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Prospectus for commercialization and sustenance of sericulture at high altitude Kargil-Ladakh

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Abstract

Sericulture has great potential to alleviate poverty and unemployment in the areas where sericulture has not been introduced. High altitude belts of the J & K, like Kargil where scope of other agricultural crops is limited due to short growing seasons, sericulture has the scope to be introduced for long term basis to ensure the livelihood security and better socio-economic status of the people from this tribal region. To see how economic activities in Kargil district can be given right focus, a study on silkworm rearing cum demonstration program was launched by CoTS, SKUAST-K, Mirgund at high altitude Kargil-Ladakh during July-August 2018 and 19. In order to assess the feasibility and sustainability of sericulture in the region, a popular bivoltine silkworm double hybrid (FC2 x FC1) was procured from Nodal Silkworm Seed Agency, NSSO, CSB, GoI, Bangalore which was reared for two consecutive years in three different border villages of Kargil viz, Akchamal, Mangbour and Shilikchey. Although prior to this, small scale silkworm rearing trails were conducted at Kargil during 2012-13, 2015-17 and 2018-19 by CoTS, SKUAST-K, Mirgund and CSRTI, CSB, Pampore respectively and have reported encouraging results which laid the basis of this study for further expansion and strengthening of sericulture activities in new far flung border areas of Kargil. As such, the present investigation was aimed to test the validity of the results obtained in previous study trails for commercialization and popularization of sericulture in the region. The results obtained in the current investigation were encouraging and revealed highest hatching percentage of 98.70 and 97.80 during the year 2018 and 2019 respectively. Average Cocoon yield of 48.20 and 47.40 Kg/100 DFLs' was obtained during 2018 and 19 respectively. Average Single Cocoon Weight (SCW) and average Single Shell Weight (SSW) of 1.78g and 0.38g was obtained during 2018. Whereas in 2019 it was 1.76g and 0.39g respectively. Average Shell Ratio (SR%) of 21.34% and 22.15% was also obtained during the year 2018 and 19 respectively. Hence, results of the present investigation attest the validity of the previous study trails conducted in the region from time to time and established that sericulture can be promoted at high altitude Kargil region of Ladakh on sustainable basis, the prospectus of which are underlined in the study.

Keywords: altitude, commercialization, Kargil, Ladakh, prospectus, sericulture, sustenance

Introduction

In the high altitude regions like Kargil-Ladakh which are hardly accessible, sericulture related avocation does not exist in these areas owing to unawareness and little interactions among the farming community of these regions. Even, scope for other agricultural and horticultural crops is limited owing to short growing seasons as well as adverse climatic conditions and short summers prevailing in the region [1]. However, sericulture has the scope to be introduced for long term basis to ensure the livelihood security and better socio-economic status of the people from this area as reported in the previous study trails by [2, 3, 4] and well established by the current study.

Kargil district lies in the North-East of Kashmir at a distance of 205 km's from Srinagar. The population density as per 2011 census is 10 per square km. 99 per cent of population is schedule tribe. The district has high altitude area in the country ranging from 8000 to 18000 feet's above sea level. The district remains cut off from the rest of country from November to May in view of heavy snowfall on National Highway at Zojila Pass -The Highest Peak of the region. Kargil enjoys cold and temperate climate with the maximum and minimum temperature of 29.2 °C and -13.2 °C in the month of July and January respectively [5]. People mostly live in rural areas and only 5.3 per cent reside in the town.

The cultivated area in the district is 10,000 hectares as against 19,437 hectares of reporting area. The soil is generally coarse, mixed with stones and gravels. It is alkaline in reaction and organic matter content is very low. The fertility of the soil varies from place to place and the growing season is short. The average rainfall in Kargil is 26 mm only ^[3, 6]. The barley is the staple crop of the district. The district presents a composite culture of Balti, Ladakhi, Purki, Dardi, Zanskari and Shia cultures. Irrespective of ethnic identities, all speak the Kargali language with ease ^[7].

With regard to agriculture activities in Kargil, there is only one cropping season Kharif which extends from March to October. Cultivation is restricted to near the main valleys of Indus where crops like Barley, Buck wheat, turnips and mustard are grown. Basic survey to identify the needs of tribal community in Kargil has revealed that agriculture provides employment for less than 90 to 120 days and activities allied to agriculture can come in handy to supplement family income in tribal area like Kargil ^[1, 8]. Agriculture expansion at high altitude and non-traditional farming communities is constrained by unfavorable topological configuration and dispersed human settlement, which prevent the sector from reaping the benefits of scale economies. People of these areas are having either negligible or no source of income through agriculture or allied activities. Although, the stake holders of these areas have marginal and sloppy land holdings yet these small holdings are not efficiently used for effective income generation owing to high run off rate and other barriers confronting the mountain agriculture ^[2, 3, 6]. To see how economic activities in Kargil district can be given the right focus so that people in the far-flung regions have a sense of participation and involvement with the rest of the country, sericulture has the scope to be promoted in the region as it has great potential to alleviate poverty and unemployment. It has wider scope for augmenting family income and employment opportunities for small and marginal farmers of Kargil. Sericulture can retain people of Kargil from mass migration to other places in search of work/ employment and will create employment opportunities from June to August on farm and off farm ranging from cultivation of mulberry and rearing of silkworms to allied activities ^[2, 3, 4, 6]. Mulberry foliage is the sole food source for silkworm which already exists in the region as wild huge trees, the foliage of which was used as feed in the current investigation. However, introduction of high yielding mulberry varieties must be the area of focus for promotion and commercialization of sericulture in the region.

Materials and Methods

Silkworm rearing cum demonstration program to tribal farmers of Kargil region of Ladakh was launched by CoTS, SKUAST-K, Mirgund in collaboration with MARES,

SKUAST-K, Kargil Ladakh for a period of 45 days during 2018 and 2019 in the selected areas under the supervision and assistance of Ladakh Autonomous Hill Development Council (LAHDC) Kargil. A total of 100 DFLs' (Disease Free laying's) of silkworm double hybrid cross (FC2 x FC1) were procured from Nodal Silkworm Seed Agency of the Country i.e., National silkworm seed organization (NSSO) Central Silk Board, Ministry of Textiles, GoI, Bangalore India and was reared in three different border villages at Kargil viz, Akchamal, Mangbour and Shilikchey during June- July, 2018 and 2019 under university sponsored RCM project for Kargil-Ladakh. Prior to conduct of silkworm rearing trails, disinfection of the rearing rooms and appliances was carried out by using 2% Formalin and 2.5% Chlorine dioxide at all the rearing sites as a prophylactic measure for eradication of pathogens [Fig.1]. The temperature and relative humidity of about 25 ± 2 °C and $70\pm 10\%$ were maintained respectively inside the rearing rooms. Digital thermo and hygrometers were used to record the temperature and relative humidity in the rearing rooms. Incubation of silkworm seed was conducted under hygienic and congenial environmental conditions required for hatching of the larvae [Fig. 2]. Leaves harvested from existing natural wild mulberry trees in the region were utilized as feed during entire period of silkworm rearing [Fig.3]. The fresh mulberry leaves were harvested from the mulberry trees during morning hours and late evening hours and three feeds were given per day till cocooning by following the recommended package of practices for successful silkworm rearing [9]. The data pertaining to some economically important traits such as Hatching percentage (%), weight of ten mature larvae(g), larval duration, cocoon yield/100 DFL's by weight (kg), Single cocoon weight (g), Single shell weight (g) and Shell ratio (SR%) were recorded during the investigation [Table. 2]. As a part of program, quality mulberry saplings of Ghoshoerami variety were distributed to local farmers of the region and were also planted at farmers field under the project. Under the program a total of 151 women farmers (41 from Shilikchey, 40 from Mangbour and 70 from Akchamal) were registered and trained in silkworm rearing during and mulberry raising through different scientific techniques during entire period of the program. A Sericulture Kissan Ghosti program was also organized for the farmers cum trainees for awareness about different sericulture activities carried out in the region with regard to importance and promotion of sericulture [Fig's. 4-12]. Analysis of Soil and leaf samples collected from different areas of Kargil was also done under the project [Table. 3-4]. In addition a survey on existing natural mulberry wealth was also conducted in different areas of Kargil under the project for its further utility, improvement and enrichment of mulberry wealth in the region [Table. 1].

Table 1: Natural Mulberry wealth existing in different villages of Kargil-Ladakh

Name of the village	Number of mulberry trees
Poyen	917
Goma	180
Lankhor	69
Chanchik	56
Changra	94
Tanmosa	47
Kako-schilickhey	89
Dass	86
Daythang	97
Peechue	103

Thasgangrong	94
Schilikchey	419
Ando	73
Gargardo	107
Chulichan	64
Silmo	73
Batalik	288
Garkon	187
Derchiks	168
Daw	196
Chanigund	65
Karkitchoo	83
Badgam	14
Hardas	147
Chutaamil	117
Akchamal	546
Sharbatgund	68
Apattee	42
Tumil	84
Sanjuck	239
Hundurman	93
Pashkum	85
Lochum	79
Baroo	369
Titichumick	184
Baghkhumine Tv	94
Chutuk	31
Zamsthank	24
Minji	249
Gramthang	73
Trespone	144
Slaskut	96

Different Sericulture Activities carried out at high altitude Kargil region under the Project



Fig 1: Disinfection of rearing house and equipment's **Fig 2:** Hatching of silkworm seed under incubation at Kargil- Ladakh.



Fig 3: Demonstration of silkworm rearing to trainees at Kargil-Ladakh.



Fig 4: Trainees with successful cocoon crop production at Kargil-Ladakh.



Fig 5: Trainees harvesting cocoon crop produced under the program.



Fig 6: Quality mulberry sapling (Goshoerami) distribution to farmers at Kargil-Ladakh.



Fig 7: Natural mulberry wealth existing at Kargil-Ladakh.



Fig 8: Demonstration of grafting techniques to farmers under training.

Fig 9: Demonstration on preparation of mulberry cuttings for mulberry raising under training.



Fig 10: Demonstration on mulberry raising from cuttings under Polyhouse conditions.



Fig 11: Mulberry raising at framers field under open and Polyhouse technology at Kargil-Ladakh.



Fig 12: Sericulture Kissan Goshti organized for awareness of farmers at Kargil-Ladakh

Results and Discussion

Introduction of mulberry sericulture at high altitude belts where scope of other agricultural crops is limited, sericultural activities need to be explored and promoted so that the economic status of people of these areas is improved. In the regions like Kargil-Ladakh which are hardly accessible, the agricultural related avocation are far less owing to unawareness and little scientific interactions and even agriculture as well as horticulture in these areas has no footing thus the people of these areas have either negligible or no source of income through agriculture or allied.

The findings of the current investigation with regard to expansion of sericulture to newer areas of Kargil attested the validity of the results obtained from the previous trail studies conducted in the region and indicate that there is possibility of promoting sericulture at high altitude Kargil belt of Ladakh^[2, 3, 4]. During the current study, the rearing results were encouraging with respect to may economically important commercial traits recorded [Table-2]. The results obtained in the current investigation were encouraging and revealed highest hatching percentage of 98.70 and 97.80 during the year 2018 and 2019 respectively. Average Cocoon yield of 48.20 and 47.40 Kg/100 DFLs' was obtained during 2018 and 19 respectively. Average Single Cocoon Weight (SCW) and average Single Shell Weight (SSW) of 1.78g and 0.38g was obtained during 2018 and in 2019, average Single Cocoon Weight (SCW) and Single Shell Weight (SSW) recorded was 1.76g and 0.39g respectively. Average Shell Ratio (SR%) of 21.34% and 22.15% was also obtained during the year 2018 and 19 respectively. (Table-2). The results of the present study are in conformity with the study of Malik *et al.* (2018)^[2] who have reported successful bivoltine cocoon crop production in the region while conducting trail rearing's and with respect to important economic traits the results of the study has revealed good cocoon characters which need to be improved though maximation of quality mulberry leaf in the region through introduction of improved mulberry varieties for popularization and commercialization of sericulture at high altitude Kargil. The results of the study are also in conformity with the study of Neelaboina *et al.*, 2018^[4] who have reported encouraging results with respect to economically important cocoon traits and concluded that sericulture can be promoted in high altitude regions like Kargil by introduction of quality mulberry plantation as the region provides great scope for sericulture expansion for commercialization. The results of the present study are also in agreement with the findings of Dar *et al.* (2020)^[3] who have achieved considerable results with respect to most of the important commercial traits during silkworm rearing trail conducted in the region and have further reported that sericulture could be a viable option to the farmers of Kargil for their socio-economic upliftment as mulberry can thrive well in the region, the intervention of which is of utmost importance for commercialization of sericulture in the region as mulberry is the sole food for silkworm. While surveying feasibility of having sericulture in Kargil Mir *et al.* (2010)^[6] have reported that Kargil is ideal for starting sericulture activities as luxurious growth and survival of mulberry trees

in Kargil is possible. The feasibility of sericulture at different altitudes has also been reported by Mubina (2010)^[10] and Nanda *et al.* (2003)^[11] while studying the effect of different altitudes with respect to growth and productivity of mulberry and concluded that mulberry can grow up to altitudes of 7000 m above mean sea level. These studies have established that sericulture can be promoted in high altitude regions like Kargil. Although abundant natural mulberry exists in many areas of the region [Table. 1] however, introduction of quality mulberry plantation needs to be introduced in the region for successful intervention of sericulture in the region.

Soil and leaf analysis of the samples from the region revealed deficiency with regard to important macro and micro elements which could be attributed to low agricultural activities carried out in the region with short growing seasons coupled with harsh climatic conditions and small agricultural land holdings. Soil analysis is important to evaluate nutritional status of soil and leaf analysis is equally important for redressal of disorders, if any (Basso *et al.*, 1990)^[12]. Present finding regarding pH of soil indicated alkaline nature of soil in the region which could be attributed to leaching of basis and variation in organic matter as reported by Minhas and Bora (1982)^[13] and Dar *et al.*, (2020)^[3]. Low electrical conductivity observed in the soil samples of the could be attributed to leaching of soluble salts from surface to subsurface horizons. Low organic carbon found the in soil samples of the region could be attributed to low agricultural activity in the region thereby depicting low organic carbon in the soils. This the results are in agreement with the findings of Dar *et al.* (2020)^[3] who have also reported low organic carbon in the soils samples of Kargil region. Nitrogen plays an important role in nutrition of plants. Nitrogen being part of protein is an important constituent of protoplasm, enzymes and chlorophyll as reported by Subbarayappa and Bongale (1997)^[14]. Shankar (1997)^[15] has reported that the quality of leaf is dependent on nitrogen content available in the leaf. Phosphorus helps in early root development and growth of plants. It has close relationship with synthesis of proteins metabolism of fats, carbohydrates, photosynthesis and other metabolic activities which contributes to leaf maturity. Potassium plays an important role in photosynthesis water regulation by maintaining turgidity of cells induces resistance against pests and diseases, cold breeze injuries and other adverse climatic conditions. It is involved in number of enzymatic activities. Current findings recorded lower trend with respect to available nitrogen, phosphorus and potassium in the soil and leaf samples of the region. The decreasing trend of nitrogen, phosphorus and potassium in region could be attributed to higher amounts of organic matter as organic matter is important source of phosphorus and nitrogen, soils with more amount of clay absorb more phosphorus and potassium. The average N, P, K content recorded in the region showed a significant and positive correlation with their availability in soil. Hence, the results obtained from the current study are in conformity with the results obtained by Dar *et al.* (2020)^[3] with respect to macro and micro nutrient availability in soil and leaf samples of the region.

Table 2: Rearing performance of silkworm double hybrid (FC2×FC1) at Kargil- Ladakh during 2018 and 2019.

Year	Silkworm Hybrid	Date of Incubation	Date of Hatching/Brushing	Hatching%	Larval period (Days: hours)	Weight of 10 mature larvae (g)	Yield/ 100 DFL's (Kg)	Single Cocoon Weight (g)	Single Shell weight (g)	Shell ratio(%)
2018	FC2×FC1	01-07-2018	12-07-2018	98.70	33:42	39	48.20	1.78	0.38	21.34
2019	FC2×FC1	09-07-2019	18-07-2019	97.80	35:19	44	47.40	1.76	0.39	22.15

Table 3: Chemo assay of local mulberry leaf samples from different areas of Kargil- Ladakh (Mean estimates of three replicates).

Sample Area	P (%)	K (%)	Ca (ppm)	Mg (ppm)	S (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)	B (ppm)
Poyen	0.32	2.50	7700	682.0	450	98.40	174.4	15.00	22.9
Goma	0.30	2.45	7214	706.8	500	96.00	228.0	26.20	27.7
Chanchik	0.36	2.40	7304	670.8	450	72.20	258.2	20.60	28.8
Mangbour	0.30	2.50	7040	649.0	400	27.60	238.2	52.20	35.2
Peechue	0.34	3.00	7452	648.4	900	35.00	268.2	41.00	37.5
Schilikchey	0.34	2.30	7240	683.6	900	80.60	221.4	37.40	31.0
Batalik	0.50	2.75	7442	667.2	500	34.40	144.2	22.40	25.0
Hardas	0.32	2.25	7384	633.4	350	28.80	201.2	15.00	29.0
Akchamal	0.30	2.35	7582	673.6	400	27.60	231.4	18.80	21.5

Table 4: Chemo assay of soil samples from different areas of Kargil (Mean estimates of three replicates).

Sample Area	pH	EC (dSm ⁻¹)	OC (%)	Average Nitrogen (Kg/ha)	Average Phosphorous (Kg/ha)	Average Pottasium (Kg/ha)	Average Calcium (ppm)	Average Magnesium (ppm)	Average Sulphur (ppm)	Average Zinc (ppm)	Average Iron (ppm)	Average Mangense (ppm)	Average Boron (ppm)
Poyen	8.44	0.03	1.75	560	09	201	222.5	16.07	1.60	0.510	11.42	4.392	0.89
Goma	8.71	0.02	2.10	680	05	448	216.0	15.72	1.70	1.692	10.02	5.484	1.00
Chanchik	8.61	0.02	1.95	630	09	269	221.9	15.27	1.80	0.984	10.42	4.152	0.84
Mangbour	8.45	0.02	0.85	293	31	548	228.1	16.37	1.40	0.688	6.736	4.206	0.85
Peechue	8.31	0.02	2.02	656	31	521	225.2	16.05	2.30	1.166	3.880	3.596	0.93
Schilikchey	7.44	0.03	1.98	640	13	509	222.2	16.36	2.10	6.028	17.49	12.95	0.84
Batalik	8.80	0.09	0.97	315	22	224	218.4	16.20	1.90	0.738	33.44	23.88	0.80
Hardas	8.44	0.08	1.09	350	09	212	225.1	15.77	1.40	1.132	13.81	4.484	0.82
Akchamal	8.78	0.06	1.17	380	09	470	220.9	16.10	1.50	4.550	8.378	3.892	0.98

Future Prospectus for Sustainable Sericulture Development at Kargil-Ladakh

For sustainable Sericulture development in Kargil area of Jammu and Kashmir following are to be considered:

Areas of Strength

- Favourable climate for quality bivoltine cocoon production.
- Can generate direct and indirect employment.
- Agro-based industry which requires small investment.
- Raw material for fabrication of equipment required is locally available at low cost.
- The required skills are learnable in short duration.
- The activity can be pursued at home or village level.
- The raw material produced in the form of leaf, cocoon and fibre can be easily utilized within the villages and marketing at every stage of production is not required, only final product cocoon or silk is marketed once the industry is developed in the area.
- Demand is higher as compared to production.
- Only industry of state for which raw material is available locally.
- Suitable for marginal tribal Kargil farmers.
- Eco-friendly/ harmonious/salubrious nature of Sericulture.
- Silkworm cocoon is the only cash crop for which minimum support price is available.
- Proved and established production of good quality cocoons possible at Kargil.

Areas of Weakness

- Inadequate mulberry wealth.
- Scattered/un-maintained age old mulberry trees.
- No infrastructure with farmers.
- No training at farmers level.
- No knowledge about use of mulberry and silkworm rearing.
- No separate rearing houses.
- Small land holdings.

Role of CoTS, SKUAST-Kashmir and CSRTI, CSB, Pampore-Kashmir

- To recommend mulberry and silkworm rearing practices and to update this periodically.
- To offer at least some productive silkworm double hybrids and improved strains of mulberry.
- To supply quality basic seed (P₃/P₂) to the state which requests the facility.
- To provide the training assistance to staff nominated for Kargil, lead farmers and reelers.
- To assist in respect of planting material for development of mulberry at farmers place.
- To develop and transfer required technologies often requested after discussion with Director Sericulture Development Department, Jammu & Kashmir.
- To assistant Ladakh Autonomous Hill Development Council (LAHDC), Kargil in respect of requests for consultancy of various kinds.

Role of State Sericulture Development Department (SDD) Govt. of J&K

The Sericulture Development Department Kashmir in turn could have the responsibility for the following functions or need for a policy for Bivoltine cocoon production in Kargil:

- Cocoon production involves a well-balanced cultivation of mulberry and rearing of silkworms on mulberry leaves. Further, the primary product in silk industry, i.e. cocoons have a short shelf life as the moth pierces and emerges out of the cocoon to mate and lay eggs rendering the cocoon unsuitable for reeling and therefore have to be disposed off or stifled within one week and processed which requires considerable efforts.
- Further, the temperature, relative humidity and rainfall plays a vital role not only in the growth and development of mulberry but also in the development of silkworm which is considerably sensitive to climate particularly the improved breeds. Therefore, silk industry in Kargil needs a higher degree of planning, care, skills and attention compared to any other cash crop. Further, around 10,000 families can be involved for livelihood on cocoon production in Kargil whose welfare is our responsibility. In the chain of silk production and processing, one's price advantage becomes a disadvantage to the other and vice versa and therefore a balance must be maintained considering these facts, it is inferred that a policy for development and promotion of silk industry in Kargil that could be different from that of other cash crops is essential.

Thrust Areas

The Following thrust areas have been identified:

- Systematic development and strengthening of silkworm seed production ensuring healthy commercial seed and guaranteed production, because NSSO supplied double hybrid for Kargil.
- Improvement in productivity of mulberry through soil enrichment adopting eco-friendly measures.
- Infrastructure development to meet the industry's requirement at all the levels of stakeholders starting from the primary producers to the processors of the end product.
- Knowledge building and skill up gradation through well-organized training programmes at all levels of participants of the industry.

Vision

- To create livelihood opportunities for tribal families of Kargil in Sericulture.
- To contribute in achieving production target of raw silk production of J&K State.
- To encourage tribal women empowerment on large scale in Kargil.
- To make J&K State single largest producer of bivoltine silk in the country.
- To develop sustainable livelihood model based on mulberry sericulture for tribal areas in Kargil.
- To transfer best technologies and practices to the tribal rearers, reelers and weavers.
- To Provide market support to stake holders.

Policy Initiatives

To achieve the above set goals and targets, the

recommendations for bivoltine cocoon production in Kargil district of Ladakh are enumerated in the following paragraphs:

Establishment of Research cum Extension centre by Central Silk Board, Ministry of Textiles, Government of India, Bangalore at Kargil in order to ensure:

- Constant up gradation of productivity and quality of silkworm breeds and mulberry.
- Device practices for improving soil health and fertility and cultivation practices to constantly improve the productivity and quality of mulberry.
- Protection of food plant and cocoon crop from various pests and diseases.
- Development of economic farming models and practices towards optimum utilization of resources and reducing the cost of production aiming at self-sustainability.
- Imparting knowledge and skills to the grass-root level extension workers and the stakeholders.
- A rational program of manuring of old plantation should be taken.
- For achieving immediate results and increasing bivoltine cocoon production by resorting to multiple cropping in sericulture, increase in mulberry wealth of Kargil is a MUST and the farmers should be induced to take up mulberry plantation of improved varieties in private lands by making sericulture a profitable and attractive occupation.
- For ensuring better survival percentage of plants the Department of Sericulture should select proper sites before plantation as it is observed that the percentage survival of the plantation is very poor.
- Plants need to be planted after taking into consideration the soil conditions.
- The pits should be dug for the plantation purposes by the month of December. Substandard pits dug at the time of plantation season and the plants simply dumped into these pits results in the failure of plantation and low survival.
- Ascertain adoptability of different mulberry varieties and stop distribution of all types without as to which variety can thrive in Kargil zone.
- The plants uprooted from the nurseries should be transported to the destination without delay to ensure their better survival in the field.
- Establishment of Chawkie gardens for Chawkie rearing (upto second moult). If the operation of Chawkie rearing is carried on rational lines the production of cocoon will increase at least by 25 per cent.
- Maintenance of hygro-thermic conditions for the healthy growth of silkworms.
- The Chawkie worms should be distributed in accordance with the performance, manpower and leaf availability with the silkworm rearer's in Kargil.
- The female workers should be encouraged in rearing silkworms this will help in improving quality as is being done in other advanced countries like China.

Host Plant Cultivation/ Quality Leaf Production

Quality mulberry leaf in sufficient quantity is the most important factor for successful and productive cocoon crop. Therefore attempts to expand mulberry plantation across Kargil is of utmost importance. At present silkworm rearing

depend on leaf harvested from scattered unmaintained and age old mulberry trees existing in Kargil. This leaf is deficient in nutrients. The quality of leaf fed to the worms is poor resulting in poor cocoon yield. Hence, Silkworm Rearer's at Kargil need to be encouraged and supported to raise their own mulberry plantations. Only high yielding mulberry varieties need to be propagated and recommended agronomic and pruning schedules need to be adopted to enhance leaf production so that quality leaf is available for commercial rearing also.

Establishment of Kissan Nurseries: Kissan Nurseries in private sector need to be established for production of mulberry saplings. This intervention will increase leaf yield, enhance supply of Chawkie reared worms and cocoon yield. State Govt. or Central Silk Board has to support mulberry plantation under Catalytic Development Program.

Outsourcing of Mulberry Sapling Production: In order to meet the demand of mulberry plants and generate employment in private sector mulberry plant production could be outsourced by establishing Kissan Nurseries. Department of Sericulture will purchase well grown quality saplings from Kissan Nurseries and supply to cocoon farmers for plantation at Kargil. The tentative modal of establishment of Kisan Nurseries under Kargil conditions could be as under:

Establishment of Kissan Nurseries

Land Holding- 2 KANAL (0.25 ac)

Activity	Expenditure (Rs Lac)
Cost for establishment of Poly House	0.50
Plant Production per year (NO)	3000
Production cost for 2 years @Rs 12/Plant	0.36
Returns after sale of 3000 Plants @Rs25/Plant:	0.75
Net earnings from 1 Kanal of land (2yrs)	0.39

Chawkie Rearing and Establishment of CRCs and Chawkie gardens: Cooperative CRCs could be encouraged by providing technical guidance and infrastructure support. This process can be accomplished in a phased manner. Chawkie gardens with recommended mulberry variety for highly nutritious leaf need to be established.

Model Silk Villages/Clusters

A few villages in Kargil district can be initially adopted and the rearing infrastructure of farmers can be developed on modern lines so that advanced Seri-technologies are disseminated and farmers are able to produce quality cocoons. A complete support system with backward forward linkage has to be created in these clusters. Such villages/ clusters can help in spreading sericulture to adjoining areas.

Developmental Schemes Available With State Sericulture Development Department Govt. of J&K (To Be Implemented)

The ongoing development schemes available with Sericulture development department Govt. of J&K which can be implemented in Kargil after establishment of sericulture department:

CSS of Central Silk Board-Ministry of Textiles: After the

discontinuation of Catalytic Development Program by Ministry of Textiles this restructured scheme is only support from Central Silk Board wherein State Sericulture department gets financial support of 250-300 Lacs.

Rashtriya Krishi Vikas Yojna (RKVY) of Ministry of Agriculture G. o. I: Department gets sizable financial support of 40-60 Lac under this scheme depending on the availability of funds with the State Govt. This scheme is utilized to create infrastructure and promote production growth as per the guideline of the scheme.

Agricultural Technology Management Agency (ATMA) of Ministry of Agriculture: This scheme is primarily for awareness, technology demonstration, capacity building etc. Department gets little amount of 8-10 Lac under this scheme depending on availability of fund.

Convergence with MGNREGA: Department under takes mulberry plantation on community and state land under this scheme. The number of plants and the area depends on availability of funds with the District Development Commissioner. The convergence program is picking up. However funds sanctioned under these schemes are uncertain. Policy level interventions to make specific allocations from these schemes for promotion of sericulture have to be ensured. Potential and possibility of convergence with MGNREGA for promotion of sericulture is huge.

Funding's From The Projects

Project under Tribal Sub Plan (TSP): under this program tribal families doing sericulture and living in inaccessible area of the state can be covered and the funds can be utilized to upgrade the infrastructure of these families so that there is visible improvement in cocoon productivity and production besides providing them training and building their capacity to take sericulture on a sustainable basis.

Project under Schedule Caste Sub Plan (SCSP): This Project is funded by Central Silk Board, Ministry of Textiles G o I. Project to the tune of 200-250 Lac is sanctioned by CSB under this program. Under this project 200 SC families will be identified and covered at two places in two districts in cluster mode so that there will be visible impact on ground. Funds will be utilized to upgrade the infrastructure of these families so that there is improvement in cocoon productivity and production besides providing them training and building their capacity to take sericulture on a sustainable basis.

Overall Socio Economic Impact

Sericulture has a huge socio economic impact and has the potential to transform the lives of people by providing viable and sustainable employment opportunities. It involves a number of processes right from mulberry plantation through silkworm rearing, reeling, weaving and marketing and thus engaging large number of people including women. Once promoted on a larger scale with value addition, sericulture has the potential to provide gainful employment to the people of the Kargil. Sericulture activities are village based and hence prevent migration from rural to urban areas in search of jobs. Sericulture perfectly aligns with the National Goals and will help in poverty alleviation and inclusive growth. Sericulture is eco – friendly no use of pesticides. Silk is a natural fiber.

Mulberry plantation acts as a carbon sink and mitigates effects of global warming/climate change. Therefore, practicing sericulture will prevent environmental degradation in the Kargil which is having a unique natural ecosystem.

Outcome of the SKUAST-K research in the region

It is now established that Kargil district of Ladakh is well suited for sericulture development and good quality bivoltine cocoon crop production. However, with the promotion of mulberry cultivation and product commercialization in the remote region, economically viable and sustainable sericulture development can take place which in turn will have long term returns to the tribal poor farmers with immediate results as follows:

- Kargil having little potential for other crops as such the exploitation of mulberry to raise silk cocoons can be looked into for better utilization of land and other resources for sericulture development. Once, the mulberry plantation is established in the region, sericulture can be practiced as a cash crop subsidiary occupation.
- Improvement in productivity of mulberry through soil enrichment adopting eco-friendly measures.
- Promotion of improved mulberry wealth for maximization of quality mulberry leaf.
- Sustainable sericulture development in the tribal region for income augmentation.
- Planting material for development of mulberry at farmers own place for sustainable sericulture development.
- Benefit the environment by planting deep rooted mulberry trees that contribute falling leaves and branches to the soil, provide diverse wild life habitat and forage and ultimately create a more resilient and diverse landscape.
- Creation of livelihood opportunities for tribal families of Kargil in Sericulture.
- Encouragement of tribal women empowerment on large scale in Kargil.
- Development of sustainable livelihood model based on mulberry sericulture for tribal areas in Kargil.
- Transfer of best technologies and practices to the tribal farmers for their income augmentation.

Based on the above following is reiterated

- Kargil district of Ladakh having 99% Tribal and SC population are yet to reap the benefits of Sericulture. Steps need to be taken for uplifting these down trodden people so that they earn their livelihood from this intervention.
- The state and central assistance for development of sericulture in this area is needed for changing the income and employment scenario of the region.
- Establishment of Sericulture department and Silk Training Institute is of utmost importance in this remote and inaccessible area of Jammu and Kashmir Since, it is established by SKUAST-Kashmir and CSB that sericulture is the viable option for upliftment of these tribal people having less avenues in agriculture and Horticulture.

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Conclusion

It is evident from the results of the study that there is enough scope in expansion and promotion of sericulture at high altitude Kargil-Ladakh for commercialization. The performance of silkworm rearing in different areas of the region indicate that mulberry sericulture has a greater potential in the region. However, improvement of existing mulberry wealth with introduction of quality mulberry varieties is of prime importance so that mulberry foliage is maximized for sustainable sericulture in the region which is bound in accelerating economic activity besides providing gainful employment to the unemployed and uneducated youth of the region.

Competing Interest

The authors declare that there is no conflict of interest in the publication of this manuscript.

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