TROPICAL TASAR SILK : A PONTENTIAL NTFP FOR FOREST DWELLERS OF CENTRAL INDIA

N. ROYCHOUDHURY, RAJESH BAJPAI* AND B. P. SINGH**

Forest Entomology Division, Tropical Forest Research Institute, Jabalpur (Madhya Pradesh)

Introduction

Sericulture, the cultivation of silk, is an agro-forest based industry. It is a cottage industry par excellence, with its agricultural and forestry base, industrial super structure and labour-intensive nature (Singh and Sinha, 2000). It is remarkable for its low investment with quick and high returns, which make it an ideal industry or enterprise fitting well into the socio-economic fabric. It is a highly viable industry capable of generating substantial and gainful employment in the rural / forest areas (Roychoudhury, 2006, 2007). It deals with host-plant cultivation, rearing of silkworm, production of silkworm seeds and commercial cocoons. The silk industry comprises the production of raw silk. So, the industry has got two distinct phases – one is sericulture proper rearing of silk mats to produce raw silk and the other is industry processing raw silk into fabric. (Sarkar, 1980).

Silk (L. *sericum*-silk, Gr. *Serikos*-Chinese, silkworm), is a fibre made of proteins (fibroin coated with sericin) (Prudhomme *et al.*, 1985), produced by the larva of a seicigenous insects. Silk is remarkably durable fabric, yet fine and subtle to the touch. Silk obtained from the insects are commonly known as silkworms, which spin cocoons with continuous silk filaments exuded through their mouth parts out of the silk glands inside their body. Silk threads play a pivotal role in the life of caterpillars. There are four kinds of silk of commercial importance (Rana *et al.*, 2003), viz. mulberry silk produced by *Bombyx mori* (L.) (Lepidoptera : Bombycidae), tasar silk (tropical and temperate) and muga silk produced by *Antheraea* spp., (Lepidoptera : Saturaniidae), and eri silk produced by *Samia ricini* Boisduval (Lepidoptera : Saturaniidae) (Fig. 1).

India is the natural abode of a large number of sericigenous insects, which produces different types of silk (Sengupta, 1985). More than 160 species of wild silkworms have so far been recorded (Saratchandra, 2003). The humid and dense forests of India are most suitable habitat for large number of wild silk producing insects. The global production of wild silk is dependent on the genus *Antheraea* that comprises of 35 species (Singh and Mishra (2003), out of which only three species, viz., tropical tasar silkworm, *A. mylitta*, temperate tasar silkworm, *A. proylei* and muga silkworm, *A. assama* are commercially exploited for wild silk production in India (Jolly, 1985). Tropical tasar silk as one of the major components of wild silks, now popularized in India as "*Vanya Silk*", is one of the most important NTFPs. The present article deals with these aspects and succinctly describes the tropical tasar silkworm as an important NTFP for forest inhabitants with special emphasis to central India.

Tropical tasar silkworm

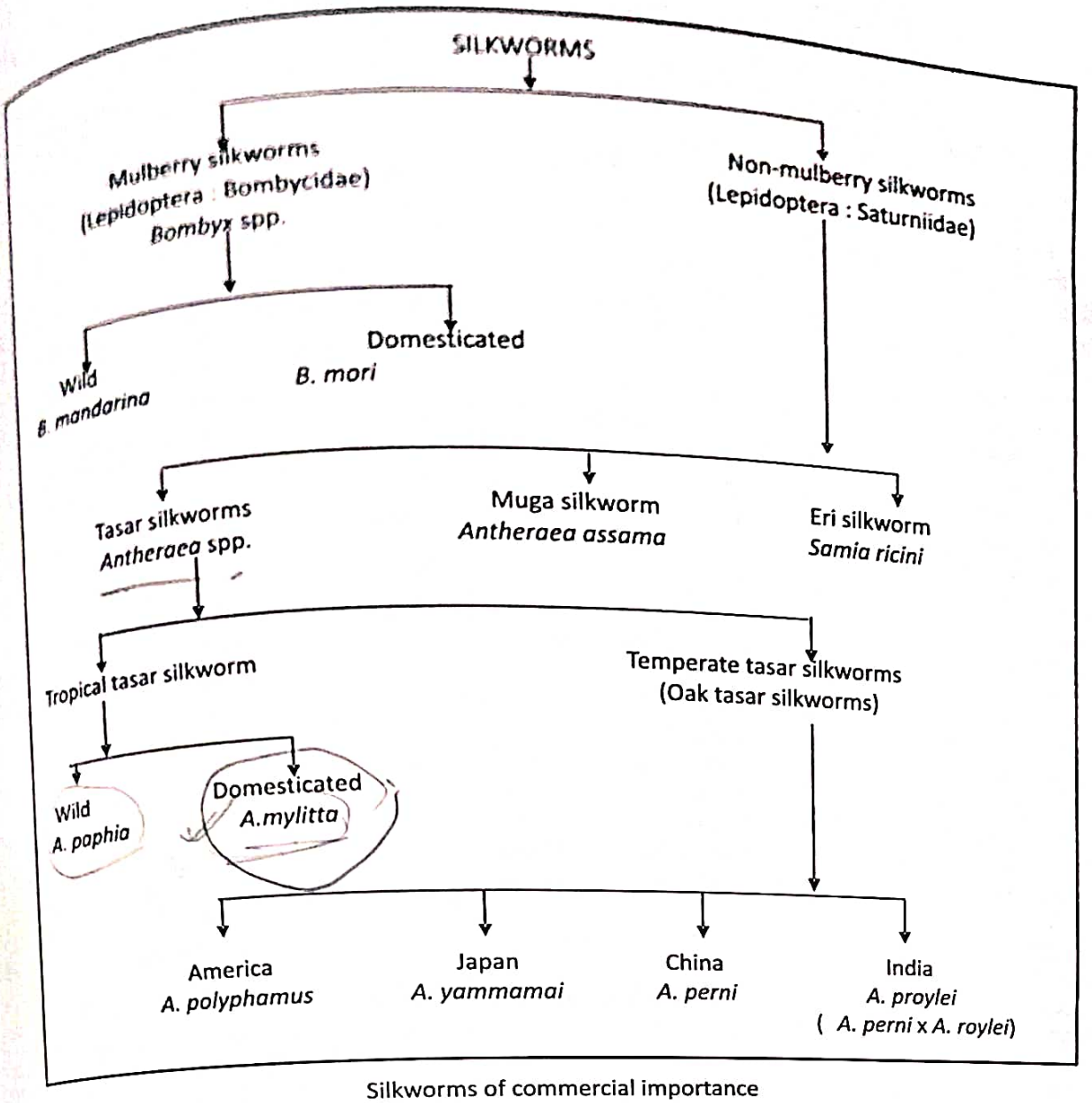
The Indian tropical tasar silk is produced in nature by caterpillars of insects, *Antheraea paphia* Linnaeus 1758 and *A. mylitta* Drury 1773 (Lepidoptera : Saturniidae) (Nassig, 1991). *A. paphia* is found in wild and *A. mylitta* is a semi-domesticated species. It has been reported by Mohanty (2003) that in Orissa, the wild tropical tasar silkworm, *A. paphia*, which reproduce in nature are found at a higher altitude (601-1000 amsl) having more economic traits and are univoltine in nature whereas cocoons produced at middle altitude (301-600 amsl) with lesser economic traits and exhibit bivoltinism and when they are cultivated in the lower altitude (50-300 amsl) by rearers, the progeny of cocoons show very less cocoon characters compared to their parents. The semi-domesticated tropical tasar silkworm, *A. mylitta*, instead of being cultivated at the highest altitude, it is cultivated at the middle and lower altitudes (50-600 amsl) (Table 1). Depending upon their commercial characters, 43 ecoraces have been mentioned (Table 2) (Mohanty 2003). According to Rao *et al.* (2003), around 64 eco-races of tropical tasar silkworm have been reported from different forest areas. Distribution of eco-races in relation to forest type/sub-type indicates that the majority of the eco-races are restricted mainly to tropical deciduous forests. Among the eco-races, *Daba* of Singbhum, *Bally* of Bastar, *Sukinda* and *Bogai* of Orissa, *Laria* of Jharkhand, *Bhandara* of Maharashtra, *Mandla* of Madhya Pradesh and *Andhra Local* of Andhra Pradesh are some of the prominent used for crop production (Gaur, 1988).

Tasar culture and tribal

Tropical tasar culture, i.e. rearing of tasar silkworm and other associated activities related to the silk

*Department of Forestry, College of Agriculture, JNKVV, Jabalpur (Madhya Pradesh)
**Central Silk Board, Field Unit, Sehora (Madhya Pradesh)

Fig. 1



Silkworms of commercial importance

Table 1

Tasar silkmoths in different altitudes of Orissa.

Altitude (amsl)	*A. paphia*			*A. mylitta*			Frequency of life cycle
	Ecorace	Voltinism	Sate of cultivation	Ecorace	Voltinism	Sate of cultivation	
50-300	*Bogei*	TV/BV	Cultivated	*Sukhinda*	TV	Semi-domesticated	3
301-600	*Nalia*	BV	Wild	*Daba*	BV	Semi-domesticated	2
6001-1000	*Modal*	UV	Wild	-	-	-	1

TV=Involtine, BV=Bivoltine, UV=Univoltine

production, is one of the oldest occupation and important source of livelihood for the tribes particularly living in and around the forests of central and eastern India (Jolly *et al.*, 1974; Chakraborty, 1982). This culture is able to generate quite remunerative and meaningful employment. Tropical tasar, produced by larvae of yellow orange colour moths known as *A. paphia* and *A. mylitta*, are the most important wild silk producing insects available in India and commercially exploited at mass level in central India by aboriginal tribal inhabitants. Tasar culture in India is an age-old tradition but mostly restricted within the different communities of aboriginal residing in the central plateau mainly Jharkhand, Bihar, Chhattisgarh, Madhya Pradesh, Orissa and West Bengal

Table 2

Eeco-races of tropical tasar silkworm in India.

State	Locality	Eco-race
Andhra Pradesh	Marim Nagar, Warangal, Adilabad, Rangareddi	*Andhra*
Assam	Boko, Hahim	*Boko*
Bihar	Singhbhum	*Daba*
Bihar	Hazaribag, Sim	*Libra*
Bihar	Simdega	*Barharwa*
Bihar	Dhanbad	*Modia*
Bihar	Palamu	*Kowa, Japla*
Bihar	Kurudh	*Kurudh*
Chhattisgarh	Jagdalpur	*Raily**
Chhattisgarh	Bhopal Patham	*Bhopal Patham*
Chhattisgarh	Dasamkhella	*Suki*
Chhattisgarh	Korba	*Korba*
Chhattisgarh	Bastar	*Janghbir*
Dadar and Nagar Haveli	Dadar and Nagar Haveli	*Dadar*
Jharkhand	Santhal Pargana	*Munga, Srihan, Mugia*
Jharkhand	Ranchi	*Palma, Lodhma*
Jammu and kashmir	Batote, Palampur	*Shivatika*
Karnataka	Belgaum	*Belgaum*
Madhya Pradesh	Multai	*Multai*
Madhya Pradesh	Mandla	*Mandla*
Madhya Pradesh	Jhabua	*Jhabua*
Madhya Pradesh	Piprai	*Piprai*
Madhya Pradesh	Seoni	*Seoni*
Maharashtra	Bhandara, Chandrapur	*Bhandara*
Meghalaya	Medipathor, Resubelpara	*Medipathor*
Manipur	Jiribam	*Jiribam*
Nagaland	Dimapur	*Dimapur*
Orissa	Simlipal	*Modal**
Orissa	Mayurbhanja, Keonjhar, Sundargarh	*Deba, Nalia**
Orissa	Sukinda	*Sukinda*
Orissa	Kandhamala	*Boudh*
Orissa	Kalahandi	*Omarkoti*
Rajasthan	Sahabad	*Tesera*
Uttar Pradesh	Damarua	*Monga*
Uttar Pradesh	Mirzapur	*Mirzapur*
Uttar Pradesh	Sultanpur	*Sultanpur*
West Bengal	Purulia, Bankura	*Tira, Murga*
West Bengal	Bankura	*Bankura*

*Wild ecorace of *A. paphia*.

(Table 3) extending to Uttar Pradesh, Andhra Pradesh and Maharashtra (Sinha, 2003). This insect has a long list of 20 host plants (Saratchandra, 2003) (Table 4), but reared mostly on arjun (*Terminalia arjuna*), asan (*T. tomentosa*) and sal (*Shorea robusta*) in the natural forests or arjun plants systematically developed in degraded forest areas/adapahi areas (Rao *et al.*, 2003) (Table 5). It is estimated that the country has 11.17 million ha of forest having primary and secondary food plants, out of which only 5% of the tasar host plants are put to use for silkworm rearing (Table 6). Similarly, out of 12.90 million available manpower resources, around 1.40 lakh tribal families are engaged in tasar rearing (Singh and Mishra, 2003) (Table 7). Hence, there is a wide scope to introduce

Table 3

Tropical tasar growing states and districts of India.

State	Districts
Andhra Pradesh	Adilabad, karimnagar, Warangal
Bihar	Banka, Rohtas
Chhattisgarh	Ambikapur, Bastar, Bilaspur, Champa, Kawardha, Korba, Raigarh, Sarguja
Jharkhand	Bokaro, Deoghar, Dhanbad, Dumka, Giridih, Godda, Hazaribag, Lohardaga, Palamau, Ranchi, Santhal Pargana, Sahebganj, West Singhbhum
Madhya Pradesh	Seoni, Balaghat, Mandla
Maharashtra	Bhandara, Chandrapur
Orissa	Balasore, Cuttack, Dhenkanal Keonjhar, Mmayurbhanj, Sundergarh
Uttar Pradesh	Chandausi, Mirzapur and Sonebhadra
West Bengal	Birbhum, Midnapur, Purulia

Table 4

Host plants of tropical tasar silkworm, A. mylitta

Food plant	Family	Common name	Geographical distribution
Primary food plants			
Shorea robusta Roxb.	Dipterocarpacea	Sal	Throughout tropics and sub-tropics
Terminalia arjuna Bedd.	Combretaceae	Arujan	Central and eastern India
Terminalia tomentosa W. & A.	Combretaceae	Asan	North India up to Nepal
Secondary food plants			
Anogeissus latifolia Wall.	Combretaceae	Dhaunta	India
Bauhinia variegata Linn.	Caesalpiniaceae	Kachnar	India and China
Bombax ceiba Linn.	Bombacaceae	Semul	Asia and Australia
Careya arborea Roxb.	Lecythidaceae	Kumbi	India
Hardwickia binata Roxb.	Fabaceae	Anjan	Tropics particularly Africa and western Peninsular India, Pakistan
Lagerstroemia indica Linn.	Lythraceae	Saoni	India, Afghanistan, Burma
L. parviflora Roxb.	Lythraceae	Sidha	Western Himalaya and south Indo - Gangetic plain
L. speciosa Pers.	Lythraceae	Jarul	India, Nepal
Madhuca latifolia (Roxb.)	Sapotaceae	Mahua	India
Shorea talura Roxb.	Dipterocarpaceae	Talura	India, Pakistan
Syzygium cumini Linn.	Myrtaceae	Jamun	India, Pakistan
Tectona grandis Linn. F.	Verbenaceae	Teak	Throughout tropics and sub-tropics
Trminalia belerica Gaertn.	Combretaceae	Bahera	India, Indonesia, Sri Lanka
T. catappa Linn.	Combretaceae	Jangali badam	Nepal, Japan
T. chebula Retz.	Combretaceae	Haritaki	Pakistan
T. paniculata Roth.	Combretaceae	Kinjal	Pakistan
Zizyphus mauritiana Lam.	Combretaceae	Ber	India, Afghanistan, China

Table 5

Systematic plantations of T. arjuna raised under ISTC programme.

Project	States covered	Area developed (ha)
Inter State Tasar Project (VI[th] and VII[th] plan)	Andhra Pradesh, Bihar, Chhattisgarh, Jharkhand, Maharashtra, Orissa, Uttar Pradesh, West Bengal	7,845

Implemented by CSB under IndoSwiss Technical Cooperation Programme

Table 6

Availability, utilization of tasar food plants and manpower resources.

Particulars	Potential	Current exploitation	Percentage
Tasar food plants (million ha)	11.168	0.558	5.00
Tribal manpower (million)	12.895	0.104	0.81

Table 7

*Tasar food plants in the forest and rearers in different states**

State	Forest area (Lakh ha)	Tasar food plants (Lakh ha)	Arjun block plantation (Lakh ha)	Rearers** (Lakh)
Andhra Pradesh	65.18	13.02	0.005550	0.030
Chhattisgarh and Madhya Pradesh	168.13	50.44	0.01440	0.200
Jharkhand	30.59	9.18	0.00162	0.600
Maharashtra	66.96	10.04	0.01100	0.020
Orissa	47.46	20.24	0.02000	0.320
Uttar Pradesh	35.10	5.21	0.01282	0.015
West Bengal	11.83	3.55	0.01000	0.050
Total	425.25	111.68	0.07535	1.235

*CSB estimates. **Number of tribafamilies engaged in tasar rearing.

an economic tasar culture among the forest dwellers.

Tasar silkworm and rearing

Silkworms are reared outdoors and therefore, the growth and development of silkworm is highly affected by various abiotic and biotic factors. Tasar silkworms are tetra-moulters and predominantly bivoltine or trivoltine in nature but univoltine has also been reported. Total length of the larval period that is partly an inherent quality and partly correlated to meteorological conditions extends from 30-70 days depending upon the crop. Larvae are polyphagous and differ in its adoption to different food plants, forest type and climatic conditions.

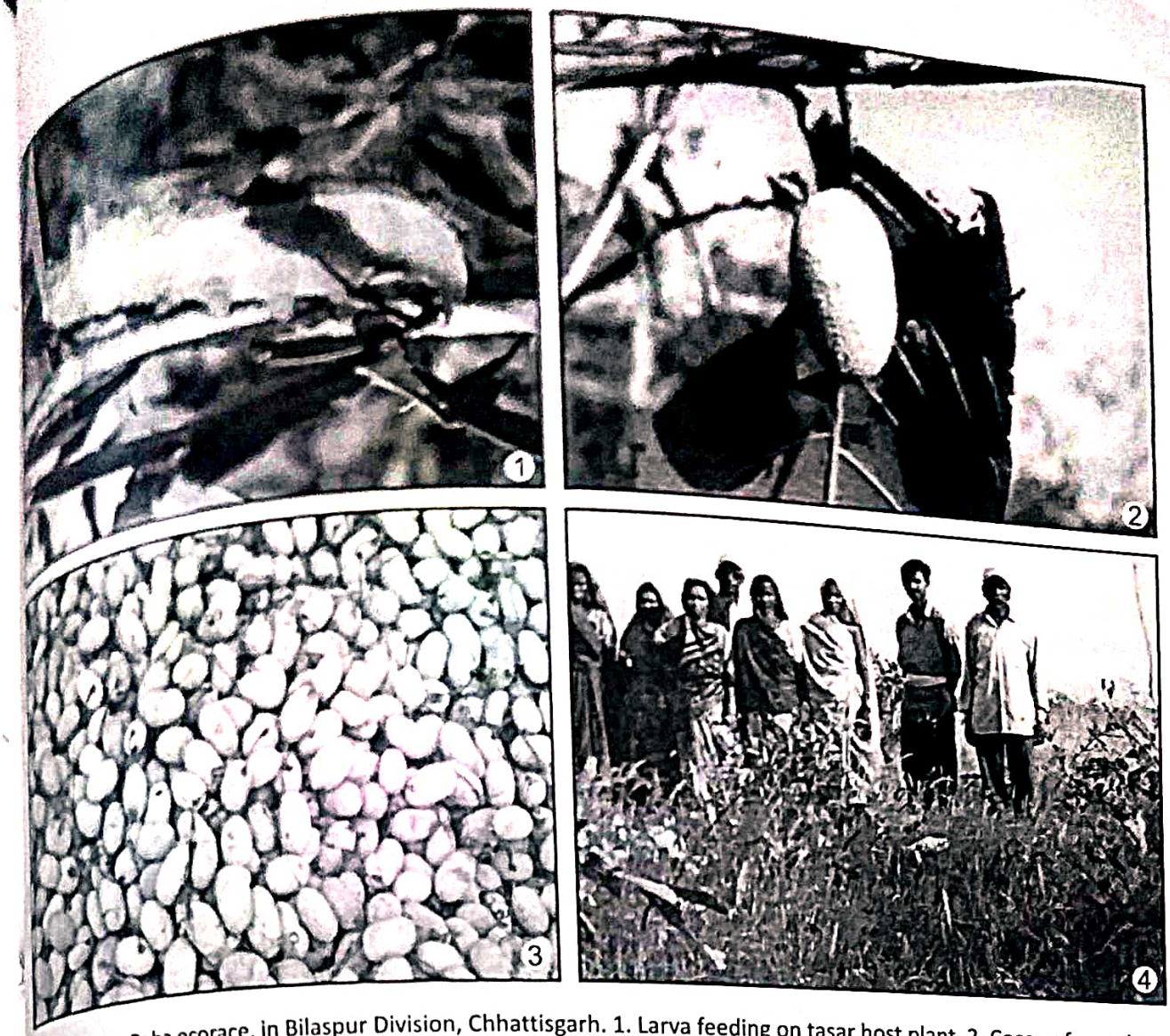
Tasar silkworm and host plant interaction

From the biological point of view, the silkworm feeds on its food plants, but since the silkworm is producing a useful commodity, the silk, it is cultured to the best advantage of the plant as well as human beings. Silk production is an excellent example of healthy biological interaction between primary producer (host plant) and consumer (silkworm) that is an integral part of the ideal ecosystem (Peigler, 1996). When the tasar silkworms are cultured on the plant, the silkworm feeds on the leaves and the litter is spread in and around the plant, which results in nutrient recycling within the microenvironment. Therefore, tasar silk culture is neither detrimental to the food plants available in the forests nor disturb the forest ecology (Rao *et al.*, 2003).

From ecological point of view, a forest insect is an integral part of the ecosystem. In nature, population build-up is regulated by biotic / abiotic density dependent and density independent factors. If the natural regulatory mechanisms (parasitoids/predators/pathogens) are active, the insects do not generally attain the status of a pest and their populations remain below Economic Threshold Level (ETL) or under the tolerance level (TL) (Bhandari, 2003). This has been true in case of wild tropical tasar as well, where worms feed on host plants in forest for a considerable period of the year without adversely affecting the ecosystem. Hence, tasar silkworm is not at all considered to be a harmful insect of forest, rather a friend of forest dwellers.

Tasar culture in central India

Since time immemorial, tasar culture as one of the major components of *Vanya Silks* has been extensively practiced by the forest dwellers of central India, mainly Madhya Pradesh, Chhattisgarh, Maharashtra and Orissa (Fig. 2). A good population of wild tasar silk moths is available in natural forests of central India. Eight districts (Ambikapur, Bastar, Bilaspur, Champa, Kawardha, Korba, Raigarh and Sarguja) of Chhattisgarh, 6 districts (Balasore, Cuttack, Dhenkanal Keonjhar, Mmayurbhan and Sundergarh) of Orissa, 3 districts (Seoni, Balaghat and Mandla) of Madhya Pradesh and only two districts (Bhandara and Chandrapur) of Maharashtra are considered as traditional tasar culture zone of (Sinha, 2003). *Terminalia tomentosa* and *T. arjuna* are predominantly being utilized for raising regular silkworm crops as planned rearing on sal does not succeed and ultimate result is heavy larval mortality. Sal forests provides base for the collection of a large quantity of naturally grown cocoons, which are regularly collected from sal forests of central India by tribal communities residing in close proximity to the forests. Tasar silkworms are reared outdoors and are predominantly bivoltine and trivoltine in nature because this region having well defined hot and cold spells. The first crop is raised during July-August following both emergence and egg laying with onset of monsoon during June. This is the seed crop for the second crop, which reared during September-October and becomes the commercial crop. The cocoons thus produced either go for reeling (post-cocoon technology) or remain in that condition showing diapause syndrome in pupae, till next June for following year's seed crop production. Out of 43 eco-races of tasar



...tasar culture, Daba ecorace, in Bilaspur Division, Chhattisgarh. 1. Larva feeding on tasar host plant. 2. Cocoon formed on tasar food plant. 3. Harvested tasar cocoons. 4. Forest dwellers involved in tasar culture.

...worm distributed in 16 states of India (Table 2), 18 ...-races are found in central India, viz. 6 in Orissa , viz. ...dal (wild), *Nalia* (wild), *Daba*, *Sukinda*, *Boudh* and ...arkati, 6 in Chhattisgarh, viz. *Raily* (wild), *Janghbir*, ...uth, *Korba*, *Suki* and, *Bhopalpatham*, 5 in Madhya ...desh, viz. *Mandla*, *Seoni*, *Piprai*, *Jhabua* and *Multai* ...d only one in Maharashtra, viz. *Bhandara* (Goel *et al.*, ...7, Mohanty, 2003).

...sar cocoon production and income gene...

The average annual income from the ...ction of ...sar cocoons in Madhya Pradesh is estimat... ...be very ...w as compared to that of other tasar states (Shukla and ...awdhry, 2003). The reasons are probably the ...attered ...stribution of food plants on which the silkworm grows, ...e absence of profitable plantations, lack of suitable ...reed and proper knowledge of breeding and ...ultiplication techniques (Roychoudhury, 2006).

...aily cocoon production in Bastar and income ...eneration

Raily is one of the richest sericigenous eco-races of ...sar silkworm in the world, found in wild in the Bastar regioin of Chhattisgarh. It feeds on sal (*Shorea robusta*). The cocoons of raily are robust and have a high silk content. Raily is distributed throughout the Bastar and differs significantly ($P<0.05$) in size and weight from place to place due to ecological conditions, i.e., altitude, temperature and humidity (Sharma and Chaturvedi, 1992) (Table 8). There is a mixed population (uni, bi and multivoltine) of raily, hence tribals get opportunity to collect the cocoons throughout the year from sal forests. During the routine work of their life, tribals collect the nature grown raily cocoons from the sal trees. Whenever, they pass through the forests, they look for debris (fecal matter) of tasar larvae on the surface, which shows presence of the cocoons on the tree and they simply collect the cocoons from the tree. Nearly, 70% of the total population is tribal in Bastar, out of which 60% of the tribals are engaged in collecting the nature grown cocoons to get additional income. The collection of cocoons is very economical for tribals since it does not need any capital investment. More than 200 lakhs raily cocoons worth of rupees one crore are collected by the tribals in a year in Bastar (Sharma and Chaturvedi, 1992).

Tasar cocoon production and income generation through culture on nature grown host plants

The income generation through tasar culture by exploiting naturally occurring food plants, *T. arjuna* and *T. tomentosa*, in two villages namely Bansajhal and Tendua, located in Lormi forest range, Bilaspur Forest Division (Chhattisgarh) under buffer zone of Achanakmar-Amarkantak biosphere reserve have been worked out recently by Chatterjee *et al.* (2007) and is presented in Table 9. Singh *et al.* (2007) suggested that tasar culture is best suited for poor landless families as compared to other activities. It is estimated that tasar culture can provide about 110 days employment especially during the stress period (Chatterjee *et al.*, 2007)

Tasar cocoon production and income generation through culture on host plants raised under social forestry programme

Growing tasar host plants under social forestry programmes and encouraging rearers to grow various vegetables and agricultural crops in between may enhance the income of poor farmers. Plantations of *T. arjuna* and *T. tomemtosa* at a spacing of 1.2 x 1.2 or 1.5 x 1.5m and then pruning, and turn them to the bushy growth. The pruned branches can also be used as firewood. Intercropping vegetables between bushes and rearing tropical tasar silkworm larvae can provide financial help to the poor farmers including tribals. Mishra and Praksh (1986) have recommended growing brinjal and tomato in between *T. arjuna* grown for rearing of an ecorace of *A. mylitta* having three generations in a year. They estimated an income of ₹ 17,500/- per hectare per anum by adopting this technique.

Thus, tropical tasar, a promising NTFP has vast potential in central India for rural development and there is wide scope for improvement in terms of quality and quantity of silk. Appropriate knowledge about the tasar culture, planting techniques of its host plants, silkworm breeding, rearing, seed production including post cocoon technology and their sustainable management can enhance productivity and concomitant improvement in terms of quantity and quality of silk production and economy of forest inhabitants.

Table 8

Data on quantitative and qualitative analysis of Raily cocoons in respect of different localities of Bastar, Chhattisgarh

Locality	Cocoon weight (g)	Shell weight(g)	Volume of cocoons (cc)	Silk weight (g)	Filament length (m)	Denier	Reelability
Darbha	15.76	2.91	39.10	1.64	1202	12.28	71.68
Tokapal	11.16	1.94	29.90	1,28	921	12.50	70.13
Geedam	15.58	3.10	26.00	1.16	746	12.56	68.17
Sukma	12.32	2.38	30.20	1.15	852	11.52	63.06
Kondagaon	16.07	2.75	29.10	1.52	1112	12.42	67.06
Pharasgaon	13.32	2.40	23.00	1.32	870	9.74	72.67
Keskal	9.80	1.99	19.80	1.07	900	11.01	68.16
Mardapal	15,29	2.89	27.30	1.38	898	13.31	60.79
Chotendonger	13.71	2.82	29.20	1.37	920	13.48	63.95
Dhawadi	14.33	2.65	27.50	1.29	858	13.06	65.01
Nangoor	16.38	3.19	33.50	1.67	1151	13.26	65.68
Lohandiguda	10.77	1.78	22.50	1.20	1022	10.45	78.09
C.D. at 1%	1.87	0.543	5.100	0.248	178.191	0.412	NS

Table 9

Data on income generation by exploiting tropical tasar silkworm, A. mylitta, in Achanakmar-Amarkantak biosphere reserve, Lormi, Chhattisgarh

Year	Village	Crop	No. of beneficiaries	No. of dfls brushed	No. of days involved	No. of cocoons/ dfls	Income/ beneficiary (₹)	Income/ day (₹)
2005-06	Bansajhal	I	10	1500	37	42	4666	126
		II	10	1500	42	41	4622	110
	Tendua	I	5	500	37	43	3115	84
2006-07	Bansajhal	I	10	1500	36	38	4138	115
		II	10	2000	43	84	13817	321
	Tendua	I	5	1000	36	45	6606	188