Redefining Competitive Edge through Internalization of Ecological Footprints – Jute Fibre versus Synthetic Fibre

Manideep Chandra
Reader, Department of Commerce,
Saheed Anuruchandra Mahavidyalaya,
Burul, 24 Parganas(South).

Abstract

The set of principles, observations and experiences that constitute the way we look into reality have been changed and redefined. Novel changes have been made in the ambience of trade and commerce. Consequently, competitive edge is required to be recalculated on the basis of newly acquired knowledge nay, wisdom of ecological footprints. In this connection, competitive edge of jute fibre is a point worth discussing. Jute fibre has got a certain degree of ecological acceptability over synthetic fibre. However, due to market failure, synthetic fibres win the race as they enjoy the freedom to generate negative externalities (specially the environmental costs). Market failure is a situation where prices fail to capture 'external' costs and benefits to third parties. Therefore, the price advantage, which has enabled synthetic fibre to displace jute so unceremoniously in world markets, is due to the failure of market prices to internalize ecological costs. The so-called competitive edge of synthetic fibre will be significantly diluted to the extent that it may lose the edge entirely (once the externalities are included in the product pricing). Thus, redefining competitive edge involves creation of a level playing field for comparison through internalization of these externalities. The effort would benefit not only the global ecology, but also some of the world's poorest people (i.e. the jute growers and agricultural labourers of underdeveloped and developing countries). This paper focuses upon exploratory valuations for ecological costs and discusses how internalization of these costs will affect the relative competitive edge of jute and synthetic fibre.

Key-words: Natural Fibre; Synthetic Fibre; Jute Fibre; Polypropylene(PP); Economic Process Re-Engineering (EPR); Ecological Footprint; Paradigm Lost, Economic-System-Crisis; Biological Efficiency; Life Cycle Analysis(LCA).

1. Introduction

We may not be interested in globalization but globalization is interested about us. It is the *Economic Process Re-engineering* (EPR) to propagate a new economic order, predominantly characterized by the wave of information technology. Profound socio-economic transformation is involved in the age of information society. The intensity, and propensity of these transformations are yet to be captured by the sociological imagination. Obviously, globalization is not merely an economic phenomenon; rather it pervades the entire field of human activities including politics, culture and ecology. The set of principles, observations and experiences that constitute the way we look into reality have been changed and redefined. Novel changes have been made in the ambience of trade and commerce. Consequently, competitive edge is required to be recalculated on the basis of newly acquired knowledge nay, wisdom of ecological footprints. Thus, there has been a paradigm shift in analyzing economic metamorphoses occurring across the world. In fact, we are heading from 'paradigm shift' towards 'paradigm lost', where there is no model at all to fall back upon for resolving economic-system-crisis. In this connection, competitive edge of jute fibre is a point worth discussing.

The promotion of synthetic fibre other than natural cotton and synthetic cellulose has become imperative due to the expanding world population and the limited natural resources available. It is assumed that the demand for fibres for clothing alone will rise from the current 60 million tons up to 130 million ton per year in the year 2050 (Koziowski, 1996), without taking into consideration the fibre consumption for various other purposes. Although, the invention of synthetic fibres has brought us uncountable benefits in our everyday life, but the increasing concerns over the global warming resulting from the ecological footprints caused by synthetics, in both developing and industrialized countries have started to change our attitude. Consequently, jute (a natural fibre that can be used in supplementing and/or replacing synthetics) has been receiving increasing attention from the industry. Competitive edge originates from core competencies. Core competencies stem from the possession of valuable and unique features that are difficult to imitate or substitute. In this connection, the unique features of jute fibre are:

1. Jute fibre is superior to synthetic fibre in physical and chemical characteristics.
2. Jute is an annually renewable energy source with a high biomass production per unit land area.
3. Jute is biodegradable and its products can be easily disposed of without causing ecological hazards.
4. Jute improves soil fertility and increases the productivity of other crops while used in rotation with other crops
5. The use of jute in the paper industry and as a geotextile will partially prevents deforestation and soil erosion.

2. Ecological Acceptability

From the foregoing discussion it is evident that jute fibre has got a certain degree of ecological acceptability over synthetic fibre. Let us see the specific points of intersection where jute fibre outperforms synthetic fibre.

- *Reduction in Carbon Footprint*: Jute is a fast growing field crop with high carbon dioxide assimilation rate. Jute plants arrest the global warming through assimilation of large quantities of CO_2 and simultaneously reduce the global warming through generation of large quantities of O_2. Theoretically one hector of jute plants can consume about 15 tons of CO_2 from atmosphere and release about 11 tons of Oxygen in the 100 days of the jute-growing season. Studies also show that the CO_2 assimilation rate of jute plant is several times higher than that of trees (Inagaki, 2000).

- *Sustainable Agricultural Practice*: Jute cultivation requires a very modest amount of fertilizers and pesticides. By default it produces 5-10 tons of dry matter per acre of land which is metamorphosed into the soil to enrich it organically. While operating crop rotation in conjunction with rice and potatoes, jute acts as a barrier to pest and diseases for other products and also provides a substantial amount of nutrients to them.

- *Generation of High Biological Efficiency*: Jute is a fast-growing crop having low pay back period. The average dry stem production of jute ranges from 20-40 tons per hector annually in a period of 4-5 months. Whereas, the fastest growing wood plant need at least 10-15 years to produce only 8-12 tons per hector annually. Due to the biological efficiency, the use of jute (as an alternative of wood) to produce paper pulp will substantially lower the cost of production.

- *Ecological Adaptability*: There is no denying the fact that food crops outperform jute fibre so far as economic return is concerned. Consequently, cultivable land is being encroached aggressively for food crops and jute fibre is being sidelined or migrated to semi-barren lands. In fact some countries are exploring the possibility of growing jute on lands with stress conditions e.g. draught, salt, flooding, low pH etc. The effort has proved to be feasible. Since jute fibre has a good tolerance to salinity, water stress and water logging, it can adapt easily to climate and soils.

3. Ecological Assessment Of Jute Fibre Production

The agricultural practices used for crop production is bound to affect the ecology through the creation of ecological footprints (i.e. the way of using the surface area, emission of gases including carbon footprints and releasing of solid and liquid wastes) and jute is no exception to that rule. The crucial question is that how far the eco-friendly jute affects the ecology in a lesser degree in comparison with the synthetic fibre. The situation is all the more interesting because both fibres are used for the same industrial purpose. We are supposed to search the answer in the Life Cycle Analysis (LCA) as it is a very effective tool for assessing the ecological footprints of a product or process. LCA of jute fibre production involves two stages, namely LCA of jute agriculture and LCA of jute processing.

❑ *LCA Of Jute Agriculture*

Jute agriculture involves the following operations:

i. Sowing
ii. Weeding / thinning
iii. Harvesting
iv. Defolination
v. Retting
vi. Fibre extraction
vii. Washing and drying

As mentioned earlier, jute cultivation requires a very modest amount of fertilizers and pesticides. At the same time only a small percentage of the farmers use seed treatment, fertilizers and herbicides/pesticides, which make the processes ecologically sound. Processes of jute retting, fibre extraction and washing have drawn some concerns regarding solid residue and gaseous emissions that arise from such processes. Complaints about unpleasant smell of gaseous emissions caused during retting are quite common. However, the water pollution by retting is transitory in nature, because in a warm climate the polluted water returns to its normal condition after 1-2 months. There are studies showing that retting water can be used as fertilizer in the growing of rice. Further, the 'humidified retting', a new retting method developed in China, can significantly reduce water pollution, the use of water and the generation of methane. Similarly, the gaseous emissions and unpleasant smell do not involve any health hazard as such. Moreover, the gaseous emissions from retting can be used as a source of energy, i.e. biogas.

LCA of Jute Processing

Jute processing involves the following operations:

i. Batching
ii. Softening with batching oil
iii. Carding
iv. Drawing
v. Spinning
vi. Weaving
vii. Finishing

The processing of jute has raised certain ecological concerns. For example, the use of mineral batching oils, chemicals and pigments during bleaching and dying. However, replacing mineral oil with vegetable oil or RBO can solve these problems. Gaseous emissions including carbon footprints occur in the course of composting/disposal of jute in landfills. These problems cannot be ignored. However these type of problems exist in any comparable industry. As per the study of The International Jute Organization (1992) 'the life cycle of jute products can be classified as less environmentally damaging than that of polypropylene' due to the following reasons:

- The production of 1 ton of jute products consumes only 7% of the energy required for the production of 1 ton of polypropylene.
- The production of 1 ton of jute generates 80% less wastes than the production of 1 ton of polypropylene. Moreover, wastes from jute are biodegradable and can always be used as manure.
- Jute production does require more water, but jute wastewater is biodegradable and does not contain any heavy metal like in polypropylene wastewater.
- The production of 1 ton of polypropylene generates 3.7 ton of CO_2(very big carbon footprint). Whereas, jute generates no CO_2 rather it absorbs CO_2 from the air.

4. Natural Fibres versus Synthetic Substitutes: A Case Study

Since Second World War, renewable natural raw materials including cotton, jute, wool, rubber etc. have lost international markets to synthetic substitutes. While the production and consumption of natural raw materials are by no means free from negative ecological impacts, the ecological cost associated with the production and consumption of synthetics is inherently larger. An interesting feature is that the production of many natural raw materials is concentrated in the developing countries, while the production of synthetic substitutes is flourished in the industrialized countries. Thus the competition between the natural raw materials and synthetics is actually metamorphosed into war of clean producers against the dirty producers. The dirty producers win the race as they enjoy the freedom to generate negative externalities (specially the environmental costs) without being accountable for it. The competition between jute (natural fibre) and polypropylene (synthetic substitutes) is a point worth discussing.

❑ Market Failure

With the globalization of markets, however comes the globalization of market failures. Market failure is a situation where prices do not capture 'external' costs and benefits to third parties. In the absence of corrective policies, the market blindly rewards productivity as measured by price. Consequently, in an environment of competitive pricing jute is being displaced by polypropylene (PP) as higher pollution costs associated with the latter are not being internalized in product pricing. Let us illustrate the matter further. Suppose, a developed country X produces PP more cheaply than jute fibre and thereby enjoying competitive edge over the jute fibre producing country Y, but in so doing country X generates more pollution. Due to the market failure (i.e. while ascertaining product pricing, the pollution costs are not internalized and consequently the market fails to reflect the pollution costs in the product pricing), trade liberalization will cause the potential orders for fibre to shift mostly to country X (with a corresponding increase in pollution and its negative externalities). Moreover, the positive externalities so far used to generate in country Y (e.g. purification of air through CO_2 assimilation, the conservation of crop genetic diversity etc.) will be ceased to generate. But the so-called competitive edge of country X (in the production of PP) will be significantly diluted to the extent that it may lose the edge entirely(once the external costs and benefits are included in the product pricing). Thus, redefining competitive edge involves creation of a level playing field for comparison through internalization of externalities (specially ecological costs).

❑ Jute versus Polypropylene

Jute is the second most important natural fibre in world trade after cotton. It has two main end-uses: burlap (also known as Hessian) cloth, and carpet backing. In recent decades, jute consumption in the industrialized countries has contracted sharply in the face of competition from synthetics. Between 1970 and 1992 the annual jute imports of North

America and Western Europe plummeted from 1.0 million to 52000 metric tons (Thigpen, 1987; IJO, 1993). Over the same period the real price of jute declined roughly 70%. The decline of the international jute market has hit the incomes of some of the world's poorest people. For example, Bangladesh accounts for roughly 80% of world jute exports (FAO, 1994). With a per capita income of S 220/year, Bangladesh ranks among the poorest countries in the world. As per (World Bank, 1992) jute related activities in agriculture, manufacturing and trade affect the livelihoods about 5 million people.

PP, the main synthetic substitute for jute, is manufactured primarily in the United States and Japan, although newly industrialized countries including Korea, China and Brazil have now entered the industry. Polypropylene producers include multinational firms such as Exxon, Hoechst, Hyundai Petrochemical and Shell (Johnson, 1990). The competitive edge in

product pricing which permits PP to capture and retain the erstwhile markets for jute has been fairly modest. In 1990 the wholesale price ratio of jute to synthetic cloth in New York was 1.35, whereas the average over the preceding decade was 1.42 (World Bank, 1992). The interesting fact is that the incorporation of environmental costs into the prices of PP and jute could substantially alter the ratio.

❑ Externalities of Polypropylene

The ecological impacts of PP manufacture are from air pollution and energy consumption. Air pollutants generated in PP production include particulates, sulfur oxides, nitrogen oxides, carbon monoxide and volatile organic compounds; total emission of which are estimated at 127 kg per ton of PP (Tellus Institute, 1992). In addition, PP production emits smaller amounts of other toxic air pollutants, including ammonia, benzene, biphenyl, ethyl benzene, lead, methane, and toluene.

Energy use in the production of PP cloth is estimated at 84 gigajoules /ton, at least six times the energy requirement for production of jute cloth (Braungart *et al*, 1992). Carbon dioxide (CO_2) emissions in the PP production process are estimated at 3.7 ton per ton of fibre. The long-term ecological effects of additions to atmospheric CO_2 derived from fossil carbon remain uncertain, but they include impacts on agriculture, forestry, biodiversity and a rise in the sea level. PP is not biodegradable. Its recycling potential is limited by the use of additives in the production process and by mixture with other plastics in the collection process. At the end of the product life cycle, PP disposal therefore incurs the costs of landfill storage, incineration, or litter. As much as six percent of PP cloth, by weight, is comprised of chemical additives, including stabilizers, coloring pigments, and flame-retardants. These contain heavy metals including chromium, copper, lead, nickel and zinc, which also ultimately enter the waste system.

❑ Externalities of Jute

Ecological impacts of jute production are relatively modest by comparison. Jute growers use some chemical fertilizer, but not very intensively. Most apply no pesticides at all to the crop and it is an important environmental plus. The flooded fields in which jute ripens support diverse fish populations. Like all plants, jute absorbs CO_2 (the most important constituent of the green house gases responsible for global warming) from the atmosphere when it grows and returns it when it decays. Jute thus provides a temporary ecological benefit. The transport and milling of the fibre, the production and transport of inputs for the crop generate some CO_2 emissions, but these are less than one sixth of those generated in PP production.

The most serious negative ecological impact of jute production probably arise in the process known as retting. Retting is a process when the jute stalks are submerged for 3-4 weeks in ponds where anaerobic microbial decomposition loosens the fibre in the inner bark. Retting causes transitory deterioration in water quality, including oxygen depletion, which can harm gill-breathing fishes. The decomposition products are non-toxic, however, and these enhance soil fertility. Retting releases methane, a potent greenhouse gas, in quantities, which have yet to be measured. Efforts are being made to capture the methane for use as biogas fuel.

The ecological impacts in the manufacturing stage of jute production arise primarily from energy consumption, the production of fibre wastes and pollution from dyes. Energy use in jute production is estimated at up to 14 gigajoules/ton. Jute dust waste produced during processing amounts to roughly two percent of the fibre; some of this are burnt for energy. Only a small fraction of jute fabrics (around 1-2 percent) is dyed, but effluent samples from jute dyeing processes show releases of heavy metals.

Jute is biodegradable. At the end of the product life cycle it decomposes in the soil. Residues from mineral oils used to soften the fibre may persist but use of vegetable oils or RBO for this purpose would ensure residue-less biodegradation. Moreover, the edible leaves of the plant provide a cheap (or even free) source of food for the poor and the jute stalks(left after the fibre is stripped away) are a renewable source of cooking fuel and building material. The high labour intensity of jute cultivation can also be regarded as a social benefit in a land where agricultural labourers are among the poorest of the world's poor.

▫ Correction of Market Failure through Internalization of Environmental Costs on Relative Price of Jute and Polypropylene

To date there have been no comprehensive attempts to evaluate the full range of ecological impacts of jute and PP in economic terms. Boyce (1995), however, had performed exploratory valuations for three major impacts: air pollution, carbon dioxide emissions and solid waste disposal. Table-1 summarizes the results, showing how internalization of these costs would affect the relative price of jute and PP.

Table 1: Internalization of Environmental Costs on Relative Price of Jute and Polypropylene

	Prices (S/000 yd)		Price Ratio
	Jute	PP	Jute/PP
Market Price(1990)	240	178	1.35
Internalizing Air Pollution Costs Only	240+0 = 240	178+46 = 224	1.07
Internalizing CO_2 Costs Only	240+2 = 242	178+4 = 182	1.33
Internalizing Non-biodegradable Disposal Costs Only	240+0 = 240	178+2 = 180	1.33
Internalizing All the Above	240+0+2+0 = 242	178+46+4+2 = 230	1.05

Boyce has considered only the high volume pollutants (suspended particulate matters, sulfur oxides, nitrogen oxides, carbon monoxide and volatile organics) and not the other toxic air pollutants released in smaller quantities in PP production. The monetary values used to translate these emissions into costs are derived from the average values adopted by the policy-making agencies in the United States as a whole. Obviously these are considerably below than those used in densely populated and highly polluted regions. Carbon dioxide emissions are here valued at S50 per ton of carbon.

In order to make the study comprehensive we need to internalize the other ecological costs i.e. retting on water quality, refinery pollution attributed to PP, Sulfur Dioxide emissions, Nitrogen oxide emissions, impact of methane emissions during jute retting, impact of heavy metals and other chemical additives used in the manufacturing processes of PP and jute, impact of other toxic air pollutants emitted in PP production and the costs associated with emissions of toxic pollutants due to the use of chemical additives during PP production.

Moreover, it seems that Carbon Dioxide emissions has been valued at lower price of S50 per ton of carbon considering the fact that Nordhaus (1991) suggested a price of S66 per ton and also corroborated by the fact that these are considerably below than those used in densely populated and highly polluted regions). The internalization of these costs (so far as internalization of costs are possible) would further lower the Jute/PP price ratio as shown in Table 2 below:

Table 2: Internalization of Environmental Costs in the Indian Perspective

	Prices (Rs./Ton)		Price Ratio
	Jute	PP	Jute/PP
Average Market Price(2000)	101130.4	85714.3	1.18
Internalizing suspended particulates Costs Only	101130.4+0 = 101130.4	85714.3+968 = 86682.3	1017
Internalizing CO_2Emission Costs Only	101130.4+0 = 101130.4	85714.3+10745 =96459.3	1.05
Internalizing SO_2Emission Costs Only	101130.4+0 = 101130.4	85714.3+1089 = 86803.3	1.17
Internalizing NO_2Emission Costs Only	101130.4+0 = 101130.4	85714.3+11858 = 97572.3	1.04
Internalizing Non-biodegradable Disposal Costs Only	101130.4+0 = 101130.4	85714.3+2424 = 88138.3	1.15
Internalizing Attributed Refinery Pollution Costs Only	101130.4+0 = 101130.4	85714.3+454.5 = 86168.8	1.17
Internalizing Retting on Water Quality Costs Only	101130.4+724 = 101854.4	85714.3	1.18
Internalizing All the Above Costs	101130.4+0+0+0+0+0+0 +724 = 101854.4	85714.3+968+10745+1089+11858+2424+454.5 = 113252.8	0.90

Note:

1. **In the tabular study(Table 1) of Boyce the unit of measurement of jute fibres were Yard(S/000yd) and we are going to use the measurement unit in Ton(Rs./Ton) in Indian perspectives.**
2.

	Jute	PP
Weight (gm/m^2)	**230-750**	**70-140**
Assumed Average Weight (gm) per Sack	**230**	**70**
Market Price (2000) per Sack	**Rs. 23.26**	**Rs. 6.00**
Average Market Price (2000) (Rs./Ton)	**10130.4**	**85714.3**

3. **Emission of Suspended Particulate Matter 5 Kg/Ton PP @ Rs. 193.60/Kg of emission**
4. **Emission of CO_2 3.7 Ton/Ton PP @ Rs. 10745/Ton of emission**
5. **Emission of SO_2 15 Kg/Ton PP @ Rs. 1089/Ton of emission**
6. **Emission of NO_2 35 Kg/Ton PP @ Rs. 11858/Ton of emission**
7. **Emission of non-biodegradable disposal costs, attributed refinery pollution costs and retting on water quality costs have been valued as per 'study conducted by Indian Institute of Technology, Kharagpur'**

5. Conclusion

The price advantage, which has enabled PP to displace jute so unceremoniously in world markets, is due to the failure of market prices to internalize ecological costs. Points may be raised that the basic polymerization process and product modification technologies for PP offer polymer scientists an opportunity to produce a plastic for any specific application combining the physical, chemical and thermal properties unique to that application. But such arguments are not tenable as the product modification technologies are also available for jute fibres through a number of institutions (Exhibit – I). Moreover, a comparison of properties and characteristics of jute and PP sacks provides a lot of points in favour of jute (Exhibit – II).

Ultimately the correction of this market failure would benefit not only the global ecology, but also some of the world's poorest people (i.e. the jute growers and agricultural labourers of underdeveloped and developing countries). On the other hand the absence of corrective prices benefits some of the world's multinational corporations not only at the cost of the livelihood of the poorest people but also at the cost of the serious irrecoverable ecological damage.

This article has performed exploratory valuations for ecological costs and empirically showed how internalization of these costs will affect the relative competitive edge of jute and PP (synthetic fibre). As it is an exploratory study, caution must be exercised in generalizing the result. However, it is hoped that this study reflecting the externalities in the market prices is valuable because it will certainly disturb the comfort level enjoyed by PP. It is, in essence, going to extend the literature in the matter of commercial viability of jute fibre over synthetic fibre.

Exhibit – I

1. Ahmedabad Textile Industries Research Association
2. Bureau Of Indian Standards
3. Bombay Textile Research Association
4. Central Research Institute For Jute
5. Directorate For Jute Development
6. Export Inspection Council
7. Indian Institute Of Packaging
8. Indian Jute Industries Research Association
9. Indian Jute Mills Association
10. Institute Of Jute Technology
11. Jute Corporation Of India
12. Jute Manufacturers Development Council
13. National Institute Of Research On Jute And Allied Fibre Technology
14. National Centre For Jute Diversification
15. National Institute Of Fashion Technology
16. Northern Indian Textile Research Association
17. National Jute Manufacturers Corporation
18. Office Of The Jute Commissioner
19. State Trading Corporation Of India

Exhibit – II

PROPERTY & CHARACTERISTICS	JUTE SACKS	PP SACKS
Biodegradability	Very Good	Nil
Capacity Utilization	Excellent	Poor
End Use Performance	Good	Poor
Grain Preservation Efficiency	Excellent	Poor
Heat Resistance	High	Low
Number Of Reuse	8-15	3-4
Operational Convenience	Good	Poor
Repairability	Very High	Very Low
Resistance To Hooking	Fair	Poor
Seam Strength	Strong	Poor
Stack Stability	Excellent	Poor
Surface Texture	Rough	Poor
Type Of Handling Tolerance	Rough	Delicate

References

Boyce, James K., 'Jute, Polypropylene and the Environment: A Study in International Trade and Market Failure', Bangladesh Development Studies, 1995.

Braungart, M. *et al.*, 'Jute and Polypropylene: Environmentally Intelligent products? Comparative Impact Assessment', Hamburg Environmental Protection Encouragement

Food and Agriculture Organization of the United Nations (FAO) 1994, mentioned by James K. Boyce in 'Globalization of Market Failure?' www. Agronor.org

IJO, 'Review of Jute Situation and policies Affecting Jute Production and Trade', International Jute Council 20th Session, Dhaka, Bangladesh, 1993.

Inajaki, H., Progress on Kenaf in Japan, Abstract, Third Annual Conference, American Kenaf Society Conference, Corpus Christi, Texas, USA, 2000.

International Jute Association (IJA), Proceedings of the workshop on environmental assessment of jute agriculture – phase I, Chiang Mai, Thailand, 1998.

Johnson, E., 'Polypropylene: Action Plan', Chemical Engineering, May, 1990

Kozlowski, R, 1996, mentioned by Dr. Amin Liu in 'Jute – An Environmentally Friendly Product', United Nation Conference On Trade And Development.

Nordhaus, W., 'A Sketch of the economics of the Greenhouse Effect', American Economic Review, Vol. 81, No. 2, 1991.

Tellus Institute, Tellus Institute Packaging Study, Boston: Tellus Institute and Council of State governments, 1992.

Thigpen, M.E., Marongiu, P. and Laskar, S.R., 'World Demand Prospects for Jute', World Bank Staff Commodity Working Paper No. 16, 1987.

World Bank, Bangladesh: Restructuring Options for the Jute Manufacturing Industry, Report No. 10052-BD, 25th February, 1992.

Internet resources:

www.jmdcindia.com