute differs in dyeing properties from that of cotton.

b) The change in colour of the substrate (i.e. undyed or bleached jute) on exposure to light is due to presence of lignin, which in turn accelerates the fading of dyes.

c) The different auxiliary chemicals used in dyeing with various classes of dyes have distinct effect on the colour of the substrate and consequently causes the apparent fading of dyestuffs.

Systematic studies of various classes of dyestuffs on jute have been carried out at BJTRA. In these studies a number of dyestuffs belonging to acid, basic, direct, reactive and vat classes were used to dye both grey and bleached jute fabric samples. The fastness to

light of these dyed samples was assessed by exposure to xenon light and the results were compared with the known fastness value of cotton.

The results indicated that with vat dyes, accelerated fading of the dyes on jute as compared to cotton was largely absent, and that the yellowing is the main factor on which apparent fastness to light depends. A number of dyes having fastness to light rating of 6 or more on wool have been rated only 3-4 on jute. Some basic dyes known to give light fastness rating of 6 or more have been rated 2-3 on jute. About 200 direct dyes having fastness to light rating of 4 or above were selected for test dyeing on grey, hydrogen peroxide bleached, and chlorite bleached jute fabrics. On and average, the grading on jute is about 1 unit lower than on cotton. Of the reactive dyestuffs evaluated for dyeing of jute, 55% was rated 5-6 and 6+ on cotton, but on jute only 2% retained in this category. The average grade for cotton is 5-6, compared with 4.2 on grey jute and 4.1 on chlorite bleached jute.

Exploratory work aimed at improvement in dyeing characteristics of jute goods has been carried out under IJO/CFC project at IJIRA. Colour fast characteristics of a large number of acid, basic, metal-complex (1:2) direct, sulphur, reactive, vat dyes and pigment on peroxide bleached fabric samples were evaluated. Of the dyes tested 10% basic dyes, 18% acid dyes, 56% direct dyes, 63% reactive dyes, 77% sulphur dyes, 98% vat dyes and 100% pigment showed light fastness grade 3 and above on bleached jute. Almost all dyestuffs, which gave light fastness grade 3-5 on bleached jute fabric, showed the same light fastness on kenaf as well. A review of the results indicates the following order of increasing stability to light (Table - 5.4).

Table - 5.4
Light Fastness Characteristics of Dyestuffs on Jute

Class of Dyestuff	Colourfastness to Light
Pigment	Excellent ↓
Vat	
Sulphur	
Reactive	
Direct	
Acid	
Basic	Poor

Shades with fairly good degree of light fastness coupled with reasonable brightness or hue could be achieved with yellow, orange, red and brown while the light fastness of violet, blue, green and black is generally of low order. In general, higher fastness to light is obtained at higher depth of shade but pastel shades (0.2-0.3%) can only be achieved with pigment.

The dyestuffs of various classes viz. basic, acid, metal-complex (1:2), direct, reactive, sulphur, vat and pigment are found capable of imparting colour fastness to light rating 3-5 on jute and have been catalogued and published by IJIRA in the form of 'Shade Card on Jute for Value-added Products (Vol. I & II)'.

The choice of dye-class depends on the type of end-products as mentioned in Table - 5.5.

Table - 5.5

Indicative Guidelines for Selection of Dye-class according to End-uses of Jute Based Products

Product	Fastness Requirements	Dye-class Recommended
1. Wall Hangings, cheap quality Mats, Matting, Decoratives and Handicrafts	Moderate to fairly good fastness to light and rubbing	Basic < Acid < Metal - complex (1:2) < Direct
2. Shopping Bags	Moderate to good fastness to light and fairly good to good wet fastness	Metal-complex (1:2) < Direct after-treated < Reactive
3. Soft Luggage	Fairly good to good fastness to light and wet fastness	Direct dye after-treated < Reactive and Sulphur < Pigment
4. Wall Cover, Dividers and Screens	Fairly good to good fastness to light and good wet fastness	Direct dye after-treated < Reactive < Pigment
5. Floor Covering	Moderate to good fastness to light and good wash fastness	Direct dye after-treated < Sulphur and Reactive
6. Furnishings / Upholstery Fabric	Fairly good to good fastness to light and good wash fastness	Direct dye after-treated < Sulphur < Reactive < Pigment < Vat

NOTE: Dye-class recommended for various products are indicated in terms of increasing colour fastness properties.

Source : *T K Guha Roy, S K Chatterjee and B Dasgupta , Manual on Preparation and Dyeing of Jute and List of Some Colourfast Dyestuffs on Jute, Report of the IJO-CFC Project on "Improvement in Physico-Chemical Properties of Jute and Kenaf Fibre, Yarn and Fabric for Manufacture of Value Added and Diversified Products ", February, 1996.*

5.5.2 Dyeing with Natural Dyes

Production of synthetic dyes is dependent on petrochemical source and some of the synthetic dyes contain toxic / carcinogenic amines and are not eco-friendly. Contrary to this, most of the natural dyes (with few exceptions) are usually based on vegetable / animal / mineral origin, and hence renewable, biodegradable, and eco-friendly. Most of them are usually non-toxic / non-carcinogenic and non-allergic. However, the practical drawbacks of natural dyes are its non-reproducibility, non-uniform shades, poor to moderate colour fastness (not in all cases) and non-availability of standard application methods.

The majority of natural dyes need a mordanting chemical (preferably metal salt or suitably coordinating complex forming agents) to create an affinity between the fibre and the dye or the pigment molecules of natural dyes. The dyeing technology for natural dyes in case of jute has been developed for manufacturing of value-added and ethno-chic diversified products in decentralised jute sector.

5.6 Printing on Jute-based Fabrics

Printing is localized or restricted dyeing using thickened dye or pigment solution / paste as per selected design and pattern. Hence, class of dyestuff used for printing are the same as those applicable for dyeing, except the pigment colour. Jute fabrics can be printed with all dyes suitable for dyeing jute as well as with pigment colours followed by appropriate print fixation techniques. However, direct, acid and basic dyes are not recommended to be used for printing of jute based fabrics due to lower colour fastness to wash and chances of colour bleeding during or after wash. Hence, jute fabrics are usually printed either by reactive dyes or more preferably using pigment colours in direct style using kerosene or white spirit or mineral turpentine oil (MTO) based emulsion thickener and Fixer-CCL (melamine formaldehyde resin) for improving rub fastness. Kerosene or MTO gives off bad smell, causes air-pollution and affects the aroma of the contents of any printed jute product. Use of Fixer-CCL or this type of formaldehyde containing resins, as rub fastness improver in pigment printing, is not eco-friendly for its releasable formaldehyde content. So, for eco-friendly printed jute products, sometimes kerosene oil-water emulsion thickener is replaced by polyacrylic acid based synthetic thickeners and addition of fixer-CCL is avoided. Jute being heavier and coarser fabric, inadequate

penetration of print paste and non-uniform printing is a major problem. Hence, use of relatively lower viscosity print paste and use of wetting agent in print paste with pre-damping by using water spray or moist steam, takes care of the said problem.

However, for printing delicate designs in jute fabrics, the hairs on the surface of jute fabric are to be removed well, and the fabric with much uniform texture should be used.

The 'Branding' of jute sacks and hessian bags is commonly done for commodity packaging. It is generally carried out by stencil or screen, using basic dyestuff and thickener such as guar gum, followed by drying in the air.

5.7 Chemical Finishing of Jute Fabrics

Chemical finishing of any textile fabric is very much customers' demand oriented. The assurance of improved functional performances in a particular end-use is the determining factor behind the selection of the chemical finishing of jute or any textile fabric. Finishing plays a key role in increasing marketability of fabrics. With the judicious application of the softener, resins and other auxiliary / functional chemicals in the finishing treatments of textiles, various desirable functional characteristics can be achieved. For jute fabrics, the usual finishing treatments are for making them (a) softened (for jute upholstery, sofa covers, etc.), (b) rot resistant (for jute sand bags, geo-textiles, etc.), (c) fire retardant (for jute brattice cloth used in mines, hessian as pandal covers, jute-based kitchen apron / gloves, etc.), (d) water repellent (for jute-based tent fabrics, tarpaulin fabrics, table cover, soft luggage fabrics, etc.). All the general and functional chemical finishing treatments of jute-based fabrics are carried out at fabric stage in a suitable chemical processing plant where facilities for such finishing treatments and required equipment exist.

5.7.1 Softening of Jute-based Fabrics

Jute based fabric is treated with a cationic softener for about 20 - 30 min at 40°C. The finished material is then squeezed in a padder and then dried.

Among the available commercial grade of chemical softeners, cationic softener is most economical and popular, but it causes yellowing on bleached jute and may change colour tone of dyed jute fabrics as well. Hence, some mills use a mixture of cationic softener and amino-silicon softener (50:50) on bleached jute fabric by pad-dry-cure technique.

5.7.2 Finish for reduced Fibre Shedding

To improve the resistance to fibre shedding and resistance to abrasion for jute fabric, a few selective thermoplastic resins, elastomers, cellulose gum or acrylic co-polymer can be applied on the fabric surface. To reduce fibre shedding of jute fabric, mills usually apply 0.2% carboxy-methyl-cellulose either to jute yarns or fabrics followed by drying. While carboxy-methyl-cellulose improves both fibre shedding and abrasion resistance, it makes the fabric stiffer. The treatment with butadiene acrylonitrile ensures flexibility along with the reduction of fibre shedding as well as improvement of abrasion resistance of jute-based fabrics. These properties can also be improved on jute fabrics by application of polyvinyl alcohol (PVA).

5.7.3 Rot-resistant Finish

Jute is susceptible to microbial attack, which results in a considerable loss of strength. Humid condition accelerates microbial growth on the fibre materials; the susceptibility is increased further after alkali or bleaching treatment and after exposure to light / heat.

Treatments for rot resistance of jute are generally carried out with a number of selected antiseptics like copper salt or copper napthenate, chlorinated phenols, etc.

5.7.4 Water-repellent Finish

The treatments most commonly applied for water repellency of jute are the use of wax / stearate mixtures by immersion or pad-dry method and stabilised rubber latex solution by coating technique. The coating technique is generally employed for heavy goods while emulsion treatments are conducted on lighter materials.

For semi-durable water repellent finish on jute fabric, commercially available 2-6% (owf) water repellent grade silicon emulsion is applied by pad-dry-cure technique. Application of appropriate doses of fluoro-chemicals can produce adequate water repellency as well as oil repellency on jute fabrics, but this is much costlier and has lower storage stability. Industrially, water proofing on jute fabric can be effectively achieved by multi-layer coating with suitable natural rubber or synthetic rubber materials, which may

also be very useful as raw materials for making water proof soft luggage made of such coated jute fabrics.

5.7.5 Fire-retardant Finish

Most of the textile fibres are combustible and hence they can cause fire-hazards during use. Treatment with borax and boric acid with or without phosphate compounds for fire retardant finish of cellulosic fabrics is common, but most of them are non-durable in nature. A semi-durable fire retardant treatment for jute has been developed by using 25% aqueous solution of mixture of borax and boric acid (7:3) with or without di-ammonium phosphate (DAP) or Urea.

Brattice cloth, used in mines, is finished with urea / phosphate solution in a pad-dry-cure technique for fire-retardancy.

5.8 Machinery for Bleaching and Dyeing of Jute

Chemical processing of jute materials is carried out in the form of fibre, yarn and fabric.

The equipment and machinery used for jute wet processing are very conventional and labour intensive and listed under Tables - 5.6 and 5.7.

Table - 5.6
Wet Processing of Jute : Machinery

A.	Plant & Machinery for Fibre or Yarn processing:
	i) Hank / Package (Cheese) dyeing machine
	ii) Hank reeling / cone or cheese winder
	iii) Hydroextractor / centrifuge
	iv) Chamber / Thermal dryer
B.	Plant & Machinery for Fabric processing:
	i) Jumbo Jig / Jig
	ii) Two or three bowl padding mangle
	iii) Cylinder dryer / stenter with pad mangle
	iv) Screen printing table with accessories
	v) Calendering
	vi) Fabric rolling machine
C.	General
	i) Boiler
	ii) Soft-water plant
	iii) Effluent Treatment Plant (ETP)

Table - 5.7
Wet Processing of Jute: Functions of Some Machines

Machine	Purpose
1. Jig	Wet processing of jute fabric in open-width form
2. Pad mangle	Removal of excess water before drying
3. Cylinder drying	Drying method for open-width fabric by contact with steam-heated cylinder
4. Stenter	Drying of fabric in open-width form along with adjustment & control of fabric width.
5. 2 or 3 bowl padding mangle	Uniform distribution of the liquor in fabric during application of dye / auxiliary from solution / dye liquor.
6. Calendering	Alteration of fabric handle, surface texture and appearance.
7. Hydroextractor	Removal of excess water from fibre / yarn hanks by centrifuge
8. Effluent Treatment Plant	Treatment of dye-house process waste on site

Jute fibre or yarns are mostly processed in tanks or vats and a few jute mills have loose stock / yarn package dyeing machine. After bleaching / dyeing, the materials are hydroextracted and dried in chamber dryer or in air under shade.

But jute fabrics, being heavy and coarse, are processed in open-width form in jigger machine and not in rope form. After processing, the excess water is removed by pneumatic padding mangle prior to drying on vertical drying range. Sometimes the fabrics are processed through weft straightener for maintenance of width and calendered to improve fabric handle, surface texture and appearance. Special finishing treatment is however carried out by pad-dry / cure technique using pneumatic padding mangle and hot air stenter (clip type).

In case of use for shopping bags and soft luggage, the jute fabrics are generally coated with low or high-density polyethylene (PE) / polypropylene (PP) by extrusion technique or laminated with low-density PE sheet for making them stiff and waterproof.

Printing of jute fabric is mostly done by print-dry and/ or curing method using screen.

5.9 Imperatives for Market

With increasing global concern for environment, the conventional jute products, as eco-friendly items, can have an opportunity to have increased market penetration, provided they are produced with attributes with no

unwanted odour, much less hairiness and lower fibre shedding. Similarly, to ensure the growth of jute diversified products, these products should also be properly bleached with reduced photo-yellowing, dyed with good light fastness, softened to the extent possible, adequately woollenised whenever required.

It should be kept in mind that printing and finishing of jute and any other textiles involves high end knowledge base, creativity and art along with the judicious consideration of any newer technology and its limitations to meet customers' aesthetic demand and functional end-use requirements. So, for evolving a new type of look and aesthetic appearance with soft feel and good handle etc. or to meet specification of special functional performance criteria, the textile and jute dyers, printers and finishers are to be creative enough and knowledgeable in textile chemical processing. The need for standardising some important parameters characterising functional properties for high valued jute decorative fabrics is felt extremely important.

In the technical textile arena, there are certainly scope for certain jute-based products to enjoy good market response, provided the functional requirements as per customers' demands are satisfied through proper finishing treatments. For the purpose, the manufacturers are employing speciality chemicals and polymeric finishes including smart polymers to improve the functional properties of the jute-based fabrics / products to make them acceptable for some specific technical textiles applications.

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JUTE basics

Jute Products

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Chapter 06



JUTE basics

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6.1 Introduction

For over a century, several jute products are being widely used across the world. In the areas of packaging and floor covering, jute products have already been established world-wide as the best suited eco-friendly materials due to their high dimensional stability. However, the development of cheaper and lighter synthetic substitutes has narrowed down the market of jute products in the areas of packaging and carpet backing cloth. The consumption pattern for jute products in different countries, specially the developed ones, has also negatively changed due to in-roads of several alternative products in the market.

The need of the hour is to reposition, in the emerging global market with increasing concern for environment, a host of conventional and diversified jute products as eco-friendly substitutes of their synthetic counterparts. For this, it is imperative, on one hand, to upgrade / modify, with the help of appropriate mechanical and chemical processing techniques, the conventional jute products to satisfy the consumer needs both quality- and cost-wise in order to retain the existing market and, in the process, recapture some of the lost market, while on the other, to judiciously develop and commercialise several diversified jute-based products, specially in the area of technical textiles, by exploiting advantageously the unique characteristics of jute materials. It is certain that jute has the potential to replace expensive fibres in certain end-products and scarce forest materials.

6.2 Conventional Jute Products

6.2.1 Hessian Fabric & Bag

The hessian fabric is a single warp plain weave jute fabric being manufactured with varying width about 76 cm – 508 cm (30"-200") and areal density or weight per unit area (gsm or g/m^2) up to a maximum of 500 g/m^2. Hessian fabrics are lighter than sacking fabrics. Hessian fabric is used for packing of agricultural produce such as onion, potato, garlic, cereal, etc., goods like machines, nuts & bolts, etc. or other industrial commodities like cotton, wool,

tea / coffee / tobacco leaves, etc. for transportation. It is also used for making tailor-made bags for rice, sugar, wheat, pulses, onion, potato, sand, bran, etc. and many other purposes, such as decoratives and wall covering, after suitable chemical processing, if required. Presently, shopping bags are being made out of hessian fabrics (bleached / dyed and with or without lamination). Jute hessian cloth is also used for construction work.

Hessian cloths, woven with gaps at regular intervals and subsequently cut between the gaps, are used as tapes of small widths.

6.2.2 Sacking Bag

Sacking refers to the coarser and heavier cloth, used primarily for manufacturing sacks (bags) of various dimensions and weight per unit area (g/m^2), meant for packaging purposes. These are a range of coarse jute fabrics, either in plain or twill weaves, being manufactured by using mostly with coarser jute yarn. In terms of fabric construction, sacks made of such fabrics are classified normally as plain bag, A- / B- / L-Twill bag, Heavy Cees bag, DW flour bag, cement bag, etc. which are used for packaging food grain, sugar, wheat, pulses, cement, corn, potato, flour, salt, meat, etc. packed in the weight range from 50 to 100 kg.

Some merits of jute packaging fabrics / bags over their synthetic counterparts are biodegradability, easy disposability, good resistance to tearing / fibrillation, better breathability, and good stability in stacks of much larger dimension (due to higher frictional characteristics of the fabric surface).

6.2.3 Poly-lined / Poly-laminated Bag

These are hessian, tarpaulin or sacking bags with a coating of polyethylene film or with a separate polyethylene bag inside. These bags are used for packing of rice and sugar.

6.2.4 Yarns

The jute yarns, of count (grist) within a range of 103 – 1034 tex (3–30 lb/spy) or so are being manufactured by different jute mills (composite / spinning). The jute yarns are of different qualities, depending on their use, as warp or weft, in manufacturing of different types of fabrics, such as hessian, sacking, tarpaulin, carpet, webbing, lighter decorative fabric, furnishing fabric, etc. Normally, good quality and / or finer jute yarns are being manufactured using

raw jute fibre of higher quality (grade) and using improved process control techniques as well as machinery.

For use as weft in carpet manufacturing using moderate to high speed rapier-type looms, good quality jute yarns, usually called as 'sale yarn', are being regularly supplied by the mills of Bangladesh and India to the overseas manufacturers. The users' demands in case of such yarns are good strength, low strength CV%, good uniformity, almost free of slubs, and low hairiness. For the production of some diversified jute products according to consumer needs, the jute yarns can further be subjected to chemical processing like bleaching, dyeing, woollenising, coating, etc. For the purpose of production of some lighter jute-based fabric of good quality in terms of texture and feel, the finer yarns of count 52 – 207 tex (1.5–6 lb/spy) or so are being manufactured by blending jute with other fine natural / synthetic fibres.

6.2.5 Twines

Jute yarns of different grists (276 – 413 tex i.e. 8-12 lb/spy) are plied (twisted) together to make twines as per requirement and use. Commonly, 2-ply and 3-ply jute twines are produced by twisting together 2 and 3 single yarns respectively, and are used for the purpose of tying, knotting, binding, etc. The end-uses of jute twine are given below :

a) Nets: Twine can be used to make nets for protecting crops, viz. hop twine, tomato twine, vine nets, etc., and as camouflage netting for defence purpose. Small nets act as packing materials for fragile articles.

b) Carpets: Home-made carpets can be made with dyed strings, plain or designed.

c) Mats: Twine can be used in manufacturing colourful mats for sitting, partition, decorative uses, etc.

d) Ropes: Several twines can be twisted together into heavy ropes for various commercial, industrial and marine uses.

6.2.6 Carpet Backing Cloth (CBC)

CBC is a type of superior jute hessian cloth used as primary or secondary backing in the manufacture of tufted carpets. These fabrics, having areal density ranging generally between 180 and 407 g/m^2 (6 oz per sq yd on average), are being produced with

varying width ranging between 74 cm (29") and 264 cm (104") for narrow carpet backing and above 264 cm (104") for its wider counterpart.

6.2.7 Canvas & Tarpaulin

Jute canvas and tarpaulin are closely woven double warp plain weave cloths. They are used for manufacturing of different types of bags, like postal bags, high quality seed bags, etc. Bitumen-coated tarpaulin bags are used in the fertiliser industry. Such fabrics are also used for hatch covers, sun blinds, tents, sail cloth, etc.

6.2.8 Scrim Cloth

This is a very light weight hessian fabric (plain weave, open mesh), being used for manufacturing bags for onions and similar vegetables and also to reinforce the non-woven fabric. It is also bonded to tarred brown paper and used as strong water proof packing or as roof cover. The scrim fabric laminated with paper or polyethylene sheet is used in mines.

6.2.9 Mat

This is twill or plain cloth used as a floor covering at homes or exhibition stalls / halls. The areal density or weight per unit area of such fabric varies between 300 and 500 g/m^2.

6.2.10 Soil Saver

As an eco-friendly and bio-degradable item, open mesh coarse jute fabrics are being used for a long time for soil erosion control and slope protection.

6.2.11 Webbing

Webbings are tightly woven, heavy narrow plain fabrics which are used for load bearing.

6.2.12 Fire or Rot Proof Fabric

As per the demand of the consumers, the jute fabrics are made resistant to fire or rot with the help of appropriate chemical treatments.

6.2.13 Odourless Bag

These bags are mainly used for packing tea.

6.2.14 Bulk Packaging Bag

These bags are used when packaging requirement is of the order of 500 kg to 1000 kg.

6.2.15 Some Typical Cloth & Bag Specifications

The following specifications are usually mentioned for any jute cloth during placement of purchase order:

- Width of the cloth in inch or metre
- Cloth porter and shots per inch (or ends per dm and picks per dm)
- Weight (oz) per running yard or inch, or weight (g) per square metre.

Some typical cloth specifications are given below (Table - 6.1):

Table – 6.1
Some typical Cloth Specifications

Product	Warp/dm X Weft/dm (Porter X Shot)	Width	Aerial density Weight per unit area or length g/m^2 (oz/yd)
Hessian Cloth	47 X 47 (11X12)	1.02 m (40")	305 g/m^2 (5-16 oz / yd of 40" width)
Sacking Cloth (B-Twill)	76 X 31 (6 X 8)	0.675 m (26.5")	608 g/m^2 (14 oz / yd of 26.5" width)
Sacking Cloth (A-Twill)	102 X 35 (8 X 9)	0.675 m (26.5")	760 g/m^2 (17.5 oz / yd of 26.5" width)
Sacking Cloth (L-Twill)	102 X 31 (8 X 8)	0.675 m (26.5")	716 g/m^2 (16.5 oz / yd of 26.5" width)
Tarpaulin	68 X 39 (8 X 10)	0.762-1.143 m (30"-45")	380-585 g/m^2 (13-20 oz / yd of 45" width)
Canvas	134 X 70 (16 X 18)	0.914-1.143 m (36"-45")	660 g/m^2 (15-16 oz / yd of 36" width)
Carpet Backing Cloth	55X 47 (14 X 12)	0.914 m (36")	271 g/m^2 (8 oz / yd of 36" width)
Scrim	22 X 15 (5 X 3 $^1/_2$)	0.97 m (36")	105 g/m^2 (3.29 oz / yd of 36" width)
Soil Saver	34 X 27 (8 X 7)	0.122 m (48")	500 g/m^2
Webbing	68 X 62 (16 X 15)	5 cm (2")	5455 g per 132 m (12 lb per144 yd)
	62 X 31-2 ply (15X 8)	9 cm (3.5")	8182 g per 132 m (18 lb per144 yd)

The following specifications are usually mentioned for any sacking bag during placement of purchase order:

- Dimension of the bag and stitching type,
- Weight of each bag,
- Cloth porter and shots per inch (or ends per dm and picks per dm).

Some typical sacking bag specifications are given in Table - 6.2.

Table – 6.2
Some typical sacking bag specifications

Bag Type	Length X Width (Stitch type)	Weight per bag	Warp / dm X Weft / dm (Porter X Shot)
B-Twill	112 cm X 67.5 cm (44" X 26.5") Hemmed	1020 g (2.25 lb)	76 X 31 (6 X 8)
	112 cm X 67.5 cm (44" X 26.5") Hemmed	907 g (2 lb)	76 X 28 (6 X 7)
	94 cm X 57 cm (37" X 22") Hemmed	665 g (1.5 lb)	76 X 28 (6 X 7)
A-Twill	112 cm X 67.5 cm (44" X 26.5") Hemmed	1190 g (2.5 lb)	102 X 35 (8 X 9)
Heavy Cees	102 cm X 71 cm (40" X 28") Hemmed	1021 g (2.25 lb)	68 X 35 (8 X 9)
DW Flour	142 cm X 71 cm (56" X 28") Hemmed	1135 g (2.5 lb)	68 X 31 (8 X 8)

6.3 Major Diversified Jute Products

The jute products other than traditional ones, preferably having higher value-addition, can be defined as diversified jute products.

The development of different diversified jute products, using jute alone or in combination with other fibres, was initiated long back due to the urge of innovation / necessity by the industry / small-scale entrepreneurs to meet market demands. Besides, a large number of diversified products have been developed by R&D institutions. Instead of giving the profile of all such products, the brief descriptions of those which are available in the present market and / or those having potential for bulk market in coming years, are given in the following paragraphs.

6.3.1 Carry Bag & Shopping Bag

Besides conventional jute bags for packaging agricultural and industrial commodities, non-traditional jute bags are used as postal bags, tea bags, shopping bags, waste disposal bags, portfolios, carry bags, school bags, vegetable bags, and soft luggage.

Jute shopping and hand bags, of varied shapes and dimensions, have been established as the most promising diversified products of jute due to their excellent texture and aesthetics. These items are being manufactured from hessian or jute-cotton union fabrics, with or without laminations, handles of cane / bamboo / cotton braids, and zippers. These bags may be grey, bleached, dyed, and printed. These 'green' bags are expected to receive market acceptance in much larger quantum and larger volumes with increasing global concern for environment protection for daily household needs.

6.3.2 Floor Covering

Varied types of jute floor coverings, viz. floor covering with jute base, jute and blended carpets, durries, rugs, etc. are being produced by many who are involved in floor covering manufacturing with other natural fibres. All such floor coverings have good dimensional stability, excellent rugged texture, and attractive exotic designs. For this, they are becoming increasingly popular as eco-friendly items for room décor and have already exhibited good growth potential in export.

A traditional jute mat, known as *Satranji*, is being produced with various designs and in different sizes, by using dyed jute yarns in handloom. Sometimes they are aesthetically enriched with embroidery, batik prints or stitches to receive consumer attention for use as door mat, floor mat, prayer mat, etc.

6.3.3 Decorative Fabric

Jute-based decorative fabrics are mainly produced by the handloom / powerloom units in unorganised sector while bleached / dyed / printed jute hessian fabrics mostly in the organised sector. Various other types of union / blended fabrics with jute content more than 50% are being produced by the unorganised units, using different weave patterns and incorporating attractive designs. While some of these fabrics are used as furnishings due to their thickness, texture, dimensional stability, and anti-static characteristics, many other fabrics are used in manufacturing fashion bags for ladies, or attractive household items like lamp-shades. Some designed fabrics, woven with jute yarns in combination with either some fancy textile yarns or golden metallic threads are already in demand in overseas markets for decorative purposes on any festive occasion, especially Christmas.

6.3.4 Food Grade Packaging Bag

This bag is produced from a hessian fabric which is manufactured from jute yarns processed with vegetable oil (instead of conventional hydrocarbon-based batching oil). These bags are being manufactured as per an international standard viz, IJO Standard 98/01 (Revised 2005).

Since these bags are free from hydrocarbon and are odourless, they can be safely used as packing bags for coffee, cocoa, hazelnuts, almonds, peanut beans, etc. for which any contamination of hydrocarbon is a matter of concern for the consumers of these commodities. As a matter of fact, the use of such bags for the packaging of cocoa and coffee has been made mandatory by the International Cocoa Organisation (ICCO) and International Coffee Organisation (ICO).

6.3.5 Jute Agro-Textiles

Jute fabrics are now being used as agricultural textiles for sun screens, plant nets, wind shield, harvesting nets, field nets for protecting crop from birds, weed protection, mulching on seed bed, soil conservation, etc.

6.3.6 Jute Geo-Textiles (JGT)

For several decades, the jute soil-saver, basically a geo-textile product, is in use for control of surface soil erosion in slopes and plains. Through several field studies, jute geo-textiles (woven and non-woven, 500 gsm onwards) are found to be suitable for stabilization of embankments, strengthening of sub-grade soil in roads, protection of banks of rivers and waterways, sub-surface drainage, soft soil consolidation, etc. JGT performs five basic functions such as separation, filtration and drainage, initial reinforcement, control of surface soil detachment, and vegetation or bio-technical support.

JGT is a preferred choice whenever solution for a specific geotechnical problem demands attributes like biodegradability, high water holding capacity, higher frictional character, and soil enrichment (after degradation) in geo-textiles either independently or in combination. For this, erosion control, highway slope protection, and soft soil consolidation can be considered as the priority areas for application of JGT. Several erosion control and highway slope protection projects in USA, UK, and Switzerland have established the efficacy of JGT and more importantly, its merit of

biodegradability for ecological reasons. The next preferred area can be the stabilisation of rural roads. In case of road stabilisation, the reduced strength and poor condition of JGT beyond two season cycles after placement should not be of any concern as by that time the fabric would have already played a very important role in providing a self-sustaining sub-grade for most types of soil. The gain in strength of the sub-grade with time has been substantiated by the field trial data showing much improvement in CBR value by using JGT. JGT treated with chemicals such as copper oxide or bitumen are used to make them rot-resistant whenever required. In India, few field trials established JGT's efficacy in stabilising the mine spoils. Both woven and non-woven jute geo-textiles are in use. These fabrics, woven and non-woven, with areal density of 500 gsm and above and width of 2 m and more as per the requirements of the civil engineers, may be widely used for solving various geotechnical problems.

Hessian cloth was bituminised and used in Germany for construction of highways and roads for smooth carpeting in the 1970s and 1980s.

6.3.7 Jute Composite

Due to its inherent characteristics, jute fibre is a very suitable candidate for effective use in production of fibre-reinforced composites. Jute composite products are techno-economically comparable with traditional wood / plywood materials and have found wide-ranging applications in building interior and transport sectors. The following types of jute fibre-reinforced composite products and jute stick particle boards are being manufactured:

a) **Rigid / Semi-rigid Composite Board of Jute**

Medium / high density jute-based composite boards, being manufactured by impregnating jute fabrics / felts in phenolic resin followed by curing, are used mainly as plywood substitutes for various end-uses like door panel, furniture, packaging, crates, boxes, etc., and also as wall panel and seat / back rest in railway coach.

b) **Board of Jute Stick Particles**

Jute stick particle boards, having different dimensions, are being manufactured by bonding particles of jute sticks (agro-wastes) by a suitable binder under heat and pressure. These boards are commercially available as (a) low-density boards (plain / textured) which have already become popular for

false ceiling, vertical paneling and interior decoration, and (b) medium-density boards (plain / decorative) which are now receiving good response for use as table-top and in furniture-making.

c) Automotive Components

Different interior components, like door panel, dash board, etc. of automobiles are being commercially manufactured by impregnating jute non-woven fabrics within polyester resin and by giving the desired shape through moulding process. Due to the presence of long and strong jute fibres, such composite materials exhibit good tensile, flexural and impact strength.

d) Jute-Coir Board

Jute-coir boards, having different dimensions with thickness of 4 – 30 mm, is a cheaper wood substitute, being manufactured by impregnating jute and coir fibres in phenolic resin followed by curing. These boards are in use for fabricating furniture, door frame, vertical panel, etc.

e) Jute-Thermoplastic Board

Jute-thermoplastic boards, which can be manufactured by using wastes of jute and plastic, have been found to be an effective material for use as industrial pellets, cable winders, garden chairs, tables and fencing, etc. It can be considered as one of the ways for saving the environment by recycling the unwanted synthetic garbage, as well as for value-added use of jute wastes.

6.3.8 Wall Hanging

Attractive wall hangings, made out of fibre, yarn and fabric of jute, are increasingly making their presence felt in the home décor market. Low-cost and aesthetic appeal owing to their characteristic textures are the main USP for such products.

6.3.9 Home Textiles

Different jute-based fabrics, with or without appropriate finishing treatments, are found suitable for table cloth, cushion covers, sofa covers, bed covers, curtain cloth, table mats, prayer mats, napkins, aprons, blankets, kitchen apron, factory apron, etc. Attractive jute-based fabrics are also found to be used as upholstery and tapestry, Venetian blinds, partition, panel, etc.

6.3.10 Jute Blankets / Quilts

Utilising the thermal insulation property of jute, being slightly inferior than wool, a variety of cheaper substitute of wool products like blanket, wrapper, sweater, etc. are being commercially manufactured, by using woollenised jute alone or in combination with mostly wool or acrylic, through the processes of weaving, raising and finishing. The appearance of these products can be made according to consumers' need. Similarly, another substitute of woolen quilts is being produced with special types of modified jute caddis with or without chemical treatment.

6.3.11 Footwears

The uppers of shoe/ slippers are being produced from different jute materials, fabrics or braids. Footwears, made of jute, are soft and aesthetically pleasing.

6.3.12 Handicrafts

The hand-crafted items like doormats, tea coasters, string bags, etc. are being appreciated by the consumers due to their texture and aesthetics.

The hand-crafted gift articles of jute are as different and varied as it can be. The tea coasters, string bags, purses, bottle carriers, hammocks, hanging chairs, pen stands, etc. and even the ethno-chic ornaments for ladies, all made out of jute by skilled craftsmen/ craftswomen, are the items gaining popularity in domestic market. A large number of women are engaged in manufacturing these handicraft items.

6.3.13 Blended Products

One important route that has been adopted since long for jute diversification is the manufacturing of different products using jute in combination with other fibres, natural or synthetic, to meet both consumer need and cost advantage. There are two types of such blended fabrics: (a) Union fabrics where jute yarns are usually used as weft while yarns of cotton / other fibres as warp, and (b) Blended fabrics where blended yarns of jute and other fibres are used as warp and weft. Such blended fabrics are certainly superior to all-jute fabrics in terms of fabric appearance as well as characteristics, and thereby become value-added products.

The above blended fabrics, after proper chemical processing, are acceptable by the consumers in the areas of home textiles as sofa cover, cushion cover, table cloth, etc. and even in apparel sector as

outer layer in jackets. In Bangladesh, a type of jute blended fabric is marketed as 'Grameen jute checks'.

6.3.14 Pulp & Paper

Jute with substantial cellulose content is considered as one of the suitable raw materials for manufacturing of paper. As a matter of fact, jute is being used for long for production of hand-made papers. Various types of chemical, mechanical, and mechano-chemical technologies are available for the production of pulp from the whole jute plant, jute fibre, jute cuttings, and jute sticks. Recently technologies for biopulping and biobleaching have been developed which may be applied to produce pulp and paper using whole jute plant. Different grades of wrapping paper, decorative paper, paper board, hard board, industrial paper, writing paper and high-quality paper can be produced from jute. Using jute-based paper/ board, usually hand-made, several utility / gift items like cartons, fancy boxes, greetings card, visiting card, envelop, toys, pen stand, calendars, art objects, etc. are being produced and appreciated by consumers.

6.3.15 Cellulose & Cellulose Derivatives

Through delignification of jute fibres or high-grade jute stick pulp, microcrystalline cellulose (MCC), a useful chemical for pharmaceutical industry, can be produced. By appropriate chemical treatment of jute fibre / stick pulp with high alpha-cellulose content, a number of cellulose derivatives, e.g. carboxymethyl cellulose (CMC), cellulose acetate, cellulose nitrate, methyl cellulose, etc. can be produced. These cellulose derivatives have wide uses in textile industry, cosmetic industry, soap and detergent industry, pharmaceutical industry, etc. Moreover, oxalic acids and their derivatives are also prepared from jute through destructive distillation. Crystalline oxalic acid can be obtained by alkali or nitric acid fusion of jute sticks.

6.3.16 Fuel Cake

Jute mill wastes, known as 'caddis', are normally used as boiler fuel. But such fibrous wastes can be compressed into a solid form such as cakes with an addition of some non-inflammable materials. These are useful alternatives to fire wood generally used by rural people.

6.3.17 Activated Charcoal

The activated charcoal can be produced on carbonization of jute mill wastes and jute sticks by pyrolysis at about 500°C. This material can be used (a) for purification of sugar, salt, and other similar chemicals, (b) as the starting material for the manufacture of carbon disulphide, an industrially important solvent, and also (c) as reinforcing filler in vulcanized rubber as substitute of expensive carbon black.

6.3.18 Products from Jute Seed Oil

Jute seed contain about 15% oils and fat. Special type of soft soap and detergent can be prepared from it through saponification. Moreover, *strophanthidin*, a heart stimulant can also be extracted from jute seed oil.

6.3.19 Furfural

Furfural is an industrially important solvent, used in petroleum refining, in synthetic rubber manufacture, as preservative for wood and leather, and so on. Furfural can be obtained from jute stick chips by acidic hydrolysis using hydrochloric acid or sulphuric acid.

6.4 Jute in Technical Textiles

Jute, being stronger and more dimensionally stable as compared to most of the textile fibres, can have greater usage potential in certain specific technical textile applications like packaging (packtech), geo-textiles (geotech), agro-textiles (agrotech) and composites (buildtech, mobiltech). In today's world with concern about environmental pollution, the jute-based technical textiles, being eco-friendly, should have a better market acceptance as compared to its synthetic alternatives.

As a matter of fact, jute is already being used in large quantum in manufacturing of some specific technical textile products. At the same time, it is also envisaged that the usage of jute may be preferred for manufacturing of some more technical textile products, provided the consumers are satisfied with the technical characteristics of such products.

In the area of technical textiles, in addition to the existing usage of jute-based products, there can be some more as mentioned below:

6.4.1 Protective Textiles

The jute fibre may be a suitable candidate for use in protective clothing against fire and heat, since it has reasonable resistance to heat, high strength, high abrasion resistance, durability, and relatively low cost than synthetic fibres. Jute can be used for protective aprons and gloves.

6.4.2 Coated Textiles

Jute fabric can be coated with suitable polymer / elastomer to develop products, such as coated tarpaulins, conveyor belt, awnings, canopy, architectural textiles, breathable aprons, flexible hood for automobiles, outdoor protective cover, fabric for soft luggage, etc.

6.4.3 Buildtech Textiles

Jute composite may be used, under Buildtech category, for different applications as furniture, doors and windows, plywood substitutes, railway coach building, partition walls, low-cost housing, etc.

6.4.4 Mobiltech Textiles

Jute fibre can be used in composite materials as required for automobile industry. Interior trim panels in automobiles, such as door panels, dash boards and head liners are manufactured from composite products using bast fibres including jute as reinforcement.

Non-woven jute fabrics can be used as seat backings, carpet underlay. For comfort in a car, a layer of nonwoven jute felt in the weight range of 300–400 gsm is sandwiched between the leather seat covers with coir and spring layers in the back.

6.5 Plant Biomass Utilisation as By-products

It is well known that huge plant biomass is produced while growing jute for fibre purpose. Fibre constitutes only 4-6% of the total biomass, while sticks (generally used as fuel source) contribute the most, and the rest (except seed) is never utilised. The plant parts, e.g. leaf, stem, root, have got great potentials for producing several pharmaco-dynamic compounds.

The available information on old and traditional therapeutic uses of different plant parts, based on the analyses of chemical constituents and bioactivity of certain compounds present in nine Indian Corchorus species, including the wild relatives, point to the untapped potential of jute, in particular, as medicinal crops. Different plant parts may contribute in four ways, viz. (i) they may be used directly as pharmaceuticals (plant extracts / decoctions / powders and similar other forms), (ii) they may serve as template for chemical synthesis of bioactive principles, (iii) the related compounds may be converted to medicinal drugs, (iv) they may be used for investigations, evaluation and other research tools in the drug development and testing process. Ascertaining appropriate crop age,

growing conditions and ensuring quality assurance of raw materials are of prime concern to get maximum therapeutic efficiency and harnessing bioactive principles. A list of therapeutically important compounds available in the cultivated jute species are presented in Table-6.3.

Table – 6.3

Pharmaco-dynamic Compounds of Cultivated Jute Species

Species	Pharmaco-dynamic compounds
C. capsularis (White jute)	Cardiac Glycosides, Olitoriside, Erysimoside, *Strophanthidin*, Helveticoside, β-Sitosterol, Tarpenoid-Corosin, Ursolic Acid, Cochoroside A, B and C, Mucilage, Corchortoxin, Oligosaccharides (as bioactive carrier molecules)
C.olitorius (Tossa jute)	Cardiac Glycosides, Olitoriside, *Strophanthidin*, Olitorin, Strophanthidol, Helveticoside, β-Sitosterol, Corosin, Ursolic Acid, Cochoroside A, B, Erysimoside, Vitamin C, Mucilage

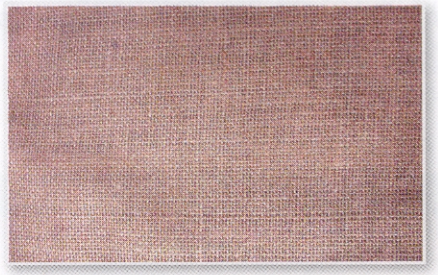
Commercialisation of the above potentials has so far not been possible because of insufficient knowledge about the biosynthetic pathways of these compounds.

Further Reading

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Products Gallary

I. Conventional Products

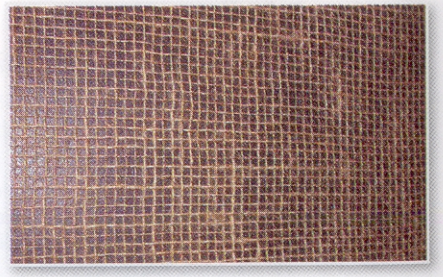

Hessian

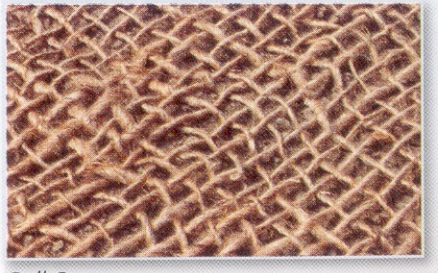

Sack


Yarn


Carpet Backing Cloth


Mat


Scrim Cloth


Soil Saver


Webbing

II. Diversified Products

a. Different Types of Bags


Braided Carry Bags


Shopping Bags


Ladies Bag


Brief case


Travel Bags



Promotional Bags


Bottle Bags



Food Grade Jute Bag

b. Different Fabrics


Jute-Cotton Fabric


Designed Fabric


Block Printed Fabric


Furnishing Fabric


Handloom Fabric


Patterned Fabric


Union Fabric


Printed Fabric

c. Home Textiles & Decorative


Cushion Cover


Blanket


Carpet


Curtain


Door Mat

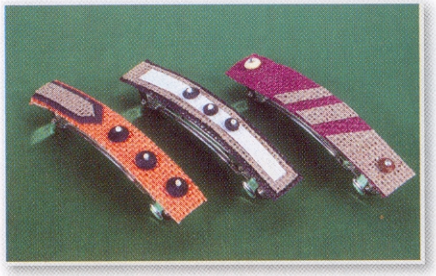

Tapestry

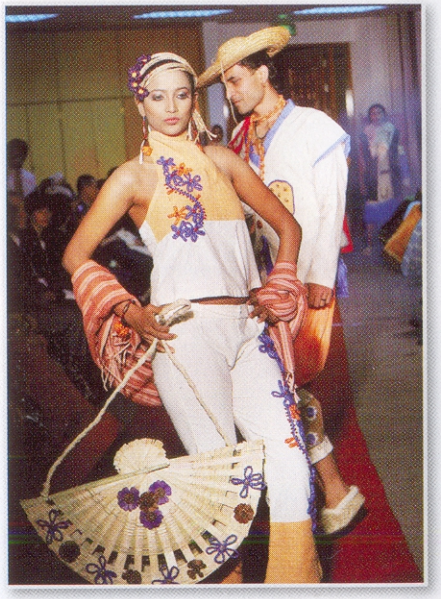

Wall Hanging

d. Fashion Accessories


Jewellry


Bangles


Hair Clips


Apparel



Belt

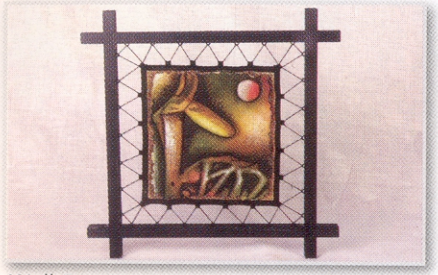

Hats


Footwear

e. Handicrafts


Basket


Doll


Wall Decor


Door Bell


Flower


Handicrafts


Trinket Box & Holders

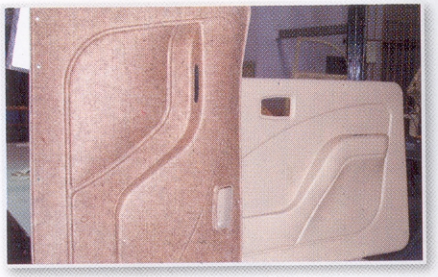

Gift Items

f. Technical Textiles & Composites

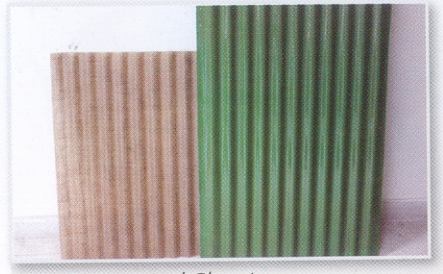

Geo-textile


Agro Textiles


Particle Board

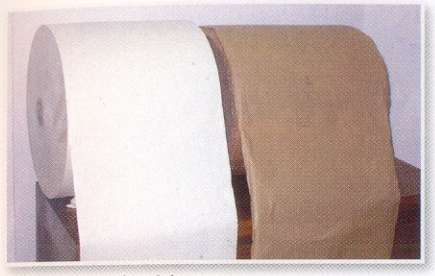

Automotive Parts


Fruit Crates


Jute Corrugated Sheet


Industrial Gloves & Shoes

g. Paper Products


Brown and White paper


Handmade Paper from Jute


Desk Calendar


Wrapping paper


Decorated Wrapping Paper


Note Book


Greetings Card

JUTE basics

Eco-Status of Jute

T K Guha Roy

Chapter 07



T K Guha Roy

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7.1 Introduction

Major recognised environmental criteria are resource depletion, pollution and human health. Industrial activity affects the global environment and all living being as well. Consequently, mankind seeks solutions for managing the problems arising due to the increasing world population, and the finite availability of natural non-renewable resources (largely fossil fuel and minerals reserved on the planet) for their usages for the benefit of this population, say for industrialisation etc.

It is estimated that the natural fibres account for 35% of the total usage of textile fibres. Although the synthetic fibres have been found advantageous in the field of textiles in terms of performance and cost, many of the drawbacks of using synthetics have started to change our mindset against them. Reportedly, 1.0 MT of synthetic fibres require 5.0 MT of oil, while 1.0 MT of natural fibres needs only 0.04 MT. Therefore, in a world which is facing oil-shocks every decade and which will have to put up with an impending situation of depletion of fossil fuel, natural fibres of low-oil equivalent have to be an obvious choice for the mankind. Therefore, the increasing consumption of crude oil for production of synthetic fibres has become a threat to the ecological imbalance in both developed and developing countries. There are other considerations as well in regard to use of synthetics vis-à-vis natural fibres as discussed in due course later in this chapter.

In this perspective, jute, a natural fibre that can be used in many different areas to supplement and / or replace synthetics, has been receiving increasing interest from the consumers. Jute is a natural fibre with numerous environmental advantages. It is an annually renewable resource with a high biomass production per unit land area, and jute products being biodegradable decompose in the soil at the end of product life-cycle. Moreover, the leaves and crop wastes, left out in the fields, are transformed to organic materials, thereby reducing demand for supplementary chemical fertilisers for subsequent crops. As regards global warming, a major concern in the present world, while the synthetic materials are being considered as the root of many problems, the natural fibre products are proven to be absolutely harmless.

In the following paragraphs, various features of jute and its products have been briefly described to highlight their eco-friendliness.

7.2 Environmental Impacts of Jute Agriculture

7.2.1 Jute Plant Purifies Air

Jute has a high carbon dioxide (CO_2) assimilation power. Atmospheric CO_2 is the most important of the greenhouse gases responsible for global warming. Like all plants, jute uses CO_2 as a way of making sugars. In the 120 days of the jute-growing period, one hectare of jute plants can absorb about 15 MT of CO_2 from atmosphere and liberate about 11 MT of oxygen, the life-supporting agent. Studies also reveal that the CO_2 assimilation rate of jute is several times higher than that of trees [1].

7.2.2 Jute Cultivation

The environmental impacts of jute production are much less harmful as compared to the production of synthetic fibres. Jute growers use fairly small amount of chemical fertilizers and herbicides. Jute yields 5 -10 MT of dry matter per acre of land. About 1 MT of dry matter is put back to the soil in the form of leaves. About 3 MT of roots remain in the soil. Jute cropping system enhances soil organic matter through leaf shedding during the growing season and improves nutrient availability in the soil. Jute is commonly rotated with other food crops like rice and other cereals, vegetables, oilseeds or pulses, all of which are moderately or heavily dependent on nutrients from the native source, but do not normally return them to soil, except in case of legumes, as jute does. Jute-based multiple cropping thus not only increases agricultural production, but also sustains the fertility level of soil mainly through decomposition of fallen leaves and organic wastes from jute, if the inputs throughout the rotation are used judiciously.

7.2.3 Biological Efficiency of Jute

Jute is predominantly a rainfed annual crop harvested at least once a year. Jute as a fibre crop is a fast-growing one that takes about 4 months to mature. Unlike jute, the production of the fastest growing wood plant requires at least 10 to 14 years from plantation to harvest, and yields only 8 to 12 MT per hectare per annum. This means the biological efficiency of jute or kenaf is much higher than

that of wood plants, and hence the usage of jute in place of wood to make paper pulp will reduce the cost of production to a large extent. It will also reduce the necessity of cutting down of trees, i.e. deforestation [2].

7.2.4 Agricultural Practices

In jute agriculture, use of fertilisers, pesticides and weedicides / fungicides is scanty. The extent of chemical fertilisers for jute growing varies between 7-53 kg nutrient per hectare [3]. The quantity of fertiliser applied is so small that the effect may be considered as insignificant. It should be noted that jute plant sheds about 5-6 MT of green leaves per hectare (i.e. ~14% of the crop) in the field. These green leaves left out after harvesting are rich in macro- and micro-nutrients (Table - 7.1), and act as manure for the subsequent crop in the field [4].

Table – 7.1
Macro-Nutrient Content in Jute Plant [4]

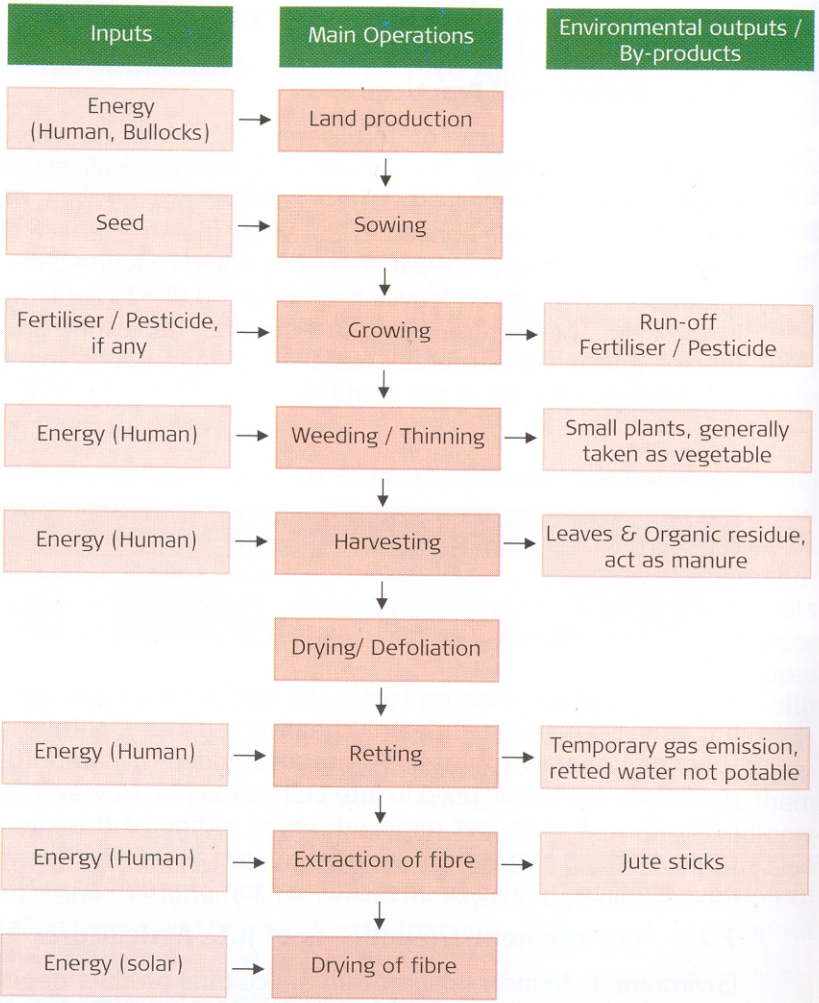
Plant Component	Nitrogen %	Phosphorous %	Potassium %
Leaves	2.85 - 3.60	0.85 - 1.20	2.50 - 3.10
Ribbon	0.35 - 0.46	0.35 - 0.46	1.50 - 1.80
Sticks	0.17 - 0.25	0.21 - 0.28	0.50 - 0.85

Generally organic manure forms the backbone of jute agriculture but usually small quantities of chemical fertilisers, N (nitrogen), P (phosphorous), K (potassium) are also added. It is reported that pesticides are hardly used in jute cultivation [5]. However, most of pesticides, if used, get removed during retting of the jute. Usage of pesticide in jute agriculture is estimated as 0.5 kg / ha, which is equivalent to 0.25 kg of pesticide per ton of product [6,7].

7.2.5 Environment-friendliness of Jute Agriculture

Environment-friendly image of an agricultural product depends on the agricultural process and not just on the physical properties of the end-product. In this context, jute agriculture has so far been regarded as environment-friendly. Production of jute fibre passes through a sequence of operations (Fig. 7.1) using the inputs, such as seed, fertiliser, irrigation water, pesticides, human labour, animal and sunlight.

Fig. 7.1
Flow Chart of Jute Agriculture & Fibre Production



7.2.6 Jute Retting and Wastes

Retting of jute is carried out in water bodies for 2-3 weeks wherein microbiological decomposition of green jute plants take place [8]. The retting effluents are rich in plant macro-nutrients such as organic matter, nitrogen, phosphorous, potassium, iron and calcium. More organic matter (about 11 MT / ha) is also released during stem retting, while in ribbon retting 3 MT / ha is obtained. Ribbon retting

is superior to traditional stem retting since this is more eco-friendly and it reduces considerably energy consumption. The large volume of ribbon wastes under mechanical extraction may be recycled back as organic manure.

Apart from leaves, stick is the major by-product after extraction of jute fibres. About 80% of sticks are used as fire wood as an additional source of energy for house hold cooking by the rural people, mostly in India and Bangladesh. A significant quantity of sticks are now used in making particle board.

7.2.7 Gas Emissions to the Atmosphere

Jute production processes generate organic acids including acetone, ethyl alcohol, butyl alcohol, and various gases like methane, carbon dioxide (CO_2) and hydrogen sulphide. Substances that contribute to global warming in case of jute are CO_2 and methane. The latter one is released mainly during retting. Methane emitted during conventional retting has been estimated to be 1-2 m^3 / kg of solid material, which on computation gives an average of 1.428 kg methane per kg of jute fibre [9,10]. It is known that the global warming potential of methane is much higher than that of CO_2 and methane is more detrimental as ozone depleting agent than CO_2.

Since generation of methane is much less in case of ribbon retting for jute, its large scale adoption would much improve the eco-status of jute.

7.2.8 Jute Life-Cycle : IJO Study

The project entitled 'Environmental Assessment of Jute Agriculture' was carried out under IJO in 1997-99. Liu summarised the work done under the project [2] as below:

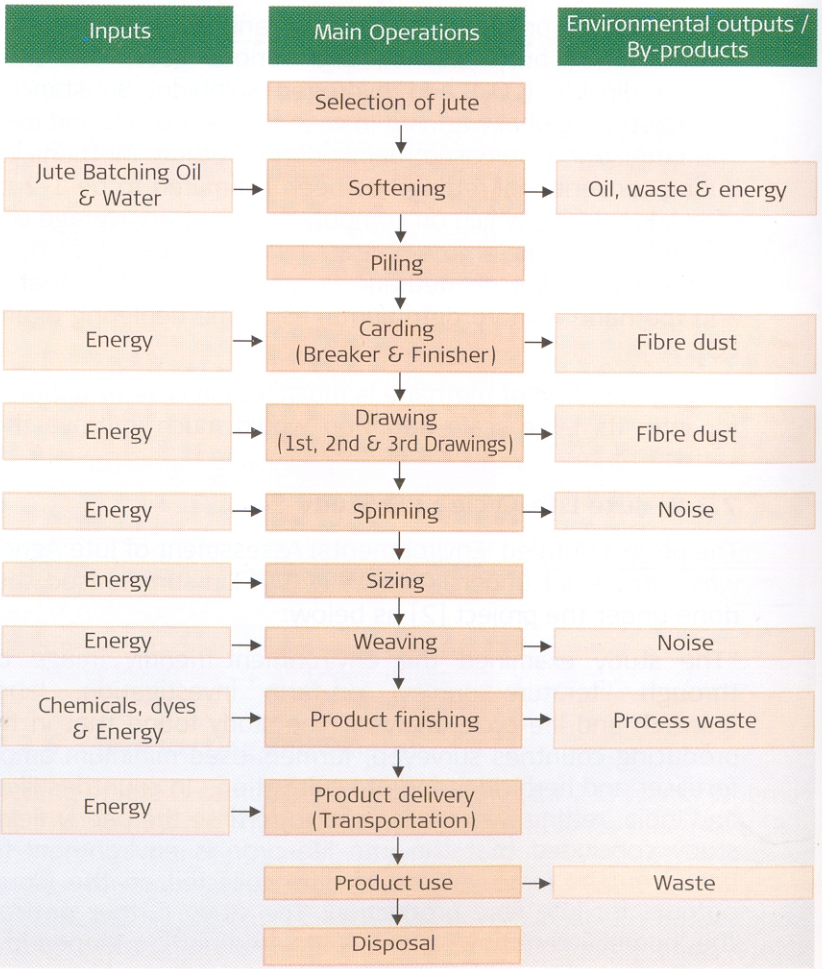
"The study examined the environment-friendly image of jute through literature survey, on-farm investigation, laboratory research and life-cycle analysis. The study found that in the jute producing countries surveyed, farmers used minimum amount of fertiliser and herbicides for jute cultivation. In countries like China and India, retting water was used to fertilise the paddy fields. The study concluded that the jute life-cycle is environment-friendly based on the large volume of data collected on the inputs and outputs for jute fibre production. The study further noticed that the 'humidified retting', a new retting method developed in China,

can significantly reduce water pollution, the use of water, and the generation of methane."

7.3 Environmental Impacts of Jute Product Manufacturing

Jute product manufacturing process comprises of selection of raw jute, softening with emulsion, carding, drawing, spinning, weaving and finishing (Fig. 7.2). The processing of jute has raised certain environmental

Fig. 7.2
Flow Chart of Manufacturing & LCA of Jute Products



concerns, due to the use of mineral batching oils in fibre preparation stage, air, noise, and water pollutions during jute manufacture, chemicals and pigments during bleaching, dyeing and printing.

7.3.1 Softening of Jute Fibre

Jute fibres are lubricated with an oil-in-water emulsion, called batching emulsion. Jute batching oil (JBO) used for jute fibre softening is hydrocarbon-based and contains both straight chain hydrocarbons (C_{14} - C_{22}) as well as aromatics.

The century-old practice of using a mineral oil (JBO) in the emulsion for softening of jute has so far not been found harmful for human health as there is no or minimal migration of oil to the material packed in jute bag. For ensuring no migration, since 2001, the use of JBO has been restricted in India up to 3% of the finished products [10].

Nonetheless, on consideration of demand by IOCCC, CAOBISCO and the ECF, a softtening process based on vegetable oil has been developed conforming to international specification [11]. It is now being extensively used to process and manufacture a new variety of jute sacks, named 'Food Grade Jute Bags'. Jute bags based on this technology have internationally been accepted by many leading consumers for packaging of cocoa and coffee beans, hazelnuts, etc.

7.3.2 Water Pollution

The water requirement during jute product manufacturing process [5] is about 750 litres per MT of jute. Water is mostly evaporated during processing stage. Studies carried out by IJIRA and Pollution Control Board of India revealed that the environmental burden in relation to effluent discharge from jute mills is very well within the permissible limits.

There is some metal contamination in waste water from jute mill. The contamination results from the process waste of jute dyeing plant of jute mills. Concentrations of metals, specifically copper, lead and zinc are high. These water contaminating agents can have negative environmental impacts when discharged into the environment without treatment.

Jute is now extensively bleached with alkaline hydrogen peroxide and / or dyed directly with acid and basic classes of dyestuff for manufacture of diversified jute products. The chemicals, dyes and

auxiliaries commonly used for bleaching and dyeing of jute in jute dyeing plants along with pollution characteristics are given in Table - 7.2.

From Table - 7.2, it is observed that only the dyeing process can have moderate pollution potential. All the above dye classes, except cationic dye-fixing agent, can be treated in conventional 'Effluent Treatment Plant (ETP)' and majority of the jute mills are now equipped with ETP being mandatory as part of pollution control measures in different countries.

Table – 7.2
Pollution due to Chemicals Used [12]

in Bleaching process		
Chemicals		**Pollution Category ***
Hydrogen peroxide		1
Sodium silicate		1
Sodium hydroxide		1
Sodium phosphate		1
in Dyeing process		
Dye Class	**Type of Pollutants**	**Pollution Category ***
Acid	Unfixed dyes	3
Direct	Salt	1
	Unfixed dyes	3
	Cationic dye-fixer	5

** Pollution category range 1 to 5 (1 being the least harmful and 5 being the most harmful)*

7.3.3 Air Pollution

Air pollution in jute mills is mainly due to solid wastes, namely dust, dirt, and short fibre. It is generally found that waste generated during product manufacturing process is about 5% of total jute processed. Most of the waste produced in the jute mills is either recycled in the process itself in subsequent times or consumed as boiler fuel.

7.3.4 Noise Pollution

Noise concentration levels in different processing sections of jute mills have been studied and were found to be 80 dB and 90 dB in the spinning and weaving sections respectively [5].

7.4 Energy Consumption

Jute farming and extraction processes differ widely from country to country depending on agronomic and agricultural practices. Majority of jute farmers are small or marginal, and cultivation including sowing, weeding, harvesting, jute fibre extraction, and baling are largely carried out manually [13]. From fields jute is lifted / carried to retting sites mostly as headloads. The raw jute bundles are then generally transported by the farmers to the village markets as headloads or on bicycles, van rickshaws and bullock carts. For this phase of transportation, no fossil energy is consumed. However, transportation in bulk on trucks, etc. is also practiced for long distance travel to the godowns or stores or mills, for which fossil fuel is required.

Total energy input for jute cultivation, jute manufacture and transportation, worked out [13], has been reported as follows:

Total Energy Input of Jute

a) For Jute Cultivation

Fertiliser Input :

N : 1- 1.6, P_2O : 0.13 - 0.18, K_2O : 0.008 - 0.10

Pesticide input : 0.13

Total : 1.27 - 2.01

b) For Product Manufacturing

Machine operation : 1.43 - 2.24

Batching oil : 0.86 - 3.50

Total : 2.29 - 5.74

c) For Transport : 0.19 - 0.27

Total Energy Input (a+b+c) : **3.75 - 8.02 GJ / MT**$_{Fibre}$

Braungrat et al. [5] reported that the average electricity consumption for production of jute products, such as hessian, carpet backing cloth and sacks is 400 – 600 KWH / MT. Total consumption of energy during jute agriculture to jute product manufacture has been worked out to be within 10 GJ / MT of jute fibre [5], which corresponds to 2.7 x 10^6 KWH / MT of jute fibre.

Environmental issues of jute concerning the consumption of natural resources have been estimated as shown in Table - 7.3 [14], where the energy, water requirement and the extent of consumption of natural resources have been taken into account and computed during production of a sack.

Table – 7.3
Environmental attributes of Jute Sack : Natural Resource Consumption

Issue	Value
Energy Consumed (Lifetime)	2.7×10^6 KWH / MT of sack 4,500 KWH /TMHLT*
Water Consumption/ Requirement	96750 l / ton of fibre = 161 l / TMHLT*
Non-Renewable Natural Resource Consumption	Nil

TMHLT *Ton of Material Handled during Life Time*

From Table - 7.3, it can be observed that water requirement of a jute sack is exceedingly high, power consumption is quite moderate and consumption of non-renewable natural resources is zero. The pollution abatement cost [14] for jute sack production has been worked out as US$ 0.025 per TMHLT (Tons of material handled during lifetime).

The environmental impact of jute vis-à-vis polypropylene in their life cycles has been shown in Table - 7.4.

Table – 7.4
Environmental Impacts of Jute and Polypropylene in their Life-Cycles, except Disposal Stage [13]

Parameter	Jute	Polypropylene (PP)	Ratio PP/Jute
Waste (MT / MT)*	0.9	5.5	6.1
Water (m^3)	55	1.3	0.02
Energy (GJ / MT)	3.75 – 8.02	84.3	10.5 – 22.5
CO_2 Emission (MT / MT)**	-1.6 – 0	3.7 – 7.5	–

* *Waste generation in MT per production of MT of goods.*
** *Amount of CO_2 emission in MT per production of MT of goods.*

7.5 Disposal of Jute Products

After certain period of usage, all materials become waste and are then disposed off. Like other fibres, jute production and processing stages also generate some wastes, which have been discussed in the previous sections. The degree of environment friendliness of the materials is very much dependent on the action they are subjected to during the ultimate phases of their functional life, biological degradation, recycling or method of disposal.

Jute is a plant fibre, composed of organic substances, and is biodegradable. However, the extent and speed of the biodegradation depend on the treatment or processing, exposure to sunlight, humidity, temperature, etc.

Incineration or disposal of biodegradable materials can also bring about environmental consequence and, therefore, cannot be as such regarded as environment-friendly practice. During incineration, some products of incomplete combustion, such as NO_2 and SO_2 are produced. During disposal, hydrogen sulphide (H_2S) and methane may be released to contribute to the 'greenhouse effect'. If certain levels of humidity, temperature, etc. for waste treatment of jute products are maintained, composting or production of biogas appears to be the most rational method of disposal of jute products [13].

7.6 Eco-status of Jute vis-à-vis Synthetics

A comparative study of jute and polypropylene (PP) in their usages as packaging material, conducted by the IJO in 1992, concluded that "the life-cycle of jute products can be classified as less environmentally damaging than that of polypropylene". The study presented also a number of specific conclusions / facts as follows:

- The production of 1 MT of jute products requires only 7% of the energy required for the production of 1 MT of PP.
- The production of 1 MT of PP generates five times more waste than that of 1 MT of jute. In addition, wastes from jute production are biodegradable.
- Jute production does require more water, but jute waste water does not contain heavy metal like in PP wastewater.
- While jute absorbs CO_2 from the air, the production of 1 MT of PP generates 3.7 MT of CO_2.

Some salient features on Life-Cycle of Jute Sacks vs. Synthetic Woven Sacks are presented in Table - 7.5.

Table – 7.5

Salient features on Life-Cycle of Jute Sacks vs. Synthetic Woven Sacks [14]

Jute sacks	Synthetic woven sacks
Raw Material	
(a) Use of chemicals as fertilisers / pesticides (7–53 kg / ha) during jute cultivation may be considered insignificant. (b) During retting of jute, methane gas is mostly generated which has been estimated to be 1–2 m^3 / kg of solid material or 1.43 kg methane / kg of jute fibre. (c) The green leaves left behind in the field after harvesting are rich in minerals and act as manure. (d) There is no authentic study reporting on health hazard due to retting water.	Synthetic fibre production from mineral oil as well as refined natural gas is associated with generation of toxic air pollutants like ammonia, lead, methane, toluene and xylene.
Wastes	
(a) After fibre extraction, the left-over sticks are mainly consumed as fire wood for cooking. (b) During manufacturing of bags in jute mills, 5% of jute processed becomes waste and is either recycled in the process itself in subsequent times or consumed as boiler fuel.	5.5 MT of non-biodegradable wastes are generated for every MT of polypropylene right from the extraction of mineral oil to the stage of fibre production.
Energy consumption	
Total energy consumption during jute agriculture and jute sack production is 10.0 GJ per MT of jute fibre	The production of polypropylene fibre from granules consumes an energy of 84.3 GJ per MT of polypropylene fibre.
Energy consumed (Lifetime)	
4,500 KWH / TMHLT*	10,990 KWH / TMHLT*
Effect of JBO use	
The century-old practice of using a mineral oil, (JBO) (3–6% of jute processed) in emulsion for softening of jute has so far not found harmful for human health as there is no or minimal migration of oil to the material packed in jute bag. For ensuring no migration, since 2001, the use of JBO has been restricted up to 3% by a Govt. stipulation. A new variety of jute sacks, named Food Grade Jute Bags, are now being manufactured by using a non-edible vegetable oil, Rice Bran Oill (RBO), instead of JBO which are used by countries producing cocoa and coffee beans, hazelnuts, etc. for packaging.	Not applicable
Water consumption	
161 litre / TMHLT *	0.61 litre / TMHLT *
Non-renewable natural resource usage	
Nil	0.2 million MT of crude oil per year
Pollution abatement cost	
INR 1.21 / TMHLT *	INR 8.63 / TMHLT *
Disposal effect	
Jute is biodegradable and therefore does not cause any environmental pollution during disposal.	Due to non-biodegradability, synthetic sacks are disposed through any one of the three routes: recycling, land filling and incineration, each of which causes serious environmental pollution.

* **TMHLT** - Ton of Material Handled during Lifetime

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JUTE
basics

Market of Jute

F H Bhuyian and C Roul

Chapter 08



F H Bhuiyan

Former Director (Market Research & Planning), JDPC; & Former Director (Research & Quality Control), BJMC; MCom (Dhaka University); Specialisation – Jute Goods Marketing.

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8.1 Production and Consumption of Raw Jute

8.1.1 Global Scenario

As regards production of raw jute (inclusive of kenaf / mesta), Bangladesh's production was 1138.1 thousand MT in 2005-06 which marginally increased to 1186 thousand MT in 2007-08, while India's production was 1530 thousand MT in 2005-06 which substantially increased to 1782 thousand MT in 2007-08.

The production of jute, kenaf and allied fibres by major producing countries was about 2853 thousand MT and 3180 thousand MT in 2005-06 and 2006-07 respectively. The total production of jute, kenaf and allied fibres in 2007-08 was about 3196 thousand MT which is 12% more than that of 2005-06.

Production figures for raw jute, kenaf and allied fibres by major producing countries during 2005-06, 2006-07 and 2007-08 are shown in Table-8.1 below:

Table – 8.1

Production of Jute (inclusive of Kenaf & Allied Fibres)

(in '000 MT)

	2005 - 06	2006 - 07	2007 - 08
Bangladesh	1138.1	1186.0	1224.0
China	82.8	86.8	86.8
India	1530.0	1800.0	1782.0
Myanmar	36.9	43.6	40.0
Nepal	17.7	17.1	17.1
Thailand	36.0	36.0	36.0
Vietnam	11.7	10.5	10.5
Total	**2853.2**	**3180.1**	**3196.4**

The world consumption of jute and allied fibres is gradually declining since 1998, in which year the consumption was 3019.9 thousand MT. The consumption in 2006 was about 12% less than what it was in 1998. The decline in the developed countries is more pronounced than the developing countries (Table-8.2).

Table – 8.2

Trends in Regional Consumption of Jute and Allied Fibres

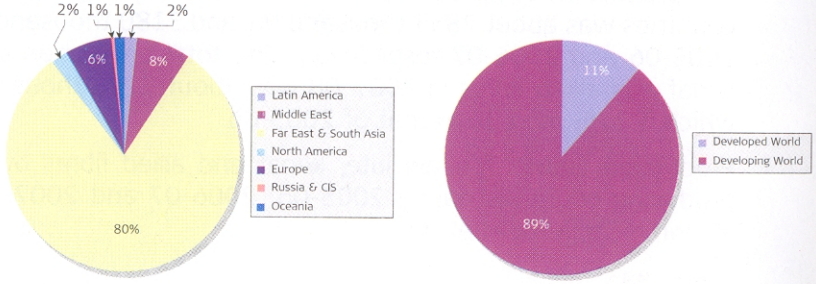
(in '000 MT)

Region	2001	2002	2003	2004	2005	2006	2007
Latin America	43.2	39.2	53.0	42.0	53.5	58.2	55.8
Middle East	204.5	253.8	268.0	254.3	266.5	258.2	275.3
Far East & South Asia	2160.6	2106.2	2004.3	2086.4	2065.6	1960.8	2265.3
North America	61.3	67.6	63.5	68.9	69.4	58.8	55.3
Europe	168.1	148.4	155.6	110.3	102.3	103.2	99.7
Russia & CIS	14.2	13.8	11.3	12.8	12.2	16.3	26.5
Oceania	40.0	46.1	38.7	34.6	40.7	31.8	30.8
World	**2782.6**	**2765.7**	**2685.3**	**2702.1**	**2703.7**	**2589.7**	**2905.5**
Developed World	316.2	304.1	295.9	251.0	247.1	229.5	230.7
Developing World	2466.4	2461.6	2390.3	2451.1	2456.6	2360.2	2674.8

Source : *FAO (2005, 2008 & 2009)*

Fig. 8.1

Geographical Distribution for Consumption of Jute and Allied Fibres



The consumption of jute in India, which accounts for 58% of the world consumption (Table-8.3), has been almost stagnant at around 1600 thousand MT per annum. There is some increase in jute consumption in Bangladesh in 2002 and 2003, but then consumption declined to about 100 thousand MT in 2006. There is also decline of jute consumption in China, a major developing country. Except for Syria, Pakistan and Thailand, there is decline in consumption in most of the major consuming countries, both developed and developing. Considering the jute consumption figures of 2000 and 2006, other significant declines are noticed in Egypt (53%), and Sudan (57%) in the developing world, and France (56%), UK (54%), Australia (38%), and New Zealand (51%) in the developed world. The reasons for such drastic decline in jute consumption may be due to one or more of the reasons like (a) the decline in demand for locally produced products due to availability

of economically better alternatives / substitutes, (b) closure of unviable production facilities, (c) lack of growth of demand for diversified products of jute and allied fibres in these countries. But, it is a fact that without the protection of domestic demand for jute materials for packaging of food grains and sugar in India, the world demand for the jute fibre would have seen a further dramatic decline.

Table – 8.3

Jute Consumption in Major User Countries

(in '000 MT)

Country	2000	2001	2002	2003	2004	2005	2006	2007
India	1638.4	1694.3	1597.0	1548.9	1588.7	1612.0	1456.0	1751.4
Bangladesh	138.6	163.7	165.6	182.6	69.4	144.6	102.7	87.0
China	131.2	142.8	188.8	189.1	211	124.5	157.0	194.8
Pakistan	97.6	94.5	98.3	111.6	110.5	127.2	122.0	134.4
Thailand	36.9	37.2	38.8	40.6	41.8	37.7	37.6	41.5
Myanmar	23.1	18.8	19.0	19.0	190	19.0	19.0	20.0
Japan	28.0	28.8	26.1	25.4	18.4	18.0	15.0	15.0
Vietnam	10.7	13.6	18.5	11.8	13.2	13.2	10.0	11.0
Brazil	22.8	20.3	16.1	26.4	33.4	32.8	18.0	31.3
Cuba	14.0	9.0	12.0	13.0	12.5	12.5	12.5	13.0
Egypt	17.2	23.4	8.3	5.0	6.1	6.3	8.0	7.3
Iran	68.2	66.9	74.0	68.7	73.8	74.5	70.0	65.0
Sudan	35.4	19.8	15.0	15.1	15.1	16.3	15.1	5.5
Syria	38.4	38.1	70.5	85.6	85.6	86.7	57.0	42.5
Turkey	50.0	46.2	70.6	79.7	111.7	97.6	132.0	127.8
USA	71.2	55.8	62.3	58.4	64.2	64.4	56.0	51.0
Belgium-Lux	72.4	70.8	59.8	51.5	34	30.2	36.4	85.6
France	10.9	9.8	7.1	8.8	6.3	4.4	4.8	5.9
Germany	13.4	13.0	13.3	12.4	11.5	9.6	8.7	13.7
Netherlands	14.2	10.6	8.1	23.6	11.4	11.7	7.3	14.8
Spain	12.3	11.5	11.9	10.6	7.6	8.9	9.1	6.5
UK	28.3	29.5	23.4	26.0	18.8	14.5	12.9	15.9
Australia	41.8	32.2	35.5	32.0	28.5	32.8	26.0	26.7
New Zealand	10.2	7.7	10.6	6.8	6.1	7.7	5.0	4.1

Source : *FAO (2005, 2008 & 2009)*

8.1.2 Scenario in Major Jute Growing Countries

It is worthwhile to consider the detailed scenario of production and consumption of jute for the major jute growing countries. In Table-8.4, figures for four years, 2004-05 to 2007-08, have been shown to give an idea about the scenario.

Fig. 8.2
Trends of Fibre Consumption by some Major User Countries

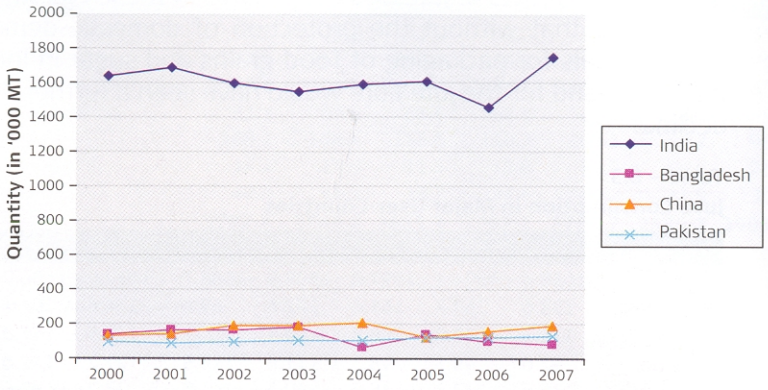
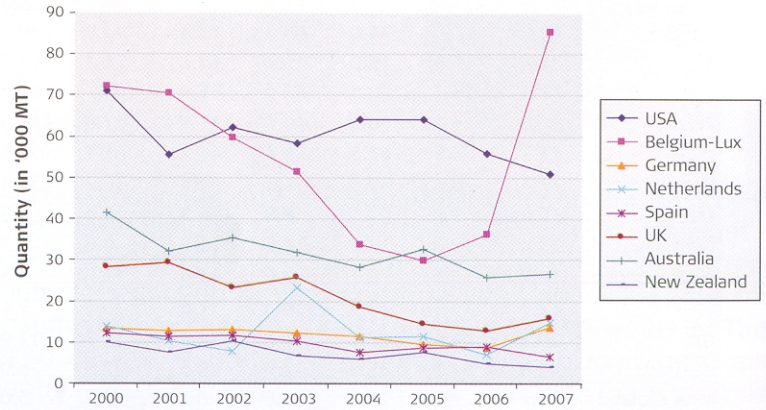


Fig. 8.3
Trends of Fibre Consumption by some Developed Countries



8.2 International Trade in Jute and Allied Fibres

More than 90% of total world export of raw jute is from Bangladesh (Table-8.5) except for 2001-02 and 2004-05. It is worth mentioning here that India, the largest producer of raw jute, does not export raw jute as the quantum of raw jute produced in India is totally consumed by the Indian jute industry. The world export of jute and kenaf has been found to steadily increase with an average growth rate of about 11% from 2000-01 to 2007-08 and has reached at 533.8 thousand MT in 2007-08.

Table – 8.4
Production & Consumption of Jute & Kenaf in Major Producing Countries from 2004-05 to 2007-08

(in '000 MT)

Countries	Year	Opening Stock	Production	Total Supply	Mill Consumption	Village Consumption	Total Domestic requirement	Closing Stock
Bangladesh	2004-5	66.6	810.0	876.6	522.0	48.6	570.6	0.0
	2005-6	34.0	965.0	999.0	522.0	54.0	583.9	7.9
	2006-7	0.8	990.0	990.8	504.0	45.0	551.5	2.5
	2007-8	20.0	990.0	1010.0	468.0	45.0	515.0	2.0
India	2004-5	953.5	1719.9	2764.8	1630.6	171.0	1764.8	963.2
	2005-6	272.3	1530.0	1910.3	1665.0	144.0	1910.3	101.3
	2006-7	99.5	1800.0	1971.5	1620.0	144.0	1971.5	207.5
	2007-8	377.2	1746.0	2267.2	1674.0	162.0	2267.2	431.2
Thailand	2004-5	274.4	44.0	344.4	44.0	0.0	344.4	300.4
	2005-6	274.4	36.0	323.4	44.0	0.0	322.3	278.3
	2006-7	266.3	36.6	314.3	44.0	0.0	313.3	269.3
	2007-8	269.3	36.0	323.3	44.00	0.0	322.3	278.3
Myanmar	2004-5	36.7	50.0	86.7	14.0	6.0	69.7	49.7
	2005-6	37.0	43.3	80.3	14.0	6.0	63.0	43.0
	2006-7	47.9	43.6	91.5	14.0	6.0	82.5	62.5
	2007-8	62.4	40.0	102.5	14.0	6.0	92.5	72.5
Nepal	2004-5	10.1	17.0	27.1	15.0	0.0	27.1	12.1
	2005-6	11.5	17.7	29.2	15.0	0.0	29.2	14.2
	2006-7	14.2	17.1	31.3	15.0	0.0	32.9	17.9
	2007-8	16.3	17.1	33.4	16.0	0.0	33.4	17.4

Source : *FAO (2005, 2006 & 2008)*

Table – 8.5
Exports of Jute and Kenaf Fibre

(in '000 MT)

Country	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Bangladesh	279.8	253.9	453.4	342.9	306.6	440.5	439.3	495.0
China	2.2	2.0	1.3	1.0	0.6	0.3	0.1	0.2
Myanmar	10.0	30.6	4.1	16.9	13.7	5.6	9.0	10.0
Thailand	1.8	1.1	0.6	1.1	1.0	1.1	1.0	1.0
Other developing countries	0.8	0.9	2.4	1.2	4.4	4.9	4.1	4.2
Developed countries	12.8	12.0	10.8	10.9	16.8	16.1	14.6	23.4
World	**307.4**	**300.5**	**472.7**	**373.1**	**345.3**	**468.5**	**468.1**	**533.8**

Source : *FAO (2008) and Ministry of Textiles & Jute, GoB*

During 2002–07, the total volume of imports has also registered a steady growth from 284 thousand MT (2002) to 500 thousand MT (2007), mainly due to increasing use of jute in India, China, and USA (Table-8.6). This growth of jute import may be due to the fact that jute is increasingly being preferred for production of packaging materials, agro-textiles, geo-textiles, composites, etc. in the arena of technical textiles.

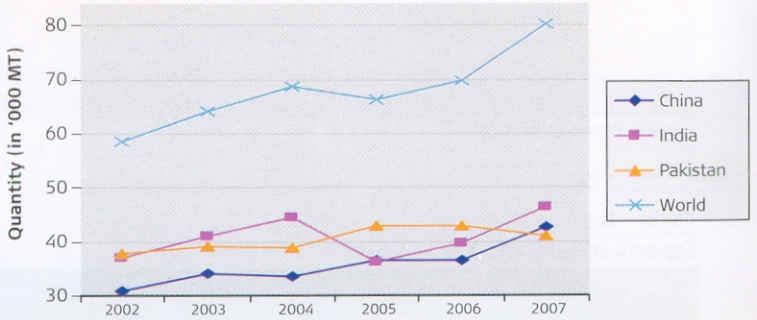
Table – 8.6
Imports of Jute and Kenaf fibre

(in '000 MT)

Country	2002	2003	2004	2005	2006	2007
Cote d'Ivoire	12.1	24.2	15.2	16.0	16.0	12.0
Brazil	11.0	4.0	13.8	19.4	19.4	0.2
Egypt	6.2	1.3	1.0	1.7	1.7	1.5
China	7.2	41.1	34.3	65.1	65.1	125.7
India	69.3	110.4	144.2	62.3	97.5	162.7
Pakistan	78.0	90.9	89.2	129.4	128.5	110.1
USA	0.5	0.3	0.3	0.9	2.5	3.6
EU	27.7	20.4	17.3	14.6	14.1	20.7
Australia	2.8	2.4	2.1	1.5	1.5	1.5
Japan	2.6	2.1	1.0	1.2	1.2	1.0
World	**284.1**	**341.1**	**386.9**	**361.7**	**397.5**	**500.6**

Source : *FAO (2005 & 2008)*

Fig. 8.4
Imports of Jute and Kenaf fibre



8.3 Jute Products

8.3.1 World Production of Jute Products

The world production of jute and allied fibre products has slightly declined and remained more or less stagnant during the last five-six years (Table-8.7). The decline in production is in all categories

of products: Yarn, Hessian, Sacking, CBC and other products. But during 2007-08 total production of jute products has increased to a maximum level of 2362 thousand MT with increased production in all categories of products.

These figures are graphically shown in Fig 8.5.

Table – 8.7
Production of Jute Products in Major Producing Countries (Bangladesh, India, Thailand, Pakistan & Myanmar)

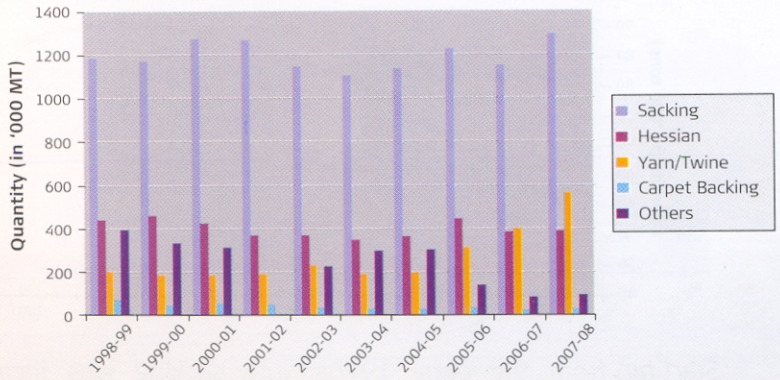
(in '000 MT)

Season	Sacking	Hessian	Yarn / Twine	Carpet Backing	Others	Total
1998-99	1187.21	440.42	201.29	64.91	392.91	2221.83
1999-00	1170.65	460.13	182.96	40.32	330.42	2184.48
2000-01	1270.31	425.18	185.86	53.28	314.17	2248.80
2001-02	1269.58	365.97	189.39	47.05	282.,61	2154.60
2002-03	1145.71	366.31	228.86	31.20	225.09	2057.17
2003-04	1101.94	347.21	188.69	23.20	295.95	1956.99
2004-05	1135.50	363.20	195.40	25.30	299.20	2018.60
2005-06 *	1225.32	444.82	309.40	29.47	135.50	2144.83
2006-07 *	1149.42	384.82	400.66	22.60	80.79	2038.29
2007-08 *	1290.72	388.79	562.70	27.90	91.91	2362.02

** For Bangladesh & India only*

Source : *FAO (2005 & 2008), Ministry of Textiles & Jute, GoB and Jute Commissioner's Office, GoI*

Fig. 8.5
World Production of Jute Products



8.3.2 International Trade in Jute Products

The world demand for all kinds of jute products increased from 643 thousand MT in 2001 to 766 thousand MT in 2006 and thereafter again slightly decreased to 754 thousand MT in 2007 (Table-8.8).

Table – 8.8

Exports of Jute Products

(in '000 MT)

Country / Region	2001	2002	2003	2004	2005	2006	2007
Bangladesh	409.2	400.6	391.9	439.4	440.0	478.9	477.0
China	5.3	9.1	14.4	16.1	16.5	18.5	20.0
Europe	46.6	49.4	39.0	52.2	55.6	42.2	41.4
India	151.0	189.9	243.8	193.0	208.1	189.5	175.6
Nepal	10.0	10.0	10.0	13.0	13.0	13.0	13.0
Thailand	6.3	5.2	4.1	6.3	6.3	7.0	7.0
Others	10.3	9.7	11.4	13.9	14.4	17.2	20.0
World	**642.5**	**676.0**	**716.9**	**740.2**	**758.0**	**766.3**	**754.0**

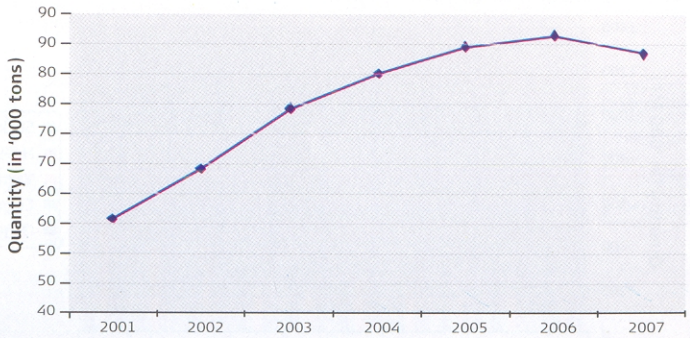
Source : *FAO (2005 & 2008)*

Presently, the nature of jute products exported from developed countries varies significantly from those of the developing countries like India, Bangladesh and Myanmar. Europe is exporting nearly 50 thousand MT of jute products, out of which 50-60% is contributed by Belgium-Luxemburg. Bangladesh and India together accounted for around 85% of total world export of jute goods during the period 2001-2007. Bangladesh alone accounted for around 60% of total world export of jute goods.

The world exports are shown graphically in Fig. 8.6.

Fig. 8.6

World Exports of Jute Products



Starting from the early 1970s, jute sacking was increasingly substituted world-wide with low cost synthetic bags and the process is still continuing in most developed countries, which resulted in significant decline in export demand for jute sacks. In addition, major developed economies switched to containerised bulk handling obviating the need for usage of any conventional

packaging bags / materials. It is only the mandatory packaging order of the Govt. of India in favour of jute bags which arrested to some extent the faster decline in world demand for jute sacks.

Table – 8.9

Export of Major Jute Products from India and Bangladesh

(in '000 MT)

Season	Yarn/Twine		Hessian		Sacking		CBC		Others		Total	
	India	B'desh	India	B'desh	India	B'desh	India	B'desh	India	B'desh	India	B'desh
1998-99	79.2	158.7	54.6	107.3	9.4	134.4	15.6	25.6	14.3	5.4	173.1	431.4
1999-00	83.8	156.6	56.5	87.0	5.4	123.7	5.1	34.6	15.9	3.3	166.7	405.2
2000-01	80.5	153.5	62.3	75.2	13.4	144.1	5.8	31.3	14.5	4.4	176.5	408.5
2001-02	73.1	147.2	36.5	84.2	10.0	130.9	3.7	27.5	14.5	4.6	137.8	394.4
2002-03	87.8	183.0	88.8	57.2	48.4	117.3	2.3	25.8	28.2	0.4	255.5	383.7
2003-04	90.6	175.2	157.1	48.7	33.4	81.8	5.2	19.2	24.1	1.3	310.4	326.2
2004-05	120.4	143.9	153.7	100.4	31.2	124.2	1.5	NA	15.0	NA	321.8	439.4
2005-06	69.1	149.6	171.6	112.6	33.2	151.0	0.9	21.07	11.0	4.8	285.8	439.9
2006-07	78.3	285.4	122.2	110.2	31.6	147.3	0.1	18.62	10.6	5.6	242.8	481.1
2007-08	79.9	337.4	26.7	42.8	33.6	113.9	0	18.5	9.3	4.3	149.5	516.5

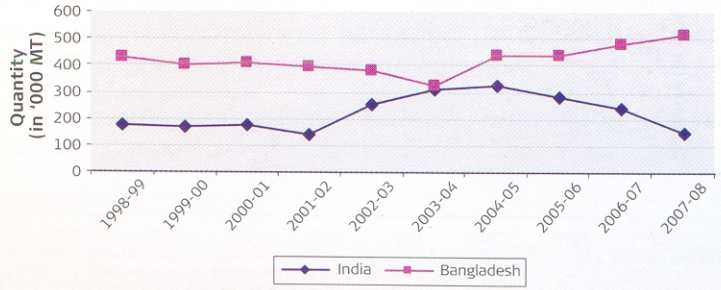
Source : *FAO(2005 & 2008) and Ministry of Textiles, GoI & Ministry of Jute, GoB*

Carpet backing also faced similar competition from synthetics. The world demand for CBC declined to 25 thousand MT in 2004 from 240 thousand MT in early 1970s. Presently, Europe imports jute yarn for use as weft of woven carpets.

Fig. 8.7 depicts the comparative picture of the exports of various jute products by Bangladesh and India since 1998-99.

Fig. 8.7

Export of Major Jute Products from India and Bangladesh



The world import of products of jute, kenaf and allied fibres has been hovering around 600 thousand MT since 2000 (Table–8.10). Developing countries accounted for 57% of world import of jute and allied fibre products, while developed countries accounted for the remaining 43%. In terms of countries, Turkey has emerged as

the major importer of jute products followed by Iran, Syria, Belgium, United States and Africa as per FAO Statistics, 2008.

Table – 8.10

Imports of Jute Products

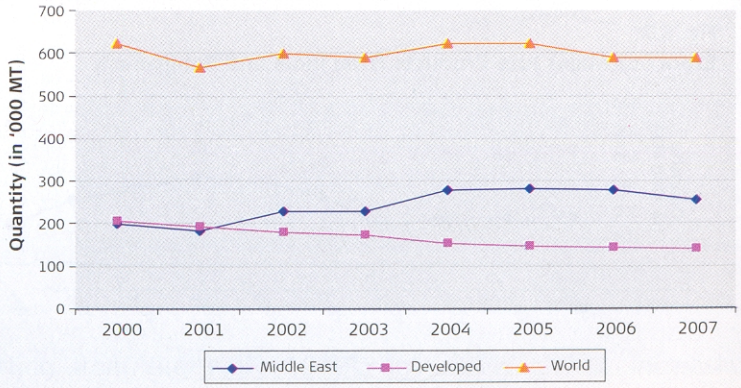
(in '000 MT)

Country / Region	2000	2001	2002	2003	2004	2005	2006	2007
Africa	32.1	38.3	28.1	31.5	33.5	35.5	43.5	49.9
Latin America	12.3	10.2	8.0	10.4	9.2	10.0	12.0	12.4
Middle East	202.8	184.1	232.5	232.6	282.0	285.0	280.9	258.1
Iran	60.9	57.0	67.2	63.1	68.2	75.1	50.0	–
Sudan	30.0	15.4	11.0	11.0	11.0	11.0	11.0	2.1
Syria	36.9	35.8	65.9	58.8	73.0	73.0	53.7	39.7
Turkey	47.0	43.4	64.6	78.1	108.5	101.2	127.9	125.1
Far East	24.5	21.0	16.9	21.2	21.3	21.5	26.8	30.3
USA	70.7	48.8	56.6	51.9	55.4	54.7	46.5	42.4
Europe	208.1	193.7	181.2	175.6	155.2	149.2	144.4	142.8
Belgium-Lux	99.0	91.8	79.4	70.8	67.2	62.7	60.7	56.5
Germany	16.2	15.6	16.6	15.9	14.8	14.1	13.5	14.7
Netherlands	19.8	14.7	16.8	25.0	15.2	16.3	12.1	14.1
UK	29.2	28.4	24.0	26.2	23.1	18.0	14.0	12.0
Australia	34.8	27.6	31.0	28.0	25.4	28.7	23.3	15.0
Japan	24.0	25.0	23.0	23.0	17.8	18.0	14.5	13.6
World	**624.5**	**567.2**	**600.1**	**591.2**	**623.1**	**625.2**	**591.9**	**828.7**

Source : *FAO (2005 & 2008)*

Fig. 8.8

Import of Jute Products by Middle East, Developed Nations & the World



The import of jute products by Middle East, comprising Iran, Sudan, Syria, Turkey, Saudi Arabia and Egypt, increased from 32% of total world import to 47% during the period 2000-06 (Table-8.10).

This region has shown substantial increase in jute goods imports since 2004, the major reason being the usage of jute yarn in the carpet weaving sector of Middle East. The second largest importing group is the European countries (Belgium-Lux, Germany, the Netherlands, and UK being the major ones) which was nearly 33% of total world imports of jute goods in 2000; but, since then such import has been continuously decreasing. The other important importers are Australia and Japan.

8.3.3 Product-wise Exports of Jute Goods

Out of the total jute goods production, in case of Bangladesh, around 90% was exported, and in case of India, around 15% was exported in 2007-08.

Yarn

Jute yarn is mainly used for carpet weaving as weft yarn and in some cases as face yarn. Jute yarn and twines are also used in making mats and mattings, braided rugs and in horticultural applications. The carpet weavers in Europe have installed faster rapier looms for weaving carpets. Export markets for yarn are sensitive to quality and price as well as factors affecting timely shipment. The global trade in jute yarn is primarily shared by Bangladesh and India. Bangladesh has a market share of about 78%, while India around 20% and others 2%. Hence, jute yarn has a special position among exports of jute products by these two countries. The jute yarn export growth rate was around 15% for Bangladesh and about 8% for India during the last few years. But the production capacity in Bangladesh is currently over-saturated. And India has become an importer of yarn and twine from Bangladesh.

Japan, Malaysia, both South and North Korea import jute yarn and twine.

Hessian and Sacking

The export and import scenarios for jute hessian and sacking of Bangladesh and India can be summarized as follows:

a) There is a huge domestic market for hessian and sacks in India.

b) During the period 1998-99 to 2003-04, in case of hessian export, Bangladesh had a market share of 54% whereas India

had a share of 30%. There is declining trend in export of hessian from Bangladesh and India.

There are 70 countries in the world which import hessian, the quantity varies from 50 MT to 40,000 MT per annum. Hessian is used for various purposes – for making bags to pack food grains, cereals, potatoes, agricultural produce, and protect trees and plants. It is also used in construction sector in roofs, for insulation purposes as well. USA, Iran, Syria, Belgium, and UK account for 50% of world import demand. The next category of countries like Egypt, Australia, Netherlands, Turkey, Japan, UAE, Germany, Sudan, Ghana and Indonesia accounts for 25-30% of world import demand.

Jute hessian fabrics are used to be imported by South American countries– Argentina, Brazil, Chili, Peru, Paraguay, Nicaragua, Uruguay, in the 1960s, 1970s & 1980s. But their imports started declining on account of protection to local industries with the formation of Latin American Free Trade Association (LAFTA), Central American Free Trade Agreement (CAFTA), and inroads of cheaper and easily available locally produced synthetic and PP materials.

c) In case of sacking, Bangladesh meets 98% of the world demand whereas India only 2%.

As regards sacks, countries like Sudan, Syria, Iraq, Indonesia, Thailand, East & West African countries, Egypt, Australia, Iran, Belgium, Turkey, Japan and USA account for more than 85% of total world import demand for jute sacks, mainly exported from Bangladesh.

Japan used to import good quantities of special sacks called Japanese Rice Bag (JRB) for packing and internal distribution of rice, the market of which has also been lost to woven PP sacks. Japan also imports hessian cloth and bags, odourless hessian cloth etc.

Malaysia, Indonesia and Thailand used to import sacks called Heavy Cees and Light Cees Bags for packing of paddy and rice to supplement their local production. Malaysia and both South and North Korea are also importers of hessian cloth, sacks etc.

China also imports sacks to supplement her local production as

and when necessary. Jute goods market erosion took place in this market also with their increased local output of Kenaf, inroads of locally produced cheaper woven PP sacks etc.

Australia and New Zealand used to import huge quantities of Australian Woolpacks and New Zealand Woolpacks for the packing of wool for exports to European and other countries. These markets have been almost lost to cheaper synthetic bags. Both these countries are also importers of various types of hessian cloth and bags for packing of other agricultural produce.

Carpet Backing Cloth (CBC)

Jute carpet backing for tufted carpets is either used in the form of a primary backing or as a secondary backing. Jute CBC lost the primary backing market almost completely due to consumers' preference for synthetic alternatives having cheaper price and assured supply in time. In the secondary CBC market, jute CBC could still maintain some market share due to the inherent properties of jute CBC like much less flammability and low smoke toxicity as compared to synthetics. The total jute CBC demand in the world is around 20 thousand MT per annum. Bangladesh accounts for 80% of the world export of jute CBC while India's share is 20%. Australia, Belgium and UK are major importers of jute CBC in the world, accounting for nearly 60% of total imports.

In case of primary CBC, USA and European carpet factories shifted entirely to synthetic materials from jute cloth. In case of secondary CBC, Australia and New Zealand carpet factories are using eco-friendly jute cloth. Some European carpet manufacturers use secondary jute CBC of wider width. Japan, and both South and North Korea import jute CBC.

USA used to be the biggest market for CBC. Initially they used to import Primary CBC whose market has been lost to synthetics in the late 70's and first half of 80's and then the Secondary CBC market has also been lost to synthetic on account of cheaper price and easy availability.

Jute Geo-textiles

An analysis of the broad consumption pattern of different geo-textiles in 2000 shows that synthetic materials account for 94%, jute for 1% and other natural fibres for 5% of total geo-textile

market. The total consumption of geo-textiles of all categories was 1400 million sqm in 2000-01. The aggregate demand had increased to 1621 million sqm in 2002. Presently, the market for jute geo-textiles is estimated at about 3000 million sqm. The total jute geo-textiles export market is shared by Bangladesh and India where the latter is the major supplier. Jute geo-textiles are categorised as woven and non-woven. USA is the major importer accounting for 70% of the total market for geojute followed by EU. The other major markets are Japan, Korea and Australia. The exported geojute materials were mainly used for soil erosion control in hill slopes / river banks, construction of roads and embankments and protection of trees and canals.

Food Grade Jute Bags

In Bangladesh these bags are being manufactured as per IJO Standard 98/01 (revised 2005) using vegetable based palm oil while in India rice bran oil is being used for the purpose. Such bags have been made mandatory for packaging cocoa by the International Cocoa Organization. These bags are also recommended for packaging coffee. Countries like Ghana, Cameroon, Cote d' Ivoire and Nigeria are major cocoa producers and countries like Brazil, Colombia, Mexico, Indonesia, Ghana and Cote d' Ivoire, are major coffee producers. Turkish hazelnuts are also required to be packed in Food Grade Jute Bags. The market for such bags is growing at the rate of 15% per annum. Above countries are the major consumers of Food Grade Jute Bags. USA, Argentina, Australia, Japan, Saudi Arabia and Turkey also import these bags to some extent.

Jute Floor Coverings

Jute floor coverings include jute-blended carpet, mats and matting, jute-based floor coverings, and rugs. The world demand for jute floor coverings was 7.7 million sqm in 2002. The USA was the major importer accounting for 54% of total imports in the world. Europe is the second largest consumer (19%). India was the major supplier (90%) for total world import demand for floor coverings.

Shopping and Carry Bags

Jute shopping bags and carry bags constitute one major item of export of non-traditional jute products. These items also find their application as promotional or give away material by manufacturers

or by retail stores, which are subsequently used as shopping and carry bags. The Indian export of such bags was 16 million pieces in 2002-03, with a value of around USD 25 million. The annual growth of demand for such bags is around 15%. Bangladesh is a minor exporter of such bags. USA, Japan, Saudi Arabia, UK, Belgium and Spain are major importers accounting for 57% of total imports in the world.

JUTE basics

A Strategy for the Jute Sector

International Jute Study Group

Chapter 09



9.1 Introduction

With the changing scenario in global natural fibres' markets, a new development strategy for jute and allied fibres has become an imperative. Such strategy for jute and allied fibres could also serve as a broad road map for governments of the jute producing countries to take policy decisions, international agencies to contribute to the programmes and the private sector to diversify its products and markets.

This strategy needs to take into account the major changes that have occurred in the jute sector during the past two-three decades and the new opportunities likely to be created with the renewed commitment for sustainable development and for protecting the environment. It is, however, difficult to predict the changes that are likely to take place in the market and its impact on natural fibres.

9.2 Background

Jute lost substantially its market share to synthetics and also to technological changes in the packaging sector. The declining trend in consumption is also reflected in the trend of prices of both jute and jute products though there are signs of recovery in recent times. The image of jute as a 'regional' commodity since production is confined to a few countries namely, India, Bangladesh, Nepal, Myanmar (and to some extent in Thailand and China) has also affected its growth.

Jute is an important item of international trade for the producing countries. Most of these countries have since moved up the value chain in manufacturing and textile processing. Jute's contribution to export has declined as a percentage of total export of these countries. But its contribution to agriculture and employment remains significant. In spite of fluctuating prices, farmers have continued to grow jute and allied fibres mainly due to the fact that it is an intercrop and the humus deposited in the soil improves its fertility. The loss of market share by jute and allied fibres to synthetics has been attributed mainly to the price factor. In addition, synthetics, as an industry, has been more progressive in terms

of manufacturing new products to meet exact end user specifications and have invested substantial money in R&D for both product and process development as well as market research. Synthetics are also dominated by huge multinational and national companies. They have, therefore, been able to displace jute and allied fibres from many segments of the market by superior product specifications, aggressive market campaign and financial strength.

The JAF industry is also characterised by inadequate technology development and the absence of large multinational players. The relatively small size of the industry has also contributed to its weakness in the markets. Inability to respond quickly to market needs with consumer friendly specifications and standards for new products have affected the growth of this industry. Inadequate research and development in products and lack of improvement of processing machinery have also contributed to the present state of affairs.

However, due to certain inherent characteristics of jute and allied fibres and specific consumer preferences, such market segments have been retained.

Efforts by international and bilateral donor agencies have also not been commensurate with the size of the problem nor have the efforts of producing and consuming countries been consistent and effective in the external markets. All these factors have contributed to a declining market. Side by side, new hope has been generated by global concern for environment and growing emphasis on use of natural products. It is in this context that a need has been felt for development of a new strategy for jute and allied fibres.

The major issues which are confronting the world of jute relate to all the areas of jute, right from agriculture to industry to trade.

Improvement in the quality of fibre remains an area of concern. The emphasis on higher yields has resulted in the deterioration of quality of jute produced. The non-availability of adequate certified seeds and the absence of a proper distribution system have led to the advent of spurious seeds which have affected both productivity and quality. Retting of jute which is the fundamental requirement for obtaining better grade of jute has been badly affected due to scarcity of retting water.

The lack of technology upgradation and modernisation, both at the manufacturing and processing stages, has resulted in low output and has

affected cost competitiveness against cheaper synthetic products. Unless the traditional products are retained and new diversified products are introduced, the loss of market share in all segments would continue.

The emerging environmental considerations and consumer preferences need to be taken advantage of for the promotion of both conventional and innovative diversified products. Among the diversified jute products, natural fibre floor coverings, shopping bags, home textiles, jute blended fabrics, and non-wovens may be considered as the key items.

High volumes of jute off-take is possible if products such as jute geo-textiles, which have a very large potential, is given adequate focus both in terms of product development and market promotion. Other potential areas for bulk use of jute exist in development of composites, pulp and paper, building and insulation materials. Some interesting projects have been successfully implemented in these areas but there is an urgent need to commercialise these efforts.

Though there is a demand for environment friendly products, jute diversified products have not been able to take a significant share of this market. Therefore, as a follow-up of the product development, market development efforts for diversified products should be considered as a key area of concern. New environmental considerations have prompted many countries to legislate in favour of environment friendly products. In spite of this, the cost of disposal of non-biodegradable products is still not reflected in the pricing of these products. The movement towards more environment friendly products in packaging is also hampered by the absence of adequate product development and the inability of jute and allied fibre products to be price-competitive. Development of new products to capitalise on the market opportunities should be an area of focus. The use of food grade jute bags for packaging grains, fruits, cocoa, coffee and tobacco needs to be encouraged. It is, however, imperative that concerns regarding any form of contaminants present in these bags are addressed.

The other fundamental issues which emerge from the possible effort to create demand for jute is the necessity to develop an efficient supply chain management system. If there is a rapid increase in the demand for jute, it has to be ensured that jute of appropriate quality is available in adequate quantity. The present availability of jute is grossly inadequate to meet increased demands. If the material required is not available at the right time the whole initiative will collapse and the process effect will become irreversible which is likely to adversely affect the entire industry.

9.3 Action Plan and Current Status

The International Jute Study Group (IJSG), an intergovernmental body has been set up under the aegis of UNCTAD to function as the International Commodity Body (ICB) for jute, kenaf and other allied fibres. It is the responsibility of this organisation to protect the interest of all stakeholders involved in the production and consumption of jute and jute products.

The primary objectives of the IJSG are to provide an effective framework for international co-operation among member countries in regard to all relevant aspects of the world of jute economy and promote expansion of international trade in jute and jute products by tapping new markets through the introduction of new jute products. This has led to the involvement of the private sector in this development process. At the same time, important social issues such as poverty alleviation, employment and development of human resources, particularly women have been addressed. IJSG also seeks to facilitate the improvement of structural and functional frameworks of the jute sector through improvement of productivity and quality and promotion of the application of new processes and technologies as well as the development of modern machinery. It is, therefore, incumbent on their part to develop and outline an appropriate strategy for the growth and promotion of the jute sector in line with the goals of the organisation.

Given the dynamics of the market and environmental concerns and keeping in view the declaration of the World Summit on sustainable development and the key elements of the Doha Development agenda - the Council of the IJSG at its Fifth Session in April 2004, approved the key elements of a Strategy for the Jute Sector. The Council also decided that an Action Plan based on these key elements should be drafted by a Committee consisting of one representative from each of the members viz. Bangladesh, European Community, India and Switzerland and three representatives from the private sector. This document has been considered and approved by the Drafting Committee in accordance with the above decision of the Council.

This Action Plan identified the main action points under each of the eleven key elements in the Strategy Paper. While action by the IJSG, National governments or the Private Sector are not necessarily limited to the points given in this document, it is expected that these will receive adequate consideration and attention at all levels. This Action Plan has not set *inter se* priorities. The Governments / organisations concerned

may set priorities based on the urgency / importance of the problem and the resources available. The Action Plan envisages an important role for the International Organisations (with IJSG as the coordinating agency), National Governments (including R&D organisations under the Government) and Private Sector (including Government-owned entities). These have been indicated after each action point. Now after five years appreciable progress in achieving these goals has been made but a lot is yet to be done. The action plan and the results achieved have been described below:

9.3.1 To Retain / Increase Market for Jute Products

Packaging Segment (Traditional)

a) Develop appropriate light weight packaging material to meet ILO Standards (50 kg bags for manual handling and the standard heavy bags/packages in vogue for mechanical handling) and to be cost competitive. At present, with the mandatory packaging act in place in India, bags are being produced there in bulk for storing food grains and sugar.

Action: National Govts. / Private sector

Type: Short term

b) Sustain / develop the domestic market for packaging by appropriate Government intervention for mandatory use of eco-friendly products. The mandatory packing act promulgated by the Government of India has ensured that hundred percent foodgrains and sugar are packed in jute bags for storage and transportation.

Action: National Govts.

Type: Long term (Continuous)

c) Address key concerns of buyers / consumers such as size, structure, delivery etc. in this segment effectively and ensure quality and specifications of products as per requirement of the consumers. Efforts are on to ensure quality through rigorous inspection processes.

Action: National Govts. / Private sector / IJSG

Type: Short term

d) Conform to approved specifications of food grade jute bags, develop a rapid test method and establish traceability norms. The use of rice-barn jute batching oil has been globally standardised and food-grade jute bags are being widely imported by European, African and Latin American countries.

Action: IJSG / National Govts. / Private sector

Type: Short term

Shopping Bags

a) Support creation of adequate production capacity and effective distribution network for quality jute/jute blended fabrics in producing countries as demand is ever mounting with growing environmental concerns.

Action: National Govts. / Private sector

Type: Medium term

b) Make arrangements to ensure availability of good quality jute / jute blended fabrics at reasonable prices.

Action: National Govts. / Private sector

Type: Medium term

c) Provide technical and design support to Small and Medium Enterprises (SMEs) for manufacturing shopping bags and related products. The Small Scale Entrepreneurship Development Project for Diversified Jute Products, funded by CFC has been able to provide such support to the small entrepreneurs.

Action: National Govts. / Private sector / IJSG

Type: Medium term

d) Take up focused market promotion in target markets with the active involvement of manufacturers. The problem is to ensure the supply of quality shopping bags as per the increasing demand.

Action: National Govts. /Private sector

Type: Short term (Continuous)

Floor Coverings

a) Focus on woven / braided / tufted carpets, rugs (Durries / Satranjis) etc. which have preference in the market at present.

Action: Private sector

Type: Short term

b) Provide technical and design support to manufacturers to enable them to meet consumer demands in target markets. The National Centre for Jute Diversification (NCJD) in India and Jute Diversification Promotion Centre (JDPC) in Bangladesh are actively working in these areas.

Action: National Govts. / Private sector / IJSG

Type: Medium term

c) Take up promotional campaigns through participation in fairs etc. in target markets. The Government of India through Jute Manufactures Development Council (JMDC) subsidises entrepreneurs to participate in international fairs. In Bangladesh, JDPC has organised district level fairs to promote diversified jute products. The Private Sector has been attending both domestic and international fairs regularly.

Action: National Govts. / Private sector

Type: Short term (Continuous)

9.3.2 To Develop New Applications of Jute Products

Geo-textiles / Agro-textiles

a) Assess manufacturing capacity of the industry to produce suitable fabrics for diverse applications; assist the industry in technology upgradation and develop specifications / standards for diverse applications in producing / consuming countries in consultation with user groups. The IJSG, with the funding from CFC has launched a major project on geo-textiles for rural road construction and protection of river banks and hill slopes.

Action: National Govts. / Private sector / IJSG

Type: Medium term

b) Take up on-site trials in producing and consuming countries to establish the comparative advantages of jute geo- / agro-textiles and investigate the market potential in producing / consuming countries. A lot of R&D work has been carried out by national and international universities and research organisations. The results are expected to emerge shortly.

Action: National Govts. / Private sector / IJSG

Type: Medium term

c) Promote use of jute geo- / agro-textiles in different applications (rural road construction, embankment protection, erosion control, etc.). For this, the supply chain management to ensure timely supply, to prevent fluctuation in quality and price and adherence to standards and specifications have to assured.

Action: National Govts. / Private sector / IJSG

Type: Medium term

9.3.3 To Develop New Products using the Advantages of Natural Fibres

Taking into consideration the dwindling forest resources in many countries and the need to reduce the use of wood in many applications, R&D efforts in producing composites, wood substitutes and paper pulp along with other new products like non-wovens from jute have been initiated. Though IJSG has successfully implemented the technology, the absence of a regulated market is preventing commercialisation of these technologies / products.

Jute Composites

a) Strengthen research and development activities for development of jute composites of various specifications / designs for diverse applications. Both injection moulding and compression moulding techniques have been tried out. The commercialisation, except for certain car components and particle boards, has not taken place in the absence of a detailed market study.

Action: IJSG / National Govts. / Private sector

Type: Long term

b) Encourage the setting up of units for producing jute reinforced composites for automobiles, engineering / structural / house hold and other applications. The process is on.

Action: National Govts. / Private sector

Type: Medium term

c) Taking advantage of the preference for natural fibres in certain market segments, develop new products using jute in combination with other natural fibres.

Action: National Govts. / Private sector

Type: Medium term

d) Use technologies already developed and established for converting jute into pellets / granules for ultimate conversion into composites through injection moulding or extrusion processes and disseminate suitable cost-effective technologies viz. Pultrusion / Liquid Resin Infusion (LRI) / Resin Transfer Moulding (RTM) techniques to entrepreneurs.

Action: Private sector / National Govts. / IJSG

Type: Medium term

Wood Substitutes

a) Adopt suitable technologies for producing wood substitutes from rigid composite boards of jute or jute sticks, evaluate their performance and promote these products as an environmental alternative.

Action: Private sector / National Govts. / IJSG

Type: Medium term (Continuous)

Pulp and Paper

a) Study the economic viability of setting up new paper mills or converting existing paper mills for using the developed technologies for pulp and paper from jute/ kenaf and encourage the private entrepreneurs to set up such units by giving fiscal / financial incentives.

Action: National Govts. / Private sector / IJSG

Type: Medium term

Non-wovens

a) Determine the specifications of non-wovens for various applications and develop and expand the existing production capacity after assessing market potential.

Action: Private sector / National Govts. / IJSG

Type: Short term

9.3.4 To Improve Fibre Quality

a) Focus on development of varieties of appropriate fibre quality for specific diversified uses.

Action: National Govts.

Type: Long term

b) Establish an appropriate framework for controlled seed production, certification and distribution with participation from the private sector. It is easier said than done as appropriate soil conditions are required to grow seeds. However, efforts are on to grow quality certified seeds.

Action: National Govts. / Private sector

Type: Medium term

c) Evaluate existing retting practices and recommend suitable practices particularly to jute growers in water scarce areas and motivate jute growers to adopt suitable retting and agricultural practices for the yield of good quality fibre. The low cost retting project funded by CFC has proved that there can be quality improvement of jute by at least one grade if the retting technique needing very little water is properly implemented.

Action: National Govts. / IJSG

Type: Short term

d) Ensure a reasonable price to the growers and better price for better quality fibres. The Minimum Support Price (MSP) operations carried out by the Government of India through Jute Corporation of India Ltd (JCI) have ensured fair return to the farmers and thereby motivate them to grow jute on a regular basis.

Action: National Govts. / Private sector

Type: Long term (Continuous)

9.3.5 To Improve Productivity and Product Quality

a) Set up a policy mechanism to discourage inefficient production and encourage policies / initiatives for better management, maintenance, efficient labour practices in the jute mills and determine and use standard man-machine ratio at various processing stages.

Action: National Govts. / Private sector

Type: Medium term

b) Update / transform / modify / replace the old machinery with support from machine manufacturers. Under the JTM of the Government of India, a R&D centre has been set up under Public-Private-Partnership to develop new jute machinery.

Action: Private sector / National Govts. / IJSG

Type: Medium term (Continuous)

c) Consider maintenance and repair activities along with energy conservation efforts as integral parts of production and productivity.

Action: Private sector

Type: Short term

d) Ensure sound and effective process control measures and strict quality supervision of the products.

Action: Private sector

Type: Short term (Continuous)

e) Introduce productivity-linked wages or other such incentives to the jute mill workers.

Action: National Govts. / Private sector

Type: Medium term

9.3.6 Make Use of Sustainable Development Agenda

a) Use the commitment of the World Summit on Sustainable Development to promote jute as a sustainable natural fibre.

Action: IJSG / National Govts.

Type: Medium term

b) Use international and domestic fora to advocate the cause of jute by working with environmental groups.

Action: IJSG / National Govts.

Type: Short term (Continuous)

9.3.7 To Increase Consumer Awareness by Highlighting the Environment-friendliness of Jute / Kenaf

a) Undertake studies to develop a database to establish specifically the environment friendly attributes of jute / kenaf. These need to be publicised widely through mass media.

Action: IJSG / National Govts. / Private sector

Type: Short term

b) Take up market promotion in key markets for jute and jute products and increase consumer awareness through appropriate measures.

Action: IJSG / National Govts. / Private sector

Type: Short term

9.3.8 To Address Trade Issues

a) Collect adequate and relevant data on trade issues.

Action: IJSG / National Govts.

Type: Short term

b) Attempt to resolve tricky issues through available fora like WTO, Regional Trade Cooperation Framework (like SAFTA) or Bilateral trade negotiations.

Action: National Govts.

Type: Medium term

c) Study technical barriers like Standards / Certification procedures

etc. and work with Standards / Certification Agencies to develop appropriate standards.

Action: IJSG / National Govts.

Type: Medium term

9.3.9 To Address Supply-side Management Issues

a) Analyse supply-side problems / logistics like constraints in production / delivery, inadequate response to buyers' complaints, settlements of dispute etc.

Action: National Govts. / Private sector

Type: Short term

b) Set up appropriate trade led bodies in consultation with National Governments to intervene quickly and effectively in problems such as, non-delivery, late delivery, quality complaints, dispute settlements etc.

Action: National Govts. / Private sector

Type: Short term

9.3.10 To Create a Research & Development Network

a) Focus R&D on market related issues like new products, specifications of products in consumer markets, acceptability of products, new opportunities arising out of regulations / preferences etc. Encourage the private sector to participate financially and technically in R&D projects.

Action: National Govts. / Private sector

Type: Long term

b) Exchange and share results of R&D between various institutions involved in natural fibre related research and set up a suitable network to share such information.

Action: IJSG / National Govts.

Type: Medium term (Continuous)

9.3.11 To Highlight Employment Opportunities & to Develop Human Resources

a) Highlight the employment opportunities particularly in agriculture and the jute diversified sectors in appropriate campaigns. Special emphasis being given to women and poor farmers and artisan to enable them to earn a respectable livelihood.

Action: IJSG / National Govts. / Private sector

Type: Short term (Continuous)

b) Assess the training needs of the industry for improved product quality, productivity and diversification.

Action: National Govts. / Private sector

Type: Short term (Continuous)

c) Set up and strengthen need-based training facilities through international cooperation.

Action: National Govts. / IJSG / Private sector

Type: Medium term

d) Improve the skills of the supervisors and workers of the mill / units.

Action: Private sector / National Govts.

Type: Short term (Continuous)

The eleven point strategy which was adopted by IJSG in 2004 has been by and large comprehensive and all embracing. This strategy paper had also formed the basis of the document viz. "A Road Map for Jute" prepared by IJSG subsequently with the help of ITC and funded by CFC. Quite a few goals envisaged in the strategy note have been fully or partly achieved. Most of these goals are a part of a continuous process and therefore a revised strategy is not immediately required so far as the focus on the eleven point wish list is not lost. If the stakeholders are able to continue the on-going process, the entire jute sector would be able to achieve their social and economic development goals including the Millennium Development Goals (MDG) in the near future.

9.4 Explanatory Note

The International Jute Study Group (IJSG) Secretariat prepared and circulated a Draft Strategy Paper for consultation and decision in the Fifth Session of the Council of IJSG held during 20-21 April 2004. The Council approved the document and decided to form a Drafting Committee consisting of one representative each from Members and three representatives from the Private Sector to draft an action plan based on the key elements of the Draft Strategy Paper. The Council instructed the Committee to finalise the Strategy Paper through written procedure as per relevant provision of Chapter VII of the Rules of Procedure of the IJSG (Decision on Question without Meeting) within a period of four months.

The Secretariat held a Meeting of the Drafting Committee during 26-27 July 2004 under the chairmanship of the Secretary General. As per suggestion of the Committee the key players for taking actions have been identified under three categories i.e. National Governments, Private Sector and the IJSG. The actions were further segregated on the basis of duration as short, medium and long term categories.

The Secretariat circulated the Strategy Paper incorporating the Action Plan prepared and finalised by the Drafting Committee among Members to obtain Council's approval through written procedure on 2 August 2004 to receive a Decision (approved/not approved) of Members by 31 August 2004 with an interpretation of non response as a vote in favour.

Since the Secretariat did not receive any response from Members on the Action Plan within the stipulated deadline, it was considered as Members' approval, with all 2000 votes in favour, in accordance with the relevant provisions of the Rules of Procedure of the IJSG.

This document is the Final Version with minor editorial changes of the earlier one.

JUTE
basics

Jute Organisations – National & International

Chapter 10



10.1 International Jute Study Group

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The International Jute Study Group (IJSG) is an intergovernmental body set up under the aegis of UNCTAD to function as the International Commodity Body (ICB) for Jute, Kenaf and other Allied Fibres. The IJSG, the legal successor to the erstwhile International Jute Organisation (IJO), was established on 27 April 2002, to administer the provisions and supervise the operations of the Agreement establishing the Terms of Reference of the International Jute Study Group, 2001.

Objectives

- To provide an effective framework for international cooperation, consultation and policy development.
- To promote the expansion of international trade by maintaining existing markets and developing new markets through the development of new end-uses and introduction of new jute products.
- To provide a forum for the active participation of the private sector.
- To address the issues of poverty alleviation, employment and development of human resources.
- To facilitate the improvement of structural conditions through improvement of productivity, quality and promotion of the application of new processes and technologies.
- To create awareness of the beneficial effects of the use of jute as an environmentally friendly, renewable and biodegradable natural fibre.

Functions

- To develop an appropriate strategy for the improvement of the world jute economy with particular emphasis on generic promotion of jute and jute products.
- To conduct consultations and exchanges of information on the international jute economy.
- To initiate, sponsor, supervise, monitor and act as a catalyst with respect to projects and related activities aimed at improving the structural conditions of the world jute economy and the general economic well-being of those employed therein.
- To provide and improve statistics and market intelligence on jute and jute-based products in consultation with the Food and Agricultural Organisation of the United Nations and other appropriate bodies.
- To undertake studies on various aspects of the world jute economy and related issues.
- To consider problems or difficulties which may arise in the international jute economy.
- In implementing its functions as above, the Group shall take into account the activities of other relevant international organisations including FAO.

The highest authority of the Group is the Council, consisting of all members of the organisation which meet at least once a year.

Membership of the Group is open to all States (Countries) and the European Community which are interested in the production or consumption of or international trade in jute or jute products. At present IJSG has a total of 30 Members viz. Bangladesh, India, Switzerland and European Community comprising its 27 member states.

Associate Membership of the Group is open to those organisations and entities that are not entitled to full membership but have an interest in jute and jute products and concerned with the development of jute. At present there are 102 Associate Members of the Group. All Associate

Members are members of the Private Sector Consultative Board (PSCB). PSCB is an effective forum for private sector initiative and coordination which has made IJSG distinctly different from its predecessor organisation IJO.

IJSG has been initiating, implementing and supervising important projects for the growth of jute sector. The Group also organises Seminars / Workshops / thematic meetings on various issues related to the development of jute and jute products.

The IJSG is mandated to work in close cooperation with international and bilateral agencies concerned with commodity development, agriculture, trade and development, environment, poverty alleviation, etc. The IJSG is thus working closely / jointly with the Common Fund for Commodities (CFC), the Food and Agriculture Organisation of the United Nations (FAO) and International Trade Centre - ITC (WTO/UNCTAD). IJSG and FAO signed a Memorandum of Understanding (MoU) to support the efforts of their Members to facilitate jute production, consumption and trade to improve the incomes and food security of jute producers and others associated with the jute industry.

Collaboration with Member Countries

The IJSG Secretariat is active in strengthening cooperation among member countries in developing products descriptions and standards where necessary for jute products. IJSG also addresses specific concerns of member countries to the extent feasible and mandated. IJSG attempts to promote better understanding between various stake-holders of jute / jute products in the member countries.

10.2 Bangladesh

10.2.1 Department of Jute

Ministry of Textiles & Jute
Government of the People's Republic of Bangladesh
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The Department of Jute is relatively a new establishment which was re-organised in 1992 through merger of the then Directorate of Jute and Directorate of Inspection for Jute & Jute Goods.

Mandate

- To serve the interest of jute growers, traders and all persons and institutions involved in the production of jute goods and marketing.
- To expand and to control domestic and cross boarder business of jute and jute goods.
- To collect, compile and preserve all sorts of statistics relating to production, use & marketing of jute and jute goods.
- To keep watch over various types of crimes, corruptions, misuses and irregularities in matters relating to jute and jute goods trades.
- To give strategic counsel to government in formulating jute policy.
- To impart training to jute growers in producing jute in improved way, on retting techniques and marketing jute.
- To inspect the conformity of jute goods with the standards.

Major Functions

- Application and implementation of jute ordinance, 1962.
- Application and implementation of jute (licensing and enforcement) rules, 1964.
- Undertake control measures in accordance with the Jute Growers' (border areas) Act, 1974.

- Identifying the businessmen engaged in illegal trading of jute and jute goods without trade license and taking punitive measures as per the existing rules.
- Taking legal action against the jute traders who do not export raw jute or jute goods as per the trade deal with the expatriate importers and /or violate trade deals executed with them.
- Renewal of license for trading jute and jute goods.
- Collecting, disseminating information and statistics relating to jute cultivation, acreage, export, production, internal use and storage of jute and jute goods.
- Inspecting and evaluating quality of jute goods produced by the jute mills.
- Supervising standard testing methods of jute mills.
- Assisting the jute mills in the inspection and maintaining quality control aspects.
- Preparing audit and annual stock of jute and jute goods and maintaining for use by concerned agencies.
- Implementation of projects for development of the jute sector.

10.2.2 Bangladesh Jute Mills Corporation

Adamjee Court
115-120, Motijheel Commercial Area
Dhaka 1000, Bangladesh
Tel: +880 2 9565519
Fax: +88 02 9567508/4740
Email: bjmc@bttb.net.bd

Bangladesh Jute Mills Corporation (BJMC) is the world's biggest state owned manufacturing and exporting organisation of all kinds of jute goods. Research, innovative experimentation towards product development, and modernisation approaches are the other contributing elements to its success as established over the years.

After the independence of Bangladesh in 1972, BJMC was created by the Presidential Order viz. Bangladesh Industrial Enterprises Nationalisation

Order No. 27 of 1972. The mandate of BJMC is to manage, supervise and control all the jute mills under erstwhile East Pakistan Industrial Development Corporation (EPIDC) including the abandoned and denationalised jute mills.

Initially in 1972, 67 jute mills and subsequently 10 more jute mills and two jute machinery / spares manufacturing industry were placed under BJMC. Later on, two carpet factories and one jute-plastic industry were set up by BJMC. At present, 19 mills including three non-jute industries for manufacturing jute machinery / spares, paper tubes and jute-plastic products are operational, while five are leased out and three are closed.

BJMC mills are still playing a very important role in the net export earning of Bangladesh through export of jute products. About 90-92% of the jute products manufactured in the BJMC-controlled mills are exported to around 100 countries of the world, remaining 8-10% are marketed locally. In the fiscal year 2007-08 BJMC has contributed a foreign currency earning of BDT 4900m (about USD 70m) for Bangladesh through export of jute products.

Product Range

The main products currently being manufactured by BJMC mills are hessian, sacking, twines and carpet backing cloth (CBC) e.g. sacking cloth, sacks / standard sacking bags (twill bags, double warp bags), food grade jute bags, hessian cloth, hessian bags, standard bags etc. Besides, some mills are producing some diversified products like export quality jute yarns, geojute/soil saver, jute canvas, wall covering cloth, tarpaulin, jute felt, rot proof fabric and bag, scrim cloth with different sizes & weights.

10.2.3 Bangladesh Jute Research Institute

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The Bangladesh Jute Research Institute (BJRI) is the oldest mono-crop research institute of the country. To intensify research on jute and allied fibres, Jute Agricultural Research Laboratory (JARL) was established by the Indian Central Jute Committee (ICJC) in Dhaka in 1936.

During 1936-47, the effective infrastructure required for a broad spectrum of jute research activities was established. After the partition of India in 1947, in the light of erstwhile ICJC, Pakistan Central Jute Committee (PCJC) in turn reorganised the existing JARL as Jute Research Institute (JRI) at the present site in 1951. Later on in 1963, jute technological / industrial research activities were initiated in the present site as an independent body in the name of Jute Technological Research Board with the help of the then Pakistan Jute Mills Association.

Mandate

After the liberation of Bangladesh in 1971, the Jute Sector was geared up with approach for achieving realistic goals. The Bangladesh Govt. promulgated the Jute Act in 1974 and established Bangladesh Jute Research Institute (BJRI) with specific mandate which was modified in 1996 with the following major functions.

- To promote agriculture, technological and economic research on jute and allied fibres and their manufactures and dissemination of results thereof.
- To organise production, testing and supply of improved pedigree of jute seeds and multiplication, procurement & their distribution to recognised organisations, selected growers and such other agencies as may be approved by the Board.
- To set up research centers, sub-stations, pilot projects and farms in different regions of the country for carrying out research on different problems of jute and allied fibre crops, jute products and allied materials.
- To establish project areas for demonstration of new varieties of jute developed by the institute and to train the farmers for cultivation of these varieties of jute.
- To establish annual reports, monographs, bulletins, and other literatures relating to jute research and the activities of the institute.
- To organise training of officers and progressing farmers on modern improved methods of cultivation of jute and allied fibre crops and also to train technical hands for utilisation of technological findings.

- To undertake scientific and technological research on jute fibre and products.
- To improve conventional jute products.
- To evolve new and diversified end uses of jute for increasing export potential.
- To provide technological support to jute textile industries in up-dating their manufacturing process and to adopt technologies for new jute products.
- To provide information on research for breeding quality jute fibre to feed back the jute industry by growing jute with desired textile properties.

The research activities being conducted by BJRI can broadly be divided into two sections: (a) Jute Agricultural Research, and (b) Jute Technological Research, which have started functioning since 1951 and 1963 respectively.

At present there are 10 research divisions under Agricultural Research Wing and Technological Research Wing of the institute. With recent addition of a new Division namely Planning, Training and Communication, altogether BJRI now consists of 11 Divisions. Besides, there is a Central Experimental Field of jute agriculture at Manikganj and four regional stations at Rangpur, Faridpur, Kishoreganj and Chandina (Comilla); and three sub-stations at Tarabo (Narayanganj), Monirampur (Jessore) and Kolapara (Patuakhali); and a recently established Breeders' Seed production Farm at Nasipur (Dinajpur).

The Central Germplasm Repository for Jute, Kenaf and Allied Fibres was established in the Germplasm Division, BJRI in 1987 with the help and support of the erstwhile IJO, for conservation of seeds of different varieties of jute, kenaf and mesta; and variety development research. At the moment there are about 6000 germplasms of jute and allied fibres in the Gene Bank, collected from all over the world.

Major Achievements

1. Development and release of 38 high yielding variety of jute, kenaf and mesta to suit different agro-ecological conditions of the country. Out of 38 varieties, 14 improved varieties (6 white, 5 tossa, 2 kenaf and 1 mesta) are being cultivated largely in the farmers' fields.

2. Release in 2006-07 of D-6 variety of white jute, which without or with very little bleaching, is much suited for the manufacture of bright jute products.
3. Development and adoption of new tossa varieties, which resulted in substantial increase in tossa cultivation with a shift of white-tossa ratio to 20:80 from 70:30 (during 1970s).
4. Development of jute varieties with short & low temperature tolerance & having shorter field life and identified as completed crop in cropping patterns involving three crops.
5. Improved jute seed production technology for doubling seed productivity (about 700 kg/ha) within a shorter period (3 months).
6. Development of improved ribbon retting technology, especially to solve retting problem in water scarce areas.
7. Development of technologies for producing fine jute-based fabrics, using grey or chemically processed all jute / blended yarns.
8. Development of improved photostable dyes and dyeing technologies for jute textiles.
9. Development of cost-effective chemical, microbiological and enzymatic processes to soften jute cuttings and low-grade jute for improving their quality.
10. Development of fire-retardant jute fibre / jute fabric, rot-proof nursery pot / sheet, jute-wool yarn, jute-based absorbent cotton substitute, etc.
11. Production technologies of various cellulose derivatives, like carboxy methyl cellulose (CMC) or micro crystalline cellulose (MCC) from jute.
12. Development of blankets of jute or jute-acrylic blend (80/20 and 70/30).
13. Development of improved dyeing and finishing techniques for jute and jute products.
14. Development and modification of few apparatus /equipment viz. thermal conductivity tester, a fault finding testing apparatus and yarn irregularity tester etc.

Out of 40 technologies developed through research under the Technology Wing of BJRI, 23 technologies are being used in the industries.

Major Services

1. Production and distribution of Breeders' seeds of different varieties to Bangladesh Agricultural Development Corporation (BADC) for production of foundation seeds and certified seeds of jute.
2. Trainings, counseling and various services are provided to the farmers, weavers, artisans and other relevant people involved with cultivation of jute or production of jute products.

10.2.4 Jute Diversification Promotion Centre

Ministry of Textiles & Jute
Government of the People's Republic of Bangladesh
145, Monipuripara, Near Farmgate
IJSG Premises, Dhaka 1215
Tel: +88 02 9145511
Fax : +88 02 9121523
Email: edjdpc@yahoo.com

The Jute Diversification Promotion Centre (JDPC) has been created with the vision of improving jute scenario, sustained development of jute economy and reviving the past glory of jute as 'Golden Fibre' through extension of uses and production of value-added products and thereby improving socio-economic conditions of farmers and other sections of people involved directly or indirectly with the sector.

Mandate

JDPC is mandated with the responsibilities and functions of promotion and development of JDP enterprises in the private sector and thus it is involved in creation of new capacity and maximisation of the existing capacity. The major functions are:

- To assess the current status of jute diversification and its potentials in the short-term, mid-term and long-term perspectives.
- To identify the suitable technologies and processes for production of jute diversified products and uses and acquire marketable technologies and processes for commercialisation including transfer of technology from R&D organisations / institutions and individual researchers.
- To assess demand and supply situation of diversified jute products and the related products in domestic as well as overseas markets and make projection on their future growth.
- To look for suitable sources of finance for enterprises producing JDPs.
- To help private entrepreneurs for the preparation of bankable project proposals for investment in JDPs, undertaking feasibility studies, market studies, research and promotion etc.
- To assist, support and facilitate the private entrepreneurs with package of promotion and extension services and linkages with financial institutions for promotion of new capacity and optimal utilisation of the existing capacity.

Major Services

JDPC offers assistance to entrepreneurs in manufacturing and marketing of diversified jute products. Some important examples of techniques / processes, being pursued by JDPC for jute diversification are as follows:

1. Production of fine jute blended yarn with jute as major component.
2. Jute-based furnishings, handicrafts and various home textiles.
3. Chemical treatment of jute for delignification / modification.
4. Wet processing for bleaching, dyeing and printing of jute / blended materials.
5. Production of fire retardant, rot resistant and water repellant technologies for jute products.
6. Production of cellulose derivatives e.g. carboxy methyl cellulose (CMC), microcrystalline cellulose (MCC) etc. from jute.
7. Jute-based substitute of absorbent cotton.
8. Jute-leather composite products.

9. Jute reinforced plastic granules.
10. Jute-based pulp and paper products.
11. UV-protective jute products.

10.2.5 Bangladesh Jute Spinners Association

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Dhaka 1000, Bangladesh
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Fax: +88 02 9562772
E-mail: bjsa_bd@yahoo.com

The Bangladesh Jute Spinners Association (BJSA), established in 1979, is a national body representing the jute spinning sector of Bangladesh. The Association has a total membership of 50 jute spinning mills. The total production capacity of this sector is more than 3,50,000 MT per annum. The Association is represented in various Advisory Councils / Committee under different Ministries and Departments of the Govt. of Bangladesh.

The Association is a dynamic, vibrant entity providing relevant, up to date and useful information and other services to its members comprising the leading entrepreneurs and manufacturers of jute yarn & twines. Each of these members has vast experience in commerce and industry.

The member mills produce a wide variety of jute yarn and twine from the world's best quality raw jute, meeting the international quality requirements the world over. Its products are used for carpet weaving (Wilton & Axminster Carpet), wall covering, jute webbing, fabrics for shopping bags, caps, handicrafts, jute cloth for various uses like canvas, decorative fabrics, laminated cloth, safety fuse for explosive and many other uses.

The jute spinning sector employs about 48,500 personnel, exporting nearly 100% of its products, and is one of the largest foreign exchange earners in the private jute sector (BDT 13350m equivalent to USD 193.48 m).

The Association has a well structured Secretariat. It has a number of publications which are very popular in the country and abroad. Its monthly publication *Spinners News* contains information on national and international issues related to jute and jute industry, statistics on exports etc.

10.2.6 Bangladesh Jute Association

77, Motijheel Commercial Area
Dhaka 1000
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Fax: +88 02 9552916
Email: bjute@bangla.net

Bangladesh Jute Association (BJA) started functioning since 14 March 1972. BJA is the national representative body of all raw jute traders and exporters in the private sector. The members – exporters and raw jute traders of BJA directly purchase jute from the growers' level at a reasonable price and after processing raw jute they transform them into pucca bale and export to overseas countries and earn foreign exchange.

There is a provision for holding general election after every two years to run the Association. An eighteen member committee is elected by the general members. The committee is headed by the Chairman, a Senior Vice-Chairman and a Vice-Chairman. The rest fifteen Executive Members work in collaboration for smooth running of the organisation and conducting the business of the Association.

Major Functions

- To promote and protect the jute trade in Bangladesh and to establish just and equitable principles in jute trade.
- To arbitrate and settle the dispute arising out of the commercial transaction of all kinds and grades of raw jute referred to the Association by the parties concerned.
- To communicate with trade association and other mercantile and public bodies throughout the world and concert and promote measures for the protection of the jute trade and to protect the interests of the members of the Association.
- To protect the members of the Association against the threat of unwanted persons whose activities may render the members unworthy of participating and carrying on jute trade.
- To make adjustment if controversies arise between members of the Association and to collect and circulate statistics and other information relating to jute trade.
- To initiate and assist in the scheme of intensive cultivation

with better seed and other inputs with a view to increasing production of jute to fulfill national jute production targets.

- To publicise the utility of natural fibre to keep the environment free from hazard.

10.2.7 Bangladesh Jute Mills Association

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Bangladesh Jute Mills Association (BJMA) is the Apex Body of Private sector composite jute industry of Bangladesh. It is the national organisation of composite jute mill owners. It was established in 1982. At present the Association represents 88 member jute mills.

Objectives

The objectives of the Association are to promote, encourage and protect the interest of member mills. The Association maintains close contact with different Ministries and Departments of the Government viz. Prime Minister's Secretariat, Ministry of Textiles & Jute, Ministry of Finance, Ministry of Agriculture, Ministry of Industry, Ministry of Environment, Ministry of Commerce, Export Promotion Bureau (EPB), Department of Jute, non-government, National and International Organisations e.g. Bangladesh Bank, Commercial Banks, Federation of Bangladesh Chamber of Commerce & Industry (FBCCI), Dhaka Chamber of Commerce & Industry (DCCI), Metropolitan Chamber of Commerce & Industry (MCCI), Bangladesh Employers Federation (BEF), World Bank, FAO, IJSG, PSCB etc.

Functions

The Association collects the statistical information from the member mills, compiles and disseminates among the Member mills and also sends to the Ministry of Textiles & Jute, Department of Jute, FBCCI, Bangladesh Bank, Bureau of Statistics and other organisations. It represents in various Councils / Committees under different Ministries and departments of the Government. The Association is

a Member of the Federation of Bangladesh Chamber of Commerce and Industry (FBCCI), the Bangladesh Employers' Federation (BEF) and an Associate Member of the International Jute Study Group (IJSG).

10.2.8 Bangladesh Jute Goods Association

3/12 Naya Paltan, 4th Floor
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Email: bjgabd@yahoo.com

Bangladesh Jute Goods Association (BJGA), one of the elite and old Associations of its kind, is the association of exporters of jute goods in Bangladesh. The Association was established in the former East Pakistan in 1969 with very limited members.

Immediately after the independence in 1971, it was reformed as Bangladesh Jute Goods Association. At present the Association has 214 members.

The Association is governed by an Executive Committee consisting of 13 members elected for a period of two years with the Chairman as the Chief Executive.

Functions

- Bangladesh Jute Goods Association, an association of exporters of jute goods keeps in constant touch with Export Promotion Bureau (EPB), BJMC, BJMA, BJSA, BJA, Ministry of Commerce, Ministry of Textiles & Jute and gathers all related available information and data for jute and jute goods and provides the same to its members for market research and planning.
- The Association also looks into various issues and barriers for exports of jute goods abroad and forward appropriate proposals and necessary recommendation(s) to the respective government authority(ies) for consideration and execution for smooth export business in Bangladesh. BJGA facilitates promotional activities to its members and provides all kinds of supports for the improvement of the structural conditions related to jute goods export.

10.3 Europe

10.3.1 EUROJUTE

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The Netherlands
Tel: +31 70 34 90 750
Fax:+ 31 70 34 90 775
E-mail: info@eurojute.com
Website: eurojute.org

EUROJUTE (European Association for the Trade in Jute and related Products) is serving the interests of its members in all aspects.

It keeps a close relation with international organisation of importance to Jute; the European Commission in Brussels, national governments of the member countries, embassies and organisations of jute producing countries and similar organisations like EUROJUTE in other parts of the world.

EUROJUTE services include:

- Contact and lobbying at appropriate organisation,
- Information about new developments in trade,
- General sales conditions,
- Standard buying contracts for jute,
- Arbitration system, and
- General meetings of members of the Association twice a year.

Currently EUROJUTE has members in Belgium, France, Germany, Great Britain, Italy, The Netherlands, Spain, Sweden and Switzerland.

EUROJUTE supports packaging requirement whilst maintaining the necessary integrity to protect the packed goods. Their members offer environmentally friendly products including reusable and recyclable packaging. Jute and jute products like raw fibre, yarn / twine, cloth, sacks, retail fancy goods are handled among others by EUROJUTE members.

10.4 India

10.4.1. Office of the Jute Commissioner

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Salt lake City, Kolkata-700064
Tel : +91 33 2337 6970/6971,
Fax: 00 91 33 2337 6974/6972
E-mail: jccal@vsnl.com

According to the Allocation of Business Rules, the Office of the Jute Commissioner, a subordinate office of the Ministry of Textiles, Govt. of India, is required to attend to production, distribution (for domestic consumption and exports) and development of jute as well as jute products. Enhancement of export promotion of jute and jute products is also one of the duties of the Jute Commissioner.

The Performance Budget for the year 2004-05 stated that the Jute Commissioner is entrusted with the responsibility of implementing the policies of the Union Government in the jute sector. Like the Textile Commissioner acting as the principal technical adviser to the Ministry on textile sector, the Jute Commissioner gives technical advice to the Ministry on all matters relating to the jute sector including the jute machinery industry.

The office started functioning in April 1958 following enactment of Jute Textiles (control) Order, 1956.

Functions

Jute Commissioner serves as the monitoring and controlling authority for

a) Jute Packaging Materials (compulsory use in packing commodities) Act, 1987
b) Jute and Jute Textiles Control Order, 2002, issued under Sec. 3 of EC Act. 1955
c) Jute Manufactures Cess Act, 1983
d) Prices for different varieties and grades of raw jute based on Minimum Support Price (MSP)
e) The Jute Commissioner issues production control orders for jute mills for supply of B-Twill Jute bags.

The Jute Commissioner serves as Chairman / member in various Govt. Committees, in management committees of different jute-related organisations of India, and represents Govt. of India in the Council and Committees of the IJSG.

10.4.2 Jute Manufactures Development Council

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Tel: +91 33 22172107/2540
Fax: 91 33 2217 2456
E-mail: jmdc@jute.com , jmdcindia@vsnl.com
Branches: Delhi, Hyderabad, Chennai

Jute Manufactures Development Council (JMDC) was created in 1983 by an Act of Parliament to serve as the national agency and to perform functions for promotion of jute and jute products within and outside the country. It is under the administrative control of Ministry of Textiles, GOI. It has a Governing Council with 32 members representing important sectors concerning jute and Secretary (Textiles) as Chairman, which is reconstituted by the Government every two years. Its total non-plan budget is fully funded by appropriation of the Cess collected on jute manufactures through the Ministry of Textiles.

Functions

a) To execute all the functions, JMDC is statutorily responsible under Section 7 of the Jute Manufactures Development Council Act 1983.

b) To create awareness, promote innovative and pro-active market promotion and developmental measures attaching significant importance to eco-friendly and life style attributes of jute.

c) To promote arrangements for better marketing and sale of jute products and to act as deemed Export Promotion Council for jute.

The main functions of JMDC are:

Domestic Market Development

- Promoting arrangements for better marketing and sale of jute.
- Organisation of domestic exhibitions and sales.

- Collaboration with the apex state and central marketing agencies and jointly organising show rooms, exhibitions etc.
- Holding of seminars, workshops and live demonstrations.
- Grant of financial support to jute training institutions.
- Running of promotional offices.

Export Market Development

- Implementation of External Market Assistance (EMA) scheme.
- Providing trade intelligence services to the manufacturers and exporters.
- Partnership in the specialised trade shows and fairs.
- Sponsoring of market exploratory mission.
- Organisation of buyer-seller meets.
- Commissioning of product specific and market specific studies.
- Carrying out of publicity and promotional campaigns. Release of informative brochures / statistics etc.

10.4.3 National Centre for Jute Diversification

Ministry of Textiles, Govt. of India
75 C, Park Street, Unit No.G-2A (Gr. Floor)
Kolkata – 700 016, India
Tel: +91 33 6455-2402 & 6455-2403
Fax: +91 33 2356 1270
E-mail: ncjd@vsnl.com

The National Centre for Jute Diversification (NCJD) is the nodal agency for country-wide promotion of jute diversification activities through commercialisation of technology on manufacture of JDPs. To carry out its mandate NCJD operates 7 different schemes which are basically promotional in nature for entrepreneurship development mainly targeted to small scale entrepreneurs, NGOs, self-help groups, weavers and artisans. All these schemes are fully funded by the Govt. of India.

10.4.4 Jute Corporation of India Ltd.

15N Nellie Sengupta Sarani
Kolkata 700 087, India
Tel: +91 33 2252 6720, 7027,7028
Fax: +91 33 2252 1771/7027
Email: jutecorp@vsnl.net

The Jute Corporation of India Ltd. (JCI) is the nodal agency entrusted with the Minimum Support Price operation in jute so as to ensure that farmers get a remunerative price, price fluctuations in raw jute market are minimal, and the cooperative sector in jute is strengthened.

Functions

- The JCI undertakes purchase of around 7 to 12 percent of the total market produce and price operation undertaken, helps to stabilise the market. JCI tries to procure raw jute in the early part of the season when growers generally tend to dispose off their produce.
- Besides, JCI also operates one outlet, Sonali in Kolkata, for jute diversified products.
- Instability in prices and supply of raw jute has been the single most important factor affecting the jute economy. The direct intervention of JCI through MSP operation is required at times when the market price falls below the support price and thus helps to stabilise the price. The creation of a Buffer Stock, both on intra-seasonal and inter-seasonal basis, maintains stability in prices of raw jute. A scheme for setting up a Buffer Stock was implemented out of stock procured under price support operation during 1985-86 with participation of industry and the cost of maintenance of such stock was equally shared by the Union Government, JMDC and the Industry.

10.4.5 Directorate of Jute Development

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234/4, Acharya Jagadish Chandra Bose Road,
Kolkata – 700 020, India
Tel: +91 33 2247 9337, 9521
Email: djdwboo@hub.nic.in; jute_cal@wb.inc.in

The Directorate of Jute Development plans and formulates the development programmes on JAF crops in the country. After the approval of the development programmes by the Ministry of Agriculture, the same are implemented by the different state governments as well as by different organisations. The Directorate of Jute Development, subsequently, monitors the progress of the implementation of these programmes. After the reorganisation of the Directorate in 1996, the Directorate has been assigned bifocal responsibility: (a) to look after the overall development of the Nodal Crop, i.e. JAF crops, in the country, and (b) to monitor other crop development programmes in the assigned states. Accordingly, now the Directorate performs various activities related to development of JAF crops as nodal crop in the country, and also monitors other crop development programmes in the assigned states, viz. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, West Bengal and Andaman & Nicobar Islands.

Activities for Jute & Allied Fibres

- To assist the Dept. of Agriculture & Cooperation to plan, coordinate and monitor JAF crops development programmes at the national level and recommend measures to improve them.
- To assist the States / Union territories to plan, formulate and implement programmes to increase production and productivity of JAF crops.
- To interact with national and state institutions in planning the production of seed and watch the performance of the newer released varieties of seeds.
- To liaise with State Agricultural Universities and Central Government Institutions for organising training courses in improved production technology.
- To have closer interaction / coordination with the research institutes / centres with a view to benefiting from research and improved production technologies and to assist the Ministry of Agriculture to formulate farmers' friendly scheme with a unified approach for the overall development of the agriculture sector.
- To have close liaison with agencies in the area of agricultural extension for increasing productivity of JAF crops.

- To study and analyse the trends in weather, crop area, production and productivity as well as transport, marketing and prices; and report regularly to Department of Agriculture and Cooperation on weather and crop prospects as well as market and price trends.
- To assist concerned Departments in fixing targets of crop production and suggest measures to achieve them.
- To build up relevant records and data for jute and serve as a Secretariat for the Crop Development Council for JAF crops.

10.4.6 Central Research Institute for Jute & Allied Fibres

Nilgunj, Barrackpore, 24 Parganas (North)
Kolkata 700120, India
Tel: +91 33 2535 8124
Fax: +91 33 2535 0415
Email: crijaf@wb.nic.in

The Central Research Institute for Jute and Allied Fibres (CRIJAF) is one of the premier institutes for research on Jute and Allied Fibres in India.

The Indian Central Jute Committee (ICJC) was formed in 1936 in view of the importance of jute in the economy of the country in general, and eastern India in particular. Subsequently, Jute Agricultural Research Laboratory (JARL) was established in 1938 at Dhaka, now in Bangladesh. After partition of the country, jute research shifted to Chinsura in West Bengal, and then to Barrackpore, and finally established at the present place (Nilganj, Barrackpore) in 1953 as Jute Agricultural Research Institute (JARI). ICJC was taken over by Indian Council of Agricultural Research (ICAR) in 1966. The institute has been rechristened to its present name Central Research Institute for Jute and Allied Fibres in January, 1990.

CRIJAF deals with jute and various important allied fibres. To carry out research work on allied fibres and seed, the institute established the following four research stations at different parts of the country.

1. Ramie Research Station, Sorbhog, Assam
2. Sisal Research Station, Bamrah, Orissa
3. Sunn Hemp Research Station, Pratapgarh, Uttar Pradesh
4. Central Seed Research Station for Jute and Allied Fibres, Budbud, West Bengal

Mandate

a) Improvement of JAF crops like mesta, sunn Hemp, ramie, sisal and flax for yield and quality.

b) Improvement of JAF crops for biotic and abiotic stresses.

c) Development of economically viable and sustainable production technology and cropping systems with JAF crops.

d) Development of proper post-harvest technology for improving the quality of fibre.

e) Transfer of technology and human resource development in relation to JAF crops.

CRIJAF maintains a Gene Bank with 4723 types of germplasms. CRIJAF is assigned with the production of Breeder Seed for jute annually as per the indent of Department of Agriculture & Cooperation, Government of India.

Major Achievements for Jute

1. Eleven *olitorius* and nine *capsularis* jute varieties, three *H. cannabinus* and seven *H. sabdariffa,* were developed / identified and released under different situations.
2. Five wild species of jute have been assessed for their potentialities. *C. pseudo-olitorius* and *C. pseudo-capsularis,* were found to produce very fine fibres.
3. Tissue culture protocol, hardening process and transfer to field condition have been standardised in jute *(C. capsularis L).*
4. An induced phloem fibre lignin deficient mutant of *capsularis* cultivar was registered.
5. Jute based cropping sequences for irrigated and rainfed conditions were identified in terms of wet rice, pulses and oilseeds.
6. The scientific protocol for application of fertiliser (organic + inorganic) and herbicide was developed and validated in the farmers' fields.

7. Sustainable production of jute with the help of combined application of inorganic and organic forms of nutrients was developed.

8. A rice virus named 'Rice Necrosis Mosaic Virus' (RNMV) was utilised directly to increase fibre production in jute and mesta. On-farm trials revealed that the requirement of such energised seeds was 50% less where the production was 30% more than normal standard seed (JRO-524).

9. Large number of fungicides for plant and seed have been identified as effective and are in practice at present.

10. Biofertilisers and botanical pesticides have been developed for jute, and seed treatment with *Trichoderma viride* formulation and its soil application have been successful for controlling root diseases of jute.

11. The various important findings in the field of biotechnology includes (i) six STMS markers in jute developed for the first time, (ii) molecular characterisation of entire genome of a new monopartite begomo virus species associated with newly emerged yellow vein mosaic disease of mesta completed, and (iii) molecular diagnostics for detection of yellow vein mosaic virus developed for adopting disease management strategy.

12. A hand driven, light weight and low cost 4 or 5 row seed drill suitable for jute sowing was developed and found large applicability in farmers' fields. Besides, wheel hoe and scrapper were designed suitable for weed management in jute fields.

13. An improved 'Fibre Extractor' (electric motor / kerosene engine driven) has been developed which helps extraction of good quality fibres of jute, mesta, sunn hemp and ramie.

10.4.7. National Institute of Research on Jute & Allied Fibre Technology

12, Regent Park
Tollygunge, Kolkata – 700 040
Tel: +91 33 2471 1807
Fax: + 91 33 2471 2583
Email: nirjaft@vsnl.net

With a view to improving the quality of jute fibre and technology for manufacturing jute products with competitive nature, this R&D institute was formally established in May, 1938 under the auspices of the Indian Central Jute Committee (ICJC) as Technological Research Laboratories (TRL) and later on named as Jute Technological Research Laboratories (JTRL) when integrated to the Indian Council of Agricultural Research (ICAR) as a constituent unit in 1965. In 1997, the name of the institute was further changed as National Institute of Research on Jute & Allied Fibre Technology (NIRJAFT) in a better compliance of its R&D activities.

Initially the research in the institute was concentrated mainly on technological aspect of jute fibre. After the partition of India in 1947, efforts were initiated to identify the substitute fibres of jute and several natural fibres having potential textile uses like ramie, sisal, pineapple, mesta roselle, banana etc. came into prominence. The institute carried out extensive work on physics, chemistry, biology, technology and engineering aspect of these fibres. Attempts were made to find diversified applications of jute fibre such as usage of waste jute constituting the short, unspinnable fibres for manufacturing nonwoven products. Blending of jute with other natural and synthetic fibres opened a new avenue for producing various diversified jute products with decorative high value yarns. At the same time an integrated approach was adopted by utilising the whole jute plant for making pulp & paper. Studies were also carried out on jute seeds and leaves, which have the potential to be used as a constituent unit as raw material for pharmaceutical industries.

Mandate

- To carry out basic and technological research on jute and allied fibres.
- To promote production of good quality fibres.
- To upgrade the fibre and the product quality.
- To find diversified uses of plant fibres, their agricultural by-products and industrial wastes in large scale and decentralised sectors.
- To act as a repository of scientific and technological information on jute and allied fibres.
- To act as a centre of human resource development in relation to JAF and establish linkages among different scientific and

industrial organisations through exchange of scientific and technological knowledge.

Major Achievements

1. Analysis and characterisation of major fibre constituents such as cellulose, pentosans, lignin, etc, present in JAFs.
2. Studies on fine structure and physical properties of jute and some allied fibres.
3. Development of mixed bacterial culture for accelerated retting process of jute without affecting the fibre properties.
4. Development of special fungal culture in solid carrier for upgrading the barky jute.
5. Development of a Jute Plant Ribboner for extracting green bark from jute stems for facilitating ribbon retting with less volume of water.
6. Evolution of a scientific grading scheme for raw jute which was introduced later by Bureau of Indian Standards (IS:271-1975).
7. Development of 'Caplon' blankets, produced from texturised jute-polypropylene blended yarns, as cheaper substitute of woollen blankets.
8. Development of adhesive-bonded jute nonwovens to be used as decorative, wall coverings, air filtration medium, etc.
9. Development of needle-punched jute nonwovens suitable for floor covering, geo-textiles, etc.
10. Development of chemical treatments for jute for water repellency, rot proofing, wrinkle resistance, flame retardancy and woollenisation.
11. Development of Diversified Jute Products :
    - Particle Board from jute stick
    - Jute-based Composite and Moulded products
    - Different grades of Paper and Board from jute waste / stick
    - Newsprint from whole mesta plant

12. Development of Jute Yarn Hairiness Tester, and Thermal Insulation Value (TIV) Tester.
13. Integrated technology for generation of Biogas from jute caddis and utilisation of its residual slurry for mushroom cultivation.

10.4.8 Indian Jute Industries' Research Association

17, Taratala Road, Kolkata – 700 088, India
Tel: +91 33 2401 0106/2489 4621/2401 4615
Fax: +91 33 2401 4298/4621
Email: director@ijira.org
Regional Centre : Guwahati (Assam)

This private autonomous R&D institute with the name Indian Jute Mills Association Research Institute (IJMARI) was formally established in 1937 as the first cooperative research institute in the field of industrial R&D. Later in 1966, with the patronage and financial support of the Council of Scientific & Industrial Research (CSIR), the institute was renamed as Indian Jute Industries' Research Association (IJIRA) and registered under West Bengal Societies Registration Act of 1961. The services of IJIRA are available to the primary members from the organised sector, associate members from decentralised sector, and certain government agencies. Presently, IJIRA functions and is maintained with the fund comprising of memberships and grant for approved projects provided by the Ministry of Textiles, GOI / other agencies.

With the humble beginning of a testing laboratory in a hired building in 1937, IJIRA had legitimate growth over the years and moved to its current premises in 1952. The institute was opened by the first Prime Minister of India, Jawaharlal Nehru. The institute is equipped with several laboratories having both conventional and modern instruments as well as machinery, a pilot mill, a workshop, and a library.

Mandate

- To encourage innovations, beneficial for the jute industry.
- To transfer newer technologies and products for progress of jute industry.
- To foster education of persons engaged in the jute industry and trade.
- To extend technical support towards standardisation of jute products, setting up of industrial norms, etc.

- To disseminate scientific and technological information relevant for jute sector.
- To offer various technical services for the effective functioning of jute industry.

Major Achievements

1. Development of improved retting process of jute based on malleting the root-ends of green jute plants followed by treatment of the malleted portion with a dilute solution of urea and conventional retting.
2. Development of enzymatic softening of jute for better spinnability.
3. Development of newer techniques of bleaching and dyeing of jute materials for saving of cost, energy and water consumption.
4. Development of process for using rice bran oil (RBO) as alternative to JBO.
5. Development of improved sizing process using bio-modified TKP.
6. Development of process for improved brightening of jute fabric.
7. Development of process for producing water repellent & fire retardant jute fabric.
8. Development of
   - Autoleveller for finisher card for reducing sliver irregularity.
   - Self-rotating bobbin holder for increased winding productivity.
   - Twist regulator for increased spinning productivity.
   - Improved warp tension control for increased weaving productivity.
9. Development of the following Jute Testing Instruments :
   - Electronic Moisture Meter
   - Sliver Irregularity Tester
   - Yarn Evenness Tester & Slub Counter (photoelectric)
   - Electronic Yarn Strength Tester (computer-controlled)
   - Cover Factor Tester
   - Brightness Tester
   - Fibre Bundle Strength Tester
   - Fibre Shedding Tester
   - Impact Tester for Card & Gill Pins
10. Development of hydrocarbon-free jute bag for packing cocoa, coffee, etc.
11. Development of value-added jute-based yarns & fabrics for diversified end-uses.
12. Development of jute geotextiles (woven) for controlling soil erosion, stabilisation of rural road, embankment, mine spoils, etc., consolidation of soft soil, mulching, etc.
13. Development of jute reinforced composite products as substitute of wood / plywood.
14. Development of technique of machine auditing.
15. Development of technique of inter-firm comparison on productivity.
16. Development of technique for reducing thermal & electrical energy consumptions.
17. Development of quality Statistics of jute yarn for Export.

10.4.9. Institute of Jute Technology

35, Ballygunge Circular Road, Ballygunge, Kolkata– 700 019, India
Tel:+91 33 2461 5632/ 2461 5444
Fax: +9133 2461 5632
Email: ijt@cal2.vsnl.net.in

The Institute of Jute Technology (IJT) was established in 1947 and jointly founded by the University of Calcutta and Indian Jute Mills' Association. IJT, a registered academic institution under West Bengal Societies Registration Act 1961, is the only educational institution of its kind imparting teaching exclusively on jute in India. It is affiliated with the University of Calcutta and All India Council for Technical Education, Govt. of India. The Institute is receiving grant-in-aid from Jute Manufactures Development Council (JMDC).

IJT teaches Jute & Fibre Technology at graduate and post-graduate level, undertakes consultancy assignments and guides research. It has been rendering services since its inception in human resource development both for the organised and decentralised sectors of jute industry in India.

Mandate

- To impart knowledge of Jute technology through course of instruction and promote research and other scientific work connected with jute trades and industries allied with or accessory thereto in all branches of the engineering and technology pertaining to jute fibres, jute fabric, jute finished fabrics and other products using 100% jute and jute blended fabrics; to establish and maintain laboratories, workshops and conduct experiments therein; and
- To prepare students for examination leading to award of degrees, diplomas, certificates and other academic distinctions of the University of Calcutta, West Bengal State Council of Technical Education, All India Council of Technical Education and other academic authorities.

HRD Activities

1. IJT conducts the following degree courses of the University of Calcutta
   (a) B. Tech. in Jute Technology
   (b) B. Tech. in Jute & Fibre Technology
   (c) M. Tech. in Technical Textiles
2. IJT offers short-term certificate courses for Junior Level Supervisors and also some tailor-made training programmes as per the requirement of the jute mills / decentralised units.

10.4.10 Indian Jute Mills Association

6, Netaji Subhas Road, Kolkata – 700001, India
Tel : +91 33 2230 9918 / 0742
Fax : +91 33 2230 5643
Email : ijma@cal2.vsnl.net.in
Website : www.jute-ijma.org

The Indian Jute Mills Association (IJMA) was established in 1884 by a group of British jute mill owners. The founder members created IJMA to serve the jute mills' growing needs based on commercial practices, market economics, continuous technological improvement of the mills and newer product development for the market. In 1931, IJMA was registered under the Indian Trade Union Act, 1926 and in 1989 it was incorporated under the Companies Act, 1956.

In India, IJMA took pioneering effort to establish, in 1937, Indian Jute Mills Association Research Institute (IJMARI) as the first autonomous cooperative research institute in the field of industrial R&D, which was later renamed, in 1966, as Indian Jute Industries' Research Association (IJIRA). Besides, IJMA felt the need of HRD for progress of the jute industry and thus established, in 1947, the Institute of Jute Technology (IJT) in collaboration with the University of Calcutta.

IJMA, being the body of the members of the Indian jute industry, is well represented in all government organisations / committees of India concerned with jute; IJIRA Council of Management; IJT Governing Body, and other agencies for jute and is being considered everywhere as the voice of the Indian jute industry.

Objectives

- To organise and unite all those engaged in jute industry for establishment and maintenance of cooperation amongst them for the progress of Indian jute industry.
- To ensure economic progress of the Members of the Association.
- To ensure technological progress of the Member mills by way of technology and product development and also continuing HRD programme for the jute industry.

Functions

- Protection, to the extent possible, of the interests of the Member mills in the matter of uninterrupted mill operation, trade and marketing, raw jute procurement, negotiation with labour unions, govt. support towards industry, technological improvement, publicity, etc.
- Maintenance of effective liaison with the Central and State Governments to protect the business interests of the Members of the Association.

- Rendering of service to members in all matters relating to efficient running of the mills, market research, trade promotion, public relations, etc.
- Continuous interaction with IJIRA and other R&D organisations for offering purposeful direction and assistance towards transfer of improved technologies to the Member mills and development of newer jute products;
- Information dissemination and counseling in matters such as human resource management and labour relations, raw material procurement and stores, marketing statistics, export and domestic trade enquiries, costing, R&D, HRD, etc.
- Promotion of jute industry by arranging participation of jute industry in various domestic and international fairs / exhibitions and also in trade delegations from India for jute; and also receiving the visiting foreign delegations in India.

10.4.11 The Jute Balers' Association

12, Indian Exchange Place,
Kolkata - 700001, India.
Tel: +91 33 2220 2805,
Fax: +91 33 2220 1491

The Jute Balers' Association (JBA) was established in 1909 as an organisation to look after the interests of the traders engaged in the raw jute marketing and hence enjoyed the membership of all such traders at that time. Before 1947, JBA had been instrumental, through promotional programmes, to enhance jute cultivation in India, while later it had helped in creating secondary raw jute market in different Indian districts by encouraging the installation of baling press and construction of godowns for raw jute storage. For the benefit of the members, JBA used to publish a journal containing various information on jute agriculture and trade. Since1950, JBA started operation from their own building at Kolkata.

Since1970s, JBA has been helping the Agricultural Price Commission, Govt. of India, towards determining the Minimum Support Price for raw jute. Since 1987, the JBA-published raw jute price structure is being considered for fixing the price of B-Twill bag being purchased by the Govt.

At present, about 200 numbers of raw jute traders are members of the Association.

Objectives

- To organise and unite all those engaged in raw jute trading for establishment and maintenance of cooperation amongst them for increasing benefits;
- To ensure economic progress of the Members of the Association and also to help them in tackling any problem related to raw jute trading.
- To make the Association members aware of improved raw jute cultivation.
- To help the members to be aware, much before the actual harvesting of the probable quantum of raw jute production of every year.

Functions

- Protection of the interests of the raw jute traders in the matter of raw jute procurement, marketing, govt. support towards jute cultivation, technological improvement, publicity, etc.
- Maintenance of effective liaison with the Central and State Governments to protect the business interests of the Members of the Association.
- Publication of quotations for raw jute price on daily basis for the benefit of all concerned with raw jute market, insurance / financial institutions.
- Publication of Crop Survey Report, much prior to harvesting period, for helping the JBA members to become aware about the quantum of raw jute likely to be produced after harvesting in each and every jute season.
- Rendering of services to members in all matters relating to raw jute cultivation, market research, trade promotion, publicity, etc.

10.5 Myanmar

10.5.1 Myanma Jute Industries

Ministry of Agriculture & Irrigation
The Union of Myanmar
Tel: +951 666006, 666056
Fax: +951 666091
Email: mji@myanmar.com.mm

Myanmar is an agricultural country, jute and jute products play an important role in the economy. Planned production of raw jute started simultaneously with the setting up of a jute mill, in Yangon, in 1995, primarily for jute bags and hessian. The production of other jute by-products was also brought into focus. Since then the production of raw jute has considerably increased and Myanmar from the position of an importer of jute (till 1968), has become a sizable exporter of raw jute.

Jute production, purchasing and all Jute Grading & Baling Factories with the exception of the Jute Mill under the Textile Industries Corporation (TIC) were all under the responsibilities of the Agriculture Corporation until 1977. Subsequently, all jute purchasing and all jute Grading & Baling Factories were transferred to TIC under the Ministry of Industry. At that time Jute Products Division was under TIC. In 1984 Jute Industries Corporation became a separate entity under the Ministry of Industry and renamed as Myanma Jute Industries (MJI) in 1989.

Functions

The functions of Myanma Jute Industries (MJI) are as follows :

- Provision of technical supply and other necessary assistance to jute farmers in order to boost crop production.
- Procurement of jute for export and local mills consumption.
- Establish jute grading and baling factories.
- Production of jute products at Jute Mills and Jute Carpet Products Factory for local and foreign markets.

The Managing Director of MJI oversees the tasks of above mentioned functions with the assistance of 6 General Managers who are responsible to manage each Divisions, namely, Jute Cultivation and Purchasing, Planning, Production, Marketing, Finance and Administration. Functions of the six jute zones and mills and factories are also supervised by each

General Manager. There are altogether six separate jute zones under MJI. Yangon Division is directly supervised by Head Office.

10.6 Nepal

10.6.1 Nepal Jute Mills Association

Golchha House
Main Road, Biratnagar
P O Box No. 25, Nepal
Tel: +977 215256 27, 528673,
Fax: +977 21524395, Cell: +977 9852020007
Email: rkg@golchha.com; swastik@cworld.com.np
brt@golchha.com; sanjay@golchha.com

Nepal Jute Mills Association (NJMA) was established in 2000.

Industrialisation in Nepal started with the establishment of Biratnagar Jute Mills Ltd. (BJML) in 1936. The contributing factors, at that time, were the easy availability of raw jute, the inclination of farmers towards jute cultivation, availability of abundant labour and low power cost.

The healthy economic performance and growth of BJML, for more than five decades, helped encourage the private sector to establish jute mills in Nepal. There are, at present, eleven jute mills in Nepal, out of which three have closed down while the rest are still running. Major jute products manufactured by these mills are hessian, sacking and twine.

10.7 Pakistan

10.7.1 The Pakistan Jute Mills Association

PJMA House, Plot # 18 D-E II
Gulberg III, Lahore – 54660
Pakistan
Tel: +92 42 5715447-8,
Fax: +92 42 5715475
E-mail: secretary@pjma.com.pk; info@pjma.com.pk

The Pakistan Jute Mills Association PJMA was established to serve as the industry association body for promotion of jute & jute products of private

owned jute mills / industries within and outside the country through research, innovative experimentation and modernisation approach towards product development. It was also aimed at providing guidelines to the buyers in establishing L/C, shipment of goods, product specification, quantity, shipment time, destination etc.

As jute products have always been the natural choice for packaging food grains, such as wheat and rice, the jute industry is playing a very important role in the agriculture and economic sector of Pakistan. At present PJMA represents 9 Member mills situated in and around Karachi, Lahore, Rawalpindi and Multan Cantonment. The member mills provide direct employment to over 25,000 and indirect support to 100,000 people.

The members of PJMA have started exporting their products and have been able to establish themselves as suppliers in Iran, Egypt, Sudan, United Kingdom and UAE. Exports to many other countries in Asia, Africa and Europe are in the process and PJMA hope to make significant inroads in these markets shortly.

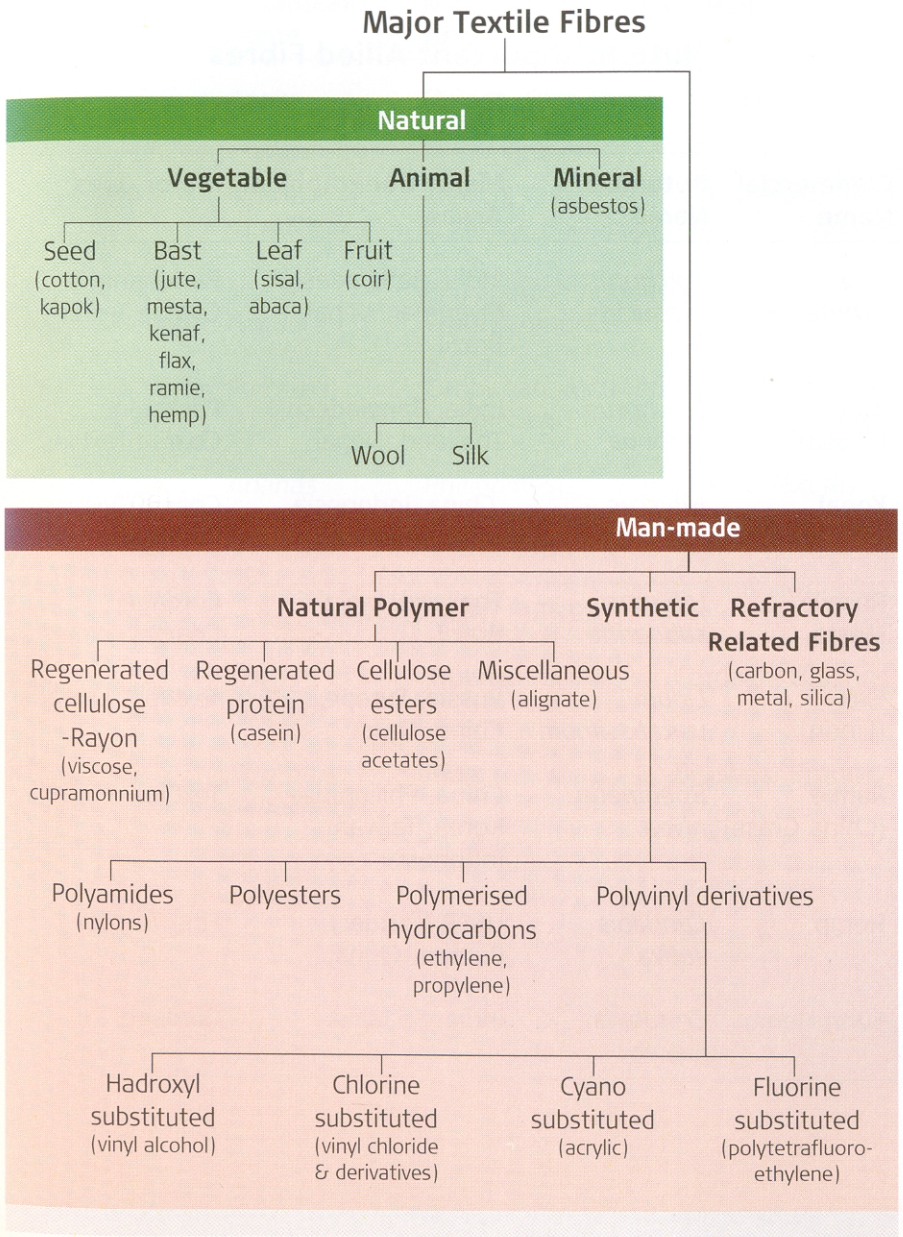
The major products manufactured by the member mills of PJMA are hessian, sacking and some other products like yarns, ropes / twines, Carpet Backing Cloth (CBC) etc.

JUTE
basics

Appendices



Appendix-A


Major Textile Fibres
Natural
Vegetable
Animal
Mineral
(asbestos)
Seed
(cotton, kapok)
Bast
(jute, mesta, kenaf, flax, ramie, hemp)
Leaf
(sisal, abaca)
Fruit
(coir)
Wool
Silk
Man-made
Natural Polymer
Synthetic
Refractory Related Fibres
(carbon, glass, metal, silica)
Regenerated cellulose -Rayon
(viscose, cupramonnium)
Regenerated protein
(casein)
Cellulose esters
(cellulose acetates)
Miscellaneous
(alignate)
Polyamides
(nylons)
Polyesters
Polymerised hydrocarbons
(ethylene, propylene)
Polyvinyl derivatives
Hadroxyl substituted
(vinyl alcohol)
Chlorine substituted
(vinyl chloride & derivatives)
Cyano substituted
(acrylic)
Fluorine substituted
(polytetrafluoro-ethylene)

Appendix-B

Jute & Important Allied Fibres

SOFT (BAST) FIBRES

Commercial Name	Botanical Name	Major Geographical Areas	Major uses
Jute (White)	*Corchorus capsularis*	India, Bangladesh, Myanmar, Nepal, Brazil	Packaging, Coarse Textiles
Jute (Tossa)	*Corchorus olitorius*	India, Bangladesh Thailand, Nepal	Packaging, Coarse Textiles
Kenaf	*Hibiscus cannabinus*	China, Indonesia, USA, Australia	Coarse Textiles, Packaging
Roselle/ Mesta	*Hibiscus sabdariffa*	Thailand, India, Brazil	Cordage, Coarse Textiles
Flax (Linen)	*Linum usitatissimum*	Russia, Europe, China, Egypt	Textiles, Threads
Ramie (China Grass)	*Boehmeria nivea*	China, Philippines Korea, Taiwan Indonesia	Textiles, Threads
Hemp	*Cannabis sativa*	USSR (former), Europe, China,	Fine Textiles
Sunn Hemp	*Crotalaria juncea*	India, Sri lanka	Cordage

HARD (LEAF) FIBRES

Commercial Name	Botanical Name	Major Geographical Areas	Major uses
Sisal	*Agave sisalana*	Mexico, East Africa, Brazil, India	Cordage
Hanequen	*Agave fourcroydes*	Mexico, Cuba, E. Africa, Philippines	Cordage, Coarse Textiles
Abaca (Manila Hemp)	*Musa Textilis*	Philippines, Indonesia Central America	Cordage
Mauritius Hemp (Green Aloe)	*Furcraea gigantea var.*	Caribbean, Mauritius, S. America	Cordage, Coarse Textiles
Pineapple Fibre	*Ananas comosus*	Philippines, West Indies, India	Fine Textiles

HARD (PALM) FIBRES

Coir	*Cocos nucifera*	Tropics	Cordage, Brushes
Palmyra (Palm leaf/ Stem fibre)	*Borassus flabellifer L.*	India	Brushes, Brooms

Appendix-C

I. Jute Grading Systems of India (IS:271-1975)

Table 1. Fibre Characteristics and Scoring Scheme for Different Grades of White Jute *(Corchorus capsularis)*

Grade	Strength	Defects	Maximum root content (% mass/ wt.)	Colour	Fineness	Density	Total score
W1	Very good (25)	Free from major and minor defects (25)	5 (20)	Very good (10)	Very fine (15)	Heavy bodied (5)	(100)
W2	Good (20)	Free from major and defects (25)	8 (18)	Good (9)	Fine (2)	Heavy bodied (2)	(85)
W3	Fairly good (18)	Free from major defects except some loose leaf and a few specks (18)	20 (24)	Fairly food (7)	Fibres well separated (1)	Medium bodied (1)	(69)
W4	Fairly average (14)	Free from major defects and substantially free from specks & loose sticks (14)	26 (20)	Fairly Average (4)	Fibres well separated (1)	Medium bodied (1)	(54)
W5	Average (10)	Free from major defects (10)	36 (16)	Average (3)	-	-	(39)
W6	Average (10)	Free from centre root and dazed/over retted fibre and reasonably free from entangled stick (4)	46 (12)	-	-	-	(26)
W7	Weak mixed (3)	-	57 (9)	-	-	-	(12)
W8	Entangled or any other jute not suitable for any of the above grades but of commercial value						

Note :
1. Figures in parenthesis indicate score mark.
2. The minimum reed length should be 150 cm or the effective reed length should not be less than 100 cm except for TD8.
3. Jute should be in dry storable condition.
4. Jute should be free from Hunka, mud and other foreign materials.
5. Natural dust may be allowed in grades TD3 to TD8 with proportionate discount.
6. Root content will include hard barky croppy ends.
7. A parcel of jute which would not secure full marks for a particular grade shall still be considered for that grade with suitable discount to be settled between the buyer and seller provided its score is not less by 50 (or more) precent of the difference, between the maximum scores for that and next lower grade. When the score is less by 50 (or more) percent of the difference, the buyer will have option to reject or settle with a suitable discount. Scores on the table may be taken as guidance for determining the discount.
8. For instrumental determination of various characteristics like strength, defects, root - content, fineness, bulk density, etc. relevant part of IS : 7032 may be consulted.

Table 2. Fibre Characteristics and Scoring Scheme for Different Grades of Tossa Jute *(Corchorus olitorius)*

Grade	Strength	Defects	Maximum root content (% mass/ wt.)	Colour	Fineness	Density	Total score
TDI	Very Good (26)	Free from major and minor defects (22)	3 (33)	Very good (12)	Very fine (5)	Heavy bodied (2)	(100)
TD2	Good (24)	Free from major and minor defects (20)	10 (28)	Good (9)	Fine (2)	Heavy. bodied (2)	(85)
TD3	Fairly good (18)	Free from major & minor defects except some loose leaf and a few specks (18)	15 (24)	Fairly good (7)	Fibres separated (1)	Medium bodied (1)	(69)
TD4	Fairly aveage (14)	Free from major defects and substantially free froom specks and loose sticks (14)	20 (20)	Fairly average (4)	Fibres well separated (1)	Medium bodied (1)	(54)
TD5	Average (10)	Free from major defects (10)	26 (16)	Average (3)	-	-	(39)
TD6	Average (10)	Free from root dazed / over retted fibre, reasonably free from entagled sticks (4)	35 (12)	-	-	-	(26)
TD7	Weak mixed (4)	-	42 (9)	-	-	-	(13)
TD8	Entangled or any jute not suitable for any of the above grades but of commercial value.						

Note :

1. Figures in parenthesis indicate score marks.
2. The minimum reed length should be 150 cm or the effective reed length should not be less than 100 cm except for W8.
3. Jute should be in dry storable condition.
4. Jute should be free from Hunka, mud and other foreign materials.
5. Natural dust may be allowed in grades W3 to W8 with proportionate discount.
6. Root content will include hard barky croppy ends.
7. A parcel of jute which would not secure full marks for a particular grade shall still be considered for that grade with suitable discount to be settled between the buyer and seller, provided its score is not less by 50 (or more) precent of the difference, between the maximum scores for that and next lower grade. When the score is less by 50 (or more) percent of the difference, the buyer will have option to reject or settle with suitable discount. Scores on the table may be taken as guidance for determining the discount.
8. For instrumental determination of various characteristics like strength, defects, root - content, fineness, bulk density, etc. relevant part of IS : 7032 may be consulted.

II. Jute Grading Systems of Bangladesh

A. Pucca Grading System or Export Grades of Long jute

WHITE JUTE *(Corchorus capsularis)*

Grade	Definition	Abbreviation
BANGLA WHITE Special	White/creamy white jute of finest texture. Very strong and very good lustre. Completely free from any defect. Clean cut and well hackled and entirely free from red ends.	BW-Special
BANGLA WHITE A	White to light cream. Jute of fine texture, strong and very good lustre. Completely free from any blemish. Clean cut, well hackled and entirely free from red ends.	BWA
BANGLA WHITE B	Light cream to straw colour. Jute of good texture, strong and good lustre, free from blemish. Clean cut and well hackled, red ends excluded.	BWB
BANGLA WHITE C	Light grey/light reddish to straw colour. Clean jute of sound strength and average lustre. Free from hard specks and croppy or hard gummy tops. Well hackled, free from black roots, red soft ends permissible.	BWC
BANGLA WHITE D	Any colour, average strength, occasional bark and specks, permissible, slightly croppy and gummy tops permissible. Well cut on the hard and hackled. Red ends permissible.	BWD
BANGLA WHITE E	Any colour. Any strength but free from perished fibre. Free from any unretted jute and stick but bark and hard centre permissible. Rough cut on the hard end hackled.	BWE

TOSSA JUTE *(Corchorus olitorius)*

Grade	Definition	Abbreviation
BANGLA TOSSA Special	Uniform colour golden/red. Tossa of finest texture.Very strong and very good lustre. Completely free from any defect, clean cut and well hackled.	BT-Special
BANGLA TOSSA A	(a) Uniform colour, silver grey to golden. Tossa of fine texture, strong and good lustre. Completely free from any blemish. Clean cut and well hackled. (b) Uniform colour, light golden to reddish. Tossa of fine texture, strong and of good lustre. Completely free from any blemish. Clean cut and well hackled.	BTA
BANGLA TOSSA B	(a) Light to medium grey / copperish grey. Clean sound fibre of good texture and of good average lustre. Free from blemish. Clean cut and well hackled. (b) Light grey / reddish excluding dark grey. Clean sound fibre of good texture and of good average lustre. Free from blemish. Clean cut and well hackled.	BTB
BANGLA TOSSA C	Mixed colour. Average strength, occasional bark and soft speck, but free from runners. Slightly croppy gummy tops permissible. Free from black wiry tops. Well cut and hackled and free from black root ends.	BTC
BANGLA TOSSA D	Mixed colour. Average strength, occasional bark specks but free from runners. Croppy and gummy tops permissible. Rough cut and hackled. But free from black root ends.	BTD
BANGLA TOSSA E	Any colour. Average strength but free from perished fibre. Free from unretted jute and stick but bark and hard centre permissible. Rough cut and hackled.	BTE

More classifications are now being adopted in the lower grade of jute.

B. Kutcha Grading System & Its Relationship to Pucca Grades

Kutcha/ Raw Grade	Fibre characteristic	Fibre colours		Percentage of cuttings (max)		Pucca Grade
		White	Tossa	White	Tossa	
Top	Very strong, creamy white, excellent lustre, free from any defects and clean	Bright white/ creamy white	Golden/ reddish golden	15	10	Special
Middle	Very strong, good lustre, creamy and free from defects	Light creamy white/ creamy	Light golden/ reddish golden to brownish	20	15	A
B-Bottom	Strong, good lustre, free from defects & average light fibre	Light grey/ light grey to straw colour	Reddish/ grey/ copper colour	25	20	B
C-Bottom	Average strong, long white fibres	Any colour	Any colour	30	25	C
X-Bottom	Colourless, long, light grey and may be infected with dust	Any colour	Any colour	40	30	D
SMR	Very low fibre, pale & weak, colourless and may be infected with diseases with full of dust	Any colour	Any colour	plenty	plenty	E

JUTE
basics

Glossary



A

accession

An accession is a plant or a group of similar plants received from a single source at a single time. Each accession is assigned a unique accession number by the Gene Bank maintaining it.

alluvial soil

Alluvium is soil or sediments deposited by a river or other running water. Alluvium is typically made up of a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel.

amorphous

The three-dimensional arrangement of chain molecules within a fibre structure when the molecules are randomly curled and interwined; such areas are having zero order, much open space, and less denser than crystalline regions.

Angstrom

The unit of length, being used generally at the atomic / molecular level.

$1Å = 10^{-8}$ cm = 10^{-4} μm (micron) = 0.1 nm.

assortment

The process of selection and classification of raw jute according to fibre characteristics prior to packing or baling.

ASTM

Acronym for the American Society for Testing and Materials; most textile standards in ASTM are developed by the Committee D-13.

ATPR

The shuttleless loom in which the weft is inserted in the warp shed with the help of air through a tunnel formed by a pair of hollow pipes

Axminster carpet

A machine-woven carpet, with cut pile, in which successive weft-wise rows of pile are inserted during weaving in a pre-arranged colour sequence. Such carpets are often made with jute or cotton yarns as warp and woolen or worsted yarns as weft and heavy piles.

B

bale (kutcha)

A package of raw jute consists of various morahs, usually weighing 130 kg to 150 kg and sometimes only 55 kg. It is bound with jute ropes.

bale (pucca)

Hydraulically pressed bale of raw jute, usually bound with jute ropes. Its standard size is (120 x 45 x 50) cm having net weight of 180 kg.

bast fibres

The class of fibres derived from the bark (phloem) of plants such as jute, flax and ramie (Appendix B).

batch

A quantity of raw jute selected from various assortments to produce yarn of desired type of quality.

batching

The process of selecting and mixing of jute fibres into batches.

beaming

Winding of warp yarns on the warp beam with or without size.

bioactivity

It refers to pharmacological or biological activity as an expression describing the beneficial or adverse effects of a drug on living matter.

biofertilisers

Naturally occurring organic substances applied to soil for the purpose of maintaining or improving fertility. They include animal manures, composts, nitrogen fixing bacteria, fungi, algae etc.

biological efficiency

It refers to biological product assimilation or productivity as a function of time.

biological oxygen demand (BOD)

A measure of water quality by way of estimating the amount of oxygen needed to oxidise reducing materials (organic pollutants) in a water sample by biological means.

blending (spinning)

The process concerns primarily with efficient mixing of various lots of fibres to produce a homogeneous mass. Blending is normally carried out to mix fibres, which may or may not be of different physical properties, market values, or colour. Blending is also used to insure consistency of the end products.

boiler fuel

An energy source to produce heat that is transferred to the boiler vessel in order to generate steam or hot water. Fossil fuel is the primary energy source used to produce heat for boilers.

braid

A narrow tubular or flat fabric produced by interlacing three or more threads in such a way that they cross one another in diagonal formation.

branding

The printing of manufacture's name and logo, type of content, etc. on the surface of the packages / bags/ sacks etc.

breaking extension

The extension at the breaking load.

breaking length

The length of a yarn whose weight is equal to the breaking load.

breaking load

The maximum load or force supported by a specimen in a tensile test carried to rupture. It is commonly expressed in gram or kilogram or Newton.

breeding

Plant breeding is the art and science of changing the genetics of plants in search of improved trait(s) for the benefit of humankind and can be accomplished through many different techniques ranging from simply selecting plants with desirable characteristics for propagation, to more complex molecular techniques.

bulk yarn

A yarn having greater covering power, or apparent volume, than a conventional yarn of equal linear density and of the same basic material with normal twist.

burlap

The other name of jute Hessian fabric.

C

cabled yarn

Two or more plied yarns twisted together in one or more operations.

caddis

The short jute fibre droppings from different processing machines.

cambium

In botany the cambium is a layer or layers of tissue, also known as lateral meristems that are the source of cells for secondary growth.

canvas

A compact, firm, heavy, plain-weave fabric; also called as duck.

carding

An operation which opens and cleans the fibres, separates the individual fibres (in case of jute, by breaking the meshy structure of jute reeds), intermixes the fibres, and delivers them in sliver form or as a carded web.

cell wall

The thick material, comprising of cellulosic and non-cellulosic chain molecules, in ultimate cells of the natural cellulosic fibres. It is the main load-bearing region of fibres. It has a lamellar growth pattern.

cheese

A cylindrical package of yarn, cross-wound on to a flangeless support.

chemical oxygen demand (COD)

A measure of water quality by way of estimating the amount of potassium dichromate needed to oxidise reducing materials (organic pollutants) in a water sample.

chenille yarn

A yarn consisting of a cut pile which may be of one or more of a variety of fibres helically disposed around axial threads which secure it. Chenille yarns are basically fancy yarns and traditionally used in the manufacturing of furnishing fabrics and as decorative threads in many types of broad and narrow fabrics.

CO_2 assimilation power

The rate for conversion of nutrients into living tissue through an act or process of assimilation; constructive metabolism in plants.

colourfastness

The ability of a yarn or fabric to retain its original colour throughout its normal life span.

combing

A process by which short staple fibres are removed to the extent as desired in order to spin a finer yarn with improved regularity.

cop

A form of self-supporting cylindrical hollow package of yarn tapered at one end, used in shuttle to supply weft yarns in the woven fabric structure.

cord yarn

Yarn composed of two or more plied yarns twisted together.

cordage

Any product, regardless of size, made by twisting or braiding textile yarns, which is generally round in cross-section and capable of sustaining loads.

core-spun yarn

Yarn consisting of a yarn or filament as a core surrounded by staple fibres.

count

The common term indicating linear density of yarn, expressed as mass per unit length (direct system) or as length per unit mass (indirect system).

creel

A rigid metallic structure used for holding a large number of yarn spools capable of easy unwinding as required for yarn beam preparation.

crepe yarn

A filament yarn having 1800 to 3000 twists per metre, either in single or ply, and used for making crepe fabrics.

crocking

The transference of colour by a rubbing action.

cropping pattern and cropping system

Cropping pattern is the yearly sequence and spatial arrangement of crops and fallow on a given area, and the cropping system is the cropping pattern used on a farm and its interactions with farm resources, other farm enterprises, and available technology which determine their makeup.

crystalline

The three-dimensional arrangement of chain molecules within a fibre structure when the chain molecules are very closely packed with distances between the atoms or molecules being repeated perfectly in all the three directions; such areas are having perfect order, high strength, and much denser than amorphous regions.

cuttings

Hard and barky portions of raw jute strands which are cut-off before carding operation.

D

decortication

The separation of woody, pithy matter from bast fibres by mechanical means.

defoliation

It is a natural process of shedding of leaves after harvest of the crop in case of jute.

degree of polymerization (dp)

The number of monomer units occurring in an average polymeric unit.

denier

Weight in gram of 9000 metre in length of fibre or yarn.

denim

A twill fabric made of hard-twist warp yarns, dyed traditionally with blue, and undyed wefts, commonly used for jeans.

desizing

The process of removing the sizing materials from textiles.

dicotyledons

Dicotyledons or dicots is a name for a group of flowering plants whose seed typically has two embryonic leaves or cotyledons.

dimensional stability

The extent to which a fibre, yarn, or fabric retains its shape and size after being subjected to different external stresses during use and maintenance.

doffer

The pinned roller which takes out fibres from the cylinder in a card.

doffing

The operation of product removal from any textile machine (e.g. removal of bobbins, after being full with yarn, from the spinning machine).

doubling

A process in which a number of jute slivers fed simultaneously as input into a machine for drafting and delivered as a single sliver as output. By this process, the irregularity of input slivers gets reduced.

draft

The amount of attenuation of textile material at different stages of spinning preparatory and spinning process; for example, 1 m of input material when delivered as 5 m is said to have undergone a draft of 5.

drafting

The process of reducing the bulk and weight per unit length of sliver and simultaneously parallelising its fibrous components, as it passes through the various machines used in making yarn.

drape

The way a fabric hangs or falls.

drawing

Operations, preparatory to spinning, by which slivers are attenuated progressively, leveled, doubled, or blended. This operation improves the fibre parallelisation.

DREF

A high speed open-end spinning process for producing coarser yarns without or with a core filament and also blended yarns with preferential disposition of different component fibres across the yarn cross-section.

dressing

A process of treating jute warp yarns with size prior to weaving.

E

elasticity

The property of a material by which it recovers its original form immediately after removal of the external stress causing deformation. Any material possessing such property is called 'elastic' material (e.g. metals, rubbers).

elongation

The deformation in the direction of load caused by a tensile force.

emulsion (for jute)

An emulsion, prepared with water, oil (JBO / RBO) and an emulsifier, is applied on jute fibres for softening and lubrication prior to mechanical processing.

end

See warp.

evenness

The uniformity of any textile material in terms of thickness or diameter or weight per unit length.

extension

The elongation expressed as a percentage of the initial length.

F

family

The usual major subdivision of an order or sub-order in the classification of plants and animals.

see Taxonomic Tree (Fig.2.1).

fancy yarn

A yarn that differs from the normal construction of single and folded yarns by way of deliberately produced irregularities in its construction. These irregularities relate to an increased input of one or more of its components, or to the inclusion of periodic effects, such as loops, curls, slubs, or the like. Example: bouclé yarn, chenille yarn, etc.

farm yard manure

This is the traditional manure and is almost readily available to the farmers as farm yard manure as a decomposed mixture of cattle dung and urine with straw and litter used as bedding material, and residues from the fodder fed to the cattle.

felt

A nonwoven fabric in which the fibres develop a tight bond through mechanically imposed entanglement and will not ravel.

fibre

An entity, natural or manmade, that serves as the basic element, or 'building block', of yarns, fabrics and other textile structures. Most fibres are characterised by having a length at least 100 times their diameter.

filling

Weft yarn in a fabric.

flexural rigidity

The resistance to flexural deformation.

fly

Waste fibres which fly out into the atmosphere during mechanical or other processing.

G

gene bank

Gene bank is a means of preserving genetic material. In plants, this could be freezing cuts from the plants or the seeds themselves. In an effort to conserve agricultural biodiversity, gene banks are used to store and conserve the plant genetic resources of major crop plants and their wild relatives over the years.

gene / genetics / genome

A gene is the basic unit of heredity in a living organism. All living things depend on genes. Genes hold the information to build and maintain their cells and pass genetic traits to offspring. In general terms, a gene is a segment of nucleic acid (DNA) that, taken as a whole, specifies a trait. The notion of a gene has evolved with the science of genetics. The genome of an organism is a complete genetic sequence on one set of chromosomes.

genus

The usual major subdivision of a family or sub-family in the classification of plants and animals, usually consisting of more than one species.

see Taxonomic Tree (Fig.2.1).

geo-textile

Any permeable textile material used for filtration, drainage, separation, reinforcement, soil consolidation and stabilisation purposes as an integral part of civil engineering structures.

germplasm

The genotypes that constitute a species.

gilling

A system of drawing in which the movement of fibres relative to one another in a sliver is controlled by gill-pins as in case of jute drawing machines.

grading of jute

Jute fibre quality is classified into different grades depending on a 'hand-and-eye' method of assessment of its strength, defects, root content, colour, fineness and bulk density. For a specified yarn / fabric quality, a particular grade or a combination of two / three grades of jute fibres is used for ensuring the product quality as well as the productivity (Appendix C).

grist

Grist (basically, linear density), expressed as lb/spyndle, of jute yarns is the weight in pounds of 14,400 yards of yarn length. It is the most commonly used term for expressing the coarseness or fineness of jute yarn.

H

hand (handle)

The quality of a fabric or yarn assessed by the reaction obtained from the sense of touch. It is concerned with the judgment of roughness, harshness, pliability, thickness, etc.

hand-and-eye method

A subjective method employed for grading of raw jute in which strength and bulk density are assessed by 'hand' while colour, fineness, defects and root content are assessed by 'eye' i.e. visual observation.

hank

A yarn or twine of a particular length in coiled form. Commonly, the hank is the traditional unit of length in the indirect system of yarn count, e.g., the cotton count of a yarn is calculated as the number of hanks of 840 yd per pound.

hard fibres

These are nothing but leaf fibres and also coir and palmyra fibres (Appendix B).

hard twist

Yarn having more twist than normal.

hard waste

Yarn or fabric waste produced during spinning, weaving preparatory and weaving processes.

harvest index

It is a measurement of crop yield: the weight of a harvested marketable product as a percentage of the total plant weight of the crop.

hectare

A unit of area, generally used for measuring land.

1 hectare = 10,000 sqm = 2,471 acres

hessian

A single warp plain weave jute fabric manufactured in various widths and weights up to a maximum of 500 gsm.

humidity, absolute

Concentration (density) of water vapour in the atmosphere expressed as weight per unit volume or weight per unit weight of (i) dry air or (ii) water vapour and air.

humidity, relative

Ratio of actual pressure of existing water vapour to maximum possible pressure of water vapour (saturated vapour pressure) in the atmosphere at the same temperature, expressed as percentage.

hydrophilic

Water loving; having a high affinity for moisture by either absorption or adsorption.

hydrophobic

Water fearing or hating; having a low degree of moisture absorption or attraction.

I

Index Kewensis

Index Kewensis (IK), maintained by the Royal Botanical Gardens, is a publication that aims to register all botanical names for seed plants at the rank of species and genera. It also includes names of taxonomic families and ranks below that of species.

initial modulus

The ratio of stress to strain within elastic limit during tensile deformation.

J

Jacquard

An attachment, named after the inventor : Joseph Marie Jacquard (1752 – 1834), for producing large, woven designs according to a pattern punched on a endless chain of cards.

Jak

It refers to jute plant bundles which are loaded down in water for decomposition during the natural process of retting.

jute batching oil (JBO)

Light mineral oil, transparent and colourless, composed mainly of alkanes and cyclic paraffins, obtained as by-product from the distillation of petroleum crude oil is used in textile industries especially in processing jute.

K

knot

A process of joining two broken pieces of yarns by tying together.

L

lea

In cotton, a length of 120 yd; in worsted, 80 yd; in linen, 300 yd.

leaf fibres

Comparatively stiff, elongated strands extracted from leaves or leaf stems of some plants. Examples - sisal, abaca, henequen, banana (Appendix B).

linear density

Mass per unit length for any textile fibre, sliver or yarn.

lumen (fibre)

The central canal found in the ultimate cells of plant fibres (Fig. 3.3).

lustre

The surface gloss, sheen, or shine of a textile material with reflected light.

M

macro- and micro-nutrient

Sixteen chemical elements or nutrients are known to be important to a plant's growth and survival. Of them, macronutrients are those required essentially by plants in large quantities, and may be broken into two groups: primary and secondary nutrients. The primary nutrients are nitrogen (N), phosphorus (P), and potassium (K). The secondary nutrients are calcium (Ca), magnesium (Mg), and sulphur (S). Besides, there are about eight micro-nutrients essential to plant growth and health that are only needed in very small quantities. These are manganese (Mn), boron (B), copper (Cu), iron (Fe), chlorine (Cl), cobalt (Co), molybdenum (Mo), and zinc (Zn).

mercerisation

Application of sodium hydroxide to cotton yarn or fabric under tension, to improve the lustre and increase the affinity of the fibre for dyes. In slack mercerization, without tension, the finish imparts stretch properties.

microbial decomposition

During water retting of jute plants microbial action takes place to loosen the fibres from other components of the stem through decomposition of the stalks by a consortium of indigenous micro flora. The consortia attack primarily pectin and selectively lignin, freeing the lingo-cellulosic fibres.

microfibril

An entity comprising of a bundle of chain molecules, arranged in a highly ordered manner. In case of natural cellulosic fibres, a bundle of about 30 cellulose chain molecules, arranged with high order as a crystalline region with defects of varying magnitude.

mildew

A growth of certain species of fungi. On textile materials, this may lead to tendering, discolouration, and variation in dyeing properties.

modulus

The ratio of change in stress to change in strain.

moisture content

The amount of moisture in any textile material expressed on the basis of its weight.

moisture regain

The amount of moisture in any textile material expressed on the basis of its oven-dry weight. Commercial moisture regain is a published value established for buying and selling textile materials.

mokam

A distinct jute producing area, identified for availability of one / two particular quality of fibre from its primary / secondary market.

monomer

The single chemical unit, or molecule, from which polymers are formed.

morah

It is the bundle of jute in a bale, usually weighing 2.25 to 4.50 kg. Each morah is given a twist and folded prior to packing in the bale.

mulch / mulching

A protective covering, usually of organic matter such as leaves, straw, or peat, placed around plants to prevent the evaporation of moisture, the freezing of roots, and the growth of weeds, etc.

mutation

This is an act or process signifying a change in genetical composition of the material, resulting in the creation of a new character or trait not found in the parental type.

N

newton

A unit of force, denoted by N, in the MKS system. 1 N = 102 gf = 10^5 dynes.

nonwoven fabric

Sheet or web structures made by bonding or entangling fibres or films (and by perforating films) via mechanical, thermal, or chemical means, and combinations thereof.

O

oleophilic

Tending to absorb and retain oily materials.

oleophobic

Tending to repel oily materials.

order

The usual major subdivision of a class or sub-class in the classification of plants and animals, usually consisting of several families.

see Taxonomic Tree (Fig. 2.1).

Ozone

Ozone (O_3) is a molecule, consisting of three oxygen atoms. It is an allotrope of oxygen that is much less stable than the diatomic O_2. Ground-level ozone is an air pollutant with harmful effects on the respiratory systems of animals. The ozone layer in the upper atmosphere filters potentially damaging ultraviolet light from reaching the earth's surface. It has many industrial and consumer applications.

P

pH

pH is a measure of the acidity or basicity of a solution. It is the negative logarithm of active hydrogen ion concentration.

pharmaco-dynamics

It is the branch of pharmacology that studies the effects and modes of action of drugs upon the body.

phloem

Main tissues in plants that conduct foods made in the leaves to all other parts of the plant.

photoperiodicity

Photoperiodicity is a phenomenon of physiological reaction of plants to the length of day or night.

phylogenetics

In biology phylogenetics is the study of evolutionary relatedness among various groups of organisms (e.g., species, populations), or evolutionary lineages of organisms.

pick

See weft.

picks per minute

The number of times per minute the shuttle traverses the loom sley.

pile

The raised loops or tufts (cut loops) that form all or part of the surface of a pile fabric.

piling

For the purpose of softening, the storing of raw jute bundles under a cover, after application of oil-water emulsion, for 24 – 72 hours to facilitate increased microbial attack on fibres.

pilling

The formation of tiny balls of fibre on the surface of a fabric, caused by fibres entangling with other fibres or lint and adhering to the fabric surface.

pirn

A wood, paper, or plastic support, slightly tapered, with or without a conical base, on which yarn is spun or wound for use as weft (filling).

plain weave

The simplest of the three basic weave patterns, in which each weft yarn passes successively over and under each single warp yarn in alternating rows.

ply yarn

An assembly of two / more single yarns twisted together to have a balanced twisted yarn.

pod

A dry, several-seeded, dehiscent fruit, also called seedpod.

polymer

A large molecule produced by linking together many monomers in a chainlike structure.

primary wall

The thin portion at the periphery of cell wall in plant fibres. In this region, the fibrils are arranged in a criss-cross manner, and hence with less order.

puddling

A process of wet soil preparation by ploughing and laddering for sowing.

Q

Quality Circle

A small group of persons who perform, with the superiors, quality control activities voluntarily in the same work-place.

Quality Ratio (QR)

It is an expression of jute yarn strength, expressed as

$$QR = \frac{\text{Average breaking load (lb)}}{\text{Grist (lbs/spy)}} \times 100$$

R

resiliency

The ability of a fibre, yarn or fabric to recover from a deformed state, i.e. return to its original shape from compression, bending or other types of deformation.

retting

In bast fibres such as jute or flax, a biological or chemical actions on the cut stems for the purpose of making the fibre bundles more easily separable from the woody core. According to the process employed, the stems can be water retted, dew retted, or chemically retted.

Rkm

A unit for strength of yarn in terms of breaking length in kilometer (breaking length means the length of a yarn which will break by its own weight).

rope

An article of cordage, more than approximately 4 mm in diameter obtained when three or more strands are laid or plaited together.

roving

A loose assemblage of fibres drawn or rubbed into a single strand with very little twist. An intermediate stage between sliver and yarn.

S

sacking

Jute fabric made of double warp and single weft with plain or twill weave mostly used for manufacturing jute bags in various widths and weights / sq. meter.

sale yarn

The export quality jute yarns being used mainly by carpet manufacturing mills.

secondary wall

The thick portion, surrounded by thin primary wall, in the cell wall of plant fibres. In this region, the fibrils are arranged parallely, and hence with higher order.

seed drill

A seed drill is a device for planting seeds in the soil at regular distances and in lines vis-à-vis random sowing known as broadcasting as a traditional practice.

SI Units

The units of various physical properties which are defined by the Systems International worldwide system of weight and measures standards.

skein

A continuous strand of yarn or cord of any desired length in the form of collapsible coil, obtained by winding a definite number of turns on a reel under prescribed conditions.

sliver

The long continuous ribbon of fibres, loosely held together, that comes out from the carding, drawing or combing machines.

slub

A very thick portion of short length in a jute yarn. This is considered as an objectionable fault for any jute yarn.

soft fibres

These are nothing but the bast fibres (Appendix B).

soft waste

Waste from sliver in carding, drawing or spinning, and also caddis.

soil saver

A typical open weave woven jute geotextile used for controlling surface erosion of soil. Also branded as 'Anti-Wash' and loosely as 'Geojute'.

species

The major subdivision of a genus or sub-genus, regarded as the basic category of biological classification composed of related individuals that resemble one another and are able to breed among themselves.

see Taxonomic Tree (Fig. 2.1).

spinning

The thin slivers as received after drawing operations are processed through spinning machine where slivers are spun into yarn with a twisted structure. Normally two types spinning machines are employed in Jute Industry – 4¼ inch and 5½ inch spinning machines are operated for making finer and coarse quality of yarn respectively.

splicing (yarn joining)

The joining of two ends of yarn by fibre entanglement wrapped with another finer yarn or filament, adopted as an alternative to knots which produce joints of higher diameter.

spun yarn

A yarn produced from staple fibres.

spyndle

A unit of length used in the determination of grist of jute yarn; it is equal to 14,400 yds. (13167 m).

staple fibres

The fibres of finite length which can be measured in centimeters or inches as opposed to meters or yards.

stubble

These are short, stiff stalks of grain or hay remaining on a field after harvesting.

sub-order

A category of related families within an order.

see Taxonomic Tree (Fig.2.1).

T

Taxonomic Tree (ranks)

In botany, there are eight main taxonomic ranks: domain, kingdom, phylum or division, class, order, family, genus and species. The basic rank is that of species, and if an organism is to be named it most often will receive a species name. The next most important rank is that of genus. The third-most important rank is that of family. Crop variety is a taxonomic sub-division of a species consisting of naturally occurring or selectively bred populations or individuals that differ from the remainder of the species in certain minor characteristics.

Taxonomy

It is the science that finds, describes, classifies, identifies, and names plants.

technical textile

These textile materials are meant for serving some technical or utility functions and not for normal textile uses like apparel, home furnishings, etc.

tenacity

Tensile strength of fibre or yarn expressed in terms of the ratio of breaking load and linear density; and of fabric in terms of the ratio of breaking load and fabric width.

tensile strength

The resistance of a material to be pulled apart parallel to its surface. The maximum stress developed in a tensile test.

tex

The universal unit for linear density of yarn or fibre; it is the weight in gram of 1000 m of yarn.

textile / textiles

The terms textile or textiles mean fibres, filaments and yarns, natural and manmade, and most products for which these are a principal raw material.

thread

A strong, high-grade yarn, usually plied, of even surface for sewing fabrics or for needlework.

tire cord

Cord (ply yarns twisted together) of cotton, rayon, or nylon used in rubber tyres.

torsional rigidity

The resistance to torsional deformation.

Total Quality Management (TQM)

A management approach of an organization, centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society.

tow

A continuous multifilament strand of manmade fibres processed to form staple fibres.

twill

A weave pattern characterized by diagonal lines or ribs produced by staggered floats. One of the basic weaves adopted to produce heavier, denser fabric than plain weave.

twine

Twisted cordage less than 4 mm in diameter.

twist

The number of turns per unit length of a yarn expressed as turns per metre (tpm) or turns per inch (tpi).

twist factor (twist multiplier)

A number (or value) given by the product of the twist level in a yarn (turns/unit length) and the square root of its count (direct system) or the inverse square root of its count (indirect system).

twist liveliness

The tendency of a yarn to twist or untwist spontaneously.

twist-on-twist

A construction in which the twist is the same as that of the constituents, such as S-twisted single yarns plied with S-twist.

Two-for-one twisting

A system which inserts two turns of twist for every revolution of twisting element.

U

ultimate cell

It is the single fibre cell. While unicellular cotton fibre comprises of only one cell, the multicellular bast fibres like jute are composed of a number of ultimate cells cemented together (Fig. 3.3).

union fabric

A fabric made with warp of one kind of fibres and weft of another, e.g., a fabric having cotton yarn as warp and jute yarn as weft.

V

Variety

A category within a species, based on some hereditary difference (Fig. 2.1).

visco-elastic material

The material whose mechanical properties are time-dependent and exhibits creep, creep recovery and stress relaxation. The fibres, yarns and fabrics are visco-elastic materials.

W

warp

Set of yarns running length-wise of the fabric is called warp or end.

warping

The process of preparing of warp for weaving or knitting. A number of methods are employed such as beam warping, chain warping and sectional warping.

weave

The manner in which the warp and weft yarns interlace in a fabric. Basic weaves: plain, twill, and satin. These are also called the 'foundation weaves'.

webbing

A tightly woven, heavy, narrow, plain-weave fabric, the prime function of which is load bearing, generally with multiple plies.

weed

It is a plant considered undesirable, unattractive, or troublesome, especially the ones growing in an agricultural field where these are not wanted.

weft

Set of yarns running width-wise or selvedge of the fabric are called weft or pick.

Wilton Carpet

A woven carpet, first made in Wilton, UK, in which the pile threads run continuously into the carpet, being raised above the surface of the backing to form a pile by means of wires or hooks (warp wires), or by being stretched between two backings (face-to-face weaving).

winding

An operation of transferring yarn from one form of package (bobbins) to another (spools).

Y

yarn

A twisted or an untwisted assembly of fibres and / or filaments having substantial length : breadth ratio.

yarn package

A length of yarn in a form suitable for handling, sorting or shipping. Packages may be unsupported as skeins or cakes, or prepared with various winding patterns of bobbins, cops, pirns, spools, tubes or beams.

yarn appearance

The visual effect obtained by viewing a sample of yarn wound with a designated traverse on a black board of designated size.

yarn clearer

A device designed to cut or break yarn when it detects changes in mass or diameter which exceed set limits. Yarn clearers are normally part of, or an addition to, a winding machine.