II. REVIEW OF LITERATURE

The literature pertaining to the study on “Economics and Ergonomics of Silk Processing Activities - Impact on Meitei Women in Manipur” is reviewed under the following broad heads:

A. Manipur - The Harbinger of Silk
B. Silk Processing – The Yarn of Employment for Manipur Women
C. Silk Weaving – The Magic Wand of Meitei Women
D. Economics of Silk Processing Avenues
E. Ergonomics and Silk Processing Activities

A. MANIPUR – THE HARBINGER OF SILK

North – eastern region of India is characterized by varying climatic conditions with distinct rainy and dry seasons. Sericulture forms a part of tradition in India, especially in the States of Assam, Tripura, and specifically Manipur (Borpujari et al, 1997). The state’s climatic condition and policy of Manipur has recognized sericulture as a thrust area (http://databank.rediff.com/content/sericulture-manipur), and, the tradition seems to be much intermingled with the life of majority of the people of Manipur (Chinnaswamy and Hariprasad, 1991). All the four types of silk, are produced and processed here from sericulture to weaving. Manipur was a key staging post in the fabled silk route. Traders carried silk from there to China’s Yunnan Province through Myanmar, across India and finally to Afghanistan where they joined the main silk road (http://themanipurpage.tripod.com/economy/manisilk.html).

Sericulture is an age-old, agro-based industry in Manipur, which involves largely the weaker sections of the society, especially women. The culture was confined predominantly to four schedule caste populated villages earlier. Nevertheless, the occupation was under the Royal patronage because the raw silk produced by these villagers was used exclusively for preparation of royal attire/dresses of the king, queen and their family members (www.commissioned studies.com).
Till 1960s, mulberry sericulture was not commercially exploited, and was confined to a few villages with stray plantation in the backyards or isolated mature grown plants. As per the information provided by Department of Sericulture, silkworms are usually reared in small separate spaces within the dwelling houses, which usually lack sufficient ventilation. Rearing is done either in wooden or bamboo trays or on shelves with leaf feeding, until they spin golden yellow yarns. Then the cocoons were boiled and the fibrous silk unravelled and wound on to a stick (http://www.e-pao.net). Obviously, being home oriented, the entire operation in Manipur remain with women only, from rearing of cocoons right upto weaving of fabrics, even thereafter that is printing (www.flipkart.com/women-manipur-sukhlaghosh).

In Manipur, silk worms are reared for the production of “cocoon” - the raw material for silk production. The farmers rear silkworms and produce cocoons. Silk reelers buy the cocoons produced by the farmers and from other neighbouring states (when in demand) for producing silk. The silk obtained out of this process is referred to as “raw silk”. The raw silk produced by the silk reelers are marketed to the weavers. The raw silk is to be twisted before they are fed into looms. Twisting is undertaken either by separate group or by the weavers themselves. Then the silk is woven on handlooms, namely, loin, throw shuttle and/or fly shuttle looms (http://www.tnsericulture.gov.in).

Although India is one of the world’s largest silk producers and Manipur contributes for just a fraction of the 15,000 tonnes it produces annually, sericulture accounts for a considerable proportion of the State’s real GDP. Despite all the potential, the avenue was not found to be very lucrative for those involved in these activities as such.

In recent years, Manipur has meant to spin tradition into profit once again. Japan’s Overseas Economic Cooperation Fund (OECF) has lent Manipur $32.77 in the first phase of a project to revitalize its silk industry, even though Manipur cocoons yield only up to 800 metres of raw silk thread each, compared to 12,000 meters from cocoons in Japan. The second phase, aims at expanding production further and looks at the processing of silk (http://themanipurpage.tripod.com/economy/manisilk.html). Table.1 gives the latest available data on the district-wise sericultural statistics of Manipur.
Table 1: District-wise Sericultural Statistics of Manipur-2004-05

<table>
<thead>
<tr>
<th>District/State</th>
<th>Cocoon Production</th>
<th>Mulberry (MT)</th>
<th>Eri (MT)</th>
<th>Tasar (lakhs nos.)</th>
<th>Muga (lakhs nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senapati</td>
<td>10.00</td>
<td>55.00</td>
<td>0.30</td>
<td>3.50</td>
<td>-</td>
</tr>
<tr>
<td>Tamenglong</td>
<td>4.00</td>
<td>5.00</td>
<td>1.00</td>
<td>0.30</td>
<td>-</td>
</tr>
<tr>
<td>Churachandpur</td>
<td>14.00</td>
<td>20.00</td>
<td>10.00</td>
<td>0.60</td>
<td>-</td>
</tr>
<tr>
<td>Chandel</td>
<td>6.00</td>
<td>6.00</td>
<td>0.50</td>
<td>0.45</td>
<td>-</td>
</tr>
<tr>
<td>Ukhrul</td>
<td>7.00</td>
<td>75.42</td>
<td>0.28</td>
<td>0.50</td>
<td>-</td>
</tr>
<tr>
<td>Imphal West</td>
<td>13.00</td>
<td>85.00</td>
<td>53.00</td>
<td>0.75</td>
<td>0.23</td>
</tr>
<tr>
<td>Imphal East</td>
<td>26.00</td>
<td>145.00</td>
<td>101.00</td>
<td>5.35</td>
<td>1.95</td>
</tr>
<tr>
<td>Bishnupur</td>
<td>6.00</td>
<td>20.00</td>
<td>40.00</td>
<td>0.50</td>
<td>-</td>
</tr>
<tr>
<td>Thoubal</td>
<td>9.00</td>
<td>35.00</td>
<td>18.20</td>
<td>0.75</td>
<td>-</td>
</tr>
<tr>
<td>Manipur</td>
<td>95.00</td>
<td>446.42</td>
<td>284.28</td>
<td>12.70</td>
<td>2.18</td>
</tr>
</tbody>
</table>

Source: Economic Survey of Manipur 2007-08

Manipur women are active and they know the craft of spinning and weaving of the silk fabrics. They also are experts in marketing of their products (http://data.ashanet.org). Manipur’s silk farmers were and are riding high on the fact that it is the only place, apart from China, where international quality bi-voltine silk is produced (http://www.indianexpress.com/news/Manipur-breakgrounds). Likewise, Manipur also prides over its strong handloom sector. As per the National Handloom (silk, cotton and wool) Census (latest statistic), population of looms and weavers in Manipur are as given under Table.

Table 2: Statistics on Looms and Weavers in Manipur

<table>
<thead>
<tr>
<th>S.No</th>
<th>District Name</th>
<th>No. of Weavers</th>
<th>No. of Looms</th>
<th>Consumption of yarn per month (in Kg)</th>
<th>Production of cloth per month (in metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Imphal (Both Imphal East and West)</td>
<td>91820</td>
<td>68273</td>
<td>5,01,936.10</td>
<td>44,26,402.00</td>
</tr>
<tr>
<td>2</td>
<td>Thoubal</td>
<td>37835</td>
<td>26586</td>
<td>1,60,334.50</td>
<td>19,33,600.00</td>
</tr>
<tr>
<td>3</td>
<td>Bishnupur</td>
<td>53069</td>
<td>31420</td>
<td>1,86,294.70</td>
<td>13,25,974.00</td>
</tr>
<tr>
<td>4</td>
<td>Churachandpur</td>
<td>39294</td>
<td>43847</td>
<td>56,502.10</td>
<td>3,61,953.60</td>
</tr>
<tr>
<td>5</td>
<td>Ukhrul</td>
<td>24233</td>
<td>22629</td>
<td>23,567.00</td>
<td>1,98,933.50</td>
</tr>
<tr>
<td>6</td>
<td>Tamenglong</td>
<td>35577</td>
<td>36918</td>
<td>1,02,953.80</td>
<td>2,29,434.30</td>
</tr>
<tr>
<td>7</td>
<td>Senapati</td>
<td>44250</td>
<td>35443</td>
<td>12,763.80</td>
<td>92,901.12</td>
</tr>
<tr>
<td>8</td>
<td>Chandel</td>
<td>13554</td>
<td>11639</td>
<td>20,209.70</td>
<td>71,615.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>339632</td>
<td>276755</td>
<td>10,70,557.00</td>
<td>86,40,814.00</td>
</tr>
</tbody>
</table>


Thus this State proves to be the harbinger of silk.
B. SILK PROCESSING – THE YARN OF EMPLOYMENT FOR MANIPUR WOMEN

Manipur has the distinction of cultivating all the four commercially known varieties of silk, namely Mulberry, Tasar, Eri and Muga (www.texmin.nic.in/sericulture20% industry.pdf). The systematic cultivation of mulberry, the food plant of Bombyx mori, is the first step in the production of mulberry silk. Sericulture is an art of rearing silkworm for the production of cocoons which is the raw material for the production of silk. It is an agro-based cottage industry since it involves mulberry cultivation. By marketing the cocoons the farmers earn money. Extraction of silk filament from cocoons by employing reeling or spinning is done by different devices. It is reeled by drawing together the filaments from a number of cocoons (6-12) based on the thickness required for the weaving sector. The raw silk produced by the silk reelers are marketed directly to the weavers or to the market for weaving different products (www.tnsericulture.gov.in).

Sericulture: The pursuit of sericulture offers gainful employment to the rural masses (www.texmin.nic.in/annualrep/aros-04-16). Since the industry encompasses different ‘on farm’ and ‘non farm’ activities having diversified nature of skills involving heterogeneous group of people, and working for the production of silk, sericulture is a suitable tool to eradicate seasonal and disguised unemployment in rural areas. It is a promising appropriate technology which can generate employment for rural women (Narasaiah, 2003), as the activities starting from mulberry garden management, leaf harvesting and silk worm rearing are more effectively taken up by the women folk. Silk reeling industry including weaving is also largely supported by them (http://indiansilk.kar.nic.in/body-sericulture). Sericulture provides the much needed employment to a larger section of vulnerable section of population at village level, by transferring wealth from richer sections of the society to poorer sections. In most of the third world countries, especially in labour – rich developing countries, silk is consumed mostly by the affluent and the money so spent by them on purchase of silk is distributed among different integrated components of silk professionals including silkworm rearers, reelers, twisters, weavers, traders etc., in the course of closely integrated channel operation (The Indian Textile Journal, 1999).
Sericulture is one among such poverty alleviation and employment generation programmes initiated in the country. The main thrust of this rural based activity is in assuring considerable income and self employment to a greater extent to the marginal and small agricultural holders (Lakshmanan, et.al., 1997). It is an enterprise with specific features in respect to labour involvement. With its ‘cottage industry’ garb, it features the following advantages which are suited for rural women.

- **Employs mastery in indoor activities with less muscle power or manual labour**
- **Demands delicacy and patience**
- **Involves no ‘High technology’ and literacy**
- **Spreads work over to 12-14 hours of the day and could be an off time or leisure hour job.**
- **Silkworm rearing warrants hygiene and intense care, where women have greater skill and adequate knowledge**
- **Offers gainful employment on non-farm activities like rearing, reeling and weaving for landless families.**
- **Provides regular income with low capital investment** (Murugesh and Mahalingam, 2005).

Sericulture also provides self employment opportunities to the educated unemployed youth in its varied sectors state, Savithri and Sujathamma, (2005) as it creates job pockets for atleast 12-13 people per hectare of mulberry. Being a technical profession which keeps the farmers busy throughout the year, a sericulturist need not go in search of off season jobs as in the case of other agricultural crops because one hectare of mulberry cultivation provides direct employment for seven persons throughout the year affirms, Godbole (1990).

Sericulture can play a crucial role by providing job opportunities. A very large part of rural women population is underemployed in India. Among the total labour population, women constitute about 48 per cent (Venugopal, 1994).

Sericulture includes in its stride cultivation of silk worm food plants, silkworm rearing, silk reeling, and other post cocoon processes such as twisting, dyeing, weaving, printing and finishing (www.texmin.nic.in/sericulture.industry). Alagumalai et al., (2000) have divided sericultural operations under four types as agricultural operation (mulberry cultivation), biological operation (rearing of silk worm), industrial operation (reeling and
weaving) and marketing operation (sale of cocoons and silk). It has distinct steps such as cocoon production, reeling, twisting, weaving and trading (Reddy, 1994).

1. Agricultural Operations: These enlist the following opportunities

- **Mulberry farming:** This is an essential part of sericulture, purely an agricultural operation and a major factor determining quantity of production and hence the profitability of sericulture. It is the major cost factor and time and labour consuming activity though less skilled as compared to silkworm rearing. As mulberry is an important crop for production of silk, cultivation of mulberry crop and rearing of cocoons provide sustainable employment for large masses in the rural sector, project, Murugesh and Mahalingam (2006). In over 90% of such farmers, the work of harvesting leaves and rearing of silkworms is done through the family members, because it engages most of their idle hours. Since the work such as growing mulberry, harvesting leaves, chopping them, feeding to larvae, transfer of larvae from trays to trays or finally to chandrika, are done by family members, without distinction between age, sex, physical or mental skills, (http://www.inbar.int) helps key all the family members engaged for a family income.

- **Rearing saplings:** Murugesh and Mahalingam (2005) state that in mulberry cultivation, an activity which women can effectively and efficiently carry out is mulberry sapling production as healthy saplings ensure successful establishment of a mulberry garden and contribute also as an income generating activity.

2. Biological Operation: This includes:

- **Silkworm rearing:** Silkworm rearing is the second major cottage activity carried out by the sericulturists in their own house or in a separate shed built for this purpose. It requires a lot of manual attention. As this offers a lot of alternatives in rearing methods, based on the farmer’s affordability, it is a very viable avenue for rural employment. These activities become a complicated process when various technical and scientific aspects are to be understood and implemented for high productivity. It demands a substantial amount of managerial skill on the part of the rarer, though one’s own experience can form a good guide. There are two types of rearing methods and two phase-wise rearing products followed. The former includes common rearing and shelf rearing and the latter chawki rearing and late age rearing respectively.
3. **Industrial Operations**: These include:

- **Reeling**: Silk reeling is simply the unwinding of filaments from a group of cocoons in hot water bath on to a reel. Depending upon the required thickness (denier) of silk thread, filaments from a number of cocoons are combined together and reeled. It is carried out by distinctive methods (www.indiaagronet.com and Lee, 1999). Cocoons of various grade and quality produced indigenously in the State have been consumed locally and utilized for the conversion to silk yarns (Department of Sericulture, Manipur, 2005-06).

- **Bailing and Skeining**: The silk filament is reeled into skeins (from cocoons), which are packed in small bundles called books, weighing 2 to 4.5 kg. These books – a form in which raw silk is shaped (Plant Hortitech, 2007) are put into bales weighing about 60 kg and sent to silk mills all over the world.

- **Dyeing**: Brilliant dyes may be applied to silk yarn after it has undergone throwing and boiling before it is woven – the method called skein dyeing - or fabrics are dyed after they are woven, called piece dyeing.

- **Weaving**: Silk yarns are woven on looms (www.members.fortunecity.com/nadaes/ziad.html). Handloom sector provides direct and indirect employment to more than 30 lakh weavers and is the largest economic activity second only to agriculture reports, Mathew (2005). Shoulder to shoulder supports from female workers are always the choice for post cocoon technology operations because of their subtle skill and concentration for long hours. These activities facilitate women to earn money by providing them employment opportunities near their doorsteps.

4. **Marketing Operations**: These include:

- **Sale of cocoons and silk**: The cocoons are sold at various government and private marketing yards, to middlemen and commission agents, again which is a gateway to employment. This encompasses activities like:

  - **Production of silkworm eggs**: This is yet another avenue requiring precarious activities. The layings are called disease free layings (dfls) and the establishment where the layings are produced is called a grainage. (Afifas et. al., 2000). Success of sericulture depends on the quality of silkworm eggs. The management of seed production plays an important role on
over all returns. Eggs produced from the grainage possess good demand among the farmers. Certain activities in the grainage like sex separation, mother moth examination, disinfection of egg cards and acid treatment which require maximum care and keen observation with meticulous planning are solely undertaken by women labour.

- **Marketing of saplings:** Saplings are very much in demand and fetches good returns to the growers. This is certainly quite a profitable venture for the women farmers. It is a viable commercial proposition to raise saplings as subsidiary units on large scale and make them available to the farmers during planting season.

- **Processing of cocoons before reeling:** A number of preliminary steps have to be performed on the silk cocoon prior to reeling before it is marketed. These include stifling, drying and storing, cooking, deflossing and riddling (Hariraj et.al., 1997).

- **Commercial use of by-products:** Mullberry leaves, roots, shoots, damaged cocoon etc (the by-products of silk process) can also offer possibilities for income generation for women as they can be transferred into recovered resources.

**Handlooms:** With a decentralized set-up, spread all over the country, the handloom industry provides direct employment to over lakhs of people by way of weaving and marketing, besides indirect employment to several lakhs who are engaged in pre-loom, post-loom and marketing activities (Geiger, 2007 and Nagarajan, 2007). Unlike other places, handloom production is a traditional occupation of the women folk in Manipur. The handloom industry is by far the most important household industry in Manipur giving employment to the urban and rural unemployed, particularly, women folk. Nearly 3,00,000 women are working in handloom sector in Manipur reports, Swarajyalakshmi (1998).

The rural based industrial units, therefore, have proved to be more efficient in generation of employment than their urban counterparts on more grounds than one. As silk in all its stages – from raising feeder stock to weaving - involves ‘labour’ or ‘man (women) power’ components, thus has emerged as a viable employment generator (Devi, 2004).

C. **SILK WEAVING – THE MAGIC WAND OF MEITEI WOMEN**

Weaving is a process of formation of fabric with interlacement of two or more sets of yarns using a stable machine called loom. Human beings have started using the woven fabrics since the dawn of history opines, Rajagopalan (2007). A loom is a machine or device...
for weaving thread or yarn into textiles. ‘Loom’ itself is derived from Middle English ‘lome’, meaning “an implement or tool of any kind” (http://fiberarts.org/design/articles/loom type.html). Looms can range from very small hand held frames, large free-standing hand looms to huge automatic mechanical devices. In practice, the basic purpose of any loom is to hold the warp threads under tension to facilitate the interweaving of the weft threads (Fig.1). The precise shape of the loom and its mechanics may vary, but the basic function is the same (Desai, 1999).

The loom was the first attempt by prehistoric people to supplement the human hand when working with raw materials. Historians and anthropologists believe that the development of the loom progressed independently within discrete cultures and that improvements occurring in differing time periods were made to suit the specific needs of these separate cultures. The loom has since undergone countless transformation to speed up its operation and to more easily produce complex textiles. Despite all these changes some of the most outstanding fabrics ever woven are still produced on the least sophisticated equipment (Held, 1999).

Hand weaving, along with hand spinning, is a popular craft. Weaving is an ancient textile art and craft that involves placing two sets of threads or yarn called the warp and weft of the loom and turning them into cloth. ‘Warp or ‘end’ lies lengthwise in the fabric all along the selvedge and ‘weft’ or ‘pick’ travels and interlaces the warp threads at right angles (Naik and Wilson, 2006). It is quite simply the art of interlacing one element in and out of another. The warp are held taut and in parallel order, typically by means of a loom and the loom is warped (or dressed) with the warp threads passing through heddles on two or more
harnesses. A beam at one end of the loom holds the warp first and the woven cloth is wound in a beam at the other end of the loom. The warp threads are moved up or down by the harnesses creating a space called the shed. The weft thread is wound onto spools called bobbins. The bobbins are placed in a shuttle which carries the weft thread through the shed. A shuttle carries the filling yarn through the sharp, and, a reel or batten beats the filling yarn back into the cloth to make the weave firm. The raising/lowering sequence of warp threads gives rise to many possible weave structures. Looms might be broad or narrow or wide for the weaver to pass the shuttle through the shed. Earlier the weaver had needed an assistant for this. Invention of the flying shuttle in 1733, has sped up the process of weaving (wiki/image:weave.jpg and Jefferson, 2005).

The throw shuttle loom (Pangyong) and loin loom (Kwang), constitute the traditional looms in Manipur. The fly shuttle loom originated from the difficulties faced in weaving broad cloth on throw shuttle looms. Dobby, Jacquard machines are mainly found in government production centres. Only a meagre per cent use power loom in Manipur (www.e.pao.com).

<table>
<thead>
<tr>
<th>Weaving in Manipur was started with an emotional attachment since the women and girls wove only for their dear and near ones and in each of their products, they tried to express something of a personal emotion and communicate warm feelings through the fabrics, that were intended to be worn.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women expressed their styles mainly in the weaving. Because of these reasons in almost all Manipuri households, there was at least one or two looms. Every Manipuri adult-woman wove for herself and her domestic consumption. The mother acted as the master craftsman in the family (Roy, 1979). As every household in Manipur owns a loom, women folk alone are weavers (<a href="http://en.wikipedia.org/wiki/">http://en.wikipedia.org/wiki/</a> Manipur/economy).</td>
</tr>
<tr>
<td>In Manipur, because of the tradition in vogue and geographical isolations, entire textile operation is still considered as cent per cent women activity only. It is said a girl cannot be married unless she knows weaving and she carries her loom to her husband’s house when the marriage is solemnized. However the type of loom used by various communities varied considerably (<a href="http://www.flipkart.com/women_manipur_sukhla">www.flipkart.com/women_manipur_sukhla</a> Ghosh).</td>
</tr>
</tbody>
</table>

The loin loom (Back strap looms) as the name implies, is tied around the weaver’s waist on one end and around a stationary object such as a tree, post or door on the other. Tension can be adjusted simply by leaning back. Back strap looms are very portable, since they can simply be rolled up and carried (www.mediawiki.org). It is a simple one with a
continuous horizontal warp consisting of six sticks serving the sword, and extra warp beam. For setting the loom, first the warp beam is securely fastened to the wall of the house or any other suitable firm supporting in the horizontal position at a height of nearly 70 cms from the ground (www.flipkart.com/women_manipur_sukhla Ghosh). Ooldinger (1994) adds that the warp threads can simply be wound round a peg instead of a warp beam. The weaver sits with a loom fixing the back strap, keeps her legs against the footrest, which is adjustable for keeping the loom in tension (http://ignca.nic.in/crafts.258.html).

Throw shuttle loom is predominantly found in almost all Manipuri households. The loom is fitted to four bamboo or wooden posts fixed on the ground. It is hung free from an upright bamboo. Shedding is effected by a set of heads operated by the foot. The shuttle is thrown across the shed by one hand and caught by the other at the opposite side of the cloth. The beating up of weft is performed by pulling the slay which is given to and fro motion also by the hand. The operation of the loom is very simple, says Venkateswara, (1991). It is the most popular and an improved type of handloom in the country which increased three to four times the production of the weavers (www.crafts.of northeast.com and Dalte and Navarathy, 2007).

Manipur is famous for its special silk fabrics for men and women (varieties of phi, phanek, phaijam, suiting and shirting) and for home furnishings (bedsheet, mosquito net etc.). The patterns in use here are typical of the region. Bold colours, and geometrical patterns and floral patterns are in evidence in most of their textiles (Naik, 1996).

As women are the major stakeholders in such small settings their magic hands weave thousands of fabrics a day and clothes innumerable people across the nation (Kala, 2008). Exhibit.1 presents a monograph entitled ‘Art of Silk Processing’, prepared by the researcher for generating awareness on the modalities of silk processing.

D. ECONOMICS OF SILK PROCESSING ACTIVITIES

Nagarajan and Gangadharan, (2008) express that small scale industries (SSI) play a significant role in the Indian economy. They increase the supply of manufactured goods, promote capital formation, develop indigenous entrepreneurial talents and effective utilization of resources, skills and capital which otherwise remain unutilized, create
Exhibit.1
employment opportunities, encourage regional balance, increase the purchasing power and behaviour of the people and subsequently the increase of national income. Silk processing, as SSIs, also contribute in economical terms.

**Sericulture:** It is a cottage industry par excellence with its agricultural base, industrial superstructure and labour intensive nature. It is remarkable for its low investment, and quick and high returns which make it an ideal industry or enterprise which fits well into the socio-economic fabric of India. Being a labour intensive industry in all its phases, namely mulberry cultivation, silkworm rearing, silk reeling and other post cocoon processes such as twisting, dyeing, weaving, printing and finishing (Afifas et al., 2000), it is highly recommended by planners and administrators as one of the most effective tools for rural reconstruction and development of the rural society.

Being an agro-base enterprise it also plays a predominant role in shaping the economic destiny of the rural people and fits very well in India’s rural structure, where agriculture continues to be the main occupation. The pursuit of this sector offers gainful employment to the rural masses (Chinnaswamy et al., 1993 and Savithri and Sujathamma, 2005) and is expected to improve upon the living standard of the marginal and middle order of farmers. India is one of the oldest countries practicing sericulture add, Murugesh and Mahalingam (2006).

It is again ideally suited for improving the rural economy of the country, as it is practiced as a subsidiary industry to agriculture with potential for development as a highly rewarding agro-industry. The limited availability of land, the limited cash returns, and agriculture being confined to one or two seasons in the year, make villagers especially women, to look for supporting rural industries, such as sericulture ([www.krishiwold.com/seri_ind1.htm](http://www.krishiwold.com/seri_ind1.htm)), which provides an excellent and unique opportunity for socio-economic progress in the context of developing countries like India. Further, it is mostly accepted by small and marginal farmers, since they need income in short spans of cycles for their livelihood. Growing mulberry provides employment opportunities is an essential complement or part of sericulture as it is the only cash crop which provides frequent attractive returns with minimum investment.
About 57 per cent of the gross value of silk fabrics flow back to the cocoon growers with share of income to different groups to the tune of 56.8 per cent to cocoon growers, 6.8 per cent to the reeilers, 9.1 per cent to the twisters, 10.7 per cent to the weavers and 16.6 per cent to the traders. Thus, a large chunk of income gets transferred back to the villages from the cities (http://indiasilk.kar.nic.in). Silk worm rearing thus benefits about 3,500 families in Manipur. In Manipur, the industry was started laying greater emphasis especially on the development of sericulture for the quick improvement of the socio-economic conditions of the State through industrialization (http://nerdbank.nic.in), because weaving has always been a part of their economic tradition.

Reeling: Reeling is one of the economic sources for women. Reeling sector is a vital component of sericulture linking the agriculture based activity of cocoon production with the industrial activity of fabric production. Reeling converts the cocoons into raw silk yarn. Reeling sector is an input dependent activity and its operations are influenced heavily by three factors viz, cocoon quality, cocoon price and cocoon supply. The development of the spinning and reeling industry owed much to the efforts of private individuals. The silk-reeling part of the textile industry operated on a small scale and was scattered over a broad area (http://www.fao.org). Reeling/spinning of all varieties of cocoons and silk waste are a household, part-time cottage industry in Manipur.

Weaving: Handloom industry occupies an important place in the Indian economy, especially in the decentralized sector, located in rural and semi urban areas. It provides livelihood to a large number of people (Desai, 1999). Reddy(2007) opines that the creations of the handloom weaver cover a wide range of products, and their application and use likewise cover a wide range of consumers, from the indigenous to the overseas. All these have contributed to the role of their ancient craft in the economic and cultural life of the people, especially in the rural areas. Handloom cloth has become an important foreign exchange earner. On account of its ability to meet the needs of fashion markets, producing, even a 100 metre of fabric in a particular design or colour combination to meet the individual taste of the consumer, has become quite an income-earner. In recent years what counts more is how safe it is to work and earn a living.
Health of individuals is closely linked to their status in the society. Women universally have lower status. Women are seen only in their reproductive roles and their productive roles are completely ignored. There is enough evidence to show that almost all the women are economically active. However majority of them work in the unorganized sector and consequently get hardly any benefits made by the provisions of the law. The changing economic scenario in India necessitates placing emphasis on creation of a work environment where people are continuously motivated to realize their full potential.

E. ERGONOMICS AND SILK PROCESSING ACTIVITIES

“Health is a resource for every day life, not the objective of living”


Health is a positive concept emphasizing social and personal resources, as well as physical condition of individuals and their diseases, and thus motivate people to focus attention on what is called social determinants of health (http://en.wikipedia.org/wiki/ergonomics). Women have the right to the enjoyment of the highest attainable standard of physical and mental health. The enjoyment of this right is vital to their life and well being and their ability to participate in all areas of public and private life (Antony, 2006 and http://www.phdre.org/rights/health-html) that is work related or domestic.

The four basic safety guidelines to be practiced while performing any activity are learning and applying proper skill, having appropriate and well maintained tools / equipment, knowing the safety rules specific to the activity and preparing adequately for the activity (Pruit et.al., 1994).

An ‘occupational’ health or safety hazard is anything in the ‘workplace’ that has the potential to cause harm to the human body, which vary greatly depending on the type of work involved. Equipment, processes, work procedures and the design of the workplace are all potentially hazardous (http://www.worksafeshash.net). By “occupational environment” is meant the sum of external conditions and influences which prevail at the place of work and which have a bearing on the health of the working population.

Ergonomics is the science that studies the relationship of humans to their working environment and seeks to improve working conditions and increase efficiency (www.nonprofithub.com). It is also the study of designing objects to be better adopted to the
shape of the human body and / or to correct the user’s posture (www.google.co.in). It is the analysis and design of work equipment and environments to fit human physical and cognitive capabilities (Arnold et. al., 1995). Thus ‘ergonomics’ as a field of study can take up many connotations.

**Physical Ergonomics:** This is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. The relevant topics include working postures, materials handling, repetitive movements, work related musculoskeletal disorders, workplace layout, safety and health (Pheasant, 1998). In practice, ergonomic studies must include the aspects of users (individuals), machine, workplace, and environment to analyse the problems (Dalela and Saurabh, 1999).

**Cognitive Ergonomics:** It is concerned with mental processes (brain work), such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system. The relevant topics include mental workload, decision making, skilled performance, human computer interaction, human reliability, work stress and training, as these may relate to human system design.

**Organizational Ergonomics:** It is concerned with the optimization of socio-technical systems, including their organizational structures, and processes and includes communication, work design, design of working times, teamwork, participatory design, community ergonomics, cooperative work and quality management (Pheasant, 1998).

**Work Place Ergonomics:** The term workplace is comprehensive and includes any area where work is performed. The design specifications of the workplace in relationship with workers, physical characteristics and job requirements have significant impact on their productivity, and physical and mental well being. The worker also must ensure the use of right place and right equipment, for, work organization of the work place is very important and saves more than 80 per cent of the human energy during work besides minimizing the mental fatigue felt as inherent (Oberoi and Gill, 2003). Basically, there are three types of interaction in a working environment: man and physical agents, man and machine and man and man.

A number of factors in the physical work environment may lead to accidents. These factors could be unprotected place, congested work, unsafe piling and storage, overloading, poor maintenance, slippery surface, insufficient illumination and ventilation, contamination
and pollution, unnecessary heat and dust, unguarded machines, unsafe equipment, and so on. Among the factors affecting the workers the following are most important to be considered in optimizing the relationship between workers and their job.

- **Environmental conditions (temperature, illumination, noise) of the workplace**
- **The physical and mental requirements of the job**
- **The worker’s exposure to hazardous materials**
- **The interaction between the worker and the work equipment** (Tayyari and Smith, 1997).

**Work Environment Vectors:** Environmental factors indicate improper physical and atmospheric (surrounding) conditions of work which indirectly promote the occurrence of accidents. Environmental factors include:

- Too low a temperature to cause shivering,
- Too high a temperature to cause headache and sweating,
- Too high a humidity (in textile industry) to cause discomfort, fatigue and drowsiness (especially when the atmospheric is also hot),
- Defective and inadequate illumination causing eyestrain, glare, shadows etc.,
- Presence of dust, fumes and smoke and lack of proper ventilation,
- High speed of work because of huge work load, more number of working hours
- Inadequate rest pauses or breaks between the working hours, noise, bad odour coming from the nearby equipment or processes and
- Poor housekeeping (Khanna, 1992).

**Physical agents:** The physical factors in the working environment which may be adverse to health are heat, cold, humidity, air movement, heat radiation, light, noise, vibrations and ionizing radiation (Ashtekar, 2001).

**Temperature:** Individuals must keep the temperature of the vital organs within narrow limits, if one is to survive exposure to intemperate environments. If the combination of workload and environmental heat is so great that thermal balance cannot be maintained, workers will become susceptible to heat collapse. While there may be particular economic and technical difficulties in reducing the harmful effects of heat and illumination, sustained efforts are needed to provide an optimum and comfortable work environment.
If the temperature is too high, the body makes extra exertion by means of the sweat glands and blood vessels to lower the temperature. As a result the blood is drawn to the surface from other parts of the body, and even the body temperature may not be kept down to the proper level. One of the most common causes of ill effects from poor ventilation is too high a temperature. It has been proved that the most healthful temperature for the living room is between 65 and 70\(^0\) F. When the temperature becomes higher than 70\(^0\), it produces feelings of discomfort, and makes work more difficult. The temperature at which one feels comfortable depends on the humidity. With the low degree of humidity usually found in homes, about 68\(^0\) F is the best temperature. But if enough moisture is added to raise the humidity from 50 to 60 per cent, one may feel just as comfortable at 65\(^0\) F. The best temperature also depends on the occupation and dress of the people living in the room (Chakravorty, 2007).

**Humidity:** If the air is too moist, evaporation in the skin takes place too slowly and the body becomes too warm. If the air contains too little moisture, evaporation takes place too rapidly. The lack of moisture in the heated air in the homes in winter has an injurious effect on the nose and throat (Chakravorty, 2007).

**Noise:** It may also reduce output and efficiency and cause fatigue apart from various health disorders. The decibel is the common unit of sound measurement and decibel scales provide a convenient notation to describe the range of sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect (Haro et. al., 1997).

**Illumination:** It is often used as a general term that refers to the quantity and quality of light. Illumination is the amount of light received on a specified surface area (Steffy, 2001). Although man has an extraordinary ability to adapt to his environment, his well being, morale and fatigue are affected by light and colour. Cases of visual disorders at work places are very frequent, and their causes are manifold. They should always be taken seriously and workplace should try to provide for optimum seeing conditions. According to the present state of the art, good lighting should meet optimal illumination, uniform lighting, avoidance of glare, appropriate contrast and correct colour. Importance of the level of illumination varies according to the task in hand. General lighting can be either direct – the light shines
directly on objects to be illuminated – or indirect – the light is thrown against a surface, usually the ceiling, from which some of it is reflected. Latter is usually more pleasant, soft for general illumination than the former, but it costs more to operate and may make the reflecting ceilings or walls more dominant than as desired. General lighting is monotonously even in effect and seldom bright enough for work. Therefore, it is usually combined with local lighting. Local lighting provides the kind and amount of illumination needed at specific places. The light source can be high or low, but eye comfort suggests that it is shielded. Planned lighting demand attention to brightness, location and size of light sources and direction of light, the colour of light and its effect on colors, and the amount of light reflected by colours on ceilings, walls and floors.

**Personal factors:** Age, health, home environment, lack of knowledge and skill, improper attitude towards work, incorrect machine habits, carelessness and recklessness, day-dreaming and inattentiveness, fatigue, emotional instability, high anxiety level, mental worries, unnecessary exposure to risk, non use of safety devices, working at unsafe speeds and improper use of tools – all contribute to ergonomic defects (Khanna, 1992). Some of the physical elements are poor eyesight, colour blindness, slow reaction, poor hearing and other such organic defects (Sharma, 2000).

- **Work Behaviour:** Working conditions, in varying degree contribute to work behaviour. Unsafe working condition, poor illumination, hot and humid environment not only influence the productivity and efficiency but also affect satisfaction and human behaviour. Two important aspects of work behaviour are accidents and fatigue. Human factors like physical or attitudinal predispositions of the workers are also responsible for many accidents (Sharma, 2000). As far as attitudinal factors are concerned such things as indifference, emotional instability, frustration, hostility, and a host of other such variables may lead to accidents.

- **Accommodation:** Accommodation is the process of focusing on an object or task. Because accommodation is a muscular activity, a constant focus on a single object or task is tiresome. Indeed, eye breaks are recommended from time to time during the course of a work day so that focusing is not limited to static viewing situation. On the other hand, continually changing focus from one object / task (that is near, for example) to another object/ task (that
is somewhat further, for example) fatigues the ciliary muscle from too much operation. This constant accommodation can result in visual fatigue.

- **Ageing:** There is a general decline in all the special senses with age. The most significant changes in the eye occur in the lens. This condition, called ‘presbyopia’ or farsightedness of ageing, probably is the most common age-related dysfunction of the eye (Applegate, 2000). Aging affects the eye in several ways, any one of which can reduce the effectiveness of one’s vision. Generally, all functions tend to slow with age and the process of adaptation also becomes slower. This leads to a serious potential issue particularly when moving from bright settings to dim or dark setting. ‘Presbyopia’ is an eye related phenomenon whereby the aged person can no longer focus on near objects. The lens hardens and, hence, is less elastic as the eye ages. Focusing of near objects/tasks becomes difficult. Near focus is perhaps 7 cm at the age of five, 25 cms at the age of 21, 32 cm at 46 years of age (a considerably reasonable reading distance). By the age of 55, near focus is now at arms length reading distance which is about 55 cm (22 in). Hence holding the newspaper this far away becomes practical, if not a tiresome necessity, without corrective eyewear. Presbyopia does not affect accommodation of far objects/tasks. Further as the lens ages, it can become somewhat cloudy and yellow. By the age of 60, it may take twice as much light for an individual to see tasks as he/she required at 20 years of age (Steffy, 2001).

- **Fatigue:** Fatigue is defined as reduction in the ability to carry on with work because of previous work. This is accompanied by a feeling of weariness which is often the result of the length and intensity of the activity. Fatigue can be physiological and/or psychological. The former is essentially the physical fatigue of muscles and nervous system as a result of sheer physical exertion like lifting heavy loads, pushing or pulling heavy objects, and so on. Monotony is a state of mind caused by repetitive work. Boredom, on the other hand, is a person’s unfavourable outlook to the task he is performing. Thus, while monotony may flow from the nature of task, boredom is essentially a function of the personality, attitude, and the perception of the task performed (Sharma, 2000). Fatigue results in reduced capacity of mental efforts. Human beings attempt to increase the mental effort to compensate for the fatigue and this might result in mental stress (Balasankari, 2004).
A state characterized by lack of motivation, interest and or an inability to maintain normal, consistent productivity and quality due to physical or mental exertion is called, demanding work-made fatigue. Fatigued workers may be unable to make safe judgments; they may lead to incidents that can result in injuries or other inadvertent exposures (Kathirvel, et.al., 2003).

Ergonomics deals with the applied science of equipment design and of the workplace, intended to maximize productivity by reducing operator fatigue and discomfort (www.answers.com/ergonomics).

- **Posture:** In recent years, ergonomists have attempted to define postures which minimize unnecessary static work and reduce the forces acting on the body. Most of our troubles happen because of bad habits, generally developed over a long period of time, poor posture, over exertion in work and play, sitting incorrectly or pushing, pulling and lifting things carelessly. Sometimes the effects are immediate, but in many cases back problems develop over time. The most common type of back pain comes from straining the bonds of muscles surrounding the spine. Although such strains can occur anywhere along the spine, they happen most often in the curve of the lower back; the next most common place is at the base of the neck (www.personal.enginumich.edu). Good posture actually means keeping cervical curve, thoracic curve and lumbar curve in balanced alignment (http://www.infinitehealthresources.com).

Changes occur naturally in body as a person grows older. These changes can influence the posture, maintain a good posture or correct a poor posture (http://www.infinitehealthresources.com). In reality, posture change seems to be as important as posture correctness, especially with regard to the intervertebral discs in the spine. These discs lose fluid over the course of the day because of the weight they carry. It appears that posture change is essential to help pump fluid back into the discs. People who stand all day tend to have back problems but so do people who sit still all day (http://office_ergo.com/conventi.htm).

Good posture is also good prevention. If workers adopt poor posture, their bones are not properly aligned, and muscles, joints and ligaments take more strain than nature intended. Faulty posture may cause fatigue, muscular strain, and, in later stages, pain. Many individuals with chronic back pain can trace their problems to years of faulty postural habits.
In addition poor posture can affect the position and function of vital organs, particularly those in the abdominal region (http://www.infinitehealth resources.com).

Poor work posture for any type of task is the greatest source of fatigue and body stress. It not only causes discomfort, but also leads to breaking of bones and irreparable muscular pull, thus making the women permanently handicapped. However, women are not aware of this drudgery prone truth, neither the work conditions are conducive to this, so they knowingly or unknowingly face the consequences and suffer from physical and mental torture of work. Suitable technologies are therefore needed to make them work in good posture (Oberoi and Gill, 2003).

- **Equipment and Ergonomics:** When equipment is intended for human use it should, as far as possible, be designed as a man-machine unit. There are times, however, when this may involve a compromise between the needs of the man and the requirements of the machine. This compromise may in turn require the striking of an economic and operational balance between the two (Oberoi and Gill, 2003). Women perform many of the tasks with old traditional time and energy consuming equipments resulting in loss of time, energy, fatigue and body discomfort. Ergonomically designed equipments must be, therefore, developed at a very reasonable cost and made available to them to minimize their drudgery.

- **Work Related Factors:** Working for long hours in unphysiological postures as stated earlier, causes fatigue, backache, disease of joints and muscles, and impairment of the worker’s health and efficiency (Park, 2000). For the majority of the people involved in different sub-industries of silk processing there is a likelihood of getting exposed to various health hazards (Manibashetty, et.al., 1997).

  - **Sericulture:** Women in sericulture operations face quite a lot of physical and mental drudgery, due to long work hours, thereby spending more energy than is physically feasible. Difficulties experienced at work and poor managerial skills also cause fatigue. Farm women can optimize and synchronize their time in attending to their work with other household activities (Shobha, 2007).

There is a need for the farm women to adapt and use improved implements and newer technologies, so as to help them increase their work efficiency, which in turn can improve the
quality of life and help in drudgery alleviation. To make the women more competent in various processes of sericulture production, awareness generation and imparting of skills to adopt these technologies can help, make their life safe qualitatively and at the same time, reduce health problems (Shobha, 2007). Development of sericulture appliances/implements better suited to women for reducing drudgery thus gains more importance (Chandrakala and Suguna, 2007).

- **Reeling:** The key to proper silk reeling is whole body movement originating from the centre. Silk reeling is named for the quality of movement that is practiced. It is said that the movement must be like a spider spinning a web. Movements must be continuous. If an understanding of the body’s potential for a natural flow is developed, silk reeling will develop into a deeply satisfying, healing and beautiful art ([http://www.wormspit.com/domestic.htm](http://www.wormspit.com/domestic.htm)).

  There has been a lot of controversy about the health hazards of the reeling process and this has become an extremely sensitive issue. Health hazards are also of different types. Firstly, there are lung problems associated particularly with stifling, cooking and boiling and charka and dupion reeling. Secondly, in reeling basin the hands are kept in hot water for long periods which eventually results in severe softening of the skin. It is usually possible to distinguish female reelers from other women by the appearance of their hands which are often whitish and sometimes deformed. The reelers cannot perform other tasks such as agricultural work for sometime, and have problems handling chillies etc., In basin reeling also good eyesight is required and long hours of night work in poorly lit work sheds at times of peak production may be particularly harmful and account for many of the reports of headache and giddiness. Finally the damp humid atmosphere is an ideal breeding ground for many types of bacteria and virus including tuberculosis. Thus the tasks in which women predominate involve considerable health hazards (Indian silk, 1992).

- **Weaving:** It is just as important to make sure that the weaving area has been set up not only for space and efficiency, but also ergonomically. This cannot only reduce eyestrain, it can also prevent back or neck ache from leaning in at strange angles to be able to see what one is doing. Weaving and planning area has to be painted a light neutral color. This allows maximum light in the room and prevents bounce-back of odd wall color on the project that
can skew the color that one sees. (www.weaversguildmn.com). Weaving operation is considered as a precision work, for the knots are very fine and close together, and colour recognition is of vital importance. Such operations require adequate lighting both qualitatively and quantitatively. In many weaving workshops, lighting is not adequate, which results in considerable eyestrain (Choobineh, 2004).

The exact risks weavers face depend on the type of work that they are doing. Common risks include: dangerous equipment, fast, repetitive work, work in awkward positions/postures, noise and vibration, exposure to extreme heat or cold, stress and violence from other members (www.osha.europa.eu/ priority groups / young people).

While a flying shuttle is an indispensable option when weaving fabric, weavers find the process of throwing the shuttle at narrower widths difficult (Leclerc Loom Options.htm). It has long been known that workers’ behaviour and attitudes are affected by the nature of the work they do and the environment they do it in.

Eventually all the factors that contribute to an ergonomically designed environment - worker, physical health, work place, effort, tools, worker behaviour and satisfaction - have to be considered to make silk processing ‘productive’ in the real sense.