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Survey Based Research Paper

Health Hazards of Rearing Silk Worms and Environmental Impact Assessment of Rearing Households of Kashmir, India

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ABSTRACT

The objective of the study was to investigate the role and importance of sericulture in Kashmir, the environmental impact of sericulture rearing units, and to assess the health risk factors of the workers working in this industry. The study was conducted at different rearing units of Kashmir valley situated in India. A prepared questionnaire was circulated among the rearers and control subjects to assess the health risk factors of the workers. Temperature, humidity and light intensity were measured with the help of thermo-hygrometer and digital lux meter, respectively. The present investigation 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. Therefore, it is recommend that personal protective equipments and appliances for rearing should be provided to the rearers to reduce the health risk factors.

INTRODUCTION

Sericulture is a major cottage industry in many countries, and in India it plays an important role in the national economy (Veer et al. 1996). It is a labour intensive, export oriented, agro-based industry, generating high employment and income per unit area of land (Rani 2007, Unni et al. 2009). The annual production of silk in the world is estimated at 45,000 tonnes (www.krishiworld.com) and India ranks second in silk production amongst the mulberry silk producing countries of the world (Veer et al. 1996). The bulk of commercial silk is obtained from the mulberry silkworm (*Bombyx mori* L.). Sericulture in India is practiced predominantly in tropical environmental regions such as Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal and to a limited extent in temperate environment of Jammu & Kashmir (Singh & Kumar 2010). The salubrious climate of Jammu & Kashmir State is very much suitable for producing silk by rearing bivoltine silkworms. The silk industry of Kashmir provides employment to about 0.022 lakh rearers and produces about 8800 kg of raw silk annually. It also exports products to a tune of 1.22 lakh INR (Digest of Statistics 2008).

Silk worm rearing demands specific environmental conditions to produce qualitatively and quantitatively superior cocoons. Enough space must be available to carry out leaf preservation, chawki rearing, mounting, cleaning and disinfection. However, the incompatible climatic conditions of Kashmir are contributing to the poor performance of the bivoltine breeds and the most important aspect is that many qualitative characters such as viability and cocoon traits decline sharply when the temperature and humidity are not well within the standards (Shibukawa 1965). Proper lighting conditions in rearing houses are also very important for overall quality of cocoon production (Meenal et al. 1994).

In Kashmir silkworm rearing is done as a subsidiary to agriculture during summer season only. The rearing is still relatively of simple kind and includes traditional Sikiris, local mounting material and is done under domestic conditions. Sometimes, rearing as well as cooking is carried out in the same room due to lack of space without proper ventilation. The rearers 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. The nature of work, low income, poor work environment and lack of access to occupational health services cause anxiety in the minds of rearers. These factors affect the health of rearers, and also their efficiency and production. The present study was undertaken to identify the environmental and health concerns associated with silk rearing, assess the potential environmental problems due to rearing and to suggest remedial measures to reduce the adverse impact of the rearing activities on the environment and public health.

MATERIALS AND METHODS

The present study was conducted in different rearing houses

of Kashmir (India). Altogether 214 and 192 rearers participated in the present investigation during summer 2008 and 2009, respectively. An equal number of controls of the similar age group belonging to similar socioeconomic status with no exposure to silk worm rearing and who were normally healthy were selected from the same locality. Information on occupational and medical history, job description, and socioeconomic status were obtained through questionnaire. Subjects having previous history of diseases were excluded from the study. The selection of the rearers and control subjects was based on random sampling technique.

The blood pressure was recorded using a mercury sphygmomanometer. Height was measured in all participants with the help of nonstretch measuring tape. The weight of the participants was measured by placing a weighing machine on a hard-floor surface. Calibration was done at the beginning and end of each examining day.

Temperature, humidity and light intensity in rearing houses were measured with the help of thermo-hygrometer and digital lux meter respectively.

RESULTS

Demographics: Out of the total workers surveyed, 85% were males and 15% were females. They were in the age group of 35-55 years. Most of the rearers were illiterate and male rearers were consumers of tobacco. The average professional years as a rearer were about 15-20 years. Table 1 summarizes the demographic data of both the rearers and the control subjects.

Income and economic factors: The data are on income and other factors are given in Table 2. Reasons for joining rearing work are essentially related to economic factors, this seems to be the most regular and suitable occupation to take up from the economic point of view. Other occupations are either not available or are not sufficiently income generating. Hence, in spite of health problems like respiratory disorders, headache, common cold, burns, backache, people still opt for silk rearing. Workers earn about 2100-3500 INR per month and usually work about six to seven hours a day. The low income levels of the workers and health problems that they encounter intensify their already precarious living conditions. Work in silkworm rearing units is not continuous over the year, but last only for two to three months per year in Kashmir due to its climatic conditions. Silk rearing is being conducted by elder members of the family, both men and women of the respective families. Children are involved infrequently even though it is common to find that parents are introducing them to sericulture techniques very early. Substantial number of rearers has followed this line after their parents. Women bear several responsibilities, which also enhance or increase their prosperity to suffer from various health problems. Burning biomass fuel in these units provokes their health problems. Further they are also exposed to several hours of wood fuel smoke in their homes while, they cook food. It was observed that both rearing as well as other household activities are carried out in the same house simultaneously and in an average two-three rooms were occupied by silkworm rearing.

Problems of Silk Worm Rearing

Poor quality of leaves: Sometimes silkworms get diseased during the course of silkworm rearing. Rearers remarked that this was probably because of the low quality of mulberry leaf. Bivoltine silkworms are also susceptible to diseases and are very sensitive and require proper temperatures and humidity, good rearing technique, and good mulberry leaf quality to survive. In the last stages of growth, silkworms need a greater quantity of mulberry leaves that the rearers have to spent more time in collecting leaves, which they usually cannot afford.

Heating system: Sometimes, climatic conditions in the valley changes unexpectedly, as a result of which the required temperature for silkworm growth is not maintained owing to lack of heating system. The outcome of this is a great loss to the rearer due to low cocoon production.

Plantations

Mulberry plantation is mainly available on roadsides with some farmhouse plantations put in by rearers and bush plantations are found only in sericulture centres. Mulberry sapling root purification (protection from insects) is done by soaking the plant three or four times in a solution of dyathin, after which the pesticide wastewater is thrown away. Heptachlor powder is used as a protection against termites and applied directly to affected trees. Kerosene oil is used against the stem borer. Fertilizers consisting of urea, phosphate, potash, cow-dung, are used in fertile areas for saplings. Throughout the application of pesticides and fertilizers the rearers do not use any kind of personal protective equipment, which exposes them to large number of health risk factors.

Rearing shed

The rearers were more concerned about rearing sheds than health problems. The rearing occupies all the rooms and rearers are facing acute shortage of rooms as rearing progresses. It has been observed that on an average two-three rooms are occupied by rearing, which puts these rearers to a mental stress. The unpleasant smell coming out from theses rooms affects their children badly. Although, the concerned

department has assured several times that rearers will be given proper sheds for rearing. It has been observed that sikiris were not provided to rearers for burn charcoal to keep the temperature of the room constant. They were using tin canes and instead of charcoal they burn biomass for maintain the room temperature.

In order to provide optimum environmental conditions like temperature and humidity during rearing period, a separate rearing shed should be constructed with a size of 20' × 40' × 15' (L × B × H) or 30' × 18'13' (L × B × H). Free cross ventilation must be ensured by providing adequate number of windows.

Environmental conditions: For the proper growth of silkworm the proper humidity, temperature and light intensity is very important. The average temperature at the rearing units was 23.6±0.3°C in summer 2008 and 23.01±0.59°C in summer 2009 with the maximum of 29.8 ±1.2°C in summer 2008 and 30.265±0.53°C in summer 2009 (Table 3).

The observed maximum and minimum average humidity were below the standards (65-70%). The average humidity at the units was 64.3±4.3 (%) and 58.96±1.65 (%) during summer 2008 and 2009 respectively (Table 3). The average light intensity was found between 95.2±1.0 in summer 2008 to 121±7.8 in summer 2009 at the rearing units (Table 3).

Health risk factors

Workers involved in rearing mentioned that they suffer from respiratory problems, musculoskeletal disorders, eye irritation, allergies and injuries. Most of the people involved in rearing were suffering from headache (42.99%), common cold (31.77%), asthma (12.14%), chest pain (27.1%), vertigo (35.51%), eye irritation (14.95%), injuries (37.38%), burns (11.21%), wheezing (2.8%) and allergy (4.5%). However in control group, headache, common cold, asthma, chest pain, vertigo, eye irritation, injuries, burns, wheezing and allergy were observed in 14.01%, 10.28%, 1.84%, 8.41%, 6.54%, 1.8%, 0%, 0%, 0%, 0%, respectively during the year 2008 (Fig. 1). The prevalence of headache, common cold, asthma, chest pain, vertigo, eye irritation, injuries, burns, wheezing and allergy were observed in 46.35%, 32.81%,13.54%, 29.16%, 38.02%, 16.66%, 40.10%, 13.54%, 3.12% and 6.25% rearers, respectively and the prevalence of headache, common cold, asthma, chest pain, vertigo, eye irritation, injuries, burns, wheezing and allergy were observed in 16.14%, 10.93%, 1.56%, 6.25%, 8.33%, 2.08%, 0%, 0%,0.52% and 0% in control subjects, respectively (Fig. 2).

Environmental impact

During the investigation it was found that the wastewater and solid waste disposal causes impact on the surrounding environment. There are many chemicals, pesticides and fertilizers used in different stages of sericulture activities, including plantation, rearing, grainage and weaving. These chemicals have deleterious effects on the human ecosystem if not handled properly. Fertilizers and pesticides used in mulberry plantations may have an effect on the silkworm due to its residual toxicity, which affects the quality and quantity of cocoon production and causes negative impacts on the environment.

Employees, who work in rearing, suffer from many diseases which has an impact on their economic status as they work less due to poor health. A large amount of fire wood is used for keeping the temperature of the room constant. The smoke may emit toxic carbon monoxide fumes in to the air and use of firewood also adds to forest destruction. In most of the rearing houses, the disposal of the chemicals and solid wastes is a neglected issue. Rearers are not aware about the hazardous effects of these chemicals on their health and environment.

Land-soil characteristics: Solid waste is dumped in open land or thrown outside, which may cause changes in soil characteristics. Different types of chemicals from wastewater and solid waste decomposition left on soil may destroy soil microbes and reduce the natural soil fertility. The chemicals may also alter soil texture and permeability of soils.

Water pollution: Surface water pollution may occur due to drainage of waste into water bodies by rain water. Residues of chemicals from waste reach groundwater through infiltration. Pollutants may persist in groundwater over a long period of time and can travel a long distance without any alteration.

Air pollution: Air emissions from rearing contain oxides of nitrogen, sulphur, carbon, volatile organic solvents, dust and soot. These emissions may be toxic to the environment and cause occupational health problems of the workers. These pollutants may also cause environmental and health hazards in the surrounding areas.

DISCUSSION

Sericulture being a labour intensive rural based industry offers a qualitative and quantitative change in the poverty alleviation. It offers the chain creation of employment for unskilled farm labourers to silk artisans to all sections especially women folk, but simultaneously its byproduct cause instrumental health problems in a significant proportion of workers. The silk rearing technology, which is predominantly used, is of relatively simple, making it possible for poorly educated people to work with them. However, the health problems associated with rearing is going to get into their

Table 1: Physical characteristics of the rearers at different rearing units.

S.No.	Parameter(s)	2008		2009	
		Exposed	Control	Exposed	Control
1	Age (years)	41.36 ± 3.4	45.3 ± 4.2	42.3 ± 5.1	47.2 ± 3.1
2	Weight (kg)	62.30 ± 7.6	65.30 ± 10.2	58.23 ± 6.3	62.3 ± 8.2
3	Height (foot)	5'4" ± 0 .03	5'.4 ± 0.04	5'.2" ± 0.2	5'.3" ± 0.02
4	Systolic pressure (mmHg)	127 ± 5.7	130 ± 5.6	130 ± 8.5	135 ± 4.2
5	Diastolic pressure (mmHg)	67 ± 9.1	75 ± 5.3	73 ± 7.5	78 ± 2.7

Data expressed as mean ± 1SEM, with all values given in mean value of the parameter(s).

Table 2: Income and socioeconomic status of the rearers.

S.No.	Village*	Population*	Education*		No. of Rearing houses	Average Income monthly from sericulture		Average number of room in a house	No.of rooms occupied by rearing
			M	F		2008	2009		
1	Panner Jagir	791	370	503	25	2245	2193	4	2
2	Mondoora	843	327	563	18	2575	2396	3	2
3	Bathnoor	965	533	863	40	3287	2905	4	2
4	Brinal Lammar	6745	1232	558	31	3501	3156	4	2
5	Y. K. Pora	3767	1140	668	33	3211	2986	3	2
6	Chowgam	2693	750	453	27	3063	2735	3	2

Source: * Village amenity report DC Office, Pulwama and Anantnag.

Table 3: Temperature (°C), humidity (%), and light (lx) at different rearing houses.

Parameter(s)	Summer (2008)	Summer (2009)
Average temperature at rearing houses (°C)	23.6 ± 0.3	23.01 ± 0.59
Max. temperature at rearing houses (°C)	29.8 ± 1.2	30.26 ± 0.53
Min. temperature at rearing houses (°C)	17.5 ± 1.05	18.8 ± 0.19
Day humidity at rearing house (%)	64.3 ± 4.3	58.9 ± 1.6
Max. humidity (%) at rearing house	73.2 ± 1.7	74.9 ± 1.3
Min. humidity (%) rearing house	31.6 ± 3.2	33.8 ± 2.0
Light intensity (lx) at rearing house	121 ± 7.8	95.2 ± 1.0

Data are expressed as mean ± 1SEM.

income, this makes it likely that most of the rearing workers will remain in rearing for their life and their children too. Rearing as a means of social mobility has its own limitations, and broadly can be considered as an effective means of improving the lives of workers.

In the situation of acute poverty, people of Anantnag and Pulwama take up silk rearing as their means to earn living. However, they have to face the problems of working in an atmosphere which has many health hazards. With very high proportion of workers being victims of various diseases this seems to be a high risk occupation, which lessens the quality of life in rearers. The pollution caused by burning biomass fuel, in order to keep the temperature of the room maintained has several implications on their health. Use of various types of disinfectants like vijatha, formalin, lime and detergent solutions expose them to burning eyes, sneezing and chest related problems. Disinfection with formalin and dusting with lime without using personal protective equipments leads to burning of eyes and throat. Respiratory problems in rearers may also be attributed to inhalation of faeces and scales of silkworm by the rearers (Myers & Barnard 1998) and application of lime, formalin, bleaching powder for disinfection at the rearing units (Ramanathan 1997).

Rearers are burning biomass in traditional tin cans instead of Sikiris, and catch various types of burns. In order to chop leaves, people very often acquire injuries and find it difficult to treat them at the first place. They masticate the leaves of mulberry and apply it at the injured part which they said is very effective as compared to the medicines available in the market. Rearers have to clean the bed and feed the worms at regular intervals in addition to their domestic work without having sufficient rest, which exposes them to back-

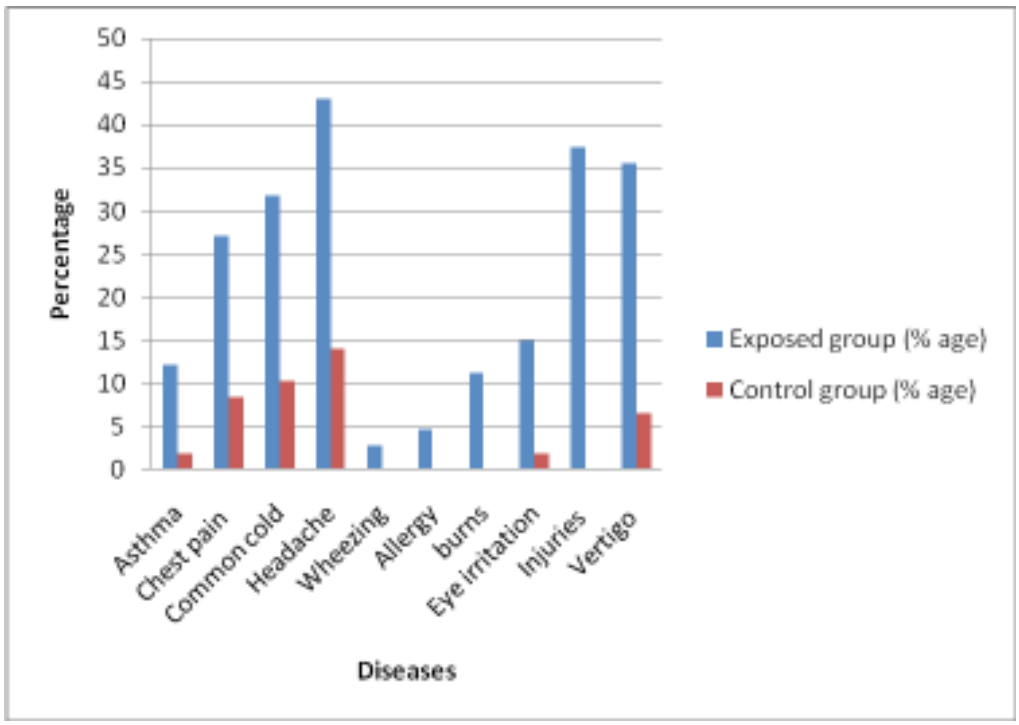

Fig. 1: Percentage of diseases among rearers and control population (2008).

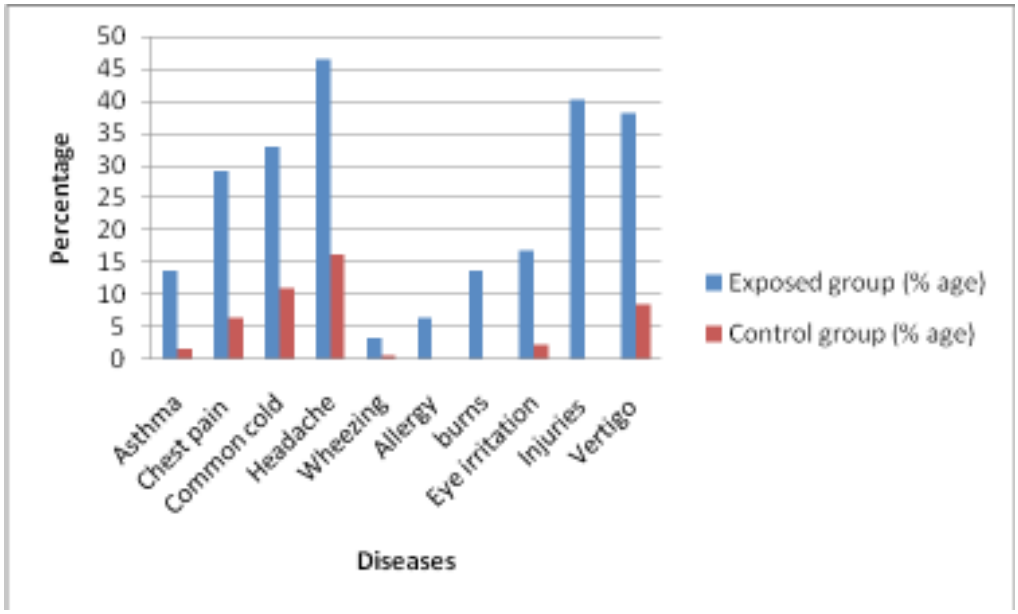

Fig. 2: Percentage of diseases among rearers and control population (2009).

ache, fatigue and headache. The low blood pressure among rearers may be attributed to excessive sweating due to weeding, transport of mulberry leaves to the rearing sheds and rearing of worms, which is further aggravated by the unbalanced food habits of the rearers.

Adherence to age old traditional practices, slow penetration of improved technologies, shortage of quality of silkworm seed, inadequate rearing space and appliances, primitive rearing, spinning and weaving and insufficient marketing and value addition linkages are some of the major con-

straints of sericulture in these areas.

Protective environmental measures are not only healthier for people and the environment in general, but are cost-effective as well. If hidden costs are considered, such as medical bills, production loss due to health effects, poor crop output due to deterioration in land quality, and negative impacts on biodiversity of neighbouring areas, the costs of ignoring environmental protection will be higher than taking appropriate steps now. Central Sericulture Research & Training Institute (CSR&TI) sericulture program may not currently have widespread environmental impacts, but as CSR&TI plans to significantly increase its output in the coming years, the potential for environmental harm will increase. This is the most important time to implement sound safety measures, as the program is still in its early stages of development. It will be easier and cheaper to develop more environment friendly alternatives to any harmful substances being used.

The multiple problems encountered by rearers are high fluctuations in cocoon prices, climatic disturbances, inadequate finance for investment, inadequate market facilities, exploitation by middlemen, transportation problem, shortage of skilled workers and health problems like respiratory problems, burning of eyes, backache and fatigue. Therefore, we recommend following measures for the overall development of sericulture industry and to lessen the health problems of the rearers.

Training programmes should be conducted at the village level to ensure greater and effective participation of women to transfer the technology to upgrade the skill and suggest simple alternatives, safe technologies and personal protective devices to overcome the health problems.

Higher fluctuations in cocoon prices are limiting the farmers from derivable higher profits, which arise due to heavy import of China silk. Government should take necessary policy decisions to safeguard the farmers from these fluctuations of prices by reducing the import of China silk based on the supply and demand of Indian silk.

To make sericulture environmentally sustainable and economically viable, it would be better to have inter-programme collaboration, routine practice and environmental awareness programs with rearers.

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