INTRODUCTION

CHAPTER I

INTRODUCTION

Wonderful are the ways of Nature; it offers bountiful to eat like a benign mother, but tests the human resilience when it becomes violent. It inspires in the form of flying birds and magnificent trees and fascinates by the colours it displays. Human beings have constantly drawn inspiration from nature and strove towards harmonizing with it completely. Man has internalized colour by responding to its vibrations emotionally and externally drew from her vast storehouse, to initially paint himself and then to dye the apparel he wore.

Thus, started the alchemy of colour and India was the forerunner in the art of natural dyeing; an art perfected during the era of the great epics. Dyeing was known as early as in the Indus Valley period (2500 BC); this knowledge has been substantiated by findings of coloured garments of cloth and traces of madder dye in the ruins of the Indus Valley Civilization at Mohenjodaro and Harappa (3500 BC). Henna was used even before 2500 BC, while saffron is mentioned in the Bible. Some of the well-known ancient dyes include madder, a red dye made from the roots of the *Rubia tinctorum* L., blue indigo from the leaves of *Indigofera tinctoria* L., yellow from the stigmas of the saffron plant (*Crocus sativus* L.) and from turmeric (*Curcuma longa* L.).Today, dyeing is a complex and specialized science. Nearly all dyestuff is now produced from synthetic compounds. This means that costs have been greatly reduced and certain application and wear characteristics have been greatly enhanced. However, practitioners of the craft of natural dyeing (i.e. using naturally occurring sources of dye) maintain that natural dyes have a far superior aesthetic quality, which is much more pleasing to the eye. Though the art of natural dyeing withstood the ravages of time, with the discovery of the first synthetic dyes in 1856 a rapid decline in natural dyeing set in. Thus, it took barely a century to erode almost all traces of natural dyes from the subcontinent. The skilled craftsmanship of centuries was practically eliminated because a cheaper alternative requiring almost no skill was made available in the captive colonial market of India in the mid-nineteenth century.

India is a country of living traditions. India has a rich tradition of painting. Painters of almost all styles of painting in India have used natural dyes or colors to decorate their paintings. Whether it be the folk paintings of India, such as Warli,

Madhubani, Patachitra, Pithora, Phad, or those that enjoyed royal patronage such as the Ragamala, Miniatures, Tanjore, Pahari, or indigenous art forms like Batik, Tie-dye, Block Printing, Kalamkari, Pichwai, the use of natural dyes is ubiquitous. Surviving traditions of arts and crafts and the most relevant and practical works of art according to the regional availability of material; are still seen today.

An eminent researcher puts it thus, "It has been our good fortune that we are people steeped in tradition and in some remote areas of our country; natural dyeing of fabric is still a way of life, else, revival of this ancient art would have been a near impossibility. Thanks to some visionaries, who realized the need to keep natural dyeing alive - it is still flourishing." (31)

Revival of this ancient art has to be contemporary in its outlook. It has to make the modern generation aware of our 'scientific and eco-friendly' heritage to be of relevance in today's world. Today, for Natural Dyeing to survive, it has to be contemporary and relevant to present day needs. Traditional methods have to be given an exposure and their scientific nature should be highlighted. It has to adopt techniques for production, without sacrificing quality. It has to step out of its image of a "Cottage Industry" to appropriate "Rural Technology" without making the mistake of becoming an "Urban Industry". That is very important because we have seen that urban industrialization has been the root cause of pollution to the magnitude that is unimaginable and – Today it is suffocating and threatening our very health and existence. (31)

With the world becoming more conscious towards ecology and environment, there is greater need today to revive our heritage and tradition of Natural dyeing. The synthetic dyes and chemicals used in dyeing process created problems both in polluting the surrounding as well as having adverse effects to human health, of late; some countries have banned some of the synthetic dyes and chemicals for fear of harmful effects to the environment. In recent years interest has been manifested towards natural dyes. The reasons are manifold including such as those of ecological movement, biodegradability and higher compatibility of natural dyes with environment. Other advantages associated with natural dyes include lower toxicity and allergic reactions in relation to synthetic dyes. This wave of global revival of natural dyeing has not come a moment too soon for India. There are still a few

scattered areas left today, where some skilled dyers are practicing this art. They have had actual experience in the use of Natural dyes. They are old now and it is imperative to support these sources of knowledge, on a priority basis, or this knowledge too, which was at best, an oral tradition will be lost forever. (55)

1.1 Natural Dyes:

With the phasing out of polluting industries in the developed countries, the interest in the naturally dyed textile products such as readymade garments and furnishing factories is picking up in these countries. At the same time there is a stress on large quantities of fabric or made-ups in some shade or design with reasonably good light and wash fastness. This requires development and standardization of technology for the application of selected natural dyes.(68)Natural dyes continue to have limitations in terms of shade reproducibility, inadequate fastness properties and complexity of dyeing process etc. Many of these limitations can and are being overcome with the advances in terms of new dyes, dyeing procedures and technology for manufacture of textiles through research and development by the users and producers of these dyes.(6)

The market for natural dyed textile products is huge and has not been fully tapped. Park B. Smith and Co. of USA has purchased about 10 million US$ worth of natural dyed made-ups every year from India. Marubeni Corporation of Japan has been sourcing organic cotton, natural dyed dress materials, knits and ready-mades in the year 2007. There are many other small exporters from Japan, Europe and U.S. who are developing markets for these products in their countries and are going to increase their business in the coming years. (41) Some companies working in the field of natural dyes in India are Alps industries limited, Noida, Sam vegetable colours Pvt. Ltd., Moradabad Uttar Pradesh, Colours of Nature - Auroville, Pondicherry, Aura Herbal wear Pvt. Ltd., Ahmedabad, NGO's like DWARKA and KARUNA working with Srikalahasti artisans or be it the Mahashakti Seva Kendra: an NGO based in Bhopal.

The Indian textile exports can greatly benefit from developing a niche market for natural dyed/printed products. High value addition is possible through the use of these dyes. Employment generation and protection of the environment are some of the additional benefits accruing of their use. Hence, the need of the hour is to direct

concentrated effort towards developing technologies, processes, products and most importantly a market awareness of the special properties of these dyes, standardization and authentication are some other issues that need to be addressed, lately there has been an increased interest in natural dyes as the people have become more aware of the ecological and environmental problems related to the use of synthetic dyes and according to Hill[6] the research effort donated to natural dyes is negligible. If there had been significant research in the use of natural dyes, it is probable that they would have already been much more widely used than they currently are. As there is much catching up to do after more than a century of neglect, there is plenty of scope for rapid developments.

Colour and dyes have been an integral part of life over several centuries. Nature was the source of dye yielding material, in the form of plants, insects, fish and minerals. History provides ample depiction of the splendour of Indian garments that captured the attention of markets world over on account of bright colours and brilliant shades.

Synthetic dyes made their advent in India in the 19th century. The main advantages of synthetic dyes were ease of processing, better fastness properties and attractive economics of operation for dyers and weavers. On account of these advantages, the synthetic dyes gained wide acceptance and use of natural dyes on commercial scales was discontinued. Over a period of time, use of natural dyes found recognition only as an art form. The absence of:

- Consistent availability of natural dyes in an easily transportable and storable form in adequate quantities and quality,
- Economically attractive raw material supply and package of practices,
- Strong marketing and distribution network,
- Reliable source of supply etc,

have been some of the deterrents that have continued to prevail in the industry for a long time. Variation of shades between seasons, from the same dye yielding source or dye yielding material produced from the same plant in different regions have been some of the other practical problems associated with natural dyes.

Most synthetic dyes are petroleum-based products, the environmental damage caused by the use of synthetic dyes in large quantities have become visibly discernible over the last two decades. The international markets, particularly the European Union, the very origin of synthetic dyes; has strongly supported banning of use of certain synthetic dye stuffs that have adverse effect on the environment and on the humans. The domestic dyeing industry has however not reacted so strongly. Though one could safely conclude that there is an increased level of awareness in the domestic consumers, yet it is not strong enough to pose any threat to the synthetic dyes. Yet the limited awareness appears to have re-kindled the acceptance towards natural dyed products. "A case in point is that one of the weavers in Kanchipuram is producing and selling saris using all natural dyes."[1] The macro level changes expected on account of WTO implications may cause increased levels of awareness on environmental issues within the domestic market.

Today, use of natural dyes is restricted to certain pockets like, in art forms of kalamkari and commercial practices like Ikat weaving, block printing, boutique work, etc. In WTO era a demand for "new" and "exclusive" products may create an additional demand for "naturally dyed" fabrics. It is also noticed that the application of natural dyes is mainly done on fabrics of commercial use and new fibre categories are not explored.

India is a country rich in resources and just as its language changes form state to state, so does its flora and fauna and hence the availability of indigenous fibres and dye material. There are craft clusters in each state of India that practices a traditional craft in the form of dyeing, printing or weaving, metallurgical crafts or pottery and ceramics, or crafts involving items of home décor and ropes and twine making. The indigenous natural fibres available in each state of India are either used for making ropes and twines, basketry or for small craft articles which fetch a minimal price in the domestic markets.

1.2 Minor fibres:

It is time to understand the terms conventional and non-conventional/minor textiles or fibres. Before non-conventional/minor textiles are to be understood, it is better to probe into the term conventional textiles. The textile items that are commonly used by convention are obviously conventional textile. If we talk about

conventional textile based on basic material one may easily pronounce cotton, silk, wool or synthetic in India, the last being one of the latest addition. But they may also be region specific or time specific. Even a few centuries back Linen was conventional textile used in Europe and Egypt while cotton in India and silk in China. The scenario has been changed often gradually, later drastically. With scientific development rayon (both acetate and viscose) as well as synthetics has been added in the list of conventional textile, many natural fibres used in yesteryears and forgotten, many area specific items were universalized and finally blending of more than one items brought in new certain conventional products. In the process however, many wonderful natural products that were conventional during those times were ignored which became non-conventional later. These are also products which have potentiality to become useful textile but were never tried seriously. Considering textile from natural resources the consumption is increasing in such a galloping rate that even renewable resources are becoming non- renewable. The method of manufacturing textile in the modern era causes pollution to a considerable extent. Manufacture of synthetic fibres also causes pollution to a certain extent. For this reason, there is a need to search for non-conventional renewable resource for textile to give an effective solution.

There are various minor fibres available through out the length and breadth of India, which find application into indigenous craft forms of the region. Some like jute, cane and bamboo have created a niche for themselves and are used to make very useful utility products. Some of the plants whose leaf, fibre or stem are used are palm, banana, pineapple, screw pine, cane, betel nut/areca, sisal, bamboo, hemp, *munj* (grass craft of Bihar), *korai* grass/sedge (grass craft of Kerala), coir, water hyacinth, etc. Parts of these plants are woven, knitted or handcrafted to manufacture products like baskets, trays, mats, mattress, rope, carpets and floorings, sack, seat base, rugs, doormats, hats, furniture, rope, fishing rods, walking sticks, handmade paper, table mats, gift boxes, lamp shades, composite ply boards, pack saddle for horses, mules and donkeys and for tying garlands.[75]

1.2a. Hair and Silk:

Sheep wool is also a type of hair which is accepted as a conventional textile universally known. In a stricter sense for the purpose of textile there is a basic difference between wool and hair in their characteristics. Wool has basic modulity

whereas hair is rigid; hence wool has greater acceptability than hair. There are certain animal hair which can be explored for various textile purposes like camel hair, goat hair, rabbit hair, yak, alpaca, ilama etc and also fibres derived from wild silk worms.

"Endi silk worm is a staple diet of the Ao Naga tribe. To save the silk worm for consumption and also to get silk fabric out of it; the Ao Naga tribe of Nagaland has an interesting practice. A hollow bamboo frame is placed on the floor and a stipulated number of mature silk worms are kept into it. The worm does not find a place to anchor for cocoon weaving hence it spurts out the liquid on the floor the fibroin liquid solidifies into nonwoven silk fabric on exposure to air thus a square thick non woven fabric is obtained. The worms are picked after they have finished exuding the liquid sericin and taken for cooking." [20]Similarly there might exist many practices indigenous to each state and according to the regional availability and need of fibre and food.

1.2b. Bast and Leaf fibres:

The leaves of monocotyledonous plants are held in shape and strengthened by fibres which run in hawser like strands through the length of the leaf. These leaf fibres are of great commercial value, and are used in large quantities for making ropes and cordage, and for the production of textile fabrics.

Plant fibers have been used for making paper and clothing for a long time and the need for use of natural fibres has increased greatly. Among natural fibres, 90 per cent are of vegetable origin and among them 80 per cent is constituted by cotton and the remaining by other long vegetable fibres like flax, jute, hemp, sisal, ramie, coir, abaca, banana and pineapple fibres. They are classified as minor fibres.

Among the minor fibres, leaf fibres (fibres extracted from leaves) are one of the important unconventional fibres, which could be analyzed and evaluated for their use in textile and paper industries. Their use is based on the length and width of fibres besides their wall thickness and cell wall composition.

1.3 Prospects of the textile and clothing sector:

Textile and clothing sector accounts for 16.98 million employment generation (principal and subsidiary) in the country as per the data available from

NSSO(National Sample Survey Organization) employment by industry of work, 61st round data (2004-05) as compared to employment generation of 459 million in the entire economy. Thus share of employment generated in textile and clothing sector account for 3.7 per cent of the total number of employees in the economy.

The Indian textile and clothing industry continues to have an important place in the national economy as regards employment, value addition or income generation, and export earnings. It is estimated to provide employment to more than 16.98 million workers as per NSS (National Sample Survey) 61st round, (July 2004 – June 2005), 11.6 percent of manufacturing value added during 2006-07, and 13.8 percent of total export earnings during 2007-08 (Compendium of Textile Statistics, Office of the Textile Commissioner, Mumbai). The share of clothing in total expenditure of households is estimated at 6.65 per cent in 2004-05 at all India level, while expenditures on clothing account for more than 4.02 percent of total private consumption expenditures during 2006-07 (National Accounts Statistics, 2008).

The total value addition in textile and clothing sector is estimated at Rs 718520 million, which accounts for 11.6 per cent of the total value addition in the manufacturing sector (NAS, Central Statistics Office; (CSO) data for year 2008).[80]

The made-ups are likely to grow at much faster rate from 13194 million square metres to 19001 million square metres by 2011-12 and further to 26819 million square metres by 2015-16. The household consumption is likely to grow from 28071 million square metres during 2007-08 to 34327 million square metres by 2011-12 and 40841 million square metres by 2015-16.

1.3a Trends in consumption of various textile items:

1.3a.i. House hold consumption /Made –ups

Items that are meant for the common use for all members of the family are categorized as household items. In other words, the items, which are not purchased for a particular family member but are generally used by all members for e.g. furnishing, tapestry, etc. are, called household items. The prominent items include bed-sheets, mattresses, decorative items, wall hangings etc and is also popularly known as made ups.

The share of made-ups (including both Household Varieties and Furnishing Material) in woven cotton textiles has increased from 10.01% in 1990 to 17.55% in 2000 and further to 19.15% in 2006. The number of units producing made up in the unorganized sector are estimated at 1.68 lakh. The share of handloom units is 83.7 of total units.

1.3a.ii. Non-household consumption

Any surplus not exported and not consumed in household sector is taken as available for non-household consumption purposes. Non-household consumption is described as the consumption of textiles in hotel, restaurant and office setups, where a considerable amount of textiles are used in order to do the interiors which match the brand identity of the organization.

The availability for non-household consumption was estimated at 5322 million square metres in 1993-94, which increased to 13108 million square metres in 2004-05, according to Textile Committee data for household consumption. So the annual growth rate of non-household consumption is 8.54 per cent. Hence the growth in non-housed consumption is estimated to be much higher compared to household consumption. The possible reason for high growth rate is very high growth in segments consuming textiles and clothing products in non-household sector such as hotel, restaurant and offices. The hotel and restaurant industry has shown growth more than 10 per cent since last 5 years (Economic Survey. 2007-08).[44]

1.3a.iii. Overall consumption

The overall per capita consumption of Household Items showed an increasing trend during 1990 to 2006. It increased by 45% during 1990 to 2000 and then by 22% during 2000 to 2006. The gross value of consumption increased over the years as expected due to increasing per capita consumption and population. The gross household consumption of 118 woven household varieties first increased by around 75% during 1990 to 2000 and then by around 34% during 2000 to 2006. The share of Household Varieties in woven textile items increased from 9.11% in 1990 to 15.99% in 2000 and then to 17.75% in 2006. [44]

1.4. STATEMENT OF THE PROBLEM

When we consider colouring textile materials from natural sources, a field is entered that has been explored in the past and looked upon with renewed interest by the present generation dyers. Natural dyes had ruled the markets of textile colouring and exports for years to the extent that natural dyed textiles had been the key export commodity to the western world, but suffered discontinuity of use due to certain limitations.

"It is true that vegetable dyes may be duller and that they do not run through a lengthy, diverse and brilliant gamut as various branches of aniline. But they are apt to be permanent and are so softened by the mellowing touch of time that they gain with age an exquisite combination of colour values that is altogether inimitable. "It was claimed that the Shah of Persia punished with death the man who brought aniline dyes into his kingdom." (37)

"Natural Dyeing" is an oral tradition and its scientific nature needs to be highlighted. Though being our art heritage, we have not been able to protect it from the onslaught of synthetic dyes. Yet it is still practiced in some of the rural areas of India. (31)

Minor fibers and natural dyes are indigenous to the rural areas of India and so is natural dyeing process. It is the need of the hour to highlight the scientific nature of the process that are already known to the rural dyers, instead of introducing synthetic dyes, and polluting their only water sources, which are lakes and ponds and land pollution through dumping, as they have no means of proper effluent treatment and discharge. Hence, the purpose of the study was to focus on the natural dyeing process, to dye minor fibers.

The handicraft industry is unique for being self-reliant due to India's biodiversity and availability of cheap labour. From growing its raw material to delivering a highly value added product to the consumer, it is in the position to contribute to the whole range of activities significant to the economy of the country. At present it adds 14% to industrial production and 35% to the country's export earnings, with less than 2% share in the gross import bill. It has immense potential for employment generation for the weaker sections including SC/ST and women in the

rural areas providing jobs to agriculturists, weavers, artisans and technicians in the decentralized as well as the household sector. The industry has a wide sector distribution and it uses a variety of fibres, natural as well as man-made and synthetic, and blends of one or more fibres.(31)

"One of India's biggest strengths is that it has the ability to export everything from raw fibres, to yarns, fabrics and garments. At lower levels of the chain, we recover less value. Our industry's goal should be to consume all the fibers, yarns and fabrics for making home textiles and garments ourselves. We can create a lot of value by converting the raw materials into final products for export rather than exporting them in their raw material form."(33)

Natural dyeing gives high value addition to the products and also increases the export potential of these goods, since the market has a high demand of goods processed in an eco-friendly manner, on account of the German ban on Azo dyes and other red listed chemicals, that are to be avoided in the textile wet processing.

This research aimed to utilize the exclusivity factor of minor fibres and also diversify the form of their usage in order to add value and make them applicable for niche market consumption. Cellulose and protein minor fibre categories were selected. Each category had two fibres each; they were: Jute fabric and sisal fibre in the cellulose minor fibre category and Eri silk and Kutch goat wool in the protein fibre category.

The décor in the high end Indian homes across metros, especially in the capital, is going back to traditional after years of dabbling in the utility and Spartan chic of contemporary west. This means, tradition is making a comeback in Indian home décor.

Hence, the investigator proposed "A Study on dyeing of Minor Fibres with Natural Dyes". In an environment conscious world today Natural fibers hold an important place and to fulfill the demand of newer varieties of fibers, various Natural sources have been explored to obtain them. Various types of fibers like banana, jute, sisal, flax, coir, coarse wool, wild silks, etc are amongst the few varieties of fibers used for apparel purpose and for other textile made-ups.

Due to an occurrence of a wide variety of natural fibres in the country, Indian researchers have directed efforts for quite some time in developing innovative natural fibre composites for various applications. While the national research agencies in India have excellent scientific achievements to their credit for development of natural fibre composites, efforts on their utilization in home textiles have been limited so far. The product diversification and value addition of minor fibres is based on a two-pronged strategy of utilizing underexplored local resources as well as ensuring good economic returns due to value addition by means of natural dyeing.

1.5. The objectives of the study:

1.5.1. To assess the dye ability of cellulose and protein minor fiber with selected natural dyes and mordants.

1.5.2. To evolve a colour palette from the selected natural dyes.

1.5.3. To assess the fastness properties of the dye on the fiber.

1.5.4. To assess the eco-parameters of the dye.

1.5.5. To explore designs for value addition and product diversification of minor fibres/minor fibre fabrics.

1.5.6. To assess the consumer preference for designed products.

1.6. Delimitation of the study:

1.6.1. The study was limited to six natural dyes namely: Madder, Marigold, Flame of Forest, Henna, Ratajot and Catechu and a combination of Madder and flame of forest, Madder and Marigold and Madder and Ratanjot.

1.6.2. The study was limited to the use of four metal mordants; alum, copper sulphate, potassium dichromate and ferrous sulphate and also limited to the use of two natural mordants namely: tea leaves and pomegranate rind. pH variation was limited to pH 4 and 8; with pH 6 being the pH of the extract.

1.6.3. The study was limited to the use of four natural fibres: Sisal and Jute fibres amongst the cellulose category and Eri silk and Goat Hair in the protein category.

1.6.4. Designing of products was limited to products for home décor namely: wall hangings, partition panels, rugs and lampshades.

1.7. Scope of the Study:

The study was aimed to develop products using indigenous dyes and fibres and non-machine intensive techniques in order to create value added products that would fetch a high price in the market. It would be of immense importance to the small scale industry segment and to agencies working at the grass root level for training of rural artisans in the art of natural dyeing and product making.

The study will help to realize higher value for indigenous fibres available all across the country as a value added end product could be made by imparting dyeing and product designing skill to the traditional weaving and printing clusters of India.

1.7a. *Year 2009: International year of natural fibres*

"Natural fibres close to thirty million tons are produced annually. Natural fibres form an important component of clothing, upholstery and other textiles. Many of them also have industrial application in packaging, papermaking and in composite materials with many uses, including as parts in automobiles. In many developing countries, proceeds from the sale and export of natural fibres contribute significantly to the income and the food security of poor farmers and those working in fibre processing and marketing. For some developing countries, natural fibres are of major economic importance: for example, cotton in some West African countries, jute in Bangladesh and sisal in Tanzania. In other such cases, fibres are of less significance at the national level but are of major local importance, as in the case of jute in West Bengal (India) and sisal in north-east Brazil. Since the 1960's the use of synthetic fibres has increased and natural fibres have lost a lot of their market share. Producers and processors of natural fibres face the challenge of developing and maintaining markets in which they can compete effectively with synthetics. In some cases, this has involved defining and promoting market niches. The main goal of the International Year of Natural Fibres is to raise the profile of these fibres and to emphasize their value to consumers while helping to sustain the incomes of the farmers."

1.7b. Sisal fibre in Indian perspective

In rapidly developing countries like India, it is the need of the day to explore the potential of available raw material from all the pockets of the country. A country with a rich biodiversity will present many areas with great potentiality. One such area is the sector of under utilized/minor fibres. According to a study by **Amit Rai and Jha (2004)** utilization of plant fibers for generating employment in rural sector is cost-effective and ecologically sustainable. India has a vast resource for different natural fibers viz., jute, sisal, banana, coir etc., which are abundantly available in many parts. Presently, the production of natural fibres in India is more than 400 million tones. Among others, sisal has many advantages like thriving in wastelands and yielding superior fiber continuously for 6-8 years with least management input.[49]

Present scenario indicates that the use of plant fibre (sisal / flax / hemp etc) based automobile parts like trim parts, various panels, seat backs, shelves, brake shoes etc., are picking up momentum worldwide. Reduction in weight (10%), energy of production (80%) and cost of the components (5%) as experienced elsewhere, attracts the automobile industry to employ sisal fibre composite parts in India. The conservative estimates indicate that about 6,000 TPA plant fibre based composite parts can find their way into passenger cars and multi utility vehicles (OSEC, 2004). Railways are also a potential application area where in it is estimated that about 350 TPA fibre composites is required for manufacture of doors, luggage racks, panels, partitions, seating etc.[42]

Packaging materials for bags, boxes, crates, containers, which is now made up of wood, can be replaced by cost-effective sisal reinforced composites. Boats can be made by replacing the conventional polymer composite fibres with sisal as reinforcement. The market potential of geotextiles for roads, paved road networks and railways applications in India is estimated to be 2,72,500 tonnes, of which a considerable portion can be earmarked for sisal-based textiles (Vibrant Gujarat, 2005). Similarly, the potential of the fibre to be utilized into crafts and textile material should also be explored.