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Skill Gap Analysis in Silkworm Rearing among Farmers and Extension Workers in Eastern India

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ABSTRACT

Skills are ingredients of productivity and profitability for any of the undertaking. Attaining appropriate technical skills triggers development as well as innovation. This paper engrossed on the skill gaps and training needs of farmers and extension workers in silkworm rearing of Eastern India. Data was collected from 300 randomly selected mulberry sericulture farmers from 4 districts of West Bengal (2), Bihar (1) & Jharkhand (1) and 50 extension workers of the study area. Forty-five skills items were used as a checklist for measuring silkworm rearing skill competency levels using the Likert rating scale. Descriptive statistics and exploratory Principal Component Analysis (Orthogonal rotation technique) was performed on the collected data. Findings revealed that, farmers showed competencies in seven skill items only out of 45 skill items which included appropriate discarding of diseased worms (x = 3.68); identification of moulting (x = 3.55) and ability to identify matured worms (x = 3.96), amongst others; while the extension workers showed competency in 31 skills items. Nine factors with Eigen value of >1, accounted for 61.824% were extracted, with each factor loading ranging from 0.362 to 0.937. Factor loading after rotation were described as disinfection and hygiene of rearing house; disease management in late age rearing; incubation of silkworm eggs; environment conditions and hygiene during young age, late age and mounting of silkworms; disinfection; hygiene; mounting, harvesting and record keeping and marketing. It is recommended that intensive training is needed for both the farmers and the extension workers for up scaling skills and practices in the sericulture.

Keywords: Incubation skills, Late age rearing skills, Sericulture, Skill gap, Training needs

INTRODUCTION

Skill development is a crucial element in improving the efficiency for any work to be done for any enterprise which needs to be improved and requires regular update. It is well known that skills are an important means to increase income and sustainable livelihoods for the poor (World Bank, 2004). Skills are fundamental for improving rural productivity, employability and income-earning opportunities, augmenting food security and promoting environmentally sustainable rural development and livelihoods (Eskola and Gasperini, 2010). Hence it implies that Sustainable Development Goal (SDG) can be realized through a continuous process of building skills of the associated persons with any enterprises.

According to Vreyens and Shaker (2005), skills are observable abilities that are manifested by an individual indicating how to do something. An appropriate skill is required to attain any objectives or tasks of an enterprise. Hence, people are expected with the correct skill sets to complete the tasks. However, often it happens that individual lack certain knowledge & training which creates skill gap. According to American Society for Training & Development (2012) skills gap is defined as a significant gap between an individual's current capabilities and the skills it needs to achieve its goals.

Sericulture is a skilled-based enterprise which comprised of mulberry leaf production to cocoon production, which is later converted to silk fabric. In each of the sericulture activities, skill is highly indispensable because it will result in good quality of silk cocoons and can only be used to produce superior quality of silk which will fetch good remunerative price. However, one of the key challenges in the improvement of sericulture sector is the low productivity of good quality of silk cocoons at the farmers' level which is related with a set of low level knowledge, skills and attitudes (KSAs).

As per an existing literature there is an ample scope

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for improvement in key skill gap areas in the sericulture sector. Keeping in view the importance of this, a study was designed to identify the skill gaps in silkworm rearing of the farmers and extension workers of Eastern India. The overall goal of the study was to examine the potential for enhancement in the skills of the farmers and extension workers so as to develop a skill building strategy aiming at improvement in the livelihood of masses associated with it.

METHODOLOGY

The study had a direct approach to measure the skill gap of farmers and extension workers using descriptive and analytical research design. The investigation was undertaken with the farmers and extension workers of Eastern India comprised of traditional (West Bengal) and non-traditional states of sericulture (Bihar and Jharkhand). Two districts from traditional and each from non-traditional state were selected purposefully where mulberry sericulture is the major source of livelihood. After that 75 farmers from each district were randomly selected out of total list of sericulture farmers and hence a total of 300 farmers were selected for the study as a sample. Besides 50 extension workers (*i.e.,* Technical Assistants of different units of Eastern region of Central Silk Board) were interviewed for the study.

The skills gap measurement for both the farmers and the extension workers was a Likert scale questionnaire developed from review of the relevant literature on skills essential for sericulture. A total of 45 skill items for silkworm rearing were identified with respect to different management practices of sericulture. The questionnaires consisted of questions eliciting information on the basis of the skill assessment level from poor (1), fair (2), good (3), very good (4), and excellent (5). Total and mean perception scores were computed for each skill item, after which a cut-off means score of 3.5 [(1+2+3+4+5) /5+0.5)] was used to differentiate between the skills gap for both the farmers and the extension workers at $x > 3.5$ rated competent and $x < 3.5$ rated skill deficient (Yusuf, 2014).

Content and face validity of the questionnaire was established by experts on sericulture of Central Sericultural Research and Training Institute (CSR&TI), Berhampore (WB). The Cronbach's alpha reliability coefficient was 0.89. A descriptive statistics analysis and exploratory Principal Component Analysis (PCA) (Orthogonal rotation technique) was performed on the data collected for the farmers using the SPSS. PCA could not be performed on the extension workers because the population sampled was below the acceptable sample size of 300 (Tabachnick and Fidell 2001) and 150 (Field 2009).

RESULTS AND DISCUSSION

Demographic Distribution of Farmers and Extension workers

Data was collected from the farmers of the study area which was consisting of 214 males (71.4%) and 86 females (28.6%). More than half, i.e., 52.4 per cent of the farmers were middle aged, 37.3 per cent farmers were old while only 10.3 per cent of the farmers were in young age group. The mean age of the farmer was 45.9 years with standard deviation (SD) of 1.06. Majority of the farmers (47%) had more than 20 years of sericulture experience, 29.3 per cent farmers 10-20 years of experience while only 23.7 per cent of farmers had less than 10 years of sericulture experience. Most of the farmers (62%) were educated up to secondary school, 22 per cent were illiterate, 14.7 per cent were functionally literate and only 1.3 per cent of the famers had education above secondary school (Table 1).

It is also revealed from Table 1 that almost all (92%) the extension workers of Eastern India were male while 8 per cent extension workers were female. There were no young extension workers in the study area. Majority of extension workers (60%) were old aged while 40 per cent extension workers were middle aged. The average age of the extension workers were 52.6 years with standard deviation (SD) of 3.8.

Table 1: Demographic characteristics of the farmers (n=300) and the extension workers (n=50)

	Frequency	Percentage (%)	Mean	SD
FARMERS				
Age			45.9	1.06
Less than 30 years (young)	31	10.3		
30-50 years (middle-aged)	157	52.4		
Above 50 years (old-aged)	112	37.3		
Gender				
Female	86	28.6		
Male	214	71.4		
Education				
Illiterate	66	22.0		
Functionally literate	44	14.7		
Secondary School	186	62.0		
Above	4	1.3		
Sericulture experience				
Less than 10 years	61	23.7		
10-20 years	88	29.3		
Above 20 years	141	47.0		
EXTENSION WORKERS				
Age			52.6	3.8
Less than 30 years (young)	-	-		
30-50 years (middle-aged)	20	40.0		
Above 50 years (old-aged)	30	60.0		
Gender				
Female	04	8.0		
Male	46	92.0		

Farmers and Extension workers' Skills Assessment Level

Disinfection Management Skills

Disinfection is an essential activity before rearing to prevent and/or control silkworm diseases. Table 2 revealed that no farmers were competent in any of the skill item for disinfection management, as all the farmers were below the critical value (x=3.5). The extension workers were competent in four skill items out of six. They were all aware about the disinfection time (x=3.96), followed by ability to select an appropriate disinfectant (x=3.92), identification of rearing materials for disinfection (x=3.52) and knowledge of applying disinfectant (x=3.60). It was observed that majority of the farmers were not taking much care about disinfection for rearing in all crop seasons.

Table 2: Disinfection Management skills

Skills	Farmers (n=300)			Extension workers (n=50)		
	Mean	SD	Remarks	Mean	SD	Remarks
Identification of rearing materials for disinfection purpose	3.18	0.52	NCO	3.52	0.67	CO
Time of disinfection for upcoming crop	2.32	0.63	NCO	3.96	1.16	CO
Ability to select an appropriate disinfectant	2.22	0.62	NCO	3.92	0.92	CO
Ability to estimate the quantity of disinfectant as per requirement (floor area)	1.58	0.60	NCO	3.40	1.01	NCO
Ability to prepare the disinfectants with correct formulation	1.75	0.62	NCO	2.90	1.01	NCO
Knowledge of applying disinfectant for rearing purpose	2.19	0.69	NCO	3.60	0.90	CO

Note: CO-Competency Observed, NCO-No Competency Observed

Hygiene Management Skills

Hygiene means cleanliness or sanitation which is very important during rearing. Table 3 represents the skill competency level of farmers and extension workers for hygiene management. Extension workers were competent in four skill items out of six. The farmers were less competent in hygiene management. They had knowledge about discarding of diseased/unequal pected disease worms (x=3.68). Similar to disinfection management, it was also observed that farmers were not taking much care or less aware about the hygiene management during rearing.

Table 3: Hygiene Management skills

Skills	Farmers (n=300)			Extension workers (n=50)		
	Mean	SD	Remarks	Mean	SD	Remarks
Precautions for entering rearing house	2.40	0.56	NCO	3.54	0.79	CO
Cleaning of rearing bed using bed cleaning net	2.12	0.56	NCO	3.20	0.63	NCO
Discarding of diseased/unequal/suspected disease worms	3.68	0.72	CO	3.72	0.77	CO
Disinfecting the hand after picking the diseased worms	1.85	0.62	NCO	3.96	0.61	CO
Proper storing of rearing materials during off-season	2.48	0.59	NCO	4.22	0.76	CO
Management of bed refuse	2.27	0.69	NCO	3.36	0.49	NCO

Note: CO-Competency Observed, NCO-No Competency Observed

Rearing House Management Skills

Most of the extension workers showed competence in the management of cleanliness and hygiene of rearing house (x=3.52) and method of rearing in rearing house (x=3.60). Other factors that are essential to housing and directly proportional to the good rearing practice (Table 4); i.e., rearing house construction with appropriate specification and proper height (x=3.00) and maintenance of proper aeration and ventilation (x=3.44). There was no skills competence displayed by the farmers in any of the items assessed under rearing house management. It was observed that farmers of the study area were resource poor to afford separate house for rearing. They were using the available house for rearing as well as dwelling purpose in off-season.

Table 4: Rearing House Management Skills

Skills	Farmers (n=300)			Extension workers (n=50)		
	Mean	SD	Remarks	Mean	SD	Remarks
Rearing house construction with appropriate specification and proper height	1.65	0.54	NCO	3.00	0.78	NCO
Maintenance of proper aeration and ventilation	2.96	0.64	NCO	3.44	0.81	NCO
Cleaning and hygiene management of rearing house	2.85	0.59	NCO	3.52	0.93	CO
Method of rearing in the rearing house	2.89	0.63	NCO	3.60	1.01	CO

Note: CO-Competency Observed, NCO-No Competency Observed

Incubation Management Skills

Incubation is a phase of protecting the activated silkworm eggs before rearing which is received from the grainages for the upcoming season. Table 5 represents the skill competency assessment levels for incubation management of the farmers and extension workers. It revealed that extension workers were competent in three skill indicators out of five. They were competent in selecting disease free layings (dfls) for upcoming season (x=3.78), followed by black boxing procedure (x=3.88) and techniques of brushing dfls (x=3.6). Farmers were below the critical value (x=3.5) for all the skill indicators of incubation.

Table 5: Incubation Management skills

Skills	Farmers (n=300)			Extension workers (n=50)		
	Mean	SD	Remarks	Mean	SD	Remarks
Selection of dfls for rearing for the upcoming season	3.40	0.65	NCO	3.78	0.86	CO
Knowledge of precautions for transportation of eggs	3.18	0.63	NCO	2.72	0.64	NCO
Maintenance of environmental conditions during transportation	1.93	0.64	NCO	2.64	0.78	NCO

Awareness of black boxing procedure, duration and exposure timing	1.80	0.59	NCO	3.88	0.69	CO
Technique of brushing of dfls	1.83	0.65	NCO	3.60	0.90	CO

Note: CO-Competency Observed, NCO-No Competency Observed

Rearing of silkworms during first two instars (till the third moult) are known as young age or chawki rearing which required to rear under controlled micro climate condition with special care. Table 6 depicts the chawki management skills of the farmers as well as extension workers. It revealed that the farmers were not much competent in the chawki rearing management. They had knowledge about the moulting of silkworms (x=3.55) but it was not sufficient for good chawki rearing which is essential for good rearing. Extension workers were competent in all the skill indicators (x > 3.5) of chawki rearing. It was found that many farmers were not at all aware about the importance of chawki rearing although they had vast experience in silkworm rearing. Extension workers were supervising the Chawki Rearing Centers (CRCs) and hence they had good knowledge and skills of chawki rearing.

Table 6: Young Age Rearing Management Skills

Skills	Farmers (n=300)			Extension workers (n=50)		
	Mean	SD	Remarks	Mean	SD	Remarks
Ability to maintain the environmental conditions during I-II instars	2.10	0.68	NCO	3.60	0.90	CO
Knowledge of trays required during I-II instars and feeding method	2.04	0.65	NCO	3.58	0.59	CO
Identification of the moulting and moult out worms	3.55	0.67	CO	3.94	0.74	CO
Knowledge of cleaning method in I-II instars	2.21	0.58	NCO	3.52	0.51	CO

Note: CO-Competency Observed, NCO-No Competency Observed

Late Age Rearing Management Skills

Rearing of third, fourth and fifth instar silkworm is called as late age rearing. During this stage specific requirements are suggested which need sound knowledge and specific skills. Table 7 shows the late age rearing management skills competency levels amid the farmers and the extension workers. It revealed that farmers were competent in two out of four skill indicators for late age rearing. Farmers were having good knowledge about the quantum of leaves (x=3.60) and frequency of leaf feeding in late age rearing.

The extension workers were competent in two skill indicators out of four. It was observed that some basic requirements like environment condition, timely bed cleaning, appropriate bed spacing, etc. during rearing was not provided and hence resulted in poor productivity and poor quality cocoons.

Table 7: Late Age Rearing Management Skills

Skills	Farmers (n=300)			Extension workers (n=50)		
	Mean	SD	Remarks	Mean	SD	Remarks
Maintenance of environmental condition for III-IV-V instars of silkworm	3.15	0.66	NCO	3.76	1.14	CO
Knowledge of quantum of leaf required for feeding at III-IV-V instars	3.60	0.71	CO	2.52	0.51	NCO
Frequency of leaf feeding during III-IV-V instars	3.54	0.59	CO	3.76	0.96	CO
Maintenance of bed spacing and bed cleaning with respect to no. of dfls	2.16	0.63	NCO	2.72	0.61	NCO

Note: CO-Competency Observed, NCO-No Competency Observed

Disease Management Skills

Table 8 indicates the diseases management skills competency levels amongst the farmers and the extension workers. It revealed that farmers had competencies in one skill out of the six examined for disease management, while the extension workers displayed competency below the critical value in two skills out of five parameters evaluated. Farmers showed high competencies in maintenance of equal size worms throughout the rearing (x=3.56). It was found that they were lack of clear information about the diseases of silkworm and hence not able to manage it effectively.

Table 8: Disease Management Skills

Skills	Farmers (n=300)			Extension workers (n=50)		
	Mean	SD	Remarks	Mean	SD	Remarks
Identify signs of diseases in silkworms at young and late age silkworms	2.22	0.61	NCO	3.51	0.65	CO
Ability to identify the symptoms of particular diseases	1.94	0.59	NCO	2.42	0.49	NCO
Disposing of diseased silkworms properly	3.14	0.66	NCO	3.66	0.87	CO
Maintenance of equal size worms throughout the rearing	3.56	0.63	CO	3.56	0.97	CO
Minimize the chance of disease incidence	3.05	0.65	NCO	3.32	0.65	NCO
Application of bed disinfectants to prevent the spread of diseases	2.95	0.74	NCO	3.76	0.94	CO

Note: CO-Competency Observed, NCO-No Competency Observed

Mounting and Harvesting Management Skills

Mounting is the transfer of matured larvae to chandrike for cocoon formation and harvesting is the removing of fully formed cocoons from chandrikes. Table 9 represents the farmers and extension workers skill assessment level for mounting and harvesting. Farmers were competent in two skills out of five items for mounting and harvesting. Farmers were competent in ability to identify matured larvae (x=3.96) and ability to harvest cocoon (x=3.09). Extension workers were competent in four skills out of five items.

Table 9: Mounting and Harvesting Management Skills

Skills	Farmers (n=300)			Extension workers (n=50)		
	Mean	SD	Remarks	Mean	SD	Remarks
Ability to identify matured larvae	3.96	0.63	CO	3.78	0.95	CO
Density of larvae for mounting	2.79	0.54	NCO	3.26	0.93	NCO
Maintenance of environment condition for mounting	2.90	0.58	NCO	3.64	0.92	CO
Ability to harvest the cocoon after pupation	3.87	0.59	CO	3.72	0.90	CO
Sorting of cocoons	3.09	0.76	NCO	3.84	1.09	CO

Note: CO-Competency Observed, NCO-No Competency Observed

Record keeping and Marketing Skills

The importance of record keeping and access to markets are very critical in any agricultural enterprises. Record keeping is a real indicator of whether the farming business is moving in the right direction or not. However, Table 10 specifies that both the farmers and the extension workers lack the prerequisite skills in record keeping. The farmers displayed poor knowledge recording temperature, humidity, *etc.*, poor knowledge of marketing their produce. Farmers lack skills of marketing their produce, *i.e.*, silk cocoons or raw silk. This is another skill gap where farmers need training. There is need to develop a proper marketing information system as well.

Table 10: Record keeping and Marketing Skills

Skills	Farmers (n=300)			Extension workers (n=50)		
	Mean	SD	Remarks	Mean	SD	Remarks
Recording the temperature and relative humidity on day-to-day basis during rearing	1.31	0.59	NCO	3.50	0.68	CO
Record keeping of number of dfls, race, brushing date, diseases and rearing period	1.12	0.33	NCO	3.50	0.68	CO
Maintenance cost, leaf supplied, bed disinfectant applied, etc.	1.10	0.32	NCO	2.32	0.79	NCO
Sales of cocoons, silk, etc.	2.44	0.63	NCO	3.62	0.59	CO
Knowledge of markets for cocoon and silk sale outside the village or in the cities	2.46	0.64	NCO	3.82	0.67	CO

Note: CO-Competency Observed, NCO-No Competency Observed

KMO and Bartlett's Test for the 45 Skills Components

Principal Component Analysis (Orthogonal rotation technique) was used for analysis of 45 skill items. A test was performed for the suitability of the data for factor analysis before performing PCA.

The Kaiser-Meyer-Olkin (KMO) value was 0.899 exceeding the recommended value of 0.5 (Field, 2009). Bartlett's test of Sphericity was significant at $p<0.001$ (Table 11), supporting the factor ability of the correlation matrix. A principal component analysis (PCA) with varimax rotation was performed to ascertain the dimensionality of the skill items measures. The Eigen value and the Scree-plot suggested a 9-factor skill items (Table 12). The nine factors accounted 61.824 per cent of the variance scores. The item loadings on the factor ranged from 0.362 to 0.937. The nine components that had the Eigen value of >1 were extracted.

They are, Method of rearing in the rearing house, Record keeping of number of dfls, race, brushing date, diseases and rearing period, Disposing of diseased silkworms properly, Knowledge of precautions for transportation of silkworm eggs, Knowledge of cleaning method in I & II instars, Time of disinfection for upcoming crop, Proper storing of rearing materials during off-season, Cleaning and hygiene management of rearing house and Management of bed refuse after cleaning.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.899
Bartlett's Test of Sphericity	Approx. Chi-Square	5.911
	df	990
	Sig.	0.001

Before the rotation, the main component (method of rearing in the rearing house) accounted for more variance (26.544%) compared to the remaining eight components.

Table 12: Total variance of the Eigen values from the 45 Skills items

Total Variance Explained					
Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
11.945	26.544	26.544	5.778	12.840	12.840
5.682	12.627	39.170	5.012	11.138	23.978
2.352	5.226	44.397	3.153	7.007	30.985
1.993	4.430	48.826	2.838	6.306	37.291
1.396	3.103	51.929	2.803	6.228	43.520
1.256	2.791	54.720	2.525	5.610	49.130
1.113	2.474	57.194	2.039	4.531	53.661
1.080	2.401	59.594	2.008	4.463	58.124
1.004	2.230	61.824	1.665	3.700	61.824

Extraction Method: Principal Component Analysis.

The sericulture farmers were competent (>3.5) in seven out of 45 skill items analyzed. Poor skills among the farmers is said to be as a hindrance to profitable and sustainable sericulture. In an attempt to identify the critical skill items in designing a training program for farmers, attention should be placed on the factors extracted from the components. Therefore, a suggested road map of activities is presented in Table 13.

Table 13: Training road map

Critical factors identified	Suggested activities for the road map
Disinfection and hygiene of Rearing House	Information on designing an appropriate rearing housing structure made with proper specifications. Guidance on disinfection of rearing house and its hygiene management
Disease management in late age rearing	Training on identification of diseases of the larvae. Maintenance of uniformity of larvae during rearing. Appropriate use of bed disinfectants.
Incubation of silkworm eggs	Suitable advice on selection of silkworms breeds based on season. Training for transportation silkworm eggs. Training on Black boxing and brushing methods.
Environment conditions and hygiene during young age, late age and mounting of silkworms	Training and advice on maintenance of environment condition during young age rearing, late age rearing and mounting of silkworms. Besides training on hygiene management during this situation.
Disinfection	Guidance on disinfection on appropriate time and with suitable disinfecting materials. Technique of using correct formulation of disinfecting chemicals for the rearing materials and rearing house.
Hygiene	Advice on caring of the silkworms during the rearing and management of silkworms refuse.
Mounting of ripened silkworms	Training on placing of ripened larvae on chandrike with appropriate density. Advice on care during spinning.
Harvesting of cocoons	Training on identification of fully formed cocoons for harvesting and sorting of cocoons for sale.
Record keeping and marketing	Training of farmers in simple record keeping, management and marketing tips.

CONCLUSION

Sericulture is labour intensive activity, mostly secondary occupation for farmers who have less technical knowledge or skills in the production process. There is more need to put conscious effort (need-based with bottom-up approach) by providing extension services towards the capacity development of the sericulture farmers. The extension workers were skilled, competent but it requires time-to time updating and its transfer to farmers' field. Sericulture farmers being, resource poor, this condition has created multiple challenges, which as a result, has created a limited expansion in sericulture production because farmers make use of only local skills. Other challenges such as lack of disinfection, disease management and poor housing have bound the farmers to remain stagnant, hesitant to invest and extremely cautious in expansion.

This sector is however, remains in the hands of farmers, because of their miserable socio-economic condition and incapable to take bold steps. They are content with what little advantage got from conventional sericulture. Therefore sericulture in Eastern India may remain crude, if this situation continues for long time. Thus, adequate capacity development programme for farmers, extension workers in silkworm rearing should be put in place on regular basis for changing the scenario better. In view of these findings, it is recommended to prepare a training manual for capacity building of both the sericulture farmers and extension workers.

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