



COMPETENCIES IMPLICATED IN TASAR SILK REELING PRACTICES: QUANTIFICATION THROUGH TIME STUDY AND WORK MEASUREMENT-A CASE

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I. INTRODUCTION

Silk industry leads with rapporttag for sustainable livelihood opportunities for millions owing to high employment oriented, low capital intensive and remunerative nature for its production. As a ‘Queen of Textiles’ silk features it’s elegance with unparalleled grandeur, natural sheen, affinity for dyes with high absorbance, soft touch, light weight with restrained tenacity and elongation. The intrinsic identity nature of this industry with its rural base and enormous employment generation potential has engrossed the attention of the planners and policy makers to recognize the industry among one of the most appropriate avenues for sustainable socio-economic development of a largely agrarian economy like India. Sericulture in India has proved to be an model avocation for inclusive development of rural populace especially the weaker sections of the society addressing equity distribution from urban rich to rural poor. With its ecofriendly production process and high potentialities became an ideal tool for biotechnological development, and a way for women and tribal empowerment. Simultaneously the industry also faces few challenges arising due to urbanization, industrialization, climate change, depleting soil conditions and water sources, threat from manmade fibers, etc.

India is a unique country producing all the four known varieties of silk, namely, domesticated Mulberry silk (*Bombyx mori*), semi- domesticated Eri silk (*Philosomia ricini*), wild Tasar silk (*Antheraea mylitta*) and exclusive Muga silk (*Antheraea assama*), the wild golden silk being unique to India. Out of 31,906 MT of total silk produced in India, contribution of 2988 MT comes from Tasar sector. Tasar culture is a forest-based activity suited to the economy and social structure of central and eastern Indian regions. Tribal involve predominantly in Tasar culture as a part of tradition and for remunerative income but also helps to arrest their migration to urban areas. Tasar culture also simultaneously permits conservation and reclamation of forests. Tasar silk is unique for its natural rusty colour and exclusive hand value. Tasar sector directly provides employment to nearly 1,40,000 families in the central Indian region. Major Tasar producing states in India are Jharkhand, Chhattisgarh, Odisha, Bihar, Madya Pradesh, Maharashtra and Telangana.

Traditionally, Tasar silk reeling is practiced in tribal and rural areas by women folk through a practice known as thigh reeling. Commercially reelers opt for soap and soda method to soften cocoons and adopt thigh reeling process usually practiced during spare time using their hands and thigh to rub silk filaments drawn from 7-8 cocoons, ensuring cohesiveness with a false twist to produce weft quality yarn, which is wound on a small package known as Natwa – a sturdy bamboo structure. On an average, in a day a thigh reeler produces 70 -80 grams of 70 denier silk confining their daily income for Rs. 80 -100.

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Workflow, work layout and the time standards involved in the processes were engrossed. With the objective of component quantification of skill, abilities and competencies intricate in traditional Tasar reeling practices, this case study was commenced covering important reeling clusters of Odisha state.

II. LITERATURE REVIEW

Productivity average of 85 grams / reeler confines daily income to less than ₹ 100/-. Usage of cocoonase by, B.C. Prasad, J.P. Pandey and A.K. Sinha, (2012) for cocoon cooking was investigated and established. Thigh reeling, the conversion process corroborated by Kiran B. Malali, Uday Javali and Dr. Subas V Naik (2018) elaborates on posture which constrains reelers with fatigue and highlights the importance of inherited skill attributing factors. Kanawaty (1992) averred that, the work study is a management tool that can be applied in production formulation. Its essence lies in seeing operations done procedurally, in the best way possible, timeously and by the most skilled individual. Work study improves an entity's competitiveness and the entire production process through techniques that optimizes production (Chary 2009), Tanvir and Ahmed (2013) Singh and Yadav (2016) also opined that the work study results in increased production by improving efficiency.

III. RESEARCH DESIGN

Qualitative Research Design has been adopted for the study, in which observation research techniques were used, where researchers observe enduring behavior of participants in a natural condition. Depending on the kind of observation research and the goal of the study, the researchers will have changeable levels of involvement in the study.

IV. OBJECTIVES

- To understand the process of Tasar reeling
- To evaluate- process elements through Time Study and Work Measurement for observed samples
- To analyse the impediments associated with Tasar reeling segments

V. DATA COLLECTION

Both Primary and secondary data were used for this study. The proposed study is qualitative in nature and based on specific sample observation method. The study at large depends on primary data. The required primary data were collected by means of structured observation method covering Fakirpur and Gopalpur Tasar reeling segments in Orissa. To substantiate certain concepts under the study, secondary data were used from the published reports of the Central Silk Board, Ministry of Textiles, and Government of India.

VI. SAMPLING

The sample size used for this study covers 50 traditional thigh reelers, comprising of women with various age groups representing major reeling clusters of the state of Odisha. Convenience sampling method is used for data collection. A recorded video clipping of individual reeler covering entire reeling activity captured over five days was considered to arrive at average timings of each element. Age based stratified data are considered for this study.

VII. TOOLS FOR DATA ANALYSIS

The task of Tasar reeling activity was divided conveniently in to sub activities and elements. The timings of each element has been recorded using modern contrivances like camcorder, inter phase surveillance cameras, stopwatch and scales. The study covered represents two major reeling clusters covering fifty traditional women reelers between the age group of 20 - 55 years for five continuous days. Primary data including reelers name, age, family background, cocoon cooking recipes followed and hands-on experience were ascertained. The entire production process was recorded and analysed for the following facts. The silk yarn produced was also assessed for quality consistency.

Structured observation method is used to record the time and performance of the Sample units. Data Analytical software used in this study is MS Excel and SPSS.

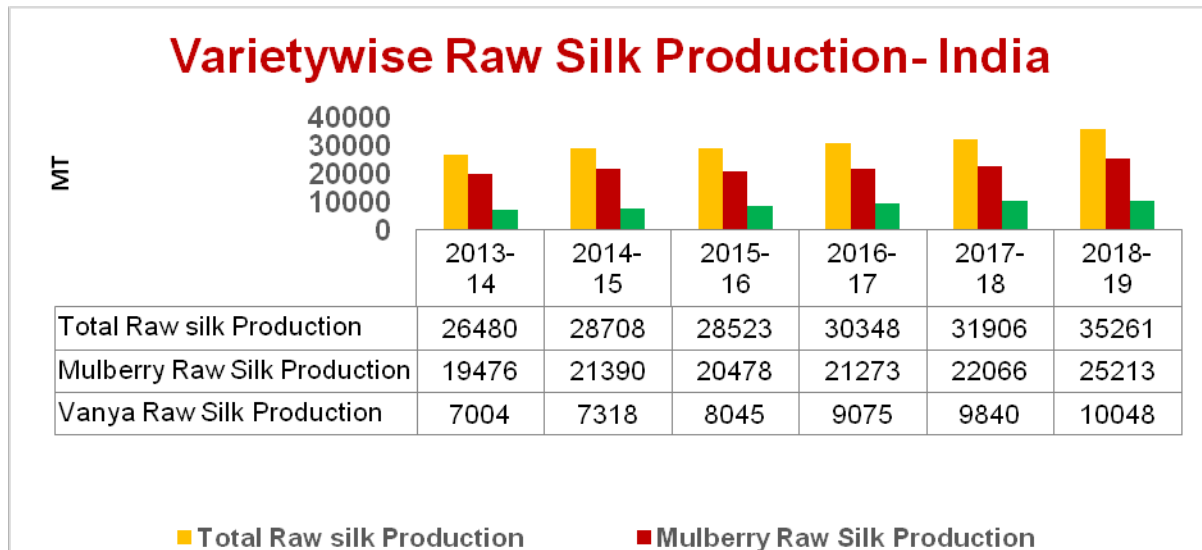
LIMITATIONS OF THE STUDY

In order to get more pragmatic data and an enhanced examination of the real activities, the sample size selected throughout the observation could have been increased with which, more consistent data would have also been improved in assessing the intensity of influence of the performances and the time involvement adopted by Tasar reelers across India.

VIII. HISTORY AND DEVELOPMENT OF SILK PRODUCTION IN INDIA

India has an affluent and multifarious history in production of silk and its silk trade dates back to 15th century. India is a unique country producing all the four known varieties of silk, namely, domesticated Mulberry silk (*Bombyx mori*), semi- domesticated Eri silk (*Philosomia ricini*), wild Tasar silk (*Antheraea mylitta*) and exclusive Muga silk (*Antheraea assama*), the wild golden silk being unique to India. Silk industry currently provides employment to 8.5 Million rural people of the country. It is an ideal occupation for employment generation and poverty alleviation and aligns with most of the objectives of the Sustainable Development Goal (SDG) set by the United Nations. The annual turnover of the industry is about Rs.10,956 Crores and has all the potential to become a major foreign exchange earner. The outlook of the industry is estimated to be positive propelled by strong domestic demand and consumption, which is expected to be continued in the coming years.

Figure I



PROCESS AND CHALLENGES OF TASAR THIGH REELING

Figure II: Tasar Thigh Reeler



Tasar reeling activity is community-based women dominated traditional process of extracting silk filaments from cocoons involving girl children to the women at her old age. Even with the resentment of younger generation to carry forward the Thigh Reeling practices, elders envisaging on the traditional community occupation to keep alive and with the sole idea of empowering woman for their future financial sustainability exert a pull of eagerness with compulsions among thousands of tribal women at their younger age without considering their participation and willingness in the activity.

IX. DISORDERS AND DISEASES: OCCUPATIONAL ENTRAPMENT

Thigh reelers were compelled to keep their legs crossed during the production process for years - can cause entrapment neuropathy (pressure on the nerves in the legs) causing muscle weakness as they grow old. i] They were constrained for prolonged sitting posture – resulting in degenerative spinal diseases - up shot of severe back pain and possible nerve injury, in later life can cause osteoporosis and vertebral fractures leading to kyphosis (bending of the spine) and can also cause hip joint problems like arthritis as witnessed in the cluster. As cocoons used for thigh reeling were cooked in washing soda and soap, ii] the continuous contact of rubbing and rolling friction of approximate 10,200 meters of yarn per day over sensitive thigh skin - could cause irritant contact dermatitis (ICD). A prevailing humid condition further induce and spreads it across, causing burning or stinging sensation with redness and swelling on thigh, making woman reelers endure a lot of humiliation and discomfort. Neither this conduit may be explained to Doctors for care nor gracefully embraced with.iii] Also the constant rotational movement of spindle [Natwa-Crude Bamboo Device] on the left foot can cause hyperkeratosis (thickening and inflammation of skin). iv] Incidence of occurrence of minor cuts on palms due to speedy yarn passage was common among Thigh reelers, because of which reelers suffer from burning cuts or wounds for a day or two. Practicing thigh reeling continuously, v] the vision attentiveness on cocoons to maintain them evenly for yarn uniformity can pose strain on the eyes, which can cause persistent headache and possibility of developing myopia if they start at young age.

X. TIME STUDY

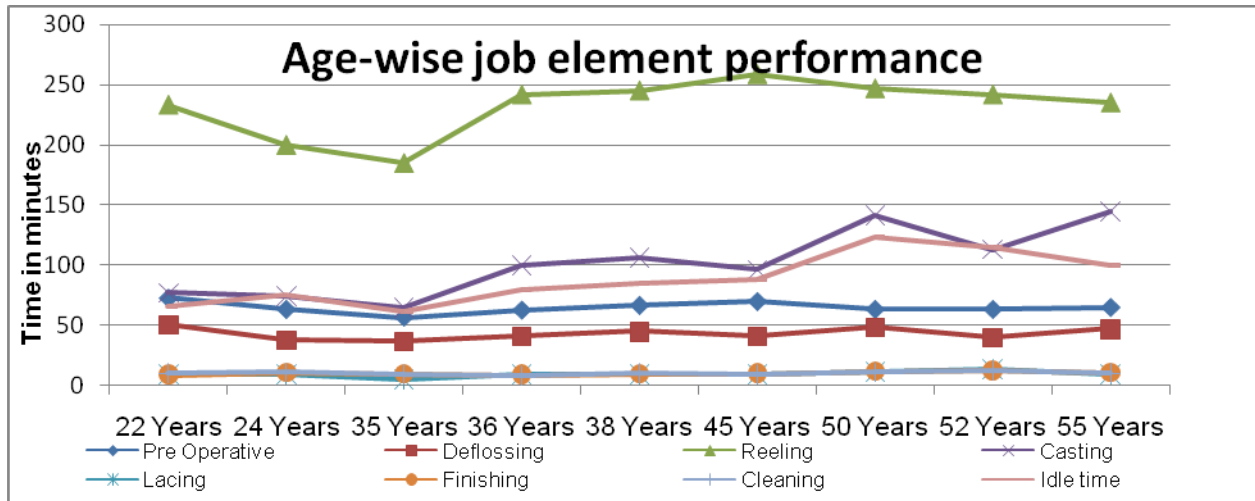
Duration of the principal task depends on several factors, such as its nature (simple or complex), operator fatigue or stress, properties of material being handled, devices and working environment etc., Senem Kursun and Fatma Kalaoglu (2009). To arrive at approximate real process time of a task, entire process was recorded covering all the 50 reelers over a successive period of five days using modern contrivances. The Time study was conducted using a stop watch by measuring each element of operation and were recorded. Time readings arrived for every worker during different periods of the day, which were averaged. The cycle time or the observed time has been converted to normal or basic time by multiplying it with the operator performance ratings using the standard Westinghouse performance factors. This system considers four factors: (a) Skills(b) Efforts(c) Conditions and (d) Consistency. The actual timings were compared and matched with one of the ratings in each of the above four factors, which are summed up

for finding total ratings depending on each of the case. This is added (or subtracted) to unity to find the rating percentage factor. On multiplying the actual (Observed) time with performance rating factor, to arrive at Normal or Basic time. The standard time is then calculated by adding the allowances of 9% (as per ILO) to the normal time.

Figure III: Work elements involved in Tasar reeling activity.

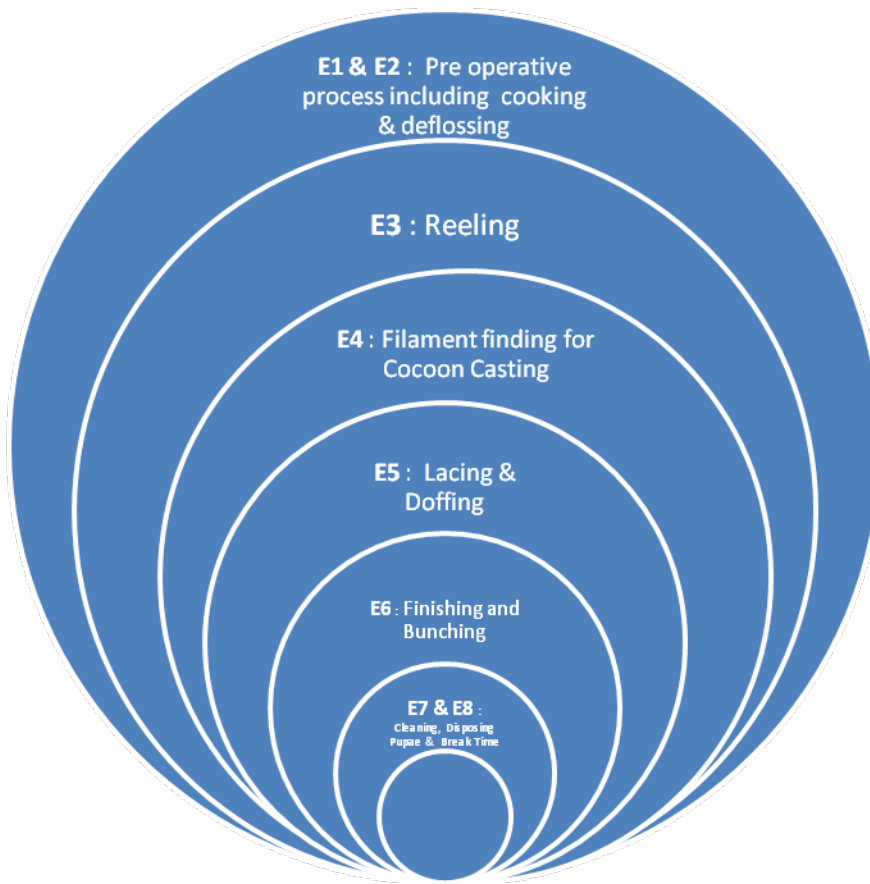
DATA ANALYSIS

Figure IV: Influence of age factor on job elements



*Index has been constructed by giving equal weight of 12.5% to each job element in 100 weight score. The lowest index is 45.43, which corresponds to 35 years.

Table 1: Determined values for individual work elements [Job]



Task Description [Element Name] in Minutes										
E1: Pre-operative process including cooking					E5: Lacing and Doffing					
E2: Deflossing					E6: Finishing and Bunching.					
E3: Reeling					E7: Cleaning and Disposing Pupae					
E4: Filament finding for Cocoon Casting					E8: Break includes lunch, rest & Nature call					
Number of Reelers	Age	E1	E2	E3	E4	E5	E6	E7	E8	TOTAL
R1 Gopalpur [3]	Below 22	74.3	54.0	223.0	73.3	10.7	8.7	10.3	65.0	519.3
R2 Fakirpur [2]	22-26	71.3	46.7	243.3	81.7	8.0	8.7	10.0	66.7	527.4
R3 Fakirpur [4]	26-30	63.3	37.7	200.0	75.0	9.3	10.7	10.7	75.0	481.7
R4 Fakirpur [7]	30-34	56.7	36.7	185.0	65.0	5.3	9.3	8.7	61.7	428.4
R5 Gopalpur [6]	34-38	62.7	40.7	241.7	100.0	10.0	8.7	8.0	80.0	551.8
R6 Gopalpur [6]	38-42	66.7	44.7	245.0	106.7	9.3	9.3	10.0	85.0	576.7
R7 Fakirpur [9]	42-46	70.0	41.0	258.3	96.7	9.3	10.0	8.7	88.3	582.3
R8 Fakirpur [4]	46-50	63.3	48.3	246.7	141.7	11.7	11.7	10.7	123.3	657.4
R9 Gopalpur [4]	50-54	63.3	40.0	241.7	113.3	14.0	12.3	12.3	115.0	624.2
R10 Gopalpur [5]	Above 54	65.0	46.7	235.0	145.0	10.0	10.7	10.0	100.0	622.4
Performance Rating Factor (%)		120.8	126.8	126.9	117.9	121.6	125.4	130.5	127.3	
Average Observed Time		65.7	43.6	232.0	99.8	9.8	10.0	9.9	86.0	
Normal Time = Observed Time * Rating Factor		79.33	55.33	294.4	117.7	11.88	12.54	12.96	109.5	
Standard Time (Assuming allowance 9%)		87.17	60.8	323.5	129.3	13.05	1378	14.25	120.3	

- Average production was recorded in the range of 85 – 96 grams / 10 hours / Reeler.
- Average yarn denier 77.6d
- Average weight of winding device was app. 380 grams.
- Average length of yarn produced was in the range of 10, 250 – 10,800 meters.
- Right hand movements [Clock wise with thumb pressure] 29, 000 – 29,500 times / Day.
- Synchronised left palm moments / Meter of yarn was in the range of 2.8 – 3.0 times.
- Average reeling speed 20 – 22 meters / minute.

Table 2. Westinghouse Performance Rating Table.

Effort Ratings

+0.13	A1	Excessive
+0.12	A2	Excessive
+0.10	B1	Excellent
+0.08	B2	Excellent
+0.05	C1	Good
+0.02	C2	Good
0.00	D	Average
-0.04	E1	Fair
-0.08	E2	Fair
-0.12	F1	Poor
-0.17	F2	Poor

Condition Ratings

+0.06	A	Ideal
+0.04	B	Excellent
+0.02	C	Good
0.00	D	Average
-0.03	E	Fair
-0.07	F	Poor

Consistency Ratings

+0.04	A	Perfect
+0.03	B	Excellent
+0.01	C	Good
0.00	D	Average
-0.02	E	Fair
-0.04	F	Poor

Skill Ratings

+0.15	A1	Superskill
+0.13	A2	Superskill
+0.11	B1	Excellent
+0.08	B2	Excellent
+0.06	C1	Good
+0.03	C2	Good
0.00	D	Average
-0.05	E1	Fair
-0.10	E2	Fair
-0.16	F1	Poor
-0.22	F2	Poor

Source: S. M. Lowry, H. B. Maynard, and G. J. Stegemerten, *Time and Motion Study and Formulas for Wage Incentives*, 3rd ed. (New York: McGraw-Hill), p.233.

- Synchronised left palm moments / Meter of yarn was in the range of 2.8 – 3.0 times.
- Average reeling speed 20 – 22 meters / minute.

XI. RESULTS AND DISCUSSION

The findings of this case study reveals the intricacies involved in the process of thigh reeling – the process of converting cocoons in to value added Tasar silk. Out of the eight identified elements under the job of thigh reeling, E1, E2 and E4 elements are considered as most vital and significant as they encompass skill, abilities and the transformed proficient competencies. It is apparent from *Fig. IV* and the results that the elements E1.E2 and E3 have direct bearing on productivity and the entire process gets attenuated with the age factor over the years i.e., the adopted and inculcated skills at the younger age gets transformed in to competency, resulting in optimized productivity. It is also evidenced from *Fig. IV* that the age factor has direct bearing on element E4 - Filament finding and cocoon casting, critically influencing capabilities and commitments of reeler. It is demonstrated that the E4 element has direct impact on yarn quality. Contrarily increasing age and the attributes like reelers' visionary impediments, general health disorders have direct bearing on yarn quality and productivity. Gradual increase in the age over 50 years, restrain productivity and also append physical ailments such as back pain, osteoporosis and vertebral fractures etc.

The results in Table 1, clearly indicates that all most all the reelers covered under this case study performed well within the standard time and has peak performance at the age range of 26-34 years with the optimal deliverable proficiency skills. Since thigh reeling is the only accessible livelihood community activity –attributing factors such as inherited talent, passion, contentment, painstaking mind-set, occupational reverence, attitude, eagerness to earn, supporting needs, opportunities, sentiments etc., have a great command over the entire reeling process, which is evidenced by the sizeable difference between observed and standard time.

XII. CONCLUSION

These inputs become point of reference in evolving appropriate technology for reeling Tasar cocoons as well as for designing customized implements to achieve higher productivity thus assuring higher income for thigh reelers. Observations on reeler's physical ailments and surveillance covered under this case study will also help in understanding intricacies and impediments involved in thigh reeling process to design customized capacity building training programmes to keep the reeling activities alive. Thereby giving scope for technocrats to explore and enlarge technology packages to strengthen prospective augmentation of reeling activities to meet the increasing demand for Tasar silk.

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