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Traditional beliefs and practices of Muga silkworm rearing: An exploration and validation in Assam, India

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A study was conducted to explore the indigenous beliefs and practices followed in Muga silkworm rearing, to determine the scientific rationality of the explored practices, and also to chalk out the associated problems faced by the rearers during production. The study involved 80 rearers of Sivasagar district of Assam and 30 Entomologists of Assam Agricultural University. The indigenous practices collected from the rearers were validated by the Entomologists. The data were collected with the help of a semi-structured schedule through personal interview whereas the problems faced by the Muga-rearers were ranked through Weighted Mean Score method. The scientific rationality of the identified practice as perceived by the Entomologists was obtained through a questionnaire. We identified 30 indigenous beliefs/practices belonging to 8 sub-dimensions outlined in different phases of silkworm rearing, of which only 3 practices are followed by all the rearers. More than half of the identified practices (16 nos.) are pertinent to the selection of seed-cocoon and moth copulation which indicates that the traditional rearers are more concern about the production of disease free layings, – the basic input of a productive rearing. Out of 30 identified practices, 27 were rated as rational by more than half of the Entomologists, but only 6 practices were validated as rational by all of them. High mortality of silkworms due to the negative impact of agrochemical sprayed in the nearby tea-gardens has been identified as the most severe problem (WMS=2.81) faced by the rearers. The overall mean annual income of traditional muga-rearers was found to be Rs. 50,325.00 and impact of rationale traditional practices on muga production is clearly visible.

Keywords: *Antheraea assamensis,* DFL, Geographical indication, Golden yarn, ITK

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Assam stands as the sole producer of all four kinds of commercial silk including the Muga silk, called as "Golden yarn". Muga silk is known for its durability and elegant lustrous natural golden colour. The production of Muga silk is confined to the Brahmaputra Valley of Assam only, in the whole world[1]. The state is a uniquely suitable place for muga culture due to its favourable climatic conditions[2]. *Antheraea assamensis* Helfer is known as the Muga silkworm in its larval stage and Assam silk moth in its adult stage. Assam produces 5,745.37 MT of raw silk during the year 2023-24 (Statistical Handbook Assam, 2024). The state plays a major role in silk production, supplying more than 95% of Muga silk and 65 per cent of Eri silk at the national level. Owing to its unique geographical origin and method of production, Muga silk received the Geographical Indication (GI) tag for Assam in 2007 under the Geographical Indication of Goods (Registration and Protection) Act, 1999, and was also awarded a GI logo as a trademark in 2014.

Assam has a long history of sericulture with rich traditional knowledge. The handloom weaving and rearing of mulberry, *endi* (eri) and Muga worms for production of different kinds of silk yarn were known to be patronised by the Ahom Kings during their reign from 1228 to 1826 in Assam[1]. Indigenous Knowledge is the systematized body of knowledge and culturally rooted practices gained though experiences of people in their whole life by dealing with various challenges and aspects of life[3]. These forms of traditional knowledge have been recognized as valid and useful in the field of agricultural and the farmers have increasingly been recognized as themselves innovators and experimenters[4]. The ability of farmers to monitor environmental occurrence around them has been ignored[5,6], but involvement of traditional farmers is essential for the documentation of traditional knowledge in scientific way.

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Scientific documentation on traditional Muga cultivation have been made from different districts of Assam[1,2,7-10], however no expert opinion validation has been made with the help of entomologists. In this context, the present study was conducted to identify the traditional beliefs and practices followed as a part of Muga cultivation in Sivasagar district of Assam, and to know the scientific rationality of the identified traditional practices from a group of Entomologists. An attempt has also been made to know the annual income and problems faced by these Muga-rearers.

Materials and Methods

The study area, Sivasagar district, belongs to the Upper Brahmaputra Valley Agro-climatic Zone of Assam and is situated between 26.45°N to 27.15°N latitudes and 94.25°E to 95.25°E longitudes.

The study was conducted during 2024-25 using the methodology of Barman *et al*.[11], Barman and Sarma[12] with a few modifications as described below.

A descriptive research design, following an *ex post facto* approach was adopted in the study. Two groups of respondents are involved in the study *viz.*,(i) 80 Muga rearers of Sivasagar district of Upper Brahmaputra Valley Agro-climatic Zone of Assam and (ii) 30 Entomologists of different campuses of the Assam Agricultural University, Jorhat. The indigenous practices collected from the rearers were validated by the Entomologists.

A multi-stage purposive cum random sampling design was followed for selecting the rearers. The silkworm-rearers of two blocks *viz.*, Gaurisagar and Amguri were selected purposively based on the high concentration of the Muga cultivation. We selected 20 rearers randomly from each of the 4 selected villages. The collection of data was carried out through personal interviews using a semi-structured interview schedule. Additionally, 4 Focus Group Discussion was conducted in 4 villages for further data collection. The rationality level of identified beliefs/practice were sought from the respondent Entomologists in a 2-point continuum *viz.*, rational, and irrational. For validation of explored practices, questionnaire tool was used to receive the expert opinions. The frequency and percentage distribution of responses was calculated according to their perceived level of rationality. The scientific reasons as furnished by scientists were also noted and discussed in the following sections.

The problems faced by the Muga-rearers were ranked by Weighted Mean Score (WMS) method. Rearers were asked to evaluate each problem using a three-point scale *i.e.* Serious (3), Moderate (2) and Negligible (1). WMS was calculated using the frequencies and the severity of problems were ranked according to the scores. We also estimated the average annual income of the rearers.

Result and Discussion

Indigenous practices of muga silkworm rearing

A total of 30 indigenous practices were identified under 8 sub-dimensions (Table 1) outlined in different phases of Muga silkworm rearing. We identified 10 practices pertaining to seed-cocoon selection, 6 of moth-copulation, 2 of host-plant selection, 2 of seed-cocoon collection/preservation, 3 related to brushing of larvae, 3 related to rearing of silkworms, 3 of harvesting of mature worms and related to the selection and 1 related to preparation of rearing area. We also photographed a few traditional tools used in Muga rearing e.g., *Khorika, Chak, Chokoripera, Merbandh, Chaloni etc.* (Fig. 1 a-f).

As stated above, 16 practices followed by the rearers were pertinent to seed-cocoon selection and moth copulation. It indicates that traditional rearers were more concerned about the production of disease free layings – the base of productive rearing, which also assure the continuity in production of healthy cocoon as well as seed. The rearers had the desire and ability to produce their own Muga seed rather than being dependent on other grainage. Moreover, many a times, the govt. grainage cannot meet the need of the farmers, particularly during peak rearing season. For the rearers of remote villages, the collection of DFLs from the govt. grainage at the time of their need was an issue.

The three practices which are practised by all rearers are:

i. Preservation in *Chokoripera*, a perforated bamboo box with a provision of a lid (Fig. 1 c).

ii. The tree trunk and thick lateral branches of *Som* tree tied with banana bark (called *Merbandh*) (Fig. 1 d) to prevent the worms from crawling down.

iii. The mature silkworms come down the tree (*jumalowa*) in the evening hours and collected in *Kuki* (bamboo basket).

Table 1 — Indigenous beliefs and practices of Muga silkworm rearing followed in Sivasagar district of Assam, India

Sub-dimension	Description of sub-dimensions	Rationale as perceived by scientists of the indigenous practices	No. & % of respondent
1. Preparation of rearing space	Preparation of the rearing site (cleaning and disinfection for the next rearing (1)	Practice: Rearing site is selected preferably on the east side.	45 (56.25)
		Rationale: The morning sunlight maintains optimum temperature for the silkworms by avoiding extreme diurnal heat.	28 (93.34)
2. Host plant selection	Selection of preferable and healthy plants for next rearing (2)	Practice: Som plants are classified based on the colour and size of the leaves *viz.*, *Motasom* (Male *som* plant; if the leaves are dark green and large) and *Maikisom* (Female *som* plant; if the leaves are small and light green). *Maikisom* is preferred for rearing as perceived by rearers.	10 (12.5)
		Rationale: *Maikisom* leaves are tender with low chlorophyll and suitable for easy digestion as compared to *Motasom*.	18 (60.0)
		Practice: Chewing the *som* leaves to judge the sweetness and nutrition quality of leaves.	13 (16.25)
		Rationale: Leaves with sweeter taste indicates high sugar content which is essential for energy metabolism of the silkworms.	12 (40.0)
3.Seed cocoon selection	Selection of disease-free-layings (DFLs) for the next rearing (10)	Practice: Small and stout shaped cocoons are expected to produce male moths and longer cocoons are expected to produce female moth.	65 (81.25)
		Rationale: Male pupae are normally smaller and their silk shell is denser while female pupae are generally bigger due to their large reproductive system.	28 (93.34)
		Practice: Larvae which mature before "*Bhorpok*" stage (the peak time of maturity of silkworms and when most of the mature larvae comes down the host tree) are mostly male, while the larvae which get maturity after "*Bhorpok*" are mostly female; based on this seed cocoons are selected	45 (56.25)
		Rationale: Male silkworms attain maturity faster as their body mass are less as compared to females owing to their large of reproductive organs.	22 (73.33)
		Practice: Eggs laid scattered condition are considered to be good for seed	36 (45.0)
		Rationale: Scattered egg laying indicates good performance of nervous system and muscle control.	16 (66.67)
		Practice: Silkworms which raise their heads upon touching are healthy	24 (30.0)
		Rationale: Raising head upon touching is a protective mechanism of the silkworms which is also a sign of a healthy nervous system.	26 (86.66)
		Practice: Female moths which discharge white urine during of decoupling are healthy.	9 (11.25)
		Rationale: White urination after coupling indicates an excretion of metabolic waste after a successful mating event.	16 (53.33)
		Practice: Larvae that excrete brown, dry, and round droppings of about 3mm in size are healthy.	30 (37.5)
		Rationale: Dry and round droppings indicates good gut health and proper nutrient absorption.	20 (66.67)
		Practice: Silkworms, when touched and pressed slightly, if "*Ronga pani*" (Red water) is oozed out, is unhealthy and should be discarded.	36 (45.0)
		Rationale: Discharge of red water is often a symptom of internal injury and septic condition of silkworms which are unsuitable for seed cocoon.	22 (73.33)
		Practice: If the worms have excreta in their posterior end are healthy for seed	20 (25.0)
		Rationale: Presence of excreta in posterior is a sign of good gut health and proper digestive metabolism.	20 (66.67)
		Practice: Brown eggs are considered to be healthy	25 (31.25)
		Rationale: Brown colour of eggs often signifies the fertilized condition of healthy eggs.	24 (80.0)
		Practice: Cocoon seeds collected from villages of the other bank of a river are considered to be good.	9 (11.25)
		Rationale: This practice mainly indicates introduction of genetic diversity and breaking of disease cycle.	12 (40.0)

… *Contd.*

Table 1 — Indigenous beliefs and practices of Muga silkworm rearing followed in Sivasagar district of Assam, India (Contd.)

Sub-dimension	Description of sub-dimensions	Rationale as perceived by scientists of the indigenous practices	No. & % of respondent
4. Seed cocoon collection and preservation	Preservation of selected seeds in well aerated bamboo box for next rearing (2)	Practice: Preservation in *Chokoripera* (a perforated bamboo box of about 2 m x 1.5 m size) with a provision of a lid.	80 (100)
		Rationale: Preservation of seed cocoon in perforated bamboo box (*Chokoripera)* ensures a better aeration.	28 (93.34)
		Practice: *Chokoripera* containing seed cocoon is kept in the kitchen on a hanging platform that receives smoke from the fire source above fire for providing optimum temperature during winter.	65 (81.25)
		Rationale: Such arrangement of fire smoke maintains an optimum temperature (25-28°C) for proper pupal growth.	28 (93.34)
5. Moth copulation	Moth copulation indicates mating of male and female moth (6)	Practice: Male and female moths are kept in *Chokoripera* for mating and after mating smoke is blown to separate *Chokora* (male moth) from the *Chokori* (female moth)	56 (70.0)
		Rationale: *Chokoripera* provides a controlled and well-aerated environment for mating and giving smoke after mating works as an irritant which helps to separate *Chokora* and *Chokori* without harming them. The smoke also works as a mild disinfectant.	26 (86.66)
		Practice: Mated female moths are tied with *Khorika* (bundle of dried thatch grass, locally known as *Ulu kher* (*Imperata cylindrica*), of about 1cm in diameter with a hooking arrangement at the base) for egg laying and loom threads (*Dohikota*) are used for tying the moths.	60 (75.0)
		Rationale: *Khorika* provides a natural rough surface for better egg laying and good grip for the female moth and good adherence of the newly deposited eggs. Use of home-produced loom thread basically ensures free of contamination.	30 (100)
		Practice: The *khorika*s are kept in the kitchen area for egg-laying	54 (67.5)
		Rationale: Traditional kitchen area is hygienic due to smoky, dry and warm condition which helps in maintaining eggs disease free and early maturation.	24 (80.0)
		Practice: Smoke is given to *khorika*s in a belief that it helps in laying more eggs	25 (31.25)
		Rationale: Smoke provides mild stimulation to the moths to complete egg-laying early and also acts as a disinfectant.	14 (46.67)
		Practice: *Tulsi pani* (holy basil water) is spread for hatching of eggs	47 (58.75)
		Rationale: Spraying of holy basil water acts as a disinfectant due to its antimicrobial properties.	20 (66.67)
		Practice: Thorny branches of trees are kept in door-steps to protect the moths from nocturnal birds	51 (63.75)
		Rationale: Thorny branches act as physical barrier against nocturnal predatory insectivorous birds.	28 (93.34)
6. Brushing of larvae	Transferring the newly hatched silkworms to the host plant (3)	Practice: Newly hatched silkworms are transferred to the host tree by hanging the *khorika*s in its branches (*Kharika Lowa*).	78 (97.5)
		Rationale: A *Khorika* allows easy handling and helps in transfer of newly hatched silkworms to the host plant.	30 (100)
		Practice: Newly hatched worms first feed on its egg crusts which is believed to promote their health	62 (77.5)
		Rationale: The crust of egg contains protein and provides initial immunity to the worms before eating the leaves.	24 (80.0)
		Practice: During the summer, the silkworms are reared in shade areas while in the sunny sites during winter.	51 (63.75)
		Rationale: This practice is a seasonal management for proper growth and development of silkworms since they are cold blooded and sensitive to temperature fluctuations.	30 (100)
7. Rearing of worms	Feeding the silkworm up to fifth instar in the host plants (3)	Practice: The tree trunk and thick lateral branches of *Som* tree is tied with banana bark (called *Merbandh*) to prevent the worms from crawling down	80 (100)
		Rationale: Banana bark prevents silkworms from crawling down as it is slippery in texture.	28 (93.34)
		Practice: The worms which have loose skin and nutrient deficiency (*Selapotia muga*) are transferred to "*Dighloti*" (*Litsea salicifolia*) plant, because it is rich in nutrient and helps to improve the health of silkworms.	24 (30.0)
		Rationale: *Dighloti* leaves are rich in nutrients and the weak silkworms feeding on it recover from the weakness quickly.	26 (86.67)
		Practice: The silkworms which have two small balls of fecal matter in their posterior end at the time of ripening are considered to be healthy.	32 (40.0)
		Rationale: Presence of two balls of excreta in posterior indicates good gut health and proper metabolism.	18 (60.0)

… *Contd.*

Table 1 — Indigenous beliefs and practices of Muga silkworm rearing followed in Sivasagar district of Assam, India (Contd.)

Sub-dimension	Description of sub-dimensions	Rationale as perceived by scientists of the indigenous practices	No. & % of respondent
8. Harvesting of mature worms	Collection of mature silkworms (3)	Practice: Mature (ripened) silkworms stop feeding and become motionless (*jholomdhora*) and discharge semi-liquid excreta (*jolom*)	58 (72.5)
		Rationale: During ripening, silkworms stop feeding and become motionless as they prepare themselves for pupation. At this stage, they discharge the last semi-liquid excreta as a natural process to empty the digestive track before cocooning.	30 (100)
		Practice: The ripened silkworms come down towards the tree (*jumalowa*) in the evening hours and are collected in *Kuki* (bamboo basket)	80 (100)
		Rationale: Ripened worms come down the tree to find a shady and safe area for cocooning naturally. These are collected in "Kuki" to prevent silkworms from falling down to the ground.	30 (100)
		Practice: The silkworms that make hollow sound, if pressed gently between two fingers, are considered as mature worms	75 (93.75)
		Rationale: Hollow sound indicates empty stomach of worms which means they are ready for cocooning.	30 (100)

Fig. 1 a-f (Clockwise staring from SW corner): Photographs on various traditional practices/tools of muga rearing. (a): *Khorika*; (b): *Khorikas* hanged on *chak*; (c): *Chokoripera;* (d): A *Merbandh* made of banana pseudo-stem bark; (e): *Chaloni* for transferring silkworms to host tree; (f): Tying of female moth in *Khorika*

Except for the above three, 11.25-97.5% rearers follow the other traditional beliefs/practices (Table 1). Similar traditional practices have also been reported from other parts of Assam[1,2,7-10,13,14]. Various traditional practices of Muga rearing have also been reported from Golaghat district of Assam[14] and a great similarity in ITKs has been observed with that of Sivasagar district. The proximity between the two districts may be one of the reasons of such similarities. "Depairing of moths using smoke" is an indigenous method used during the seed production of Muga which was validated and found 40% higher in seed production as compared to normal practice[15]. They also reported higher fecundity of moths treated with smoke. About 50% of the experts involved in our study believe that smoke provides mild stimulation to the moths to complete egg-laying early and also acts as a disinfectant.

Scientific rationality of identified indigenous beliefs/practices as judged by the entomologists

The rationality of the beliefs/practices was judged by the Entomologists. The frequency and percentage distribution of the respondents have been shown according to their perception level of rationality (Table 1).

Out of these 30 identified practices, 27 practices were rated as rational by majority of the Entomologists (*i.e.,* more than 50%). However, only 3 practices were rated as irrational by majority (*i.e*., more than 50%) of the scientist respondents.

All the 30 Entomologists found following practices/beliefs as scientifically rational:

i. Mated female moths are tied with *Khorika* (bundle of dried thatch grass with a hooking arrangement at the base) for egg-laying and loom threads (*Dohikota*) are used for tying the moths.

ii. Newly hatched silkworms are transferred to the *som* tree by hanging the *khorika*s in its branches.

iii. During the summer, the silkworms are reared in shade areas while in the sunny sites during winter.

iv. Mature silkworms stop feeding and become motionless (*jholomdhora*) and discharge semi-liquid excreta (*jolom*).

v. The ripened silkworms come down towards the tree (*jumalowa*) in the evening hours and are collected in *Kuki* (bamboo basket).

vi. The silkworms that make hollow sound, if pressed gently and rolled between two palms, are considered as mature worms.

Except for the above six practices, 40-93.34% Entomologists opined other traditional beliefs/practices as rational (Table 1). No expert opinion on validation of traditional practices of Muga rearing by Entomologists has been reported from other parts of Assam.

Identification of severity of problems faced by the muga-rearers

We have identified 7 problems faced by the Muga-rearers and ranked accordingly using WMS method (Table 2). High mortality of silkworms due to the negative impact of agrochemical applied in nearby tea-gardens was the most severe problem (WMS=2.81) as perceived by the Muga-rearers followed by frequent crop loss due to disease incidence and pest attack (WMS= 2.77), and effects of weather aberration (WMS= 2.73).

Even though 'non-availability of rearing/reeling machinery' has been identified as 5th major problem, addressing this issue through Govt. policy may increase the production and income manifold.

Net annual income from muga silkworm rearing

We categories the annual incomes of the respondent rearers earned through the traditional Muga rearing into 3 groups (Table 3). Majority of the rearers (76.25%) have a medium income within Rs.26,589 to 76,311.00 annually; however, the overall mean annual income is Rs. 50,325.00. Therefore, some farmers have the scope of earning more from this venture.

Table 2 — Problems faced by the rearers in production of Muga silk

Sl no	Problems	Extent of problems			WMS	Rank
		Serious	Moderate	Negligible		
1	Mortality of silkworms due to the negative impact of agrochemical application in nearby tea gardens	70	5	5	2.81	I
2	Frequent Muga crop loss due to disease incidence and pest attack	65	12	3	2.77	II
3	Effects of weather aberration on productivity and quality of cocoon	62	13	5	2.73	III
4	Non-availability of proper grainage facility for quality silkworm seed	61	16	3	2.72	IV
5	Non-availability of rearing/reeling machinery	31	39	10	2.26	V
6	Lack of awareness and adoption of adequate scientific practices.	20	22	36	1.93	VI
7	Shrinkage of plantation of host plants	16	20	44	1.65	VII

*WMS: weighted mean score

Table 3 — Net annual income of traditional rearers from Muga rearing

Category	Frequency	Percentage (%)
Low net annual income from sericulture (Rs. 19,000 to Rs 26,589)	15	18.75
Medium net annual income from sericulture (Rs. 26,589 to Rs 76,311)	52	65
High net annual income from sericulture (Rs. 76,311 to Rs 97,000)	13	16.25
Mean	Rs. 50,325.00	

Conclusion

The scientific rationality put forwarded by the Entomologists clearly signifies the knowledge and wisdom imbibed in the traditional beliefs and practices over the generations. The traditional Assamese muga-rearers have the knowledge of optimum temperature for the silkworms, effect of chlorophyll content on digestibility of silkworm, self-judgment of nutrition quality of leaves, behaviour of healthy silkworms based on sex/motion/oviposition/coupling/food intake etc., symptoms of silkworm disease, colour of healthy individual, low-cost sericultural tools, coupling and decoupling of moths, and sound knowledge of larval maturity as well as harvesting of cocoon. The indigenous practices of the North Eastern Region of India have remained unexplored owing to the poor accessibility to many remote villages. There is a need of exploration, documentation, validation, conservation and upgradation of these practices before it is lost with time.

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Conflict of Interest

The authors of the present work declare that no conflict of interest is associated with this manuscript.

Author Contributions

PB: Literary review, Investigation, Resources, Formal analysis, Writing. IB: Conceptualization, Literary review, Methodology, Investigation, Formal analysis, Writing, Reviewing, Editing. AKS: Literary review, Formal analysis, Drafting, Writing, Reviewing, Editing.

Ethics Approval

Not applicable.

Prior Informed Consent

A prior informed consent was taken from all knowledge holders. Consent was also taken from muga-rearers for the use of the images of equipments and persons involved in muga rearing.

Use of artificial intelligence (AI)

No AI was used for preparing the MS.

Data Availability

The work is a part of PG research of the 1st author. The data generated during the study have been included in this article.

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