Introduction and Design of the Study
CHAPTER I
INTRODUCTION AND DESIGN OF THE STUDY

1.1. INTRODUCTION

The term Globalization is coming up today as a catchword. Its usage is not confined to economics and politics. Broadly speaking, the term Globalization means integration of economies and societies [Singh, L.P.]\(^1\). The essence of Globalization is connectivity. However, the term Globalization is used here in the limited sense of economic integration which can happen through the three channels of:

- Trade in goods and services,
- Movement of capital and
- Flow of finance.

Foreign trade is now an integral part of international economic relations. The success of a country’s development in economy depends on the integration of its economy with the rest of the world. The external section in the Indian economy has strategic place in the process of economic development. Ever since the adoption of planned development with the beginning of the first five year plan in 1950-51, strategies of development have been either implicitly or explicitly related to specific aspects of external sector.

Export is the most important source of foreign exchange for developing countries. All developing countries, including India, strive to increase their exports as a means for mobilizing resource for their development plans. Indian economy is basically agrarian and hence exports of food and agricultural products assume crucial significance in our export efforts. Growth in agro-exports not only brings in additional foreign exchange for the country but also benefits a large number of people involved in the production, processing and export of such products.

Foreign trade is not a mere extension of domestic trade activity; it is essentially different from domestic trade. The quality and the price of the products exported have to be adopted to the tastes and requirements of foreign purchasers. Exporters have,
therefore, to study carefully the demand conditions in the foreign markets for promoting trade in their products. The problems facing the exporters will differ from one product to another and from one foreign market to another. Consequently, foreign trade has now-a-days become a highly specialized business. On most occasions it requires the assistance and advice of teams of experts and middlemen.

Market reaction to coir as a material has been very favourable. Importers have helped develop more sophisticated products that appeal to particular user needs. Some have also had their products tested for these applications and used the information to help develop sales. It is no longer unusual to find coir being used on road sides or in railway cuttings even though it is not universal yet.

Coir and coir products occupy a pride of place in India's foreign trade. Coir has great antiquity in the commerce of nations. Marco Polo, in his account of travels, mentioned coir as an article of trade with India even in the days of ancient Greece, Rome and Arabia.

History narrates different stories on the birth of the golden fibre. Ropes and cordage, made out of coconut fibre have been in use from ancient times. Indian navigators who sailed to Malaya, Java, China and to the Gulf of Arabia centuries ago, had been using coir as their ship’s cables. Arab writers of the 11th century AD referred to the extensive use of coir as ship’s cables, fenders and for rigging. Facts record that there was coir industry in U.K, before the second half of the 19th century. During the 1840's, Captain Widely, in co-operation with Captain Logan and Thomas Treloar, founded the well-known carpet firms of Treloar and Sons in Ludgate Hill, England, for the manufacture of coir into various fabrics suitable for floor coverings.

The coir manufacturing industry producing coir mats, mattings and other floor coverings, was started in India on a factory basis, over a hundred years ago when the first factory was set up in Alleppey in 1859 by Late James Darragh, an adventurous Irish born American national. Enterprising Indians followed the trail blazed by the foreigner [Bhaskaran Unnithan]².

One of the major requisites for achieving sustainable development in agriculture in general and coconut-based farming in particular is giving more emphasis to women empowerment. Women are the pioneers of farming activity in India. It was women who
first domesticated the crop plants and thereby the art and science of farming. Nearly 84% of all economically active women in India are engaged in agriculture. They constitute 1/3rd of the agricultural labour force and 48% of self-employed farmers. Agriculture is the mainstay of Indian population as over 70% of India’s population depends upon agriculture and allied occupations for their livelihood [Darling Selvi]3.

A major change that has happened in the Indian coir export is the change in Minimum Export Price Policy (MEP). With the process of Globalization and of the Indian economy, the Coir Board introduced MEP in 1996 to satisfy the requirement of Indian coir exports. The introduction of MEP ensures better export realization to the exporters. The exporters took up the opportunity of excess production capacity bargain with the manufacturers to reduce the price. Under the new policy, embellishment has been taken out of the purview of MEP and also certain products like power loom products and geo textiles. The Indian coir products are in demand because of their special attributes namely:

- Fitness of purpose
- Price
- Craftsmanship
- Quality

The position of coir was quite vulnerable on the demand side as it accounted only for less than a third of world production of similar fibres. Besides, about one third of the end use applications of coir could always be met by these competing fibres. Its position on the supply side also was not comfortable. Since coconut trees are not grown for husks, supply of husks cannot cope up with the short-term fluctuations in the demand for coir. It was in such an uncertain supply-demand situation that coir industry was born in the rural areas of Kerala. The whole enterprise was under the aegis of a couple of British firms which started their operations in Cochin by the mid 19th century. When they offered to buy whatever quantity of coir that was produced, tens of thousands of households in hundreds of villages in the coastal areas of Kerala took to coir spinning work [Balakrishnan, P.K.]5.
The fibrous husk covering the inner shell of the coconut is the raw material for coir industry. The natural fibre extracted from coconut husk is known as coir or coco fibre. Coir fibre is a versatile eco-friendly hard fibre used commercially for production of a wide range of coir yarn and finished products of coir like door mats and floor coverings which find multiplicity of end-use applications in day to day life. The development of coir industry has all along been in areas where there is concentration of coconut cultivation and availability of coconut husks. Coir industry had its origin in Kerala, the home of coir industry. With the expansion of coconut cultivation, coir industry has been developing fast in states like Tamil Nadu, Karnataka, Andhra Pradesh, Orissa, West Bengal and Assam, thanks to the efforts of the Government of India through Coir Board and the concerned states towards the development of coir industry there. Among the states, Kerala continues to be the largest producer of coconuts contributing as much as 42% of the total production [Ajith Kumar, P.]^6.

Over the last two decades there has been a gradual process where coir exporters have been trying to move downstream to value added products, generally in competition with traditional processors located in consuming countries. The hypothesis was introduced in coir producing countries which needed the extra export earnings and the industry needed to counter, falling real value of commodity exports.

There has been an apparent sea change in attitude in Western Europe and old differences are no longer relevant. European industry understands that production in Europe is too expensive and given the increasing importance of new markets, intends to transfer downstream processing to lower wage cost countries, in particular, to coir producing countries wherever possible.

Demand for coir is livelier today than it has been for the last two decades. It is not necessarily for old applications, although some categories such as floor coverings are as relevant today as they have ever been. New uses have changed not only markets but also the production economics of coir. The most important of which is the developing market for coir dust and pith which now outweighs returns from fibre but when combined with fibre, offers viability to coir production in many countries [Vinay Chand] ^7.
Coir enjoys a dignified status as a fine decorative material in the mansions of the rich and as an article of utility in the huts of the poor. Coir industry is one of the traditional agro-based cottage industries concentrated in coconut producing states of the country. The industry provides direct employment to more than half a million people and indirect sustenance to an equal number or more. India earns foreign exchange approximately worth Rs.303 crores (1999-2000) annually from the export of coir and coir products [Jose, V.S. & Sankaranarayanan, K.C.].

Coir is a versatile natural fibre extracted from the husk of the coconut fruit. The husk contains 20% to 30% fibre of varying length. After grinding the husk, the long fibres are removed and used for industrial purposes, such as rope and mat making. The remaining material is composed of short and medium-length fibres as well as pith tissue, commonly referred to as waste-grade coir. The waste grade coir may be screened to remove part or all of the fibre, and the remaining product is referred to as coir pith.

Coir which is known and increasingly being accepted by the world as an eco-friendly, biodegradable, renewable as a natural resource, sustainable alternative to wood and ply and helpful in soil conservation besides other applications, is a versatile product but constitutes 5% of the market share with 95% held by synthetics. Since the world over there is a concern for preserving environment, demand for coir and coir products are bound to increase especially in the developed countries.

Besides being foremost among traditional ones, coir industry in India has been cottage based and hence employment oriented, spread over primarily in 21 coconut producing states with concentration mainly in Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, Orissa, West Bengal, and Assam. The fibre extracted from coconut known as coir fibre, is a versatile hard fibre used for the manufacture of wide range of wide varieties of coir yarn products like mat, matting, carpets, geo-textiles etc. [Gandhi, G.N.]

Total world coir fibre production is 3,50,000 tonnes. The coir fibre industry is particularly important in some areas of the developing world. India, as a developing nation produces 60% of the total world supply of white coir fibre. Sri Lanka produces 36% of the total brown fibre output. Over 50% of the coir fibre produced annually throughout the world is consumed in the countries of origin, mainly India.
1.2. STATEMENT OF THE PROBLEM

Export is the most important source of foreign exchange for developing countries. All developing countries, including India, strive to increase their exports as a means for mobilizing resource for their development plans. Indian economy is basically agrarian and hence export of agricultural products assumes crucial significance in our export efforts. Growth in agro-exports not only brings in additional foreign exchange for the country but also benefits a large number of people involved in production, processing and export of such products.

India is the largest producer and consumer of coir and coir products followed by Sri Lanka. Both India and Sri Lanka account for more than 90 percent of the global production. India accounts for more than two-thirds of the world production of coir and coir products. It is an important cottage industry contributing significantly to the economy of major coconut growing states and union territories i.e., Kerala, Tamilnadu, Andhra Pradesh, Karnataka, Maharashtra, Goa, Orissa, Assam, Andaman and Nicobar, Lakshadweep and Pondicherry.

In respect of international trade, India and Sri Lanka are the largest exporting countries of coir fibre and related products. Indian coir products are in great demand in the international market because of their special attributes like fitness, price, craftsmanship, quality and attractiveness. The demand for coir products is increasing every year due to growing environmental consciousness and recognition for natural fibres worldwide. Due to globalization, quantity restrictions have been removed and custom duties have been reduced, the subsidies and other benefits enjoyed by the coir exporters were also curtailed. Moreover they have to face competition from abroad. In this environment, it is imperative to find out the export performance of coir products. Keeping this in mind, the researcher focuses on the export performance of coir products.

The role of India as the largest exporter of coir products creates the following questions in the minds of the researcher. In this process the researcher tries to explore the following questions:

1. How is the export performance of coir products after Globalisation?
2. What will be the scope of export performance of coir products in future?
3. Which country is the largest importer of coir products?
4. Whether the product wise exports are stable?
Hence the questions raised above have inspired the researcher to undertake this study on "Export Performance of Coir Industry in India after Globalisation" with the following objectives.

1.3. OBJECTIVES

The main objective of the study is to assess the export performance of coir products after globalization.

The other objectives of the study are as follows:

1. To analyse the export performance of coir products after Globalization
2. To assess the inter-relationship between quantity and value of exported coir products by various companies
3. To assess the country-wise export performance of coir products by India
4. To frame an econometric performance evaluation model for coir products

1.4. HYPOTHESES

The study is based on the following hypotheses:

1. The quantity of export of different coir products is not the same.
2. The value earned by different coir products is not the same.
3. The quantity of export of different coir products from the year 1991-1992 to 2005-2006 is not the same.
4. The value earned by different coir products from the year 1991-1992 to 2005-2006 is not the same.
5. The quantity of export of different coir product of different companies is not the same.
6. The value earned by different coir products of different companies is not the same.

1.5. METHODOLOGY

1.5.1. Data

The study is purely based on the secondary data relating to export of coir and coir products namely Coir Fibre, Coir Pith, Coir Rope, Coir Rugs, Coir Yarn, Curled Coir,
Geo-Textiles, Handloom Mats, Handloom Mattings, Powerloom Mats, Powerloom Mattings, Rubberized Coir, Tufted Mats and Coir Other Sorts. In addition, data relating to 40 exporting companies and country-wise export details are collected from the publications and records of Coir Board.

1.5.2. Sources of Data

The data to substantiate the project analysis were downloaded from the websites and extracted from the books and publications of the Coir Board of India such as Coir News, Coir Board Annual Reports, Kurukshetra and Facts For You. In addition, the required data have been collected from the website sources.

1.5.3. Period of study

The study covers a period of 15 years. The period selected for the study is between 1991-1992 and 2005-2006.

1.5.4. Sample

The Coir Board, Cochin, lists 200 companies as export-oriented units. From this, 40 companies are considered for the study. All the 14 coir products that are exported from India are selected for the study. There are 200 companies that are actively engaged in exporting their coir products. From this, 40 exporting companies are considered for the study. Apart from this, all the 97 countries that are importing coir products from India are taken for the study.

1.5.5. Method of Sample Selection

The Coir Board lists 200 companies as export oriented units. Among the 200 companies, 90 companies are selected which satisfied the following criteria:

i. That data for all the 15 year period were available.

ii. That export is made continuously.

Out of 90 companies, the researcher has selected 40 companies for analysis in this study using convenience sampling.
1.5.5.1. LIST OF COIR PRODUCTS

The following are the various coir products exported from India:

1. Coir Fibre

Coir Fibre is extracted from the fibrous outer cover of the fruit of the Coconut palm, with or without retting. Coir Fibre is graded based on its nature of extraction, colour, presence of long and short fibres, impurities etc.

2. Coir Pith

A spongy material that binds the coconut fibre in the husk, coir pith is finding new applications. It is an excellent soil conditioner and is being extensively used as a soil-less medium for agri-horticultural purposes. With its moisture retention qualities, coir pith is ideal for growing anthuriums and orchids. Available in raw form or converted into organic manure.

3. Coir Rope

Coir Rope is manufactured using coconut husk. Coconut husk is cleaned for eliminating dust and other impurities. This is fed into a reeler. Here the husk is guided through a nylon thread. By this process Coir Rope is manufactured.

4. Coir Rugs

It is indestructible, scrubby, and increasingly stylish doormats. Coir Rugs are durable and natural.

5. Coir Yarn

Coir Yarn is generally of 2 ply, spun from coir fibre by hand as well as with the help of traditional ratts, fully automatic spinning machines etc. The Coir yarn is of different qualities/grades based on the quality of fibre used, the nature of twist, presence of impurities etc. Available in different forms like hydraulically pressed bales, spools bobbins, dholls, balls etc., cut in lengths for various industrial and agricultural purposes.
6. Curled Coir

Coir Fibre is cleaned with hackling machine and the cleaned hackled fibre passes through the twisting machine and the coiled fibre is framed. The same twisted fibre is bundled into required weight. Curled coir is used for mattresses.

7. Geo-Textiles

Geo-Textiles are permeable fabrics, generally used to prevent soil erosion, they protect land surface and promote quick vegetation. Woven and non-woven Geo-Textiles are 100% eco-friendly and bio-degradable and are ideal for soil bio-engineering applications. Geo-Textiles help soil stabilization and renew vegetation in varying slopes.

8. Handloom Mats

Coir Mats made on handlooms and with or without brush. Creel Mats are known for their thin brush; Rod Mats for thick brush and Fibre Mats for compact brush. Latex/rubber backing makes the mats non-slip. Available with woven or stenciled designs and bevelled patterns for use in interior or exterior door fronts.

9. Handloom Mattings

These are made out of Coir Yarn, natural or pre dyed, woven on looms to make a wide range of designs in varying width ranging from 45 cms to 5 meters and normally upto a length of 50 meters. Handloom Mattings are primarily used as floor covering material in households, offices, meeting halls, auditoriums, exhibition halls.

10. Powerloom Mats

Coir Mats made on power looms or frames and with or without brush. Creel Mats are known for their thin brush, Rod Mats for thick brush and Fibre Mats for compact brush. Latex/rubber backing makes the mats non-slip. Available with woven or stenciled designs and bevelled patterns for use in interior or exterior door fronts.
11. Powerloom Mattings

Made on powerlooms. Available in natural beach, solid colours and a multitude of designs/patterns made by weave and colour combinations and with or without latex backing. Quality of the matting is determined by the type of yarn and weave used. Mainly used as floor coverings and floor runners for furnishing stairs/corridors. Also used for wall panelling, ceiling, lining and echo-control.

12. Rubberized Coir

A non-woven mat sprayed with natural latex is known as Rubberized Coir. It is used as Mattresses, in upholstery, as seating material in cars, and in flowerpots.

13. Tufted Mats

Tufted Mats is specifically used for Bathroom purpose as floor Mats. The two types available in Tufted Mats are Hand Tufted and Machine Tufted. Tufted Mats are highly durable, long lasting and washable.

14. Coir Other Sorts

Coir Other Sorts include Needled Felt, Hand Knotted Netting, Coir Ply Articles, Coir Ship Fenders, Coir Braid, Coir Tea Leaf Bags, Coir Brushes etc.

1.5.5.2. LIST OF EXPORTING COMPANIES

The following are the list of exporting companies selected for the study:

1. DC Mills
2. Palm Fibre (India) Pvt. Ltd.
3. Kerala Balers
4. Alleppey Co. Ltd.
5. N C John & Sons Ltd.
6. William Goodacre & Sons India Ltd.
7. Floor Décor
8. Kanti Floor Furnishers
9. M/S Sivanthi Joe Coirs
10. Koncherry Coir Factories
11. R.L.Khanna & Company (Overseas)
12. Aspinwall & Co (Trav.) Ltd.
13. Indian Emporium
18. M/S Koncherry International
20. Madhavan Inc.
22. Poopally Coir Mills
26. Transoceanic Trading Corporation
28. Variamparambil Factories
30. Goodwill Coir Manufacturing Company
32. Goodmorning Coir Mills
34. Aanoo Bagely Coir Private Limited
36. United Coir Factories
38. Bawa Exports
40. G.P. Coir Mart

1.6. FRAMEWORK OF ANALYSIS

The statistical tools used to analyse the data include (i) Mean (ii) Co-efficient of Variation (iii) Analysis of Variance (ANOVA) (iv) Compound Annual Growth Rate (v) Correlation (vi) Trend Analysis (vii) Multiple Regression (viii) Econometric Model for Coir Industry evaluation

i. Mean

Mean is a measure of central tendency representing the Arithmetic average.

ii. Skewness

It is a measure of the degree of a frequency distribution.

iii. Kurtosis

Kurtosis is a measure of flatness or peakedness of a frequency distribution.

iv. Compound annual growth rate (CAGR)

The rate at which present value would "grow" to a given future value in a given amount of time.
iv. Correlation analysis

Correlation analysis is performed to measure the degree of association between two sets of quantitative data. The correlation co-efficient of all the variables also provide a good indicator of which independent variables are highly correlated with the dependent variable.

v. ANOVA

ANOVA is an important technique in the context of all those situations where we want to examine the significant mean differences between more than two groups. The result of the ANOVA will show whether or not the means of various groups are significantly different from one another as indicated by F statistic.

vi. Trend Analysis

Trend, also called secular or long-term trend, is the basic tendency of a series to grow or decline over a period of time. The measurement of trend helps to find out the direction of long term series whether it is growing or declining. It helps to estimate or predict the future behavior of the data.

vii. Multiple regression

Multiple regression is carried out in order to find the relationship between the dependent variable (Total Value earned) and the independent variables.

viii. Econometric Model for Coir Industry Evaluation

The standard diagonalization of a square performance matrix

For same n X n matrix A one can seek a vector x do that A x equals a scalar multiple λ of x. this is trivially satisfied by x=0, so impose x' x = 1 implying x 0 since A x = λ x is equivalent to (A-λI) x = 0. Thus

\[(A-\lambda I) \mathbf{x} = 0, \quad \mathbf{x}' \mathbf{x} = 1\]  \hspace{1cm} (1)

So that A-λ I is singular. This implies a zero determinant value,

\[|A-\lambda I| = 0\]  \hspace{1cm} (2)

which is known as the characteristic equation of A. For example, if A is diagonal with d1............dn on the diagonal, (2) states that the product of d1-λ over I vanishes so that
di is a solution of characteristic equation. More generally, the characteristic equation of an \( n \times n \) matrix \( A \) is a polynomial of degree \( n \) and thus yields \( n \) solutions \( \lambda_1, \ldots, \lambda_n \), these \( \lambda_i \)'s are the latent roots of \( A \); the product of the \( \lambda_i \)'s equals the determinant of \( A \) and the sum of the \( \lambda_i \)'s equals the trace of \( A \). A vector \( x_i \) which satisfies \( A x_i = \lambda_i x_i \) and \( x' x = 1 \) is called a characteristic vector of \( A \) corresponding to root \( \lambda_i \).

Even if \( A \) consists of real elements, its roots need not be real, but these roots are all real when \( A \) is a real symmetric matrix. For suppose, to the contrary, that \( \lambda \) is a complex root and \( x + iy \) is a characteristic vector corresponding to this \( \lambda \), where \( i = \sqrt{-1} \).

1. Then \( A (x+iy) = \lambda (x+iy) \), which premultiply by \( (x-iy)' \):
\[
x' A x + y' A y + i(x' A y - y' A x) = \lambda (x' x + y' y)
\]
But \( x' A y = y' A x \) if \( A \) is symmetric, so that (3) shows that \( \lambda \) is the ratio of two real numbers, \( x' A x + y' A y \) and \( x' x + y' y \).

Let \( \lambda_i \) and \( \lambda_j \) be two different roots \( (\lambda_i, \lambda_j) \) of a symmetric matrix \( A \) and let \( x_i \) and \( x_j \) be corresponding characteristic vectors. The premultiplication of \( A x_i = \lambda_i x_i \) by \( x_j' \) and \( A x_j = \lambda_j x_j \) by \( x_i' \) and subtract:
\[
x_j A x_i - x_i A x_j = (\lambda_i - \lambda_j) x_i' x_j.
\]
Since the left side vanishes for a symmetric matrix \( A \), one must have \( x_i' x_j = 0 \) because \( \lambda_i \neq \lambda_j \), this proves that characteristic vectors of symmetric matrix are orthogonal when they correspond to different roots. When all roots of a symmetric \( n \times n \) matrix \( A \) are distinct, thus have \( x_i' x_j = \delta_{ij} \) for all \( (i, j) \). This is equivalent to
\[
X' X = 1, \text{ where } X = [x_1 \ x_2 \ldots \ x_n]
\]
Also,
\[
A X = [A x_1 \ldots \ A x_n] = [\lambda_1 x_1 \ldots \lambda_n x_n],
\]
or
\[
A X = X \Lambda,
\]
Where \( A \) is the diagonal performance matrix with \( \lambda_1, \ldots, \lambda_n \) on the diagonal. Premultiplication of (5) by \( X' \) yields \( X' A X = X' X \Lambda \) or
\[
X' A X = \Lambda
\]
in view of (4). Therefore, when post multiplication of a symmetric A by a matrix X consisting of A and pre multiply by X’. One can obtain the diagonal matrix containing the latent roots of A. this double multiplication amounts to a diagonalization of A. also, post multiplication of (5) by X’ yields A X X = X X X’ and hence, since (4) implies X’ = X’ -1 or X X’ = 1,

\[
A = X \Lambda X' = \sum_{i=1}^{n} \lambda_i x_i x_j
\]

in the above equation assumed that the \( \lambda_i \)'s are distinct, but it may be shown that for any symmetric A there exists an X which satisfies (4)-(7), the columns of X being characteristic vectors of A and \( \Lambda \) being diagonal with the latent roots of A on the diagonal. The only difference is that in the case of multiple roots (\( \lambda_i = \lambda_j \) for \( ij \)) the associates characteristic vectors (\( x_i \) and \( x_j \)) are not unique. Note that even when all \( \lambda \)' s are distinct, each \( x_i \) may be arbitrarily multiplied by -1 because this affects neither \( A x_i = \lambda_i x_i \) nor \( x_i' x_j = 0 \) for any \( (i,j) \); however, this sign indeterminacy will be relevant export performance evaluation purpose, to say demand or supply orientation in the market.

**Special cases of Matrix**

Let A be square and premultiply A x = \( \lambda \) x by A to obtain \( A^2 x = \lambda A x = \lambda^2 x \). This show that \( A^2 \) has the same characteristic vectors as A and latent roots equal to the squares to those of A. In particular, if a matrix is symmetric idempotent, all latent roots are 0 or 1 because these are only real numbers that do not change when squared. For a symmetric non-singular A, pre multiply A x = \( \lambda \) x by \( (\lambda A)^{-1} \) to obtain \( A^{-1} x = (1/\lambda) x \). Thus, \( A^{-1} \) has same characteristic vectors as those of A and latent roots equal to the reciprocals of those of A. if the symmetric n x matrix A is singular and has rank r, (2) is satisfied by \( X = 0 \) and this zero root has multiplicity n-r. It thus follows from (7) that A can then be written as the sum of r matrices of unit rank, each of the form \( \lambda_i x_i x_i' \), with \( \lambda_i \) 0.

Premultiplication of (7) by \( y \)' and postmultiplication \( y' A y = \Sigma_i \lambda_i c_i^2 \), with \( c_i = y \) ' x i since \( y' A y \) is positive (negative) for any \( y \neq 0 \) if A is positive (negative) definite matrix. Similarly, all latent roots of a symmetric positive (negative) semidefinite matrix are non-negative (non-positive).
Let $A_m$ be a symmetric $m \times m$ matrix with roots $\lambda_1, \ldots, \lambda_m$ and characteristic vectors $x_1, \ldots, x_m$; let $B_n$ be symmetric $n \times n$ matrix with roots $\mu_1, \ldots, \mu_n$ and characteristic vectors $y_1, \ldots, y_n$. Hence, $A_m, B_n$ is of order $m \times m$ and has $m$ latent roots and characteristic vectors. Researchers use $A_m x_i$ and $B_n y_i = \mu_j y_j$ in

$$(A_m \otimes B_n) (x_i \otimes y_i) = (A_m x_i) \otimes (B_n y_i) = (\lambda_i x_i) \otimes (\mu_j y_j) = \lambda_i \mu_j (x_i \otimes y_j)$$

Which shows that $x_i (x_i \otimes y_i)$ is a characteristic vector of $A_m \otimes B_n$ corresponding to root $\lambda_i \mu_j$, it is easily verified that these characteristic vector from an orthogonal matrix of order $mn \times mn$;

$$(x_i \otimes y_i)' (x_i \otimes y_i) = (x_i' \otimes y_i') = (x_i' x_i) \otimes (y_i' y_i) = 1$$

$$(x_i \otimes y_i)' (x_i \otimes y_i) = (x_i' x_i) \otimes (y_i' y_i) = 0$$

Since the determinant of $A_m \otimes B_n$ equals the product of the roots, then

$$|A_m \otimes B_n| = \prod_{i=1}^{m} \prod_{j=1}^{n} \lambda_i \mu_j = \prod_{i=1}^{m} \prod_{j=1}^{n} \lambda_i^{n_j} \mu_i^{m_j}$$

It may similarly be verified that the rank (trace) of $A_m \otimes B_n$ equals the product of the ranks (traces) of $A_m$ and $B_n$.

**The Cholesky Decomposition Coir Basket**

The diagonalization $X' AX = \Lambda$ uses an orthogonal matrix $X, X' X = I$, where $X = [x_1, x_2, \ldots, x_n]$ but it is also possible to use triangular coir matrix. One can consider a diagonal matrix original coir matrix $D$ and an upper triangular matrix $C$ with units in the diagonal,

$$C = \begin{pmatrix} 1 & c_{12} & c_{13} \\ 0 & 1 & c_{23} \\ 0 & 0 & 1 \end{pmatrix} \quad D = \begin{pmatrix} d_1 & 0 & 0 \\ 0 & d_2 & 0 \\ 0 & 0 & d_3 \end{pmatrix}$$

Yielding

$$C' DC = \begin{pmatrix} d_1 & d_1c_{12} & d_1c_{13} \\ d_1c_{12} & d_1c_{12}+d_2 & d_1c_{12}+d_2c_{23} \\ d_1c_{13} & d_1c_{12}+d_2c_{23} & d_1c_{13}+d_2c_{23}+d_3 \end{pmatrix}$$
It is readily verified that any 3×3 symmetric positive definite matrix $A = (a_{ij})$ can be uniquely written as $C'DC$ ($d_i=a_{11}$, $c_{12} = a_{12}/a_{11}$, etc..) This is the so-called Cholesky decomposition of a matrix and also it had applied Barten and Geyskens (1975) and Theil and laithinen (1979). Also, note that $D = (C')^{-1} AC^{-1}$ and that $C^{-1}$ is upper triangular with units in the diagonal.

1.7. LIMITATIONS OF THE STUDY

1. The study covers 15 years only ranging from 1991-1992 to 2005-2006 and it does not include data taken before globalization.

2. The study covers only 40 selected companies and does not include all the exporting companies in India.

3. In this study primary data are not used.

4. It depends only upon secondary data.

5. Time factor is also considered to be a constraint.

1.8. CHAPTER SCHEME

The report of the study is divided into seven chapters:

Introduction and design of the study is presented in the first chapter.

The second chapter deals with the review of literature.

Third chapter is devoted to the export performance of coir products.

A detailed examination of the export performance of companies is presented in the fourth chapter. The quantity and value of exports of companies are discussed in this chapter.

Country-wise export performance is dealt with in the fifth chapter.

Performance evaluation of coir products is presented in the sixth chapter.

Summary and Conclusion is presented in the last chapter.
REFERENCES


