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Recent Insights In Occupational Health Hazards Among Sericulture Industry Workers

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Abstract

Sericulture is a vital agro-based, labor-intensive industry that sustains millions of rural livelihoods, especially in developing countries. Despite its economic significance, sericulture workers are frequently exposed to a variety of occupational health hazards. The worker engaged in sericulture is using traditional tools and techniques across different stages or tasks such as silkworm feeding, cleaning, cocoon boiling, reeling etc. The sericulture production system requires high demanding physical strength due to repetitive nature of tasks, awkward postures, extended period of sitting and standing thus, women face physical, mental and environmental challenges. The occupational risks prompted the conditions of stress, strain, work related muscular-skeletal disorders in various parts of worker's body. All the above challenges pose greater risk during working and overall reduce health of the women engaged in silkworm rearing. The drudgery involved in sericulture has significant influence on the productivity of the scheduled tribe women which will ultimately have a discouraging impact on their quality of life. This review synthesizes recent literature on the occupational risks faced by sericulture workers, categorizing them into physical, chemical, biological, and ergonomic hazards.

Overview of Sericulture Industry

Sericulture is a labor-intensive industry that plays a crucial role in rural economies, particularly in developing countries (***FAO, 2019; Ministry of Textiles, 2021***). However, workers involved in various stages of sericulture are exposed to multiple occupational health hazards (**Ghosh *et al., 2018; Singh et al., 2020***). Sericulture, the art of cultivating silkworms (Bombyx mori) for the production of silk, is an important agricultural industry, particularly in countries like China, India, and Japan. This industry provides livelihoods to millions of people, especially in rural areas, contributing significantly to the economy. Sericulture industry is employing 70 lakh people in India. About 23,060 tonnes of silk is produced in India annually, which generates a turnover of Rs. 25,000 crore of which Rs. 2500 crore is exported**(Pandey et.al 2014).** About 60 lakh people in India are practicing various activities of sericulture throughout the year as silk farmers, silk rearers, reelers, twisters, and weavers (**Sharma & Kapoor, 2020).** The demand of Varanasi silk saree in National and International market promoted the weaving of sarees on a vast scale thus generating employment on large scale **(Massey and Maurya, 2012).**

Whereas similar study **Ghonmode (2020)** reported that the sericulture is well-established agro-cottage industry. India generates nearly 25,000 crores of which Rs. 2500 crores are generated by foreign exchange by employing 5 lakh rearers and rest of them are reelers, twisters, weavers, printers etc. The sericulture industry, integral to many rural economies worldwide, has been facing growing concerns over the health and safety of its workers. These workers, who primarily engage in silkworm rearing, handling, and mulberry leaf harvesting, encounter various occupational health hazards. This review provides insights into recent studies that highlight the emerging trends in these health risks and the challenges posed by working conditions within the sericulture industry. Despite its importance, the work involved in sericulture poses several occupational health hazards to workers, who are exposed to a range of physical, chemical, and biological risks. These risks have implications for the workers' short-term and long-term health and well-being. This review paper examines the occupational health hazards in sericulture work and explores the evidence on their effects on workers' health, while proposing strategies to mitigate these risks.

The sericulture industry plays a crucial role in rural economies, yet workers involved in silkworm rearing face numerous occupational health hazards.The rearers in silk industry are engaged in several types of tasks and get exposed to multiple physical, chemical, and biological agents, which make them vulnerable to various health problems that include injuries, musculoskeletal disorders, allergies, eye irritation, and respiratory diseases**.**Recent studies highlight a range of ergonomic, respiratory, dermatological, and musculoskeletal issues that impact worker well-being. Prolonged standing, repetitive tasks, and improper postures contribute to musculoskeletal disorders, while exposure to chemicals, dust, and silkworm waste leads to respiratory and skin-related health problems. Additionally, fatigue and injuries due to manual labor further aggravate health risks. This review aims to provide a comprehensive analysis of the latest research on occupational health hazards in sericulture, emphasizing the need for improved workplace ergonomics, protective measures, and health awareness programs for workers. Silkworm rearing is a labor-intensive process requiring repetitive tasks, prolonged standing, and manual handling of materials. These activities expose workers, especially women, to ergonomic health hazards, which can lead to musculoskeletal disorders (MSDs), fatigue, and joint pain who were involved in sericulture activites. Poor posture, improper workstations, and lack of awareness about ergonomic principles contribute to these health issues. (***Patil et al., 2020***).

The extent of participation of women in sericulture production system

India contributes almost 18% of the world's raw silk, ranking next to China. The region of Jammu and Kashmir has been a prominent stakeholder in the industry. Sericulture is an ageold occupation and has an important role in Kashmir's economic development. Women perform 60% of sericulture's activities, making it one of their significant livelihoods that promote the empowerment of rural women. However, women's participation in this industry has declined due to several factors. Thus, the study explored the various causes of the decline in sericulture in Kashmir and the barriers that hinder women from participating in this industry. (***Kulsum et.al. 2022***). Whereas ***Sanjay et.al 2025*** reported that the craft of silk production, known as sericulture, has a long history of involving women, which makes it an important means for gender-neutral economic growth. The transforming potential of sericulture in empowering women and promoting sustainable livelihoods in rural communities is examined in this article. It explores the economic, social, and environmental aspects of sericulture in relation to women through case studies. It emphasizes the ways in which sericulture provides women with chances to engage in the society, gain new skills, and earn money The sericulture industry plays a crucial role in rural economies, yet workers involved in silkworm rearing face numerous occupational health hazards. The study also revealed that the potential of sericulture to empower women and provide sustainable livelihoods in a variety of cultural and geographic contexts, highlighting its many benefits and arguing for its incorporation into more comprehensive policies for rural development

Another similar study was reported by ***Kasi 2013*** that the women are playing a very important role in the sericulture industry. Their qualities like maternal instincts and loving care of those under their charge prove to be very helpful in the successful breeding of silk worms. The sericulture industry has opened up phenomenal employment avenues and helped women to become important players in the decision-making process—whether in the household or in the community at large. The role of women in promotion of sericulture activities in the village, and how their participation has led to community development. Sericulture is an important means for generating employment, income enhancement crop enterprises, and is a most appropriate household activity. In all these activities, women have shown their mettle and performed their tasks most skillfully. In the village under study, women are playing an important role in silk rearing and processing activities. Sericulture an agro-based activity has brought about overall development of individual households, the village, and the community at large. In India's sericulture business, women make up more than 60% of those engaged in downstream activities (**Satsangi, 2014**). In India from 2018 to 2019 sericulture has provided livelihood to about 91.78 lakh persons. So, it is assumed that around 55 lakh persons engaged in sericulture during this period were women labourers **(Roy Chandan and Mukherjee, 2020**). The regular money generated by sericulture is shared equally among all members of the community, regardless of their social status, race, gender, or religion. It's crucial in empowering women and helping them achieve economic, political, and social autonomy **(Kasi, 2013).** This level of female involvement in the sericulture sector revealed it as a remarkable option of occupation and helps in the eradication of unemployment problem among the rural women (**Parimala, 2009**). As per a field survey conducted by Central Silk Broad, sericulture was found to be the top sector in offering jobs as compared to other agro-sectors in India (**Satsangi, 2014**). The national raw silk production in 2019–20 was 36,152 MT, up 1.9% over the previous year's output and almost 93.8% of the annual projected output for the year 2019–20. In 2019–20, mulberry silk production increased by 0.2% from the previous year (**Galore- et al., 2020**).

Women are considered the weaker section in most societies as compared to men. The existing gender inequality has attracted the world's attention, and 17 Sustainable Development Goals (SDGs) were set up in 2015. Among 17 SDGs, gender equality is the 5th important goal and is also considered in agriculture. The present study aims to assess women's empowerment for achieving gender equality goals through the production and marketing of mulberry silk in the Chikkaballapur district of Karnataka. The data was analyzed, and the women's empowerment index was constructed to determine the empowerment level. In this study, 0.75 was considered as a threshold level of the empowerment index, meaning if the index value is more than 0.75, then there is adequate empowerment among women. The result of the study indicated that about 22.22 % of women were having Individual Empowerment Index(IEI) of more than 0.75, which opined that women had attained adequate empowerment. The remaining 77.78% of women were confined to the process of attaining empowerment. The overall Women Empowerment Index (WEI) was found to be 0.688 for these women who participated in sericulture. It shows that involvement in the production and marketing of mulberry silk could help in women's empowerment in the study area. Despite 60 per cent employment of women in sericulture, the adequate empowerment index for women has not been achieved. Before the researcher, this is the real challenge of how the women empowerment index may be improved to the desired level. **(*Anonymous2021*).**

The another study was reported that the women constitute more than fifty per cent of the world's population, one third of the labour force, and perform nearly two thirds of all working hours. Women are also mostly engaged in the unorganized sector (**Mehta and Sethi, 1977**). Sericulture is one of the important potential labour intensive agro- based rural industries in the world. No wonder women are playing a very important role in the sericulture industry. Their qualities like maternal instincts and loving care of those under their charge prove to be very helpful in the successful breeding of silk worms. The sericulture industry has opened up phenomenal employment avenues and helped women to become important players in the decision making process—whether in the household or in the community at large. The active involvement of women is very essential for the success of the any community development initiative. This has been proved on many occasions all over the world—more so in the developing countries. This study also analyzed that impact of

women workers' dominance in sericulture sector upon the process of inclusive development in the rural household sectors of West Bengal. Women have patience, perseverance, caring attitude and adaptability to new technologies have made her activities more dominant in sericulture and silk production. Present study reveals that the Women are engaged about 60% work in various sector in Sericulture i.e from Mulberry cultivation to Silk weaving etc. and women are doing their works successfully in every sector (**Sarkar et.al.2017**).

Occupational health hazards/ Accident/Risk Injuries in Sericulture Industry

Occupational health hazards among sericulture workers are a significant concern due to the nature of their work environment and exposure to various biological, chemical, and physical risks. The sericulture industry is a labor-intensive agro based industry in India. The workforce is exposed to various occupational factors at the workplace and hence, they are susceptible to various occupational hazards. . The various study was undertaken to correlate the physiological response of sericulture industry workers and their workplace environment. Sericulture, the cultivation of silkworms for silk production, involves various stages that expose workers to multiple chemical hazards, leading to significant health risks. This study consolidates findings from several studies to highlight the chemical hazards prevalent in sericulture and their impact on workers' health.

As per the **kumar et.al. (2023)** investigated that sericulture is a labour-intensive textile industry that involves growing food plants for silkworms, raising them, reeling their silk, and performing various post-cocoon operations, including twisting, dying, weaving, printing, and finishing. It employs a huge number of rural people; the majority are small and marginal farmers or work in the tiny and home sector, mostly in the hand reeling and hand weaving sections. Despite the fact that silk is of natural origin, the silk industry uses some health-hazardous substances at all stages from mulberry farming through silk fabric finishing. Pesticides, fungicides, nematicides, bactericides, and herbicides are the most common in mulberry cultivation. Similar to mulberry agrochemicals, the pre-cocoon industry employs a wide range of disinfectants and bed disinfectants to protect the silkworm crop against infections. And also, a separate class of agrochemicals is utilized in dyeing, printing, and washing because it improves the reeling process and silk quality. However, these compounds create respiratory issues and are carcinogenic to humans, as indicated by dermatitis, skin lesions, back aches, bronchial asthma, coughs, gastrointestinal pains, ulcers, throat infections, thinning nails, dry skin, and hand and eye burning. In addition to human concerns, persistent chemicals endanger the ecosystem and contribute to the overall chemicalization of aquatic and terrestrial environments. As a result, whenever possible, the discharge of toxic compounds into the natural environment should be reduced. Unfortunately, in developing countries like India, where large quantities of these chemicals are generated and dumped into the environment, they are not properly managed because little is known about their potential risks and benefits if properly managed. In this article, we intend to explore the major sources of sericulture agrochemicals, their potential risks, and how they can be properly managed.

Whereas a cross-sectional study was conducted by **mandadi et.al (2019)** to assess the morbidity pattern in 194 sericulture workers (131 men and 63 women) recruited at the Nellimarla Sericulture Industry in Andhra Pradesh, (about 57% in 1st year and about 64% from 2nd year onwards) and author also reported that the skin problems were pruritus (21.5%) and dryness (20.6%). Most of the workers had low back pain (67.8%) and headache (57.6%). Ocular problems were seen in 50.4%, while noise-induced hearing loss and tinnitus were observed in 25.8%. Whereas Physical injuries at the workplace were reported by 16.9%. About 33.4% were known hypertensive, and 25.8% were diabetics. It is concluded that the overall prevalence of health hazards among sericulture workers is considerably high. This is due to abundant production of carbon monoxide during silkworm rearing, immersion of hands in boiling water for reeling the silk filament, and usage of harmful chemicals for dying and printing. Vigorous training of health care workers is a prerequisite to increase prompt identification of workers having symptoms of occupational health problems. Referral of the affected workers to the nearest health care facilities for proper management is recommended.

Similar Problem was reported by **Sanadi (2016)** that, the workers were not aware of health and safety issues due to the majority of workers are illiterate. The workplace environment is characterized by the presence of various chemicals, noise, heat, spiteful smell and lime dust/biological dust in various activities of sericulture industry. Working environment is affecting on workers health and they were exposed to various types of health risk factors. Physiological profile of workers shows variation in body temperature, pulse rate, BP, Hand grip strength and Peak expiratory flow rate (PEFR) values.

The another important study was reported by **Mandadi et.al. (2019)** . that the majority of the workers in the present study suffered from cough (35.5%), chest tightness in 20.1%, and dyspnea in 18% of the study population. This was similar to Jaiswal study where respiratory problems were observed in 36.8% of the study population(***Jiaswal et.al. 2011***) and dissimilar to a study conducted by Pandey in Jammu where the prevalence of respiratory morbidity was 10%.(***Pandey et.al.2014***).Where as in another study , 21.5% of the study population had the itch as a skin complaint followed by dryness of skin in 20.6%. Skin blisters were observed in 6.1% and ulcers in 7.7%. In ***Wani et.al 2011 and Jaiswal et.al***.2011 study, reported that skin burns were seen in 13.54%.[……also reported that the present study, most of the workers had low back pain (67.8%) which is very high when compared to Pandey study where backache and joint pains were seen in 15% and 28%, respectively. ***Pandey et.al.2014*** reported that the prevalence of headache in the present study is 57.6%, while in a study conducted by Wani and Jaiswal at Kashmir, the prevalence of headache was 46.35%.(***Wani et.al 2011***). ocular problems were seen in 50.4% of the study population in the present study which is very high compared to Pandey study where eyesight weakness was observed in 3% of the respondents ***(Pandey et.al.2014)*** and in Wani and Jaiswal study, the prevalence of eye irritation was 16.6%. ***(Wani et.al 2011)***. the Physical injuries at workplace occurred in 16.9% in the present study, whereas in Wani and Jaiswal study, injuries occurred in 40.1% of the study population(***Wani et.al 2011***) where as…….reported that 33.4% were known hypertensive in the present study, whereas in a study done by Meshram and Murarka study, it was observed that 32% were hypertensive***.(Meshram 2017)***

As per the study **Ghonmode (2020)** ,sericulture involves hatching of eggs up to reeling. Silk has got tremendous importance in our country which is used during wedding functions and festival seasons. Several health hazards in which the workers are exposed to various health problems due to lack of education, poor nutrition, and unawareness about the hazards of their occupation. Silk manufacturing involves cultivation of mulberry and non-mulberry food plants, rearing of silkworms, grainages, reeling of filaments, twisting, weaving, printing and dyeing. It has been observed that women are more prone to the health hazards as compared to men. Further the farmers both men and women are prone to deadly health hazards like neurophysiological disorders, behavioral changes, headache, nausea, vomiting, skin and eye related problems, respiratory diseases like asthma, chronic bronchitis, diminished lung functioning, blister formations on hand, dermatitis, reproductive related problems, back pain, joint pain, stress etc. It is therefore very important to check the health, safety, welfare and protection of the workers to reduce the illness and problems.

Whereas **Ahmad et. al.** (**2011)** investigated that the role and importance of sericulture in Kashmir. The study indicates that majority of the rearers were suffering from health problems like eye irritation, injuries, back pain, allergies, respiratory problems and headache. Certain measures have been suggested that may improve the economic conditions of the rearers which may ultimately reduce the health risk factors among them.

Similar study was repoertd **Sarker et al., (2019).** by on chemical hazards in sericulture study has highlighted that the toxic effects of prolonged exposure to chemicals. The studies also have shown that pesticide exposure can lead to various health issues such as skin irritations, respiratory problems, and neurological disorders Pesticides like endosulfan and malathion, commonly used in sericulture, have been linked to adverse health outcomes including chronic respiratory diseases, headaches, and nausea (**Srinivasan et al., 2018**). Workers in sericulture are at risk of pesticide poisoning through dermal contact, inhalation, and

ingestion, particularly when safety measures like personal protective equipment (PPE) are inadequate (**Kumar et al.,2020**).

More over **Ramaswamy et al., (2020)** also reported that the sericulture workers are also exposed to various biological risks. The organic matter found in silkworm rearing facilities, such as feces and waste, is a source of bacteria, fungi, and viruses, which can lead to respiratory diseases like asthma, chronic obstructive pulmonary disease (COPD), and other lung infections Silkworms themselves are known to carry certain pathogens, and the exposure to these can increase the risk of zoonotic diseases. Furthermore, prolonged exposure to high humidity and the accumulation of mold and fungal spores in the sericulture environment have been linked to fungal infections and allergies (**Thakur et al., 2021).**

Whereas **Lal et al., (2017)** highlighted that the repetitive and physically demanding nature of sericulture work further contributes to health risks. Workers are frequently involved in manual tasks such as feeding, cleaning, and harvesting silkworms, which require repetitive motions and extended periods of physical exertion. Poor posture and the heavy lifting of materials can lead to musculoskeletal disorders (MSDs), particularly affecting the back, wrists, and shoulders. Injuries from these repetitive tasks can have long-term impacts, leading to chronic pain and even disability in some cases. Research has indicated that improper ergonomic practices in silkworm farming increase the prevalence of these injuries (**Kumar et al., 2020**).

The mental and emotional well-being of sericulture workers is another crucial aspect of occupational health. The seasonal nature of sericulture, long working hours, and financial instability associated with fluctuating silk prices contribute to high levels of stress and anxiety. In many rural areas, sericulture workers are under economic pressure to maintain productivity, which can lead to mental health issues such as depression and burnout (**Thakur et al., 2021**).

Sericulture, while being an economically significant industry, exposes workers to a range of health hazards, from chemical and biological risks to physical and psychological stress. The existing literature on occupational health hazards in sericulture underlines the need for effective intervention strategies that ensure workers' health and safety. Addressing these issues through education, improved safety measures, and better work practices is essential to mitigate the risks and improve the working conditions in sericulture

Postural Stress and Musculo-skeletal Disorders in Sericulture Production System

A study was conducted by **Yota et.al. (2025)** on Praewa silk weavers and author reported that the numerous occupational risk factors that contribute to musculoskeletal disorders (MSDs), primarily due to inadequate occupational safety measures, limited access to health services, and substandard working conditions. The aim of this study was to assess the prevalence rate and determinants of MSDs among Praewa silk weavers. The findings revealed that the prevalence rates of MSDs in the past 7 days and 12 months were 68.68% and 96.46%, respectively. The highest prevalence rates of MSDs (over 60.00%) were observed in the wrists, fingers, and neck, with similar trends reported in both the past 7 days and 12 months.

Similar Study was reported by **Rithinyo et.al**. (2022). that the prevalence rate and factors affecting musculoskeletal disorders of 378 members of a local silk-weaving community in Thailand. Target weavers are engaged in the preparation of silk thread preparation before the weaving phase. As results, the most prevalence of musculoskeletal problems among the samples were pain in the shoulder blade and lower back, accounting for 98.94 %, followed by aching in both hands or wrists which account for 98.68%; and left shoulder pain (97.35%). Factors affecting musculoskeletal disorders found were: 1) body mass index, 2) break time, 3) unchanged weaving posture that takes more than half of work time, 4) long-term excessive bending of neck and back, and 5) repetitive, prolonged arm and hand movements (at least 30 minutes).

In an another study **Vinay et.al. (2021)**reported that Agri enterprises have predominance of health risk factors which affects to the workers health and overall wellbeing. The health problems of workers in agri enterprises increased due to incessant long working hours and uncomfortable work posture. The most common health problems experienced by workers in agri enterprises are job strain and musculoskeletal

discomforts. The study revealed that among all the selected agri enterprise activities, highest job strain was found for the workers working in grain packaging activities particularly in loading and lifting of grains packets (JSI score 81 for each hand.) Weaving enterprise, vegetable cutting and grain packaging activities were associated with very high muscle fatigue as analyzed by the Rodgers overall priority matrix. The prevalence of job strain and muscle fatigue was found at hazardous level in workers engaged in small scale unorganized agri enterprises.

In similar study **Noyming et.al. (2023)** reported that musculoskeletal disorders in workers of the silk weaving professions have become a significant problem affecting production effectiveness. The objectives of this study were to explore the prevalence rate and factors affecting the musculoskeletal disorders of 400 female silk preparation process workers in the silk weaving profession in Buriram province. The results revealed that 92% of the silk preparation professionals had problems with muscle pains mainly in their lower back and 91.75% had knees pain. Buttock and hip pain were experienced by 90.50% of the workers, and 90.25% had left and right shoulder pain. Factors affecting the musculoskeletal disorders were: 1) age, 2) working time, 3) break time, 4) reaching above the shoulder to pick up or hold the material, 5) continuous bending down of their heads to work, 6) hands or arms working in repetitive movements (for at least 30 minutes).

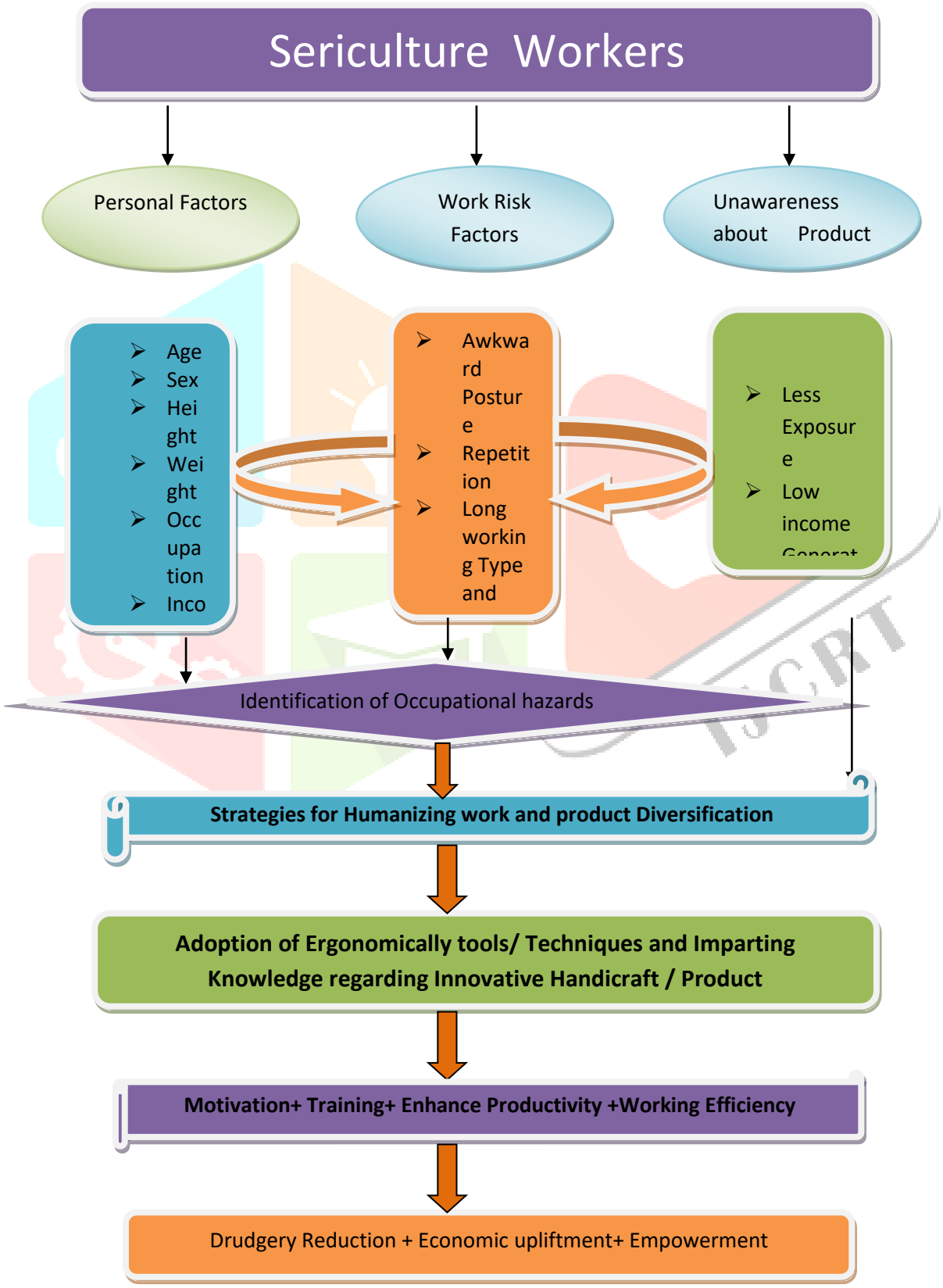
In similar study **Borah et.al. (2018)** envisaged that low back pain assessment of farm women involved in Sericulture‖ was done to assess the musculoskeletal discomforts faced by farm women who are actively involved in Sericulture industry. Sericulture is an important industry in the rural areas of Meghalaya where rural women are involved. The study was done in two villages of Samanda Block in East Garo Hills district of Meghalaya. Findings showed that most women had suffered low back pain which hindered their ability to walk, sit, stand and bend. It was also found that the intensity of pain was highest while removing worms from cocoons which require them to squat and bend for long hours. Further analysis showed that severity of pain was more in lower back in comparison to upper back. It was also found that due to low back pain 30 per cent of the farm women were affected in their sleep and 33 per cent of women were interfered by the pain in their ability to stand for long hours and 27 per cent could not stand for more than an hour in the past 2 weeks. It was also found that 23 per cent women were not able to sit comfortably in chairs and 17 per cent could not sit for more than an hour. Low back pain was also found to have interfered the farm women in their ability to walk as 47 per cent of the women could not walk for more than an hour. It was also found that low back pain had prevented some of the women from carrying out their daily activities (23%) and some women were mildly and moderately.

Conceptual Framework of the study

The theoretical framework represent a structured foundation for the study by integrating existing concepts from literature and validating theoretical assumptions through empirical evidence. It serves as a roadmap, guiding the formulation of research questions and the selection of appropriate methodologies for measuring and analyzing variables

In the context of developing countries like India, women play multiple roles in agriculture and allied activities. They are engaged in various labor-intensive tasks throughout the year especially in sericulture production system. In sericulture, it has been widely observed that women workers are primarily engaged in labor-intensive and repetitive tasks, often carried out manually and without the use of protective or ergonomic aids. The rural regions pursuing sericulture practices with majorly scheduled tribe women involvement have yet to fully adopt advanced tools and technologies in cocoon rearing practices. The traditional silkworm rearing practices, indigenous tools and techniques used in sericulture production system expose them to significant health hazards, especially work-related musculoskeletal disorders (WMSDs), resulting from poor postures, repetitive motions, and prolonged working hours. This gap is influenced by factors such as limited awareness, lack of accessibility, and the feasibility of modern facilities.

Women play a central role in the sericulture production system, yet they face a more burden of physical drudgery compared to their male counterparts. Their continuous involvement in strenuous tasks in rearing silkworm often leads to both physical and mental exhaustion. Poor working conditions, combined with the demanding nature of their activities, heighten their risk of occupational health problems, especially when subjected to repetitive or ergonomically unsound movements. These health risks can be accessed through physiological parameters such as heart rate, energy expenditure, and the physiological cost of work, all of which affect their work capacity, productivity, and overall well-being.



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