

## An Insight In To the Ikat Technology in India: Ancient To Modern Era

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**Abstract:** *Ikat technique is one of the oldest and ancient methods of fabric ornamentation made with the elegant touch of the hand of a weaver. This yarn resist the way of embellishment for cloth is entirely different from that of the fabric ikat due to its versatility of ornamentation in the field of intricacy, fineness and artisanship of a pure designer, probably evolved from Asia. Although, shuttle-less looms with sophisticated dobby and jacquard technology are introduced into the textile industry with high productivity, the traditional textiles until date attracts its class of customer all around the globe. Apart from it, many a country, by policy, wanted to nurture and preserve their cultural heritage and craftsmanship; until now most of them continue earning a good chunk of the foreign exchange on export. In fact, even during the post-WTO regime, ikat fabrics are well in a track to accolade full recognition in international fairs and exhibitions. Although the tie and dye technique is age-old and struggling to be developed by now into a very high precision and skill technique, a limited detailed technical study and review is reported. The scientific pieces of literature sometimes neglect the art! So many available are based on the narration of existing traditional process involved but lacks the artistic insight with a fore vision for sustainable growth; evaluation of different methods, new technology adoptions for up-gradation of the tie and dye technique. There is an enormous scope of mechanisation of each manual process; those are being practiced currently for development of IKAT fabrics starting from Winding, Grouping, Tying and Dyeing etc. for mass or bulk production with uniform quality that ensure sustainable growth of the sector with appreciable remuneration to the majority of poor traditional weavers. In the present article, the details of technology involved in each of the processes, current developments in India and scope of future tech are well discussed & an approach has been emphasised with indications of extended possibilities.*

**Keywords:** *Kat, Tie-n-Die, Yarn resist, Auto-Ikat-Group-Former, Bobbin winding machine, sustainability*

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### 1. Introduction

History (Ikat in World): Fabric ornamentation involves essential art and science to decorate each finished textile product concerning the rapid changes in customer's choice for style and fashion throughout the ages. The ikat or tie and dye fabrics with intricate and artistic designs, produced in leading handloom clusters of India play a vital role in the export market and attract foreign consumers to its market sphere in comparison to other countries in rest of the world. As per the findings in the "Bulletin of needle and bobbin club-Ikat Techniques and Dutch east Indian Ikats",<sup>(1)</sup> in Malayan Archipelago, the ikat technique still excels today both quantitatively and qualitatively. The word ikat means winding around, tying or binding. The effect produced by this technique is that of a flame pattern, and it is found that this term of flame-weaving applied to it in Germany, Italy and Sweden. In French, it is called Flam'e and also Cbin'e. In Spain, it is called tela-de-lenguas (Tongue of flame cloth). The earliest specimens preserved were from in Egyptian graves and were made by Arabs (Fatimides) and around 1100 AD. Plate-1, i.e. the warp ikat of the metropolitan museum of Art, New York). But it is not precisely known how far back the ikats were first made in the Malayan Islands. Evidence of this is found in the Ajanta Frescoes of Northwest British India, i.e. the Plate-3 of the metropolitan museum of Art, New York, dating from about 600AD.

It is worthy to preserve this art because of its eco-friendliness, scope of mass employment, less or investment and sustainability<sup>(2)</sup>.Pidan is special, elaborately designed pictorial ikat silk for religious architectural decorations used in Thailand and Southern Vietnam<sup>(3)</sup>.Ikats, Batiks and Plangis are each made in entirely different names, but with the conventional method, dyeing called resist method. In this process, the design is

applied to woven cloth (As in batik or plangi) or on the threads before weaving (as in ikat) with a substance that is afterwards removed, this substance resulting from the dye when the piece is placed in the vat<sup>(4)</sup>.

It is strange that resist method used in New Zealand in the making of so-called “Grass Skirts”. The fibre used here is the leaf of the New Zealand flax (Phormium Tenax). From this, the skin or fibrous part of the plant is partially scraped off. When afterwards, the flax is put into a solution of bark, the exposed fibres takes as a deep brown colour that contrasts pleasantly with the silvery lustre of the remaining epidermis which is not affected by the dye. The grass skirts consist entirely of such strips of fibres which look like white beads of different length, strung on a deep brown cord<sup>(4)</sup>. In these grass skirts of New Zealand, there is a resist process, where no substance is applied, but where the content is removed, a type described by Prof. J. W. van Nouhuys of the colonial museum in Rotterdam- to whom all are much indebted for this interesting information as the Negative of Ikat<sup>(5)</sup>. Outside British and Dutch East Indian, Ikat has been present in various parts of the world as follows. Indo-China, Philippines, Japan, Turkestan, Persia, Asia Minor, Egypt, Nigeria, Balkans, Majorla, France, Italy, Switzerland, Germany, Sweden, Finland, Guatemala, and Ecuador<sup>(6)</sup>. Also, it is used in the countries like Indonesia, Myanmar, Malasia and Thailand<sup>(7)</sup>.

From recent study, it is observed that the scope of employment in this segment has been increased in India in comparison to other countries. In most of the countries it is almost diminished in spite of support from government and non-government organizations. The application process of natural dyes followed earlier in rural cottages is now again revamped to avoid the carcinogenicity of banned synthetic dye stuffs to face such global challenge.

### 1.1 What is it in India?

It is defined as the evolvement of designs by the hand-resist-dyeing<sup>(8)</sup> process on yarn/fabric. The method is also called tie and dye, bandhani or chiticki<sup>(9)</sup> at different places of India though called ikat in foreign countries. However, Tie and dye or ikat word is originally derived from the Malayan word “Magnikat”<sup>(10)</sup> and it is in existence from 4th century BC in the form of “patalika” or potola as per Dr Moti Chandra<sup>(11)</sup>. It is in existence from 12th Century AD at Nuapatna, Cuttack as per Madala Panji of Jagannath Temple<sup>(12)</sup>.

1.2 How is it? There are 08 main methods of development of Ikat/Tie and Dye materials as follows<sup>(13)</sup>

Method/Technology	Medium	Patterns developed
Fold resist	Fabric	Bleeding pattern
Stitch resist	Fabric	Indonesian Design
Wrap resist	Fabric	Rajsthani Laharia
Tie Resist	Fabric	Bandhani/Potola
Stencil Resist	Fabric	Itlaian Design
Wax resist	Fabric	Batik Design
Mordant resist	Fabric	Printed effect
Tie resist on yarn	Yarn	Bandha or Chitick Designs

### 1.3. Where is it?

Ikat is present over the world in different names. It is called as flame weaving in Germany, Italy and Sweden, but as Flam’e or Cbin’e in French. Similarly, it is known as Tala-de-lenguas in Spain and Pidan at Thailand and Southern Vietnam<sup>(1)</sup>. It is well known in New Zealand under a special name called ‘Grass-Skirts’<sup>(5)</sup>. In India, it is known by different names depending upon the cultures to varying localities as follows<sup>(14)</sup>.

Place of production	Medium	Name of the pattern
Rajasthan, India	Fabric	Rajsthani Laharia
Gujurat, India	Fabric/Yarn	Bandhni and Potola
New Delhi, India	Fabric	Laharia
Andhra Pradesh, India	Yarn	Chiticki
Orissa, India	Yarn	Bandha
Indonesia, Malayacia and Japan (Shibori)	Fabric and yarn	Plangi, Batik and Stitch resist Indonesian designs
Itali	Fabric	Stencil resist Italian designs

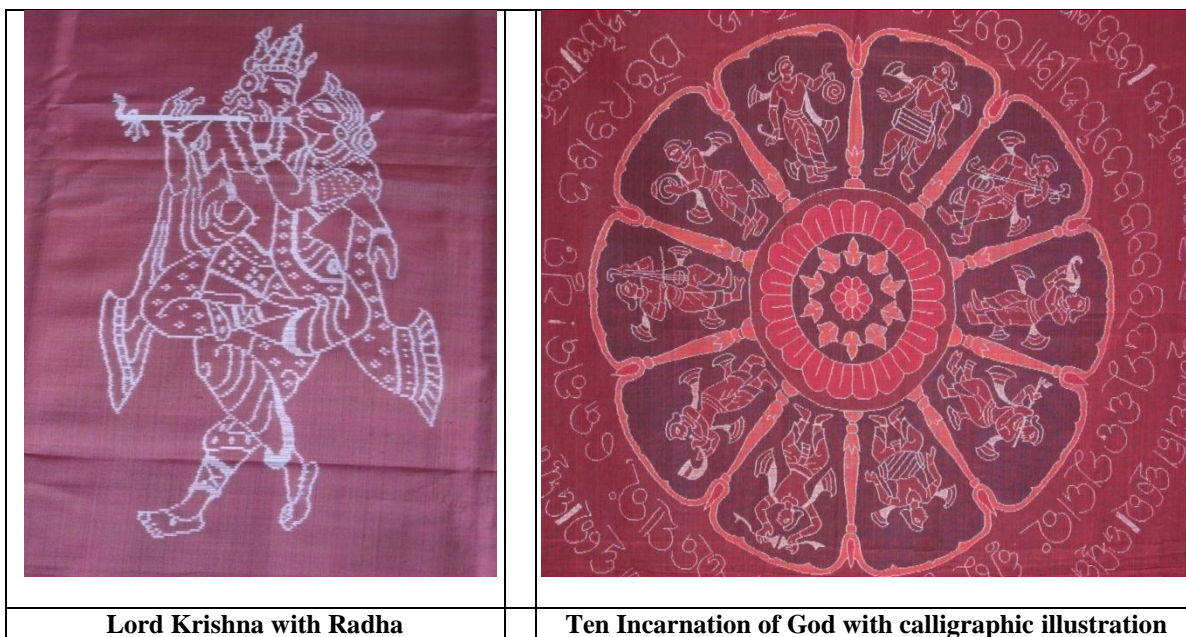
### 1.4. Why is it?

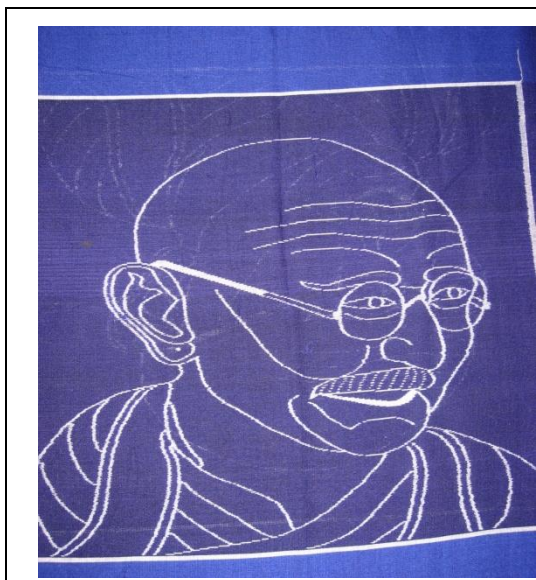
Ikat designs are more artistic, linguistic having high export value and are suitable for wide range of products. It can follow-up to consumer’s emanation, style, fashion and trend. Again it can be branded with Q = P/E quality norms (84% of consumers need this norm). The introduction of multilateral trade system creates better scope for its marketing. Again, India is one active member of WTO out of 161<sup>(15)</sup>. There is ample scope for automation of process involved in its manufacturing. Puchampalli ikat and Orissa ikat and many other ikat products are already covered under GI to safeguard its domain. The ‘SWOT’ of Indian Handloom Industry has already been analysed and proved that the future of Ikat Handloom Industry is bright and sustainable<sup>(16)</sup>. Tie and dye weaving is a complicated method of ornamentation of textiles which combines many of the above

processes. In India since long, traditional way of the hand resist process of printing, i.e. local dying popularly known as the tie and dye weaving, reserve a unique place in textile ornamentation. This technique meet the need of most modern stylish and fashionable consumers of India and abroad covering exclusive items like Potola (silk double ikat on yarn) of Gujarat, Bandhani (ikat on fabrics of Rajasthan and Gujarat and many parts of world), PagduBandhu, Buddavasi and Chiticki (ikat on yarn of Andhra Pradesh), and Bandha (tie and dye on thread of Orissa). Tie and dye craft provides a significant employer in the states like Orissa, Andhra Pradesh, Gujarat next to agriculture and to some extent in Rajasthan. It also earns an excellent foreign exchange on export.

From export scenario for last five years available with website of Handloom Export Promotion Council, Chennai, it is observed that the volume of export of handloom fabrics during 2016-17 is up to Rs. 2392.21 crores against Rs. 2353.33 crores during 2015-16. Again on analysis of exports of handloom fabrics to other 10 top countries during the year 2015-16 and 2016-17, It may be seen that during FY 2016-17, USA, UK, U.A.E. and Germany have witnessed decline of about 3%, 16%, 4% and 1% respectively whereas Italy, Spain, France, Netherland, Australia and Japan have registered positive growth of 14%, 41%, 13%, 29%, 33% and 5% respectively during this period. Of course it is not with a clear picture on ikat fabrics. However, overall growth is satisfactory. Recent trend indicates the need of hand touch value added ethnic ikat wears. Most of the designers are busy on collection of such items with latest developed designs. The life-span of such trend is expected to be more than decade, though it takes time for establishment from a blooming period<sup>(21)</sup>. Ikat was limited to traditional saris only, now it has been diversified to many modern wears with new styles as dress materials & furnishings. Now it is in attraction of domestic/foreign consumers by the print/press media & other advertising tools. Besides, tie and dye is the oldest traditional textile prevailed since 5th century A.D. in India. Here, designs are evolved followed by the resist-dyeing technique.

The modern craftsmanship and talent of ikat weavers of Odisha of India can be visualised from following few sample photographs woven by one Sant-Kabir award winner namely Sri Sarat Kumar Patra of Nuapatna Village in Cuttack district of Odisha inside India.

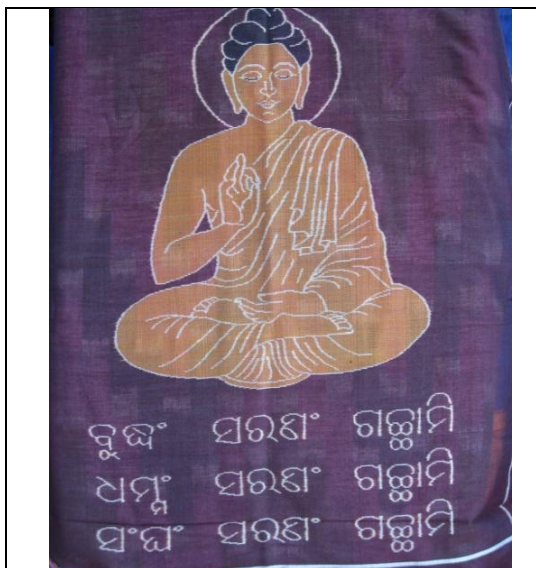




Father of Nation of India, Mahatma Gandhi



Nobel winner for peace-Mother Teresa



Lord Buddha



NetajeeSubas Chandra Bose



Lord Jagannath, God of the Universe



God of the Universe with its Ten Incarnations

	
<p><b>Gitagobinda of Jayadev (52 mtrs, entire epic)</b></p>	<p><b>KandarpadalaRatha of Epic Mahabharat</b></p>
	
<p><b>Some Ikat Samples of more than 200 years old collected by Sri Sarat Kumar Patra, Nuapatna</b></p>	

### 1.5. Tie and Dye Textiles In Fashion Domain

Fashion, naively can be termed as a changing form of clothing; not the only considered as a garment development for a market, but also the overall appearance (style), utility value and fitness for purpose with aftercare. Thus fashion represents nothing more than one of the many forms of life by the aid of which we seek to combine in uniform spheres of activity the tendency towards social equalization with the desire for individual differentiation and change. Every phase of the conflicting pair strives visibly beyond the degree of satisfaction that any fashion offers to an absolute control of the sphere of life in question<sup>(17)</sup>. In this context, the double ikat

silk sari of Gujarat, Bichitrapuriikat cotton sari of Sambalpur or Silk odhni with calligraphic Ikat effect (Gita Govinda) namely Khandua of Nuapatna of Odisha have come across a significant change on its overall appearance as well as the utility value also have substantial cultural and aesthetic impact. Khandua, the small silk Odhni with GitagobindaSloks written by great poet 'Jayadev' in ikat form prevailed during the 12th century for offering to Lord Jagannath of Puri Temple have been transformed to various types suitable for human use in the shape of fashionable modern Garments. Recently, designers select ikat clothes as a creativity item into fashion domain.

However, present textile designers have to study more on traditional ikat designing process and its development in the context of latest developments in style, science and technology. A stylish, co-ordinates the clothes, jewellery, and accessories used in fashion photography and whose designs are based upon living things, trends, and the latest collections. Ikat is one of the latest suited clothing for a custom clothier making custom-made garments to satisfy preferred customers. Most of the models now a day wear and displays ikat clothes at fashion shows and other display medias<sup>(18)</sup>.

### **1.5.1. Position Of Ikat In Fashion Classification**

A fashion can be brief or of long duration. Fashion is classified into many types, such as: Style, Basic or classic, Fad, Fashion Forecasting and Trends. Fashion plays a more conspicuous role in modern times, because the differences in our standards of life have become so much more strongly accentuated, for the more numerous and the more sharply drawn these differences are, the greater the opportunities for emphasizing them at every turn. In innumerable instances this cannot be accomplished by passive inactivity, but only by the development of forms established by fashion; and this has become all the more pronounced since legal restrictions prescribing various forms of apparel and modes of life for different classes have been removed<sup>(19)</sup>.

**1.5.2. Style** is always constant. It does not change whereas fashion changes. It is not constant. Style is the basic outline of any garment. When we make a different neckline and different sleeves with some trimming here and there over a basic garment then the basic garment is modified into a different look or a different outfit, this modification ferment will become **Fashion**, when it is accepted by people as in case of sarees, dress materials and furnishing from KhanduaOdhni stated above. When a fashion is constant or long lasting, such as, salwar kameez and bridal saree, it is called **Basic or Classic** like bridal silk ikat saris namely, Patola of Gujarat, Saktapar, Bchitrapuri, Khandua of Odisha andPuchampollyikat materials of Andhra Pradesh. It is similar to a standard music.

Now -a-days, these basic items especially ikat yardage materials become the most important promotable fashion for the forthcoming designers and remain as an integral part of the fashion domain. But, **Fad** is something which can either make a designer's life more interesting or tenses. Overall, Fad can be defined as short lived fashion, lasting for a very little time or period, acceptable by only a certain group of people. Such period never came in the ikat domain during last ages<sup>(20)</sup>.

### **1.5.3. Forecasting Ikat Fashion**

This is the important part of fashion scenario, because when any new garment is designed by the designer and worn, it will not create fashion by itself. It needs the media to spread fashion and this media which spread fashion and gets the fame and name to the designers is Fashion Forecasting. This is done through many communicating media, such as, fashion shows, BSM, NH Expo, participation in international fair, printing of ikatbroachersand product catalogues. It also includes Market Research, Consumer Research, Surveys, Shopping, Sales Records, Evaluating the collections, Fashion Trends and Plan for Target Markets adopted by state apex organisations of the country.

### **1.5.4. Position of Ikat In Present Trends**

Fashion trends are the styling ideas that major collections have in common. They indicate the direction in which fashion is moving. Fashion forecasters look for the styles they think, are prophetic, ideas that capture the mood of the time and signal a new fashion trend. Several designers may use a similar fashion idea because they have been inspired by common sources. Recent trend indicates the need of hand touch value added ethnic ikat wears. Most of the designers are busy on collection of such items with latest developed designs. The life-span of such trend is expected to be more than decade, though it takes time for establishment from a blooming period<sup>(21)</sup>.

### **1.5.5. IKAT in Fashion Cycles**

Consumers are exposed each season to a multitude of new styles created by designers. Some are rejected immediately by the press or by the buyer on the retail level, but others are accepted for a time. **The way in which fashion changes is usually described as a fashion cycle**, usually depicted as a bell shaped curve encompassing five stages: introduction, rise in popularity, peak of popularity, decline in popularity, and

rejection. We can conclude that the fashion is based on adoption by a social set, which demands mutual imitation from its members and thereby releases the individual of all responsibility ethical and aesthetic-as well as of the possibility of producing within these limits individual accentuation and original shading of the elements of fashion. Thus fashion is shown to be an objective characteristic grouping upon equal terms by social expediency of the antagonistic tendencies of life <sup>(22)</sup>.

**Introduction of style to IKAT domain:** The ikat domain was based on traditional culture and fashion without any intervention of designers; rather it was the heart and soul of the customers. With change in time, the domain is in a path to be adorned with multitude of new styles created by designers. The process is at baby stage.

**Increase in popularity:**

Ikat was limited to traditional saris only, now it has been diversified to many modern wears with new styles as dress materials and furnishings. Now it is in attraction of domestic/foreign consumers by the print/press media and other advertising tools.

**Peak of popularity:**

When a fashion is at the height of its popularity, it may be in such demand that many manufacturers copy it or produce adaptations of it at many price levels. Such peak period is yet to come in the Ikat domain.

**Decline in popularity:**

When it takes century together to establish such a trend, it is difficult to forecast a limited span of time for its decline, since it is as like as an integral part of marriage ceremony of tradition with modernity. The presently used one may be an antique for future generation.





**Rejection of a style or obsolescence:**






The rejection or discarding of a style just because it is out of fashion is called *consumer obsolescence*. But here in case of 'IKAT' the word of 'Shakespeare' in early as 1600, "fashion wears out more apparel than the man" is not proved<sup>(23)</sup>. The traditional textiles exist from 5<sup>th</sup> century AD<sup>(24)</sup> followed with ikat textiles at about 11<sup>th</sup> century AD is just at baby stage of fashion cycle even at 21<sup>st</sup> century.

**2.1. Technology Involved In Tie And Dye Making And Weaving**






**Process Sequence In Tie And Dye Making And Weaving**

The ikat/tie and dye of Odisha, Gujarat or Andhra Pradesh, i.e. resist dyeing of yarn is the most versatile method to produce diversified designs. In this technique, individual portions of yarn (warp or weft) are made to resist the dye by wrapping or covering. It is done when the yarn is tied in bundles and the sequences adopted in this technique <sup>(25, 26)</sup> are as follows:

01	Scouring / bleaching in case of cotton or de-gumming in case of silk yarn to remove the natural and additive impurities increasing its absorbency during dyeing.	 <p style="text-align: center;"><b>Cotton</b></p>	 <p style="text-align: center;"><b>Silk</b></p>
02	Yarn sub-grouping as per predetermined order. It determines the fineness of design. In Odisha 02 threads are taken in a sub group for finer designs and 04 threads for bold designs. It is 8 in Panchampally of A. P.	 <p style="text-align: center;"><b>Cotton</b></p>	 <p style="text-align: center;"><b>Silk</b></p>

03	Yarn grouping as perpredetermined order it is dependent upon the size of the repeat of design. The number of threads in a group also indicates the total number of repeats to be produced.	 <p style="text-align: center;"><b>Cotton</b></p>	 <p style="text-align: center;"><b>Silk</b></p>
04	Tying to resist the yarn from dyeing as per the design pattern. It is important with respect to tension. Color bleeds into inner side if less tension and colour penetration will be uneven if more tight.	 <p style="text-align: center;"><b>Cotton</b></p>	 <p style="text-align: center;"><b>Silk</b></p>
05	Dyeing. During dyeing the bulbs formed between two knots are ruptured manually for well penetration of color into it.	 <p style="text-align: center;"><b>Silk</b></p>	 <p style="text-align: center;"><b>Silk</b></p>
06	Washing and drying. After dyeing it is thoroughly washed, squeezed and opened to freeair for oxidation in case of vat color. All sorts of impurities during tying are also removed.	 <p style="text-align: center;"><b>Silk</b></p>	 <p style="text-align: center;"><b>Silk</b></p>
07	Resisting, dyeing, washing and drying for number of times as per the number of colours required. It is required for polychromatic effect.	 <p style="text-align: center;"><b>Cotton</b></p>	 <p style="text-align: center;"><b>Cotton</b></p>
08	Untying (removing resisting materials). Untying is done carefully, so that parent tie and dyed threads are not broken. Otherwise complete repeat of design will not be developed during weaving.	 <p style="text-align: center;"><b>Cotton</b></p>	 <p style="text-align: center;"><b>Silk</b></p>



09	Separation /unwinding of yarn from group to sub-group. From tie and dyed groups, each sub groups are separated in first hand. Each sub-group contains same designed threads.	 <p style="text-align: center;"><b>Cotton</b></p>	 <p style="text-align: center;"><b>Cotton</b></p>
10	Sub-group to individual threads. Each sub-group contains similar pattern threads and these are separated into individual threads for use as warp or weft during weaving.	 <p style="text-align: center;"><b>Cotton Individual Threads</b></p>	 <p style="text-align: center;"><b>Silk</b></p>
11	Weaving to produce tie and dye designed fabrics. The tie and dyed individual threads are arranged one by one as per predetermined order during weaving to have the exact motifs on the fabric.	 <p style="text-align: center;"><b>Silk Woven Saree</b></p>	 <p style="text-align: center;"><b>Basani/Finishing of Saree</b></p>

The double ikat silk textiles from Gujrat (Potola), Chiticki (ikat on yarn of Andhra Pradesh) and Bandha textiles from Orissa are prepared basing on the above process.

## 2.2. Technology Of Tie And Dye Weaving Through Ages

Making of an ikat often takes a year or more. It is interesting to know that the average Flores and Soemba cloth contains more than 3 or 4 thousand warp threads. Such laborious work could be only invented and practised where food was cheap and human labour not valued regarding money. If the warp threads are just stated, the weft is not treated, will impair because of its single colour, the clarity and effect of the design. To prevent this, the threads carrying the pattern are always thicker than the other. The looms without exception primitive, are different on every Island at that time, but why the width should vary every region is not known. At that time to get broadcloths, the weavings are often sewn together<sup>(27)</sup>. In silk ikatPidan of Thailand and Southern Vietnam, the basic weave followed is 2/1 twill. It is also followed in most of the areas of Cambodia<sup>(28)</sup>.

Silk used in Sumatra, Bali and Banka comes mostly from China and Japan. Palm leaf fibre (Agel) is grown in the Island and is used in Sumatra for coarse weaving as well as binding. Formerly, beautiful natural dyes were made in the Island. Reds are obtained from roots (Menkaedoe or Koedoe). For blue-Indigo, yellow is boiling tegaran wood sometimes by mud-bath<sup>(29)</sup>. Old vegetable dye process now exists in a few localities. Modern ikats made with aniline dyes, no longer have the charm that old ikat with natural dyes with dark and soft tones<sup>(30)</sup>.

The essential feature of the tie and dye technique<sup>(31)</sup> is to produce a design on fabric by ordinarily interlacement with warp and weft in plain weave, which is already died in different colours according to the design colour scheme. The yarn in warp/weft is dyed in various shades at different places. Nowadays the most developed double ikat fabrics are produced by the resist dyeing by resist yarn method.

**Motifs Involved In Kat Weaving:** In northwest Sumatra, the main motifs used were based on a shape of arrow used at that time<sup>(32)</sup>.

But in case of Thailand and Southern Vietnam, the main motifs used in silk ikat called Pidan are religious based motifs like Buddha, Naga, half-God-like serpent or dragon, temple, white elephants etc. <sup>(33)</sup>. But the motifs used in India are entirely different and mostly dependent upon nature and religion. Then it is also different from place to place. Presently, Odisha ranks number one position in Ikat field concerning design intricacy, colour combination, craftsmanship, and versatility in the range of materials used, technology used and texture of weaving. The sharp outline of design indicates the craftsmanship of artists of Odisha than stepped or wavy outline prevailed at other places of India. It is interesting that now a day, every clothing is associated with

ikat effect as identification of Odisha Ikat. The details of motifs, which are currently used in some of the traditional ikat designed Saree of Odisha can be summarised as follows<sup>(34)</sup>. (The Magic of Orissa Handlooms, Published by Directorate of Textiles, Orissa, 1st publication in Orissa, 1999)

Sl. No	Name of the traditional products	Origin of Motifs	Details of Motifs used
01	KhanduaSareeof Nuapatnaarea of Odisha	Jagannath Temple andJayadev'sGitagobinda	Traditional Lions and Elephant motifs with a central band having lotus and creeper design. Border andAnchal have floral motifs 'popularly known as Khandua Silk Saree', used as a bridal single ikatsaree. (Item No.044 at Page-31)
02	KhanduaTaraballiSareeof Nuapatna of Odisha	Milk way of sky with floral motifs	Traditional Lions, Elephant and Lotus motifs having 'taraballi' (band of stars of sky), designs in central position of the Saree along with floral motifs on border andanchal, called as TaraballiKhanduaSilksingleikatSaree used specially in bridal purpose.(Item No.042 at Page-31)
03	NabaKothiri Saree of Nuapatna of Odisha	09 specific defined motifs	Nine square segments placed in a linear way horizontally on the body containing nine different designs like, lotus, elephant, temple, peacock, pot, lion, conch, butterfly and deer in one line and another nine in the other line. With floral motifs on border andanchal popularly known as 'NabaKothiri' Silk single ikat Saree. (Item No.043 at Page-31)
04	Taraballi Saree of Nuapatna of Odisha	Milk way motifs of sky formed by stars	Body of the Saree is decorated with single ikat star motifs arranged in diamond form with traditional anchal. It is popularly known as 'Taraballi' saree. Used as a daily utility item.(Item No.075 at Page-43)
05	BadaFulla Saree of Nuapatna of Odisha	Flowers	Body of the Saree is decorated with big flowers arranged in allover pattern developed by single ikat method with traditional anchal. It is popularly known as 'Badafulla' saree. Used as a daily utility item.
06	TipaThikiri Saree of Nuapatna of Odisha	Diamond and finger tip	Body of the Saree is decorated with unitary motifs of finger tips inside a diamond (Thikiria) developed by single ikat method with traditional anchal. It is popularly known as 'TipaThikiri' saree. Used as a daily utility item.
07	BattaThikiri Saree of Nuapatna of Odisha	Geometric diamond and rod effect	Body of the Saree is decorated with unitary motifs of finger tips inside a broken lined (Rods or Batta) diamond (Thikiria) developed by single ikat method with traditional anchal. It is popularly known as 'BattaThikiri' saree. Used as a daily utility item.
08	Baghambari Single IkatSilkSaree of Bargarh area of Odisha	Lotus flowers	Lotus motifs on body with check effect along with traditional tie and dye anchal known as Baghambari Saree. (Item No.038 at Page-28)
09	Soudamini Single Ikat Cotton Saree of Bargarh area of Odisha	Floral motifs	This Cotton Saree is decorated with elementary floral motifs on body and anchal. It has colouredikat stripes and bands without a clearly differentiated border. It is popularly known as 'Soudamini Saree'. (Item No.068 at Page-41)
10	UtkalLaxmi Saree of Bargarh of Odisha	Lotus flowers in different direction	Body has different forms of lotus, placed in the centre of the square formed by intersecting floral ikat lines both horizontally and longitudinally, which is quite intricate. It has various forms of lotus on border and anchal. This Saree is popularly known as "UtkalLaxmi" because lotus is the favorite flower of goddess Laxmi. This is the main traditional double ikat saree of Sambalpur area of Odisha. (Item No.093 at Page-50)
11	Saktapar Saree of Sambalpur andSonepur area of Odisha	Dice check effect	Sakta (Dice-Check) motifs placed in different shapes (Mostly hexagonal and squares) in the body developed in double ikat method having an extra warp border and floral traditional anchal, popularly known as 'Saktapar Saree'. (Item No.111 and 112 at Page-57)
12	Aswini cotton double ikat saree of Bargarh area.	Geometric check squares	The saree is decorated with ikat check squares in linear form inside body on solid white back ground. The checks are formed here by intersecting ikat lines on body with floral designs on body andanchal, popularly known as 'Aswini' Saree.(Item No.100 at Page-52)
13	KusumaDoubleIkat Silk Saree of Sonepur area of Odisha	Geometric check effect	The silk saree is decorated with two different forms of double ikatsakta (dice check) effects in square form over the body. The anchal is decorated with traditional ikat motifs like fish, deer, elephant, swan and lotus etc.
14	Patnaikpar Single Ikat cotton Saree of Sambalpur area of Odisha	Animals, flowers and birds	It is a singleikat cotton Saree ornamented with a check pattern on both body and central border having fish and swan design along with a traditional anchal. The anchal is also decorated with the design motifs of fish, elephant,

			lotus, peacock and creeper along with extra warp and extra weft lines, popularly called as 'Patnaikpar' saree in Bargarh area of Odisha. (Item No.052 at Page-35)
15	Habaspuri Cotton Saree of Kalahandi district	Animaland Nature	This is named after the place of production i.e. Habaspur village of Kalahandi district. The special feature of this saree is that it is having longitudinal, Kumbha (Temple), Fish and Tortoise motifs in border developed by extra warp. The anchalis decorated with local tribal motifs developed by extra weft technique. It is used as a bridal Saree. (Item No.137 and 138 at Page-71)
16	Berhampuri Cotton/ Silk (Patta) Saree	Phodakumbhaand flowers of coconut placenta	This Saree is also named after the place of production i.e. Berhampur. The specialty of the saree is its small phodakumbha (Inter locked by hand) border, decorated with zarithreads. The anchal is ornamented with flowers of coconut (Placenta) using extra weft method of designing by badis (rods). It may be developed either in cotton or silk. The silk saree is used for bridal purpose. (Item No.129 at Page-67)
17	Siminoi of Dhenkanal district	Mound, temple in ikat method	The name of the Saree is based on the place of production i.e. village 'Siminoi' of Dhenkanal district. It is woven with plain body associated with extra warp border contained with solid flat shaped badiKumbhaeffect by ikat method. The anchal is decorated with large flowers by extra weft method. (Item No.141 at Page-72)
18	Jagatsingpuri	Multifarious motifs	The name of the Saree is followed after the place of production i.e. jagatsingpur. The specialty of the saree is it is woven with single fine cotton up to 120's. It is also with interlocked solid kumbha-border and 04-butis in cluster spread over the body (Called as chaributi Saree) .Anchal is combined with extra weft andikat design. (Item No.158-160 at Page-79)
19	Kusumi of Dhalapathar of Khurda district	Local flowers	The Saree is named after a local flower in the area. Earlier, it was developed with natural dye using pomegranate, manjistha, lac, black solution and jack fruit tree etc. Later with synthetic coloursand now it is diminished from the area. The chief motifs used are local 'Kusumi' flowers in different shapes using extra weft method with the help of set of badis called 'KalabhidaYantra'.
20	Bomkai Cotton Saree of Ganjam district, now prevailed at Subarnpur district	Birds, animals and flowers	This Saree is also named after the original place of production i.e in village 'Bomkai' of Ganjam district of Odisha. Initially, the saree was in production with 2ply 40's x 20's cotton yarn adorned with designs by extra weft method using help of jalla. The main motifs were used originally are Karela or bitter guard, atasi flower, Kanthiphula or a small flower, fish (machha) or fly, chadei (bird), peacock (mayur), tortoise (Kanichha), lotus (padma), wooden lamp stand (rukha), dambaru or small drum used by lord 'Shiva', danti or tooth, horizontal half diamond andnakshi or horizontal full diamond. Now a days, this is woven in both silk and cotton with a very fine texture associated with modern ikatand extra weft motifs mostly in Subarnpur district of Odisha. (Page-83)
21	Natural dyed Cotton Kotpad Saree of Koraput district of Odisha	Birds, animals and living style of tribal.	The Saree is named after it's the place of production. The color is collected from the roots of 'Aal' tree (MorindaCitrifolia). The importance of this saree is linked with its solid border decorated with numerous forms of temple in tiny shape and serrated effect along with weft ribs. The color used is in dark chocolate tone derived from the aforesaid tree. The general tribal motifs used for decoration of the saree can be summarized as fish, tortoise, hut, snake, axe, hand fan, birds, water pot, temple etc. (Item No.122, 124 at Page-65)
22	Mayurbhanj Saree of Mayurbhanj district of Odisha	Natural floral and animal motifs	It is a ceremonial Saree produced at Mayurbhanjand named after the place of production. It is woven with a heavy texture (Coarse cotton count). It is with plain border in blue or green colour on gray body or check body decorated with an anchal by weft rib solid color bands along with fish, flower, diamond and triangular motifs. Some of the motifs are developed by hand embroidery. It is used by the tribal-groom during marriage ceremony. (Item No.125-127 at Page-66)

### 2.3. Steps In Ikat.

Basic steps involved to produce a design are <sup>(35)</sup>: -

- Selection of design and fabric setup. (Yarn count, ends/inch, picks/inch, size of repeat, no. of colours, length x width of fabric etc.).
- Pre-processing of yarn including scouring / bleaching / mercerising for cotton and de-gumming for silk as described earlier.
- Preparation of suitable packages for required quantity of ikat fabrics.
- Winding, sub-grouping / grouping the threads in a predetermined order as per design and colour scheme.
- Tying or resisting or insulating the threads to dyestuffs on design/ground portion as per the colour scheme.
- Wetting with 1 – 2% TRO for 2 – 3 hours to increase absorbency.
- Dyeing of the un-tied or non-insulated portion of threads starting from lighter shades to deeper shades followed by washing / after treatments and drying.
- Rupturing the balls formed between tied nodes in the fastened materials.
- Un-tying the thread groups / sub-groups.
- Arranging the threads pick by pick to evolve exact motifs of design by weaving.

### 2.4. Tying

#### 2.4.1. Tying Materials

During ikat process, one type of fibre namely 'Agel' was used for resting/tying/binding purpose in ancient time. Winding and unwinding process is repeated for polychrome effect<sup>(36)</sup>. Nowadays the tying materials used are manifold. Mostly polythene is used in Odisha where no temperature is required for dyeing, otherwise, the leaf of Pandananas (Locally called Kia), Cotton threads or Rubber are used for tying where the heat is used for dyeing. However, cotton threads of the different count are used for excellent artistic designs at a higher temperature. The tying is done with the fibre called agel. For polychrome effects, the process is repeated<sup>(37)</sup>. Tying materials generally used are rubber, a leaf of screw pine (botanical name Pandannas), polyethene or cotton threads<sup>(38)</sup>. Cotton threads are mainly used as wrapping or tying material for white outlines or spaces for colour less than 0.5cm.

A good Tying material should have the following properties.

- Strength to overcome repeated process of dyeing.
- Resistant to different chemical and temperature.
- Smooth surface by which yarn is not damaged.
- Flexible for easy warping.
- Phobic nature towards dyestuffs.

It should not react with dye solution.

#### 2.5.2. Tying: In Olden Time 04 Steps Were Followed To Complete The Ikat Process As:-

1. Threads prepared mounted as warp on the loom, the threads tied together in bundle of five (05).
2. The entire warp threads so prepared are transferred to another loom called an ikat on loom. Here the actual process of winding and binding takes place.
3. After total pattern is tied dyeing takes place.
4. The dyed warp is now unwrapped and mounted on the weaving loom and the actual weaving begins.

#### 2.5.3. Design Intricacy/Fineness Of Design

The intricacy or fineness depends upon the number of threads per group and no. of threads per group to be taken depends upon

1. Shade and its number (colour).
2. Picks or ends per repeat i.e. two pick three pick or four pick as seen in Orissa and Gujarat. Eight picks or sixteen picks are seen in Andhra Pradesh. Number of threads per group determines the fineness and continuity of design i.e. less the number of threads per group more is the intricacy and fineness of the design.
3. Absorbency of threads or dye solution penetration through thread groups.
4. No. of repeats to be produced at a time.

Two picks per group design often will contain twenty threads per bundle to be tied for resistance, whereas it will carry fifty threads if repeats are twenty-five. Dye liquor circulation is better in twenty thread group than fifty thread group. Most important is the distance between two tied portions of a group of threads should be sufficient enough for proper circulation of dye solution; otherwise curve outer linings will be evolved instead of sharp linings. If the distance is so short, the external layered threads of the tied groups are dyed leaving the interior threads. Again the tension applied to the tying/wrapping threads should be even and enough so that the dye liquor is not allowed to pass through it; otherwise the colour is bleed which is not desirable.

During wetting bulkiness of cotton is increased and of silk is decreased slightly which is to be considered during tying.

Till date, all the kinds of literature available are based on the narration of history and traditional process involved and insufficient in developing the scientific evaluation of different means and adoption of new technology for technology up-gradation of the tie and dye industry. However, the exploitation of the advantages of recent developments in textile and allied fields have rarely been noticed yet. There is the bare need to generalise this technique from a limited number of highly skilled artists. For technology up gradation in the ikat process, it is to be scanned, and drawbacks are to be noted for the solution.

### 3. Major Drawbacks In The Process

The major draw-backs<sup>(39)</sup> of the present ikat weaving by resist dyeing methods applied to yarn can be summarized as follows.

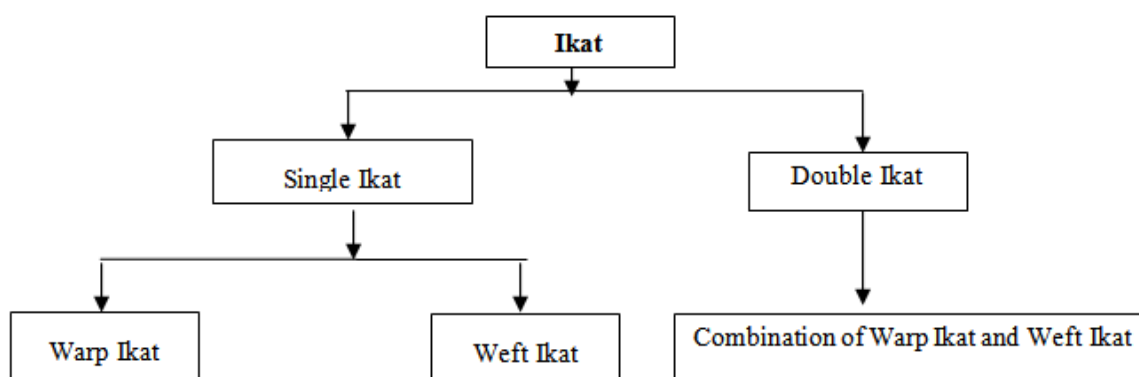
1. Till date, it is not a replicable process and the product from batch to batch differs in design and colour composition.
2. Processes involved like winding, grouping, dyeing etc. are not scientific and more time consuming with a loss of great man-days.
3. Needs high skill of craftsmanship.
4. Very low productivity and lot or mass production is difficult since most of the processes are done manually.
5. It is applicable to only handlooms till date, with few warp ikat design in power looms.
6. No or few literatures are available on process development for its generalization.
7. Involved processes are having less or no control on the quality of products. The fastness properties like colour, rubbing, washing and light fastness are not assured.
8. Colour bleeding is not completely assured.
9. Colour matching problem limits the bulk production and also exportability.
10. After treatments are not applied.
11. Most of the dye staffs containing Azo and Amino group used in the industry are banned due to carcinogenic effect.

During post-WTO regime, ikat fabrics have obtained full recognition in recent international fairs and exhibitions. Indian exporters have diverted their concentration, especially towards ikat fabrics production to meet the global market.

### 4. Classification of Ikat (Tie And Dye) Manufacturing Process

As per Algoud Henri, ikats were classified into three groups, i.e. the warp ikat-Warp threads ikated frequently, the weft ikat-Weft threads ikated here and double ikat- Both warp and weft are ikated. The double ikat was very rare. The details of Chin's ikats are described in a lengthy article Arts of Manufacturer-1753<sup>(40)</sup>. The process is defined as "one of the most delicate and intricate ever invented in arts and crafts", and at that time double ikat was not known. The colourful weavings then created are characterised by their beautiful design which is not sharply outlined but flow gently into one another. Now it is entirely different during 2017. Hundreds of looms are running with double ikat and allied combined ikat designs in western Odisha of India.

*The tie and dye fabrics prepared by yarn resist methods are mainly classified as follows.*



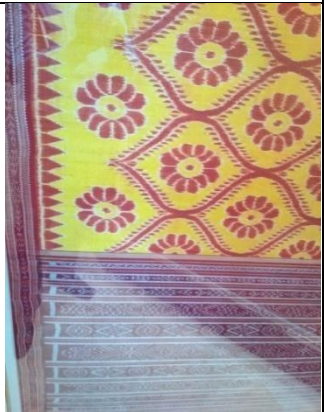






The recent inaugurated (22.03.2018) Odisha Crafts Museum at Kalabhumi, Pokhariput, Bhubaneswar, Odisha by the honourable Chief Minister of Odisha can be described as one of the research hubs of Ikat Textiles, and one should take a bird's eye view on it to get the basic idea on Tie and Dye Textiles. On 23rd March 2018, Ambassadors from 52 different countries have visited the museum and described it as one of the

best museums in the world. Some examples of latest developed single, double and combined ikats displayed in the Raw Material and Handloom Gallery of the museum described above can be observed as below.









Double Ikat Chitra akabya Bandra dhodaya Silk/Cotton/ Tassar Saree	01		Double Ikat Harapriya Saree	02	
Double Ikat Sakta (Passapalli) Saree	03		Double Ikat Utkal Laxmi Saree	04	
100 year old Double Ikat Sakta (Passapalli) Saree	05		Traditional Double Ikat Saree Multi Roll	06	
Double Ikat Stole Multi Roll	07		Double Ikat Bichitrapuri Silk Ikat Pit Handloom of Western Odisha	08	

<p>Single IkatDhan patri Saree</p>	<p>09</p>		<p>Single Ikat Traditional Machha (Fish) Saree</p>	<p>10</p>	
<p>Traditional Sachipar Saree of Sambalpur</p>	<p>11</p>		<p>Traditional Badikumbha Saree</p>	<p>12</p>	
<p>Single Ikat Dress Materials Multi Roll</p>	<p>13</p>		<p>Single Ikat Cotton Saree Multi Roll</p>	<p>14</p>	
<p>Tassar Saree Multi Roll with Ikat bits</p>	<p>15</p>		<p>Multi Roll of Traditional Saree with Hatakumbha ndIkat bits</p>	<p>16</p>	

<p>Traditional Khandua Single IKat Silk Saree of Nuapatna, Cuttack, Odisha</p>	<p>17</p>		<p>Traditional Khandua Taraballi Silk Saree of Nuapatna, Cuttack, Odisha</p>	<p>18</p>	
<p>Modified Cotton Khandua Saree of Nuapatna, Cuttack, Odisha</p>	<p>19</p>		<p>Traditional Khandua Badafula Saree of Nuapatna, Cuttack, Odisha</p>	<p>20</p>	
<p>Traditional Khandua Nabakothari Saree of Nuapatna, Cuttack, Odisha</p>	<p>21</p>		<p>Traditional Khandua Barakothari Saree of Nuapatna, Cuttack, Odisha</p>	<p>22</p>	
<p>Traditional Khandua Batathikiri Saree of Nuapatna, Cuttack, Odisha</p>	<p>23</p>		<p>Superfine Khandua Silk Saree (245gms wt only) of Nuapatna, Cuttack, Odisha</p>	<p>24</p>	



<p>Natural dyed Scot-Chakra Silk Saree with colorant Indian madder (Chay), Botanical Name :Oldenlandia umbellate , Local Name Manjistha, Nuapatna, Cuttack, Odisha</p>	<p>25</p>		<p>Natural Dyed BrukshyaDe bata Saree with colorant black solution etc, Bargah, Odisha</p>	<p>26</p>	
<p>Natural Dyed Saree with Colorant, Manjistha, Jacktree, Black solution and Pomigranate etc, Dhalapathar, Khordha, Odisha</p>	<p>27</p>		<p>Natural Dyed Saree with Colorant, Lac(Laccifer lacca), Nuapatna, Cuttack, Odisha</p>	<p>28</p>	
<p>Natural Dyed Shreya Cotton Saree with colorant black solution and pomigranate etc, Bargah, Odisha</p>	<p>29</p>		<p>Natural Dyed Lagan Cotton Saree with colorant, Ala (Morinda Citrifolia) belongs to Rubiaceae family Kotpad, Koraput, Odisha</p>	<p>30</p>	
<p>Natural Dyed Tribal (Santal and Kotpad) Fabrics with Aul color in Multi Roll, Koraput, Odisha</p>	<p>31</p>		<p>Natural Dyed Tribal Fabrics with Ala color in Book Form, Koraput, Odisha</p>	<p>32</p>	

<p>Original 100 years old Khandua Odhani of Nuapatna , Cuttack, Odisha</p>	<p>33</p>		<p>100 years old Dui-Munha Narrow PhodaKumbha Saree</p>	<p>34</p>	
<p>100 years old Dui-Munha Narrow PhodaKumbha white cotton Saree</p>	<p>35</p>		<p>100 years old TinifuliaPhodaKumbha Traditional Anchal Saree</p>	<p>36</p>	
<p>100 years old PhodaKumbhaHata-JallaAnchal Saree</p>	<p>37</p>		<p>Yoga Saree with postures of Yogasans in Ikat, Sonapur, Odisha</p>	<p>38</p>	
<p>The most complicated Sriganita Ikat Saree with Mathematical formula as design, Sonapur, Odisha.</p>	<p>39</p>		<p>Great Poet Jayadev'sGita gobindaDhadi with and Calligraphic designed fabric</p>	<p>40</p>	

From significant draw-backs of the Ikat processes indicated above, it is felt that works are to be done on sections like (A) Mechanisation of manual process of winding with ordinary charkhas to prepare suitable packages (B) Mechanisation of manual grouping process and its calculations with hand or semiautomatic horizontal drum warping machine (C) Mechanised method to calculate the exact weight of resisted material after tying to develop an precise shade of opening a path for mass production (D) Development of the new process for application of modern finishing like smoothness, fragrance and drape quality. The developer tools can help the mass production and deal with a more significant order on export.

## **5. Recent Technological Developments In Ikat Processes**

### **5.1. Development of 4 spindle Domestic-Hank-To-Bobbin winding machine**

Development of 4 spindle domestic hank to bobbin winding machines for preparation of suitable packages required for group formation. Now a day, various automatic devices are developed for composite-mill and power loom industries, which are not ideal for use by a poor weaver due to its high cost, volume, weight, electricity consumption and complicated operation mechanism. At present, the yarn is available in hank form as per hank yarn obligation scheme of India and it is to be converted to other forms like bobbins, natai or charkha etc. required for mass production of ikat or tie and dye materials. A simple 4 Spindle Domestic-Hank to Bobbin (DHTB) winding machine has been invented recently (2011) which are very much suitable for rural poor weavers with following characteristics.

**5.1.2. Objectives:** Invention of an appropriate mechanism for domestic and cottage level use, to reduce the time consumption and labour in winding operation through charkha, to increase the efficiency of winder and productivity of weaver and to increase the income of a domestic winder by more than three times over conventional winding operation. The machine has following characteristics.

- (a) Size of the device is very small suitable for installation at cottage level near the handloom.
- (b) The lightweight of the machine makes it portable.
- (c) No electric power is required to run the machine.
- (d) It is driven by a miniature motor of 60 watts capacity when run by electricity.
- (e) A chargeable battery of 12 volts can operate it.
- (f) The cost of the machine is affordable for the weavers.
- (g) The device can be run comfortably by a winder with or without electricity.
- (h) Gear, ball bearing and lever arrangement are applied for reducing the frictional forces and smooth running of machine.

The new device has overcome all the problems with a large size bobbin winder meant for factory or mill, and now it can be used at decentralised cottage level.

### **5.1.3. Output analysis of the new machine.**

A man can run a charkha for 8 hours a day to wind only 100 to 120 hanks of 840 yards of cotton yarn. The process is not only laborious but also time-consuming for preparation of suitable packages, and the productivity is severely hampered. On the other hand, available motor driven 12 spindle or more capacity winding machines are ideal for mill industry but not applicable to a cottage based handloom industry due to various reasons. Prime reasons are (a) want of space in the cabin (b) Heavyweight and not movable (c) Want of electricity connection and lack of continuous supply in remote area (d) High capacity motor consuming more electricity (e) High cost of the machine for a weaver (f) The machine cannot run manually.

Present machine is designed to run four spindles for winding hanks to bobbins, and the motion is given either by a miniature motor of 60 watts capacity or by 02 pedals driven by legs of the winder where there is no electricity. Care has been taken to make the machine for domestic use removing all the problems faced to run a machine designed for the mill sector. Even, currently, steps are being taken at the Institute of Handloom Weaving and Design, Khordha, Odisha to run this machine with solar energy.



#### **4 Spindle Domestic Hank To Bobbin (DHTB) Winding Machine**

The Machine has been developed in the joint venture of Sri Sudarsan Behera, Ex-CDE, Nuapatana and One Expert Weaver namely Sri Antaryami Tosh of Nuapatana during implementation of Nuapatana State Handloom Cluster Development Programme under Chief Minister's Special Package for Handloom Weavers of Odisha (2011). The machine is under patent, and it is under examination by the patent authority. In the meantime, depending upon its demand and popularity, 440 tools have already been supplied in the state in PPP mode by the end of 2016-17, and yet thousands of machines can be provided in the state of Odisha to strengthen the livelihood of concerned people depending entirely on winding activities.

#### **5.2. Development of Auto-Ikat-Group Former (AIGF)**

Secondly, the most tedious process in the manufacturing of Ikat or Tie and Dye materials is the preparation of groups for tie-dye design. Before weaving various ikat design/patterns on the loom, a hand winding process of yarn is required for the development of groups for manufacturing of a traditional 'Tie and Dye' cotton or silk sari. This is a very tedious and cumbersome process and involves a lot of motions of the hand for thousands of times in four-five hours. It includes both a lot of calculations and labour for preparation of groups from suitable packages made by the winding machines. The manual process adopted for the development of groups is different from one state to another. In case of Odisha and Gujarat, mostly rectangular ikat frames are used for tying the groups, whereas, in Andhra Pradesh, triangular ikat frames are used. In a tripartite structure of Andhra Pradesh, there is one central peg and 40 other peripheral pegs, and it limits the maximum number of groups to be tied on it. In Odisha rectangular frame has scope for preparing a large number of groups.



Again a paper design/pattern is to be enlarged suitably to transfer it onto the tying frame before tying every group. The enlargement is easier in case of rectangular frame than the triangular one, since the design is gradually squeezed towards the central peg in case of triangular frame starting from the peripheral pegs. It needs more mental power and skill for enlargement of typical designs. Hence, the mechanism of winding and related calculations depends upon the design of frame. Now Andhra Pradesh has reached at top point with respect to mechanisation of process of group preparation with related calculation on a triangular frame with 41 pegs including the central peg. This process

involves moving hand, over a space of one meter up and down around semi-circularly arranged pegs, 9000 times for one sari, demanding high concentration and accuracy. On each peg one has to wind four times before moving to the next peg. For each sari almost four to five hours are required. Entire design on the saris is totally dependent on the Asu (winding) process. Traditionally, ladies of the family performed this activity as it was done sitting under the shade or at home. But it involved long hours and lot of physical effort. After the grouping process, enlarged designs/patterns are marked on the thread-groups and tied suitably, and then dyed in selected colours. The weft threads with ikat effect after separation to individual thread are wound on pirns (Kanda) and used through the spindle of a shuttle in looms for weaving sari, incorporating the beautiful designs and patterns of this tradition. The pain of the weavers has led to develop an automatic grouping or 'Asu'<sup>(41)</sup> machine in Andhra Pradesh. The recent developed machine by 'Sri Chintakindi Mallesham' of village Sharjipet, Dist-Nalgonda, Andhra Pradesh is called 'Laxmi Asu Making Machine'<sup>(41)</sup>. It consists of one electronic calculating device and another automatic grouping machine..

The first machine, made in 1999, was mounted on a wooden frame. Next year, in the second machine, the same was changed to steel. Also, the speed of operation was marginally increased, a provision for stopping the machine when the thread got cut was incorporated in addition to some other minor improvements. This was the first machine to be sold. This was followed by a sale of sixty machines in 2001 followed by the sale of almost hundred pieces each year from 2002 to 2004. To improve the automation process, many electronic components were incorporated by him in 2005. The number of threads on each peg could also now be adjusted. These changes resulted in almost 90 per cent noise reduction. The revised design also helped reduce electricity consumption. Because most weavers would not be able to afford the new machine, Mallesham took special care to incorporate such changes which did not escalate the cost. He has sold over three hundred such machines over the last few years. Using this machine, the time to finish one sari has reduced from four hours to one hour and thirty minutes. This means that instead of two saris per day, now six saris could be made and that too in a wide variety of designs, which was not possible earlier. Also, the mechanised Asu making process need not be supervised much.

But the limitation of this machine is that it works only for Triangular frames and not suitable for rectangular frames used in Odisha. In the meantime, one wefting machine also has been developed at Bargarh, Odisha by the local tie-dyers, it is not automated and imparts high stress on the eyesight of the winder. Here, the winder has to shift the thread from current to a next new group on hearing a bell on completion of the current group. Again here the total number of turns on the group as per required design to be inserted is to be kept in the memory of the winder and is to be maintained throughout the winding process.

Hence, to avoid such stress, steps have been taken to develop one auto-ikat-group former with a modified horizontal warping drum associated with a long worm wheel and an electronic device suitable for preparation of groups for a rectangular frame required for Odisha Ikat industry. The machine has been initially developed in Nuapatna Handloom Cluster during the intervention of GOO-UNIDO project (2007). The mechanical parts like horizontal warping drum with the long worm wheel at the central position and its other automation parts are developed at Nuapatna by the present author with the help of one expert weaver of Nuapatna namely Sri Srinivas Dutta. Subsequently, the electronic device has been developed by College of Engineering and Technology, Bhubaneswar during 2011 on request of Director Textiles and Handloom, Odisha, Bhubaneswar. But the machine has not been commercialised till now. The developmental objective of the device is as follows.

**5.2.1 Objectives:** As narrated above, 'Tie Dye' weaving processes involve different winding steps which are presently performed manually with a lot of time consumption. These processes not only add more costs on finished products but also reduce the productivity of tie-dye materials and restrict mass production of ikat

saris. The machine has been developed intending to producing tying materials for traditional rectangular frames used in Nuapatna and Bargarh area of Odisha unlike triangular in Puchampally.

### 5.2.2 Output analysis of the new machine

This machine reduces 02-day labour on a 03-day traditional process. The mental pressure developed on the wefting machine of Barpali has also been reduced by an automatic to and fro lever actuated by a worm wheel. The present Computerised Numerical Group Controller developed by College of Engineering and Technology, Bhubaneswar, controls the entire system. Now there is the need for its training and upscaling at different application points.

The features of the machine stated above can be observed from following diagram of Auto-Ikat-Group-Former (AIGF) developed in Nuapatna Cluster.



**Auto-Ikat-Group-Former (AIGF)**

### 5.3. Development of Tie and Dye Meter to calculate the exact weight of resisted material

Wet-Processing of Ikat (Resisted) materials is a significant part of the procedure for development of design with matching colour or shade % and intricacy of the designs. The essential feature of the tie and dye technique is to produce a design on fabric by ordinarily interlacement with warp and weft in plain weave, which is already dyed in different colours according to the design colour scheme. The yarn in warp/weft is dyed in various shades at different places.

It is well understood that the exact weight of the total material is required for wet processing of materials during manufacturing of Ikat Textiles<sup>(42)</sup>. The processes adopted before tying/resist are Scouring / bleaching / mercerizing for cotton and degumming for silk. Similarly, the processes like wetting with 1 – 2% TRO for 2 – 3 hours to increase absorbency and dyeing of the un-tied or non-insulated portion of threads are followed after tying/resist.

#### 5.3.1. Objectives:

The three major processes involved in ikat weaving i.e. tying, dyeing and weaving are not scientifically defined and no developments have been made in these processes to control over the outputs. During dyeing the exact material weight to be dyed after deduction of tied or resisted material is not calculated and till date the total tied material is dyed and inputs including dye stuffs and chemicals are added on the basis of total weight of tied material without any relation with

1. Weight of the material only exposed area to dyeing.
2. Weight of the material un-exposed area to tying.
3. Weight of tying material and its nature.
4. Extent of penetration of dye liquor into the tied material.

Ultimately, we get an unknown shade or undesirable shade. Again a lot of dye stuffs and chemicals are also wasted. Study on developing a process is required for evaluation of exact material weight relation between tied and untied portion of a design pattern and establish scientific parameters for further processing to eliminate batch difference. Some works have already been done by the present investigator basing on the air flow behaviour of the yarn. Now, the model can be further studied basing on both the photographic method and airflow behaviour of the thread to find out the exact weight of the material related to tied portion.

#### 5.4. Introduction of mechanized methods for auto tying

Tying is the magic touch in the process of ikat manufacturing to develop the exclusive required design/pattern. This type of hand art and expression of a design with both tradition and modernity through the tie-dyer's finger cannot be replicated by any machine. It is good that till date no mechanism has been developed for tying the groups, or else thousands of tie-dyers lose their livelihoods on this account. The industry is unable to meet any large export order due to low productivity. But, alternately, the exact weight calculation before dyeing can help in production by Masses of tie dyers with uniform colour for carry out any export order.

#### 5.5. Application of new finishing process

Presently, the products are followed with no chemical finishing processes. The use of starch on silk fabrics in some places somewhat reduces the smoothness and lustre of the silk fabrics. Finishing properties like, smoothness, fragrance<sup>(43)</sup> and drape behaviour can be applied on both the cotton and silk fabrics in Odisha, Andhra Pradesh and other ikat producing states, which will not only improve the quality of the materials but also act as one value addition process.

### 6. Conclusions

In this is the era of technology, it can be precedent that the time may come when all the processes can be mechanised and production volume may be increased increasing the export potentiality of ikat materials. Technology up gradation in each of the process as described above in ikat manufacturing will help for mass, and volumetric production is increasing export potential of the country. But care also should be taken to the effect that mechanisation process should assist in increasing employment of rural artisan and not be diminishing the profession by substituting machines. The development of (1) Domestic-Hank-To-Bobbin (DHTB) winding machines, (2) Auto Ikat Group Formers, (3) Tie-Dye-Meter to calculate the weight of tied materials (4) application of new finishes on cotton and silk fabrics shall not only help in mass production of ikat fabrics but also assist in creating a large number of employments in rural villages. Of course, in the era of globalisation, we cannot restrict our country or rest of the world to develop the machine to perform the critical process of Ikat, i.e. 'Tying', while thousands of tie-dyers may lose their livelihood.

*Abbs :AIGF-Auto-Ikat-Group-Former, DHTB-Domestic Hank To Bobbin winding machine, Q=P/E-Quality is equivalent to Performance per expectations, TRO-Turkey Red Oil, UNIDO-United Nations Industrial Development Organisation, WTO-World Trade Organisation*

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