

DRAFT REPORT

STUDY ON RESTRUCTURING OF SERICULTURE DEVELOPMENT PROGRAM IN NEPAL

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STUDY ON RESTRUCTURING OF SERICULTURE DEVELOPMENT PROGRAM IN NEPAL

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The study team

Sustainable Research and Development Center (SRDC), Kathmandu

ACRONYMS

ADD	: Agriculture Development Directorate
ADS	: Agricultural Development Strategy
AICC	: Agriculture Information and Communication Center
AKC	: Agriculture Knowledge Centre
APP	: Agriculture Perspective Plan
CAESC	: Community Agriculture Extension Service Center
CAGR	: Current Annual Growth Rate
CB	: Cross Breed
CIED	: Center for Industrial Entomology Development
DoA	: Department of Agriculture
HMGN	: His Majesty's Government of Nepal
JT	: Junior technicians
LAU	: Local Agriculture Unit
MoALD	: Ministry of Agriculture and Livestock Development.
MoLMAC	: Ministry of Land Management, Agriculture and Cooperatives
NARC	: Nepal Agriculture Research Council
NGO	: Non- Governmental organization
NPC	: National Planning Commission
OPASS	: Other Provincial Agriculture Support Structure
R/ARC	: Regional/Agriculture Research Centre
SAN	: Silk Association Nepal
SDC	: Sericulture Development center
SRDC	: Sustainable Resource and Developmental Center
SRDP	: Sericulture for Rural Development Program
ToR	: Terms of Reference
WDP	: Women Development Program

Executive Summary

The worldwide production of silk reached 609,332 mt worth of \$ 22.83 billion market revenue by the end of 2021, and estimated to raise at the current CAGR of about 9.8% to reach a total of \$ 33.81 billion by 2027. The bulk of it is produced in China, India, Japan, Brazil and Korea. Asia is regarded as the main producer of silk as it produces over 95% of the total global output. Sericulture plays a unique role in the socio-economic development of sericulture farmers. Mulberry sericulture has a good potential and prospects in Nepal due to its labor intensive nature and suitable agro-climatic condition. From the agro-climatic point of view, among 77 districts, 40 districts of mid-hills and 20 districts of Terai/inner-Madhes areas are suitable for sericulture. Sericulture farmers can harvest mulberry leaves and rear silkworms 3-4 times a year. Twenty years APP (1995) provides long-term perspectives for agricultural development in Nepal. Data for three decades reveal an increasing trend of mulberry area, egg, cocoon and silk production in Nepal. However, the production is negligible in terms of national demand. Nepal imports silk materials every year viz. silk cocoons, silk yarns and silk fabrics from different countries. Current data reported by Department of Custom shows that Nepal imports worth of NRs 843989 thousand of raw silk from abroad and also exports silk products. This indicates tremendous opportunities of sericulture sector. In this line, the data on demand of mulberry saplings and silkworm eggs from new areas, such as Gulmi, Arghakanchi, Palpa, Rolpa, Dailekh, Salyan and Achham are encouraging and indicates necessity of establishing new sericulture farms probably in Lumbini province by Provincial Government or by Private sectors.

However, commercialization of sericulture farm is a dream of reality in Nepal. For last few years declining trend has been observed. The major problems are low cocoon price and marketing, lower quality of eggs distribution (Grasserie disease in the 5th instars), cultivation of mulberry plants in marginal land without irrigation, low yielding mulberry variety, poor management, untrained human resources including lack of research and region-season specific package of pre- and post-cocoon technology for the sericulture farmers. These problems need solutions for betterment.

There were 35 parental stock of silkworm collected from different countries mostly from Japan, India, Pakistan, Bangladesh, Korea and Lao PDR, and now only 33 races are in existence, which are reared in a traditional house and maintained by non-technicians (office assistance). There are further chances of losing these races, and poor quality egg production continues due to lack of breeder and poor record keeping system of production and distribution of silkworm eggs.

Sericulture being highly technical and sensitive farming activities there is shortage of well - trained manpower in sericulture farms, Agricultural Knowledge Centers and municipalities are also being handled by few technicians. In SDC, Khopasi, office assistance (Karyalak shahayak) has been maintaining parental lines of silkworm. In community level also, majority of technicians have insufficient experience in sericulture and their opportunities to higher training is limited because there is no provision of higher study and training for employees working in sericulture farms.

Similarly, technical services provided at farm level to farmer groups or individuals are insufficient. At the same time, there is lack of supervision by the technicians during silkworm rearing, when the farmers need frequent technical backstopping. Irregular transfer of employees from sericulture

farm to other agriculture sector and their limited scope after retirement is adversely affecting on motivation of the staff working in the farm.

Enactment of Nepal's constitution 2015, has changed structures, such as Ministry of Agriculture and Livestock Development (MoALD) transforming from a unitary to federal republic system with three tiers of government; the federal, province and local government, respectively. With the change in structure, the organizational set up also has been changed with due respect and the spirit of new constitution. The scope of MoALD is limited now and authority for various agricultural and livestock activities have been shifted from federal (MoALD) to provincial and local level by laws. The provincial and local level institutions have authority to develop and implement their own priorities and policies for agriculture development. With the change in new governance organogram, role and responsibilities of Center for Industrial Entomology (CIED) also has been changed which has created problems to run sericulture program smoothly. There is lack of coordination and collaboration between the three tiers of the government and line agencies resulting in technically less effective extension services delivery.

In the past, there was no organized market for the cocoon in the country. Therefore, initially, all the cocoon produced by farmers were collected and marketed by the government and involvement of private sectors in production and cocoon collection was negligible. After stopping cocoon procurement by the government in 2070s, cocoon market became open for private traders, but market was more unstable and farmers could not sale cocoons and receive payment in time. This was a turning points in declining sericulture in Nepal.

Another reason for declining sericulture is cocoon price which is not adjusted for long time, but cost of production is continuously increasing. As a result, farmers did not get profit from sericulture as compared to other alternative crops, and therefore, many farmers have left it. The study shows that the cost of cultivation of cocoon is Rs 826/kg whereas market price of fresh cocoon is Rs 350-500/kg of good grade cocoon. The value chain analysis of silk product (mulberry transferred to silk and silk fabrics) reveals that BC ratio of per kg cocoon is 1:2.5, which indicates that sericulture should be linked with industries. Therefore, concerning government bodies (federal, provincial and local) need to initiate adjusting pricing of cocoon either by minimum support price or providing incentives/subsides to fulfil the gap.

After the endorsement of federal system with three tiers of government the extension service delivery system which is the responsibility of local level institution (Municipalities) seems very weak due to limited staff without knowledge and skill in sericulture and thus the program could not produce satisfactory results. Lumbani and Gandaki provinces have developed working guidelines and norms for sericulture development in the province. This may be a learning lesson for other provinces and local bodies.

Field study showed that average sizes of farm holding of continued seri-farmers was 22.24 Ropani, while discontinued farmers was almost 50% less, i.e. 11.38 Ropani, which indicates that average holding is increasing than in the past. Similarly, average production of cocoon was estimated 13 kg per Ropani per rearing, and it was usually practiced twice a year. This means that an average cocoon production is just 26 kg per Ropani per year which is very low as compared to neighboring countries.

There are data anomalies on mulberry area to cocoon production, silkworm egg production to distribution to the seri-farmers including silkworm cocoon productivity per box of egg. This raises issues of data validity, sensitivity of the related personnel towards their roles and responsibility, and ultimately towards necessity of such institutions under similar management modality in the long run. Report on production and distribution level of silkworm eggs suggests for curtailing 70% of existing budget of grainage section of SDC, Khopasi in commercial egg production. In this way, 11.45% reduction on total budget could be logical for Parental Stock Maintenance Section at SDC, Khopasi as they are currently maintaining 33 parental strains only against original 35 strains (2 parental strains are lost forever).

Development of sericulture technology needs continuous research activities especially in the field of selection and maintenance of suitable mulberry germplasms; collection and maintenance of high yielding silkworm races; and pest management including other rearing and management techniques. Right now, the research institutions lack facilities and co-ordination among them. Nepal Agricultural Research Council (NARC), which is the responsible institution for research in Nepal, but has no separate unit due to lack of sericulture specialist. Training also is crucial for motivation and productivity increase, but should be conducted in cluster areas than selecting farmers from other than sericulture pockets.

Of the two modalities of sericulture restructuring, the first model takes care of the past achievement and its conservation and another model is new areas as project model. Regarding the role and responsibility at the changed context, responsibilities vary at different levels, such as quality eggs and manpower development at federal level, processing and technical back-stopping at provincial level and program implementation by the local government. At the same time, province may play coordinating role between federal and local level in program implementation, monitoring and evaluation.

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SECTION-A
(Sericulture Reviews)

1. INTRODUCTION

The mulberry silkworm moth was domesticated around 5,000 years ago in China. Its silk is regarded as one of the precious natural fibres and mulberry silkworm occupies over 95% of the total silk production. Asia is regarded as the main producer of silk as it produces over 95% of the total global output (Shrestha et al., 2016). The main produces in Asia are China, India, Japan, Brazil and Korea. Nepal lies in between the China in the north and India in the south, which together produce over 90% of the world silk production (Popesku, 2013).

1.1 World scenario

The worldwide production of silk is 609,332 mt per year. China is the largest silk producer in the world (403,021 mt/per year), which covers more than 60% of world's silk production. India comes second (161,127 mt yearly) and Uzbekistan (17,912 mt per year) is the third largest producer of silk in the world (<https://www.atlasbig.com/en-us/countries-by-silk-production>). Data are available for top silk producing countries from 1960 to 2020 ([https://www.youtube.com/watch?v=UmOUtICiwsM&ab_channel=Animated Stats](https://www.youtube.com/watch?v=UmOUtICiwsM&ab_channel=Animated+Stats)). All country together, globally the production of silk and its share per person is given in Table 1.

Table 1. Silk production and its share per person in the world

Country	Production (mt)	Production per person (kg)
China	403,021	0.289
India	161,127	0.121
Uzbekistan	17,912	0.549
Iran	13,244	0.162
Thailand	4,286	0.062
Brazil	3,054	0.015
Vietnam	2,511	0.027
Romania	1,150	0.059
North Korea	905	0.035
Afghanistan	679	0.022
Azerbaijan	514	0.052

Cambodia	158	0.010
Egypt	119	0.001
Kyrgyzstan	112	0.018
Japan	110	0.001
Spain	79	0.002
Turkey	71	0.001
Bulgaria	71	0.010
Italy	62	0.001
Madagascar	49	0.002
Lebanon	33	0.005
Nepal	30	0.001
South Korea	17	0.000
Greece	12	0.001
Syria	4	0.000
Taiwan	3	0.000
France	1	0.000

Source: <https://www.atlasbig.com/en-us/countries-by-silk-production> (2021)

The top exporters of raw silk are: China (\$315Million–88%), Italy (\$18.3Million–5.1%), Malaysia (\$12 Million –3.3%), Romania (\$7.09 Million –2%) and Germany (\$3.32 Million –0.9%), while the top importers are India (\$157 Million –44%), Romania (\$84.7 Million – 23%), Italy (\$39.2 Million –11%), Japan (\$20.8 Million 5.7%) and South Korea (\$15.7 Million –4.4%). The silk market was close to \$ 22.83 Billion by revenue by the end of 2021, which is estimated to raise at the current compound annual growth rate (CAGR) of about 9.8% to reach a total of \$ 33.81 Billion by 2027 (<https://www.marketdataforecast.com/marketreports/silk-market>).

1.2 National scenario

From the agro-climatic point of view, 40 districts of mid-hills and 20 districts of Terai/inner-Madhesh areas are suitable for bi-voltine and crossbred silkworm rearing. Bi-voltine cocoon produced in Nepal has been proven to be of the same quality as that of China, Japan and Korea.

Nepal's social, economic and geographical conditions are suitable for mulberry silkworm rearing and national silk industry (Kafle, 1970). There is tremendous scope for the expansion of its production in the country. National scenario of mulberry coverage and cocoon production from 2000/01 to 2020/21 is presented in Table 2.

Table 2. Mulberry area coverage and cocoon production in Nepal (2000/01-202/21)

Year	Mulberry acreage (ha)	Egg production (box)	Cocoon production (mt)	Raw silk production (kg)
2000/01	245	6220	31.40	1376
2001/02	685	6440	35.21	1580
2002/03	745	5362	35.00	1950
2003/04	556	6056	33.00	1500
2004/05	825	2871	31.34	1570
2005/06	865	2038	33.00	1320
2006/07	946	2417	23.30	1800
2007/08	1120	2310	26.40	1500
2008/09	1250	1768	26.10	1500
2009/10	1300	1325	29.30	1700
2010/11	1380	1536	30.10	4200
2011/12	1450	1539	31.40	4420
2012/13	1530	1703	38.00	5355
2013/14	1610	1548	45.00	6340
2014/15	1600	1462	40.00	5635
2015/16	1673	1117	52.00	NA
2016/17	1757	997	55.00	''
2017/18	1421	353	30.00	''
2018/19	1457	412	32.00	''
2019/20	1505	450	35.00	''
2020/21	1538	318	39.00	''

Total	25458		730.55	
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Source: MoAD (2014/15); MoALD (2022)

With a minimum estimate, if 0.1% of Nepal's arable land is afforded to mulberry plants, there would be 6000 hectares of mulberry garden established for silkworm rearing, and with only 500 kg cocoons production from one hectare of mulberry plantation per year. This would result in 3000 mt of fresh cocoons production every year. Based on 8 kg fresh cocoon to 1 kg raw silk thread conversion, there would be 375 mt of raw silk thread production per year. As the price of raw silk thread is Rs. 3000 per kg. It is worth of 1.12 Billions of rupees (Rs 1,12,50,00,000) per year, and adding at least 10% of the value of raw silk thread from by-products, the total value exceeds over 1.23 Billion rupees per annum. Nepal imported silk worth over 340 million rupees in fiscal year 2010-2011 which shows many opportunities of producing cocoon and silk in the country, growing mulberry in about 10 ropani of land seri-farmers earn 40,000-50,000 rupees per harvest, and repeating 3-4 times a year which is worth of about Rs. 2,00,000. The present demand in Nepal is 300 mt of raw silk yarn, out of which only about four mt is fulfilled from the national production (Ghimire, 2013). Therefore, if the national potentiality is exploited for sericulture development in the country, it can fulfill the demand and replace foreign import of silk. Hence, sericulture can support agriculture/forest and industrial development and contribute to national economy.

Despite the potential, for past few years there is a declining trend and productivity gap exists at the farmers' field, farms in Nepal and abroad in sericulture. The success of sericulture depends on the various factors including successful implementation of technological and managerial tools along with high yielding best-suited mulberry and silkworm varieties (Ghimire, 2000; 2013).

2. OBJECTIVE OF THE STUDY

Sericulture refers to the commercially rearing of silkworms in order to obtain silk. The production process consists of a long chain of interdependent and specialized operations that comprises activities in three phases: the agricultural cultivation of mulberry (*Morus alba* L), rearing of silkworm (*Bombax mori* L.), and industrial processing of cocoons for silk reeling and fabrication. The proposed study tries to explore past and present trend, identify the gaps, major constraints, and reasons behind declining sericulture development, and based on findings, prepare restructuring national plan.

2.1 OBJECTIVES

2.1.1 General Objective

The general objective is to extensively review the past and present efforts and outcomes in the sericulture sub-sector, and suggest the evidence based restructuring proposal for the sericulture development program in Nepal.

2.1.2 Specific Objectives

- Extensively review the past and present efforts in the changed context
- Review the performance of sericulture sub-sector and critically assess the reasons behind its poor performance
- Conduct value chain analysis and assess the first hand information and opinion from the value chain actors including enabling institutions and experts
- Carry out detail audit of Sericulture Development Center, Khopasi and general technical audit and review of changed context of other Sericulture Farmer Centers in the country
- Assess the stake ownership and priority of the three tiers of the government towards sericulture research and development
- Critically assess the sericulture related support services from public, community and private institutions
- Assess the primary and secondary evidences required for the restructuring of the sericulture development program
- Prepare the details of program restructuring proposal including details of strategies, modalities, interventions, action plan, institutional arrangement, investment portfolio, and the possible outcome in detail.

They are all well emphasized step-by-step and elaborately supported with data frame for collecting primary and secondary information (format for various activities in Appendix 15).

2.2 Rationale of the Study

Nepal lies in between the top leading countries China and India for sericulture production. It is cottage industry with its agricultural base, industrial superstructure and labour intensive in nature. It is remarkable for low investment, quick and high returns highly recommended as the most effective tools for rural reconstruction and development of rural society (Narsimha, 2003). Government of Nepal has established infrastructures for sericulture development and farmers are practicing mulberry cultivation and silkworm rearing for more than four decades. Maintaining healthy mulberry garden, seri-farmers can harvest mulberry leaves and rear silkworms 3-4 times a year. This is a profitable new agri-business enterprise in Nepal. The highly beneficial aspects of sericulture are: i) high employment potential, ii) providing vibrancy to rural economy, iii). low gestation period, iv) high returns, v) good national/ international market, vi) ideal program for the weaker section of the society, vii) eco-friendly rural industry, viii) professional training and expertise, ix) women-friendly occupation, and x) rural community development.

Mulberry planting in land gives full utilization of land and at the same time, it helps prevent the soil erosion (Wenhua, 2001). Silkworm rearing also gives various types of wastes. The waste products are utilized as biproducts, which support in value addition. There is continuous increasing demand of silk in the national and international markets. Nepal imports silk materials every year from different countries. In the recent year (mid-July 2021 to mid-July 2022) cocoons, silk yarns and silk fabrics were imported worth of NRs. 84,39,89 thousand. For high production and productivity, favorable weather and hygenic environment are critical. Silkworm eggs are

incubated by providing standard temperature, relative humidity and light to ascertain economic hatching followed by robust larval growth and quality cocoon production (Lee, 1998). Again, standard temperature and relative humidity during molting is maintained properly. While, ignoring temperature and humidity management during silkworm rearing seri-farmers have to bear huge loss due to frequent incidence of silkworm diseases. The production of cocoons and silk has decreased in past few years during and ad after Covid-19 in the world. In the national context, mulberry plantation and cocoon production has not shown encouraging results which is a great challenge for the expansion of sericulture enterprise, despite governmental and non-governmental organizations efforts towards sericulture development (Mainali, 2012). This study thoroughly reviews present past and trend, and support to find out and develop policies regarding the restructuring and improvement of the sericulture.

2.3 Limitations of the Study

The plans and strategies developed for restructuring sericulture are based on national and international developments, previous seri-farm operations and results, and views of stakeholders involved in sericulture. However, the new ideas transferred into practices, cannot be guaranteed to give highly ambitious results. Because, many factors influence sericulture success. After federalism, there is lack of clarity of roles and responsibilities of program executing bodies at different levels. Sericulture is itself influenced by multi variables, e.g. climate, mulberry cultivation, silkworm rearing, and farmers' knowledge and skills, etc. Major constraints are time and resource allocation, which are limited the dimension of study. Therefore, this is a resource and time bound outcome in spite of the immense problems and constraints. The findings support to guide in restructuring sericulture development under new federalism system of government. It is imperative that effective monitoring and further study based on the development planning and sericulture cycle analysis at different levels of Government in the future can provide greater enlightenment for further improvement and the success of sericulture in Nepal.

3. SERICULTURE IN NEPAL

3.1 Historical Perspective

Although Nepal lies between two highest silk producing countries in the world, i.e. China and India, sericulture is still in the infant stage in Nepal. Sericulture history is very recent in Nepal and divided in distinct three phases (Thapa, 2016):

Early Phase (1911 to 1955) : Efforts made to introduce sericulture between 1911 to 1955 resulted in failure mainly due to: i) lack of sufficient knowledge, ii) lack of technical expertise, iii) lack of manpower and iv) disease outbreaks. The whole effort was a failure, with first learning lesson in sericulture to back up with all necessary facilities.

Intermediate Phase (1956 to before 1980s) : Overseas experts during the years 1968 and 1973 from Japan and South Korea made surveys and furnished reports for the development of sericulture industry. Depending upon the results of feasibility studies, five-year plan of sericulture development was prepared and Industrial Entomology Project (IEP) covering apiculture and sericulture was initiated in 1975 with a working station at Khopasi, Kavre, about 35 km from Kathmandu. This phase included: i) Pre-/Feasibility study of Bi-voltine silkworm rearing, ii) Initiation of Industrial Entomology Project (IEP), iii) Improved varieties of mulberry distributed to farmers for the first time and silkworm eggs made available to farmers and start of cocoon production at the farmer level. After transfer of apiculture to Godavari, Lalitpur, the Khopasi station became solely responsible for sericulture developmental activities. It was later named as Sericulture Development Project (SDP) as the pioneer of sericulture development in the country. The learning was fruitful from the first phase which lead to establish initial infrastructures, mulberry gardens, silkworm rearing house, Human resource and training to seri-farmers.

Development Phase (After 1980s) : Successful production and earning from sericulture in Nepal started in this phase and major activities are as follows: i) Sericulture Development Office (SDO) also established in Syangja, ii) LWS Nepal continued 10 year sericulture project in Ilam, ii) Formation of Silk Association of Nepal (SAN) to oversee, plan and organize sericulture development activities, iii) Establishment of SDO, Bhandara in Chitwan and with ROK support, sericulture training, iv) SDP launched special program in 12 districts (Ilam, Morang, Sunsari, Kavre, Makwanpur, Chitwan, Dhading, Tanahun, Syangja, Palpa, Doti and Dadeldhura), opened SDO at Itahari and Dhankuta, v) Establishment of Industrial Entomology Development Division (IEDD), Opening of SDO at Dhunibeshi, Bandipur and Pokhara and Purchase of land at Chitapol, Bhaktapur for establishing seed cocoon and egg production, vi) JICA mini-project and multi-end reeling machine at Itahari by KOICA, vii) Starting of SRDP, in four clusters comprising seven districts (Ilam, Kabhre, Kathmandu, Chitwan, Dhading, Syangja and Palpa), viii) Teaching /training and research in sericulture in University etc. The milestone in sericulture development in Nepal is presented in Appendix -1. This phase well established preservation of silkworm parental lines and developed own double hybrid bi-voltine silkworm for distribution to seri-farmers.

Seri-industry plays a unique role in the socio-economic development of seri- farmers. Mulberry sericulture has a good potential and prospects in Nepal due to its labor intensive nature and suitable agro-climatic conditions. In the Nepalese context, nearly 45% women and children are inactive at rural areas, and therefore, sericulture is best suited to them (SDP, 1998; Thapa, 1998; Thapa and Karmacharya, 1998). Among 77 districts, 67 districts are climatically suitable for sericulture in Nepal (APROSC, 1999). Sericulture Development Section (SDS) has chosen 42 districts and categorized them into nine high priorities, twelve supportive priorities, and twenty-one low priority districts, respectively. Nepal can be also included among the top ten countries in fresh cocoon production with its increasing trend of sericulture activities and there is increasing demand of silk in the international market (Thapa and Mahadevappa, 1995).

3.2 National Sericulture Programs

Center for Industrial Entomology Development (CIED) is a mandated institution under [Ministry of Agriculture and Livestock Development \(MoALD\)](#) for the development of honeybee, mushroom, silkworm and other industrial entomology related crops and commodities. It was established to contribute the agriculture commercialization led economic development through the promotion of [policy](#) guideline, regulation and technical assistance of these crops and commodities. As the commodities under industrial entomology including honey bee silkworm and mushroom fall under the scope of CIED, it is also designed as the national focal office for the production of industrial entomology related crops and commodities. Sericulture Development Center, Khopasi, Kavrepalanchowk and Apiculture Development Center, Godawari, Lalitpur are the two farm Centers for Industrial Entomology Development (CIED).

The goal of CIED is to enhance the import substitution and export promotion of honey, mushroom, silk and other industrial entomology related crops and commodities through increased production and creating employment opportunities as well as to enhance the income of overall sectors in value chain through commercialization of these crops and commodities. The objectives of the CIED are:

- To develop and transfer technologies in order to enhance the production of quality honey, mushroom, silk and other products related with industrial entomology throughout the country.
- To generate employment and raise the living standard of farmers by developing self-sufficiency in honey, mushroom, silk and other products related with industrial entomology through import substitution and export promotion;
- To promote easy access to quality inputs for the production of honey, mushroom, silk and other products related with industrial entomology;
- To promote value addition and diversification of products related with industrial entomology; and
- To conserve and preserve bees and other pollinator and beneficial insects for food security.

The mandate of the CIED and SDC is presented in Box-1.

Box 1. Mandate under new structure of federalism

Centers for Industrial Entomology Development (CIED), Harihar bhawan

1. To work as a focal office of the country for the promotion of bees, silk, mushrooms and other products under Industrial insect development
2. To provide consultation to the Department of Agriculture on policy and program support and management aspects for the farms/ centers in the association structure related to Industrial insects.

3. Formulation, management and implementation of special production programs of national importance for bees, silk, mushrooms and other items.
4. For the overall development of products such as bees, silk, mushrooms, etc., to move forward according to the value chain based method, to facilitate the preparation and marketing of consumable products by increasing the capacity of the carriers of the value chain.
5. **Submitting** policy suggestions to the Department of Agriculture to identify, analyze and solve problems related to the development of bees, silk, mushrooms, etc.
6. Establish the relationship and coordination with Nepal Agricultural Research Council, University of Agriculture and Forestry, Nepal Science and Technology Academy and other national/international associations/organizations, maintaining the interrelationship of commercial insect development education-research-dissemination and arrange the latest technology promotion and transmission.
7. Arranging the production and distribution of specialist services and related broadcast materials at the national level on **commercial** insect related matters.
8. Collecting data of private and non-governmental organizations involved in commercial insect development and preparing and updating the national database.
9. Prepare drafts of policies (including silk and mushrooms), laws, rules, guidelines and procedures to promote commercial insect development and coordinate and take initiatives with relevant agencies for approval.
10. To prepare and update the quality and standards of production materials and products related to bees, silk and mushrooms.
11. In coordination with the state and local levels, identify resource centers and prepare a national balance sheet for ensuring the availability and supply of production materials related to bees, silk and mushrooms.
12. **Arranging** necessary arrangements for business registration and cancellation based on monitoring/evaluation of source centers.
13. To **create** the laws and regulations necessary for the implementation of the content provided in the Bee Promotion Policy 2073 and take the initiative to bring them into full implementation.

Sericulture Development Center (SDC), Khopasi

1. To protect and develop the mother source of various silkworm species.
2. To produce eggs of recommended silkworm species and distribute to various government farm centers, farmer groups and cooperatives.
3. To foster commercial insect development center in formulating national business policy and plan for the development and expansion of silkworm rearing.
4. To provide training to productive farmers and entrepreneurs for silkworm rearing, development and expansion using the latest technology.
5. Providing expert services on silk related matters.
6. To coordinate and cooperate with the nearest agricultural research center and knowledge center regarding the development and expansion of silkworm rearing technology.
7. Using land and other infrastructure and facilities to increase farm productivity and income.
8. To conduct small action-oriented research to solve the problems of related subjects.
9. Processing silk and producing yarn as well as developing the capacity of the private sector in that work.
10. Conduct demonstration of advanced technology related to silkworm rearing.
11. Acting as a national resource center for silkworm rearing, development and expansion.
12. Prepare a package of practice of latest technologies related to silk and promote and distribute them through ICT.
13. Facilitate the identification of silk and silk source centers, data collection and follow-up work.
14. To develop the technical manpower involved in the work related to silk at the union, state and local levels.
15. Projecting the annual demand and demand supply related to the demand and supply of seeds and eggs of silkworm and silkworm species.
16. To facilitate the operation of the program aimed at business groups and cooperatives involved in silkworm rearing.

Directorate of the Industrial Entomology heads the sericulture program at the department level and is responsible for sericulture policies to run the sericulture program through Sericulture Development Section, Khopasi (SDS) and other sub-centers in the country. The seri-offices,

command districts, working staffs and activities are presented in **Table 3** and trained human resources in sericulture **Table 4**.

Table 3. Government sericulture offices, working staffs, command districts and activities

Starting	Sericulture offices	Sericulture districts	Staffs (No)	Activities
1974/75	Sericulture Development Section, Khopasi, Kavre	Kavre, Sindhupalchok, Dolakha, Ramechhap, Kathmandu, Lalitpur	19	Parent stock development & conservation Technology development & standardize training Egg production & distribution Young worm rearing Pocket area development Cocoon marketing service Technical services/monitoring & supervisions
1995/96	Parent Stock Seed Cocoon Resource Center, Dhunibesi, Dhading	Dhading, Nuwakot	10	P1 stock development & preservation Technology development & standardization Pocket area development Cocoon marketing service Technical services/monitoring & supervisions
1995/96	Parent Stock Seed Cocoon Resource Center, Bandipur, Tanahun	Tanahun, Lamjung, Gorkha	10	P1 stock development & preservation Technology development & standardization Pocket area development Cocoon marketing service Technical services/monitoring & supervisions
1995/96	Sericulture Development Section, Pokhara, Kaski	Kaski, Parbat, Dang, Banke, Doti, Dadeldhura	9	P1 stock development & preservation Young worm rearing and distribution Technology development & standardization Pocket area development

				Cocoon marketing service Technical services/monitoring & supervisions
1984/85	Sericulture Development Program, Waling, Syngja	Syngja, Gulmi, Palpa, Arghakhachi	10	Young worm rearing and distribution Technology development & standardization Pocket area development Cocoon marketing service Technical services/monitoring & supervisions
1993/94	Mulberry Nursery Management Center, Bhandara, Chitwan	Chitwan, Makwanpur, Sarlahi, Mahottari, Sindhuli	12	Sub-tropical seri-technology development Winter seed development and production Mulberry nursery management & conservation Pocket area development Cocoon marketing service Technical services/monitoring & supervisions
1994/95	Silk Processing Center, Itahari, Sunsari	Jhapa, Morang, Sunsari, Saptari, Siraha, Udaipur	9	Young worm rearing and distribution Technology development & standardization Pocket area development Cocoon drying, processing & silk marketing Training on mulberry growing & silkworm rearing cocoon buying, reeling & silk marketing Technical services/monitoring & supervisions
1994/95	Sericulture Development Program, Dhankuta,	Dhankuta, Bhojpur, Ilam,	7	Young worm rearing and distribution Technology development & standardization Pocket area development

		Panchthar, Terathum		Cocoon marketing service Technical services/monitoring & supervisions
1997/98	Commercial Granaige Center Chitapol, Bhaktapur	Bhaktapur	7	Seed cocoon production Grainage/egg production & distribution The seri-farm Khopasi serves as a nucleus center for mulberry silkworm egg production & extension

Source: GC et al. (2015)

Table 4. Human resources trained in sericulture in Nepal

SN	Country	Trained human resource (No)
1	South Korea	39
2	India	27
3	Japan	10
4	China	7
5	France	2
	Total	85

Source: Compiled from various sources; 49 persons are still in government jobs (In addition, 7 persons received administrative training and 6 persons in bi-voltine silkworm rearing from India).

Distribution of silkworm eggs and sapling of mulberry at subsidized rate is practiced by sericulture development program using different types of extension, research and teaching methods to motivate the concerned farmers in 42 districts. Supply of silkworm eggs at subsidized rate, providing training and technical guidance to the farmers are efforts carried by SDC. Distributing eggs for Rs 50 per box and mulberry Rs. 2 per sapling, providing Rs 15,000 as support to silkworm rearing house are some financial supports provided by SDC. The farmers are free to sell their cocoon to the SDC or any private sector. Government has fixed cocoon price based on the shell ratio (Table 5).

Table 5. Price of different grades of mulberry silkworm cocoons

Cocoon grade	Shell ratio (%)	Price in 2015 (Rs./kg)
Damaged and under grade	<18	300
C	18-20	325
B	21-22	350
A	>22	375

Source: Tiwari (2020)

The approved budgets of Industrial Entomology Development, Harijarbhawan for the last four years are presented in Table 6. It clearly shows that except in 1976/77, budget in sericulture development activities was just 3.13%, 21.40% and 7.30%, respectively of the total budget allocated in fiscal year 2077/78, 2078/79 and 2079/80, while, approved program budget of Sericulture Development Center, Khopasi shows the decreasing trend, viz. 68.63%, 55.44% and 35.90% for the same period (Table 7).

Table 6. Approved program budget of Centre for Industrial Entomology Development (2076/77 to 2079/80)

SN	Budget allocation title	Rs in lakh			
		2076/77	2077/78	2078/79	2079/80
1	Salary, Allowances, Tea, Office Accessories, Utilities, Maintenance and Monitoring Budget	103.96	153.27	137.44	171.60
2	Sericulture Development Activities	580.86	7.00	60.25	24.24
3	Other Technical Programs	109.39	63.13	83.81	136.23
	Total	794.21	223.40	281.50	332.07

Table 7. Approved program budget of Sericulture Development Center, Khopasi (2076/77 to 2079/80)

			Rs in lakh		
SN	Budget allocation title	2076/77	2077/78	2078/79	2079/80
1	Salary, Allowances, Tea, Office Accessories, Utilities, Maintenance and Monitoring Budget	101.69	101.88	168.63	142.77
2	Sericulture Development Activities	103.22	297.56	227.94	127.77
3	Honey Bee Rearing Training	-	16.61	-	-
3	Other Capital Improvement Expenses	111.62	17.55	14.6	85.34
	Total	316.53	433.6	411.17	355.88

In the past, seri-development/production services were provided by the government to seri-farmers, which are listed in the Box 2. Similarly, subsidy schemes in sericulture in India are given in Table 8-12.

Box 2. Seri-production services provided to seri-farmers by the Government of Nepal

<p>GoN- Directorate of Industrial Entomology heads the sericulture program at the department level and runs the sericulture program through Sericulture Development Section (SDS), Khopasi and other sub-centers in the country. Support services/subsidies are provided by the Government to Seri-farmers:</p> <ul style="list-style-type: none"> • Silkworm seed: Earlier phase @NRs 20/box to NRs 50/box (20,000 eggs/box) at present. • CRC silkworm: Earlier phase @NRs 45/box to @NRs 100/box young worm (up to 3rd instar) at present. • Mulberry sapling: Earlier phase @NRs. 0.35-0.50/sapling to @NRs 2.00/mulberry sapling at present. • Cocoon purchase: By GoN in earlier phase @ Rs150/kg good cocoons to @Rs 375/kg A grade at present. • Disinfectant distribution: Free of cost disinfection of rearing house, equipment and silkworm rearing. • Mulberry orchard: NRs 4000 to women seri-farmers for buying seri-equipment (requirement: 2 Ropani mulberry garden). • Rearing shed construction: 25% of the total cost not exceeding NRs 12,500 (Rs 3000/ rearing house). • Charkha distribution: NRs 10,000 for establishment of Charkha reeling.

- **Nursery:** NRs 5,000 per new nursery (NRs 3,000 for management of old).
- **Orchard management:** NRs 5000/ ha for ideal orchard management

Source: DoIED (2010) and modified based on the recent survey and review studies

Tables 8-12 show subsidy scheme of Department of Sericulture, Gov. of Tamilnadu, India.

Table 8. Assistance for planting high yielding mulberry variety

Subsidy	75%
Description	Subsidy of Rs.10,500 per acre of unit cost Rs.14,000
Eligibility	<ol style="list-style-type: none"> 1. Should have good irrigation facility 2. Should have planted high yielding mulberry variety (V1, MR2, S series, G4 etc.) 3. Should have planted 5000 saplings/acre 4. Should have adopted paired row system of plantation [(5+3) x 2] 5. Plantation extent of minimum 1.00 acre and maximum 5.00 acres

Source: <https://tnsericulture.tn.gov.in/schemes>

Table 9. Distribution of silkworm rearing appliances & farm equipment

Description	Distribution of silkworm rearing appliances & farm equipment for a value of Rs.52,500
Eligibility	<ol style="list-style-type: none"> 1. Plantation extent – Minimum of 1.00 acres 2. Should have planted 5000 saplings/acre 3. Should have adopted paired row system of plantation [(5+3) x 2] 4. Shed size should be above 1000 square feet 5. Should conduct minimum of 4 to 5 silkworm crops per year

Source: <https://tnsericulture.tn.gov.in/schemes>

Table 10. Supply of silkworm rearing appliances and improved farm equipment to seri-farmers

Subsidy	30%
Description	Subsidy of Rs.1,20,000 of unit cost Rs.4,00,000
Eligibility	<ol style="list-style-type: none"> 1. Should conduct minimum 4 to 5 silkworm crops per year. 2. Should have erected rearing rack worth of Rs.17,500

Source: <https://tnsericulture.tn.gov.in/schemes>

Table 11. Distribution of cash awards to best seri-farmers at state and district level

Subsidy	Criteria for cash awards
Description	Best sericulture farmers' at State and district level will be provided cash awards
Eligibility	<ol style="list-style-type: none"> 1. Plantation extent - Minimum of 1.00 acre 2. Should have reared more number of Silkworm crops and obtained good cocoon yield per acre in an assessment year. 3. Should have transacted their cocoons in the Government Cocoon Markets of the State

Source: <https://tnsericulture.tn.gov.in/schemes>

Table 12. Distribution of cash awards to best silk reeler at state level

Subsidy	Criteria for cash awards
Description	Best silk reelers (MRM & ARM) at State level will be provided cash awards
Eligibility	<ol style="list-style-type: none"> 1. Should have consumed cocoons to the capacity of the installed basins and produced quality raw silk 2. Should have procured cocoons from the Government Cocoon Markets of the State and transacted raw

Source: <https://tnsericulture.tn.gov.in/schemes>

3.3 Sericulture Feasibility

Sericulture and silk production has spread over 60 countries in the world. It has become an important agro-based industry in many countries, such as Brazil, China, France, India, Italy, Japan, Korea and Russia. China and India are the two main producers of raw silk accounting for more than 85% of the world's annual production.

The clothing industry, or mostly the silk industry, is one of the strategic economic activities. Customers in Italy and Germany prefer natural fibers because of its distinctive qualities such as breathability, elasticity, and absorbency. May fair Silk, London-based significant silk product company, announced the official launch of elegant 100% mulberry silk bed linen and sleep accessories collection. This collection provides customers with excellent resistance against mold, mildew, and dust mites, enabling them to maintain strict levels of cleanliness and hygiene (<https://www.researchdive.com/7698/silk-market>).

The silk production slightly declined due to the disruptions caused by the Covid-19 pandemic during last few years. However, all the times the demand for superior quality bi-voltine silk is increasing for domestic consumption as well as value added silk products for the export market. Quality standards for seed cocoons, commercial eggs, reeling cocoons and raw cocoon is of utmost importance to build quality at all stages of sericulture to compete in the market. In India, the Ministry of Textiles Government of India and Departments of Sericulture in various states provide technical and financial assistance for enhancing the bi-voltine silk production (Sharma, 2022). The Government of India allocated IRs 2161.68 crores for three years (2017-2020) to its **Central Sector Scheme Silk Samagra**’ for the development of sericulture. Incentive are given by the State Government and also by Central Silk Board on raw silk and subsidies on all CSS scheme in the ratio of 80:10:10.

In fact, there are multifold advantages and any country with suitable environment can benefit from sericulture. The highly beneficial aspects include: i) high employment potential, ii) providing vibrancy to rural economy, iii). low gestation period, iv) high returns, v) good national/international market, vi) ideal program for the weaker section of the society, vii) eco-friendly rural industry, viii) professional training and expertise, ix) women-friendly occupation, and x) rural community development.

3.3.1 *Seri-Farmers Status*

Survey in the past showed that among the old-seri-farmers, over 30% had food security less than a year (< 10 months), of which more than 1/3rd (35.79%) did not have enough food even for 6 months and of the total 2/3rd of the selected households were self-sufficient in food more than a year (Table 13). While of the total 1039 new seri-farmers, over 45% had food security for less than a year (< 10 months), of which more than 1/3rd did not have enough food even for 6 months. Only less than 15 percent of the selected households were self-sufficient in food more than a year. Hence, majority of the farmers involved in sericulture are rural poor farmers.

Table 13. Seri-farmers’ self-sufficiency from their earning

Seri-farmer	< 6 months	6-10 months	1-year	> 1-years	Total
Old Seri-farmer	167 (8.17)	451 (22.08)	874 (42.78)	551 (26.97)	2043 (100)
New Seri-farmer	141 (13.57)	331 (31.86)	416 (40.04)	151(14.53)	1039 (100)

Source: Field Survey (2003), Figure in parenthesis indicates percentage.

3.3.2 *Employment Opportunity*

All family members, irrespective of gender and age, get employment opportunity. It is estimated that every hectare of mulberry plants provides employment to about 16 persons. Inclusive of all process, sericulture has good potential to generate employment up to 11 persons of every kg of

raw silk produced (Bukhari et al., 2019). In India, mulberry is being cultivated in about 0.192 million hectares and nearly 6 million people from around 800,000 farm families are engaged in sericulture activities. In this sense, it can be considered a home-based industry.

Sericulture supports with regular income to the community without any bias of caste, creed, gender, or religion. Seri- farmers, rich and poor, earn the same income from it. Silkworm rearing itself generates 1.5 and 4.5 person-years of employment per year per hectare of mulberry garden, under rain-fed and irrigated conditions, respectively. Activity-wise, employment generation in sericulture (per ha) is shown in Table 14.

Table 14. Activity-wise employment generation in mulberry sericulture (per ha)

Particulars	Employment generation	
	Man-days	Man-years
A. Mulberry cultivation and silkworm rearing		
a. Mulberry cultivation	585	
b. Leaf / shoot harvesting	320	
c. Silkworm rearing	350	
Sub-total	1255	5.020
B. Reeling of silk cocoons		
@ 300 man-days per 1000 kg of reeling cocoons (@ 8.0 renditta; 760 kg cocoon / ha.; 95 kg raw silk/ha)	2250	9.120
Total (A + B)	3535	14.140
C. Twisting		
@ 220 g of silk per man-days	432	1.727
D. Weaving		
Handloom @ 0.13 kg per man-days	438	1.752
<u>Power loom @ 0.3125 kg per man-days</u>	122	0.486
Sub-total (Weaving)	560	2.238
E. Printing and Dyeing		
@ 40 man-days for 40 kg of raw silk	95	0.380

F. Finishing		
@ 751 man-days for 40 kg of raw silk	1784	7.135
G. Silk waste processing		
@ 18.775 man-days per kg of raw silk	26	0.104
Total (C to G)	2896	11.58
Grand Total	6431	26

Source: Central Silk Board, Bangalore, India.

3.3.3 Women involvement

According to a legend, the discovery of the silkworm and cocoon was by a beautiful Chinese princess. Sericulture is an occupation by women and for women because women form > 60% of the workforce and 80% of silk is consumed by them. Vital role of women has been recognized in all farm-related activities—ranging from land preparation to cocoon marketing. As women have crucial role in the activities of sericulture, it equally and even more preferentially creates opportunities (Table 15). Women often take part in mulberry planting, weeding, manuring, irrigating, leaf picking, leaf transporting and storage. Women contribute about 50% and 60% of labor to mulberry cultivation and silkworm rearing, respectively (Gate, 2001; Thamizoli, 2001; Vijayalakshmi, 2002; Singh, 2006; Panda, 2007; Goyal, 2007; Srinath, 2008; Kasi, 2011). About 51% of women are assisting men in this lucrative industry to produce the - queen of textiles (Kannan, 1987). Usha Rani (2007) in one of her studies showed that the establishment of one-acre mulberry garden for rearing 300 dfls (disease free layings) of silkworms in two months generates 96.36 man-days of employment, of which 72.70 percent are women. In India, more than 60 lakh persons are employed as full time workers in the production chain, of which 35-40 lakh are women.

Table 15. Involvement of women in different sericulture activities

SN	Activity	Sericulture families	Involvement (%)
1	Silkworm seed production	82	20.46
2	Mulberry cultivation	422	49.55
3	Silkworm rearing	422	49.67
4	Silk reeling	392	48.81
5	Silk spinning	200	80.00
6	Silk throwing (twisting)	96	56.34

7	Silk weaving	267	49.02
8	Dyeing–Printing of silk yarn and fabrics	71	41.00
9	Silk bye-products	50	65.00
10	Silk and Milk production	300	75.00
Total /Overall		2002	53.45

Source: CSB, India, 2019

Almost all home-based jobs are done by women, including silkworm rearing. Various studies have brought out the vital role of women playing in all farm-related activities from land preparation to cocoon marketing, while they are out of scene in decision making in the community (Nathan and Kelkar, 1997; Rahman and Routray, 1998; Joshi, 2000; Barman, 2001; Bose et al., 2009; Satyavathi, Bharadwaj and Brahmanand, 2010). Barman (2001) argued that social and cultural constraints lead to less mobility of women and less involvement in income-earning activities in far-off places. It has been worked out that about 2,575 women work days comprising about 60% are generated per annum out of a total of about 4,225 work days in all the activities in sericulture per hectare of irrigated mulberry.

3.3.4 Import Substitution

Nepal imports silk materials every year viz. silk cocoons, silk yarns and silk fabrics from different countries. In the recent year (mid-July 2021 to mid-July 2022) cocoons, silk yarns and silk fabrics were imported worth of Rs. 843989 thousand and earned revenue of Rs. 147053 thousand as shown in Table 16. Further recent estimate could be higher than 2021 or 2022. Mulberry cultivation, silkworm rearing and silk processing industry can substitute the import from other countries and help to some extent balance the trade deficit.

Table 16. Import of silk materials in Nepal as of mid-July 2021 to mid-July 2022

Items	Quantity	Value (NRs ‘000)	Revenue (NRs ‘000)
Cocoon	20 kg	49	6
Silk	296731.1 kg	768400	139603
Fabrics	173217 m ²	75540	7444
Total		843989	147053

Source: Trade and Promotion Center (2022).

3.3.5 NGOs/INGOs in Sericulture

Realizing the important role of non-government organizations in social mobilization, community development and income generating activity promotion, GoN initiated sericulture promotion program through non-governmental organization with an objective of expanding mulberry cultivation and providing technical services at the local level for increasing cocoon production (Thapa, 2003). For the past more than three decades, non-governmental organizations have also taken initiatives in this sector and significant achievements have been realized (Thapa, 1992; Gadai et al., 1995; Thapa, 1998; Thapa, 2003). The sericulture teaching and research work was started in 1984 to provide technical knowhow in sericulture to the students at IAAS (Thapa, 1984). The Luthern World Federation (LWF) focused its activities in the rural community development undertaking (sericulture) as an income generating activity of the rural people in the eastern part of Nepal and credit goes to LWS for sericulture development in Nepal. The first feasibility study was by LWS in Ilam in 1984. In the same year, the WDP in Ilam was jointly taken by LWS and WDA and since then LWS has been using sericulture as an income and employment generating activity in its women development programs. This covered > 1000 women in sericulture with an earning worth of US\$3600 in 1993. Silk Association of Nepal (SAN) devoted in sericulture since its establishment in 1990s. Other organizations working during the SRDP project period and main organizations with sericulture as income generation activities include: HOPE, CSDEI, CDS, JMC, SOARSE, Action Aid, CECI, LEADERS, Center for Poverty Alleviation, Surya Silk, Care Nepal, CERES Nepal, SPD, SWMP, Plan International, SCF/US, CHAUTARI, SARSD including many farmers/women Association and Cooperatives (Thapa, 2001).

3.3.6 Socio-Economic Aspect

Farmers cultivate different crops for their food and living. In the past, among seri-farmers major share of their earning was from sericulture followed by other cereal crops like paddy, wheat and maize as evidenced in Madi, Chitwan (Table 17). Table 18 shows the cost benefit analysis of sericulture and other competing crops in India (Dandin, 2005). It was reported that the ratio of input to output according to the statistics office of the local government were: sericulture, 1:1.83, food production, 1:1.26; sugarcane, 1:1.32; tobacco, 1:0.95; pig raising, 1:1.59. The comparative statistics shows the strength of China in the areas of seed production and distribution system, higher unit area productivity and quality support for reducing the costs of production. China is better in terms of quality cocoon production as compared to its best competitor India (Table 19).

It is obvious that the benefit from sericulture is very promising. From the study, it is also clear that sericulture is equally competitive or even more profitable and ecofriendly than other activities in the present context of climate change and global warming.

Table 17. Household income from different farm activities in Madi, Chitwan

SN	Crop	Income (Rs)	Percent
1.	Cocoon	342162	36.5
2.	Paddy	319664	34.1
3.	Wheat	133400	14.2
4.	Maize	73970	7.9
5.	Mustard	21760	2.3
	Total	937430	100

Source: Field survey (1998)

Table 18. Cost: Benefit analysis of mulberry sericulture and other competing crops

Item	Mulberry sericulture	Sugarcane	Turmeric
Total input costs	48,659	30,575	29,610
Gross returns	96,132	60,200	55,317
Net returns	47,476	29,625	25,707
CB ratio	1:1.98	1:1.97	1:1.02
Crop period	1 year	1 year	4-5 months

Source: Dandin (2005).

Table 19. Comparative mulberry sericulture statistics- China vis-à-vis India

Parameter	China*	India
Area under mulberry (lak ha)	7.36	1.79
Leaf yield (mt/ha/year)	25-30	30-50
Races reared	All bivoltine	Mostly cross breeds
Egg production (crore dfls)	75.962	25.65
Supply system	Majority Chawki reared	Majority supplied as eggs
Time of supply	Batch-wise	Throughout the year
Number of crops/year	2-3 Temperate & 6-8 Tropical	5-6; 8-12 (Split plot system)

Dfls brushed /ha/year	1050	1492
Cocoon yield (kg /100 dfls) (2 boxes)	75.92	51.0
Leaf cocoon ratio (kg)	16-18	20-22
Cocoon yield (kg /ha)	736.89	698.0
Cocoon weight (g)	1.9-2.0	1.6-1.8
Cocoon shell percentage (%)	21-23	CB: 17-19; BV: 20-22
Filament length (m)	>1000	<1000
Renditta	6.4	8.2 (6.9 for bivoltine)
Grade of silk	A – 4A	Un-graded to A grade
Cost of cocoon production (Rs/kg)	40-45	65-70
Prevailing cocoon price (Rs)	85-90	90-120
Raw silk production (kg/ha/year)	114.87	85.02
Average crop loss/year (%)	3-5	10-15
Demand and supply position	90% Export	Self consumption 30 (%) deficit
Raw silk produced (mt/year)	86500	15445

Source: *Li Long and Hu Zhuozhong (Indian Silk, May 2006).

4. SERICULTURE TECHNOLOGY

The production and productivity of cocoon and fabrication depends on many factors (sericulture as a whole). For the success of sericulture, mulberry and silkworm variety crucial, such as mulberry varieties, silkworm breeds, climate and rearing environment, skilled technicians, post-cocoon processing and fabrication; all of them are governed by the favorable national policy.

4.1 Mulberry Varieties

The domestication of mulberry have started several thousands of years ago as a requirement for silkworm rearing (FAO, 1990). In the past, mulberry trees have solely been planted for silkworm rearing but in recent years, the roles of mulberry trees in the prevention and control of desertification, water and soil conservation, saline-land management and returning the grain plots

to forestry have been identified. Meanwhile, multi-usage of mulberry as forage for livestock, for fruit and tea preparation has been gradually explored (Jian et al., 2012). Leaf quality differs among mulberry varieties, which is responsible for silkworm rearing performances (Bongale et al., 1997). Mulberry productivity (hygienic, palatable, digestible to silkworm and more quality in production) is directly related with the silkworm productivity, which is the most important aspects of sericulture business. For example, about 15,000 to 25000 kg of mulberry leaf per year from one acre can be harvested depending upon varieties and method of cultivation. The amount of leaf required for rearing 100 dfls of the popular crossbreed PM x NB4D2 is 1000 kg. Therefore, it is necessary to identify, improve and cultivate the superior mulberry varieties to increase silk production (Vijayan et al., 2012).

Most of the seri-farmers have planted Kanva-2 variety of mulberry for silkworm rearing, and also many varieties like Mysore Local, Khopasi-1, Khopasi-3, Chinese Hybrid, Kosen, Lun-40, Khoichingo, Ilchire, Kimmochi, Syangja Local, Samalbunge, Bhote, Ichinose etc. are also in practice for rearing silkworms in Nepal (SRDP, 1998). Mulberry germplasms maintained in Bhandara is listed in Table 20 Gautam (2006) reported larval weight of 4.613 gm and 3.823 gm, reared on Kanva-2 and Khopasi-1 mulberry varieties during autumn rearing in Khopasi. In Mysore (India), The Central Sericulture Research and Training Institute have maintained 223 mulberry cultivars: 78 indigenous; 44 exotic; 21 unknown and 101 elite hybrids (Sastry, 1984).

Table 20. Mulberry genotypes maintained at Mulberry Nursery Management Center, Bhandara

Kanva-2	T.g	Bhote
Kalingpung	Dd	Chinese
Maysur local	C.b.n.b-3	Roman (France)
S.k.b	Thiland b-3	Maring-2(France)
C.s.n.b-2	Thiland-1	Kokuse-20(France)
Aapkhan	Khopasi-1	Sevenke. M. g.
Nr-2	Khopasi-3	Mereri (France)
R.f.s-135	Khopasi-4	Bhandara-2
S-54	Khopasi-6	B-125
S-36	Khopasi-10	B-122
S-34	Khopasi-12	B-124
S-13	Khopasi-14	L-40
	Khopasi-15	

Source: Mulberry Nursery Management Center, Bhandara (2020)

4.2 Silkworm Varieties

The races of mulberry silk worm may be identified on the basis of geographical distribution as Japanese, Chinese, European or Indian origin; or as Uni-, Bi- or Multivoltine depending upon the number of generations produced in a year under natural conditions; or as Tri-, Tetra- and Penta-moulters according to the number of moults that occur during larval growth; or as pure strain and hybrid variety according to genetic recombination. The parental lines maintained in SDS, Khopasi are presented in Tables 21-23.

Table 21. Stock of bi-voltine Chinese silkworm pure line, sources, years of introduction with major larval and cocoon characteristics at SDC, Khopasi (as of 2010 AD)

SN	Race	Source of country	Entry year	Larval character		Cocoon character	
				Marking instar	5 th Color	Appearance	Color
1	C ₁	Japan	1998	D ^o	Aw	Long oval	Aw ⁺
2	C ₂	Japan	1998	D ^o	Aw	Short oval	Aw
3	C ₃	Japan	2000	D ^o	Aw	Long oval	AW
4	N ₄	India	1990	D ^o	Aw	Pointed Long oval	Sw
5	N ₅	India	1990	D ^o	Aw	Ex. Long oval	Bw
6	N ₁₁₀	Japan	1999	D ^{+/-}	Cw	Long oval	Aw
7	N ₁₁₁	Japan	1999	D ^o	Aw	Long oval	Aw
8	N ₁₁₂	Japan	1999	D ^{o/+}	Cw	Long round oval	Aw
9	N ₂₀₁	RoK	1995	SL	Cw	Short oval	Aw

Table 22. Stock of bi-voltine Japanese silkworm pure line, sources, years of introduction with major larval and cocoon characteristics at SDC, Khopasi (as of 2010 AD)

SN	Race	Source of country	Entry year	Larval character		Cocoon character	
				Marking instar	5 th Color	Appearance	Color
1	J ₁	Japan	1998	D ⁺⁺	Cw	Medium peanut	Bw
2	J ₂	Japan	1998	D ⁺	Cw	Medium peanut	Bw

3	J ₃	Japan	2000	D ⁺	Cw	Long peanut	Bw
4	N ₆	India	1990	D ^{+Dark}	Cw	Peanut (D)	Bw
5	N ₇	India	1990	D ^{+Normal}	W	Peanut (R)	Bw
6	N ₈	Pakistan	1990	D ⁺	DB	Peanut <N6	Bw
7	N ₉	Pakistan	1990	D ⁰	W	Ex long oval	Bw
8	N ₁₀₇	Japan	1999	D ^{+++ (Thorax)}	Cw	Ex long peanut	Bw
9	N ₁₀₈	Japan	1999	D ⁺⁺⁺	Dbw	Ex long peanut	Bw
10	N ₁₀₉	Japan	1999	D ⁺	Cw	Ex long peanut	Aw
11	N ₁₁₃	Japan	2002	D ⁺⁺	Cw	Short peanut	Bw
12	N ₁₁₄	Japan	2002	D [±]	Bw	Long peanut	Bw
13	N ₂₀₂	RoK	1995	D ⁺⁺	Bw	Short peanut	Aw

Table 23. Silkworm stock selection from commercial bi-voltine (1-8) and multi-voltine pureline (9, 10 & 11) sources, years of introduction with major larval and cocoon characteristics at SDC, Khopasi (as of 2010 AD)

S N	Race	Source of country	Entry year	Larval character			Cocoon character	
				Marking instar	5 th	Color	Appearance	Color
1	K-101 (P)	Japan	1998	D ⁺⁺		Dw	Normal Point	Bw
2	K-101 (O)	Japan	1998	D ^{-/+ (50:50)}		AW	Point Oval Mix	Bw
3	K-103 (P)	Japan	1998	D ⁺⁺		Cw	Normal Point	Bw
4	K-103 (O)	Japan	1998	D ^{-/+ (50:50)}		Bw	Oval round	Bw
5	K-104 (P)	Japan	1998	D ^{-/+ (50:50)}		Bw	Oval round	Bw
6	K-104 (O)	Japan	1998	D ⁺⁺		Cw	Normal Point	Bw
7	K(O)	RoK	1995	D ^{-/+ (80:20)}		Bw	Oval Point mix	Bw

8	K _(P)	RoK	1995	D ⁺⁺	Cw	Normal Point	Bw
9	Khopasi- 1	BD *	1990	D ⁺⁺	Cw	Deep Point	Yellow
10	Nepal-1	BD	1990	D ^o	Aw	Short oval	Yellow
11	LMV	Lao PDR**	2008	D ^o		Pointed oval	White

* Not in existence since 2019, Not in existence since 2021**

The performance of silkworm depends on their varieties, pure and hybrid strains during different rearing seasons. At present, silkworm egg for Nepalese seri-farmers are produced and supplied by Sericulture Development Section, Khopasi, Kavre. The center has maintained the parental stocks in P₃, P₂, P₁ levels from which hybrid crosses are produced and distributed among seri-farmers. The promoted bi-voltine variety is a cross of J₁₂ and C₁₂ in Nepal, commonly known as Kinsusowa. This variety is reared by seri-farmers throughout the seri-pocket areas (SDS, 1999).

4.3 Rearing Technology

Appropriate Seri-technology generation and dissemination to technicians and Seri-farmers can boost up sericulture industry (Thapa, 2016). Rearing environment is critical; temperature and humidity management during silkworm rearing seasons has resulted in an immense difficulty in farmers' field level and Seri-farmers have to bear huge loss due to frequent incidence of many diseases. The ideal temperature for bi-voltine mulberry silkworm rearing 1st, 2nd, 3rd, 4th and 5th instars larvae are 28^oC, 27^oC, 26^oC, 25^oC and 24^oC, respectively and relative humidity of 85%, 80%, 75%, 70% and 65%, respectively (Aruga, 1994), while the standard temperature and relative humidity during molting is maintained 24^oC and 65-70%, respectively (Lee and Thapa 1999). For better success, CRC is necessary in farmers' community clusters for young silkworm rearing and distribution. Figure 1 shows the CRC rearing process for healthy larva production (Narayanaswamy et al., 2018). Due to R&D intervention the raw silk productivity increased in India from 87.84 kg/ha (2007/08) to 90.90 kg/ha (2011/12), Renditta (Number of kg of cocoons required to produce 1 kg silk) reduced from 8.13 (2007-08) to 7.66 (2011-12) (Naik, 2017).

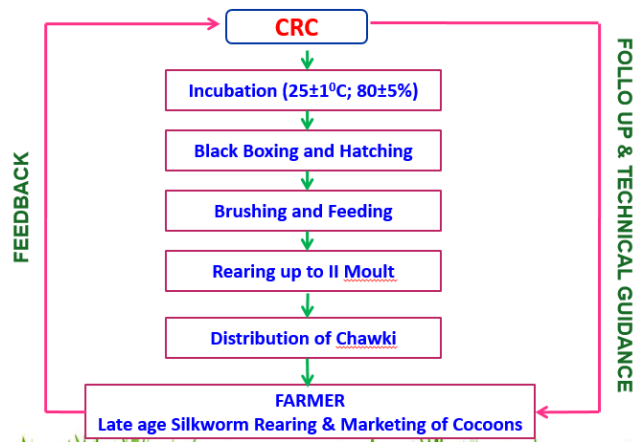


Figure 1. CRC rearing process for healthy worm production

The purpose of small worm rearing is to grow quality silkworms under micro-climate with disease free environment in order to achieve: i) Robust and healthy growth of silkworms, ii) Reduce the cost of production and silkworm rearing duration, iii) Improve the cocoon quality and productivity, and iv) Finally, production of quality cocoons. Benefits derived from CRC rearing of small worm are as follows.

- Proper egg incubation and uniform hatching
- Raising of robust and disease free small silkworms
- Prevention of crop loss and stabilized crop production (92-95%).
- Increase in cocoon yield and quality
- Higher returns (23.00 to 41.56%)
- Synchronized silkworm crop production
- Distribution of labor for other agri-related activities.
- Reverse migration
- Replacement of less remunerative crops
- Improved living standards

Silkworm eggs are incubated by providing standard temperature, relative humidity and light to ascertain economic hatching followed by robust larval growth and quality cocoon production (Lee, 1998). The silkworms can thrive with the temperature range 15-40⁰C for different instars. The early instar larvae are resistant to high temperature. This high temperature is especially beneficial in improving survival rate and cocoon characters.

Grown up worms are reared by farmers in their rearing house. The type of rearing house and micro environment have direct influence on growth and cocoon yield of mulberry silkworm. It has been observed an ideal rearing house with basic requirements, like good site, raised platform, high roof, false ceiling for rearing house construction, sufficient rearing space with mulberry leaf storage, use of geothermal ventilation etc. for getting good cocoon yield and income.

4.4 Pest Management

Insect pests are common in sericulture ecosystems and they are detrimental to the health and productivity of mulberry and in turn silkworm too. The insecticides applied for the control of mulberry pests have greater impact on silkworm. The pesticide Dichlorvos 76 EC commonly recommended for the management of mulberry insect pest, like leaf folder. While, mulberry silkworm, *B. mori* L. is highly susceptible to insecticides and its production is reduced by more than 30% annually due to insecticide poisoning. Therefore, it is necessary to look for other safer alternatives. Studies showed that among the eight insecticides tested, lambda cyhalothrin and emamectin benzoate were highly toxic to silkworms with 100% mortality even after 30 DAS. However, application of Chlorofenayl (1.5 ml/liter) recorded less mortality (12.09%) at 10 days after spray. Similarly, Azadirachtin and Novaluron (10.00% & 9.67%, respectively) at 25 DAS. Whereas, the insecticides Profenofos and fipronil at 30 DAS recorded less mortality rate of 11.00 and 10.67%, respectively, which were at par with that of standard check and untreated control. Similar trends were observed with respect to moulting duration (h), instar duration (h) and cocoon yield (g/100cocoon) of silkworms. The findings clearly indicates use of safer pesticides following appropriate dose and waiting period to be less toxic to silkworm rearing (Sunil Kumar et al., 2019).

4.5 Post-Cocoon Activities

Traditionally, sericulture is meant as the agricultural activity of silk production, from mulberry (*Morus* sp.) cultivation to silkworm (*B. mori*) rearing. It is not limited to production of cocoon only. What obtained after post cocoon activities is silk the Queen of Textiles as a mystical natural fiber of desire and passionate fashion with the lifeline attraction of millions of people. Hence, it is a fairly organized activity right from egg production to weaving and silk product marketing, i.e. multi-disciplined agro- industry, which covers growing of mulberry, production of egg laying, rearing of silkworms for cocoons, marketing and reeling of cocoons for value added products such as processing and weaving of the silk yarn (Rattan and Chauhan, 2020). It interlinks both agrarian and silk based industrial economy competing in the national and international markets.

4.6 Extension and Technology Support

Technology generation of sericulture is by the researchers and dissemination towards the target groups is through the extension workers. Thus, the role of sericulture researchers and extension personnel include testing and evaluation of mulberry and silkworm genetic materials, demonstration of newly recommended technology, selection and adoption of village for survey, training and technology transfer with a view to introduce the best result findings of research to the seri-farmers and silk industries.

In China, one of the popular and successful system is seri-fish farming. This system demonstrates a perfect ecological cycle of nutrients: recycling of wastes through mulberry cultivation, mulberry leaves harvested for silkworm, silkworm feces used to feed fishes, and pond sludge dredged to

fertilize mulberry trees (China, 2017). It was praised by UNESCO (the United Nations Educational, Scientific and Cultural Organization) as “the rare scenic spots in the world and a virtuous circular model”. The system illustrates well the traditional rural life in China “men-farming and women-weaving” and embodies rich sericulture and fishery cultures.

In India, recently Digital tools are being offered by a Bangalore-based agri-tech business to integrate the entire silk industry supply chain, from assisting sericulture farmers to achieve better pricing for their produce to ensuring the quality of cocoons and yarn to reelers, weavers, and consumers. The founder reports that more than 12,000 sericulture farmers utilize and they claim that those farmers who using the service are earning 20-40% greater prices of cocoons. According to CEO, Mayank Tiwari, the company’s new goal is to “streamline the unorganized silk business.’ This application allows silk industry participants to buy and sell their products directly. It has spread in China and many other countries like, Russia, Japan, Korea, Vietnam, Romania, Albania, Afghanistan, Libya, Africa and playing a positive role for the sustainable development.

4.7 Global Warming Effect

In the present context of climate change, the global surface temperature is likely to rise a further 0.3 to 1.7°C (0.5 to 3.1°F) for their lowest emission scenario using stringent mitigation and 2.6 to 4.8°C (4.7 to 8.6°F) for their highest emission (Patil and Walunjkar, 2013). Sericulture can be the alternative strategy for its mitigation as mulberry trees are good carbon sink plants. It is estimated that 1 ha mulberry trees is able to absorb about 62.43 mt of CO₂ (equivalent to 2.025 tons of carbon) and release 45.960 mt of oxygen each year (Jian et al., 2012). In addition, mulberry leaves have high endurance and certain absorption to air pollutants, such as chlorine, hydrogen fluoride and sulfur dioxide, and one ha mulberry forest absorbs 200 liter sulfur dioxide gas each day (Lu and Jiang, 2003).

4.8 Farmers/Institutional Problems

According to Thapa (2016), various problems and constraints realized by farmers and technicians, which need due considerations at farmers’ field and organizational levels are listed in Table 24.

Table 24. Problems/Constraints for sericulture development in Nepal

SN	Problems/Constraints at the Institutional Level	Problems/Constraints at the Farmer's Level
1.	Inadequate facilities for mulberry germplasm collection and maintenance	1. Delay in cocoon purchase by the concern agencies
2.	Inadequate facilities for silkworm germplasm collection and maintenance	2. Lack of adequate knowledge in pest control measures in field and rearing room
3.	Inadequate facility for P1 seed production and hybrid silkworm egg production	3. Lack of awareness among farmers about importance of sericulture
4.	Inadequate facility for P3 and P2 maintenance and multiplication	4. Lack of cocoon drying facility with Farmer's groups
5.	Inadequate transport facilities	5. Lack of cocoon marketing facilities
6.	Lack of adequate cocoon reeling / silk twisting facilities	6. Lack of CRC facilities and mulberry garden for rearing young worms
7.	Lack of incentive or reward for good works	7. Lack of credit facilities
8.	Lack of physical facilities for staff and technicians	8. Lack of district level quality nurseries of mulberry varieties
9.	Lack of post cocoon activities	9. Lack of separate rearing house
10.	Lack of research and development institute	10. Lack of sericulture national policy
11.	Lack of separate budget allocation for sericulture development	11. Lack of suitable variety of mulberry and silkworm races
12.	Lack of trained higher and mid level technicians	12. Lack of supervision by technical staff during silkworm rearing
13.	Lack of women working force to teach and train women farmers	13. Lack of egg and cocoon transport facilities with farmer's groups
14.	Poor facilities for silkworm rearing materials, disinfectants etc	14. Shortage of sericulture development inputs (saplings, eggs, disinfectants) in time
15.	Problems of retention of trained serimanpower in the same discipline	15. Shortage of training facilities to serifarmers and seri-groups
16.	Shortage of farm level technicians	16. Unsatisfactory hatching of silkworm eggs

Source: Compiled from field survey and different reports (Thapa, 2016)

5. SERI- INDUSTRY AND VALUE CHAIN ANALYSIS

Adoption of sericulture as an alternative to agriculture is possible under suitable agro-climatic conditions all over the country but its potentiality varies from place to place and needs scientific evaluation before venturing into this industry. Seri-farmers and other stakeholders accept any business if maximum profit can be obtained for long time. For this, high quality production is the main factor in sericulture to get maximum profit, which can be well understood by study of

mechanization, yield gap analysis, value chain analysis and feasible policy governing this sector. The ownership can be realized by empowering the communities, through appropriate technology and training to continue their own business activities reducing the role of middlemen, in another word entering seri-farmers in value addition of their products.

5.1 Mechanization in Sericulture

Sericulture is considered as a high labor requirement industry since many years. Nowadays, the shortage of labor and increasing labor wages have become a major concern for seri-industry. Mechanization helps in increasing the efficiency and productivity of the workers (Table 25). Mechanization is necessary for enhancing the work efficiency and productivity, reducing the manpower requirement, curtailing the expenditure on various activities, increasing the profitability in sericulture, smoothly running various sericulture activities in time, enabling the farmers to take up sericulture at large scale, and competing quality in market.

Table 25. Work efficiency through mechanization in sericulture

SN	Activity/Work	Manual (A)	Machine (B)	Efficiency (B/A)
1	Land preparation	2,000 m ² /day	20,000 m ² /day	10 times
2	Mulberry cutting preparation	300 cuttings/hr	1,200 cuttings/hr	4 times
3	Shoot harvesting	200 kg/day	1200 kg/day	6 times
4.	Intercultural operation	1,000 m ² /day	20,000 m ² /day	20 times
5	Leaf chopping	20 kg/hr	200 kg/hr	10 times
6	Matured silkworm picking	30 dfls/day	300 dfls/day	10 times
7	Cocoon harvesting	10 kg/hr	50 kg/hr	5 times
8	Cocoon deflossing	5 kg/hr	50 kg/hr	10 times
9	Tray washing	25 trays/hr	100 trays/hr	4 times
10	Cocoon cutting in grainage	250 cocoons/hr	2000 cocoons/hr	80 times

Source: <http://www.csrtimys.res.in/structure/seri-engineering-division>

The profitability in cocoon production has been reduced during last few years due to sharp increase in cost of inputs and labor cost mainly because of migration of farm workers to abroad, towns and cities due to urbanization, industrialization and rapid growth of construction and service sectors. The silk cocoon production is still a high return crop when compared to other farm crops and shortage of labor and increasing labor wages can be saved by mechanization (Table 26).

Table 26. Cost savings in sericulture through mechanization

SN	Activity	Manual (A)	Machine (B)	Cost saving (%) [(A-B)/A] x 100
1	Land preparation (per ha)	3500	750	80
2	Cutting preparation (per 1000 cuttings)	80	15	80
3	Intercultural operations (per ha)	2000	1200	40
4	Chemical application (per ha)	400	100	75
5	Shoot harvest (per mt)	500	125	75
6	Rearing house disinfection (per 300 dfls)	250	100	60
7	Leaf chopping (per day for 5000 dfls)	2000	200	90
8	Silkworm picking (per 100 dfls)	500	200	60
9	Cocoon harvesting (per 100 dfls)	600	150	75
10	Cocoon deflossing (per 100 dfls)	400	150	60
11	Tray washing (per 100 trays)	200	50	75

Source: <http://www.csrtimys.res.in/structure/seri-engineering-division>

5.2 Yield Gap Analysis

Mattigatti et al. (2009) worked out for yield gap in sericulture drawing sample farmers who were growing latest mulberry variety V-1 and rearing latest bivoltine (CSR2 x CSR4) and multivoltine (Kolar Gold) silkworm hybrids, using formulae as shown in Box-3.

Box 3. Yield Gap Analysis

The yield gap in sericulture can be calculated using the following formulae (Mattigatti et al., 2009).

- 1. Yield gap-I** is the gap between the research yield and the attainable yield. Yield Gap-I is also expressed as percentage of the research yield.

$$\text{Yield gap-I} = \frac{\text{Research yield} - \text{Attainable yield}}{\text{Research yield}} \times 100$$

- 2. Yield gap-II** is the gap between the attainable yield and the anticipated yield. Yield Gap-II is also expressed as percentage of the attainable yield.

$$\text{Yield gap-II} = \frac{\text{Attainable yield} - \text{Anticipated yield}}{\text{Attainable yield}} \times 100$$

- 3. Yield gap-III** is the gap between the anticipated yield and the actual yield. Yield gap-III is also expressed as percentage of the anticipated yield.

$$\text{Yield gap-III} = \frac{\text{Anticipated yield} - \text{Actual yield}}{\text{Anticipated yield}} \times 100$$

- 4. Total yield gap:** It is the gap between research yield and the actual yield. Total yield gap is also expressed as percentage of research yield.

$$\text{Total yield gap} = \frac{\text{Research yield} - \text{Actual yield}}{\text{Research yield}} \times 100$$

In case of silkworm rearing and cocoon production, the yield gap was higher in Bi-voltine (BV) compared to Multi-voltine (MV) cocoon production. A wider total yield gap was observed in mulberry leaf production (47.46%) compared to silkworm rearing (mainly MV) and cocoon production (14.46%) (Table 27).

A high yield gap-I (33.40%) was observed in mulberry with yield gap-III of 12.42%. Yield gap-II in mulberry was only 9.92%. From the observation and analysis that proper and timely use of quality inputs and providing better micro-climatic conditions looking into the uncertain variation in external environment could minimize the gap in silkworm rearing and cocoon production.

Table 27. Yield gaps in mulberry & cocoon production (Bi-voltine and Multi-voltine)

SN	Particular	Leaf production (kg/acre)	Bi-voltine cocoon (kg/acre)	Multi-voltine cocoon (kg/acre)
1	Research yield	70.00	85.00	70.00
2	Attainable yield	46.62	73.92	68.34
3	Anticipated yield	42.00	69.63	65.98
4	Actual yield	36.78	62.82	59.88
	F-Test	Significant	Significant	Significant

Source: Mattigatti et al. (2009)

Thomas et al. (2005) have shown that the imported Chinese silk is superior to the locally available silk with respect to denier, cleanness, cohesion, gumming losses and uniformity. Table 28 presents a comparison of Chinese silk with Indian and local silk based on these attributes.

Table 28 . Comparison of Chinese, Indian and Local-cross produced raw silks

SN	Particular	Chinese (A grade)	Indian (A grade)	Local cross (A grade)
1	Denier	19.95	20.25	21.40
2	Cleanliness	9.10	8.50	7.40
3	Cohesion	8.50	8.00	7.00
4	winding break	8.50	7.75	6.53
5	Degumming loss	21.60	24.25	24.90
6	Uniformity	9.28	8.75	7.70

Source: Thomas et al. (2005)

For past few years there is declining trend in all aspects of sericulture in Nepal, such as number of seri-farmers, mulberry area coverage, egg, cocoon and raw silk production while raw silk demand has increased from 250 mt to 300 mt within the same period, i.e. from 2013/14 to 2018/19 (Table 29). Shrestha presented productivity gap at the farmers' field, and seri-farms farms as compared to abroad, i.e. Japan (Table 30). The productivity is related to many factors such as mulberry varieties, leaf productivity, leaf: cocoon production ratio and cocoon quality like rendita (cocoon/raw silk thread).

Table 29. Situation of sericulture in past years (2013/14 and 2018/19) in Nepal

Particular	2013/14	2018/19
Seri-farmers (No)	1300	1200
Mulberry area (ha)	1610	1300
Cocoon production (kg)	42000	21000
Raw silk thread (kg)	1760	1000
Raw silk demand (kg)	250000	300000
Egg production (Box)	4200	1146
Mulberry area expansion (ha)	-	65 (in Dang)

Source: Tiwari, 2020

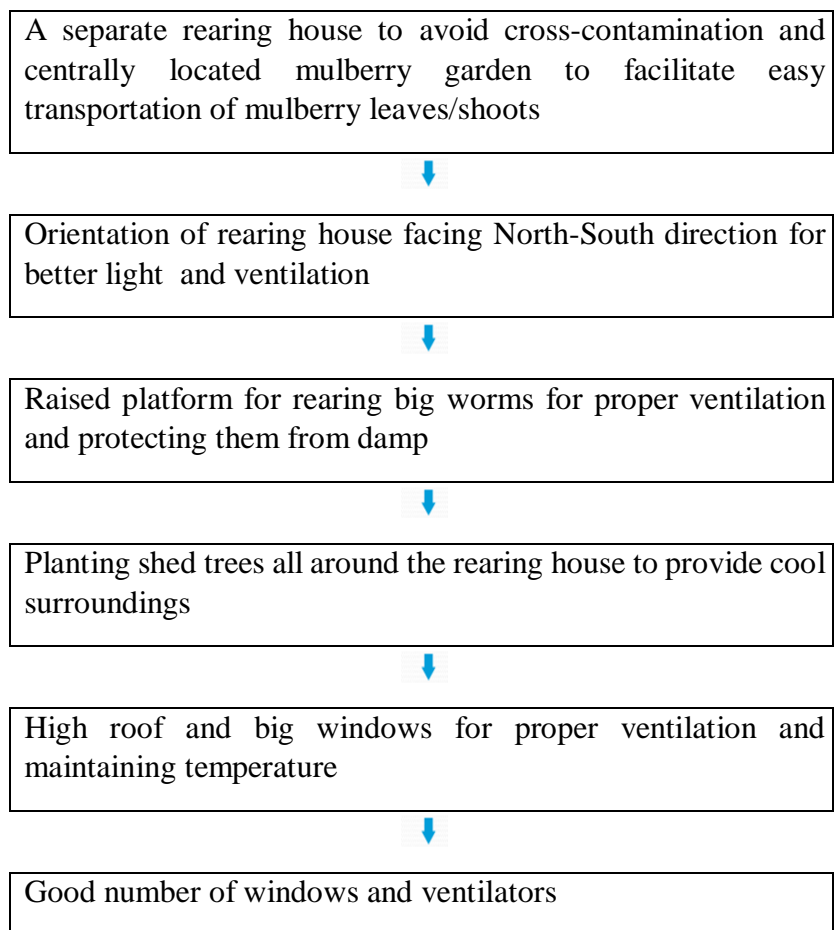
Table 30. Comparison of silkworm rearing performance at farmers' level, government farms and abroad

Particular	Farmer level	Government farms	Japan
Mulberry leaf production (mt/ha)	12	20	30
Cocoon production (kg/box eggs)	20	30	35
Cocoon production (kg/ha)	800	1200	1500
Production ratio (Leaf : Cocoon)	30:1	26:1	25:1
Rendita (Cocoon/Raw silk thread)	7	6.5	6.5

Source: Shrestha, 2015

The situation is worse in Nepal than in India. In Nepal, 70% of the population lives in rural area and depends on agriculture for their livelihood. The growth rate of agriculture and employment in

agriculture sector is not satisfactory. This sector has certain constraints like low per capita availability of cultivable land, limited cash returns, monsoon dependency, and seasonality which is further affected by climate change. Maintenance of good variety of mulberry plantation and eco-friendly rearing environment can solve the problem to great extent. The type of rearing house and micro environment have direct influence on growth and cocoon yield of mulberry silkworm. It has been observed that, an ideal rearing house is the one having basic requirements like good site, raised platform, high roof, false ceiling for rearing house construction, sufficient rearing space, application of geothermal ventilation. It is ideal for getting good cocoon yield and income (Jadav et al., 2018).



In India, per hectare raw silk productivity increased from 87.84 kg/ha in 2007 to 100.90 kg/ha in 2012, while it reduced to 13.81 kg/ha in 2012 from 24.63 kg/ha in 2007 in Northern India. It was due to fast urbanized demographic expansion, which reduced agricultural acreage and forced “mulberry” to exist only on the boundaries of agriculture field. This reduced farmer income, decelerated the proliferation process of sericulture industry and increased the burden of silk import to meet out increasing demand. (Bhatia et al., 2013). The complete process of mulberry silk production is presented in Figure 2.

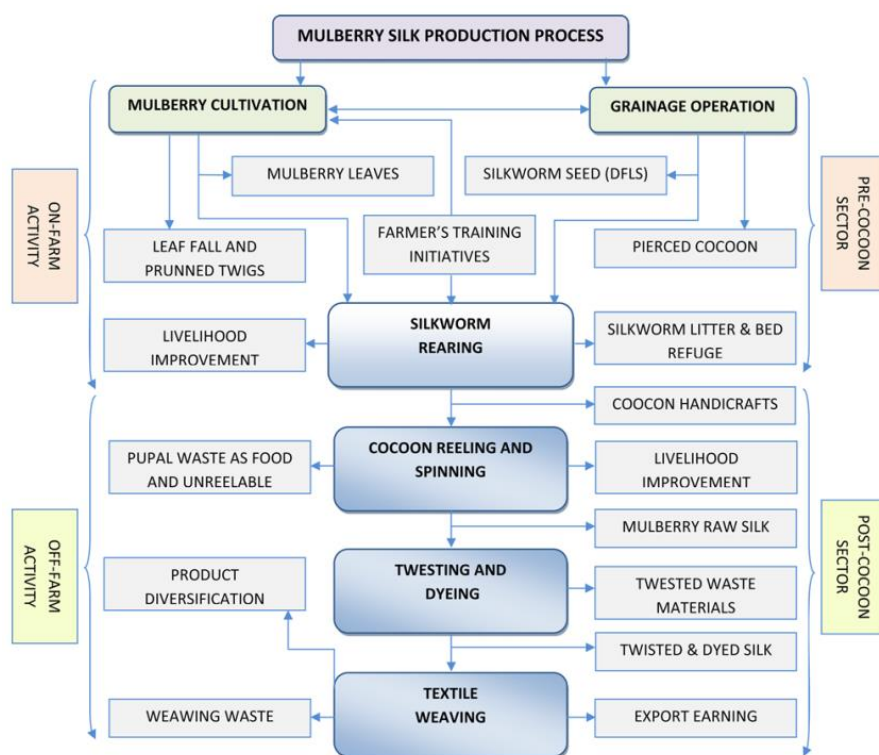


Figure 2. Mulberry silk production

The management of mulberry trees and indoor silkworm rearing to produce silk cocoon is on-farm activity in pre-cocoon sector, whereas reeling, dyeing and weaving are off-farm activity of post-cocoon sector. During any of the process or whole process such gap can occur. The best practice is to minimize the loss or wastage at each stage of pre- and post-cocoon phases. Therefore, it is necessary to perform trends analysis of mulberry sericulture and identify the constraints of mulberry production, its quality, silkworm race, pest and diseases, rearing environment and cocoon yield gaps incurred due to such factors.

5.3 Sericulture Value Chain Analysis

Value chain is a series of steps adding some benefits at each step during the creation of final silk products and their marketing. The simple model of value chain existing in Nepal is presented in Figure 3.

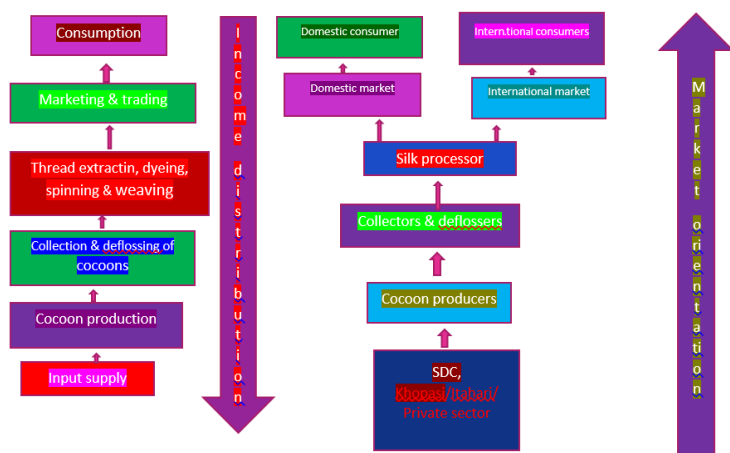


Figure 3. Simple model of value chain existing in Nepal

The current sericulture value chain include a chain of business starting from mulberry cultivation, silkworm rearing, cocoon production, silk yarn reeling, dyeing, fabrication and ultimately delivering goods and services until it reaches to the final consumer. Expected percentage value addition at different stage is presented in Table 31. For achieving higher economic growth, agriculture and sericulture should be taken into parallel with each other in Nepal (APP, 1995).

It includes both farm and industrial sectors. The farm sector comprises of mulberry cultivation, cocoon production; while industrial sector consists of cocoon collection, stifling, reeling to yarn production, yarn procurement, dyeing, rewinding, weaving into fabric, apparel making, branding, packing, dispatching, brand creation and selling products in national/ international markets. In addition, seri-byproduct is valuable. The food quotient ration of silkworm pupae (after reeling was found to be 1.8 i.e. if 1 kg of pupae is fed to fishes, 1.8 kg of fish’s weight is gained (Adhikari, 1986).

Table 31. Value addition at different stages of sericulture

SN	Value chain	Value addition (%)
1	Value addition to reelar	30
2	Value addition to dyers	50
3	Value addition to handloom weavers	350
4	Value addition to textile producer	65
5	Value addition to exporter	65
6	Value addition to foreign retailers	350

5.4 Policy Issues

Seri-enterprise requires a higher degree of strategic planning, revisiting the existing mechanisms as well as exploring new tools to make it sustainable as well as competitive in the national/international market. To achieve this, there arises the need for a comprehensive National Silk Policy. For example, small farmers in developing countries, forming groups in raising silkworms and their cooperative is a unique idea (<https://www.ahi-intl.farm/post/silkworm-farming>). In this line, Twenty years Agriculture Perspective Plan (APP, 1995) and The Agricultural Development Strategy (ADS, 2015-2035) provides long-term perspectives for agricultural development in Nepal and envisions “A self-reliant, sustainable, competitive, and inclusive agricultural sector that drives economic growth and contributes to improved livelihoods and food and nutrition security”. In the Ninth Five Year Plan also, it accorded due priority to alleviate poverty through the promotion of income generating program focusing sericulture in the mid hilly regions of Nepal.

The ADS aims at improving productivity, improving resilience of farmers to climate change, Ensuring good agricultural practices, natural resource management and livelihoods improvement, value added benefits to smallholder farmers and agro-enterprises, enhancing food safety and quality, gender- social - geographic inclusion, enhancing capacity of key institutions, improving food and nutrition security, strengthening agricultural education system, conserving biodiversity and maintaining environment sustainability, improving related pro-policies and maintaining coordination of stakeholders with priority to have impact on social, economic and environment aspects. The present global scenario clearly indicates the enormous opportunities for the Nepalese silk industry. Sericulture is cottage industry with its agricultural base, industrial superstructure and labour intensive in nature. It is remarkable for low investment, quick and high returns highly recommended as the most effective tools for rural reconstruction and development of rural society (Narsimha, 2003). Maintaining healthy mulberry garden, seri-farmers can harvest mulberry leaves and rear silkworms 3-4 times a year. In addition, the mulberry planted at marginal land gives full utilization of land and at the same time, it helps prevent the soil erosion (AICC, 2020). However, the mulberry plantation and cocoon production has not shown encouraging results which is a great challenge for the expansion of sericulture enterprise, despite governmental and non-governmental organizations efforts towards sericulture development. There are many constraints for the declining of sericulture industry in developing countries like Nepal.

If it is not adequately handled, for example, small worm rearing would result in abnormal development of the worms resulting in loss of crops. Similarly, rearing house with healthy environment is necessary for farmers rearing conditions otherwise result would not be satisfactory. A better way is an exigency of providing cross breed (CB) eggs to Seri-farmers during adverse climatic rearing seasons and provision of cross-breed seeds to Seri-farmers for silkworm rearing with good care in CRC and quality cocoons production regarded as the benediction for the sustainability of the silk industry. It thoroughly reviews national and international sericulture development, present, past and trend of performance, and help to find out ways regarding the

improvement of the sericulture development. Furthermore, under the new constitution and federal system of governance, there is also a need to restructure sericulture development program.

5.5 SWOT Analysis

SWOT analysis is a structured planning method used to evaluate the strengths, weaknesses, opportunities and threats of research study, project, organization, institution etc. It helps to identify the key internal (the strengths and weaknesses internal to the organization) and external factors (the opportunities and threats presented by the environment external to the organization) seen as important to achieving an objective (Vaidya, 2015). Sericulture is an agro-based labor intensive and commercially attractive economic activity falling under the agro- industry sector. This analysis is to develop work plan for restructuring sericulture in Nepal that takes into consideration of many different internal and external factors and tries to maximize the potential of the strengths and opportunities while seeking ways and means to minimize the impact of the weaknesses and threats (Box-4).

Box 4. SWOT Analysis

Strength	Weakness
<ul style="list-style-type: none"> • It is one of the most profitable activities in rural sector. • Favorable agro –climatic conditions and sustainable technologies. • It has comparative advantages to local and commercial farmers with large production base, knowledge and skills, land & labor, and adaptable technologies. • SDS, Khopasi through its technical development has developed quality and super-quality of silkworm seeds. • National market demand of silk is 300mt, world demand is increasing and its production is less than 4mt at present. • Tradition exclusive designs and advanced improved products have good market. • Farmers use local jaguri technology at low cost, which is suitable for shawls, jackets, and blankets because of thermal properties. • It is women’s friendly and eco-friendly occupation. • Regular and quick returns. 	<ul style="list-style-type: none"> • Handling live biological material always involves risk. • Inconsistency in output quantity and quality due to natural vagaries. • Unpredictable rainfall and reducing ground water level effects mulberry plantation. • Poor technology transfer and extension support. • The seri-farmers have small landholdings for mulberry growing and silkworm rearing. • Inadequate market facilities and linkages. • Highly decentralized areas with small and scattered production. • Low price and marketing problem of cocoon. • There is no proper organization for collecting silkworm cocoons. • Management of the sericulture farms is poor and lacks high yielding mulberry varieties. • Nepal is a member of ISC, but government is ignoring to pay member fee annually.

Opportunity	Threat
<ul style="list-style-type: none"> • High demand and popularity of hand woven silks (jacket, blanket, shawl, carpet) in the western countries. • Domestic demands and use of silk garments on cultural and festive occasions. • Large production gap to meet the domestic and international demand. • Scope for establishing the large production unit & organized sector. • It plays important role as an employment generating industry, especially in rural and semi-urban areas. • Utilization of the seri-product and byproducts, which add benefit in value chain. • It gives an additional source of income to agriculture and rural population. 	<ul style="list-style-type: none"> • Mass of rural population especially youth have left their village in search of earning, migrating from farming to urban areas. • Farmers have shifted on other competitive farming like, bees, mushrooms, fish farming. • Majority of farmers have small landholding and no knowledge, skill and awareness. • After federalism, role and responsibilities of local, provincial and federal government is not clear due to lack of sericulture policy. • Changes in the policies to liberalize the regulated market system may act as threat. • Change in the policies in neighboring countries like China and India may have threat in cocoon production and silk industries.

As a occupation, Nepalese farmers have multi-dimension farming (integrated farming) making things available for their subsistence livelihood ignoring to identify appropriate enterprise for their economic development. Sericulture is new to them, which is not like other crop production and therefore, farmers are facing many problems. The study of World Food Program (WFP), GoN and FAO shows the severity of the problems bear by rural households compare to urban, and majority of farmers involved in sericulture are of low status;

- 66% HHs are experiencing food shortages,
- 43% HHs are skipping or reducing the size of meals,
- 30% HHs in hills and mountain are forced to consume seed stock,
- 23% HHs took their children out of school during food shortages,
- 73% HHs in Mountain region migrate at least one of their member for work

Dangol & Joshi (1991) suggested that in general, faster rate of adoption was obtained with the use of interpersonal channel because of face to face interaction between the sources and have immediate solution. The feedback mechanism is not available through mass media channel due to shortage of skilled technicians, adoption rate is more likely to be slower and the whole process is failure. Some farmers quickly adopt improved innovations and proven technologies in action and are producing quality cocoons while majority of them are slow to adopt innovations because the adoption practices vary from farmer to farmer according to their knowledge, understanding about

technology and availability of resources (Khatik, 1997). Adjaye (2008) pointed that education as one of the significant factor affecting the perception of adoption. Tiwari et al. (2007) and Singh & Singh (2010) observed that farmers with higher level of education were better adopters. Similarly, Lawal & Oluyole (2008) and Ward et al. (2008) found age as a significant factor in adopting process. Chi (2008) had kept gender in the third rank among the factors affecting adoption. Farm type and farm size are the statistically significant factors affecting the adoption of technology (Payne et al., 2003). The family members also had some effect on the level of adoption of recommended technology.

Silk and milk program is famous in India. It is a good example of ecosystem that cattle are fed with the refused mulberry leaves/silkworm feces; mulberry field is manured by the cattle feces, and nutritious mulberry leaves are feed to silkworms, which support healthy and vigorous growth of worms with good cocoon production and shell percentage. At the same time, the cattle dung can be used as raw materials for biogas to produce methane gas which can be used as light and cooking meal in rural areas as alternative source of electricity and fuel wood (Ravi Kumar, 1990).

The major problems and constraints of sericulture have not been well documented over 40 years of commercial farming and no any research activities are being documented well until today (Mainali, 2012).

6. SERICULTURE FRAMEWORK

6.1 Sericulture Diversity

Sericulture as a whole covers from field production to silk product marketing in national/international market. Different types of host plants are maintained in the fields including forests and silk producing organisms reared to obtain silks. India enjoys mulberry and non-mulberry silkworm rearing and produce mulberry, tasar, muga and eri silks commercially (Table 32, 33). Eri silk rearing was reared by traditional farmers in eastern parts of Nepal, however, bivoltine mulberry silkworm rearing is common among all seri-farmers.

Table 32. Commercially exploited mulberry silkworms, their voltinisms and rearing

SN	Scientific name	Name	Primary food plant	Voltinism & Rearing
1	Bombyx mori	Silkworms	Morus alba	Univoltine in Europe
2	Bombyx mori	Silkworms	Morus alba	Bivoltine in many countries
3	Bombyx mori	Silkworms	Morus alba	Multivoltine in India

Table 33. Commercially exploited non-mulberry silkworms and their food plants

SN	Scientific name	Name	Primary food plants	Secondary food plants
1	<i>Bombyx mori</i>	Silkworms	<i>Morus alba</i>	In wild condition, Wild <i>Morus</i> spp.
2.	<i>Antheraea pernyi</i>	Oak tasar	<i>Quercus serrata</i> , Q graffiti <i>Q. florigunda</i>	<i>Quercus alba</i> , <i>Q. macrocarpa</i> , <i>Q. lyrata</i> , <i>Q. stellata</i> , <i>Q. palustris</i> , <i>Q. falcata</i> , <i>Q. phellos</i> , <i>Q. mongolica</i> , <i>Q. griffithii</i> , <i>Q. acuttissima</i> , <i>Q. robur</i>
3.	<i>Antheraea assamensis</i> Helfer	Muga	<i>Persea bombycina</i> Kost and <i>Litsea monopetala</i>	<i>Actinodaphnae obovata</i> , <i>A. anquistifolia</i> , <i>Celastrus monosperma</i> , <i>Cinnamomum glaucescens</i> , <i>C. glanduliferum</i> , <i>Gmelia arborea</i> , <i>Magnolia sphenocarpa</i> , <i>Michelia champaca</i> , <i>Xanthozylum rhesta</i>
4.	<i>Antheraea mylitta</i>	Tasar	<i>Terminalia arjuna</i>	<i>Quercus alba</i> , <i>Q. robur</i> and other unspecified <i>Quercus</i> species
5.	<i>Samia ricini</i> Anonymous	Eri	<i>Ricinus communis</i> Linn. <i>Manihot utilissima</i> Phol. <i>Heteropanax fragrans</i> Seem. <i>Evodia flaxinifolia</i> Hook. <i>Ailanthus grandis</i>	<i>Plumeria acutifolia</i> Poir. (Gulanch) <i>Sterculia colorata</i> Roxb. (Waljem)

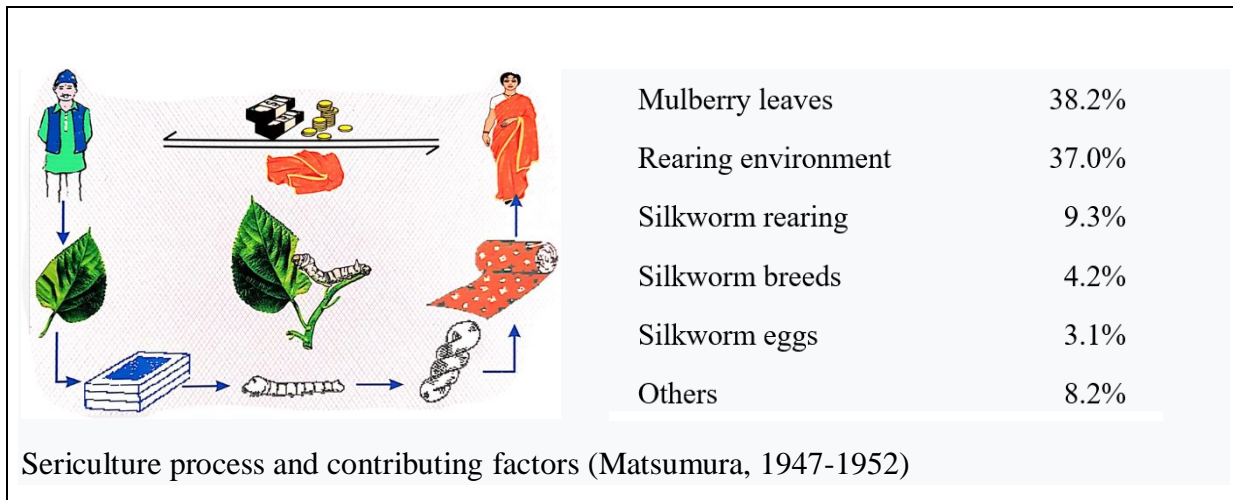
			Roxb. Ailanthus excels Roxb. Ailanthus altissima Miller	
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Source: Central Silk Board (CSB), 2020

6.2 Key Factors for Seri-Success

Mulberry silkworms rearing and cocoon production involves different from mulberry field to silk, which include many stages like mulberry gardening, silkworm rearing, cocoon processing, and fabrication. Therefore, all possible measures are taken into account to develop a framework of the study. There is truth, that the success in the first step unfold the next and so on for the complete success and accomplishment of the study. For example, maintenance of excellent parent stock of mulberry silkworms is basic to develop high yielding hybrids silkworms with high performance. Similarly, maintenance of healthy mulberry garden with better performing mulberry varieties is another prerequisite for feeding quality leaves to silkworm and producing good cocoons. Matsumura (1947-1952) provided some contributing factors in sericulture. It is true then, if there is no good mulberry garden, no small worm rearing, and there exists problem of appropriate rearing house at the farmers' level, sericulture almost collapses; expected results are not achieved in reality and serious problem in cocoon pricing and marketing. The main factor for successful cocoon production is mulberry leaf and climate, both of which together contribute more than 75% for its success followed by other factors such as improved rearing (9.3%), silkworm race (4.2%), silkworm eggs (3.1%) and others (6.6%), respectively (Box-5).

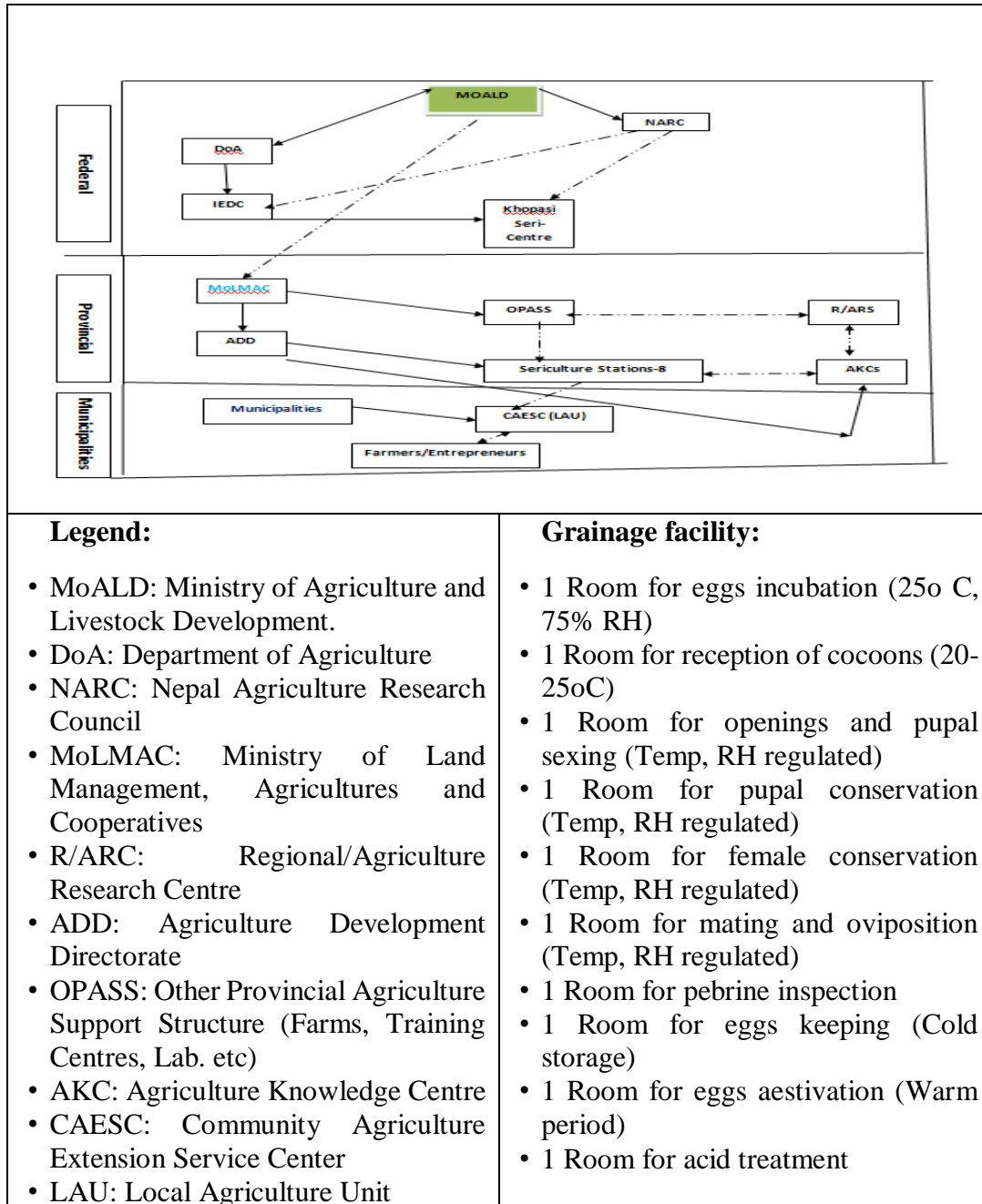
Box 5. Sericulture process and key factors for its success



6.3 Sericulture Development under Federalism

The weak linkage and misunderstanding arises after federalism in Nepal among the three tiers of governments. This has to be improved and strengthen linkage and coordination as purposed Sericulture Development under Federalism (Box-6).

Box 6. Linkage and coordination among three tiers of present federal government in Nepal



Palikhe (2018) presented the structural reform of sericulture under three tiers of government in Nepal for quality maintenance, healthy hybrid silkworm and cocoon production with fully and functionally equipped infrastructure.

At present, with new constitution, three tiers structure of Government exists in Nepal.

- Constitution of Nepal enacted in 2015 provides different functions/roles for three tiered structures –**Federal, Provincial and local level government.**
- Creation of 753 local levels in Nepal marks a major restructuring of local bodies.
- 6 Metropolitan Cities (Mahanagarपालिका), 11 Sub Metropolitan Cities (Upa-Mahanagarपालिका), 276 Municipalities (Nagarपालिका) and 460 Rural Municipalities (Gaunपालिका) as local bodies/governments.
- Local bodies are divided into 6740 wards as the lowest administrative unit of government.
- In between Provinces and Local governments there are 77 districts.

The role and responsibilities of the governing bodies at each level is crucial for smooth implementation of programs.

- Federal government limits its role to formulation of policies and legislations,
- The provincial governments to facilitation and capacity development of Municipalities, and the Municipalities involve in actual program implementation

In this federal strategic system of government, strictly realizing their specific role and responsibilities is crucial and it should run under Federal: Strategic Implementation Modality.

- Work on developing and improving policy on managing sericulture to be National Policy
- Work on formulating, proposing laws rules and regulations deemed necessary;
- Quality testing of silk
- Promote public-private partnerships for investment-develop a PPP scheme for silk development and promotion.

6.4. Strategic Model

Shrestha et al. (2012) presented a strategic model of sericulture development in Nepal. This model includes possible necessary approach which are depicted in Figure 4.

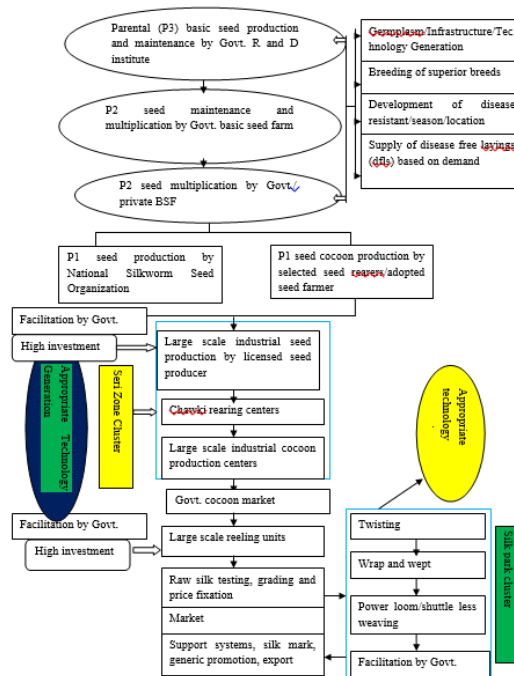


Figure 4. A strategic model to strengthen and promote sericulture in Nepal

- Evolution of appropriate cost-effective technologies through focused research projects addressing constraints and maximizing the production of quality eggs.
- Teaming up of sericulture scientists with molecular biologists, bio-engineers, immunologists, textile technologists, clinicians, experts from industry and a host of other stakeholders in charting out a new road map.
- Adoption of region and season specific approaches in the development of superior breeds/hybrids and feed package of practices.
- Establishment of close linkage between forward and backward sub-systems for greater efficiency and synergy as sericulture and silk industry is highly scattered and unorganized
- Identification and promotion of potential clusters for bivoltine silk production in potential non-traditional areas.
- Skill up-gradation through structured and specially designed training programs.
- Establishment of linkages among the four identified production sub-systems viz., seed, cocoon, yarn and fabric.
- Capacity building for production and supply of adequate quality planting material, silkworm seed, reeling cocoons and silk yarn through promotion of large-scale production units with required techno-financial support.
- Development and promotion of participatory extension system for effective adoption of technologies by similar stakeholders.
- Effective utilization of by-products for value addition.

SECTION-B

(Restructuring Study Methodology and Findings with Gap)

7. METHODOLOGY

With literature reviews, among the available and relevant documents, useful ones were reviewed orchestrated in designing the final framework of study. Appropriate methods, necessary tools and techniques were used to generate useful information. Various types of data gathering necessary for the study are presented in Appendices 2-15.

7.1 Sericulture Districts and Stakeholders

Sericulture Offices located districts are: Center for Industrial Entomology Development Office, Harihar Bhawan, Lalitpur; Sericulture Development Center, Khopasi, Kavre; Cocoon Grainage Center, Chitapol, Bhaktapur; Seed Cocoon Resource Center, Dhunibesi, Dhading; Seed Cocoon Resource Center, Tanahun, Bandipur; Seed Cocoon Resource Center, Pokhara, Kaski; Sericulture Development Office, Dhanibesi, Syangja; Nursery of Mulberry Sapling Production Center, Bhandara, Chitwan, Reeling Center, Itahari, Sunsari; and Sericulture Development Office, Dhankuta, which are shown in map of Nepal (Figure 5). Primarily, these districts were included for collecting primary information.



Figure 1. Map of Nepal showing Sericulture Offices in different districts

7.2 Primary Information Collection

As per ToR, the stakeholders for primary information collection are seri-farmers, seri-farmers' cooperatives, agriculture technicians working in Gau-palika (Rural Municipality), Nagarpalika ((Municipality)), Upmahanagar-palika (Sub-Metropolitan City) & Mahanagar-palika (Metropolitan City), sericulture development officers, agriculture knowledge center & provincial directorate of agriculture, Mayors of different level Municipalities, policy makers and sericulture experts, private sectors- silk reelers & weavers, raw silk importers, pashmina manufacturers & exporters, and NGOs/INGOs involved in sericulture as shown in Table 34.

7.3 Sampling Techniques

Purposive sampling technique was used with face to face-interview and filling up structured questionnaires. For this, Seri-farmers involved in mulberry silkworm rearing were categorized in two groups in the Seri-areas in consultation with Seri-technicians, sericulture officers in their respective command areas (such as **Seri-continued-** rearing silkworms even at present and producing cocoons, while **discontinued-** not rearing silkworm, shifted in other agriculture work). From each categorial of Seri-farmers, 36 farmers were selected randomly to generate useful primary data and compared cause of poor performance of sericulture at the grass-root level.

Besides this, study team visited, observed and discussed with staff in government sericulture firms, SDS, Khopasi, silk processing industries, user members of community forest, and Seri-farmers.

Table 1. Primary information collection from stakeholders

SN	Stakeholders	Unit	Consulted	Districts	Remarks
1	Silkworm rearer	No	72	9	36 continued & 36 discontinued)
2	Collector	No	3	3	District level
3	Processor	No	5	3	District level
4	Focus Group Discussion	Group	9	8	District level
5	Technical Audit of Farm	No	1	1	Khopasi, Federal
6	Discussion Meeting (Farm level)	No	6	6	Provincial
7	Discussion (Municipality level)	No	7	7	Municipal
8	Discussion (AKC/ADO level)	No	5	5	AKC
9	Discussion (Federal level NARC)	No	1	1	Federal
10	Sericulture firms	No	9		District level

11	Discussion (Provincial level)	No	4	4	Provincial
12	Key informants	No	15	8	National
13	Observation Visits (Farm level)	No	9	9	Firms
14	Consultative Workshop	No	1	-	National
15	Final Workshop	No	1	-	National

7.4 Secondary Information Collection

Secondary information was collected from secondary sources like published data, research reports, programs and progress reports, and import export data published by concerned organizations.

7.5 Steps of the Study

Sustainable Research and Development Center (SRDC) highly recognizes and values the intent of the client during the course of the assignment. Therefore, methodology for preparation follows the scope of work proposed by the Center for Industrial Entomology Development (CIED). The study comprises of both primary and secondary information collection and the researcher adopts both quantitative and qualitative approach in finding and analyzing the information. The data obtained served as the foundation for further analysis to identify the potential and scope. The operational steps are in line with ToR given by CIED and presented.

As shown in Figure 6, activity (1) includes boarding in the consultant and consensus building between consultant and the client. Activity (2) provides inception report to the client and outline with detail plans and proposals based on the need of the client, which is not reflected in the ToR.

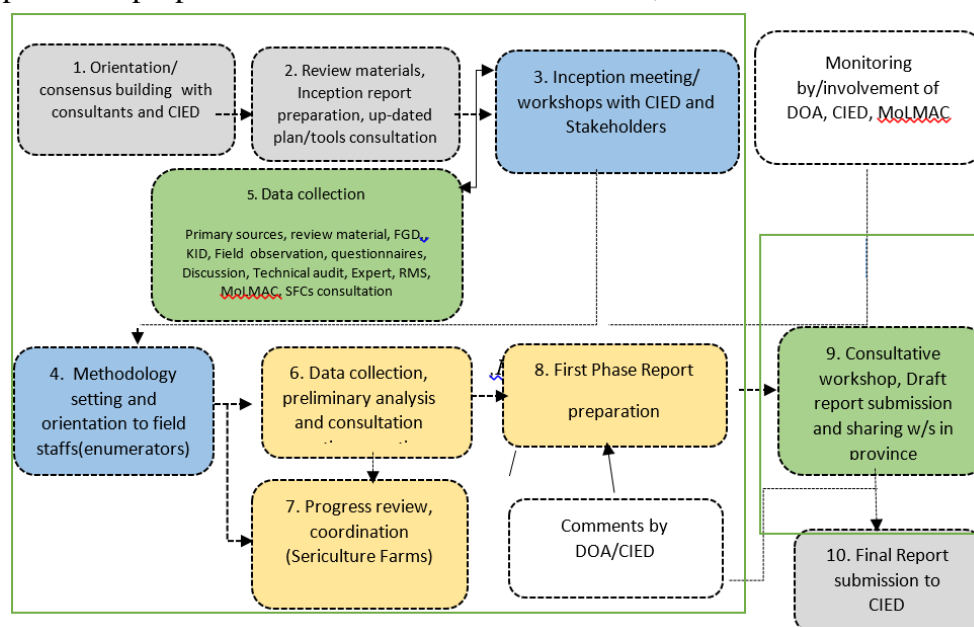


Figure 2. Steps for study

Activity (3) is crucial which comprises of inception and vision workshop with CIED and the stakeholders and collect the evidence based information from Seri-communities and other stakeholders following the proposed data collection tools. The step 4 guides the expert team towards the methodology of the study as well as orientation of enumerators for information collection. Steps 5 represents the activities to be carried out in field as one the major tasks of the study. Activities (6), (7) and (8) contributes to produce draft report -ready for sharing in the consultative workshop. The step (9) comprises of final draft report and step 10 represents final outcomes of the study as given in ToR (Appendix 15). The information's were gathered from various sources at different levels- office, farm, field observations, silkworm farmers interview, cocoon collectors/ processors, focus groups, key informant's discussion meeting, including Inception/ Consultative meetings and feedbacks from the draft report reviewers.

7.6 Report Preparation

7.6.1 Draft Report

Based on the primary and secondary information; and the validation of information from different stakeholders the consultant team performed detail analysis to assess the past and present performance of the sericulture sub-sector from the different aspect/dimensions among the [seri-continued](#) and discontinued farmers. Similarly, gaps in terms of various aspects were analyzed and reasons behind sericulture sub-sector's poor performance critically analyzed and explicitly explored. Based on evidence and lessons learned, priorities of three tiers of government and possible outcomes of sericulture, the consultant rigorously evaluated the future alternative to guide the government of Nepal to take necessary decisions. The value chain describing the current situation, opportunities, constraints, and recommendations for addressing the constraints was critically analyzed while evaluating future alternative for sericulture development program.

Then the consultant team prepared the sericulture development program restructuring report including details of strategies, modalities, business model, interventions, action plan, institutional arrangement, investment portfolio with possible outcomes and result indicators across the result chain. Suggestions are provided for future course of action based on restructuring report of the sericulture development program along with policy and action matrix presenting the role, responsibilities of all stakeholders including three tiers of government, with suggestions of three tiers of government and other stakeholders from the Consultation Workshop, which was organized on 19 April, 2023 at CIED, Hariharbhawan, Lalitpur to share preliminary findings and to capture the feedback, suggestions, experiences, and collect innovative ideas from the stakeholders.

7.6.2 Final Report

The SRDC submitted four hard copies and e-copy (in Flash Drive) of Final Report in English language to the CIED within 7 days with incorporation of all the comments and suggestions given by the CIED Team. The report has been prepared in Times New Roman Font with font size 12 and maintaining 1.5" page margin in all sides.

8. STUDY FINDINGS

8.1 Field Survey

This chapter presents the findings of the study based on the field survey. In sericulture, mulberry (*Morus alba* L.) cultivation and silkworm (*Bombyx mori* L.) rearing are the field level activities performed by the trained farmers. Therefore, the discussion with farmers in the field and interaction with the related stakeholders cover the major part of the study (Appendices 2-9). In addition, post-cocoon activities are important to continue value chain and benefit all the stakeholders which were also studied in detail visiting farmers' fields at different locations in the districts. The districts covered are Ilam, Morang, Dhankutta, Sunsari, Kavrepalanchowk, Dhading, Nuwakot, Gorkha, Tanahun, Syangja, Kaski, Dang, Susta East Nawalpur and Chitwan. The attention has been given to the analysis and interpretation of data in accordance with the objectives given in ToR (Appendix 14).

Table 35 shows that the seri-continued and discontinued farmers' family size was almost similar, i.e. 5.13 and 5.11 members/family, respectively. Therefore, there is no relationship of family size in continuation and discontinuation of sericulture activities. However, farmers' interest, profitability, assured markets and existence of marketing system in running business and prevalence of other opportunities could be the determining factors to be attracted in any agricultural activities.

Table 1. Family size (No) of seri-continued and discontinued farmers

SN	Measurement	Continued			Discontinued		
		Female	Male	Total	Female	Male	Total
1	Minimum	1.00	0.00	2.00	0.00	0.00	0.00
2	Maximum	5.00	6.00	11.00	6.00	9.00	14.00
3	Mean	2.58	2.55	5.13	2.66	2.44	5.11
4	Std-dev	1.07	1.31	2.12	1.45	1.85	3.04

Source: Field survey, 2079

Table 36 shows that the average landholding of Seri-continued farmers is 22.42 ropani while that of discontinued farmers is 11.38 ropani. The Seri-continued and discontinued farmers' landholdings on an average has increased in both upland and lowlands suitable for agriculture in comparison to earlier estimates. Almost all of them are small farmers based on the average landholding size, which is necessary for mulberry gardening as basic requirement for sericulture.

Table 2. Landholdings (ropani) of Seri-continued and discontinued farmers

SN	Measurement	Continued				Discontinued			
		Upland	Lowland	Other	Total	Upland	Lowland	Other	Total
1	Minimum	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00
2	Maximum	65.00	120.00	2.00	120.00	75.00	39.00	12.00	75.00
3	Mean	2.58	2.55	0.11	22.42	7.27	3.47	0.69	11.38
4	Std-dev	1.07	1.31	0.46	29.22	11.07	7.53	2.33	13.81

Source: Field survey, 2079

The education status of the Seri-continued and discontinued farmers is presented in Table 37. Most of the Seri-farmers are literate (58.3%) and some of them have above SLC (22%) level of education. However, it can be observed a higher percentage of illiteracy in Seri-continued category while higher level of education (Bachelor and above) in discontinued category. Education is related to diversified skills and job opportunity in various agriculture activities.

Table 3 . Education status of Seri-continued and discontinued farmers

SN	Education level	Continued		Discontinued	
		Frequency	Percentage	Frequency	Percentage
1	Illiterate	7	19.40	4	11.10
2	Literate only	21	58.30	21	58.30
3	SLC	6	16.70	7	19.40
4	+2	1	2.80	1	2.80
5	B	1	2.80	2	5.60
6	>B	0	0.00	1	2.80
	Total	36	100	36	100

Source: Field survey, 2079

The farmers practiced rearing of silkworm 1 to 4 times in a year, but varied their rearing capacity (Table 38). The farmers reared a minimum of half box to a maximum of 60 boxes of silkworm eggs per annum. Cocoon production under good management condition was at par to farm center, which is up to 30 kg cocoon per box of egg at farmers' level. The commercial farmers are producing up to 900 kg of cocoons with income of Rs 450000 per year as revealed by the field survey (Adhikari in Gadhwa Dang). This indicates that the commercial farmers are doing well in terms of earning from sericulture. However, the market price of green cocoon is Rs 365-500 per kg, which is below the rate of nearby Indian market. In Indian market, a good quality cocoon fetches IRs 700-800 per kilogram of cocoon. It was also revealed that the discontinued farmers previously reared silkworms 4 times a year. Some commercial farmers reared unto 20 boxes of eggs and cocoon productivity (30 kg/box) was at par with the Seri-continued farmers. The volume of cocoon production was up to 1000 kg a year, which was even higher than the Seri-continued farmer but their earning was less (Rs 300000) due to price factor indicating a genuine reason for leaving sericulture.

Table 4. Sericulture status of seri-continued and discontinued farmers

SN	Particulars	Minimum	Maximum	Mean	Std-dev
	a. Continued				
1	Rearing times per year	1	4.	1.97	0.84
2	Total number of egg boxes	½	200	9.72	33.30
3	Cocoon production per box	1	30	13.62	7.87
4	Cocoon production per year	5	3000	150.75	498.70
5	Price of cocoon per kg (Rs)	365	500	496.25	22.50
6	Income from Cocoon (Rs)	1500	1500000	74887.50	2.49
	b. Discontinued				
1	Rearing times per year	0	4	2.97	1.18
2	Total number of egg boxes	0	20	3.77	4.49
3	Cocoon production per box	0	30	12.38	11.11
4	Cocoon production per year	0	1000	73.75	166.74
5	Price of cocoon per kg (Rs)	0	500	260.27	193.30

6	Income from Cocoon (Rs)	0	300000	25938.88	52532.18
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Source: Field survey, 2079

The Seri-continued farmers are growing mulberry in minimum of 2 ropani to a maximum of 130 ropani of land (Table 39). In case of discontinued farmers, it was maximum of 39 ropani of mulberry garden and nearly 3/4th of them (74%) discontinued mulberry gardening before the undertaking of this survey. However, for the sustainability of sericulture, the field visits, observation, and discussion indicate that they are maintaining good mulberry gardens in large area rather than just in homestead gardens.

Table 5. Mulberry coverage (ropani) of Seri-continued and discontinued farmers

SN	Measurement	Continued		Discontinued	
		Initial area	Current area	Initial area	Current area
1	Minimum	2.00	1.00	0.00	0.00
2	Maximum	130.00	130.00	39.00	10.00
3	Mean	19.36	15.61	4.68	0.66
4	Std-dev	31.54	24.71	6.51	1.85

Source: Field survey, 2079

Female (1.63) and male (1.75) family members per household were engaged at higher level in sericulture from the seri-continued farmers than from discontinued ones (Table 40). Sericulture is a labor-intensive profession and therefore family members' engagement is positively related with the work performance and production level. During the field visit, it was also observed that the female farmers were actively participating in all seri-activities.

Table 6. Family members' involvement of seri-continued and discontinued farmers in sericulture

SN	Measurement	Continued			Discontinued		
		Female	Male	Total	Female	Male	Total
1	Minimum	0.00	0.00	0.00	0.00	0.00	0.00
2	Maximum	5.00	4.00	9.00	5.00	3.00	6.00
3	Mean	1.75	1.63	3.36	0.94	0.44	1.38
4	Std-dev	0.96	0.93	1.74	1.19	0.69	1.69

Source: Field survey, 2079

The Government of Nepal has adopted group approach as a technology extension strategy in agriculture. In case of sericulture, majority of seri-continued (77.8%) and discontinued (72.2%) farmers responded individually (Table 41). Only 22.2% and 27.8% of farmers were organized in seri-groups from the seri-continued and discontinued category, respectively. This implies for the need of reviewing and revising the government extension strategy in sericulture.

Table 7. Sericulture farming types of seri-continued and discontinued farmers

SN	Seri-farming	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Individual	28	77.80	26	72.20
2	Groups	8	22.20	0	0.00
3	Cooperatives	0	0.00	10	27.80
	Total	36	100	36	100

Source: Field survey, 2079

Mulberry based silkworm and bi-voltine sericulture is the most profitable and common practice in Nepal. The seri-continued farmers' mulberry plant population ranged from 1200 to 220000 (Table 42). However, mulberry plant population declined drastically (10 – 100%) in small farmers' gardens while larger farmers' gardens had the lowest loss, i.e. <10% before reaching the plant to productive stage. This reveals that small farmers, who are just taking opportunity to have one or two seri-crops in addition to other farming practices, while large farmers take good care of their mulberry gardens. Similarly, discontinued farmers also had higher loss at the productive level. These facts indicate that mulberry sericulture should be adopted in a large scale to make it highly successful.

Table 8. Mulberry plant population (No) of Seri-continued and discontinued farmers

SN	Description	Continued		Discontinued	
		Total planted	Existing plants	Total planted	Existing plants
1	Minimum	220	200	100	0
2	Maximum	90000	40000	30000	10000
3	Mean	11711.66	8591.66	3375.0000	807.22
4	Std-dev	18227.27	10355.07	5187.31282	1985.11

Source: Field survey, 2079

From the field survey, it was observed that Seri-continued farmers sold cocoons to government entity, local markets and Indian traders as well. Over three-fourth (75%) discontinued farmers sold their cocoons to the government entity (Table 43). The Government of Nepal followed this strategy of cocoon purchase from the farmers to promote the silkworm growers at the initial stage, which continued for a long lime. Discontinuation in cocoon buying by the government dismantled the farmers' cocoon selling channel. However, the tendency of cocoon buying by the government was criticized by different actors in the context of liberal economy, while private buyers directly could not handle the process of cocoon grading, pricing, selling/buying and instant paying to the farmers without the support of the government. Therefore, cocoon selling to the private sector and government's facilitating in this endeavor by preparing a practical guideline can be the better way to promote sericulture in the long run. There is a need of National Sericulture Board and a national policy for its promotion and development.

Table 9. Cocoon selling place of Seri-continued and discontinued farmers

SN	Selling place	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Bhandara	0	0.00	10	27.80
2	Dhankuta	3	8.20	0	0.00
3	Dhunibesi	0	0.00	10	27.80
4	Indian market	1	2.80	0	0.00
5	Kathmandu	11	30.60	3	8.20
6	Khopashi	1	2.80	6	16.70
7	Itahari	9	25.00	6	16.70
8	Local market	11	30.60	1	2.80
	Total	36	100	36	100

Source: Field survey, 2079

Majority (47.2%) Seri-continued farmers expressed the view that lower price and storage problem were the major constraints in cocoon production (Table 44). Similarly, 55.6% and 38.9% of the

discontinued farmers, expressed storage and low price of cocoons as a problem respectively. These problems can be addressed by introducing post-cocoon activities and installing drying facilities at the producer level.

Table 10. Cocoon selling problems of Seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Problems	Frequency	Percent	Frequency	Percent
1	Lower price	17	47.20	14	38.90
2	Transportation	2	5.60	1	2.80
3	Storage	17	47.20	20	55.50
4	Due money	0	0.00	1	2.80
	Total	36	100	36	100

Source: Field survey, 2079

Kanva-2 is the most popular mulberry variety planted in the fields by both Seri-continued and discontinued farmers (Table 45). The productivity of this variety is very low under farmers' field condition, because of the poor management and lack of irrigation facility. This variety doesn't suit in marginal land without additional input and irrigation facility. Its leaf yield even in the best management condition is less than 20mt/ha. The most productive and high yielding hybrid mulberry varieties have been developed in India. Some of them have been introduced in Nepal and conserved in Khopasi and Bhandara farms. Recently developed/bred/propagated most popular high yielding hybrid varieties should be introduced from other countries and promoted in commercial scale for increasing production, productivity and commercialization of sericulture.

Table 11. Mulberry variety adopted by Seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Variety	Frequency	Percent	Frequency	Percent
1	Canva	30	83.30	26	72.20
2	Local	1	2.80	0	0.00
3	Others	1	2.80	1	2.80
4	Canva + local	4	11.10	9	25.00
	Total	36	100	36	100

Source: Field survey, 2079

Mulberry Nursery Development Centre Bhandara is the main resource center for mulberry sapling production and distribution to the farmers from where over 2/3rd of the surveyed seri-farmers (continued & discontinued) fulfill their requirement of mulberry saplings (Table 46). In addition, Parental Stock Seed Cocoon Resource Center, Bandipur and Dhunibesi, and Sericulture Development Office, Itahari are also supplying mulberry saplings in the nearby areas. Farmers are getting required mulberry saplings even from the private nurseries, however, all these varieties are either local or Kanva-2 with low productivity. In these days, new high yielding hybrid varieties are commercially demanded varieties. Regarding quality, almost all of them were satisfied with good quality of saplings received from the sources.

Table 12. Sources of mulberry seedling/saplings of Seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Sources	Frequency	Percent	Frequency	Percent
1	Bhandara	18	50.00	32	88.80

2	Itahari	8	22.20	2	5.60
3	Khopasi	0	0.00	2	5.60
4	Dhunibeshi	2	5.60	0	0.00
5	Bandipur	8	22.20	0	0.00
	Total	36	100	36	100

Source: Field survey, 2079

Majority of the seri-continued farmers (61.10%) did not transplant mulberry saplings in row whereas, 58.30% of discontinued farmers practiced row method of transplanting. Among the seri-continued farmers, 61.1% practiced trench method, while 75% of discontinued farmers did not follow this method of transplanting saplings (Table 47). Transplanting methods directly and indirectly influence increasing plant vigor, and therefore, best recommended method of transplanting. A complete package of practices is needed for vigorous growth and healthy/hygienic maintenance of mulberry gardens.

Table 13. Mulberry transplanting methods practiced by Seri-continued and discontinued farmers

SN	Quality	Continued				Discontinued			
		Yes		No		Yes		No	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
1	Row	14	38.90	22	61.10	15	41.70	21	58.30
2	Trench	22	61.10	14	38.90	27	75.00	9	25.00
	Other	1	2.80	35	97.20	8	22.20	28	77.80

Source: Field survey, 2079

Majority of the continued (91.7%) and discontinued (72.2%) farmers adopted intercultural practices in their mulberry gardens, which is directly related to plant health and leaf productivity (Table 48). [In the field visit, it was found that many farmers have planted mulberry plant in embankment/ terrace of the field and least cared their mulberry gardens.](#) Trainings can be organized to reorient farmers in promoting high yielding mulberry varieties.

Table 14. Intercultural practice of mulberry garden by Seri-continued and discontinued farmers

SN	Intercultural practice	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Irregular	3	8.30	10	27.80
2	Regular	33	91.70	26	72.20
	Total	36	100	36	100

Source: Field survey, 2079

Most of the mulberry gardens, viz. 83.3% of Seri-continued and 94.4% of discontinued farmers were lack of irrigation facility (Table 49). In Mysore India, high input hybrid varieties of mulberries are developed and planted in irrigated land which yield 60-70 MT/ha of quality mulberry leaves. However, in Nepal, mulberry leaves production is very low at the farmer fields which is as low as 5 MT/ha. Therefore, irrigation is one of the most important factor inputs to increase mulberry leaves production. In the restructuring of sericulture organization, land suitability and inputs including irrigation facility needs to be prioritized.

Table 15. Irrigation facility in mulberry garden of Seri-continued and discontinued farmers

SN	Irrigation facility	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Yes	6	16.70	2	5.60
2	No	30	83.30	34	94.40
	Total	36	100	36	100

Source: Field survey, 2079

Mulberry is a perennial plant. Depending on the topography, annual pruning, weeding, manuring, irrigation etc., various insect species feed on this plant and cause yield loss. The farmers' field survey of different locations- Ilam, Morang, Dhankuta, Sunsari, Kavrepalanchowk, Dhading, Nuwakot, Gorkha, Tanahun, Syangja, Kaski, Dand, Susta East Nawalpur and Chitwan indicated the incidence of insect infestation on mulberry plants.

Among the insects, the damage by stem borer accounted the highest percentage, i.e. 36.1% followed by caterpillar (30.6%). Other more than two types of insects' species also accounted a loss of 13.9% (Table 50). Farmers used minimal insecticides to mitigate the insect infestation other than manually picking and destructing the caterpillars and removal of infested stem of mulberry plants. Only 19.4% plants were free from insect infestation in seri-continued farmers mulberry gardens. On the other hand, the discontinued farmers responded infestation by these pests at 27.8%, 13.9% and 16.7%, respectively.

Table 16. Insect pest incidence in mulberry garden of Seri-continued and discontinued farmers

SN	Damage	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	No damage	7	19.40	15	41.70
2	Borer	13	36.10	10	27.80
3	Caterpillar	11	30.60	5	13.80
4	More than two	5	13.90	6	16.70
	Total	36	100	36	100

Source: Field survey, 2079

Over 3/4th (77.8%) of the Seri-continued respondents adopted none of insect controlling practices. For managing insect infestation on mulberry gardens only 2 farmers (5.6 %) used insecticides, 8.3% practiced manual picking and destroying of pests, more than two options adopter accounted 5.6% and 2.8% pruned/removed dead plant parts (Table 51). Regarding discontinued farmers, insect infestation was managed by using pesticides by 2 farmers (5.6%), none practiced picking & destruction of insects, pruning/cutting accounted 8.3% with adoption of more than practices by 2.8% farmers. Remaining 83.3% of farmers did not adopt any kind of these controlling practices.

Table 17. Mulberry insect pest management measures adopted by Seri-continued and discontinued farmers

SN	Control method	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	None	28	77.70	30	83.30

2	Cutting used	1	2.80	3	8.30
3	Pesticide use	2	5.60	2	5.60
4	Picking up	3	8.30	0	0.00
5	More than two adopted	2	5.60	1	2.80
	Total	36	100	36	100

Source: Field survey,2079

About 2/3rd of the continued and discontinued farmers' gardens were reported free of any diseases while, 38.90% Seri-continued farmers' gardens were infested due to various mulberry diseases, i.e., powdery mildew (5.60%), root rot (5.60%) and other diseases (22.20%) (Table 52). Likewise, discontinued farmers reported powdery mildew (19.4%) and root rot (11.1%) diseases. The damage ranged between 0-22.2%.

Table 18. Disease incidence in mulberry garden of Seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Disease	Frequency	Percent	Frequency	Percent
1	None	22	61.10	25	69.40
2	Powdery mildew	4	11.10	4	19.40
3	Root rot	2	5.60	7	11.20
4	Others	8	22.20	0	0.00
	Total	36	100	36	100

Source: Field survey, 2079

As revealed by the field survey regarding continued silkworm rearing mulberry gardens, none of the farmers used pesticides to control diseases; 13.9% of them (5 farmers) adopted cultural practices. In case of discontinued farmers, 2.8% (1 farmer) farmer used pesticide and none of the discontinued farmers practiced cultural measures (Table 53).

Table 19. Mulberry disease management measures adopted by seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Management measure	Frequency	Percent	Frequency	Percent
1	None	31	86.10	35	97.20
2	Cultural practices	5	13.90	0	0.00
3	Pesticides	0	0.00	1	2.80
	Total	36	100	36	100

Source: Field survey, 2079

Table 54 exhibits that out of 36 Seri-continued farmers, damages to their mulberry garden due to wild animals such as dheduwa, monkeys, deer, rats, porcupine etc. was 22.20%, while 66.70% of the Seri-abandoned farmers indicated same problems from those wild animals.

Table 20. Wild animal damage in mulberry garden of Seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Damage	Frequency	Percent	Frequency	Percent
1	Yes	8	22.20	24	88.70
2	No	28	77.80	12	33.30
	Total	36	100	36	100

Source: Field survey, 2079

None of the discontinued and some of the Seri-continued farmers (8.30%) adopted the wild animal management measures to minimize the loss (**Table 55**).

Table 21. Management of wild animals in mulberry garden adopted by seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Damage by wild animals	Frequency	Percent	Frequency	Percent
1	Yes	3	8.30	0	0.00
2	No	33	91.70	36	100.00
	Total	36	100.0	36	100.0

Source: Field survey, 2079

Table 56 revealed that 44.4% or 16 silkworm rearing continued farmers perceived the effect of climatic hazards Likewise, 41.7% of discontinued farmers also perceived the effect of adverse climatic factors.

Table 22. Effect of climatic hazards as perceived by seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Effect of climatic hazards	Frequency	Percent	Frequency	Percent
1	Yes	16	44.40	15	41.70
2	No	20	55.60	21	58.30
	Total	36	100	36	100

Source: Field survey, 2079

Table 57 clarifies that one-third (33.3%) of Seri-farmers were highly affected by nominal droughts followed by high intensity of drought (19.4%) and low intensity of drought (16.7%) Seri-continued farmers. In case of discontinuing silkworm rearing farmers, 22.2% perceived high intensity of drought effect which is higher than continually silkworm rearing farmers.

Table 23. Intensity of drought as perceived by Seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Damage by wild animals	Frequency	Percent	Frequency	Percent
1	No	11	30.60	27	75.00
2	High	7	19.40	8	22.20
3	Low	6	16.70	1	2.80
4	Nominal	12	33.30	0	0.00
	Total	36	100	36	100

Source: Field survey, 2079

Separate silkworm rearing house/shed/room is crucial for successful silkworm rearing. However, less than half of the farmers (44.4%) used separate silkworm rearing rooms, and 55.6% farmers had no separate silkworm rearing house or shed or rooms (**Table 58**). Devastating earthquake in 2072 BS destroyed most of the silkworm rearing sheds/rooms and farmers lost their properties including their infrastructures. There was no subsidy or support to construct, repair and maintenance of such infrastructure from the government.

Table 24. Silkworm rearing house/shed of Seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Rearing house/room	Frequency	Percent	Frequency	Percent
1	Yes	16	44.4	17	47.20
2	No	20	55.6	19	52.80
	Total	36	100	36	100

Source: Field survey, 2079

Regarding the sources of young age silkworms, Table- 59 shows that 50% of Seri-continued farmers received young age silkworm from Community Silkworm Rearing Centre (CRC) followed by 27.8% hatched in their own farm and remaining 22.2% managed from other sources. While before leaving sericulture, most of the discontinued farmers (80.6%) received young age silkworm from CRC, which was well organized with 30.6% higher coverage in comparison to the present situation. It is very essential to construct /repair & maintain CRC and farmers rearing structures, which were destroyed by the earthquake in 2072 BS.

Table 25. Source of silkworms of Seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Source	Frequency	Percent	Frequency	Percent
1	CRC	18	50.0	29	80.50
2	Own farm	10	27.8	1	2.80
3	Others	8	22.2	1	2.80
4	No need	0	0.00	5	13.90
	Total	36	100	36	100

Source: Field survey, 2079

Table 60 shows that currently about 2/5th of the farmers (41.7%) obtained more than 90% hatchability of silkworm eggs followed by 80-90% hatchability by 19.4% farmers and below 80% hatchability by 38.9% farmers. In the discontinued category, 27.8%, 13.9% and 22.2% farmers obtained more than 90%, 80-90% and less than 80% hatchability, respectively. High percent of hatchability is a very important step for successful silkworm rearing.

Table 26. Hatching percentage of silkworm eggs under Seri-continued and discontinued farmers' conditions

SN		Continued		Discontinued	
1	Hatching (%)	Frequency	Percent	Frequency	Percent
2	> 90%	15	41.70	10	27.80
3	80-90%	7	19.40	5	13.90
4	below 80	14	38.90	8	22.20
5	Not applicable	0	0.00	13	36.10
6	Total	36	100	36	100.

Source: Field survey, 2079

Currently, temperature and relative humidity inside the rearing room are maintained by applying cheaper local methods (Table 61). Majority of farmers (50%) practiced soaking of jute sack in the clean water and hanging on the wall of rearing room followed by spraying of water on the floor in rearing room and other common practices, while 27.8% farmers applied none of the temperature and humidity control measures. In case of discontinued farmers, wet jute sack hanging measure was adopted by 38.9% farmers.

Table 27. Management measures adopted to maintain temperature and relative humidity of rearing house by seri-continued and discontinued farmers

SN	Management measure	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Nothing done	10	27.80	15	41.70
2	Spraying water	2	5.60	0	0.00
3	Using jute sack	18	50.00	14	38.90
4	More than two methods	6	16.60	7	19.40
	Total	36	100	36	100

Source: Field survey, 2079

Overwhelming majority of the seri-continued farmers (88.9%) expressed the need of rearing rack at present (Table 62). On the other hand, only 55.6% of discontinued farmers showed the importance of rearing rack. Continuing farmers showing importance of rearing rack was 33.30% higher in comparison to discontinuing farmers, which is related to hygienic condition of rearing of silkworm larvae.

Table 28. Preparation and use of rakes in silkworm rearing house by seri-continued and discontinued farmers

SN	Rearing slab	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Yes	32	88.90	20	55.60
2	No	4	11.10	16	44.40
	Total	36	100	36	100

Source: Field survey, 2079

The feeding frequency varied among Seri-continued farmers. It was 2-4 times for continued farmers while 4 feedings a day for discontinued farmers (Table 63). It depends on leaf quality, methods of feeding and weather maintenance during rearing period.

Table 29. Feeding frequency during silkworm rearing by Seri-continued and discontinued farmers

SN	Description	Continued	Discontinued
1	Minimum	2.00	0.00
2	Maximum	4.00	4.00
3	Mean	3.16	2.75
4	Std-dev	0.44	1.31

Source: Field survey, 2079

Table 64. shows that Seri-continued farmers reared silkworm by shoot feeding (30.60%), leaf feeding (33.30%) and practicing both methods (36.10%). Shoot feeding by discontinued farmers accounted 38.9% followed by shoot feeding & leaf feeding by 36.1% and leaf feeding by 11.1%. Currently, decline in shoot feeding by some farmers (5 farmers) might be due to cracking of rearing racks after the devastating earthquake in 2072 BS. Subsidies are not yet accessible to farmers for repair & maintenance of rearing racks from concerned offices/organizations. The advantage of shoot feeding comprises of economy in labor force, i.e. a single man can rear 2-3 boxes, natural environmental feeling of larvae while feeding, less contamination, reduced disease spreading, and mulberry leaves remaining fresh for longer duration as compared to feeding by leaf plucking.

Table 30. Mulberry feeding to silkworms practiced by seri-continued and discontinued farmers

SN	Feeding types	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Shoot feeding	11	30.60	14	38.90
2	Leaf feeding	12	33.30	4	11.10
3	Both	13	36.10	13	36.10
4	Other	0	0.00	5	13.90
	Total	36	100	36	100

Source: Field survey, 2079

Table 65 reveals that 63.9% farmers observed the highest incidence of Grasserie (Nuclear Polytherosis Virus) disease in silkworm rearing followed by more than two diseases/cross infections (33.3%) at present and even before (discontinued farmers). Grasserie is a notorious disease which occurs during 5th instar larval period prolonging during cocooning.

Table 31. Disease incidence to silkworm under Seri-continued and discontinued farmers rearing conditions

SN	Disease of silkworm	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	NPV	23	63.80	19	52.80
2	Flatcherie	1	2.80	2	5.60
3	Others	0	0.00	4	11.10
4	More than two	12	33.40	11	30.50
	Total	36	100	36	100

Source: Field survey, 2079

Table 66 shows that Seri-continued (88.9%) and discontinued (72.2%) farmers' response reveals that the highest incidence of disease in silkworm rearing is Grasserie (Nuclear Polyherosis Virus). It is a notorious disease which occurs during 5th instar larval period prolonging during cocooning, which sometime is so severe that the cocoon production fails thereby creating the situation of abandoning silkworm rearing by farmers. Proper disinfection, supply of quality mulberry leaves, maintenance of desired temperature and humidity within the rearing room, avoiding starvation of larvae and proper handling during feeding and bed cleaning play a paramount role for avoiding incidence of Grasserie disease.

Table 32. Highest affecting diseases of silkworm under Seri-continued and discontinued farmers rearing conditions

SN	Highest affecting disease	Frequency	Percent	Frequency	Percent
1	NPV	32	88.80	26	72.20
2	Flatchery	1	2.80	1	2.80
3	Fungus	1	2.80	3	8.30
4	Others	1	2.80	6	16.70
5	More than two	1	2.80	0	0.00
	Total	36	100.0	36	100.0

Source: Field survey, 2079

Disinfection plays a vital role in mitigating the incidence and spread of various kinds of silkworm diseases. Formalin/formaldehyde (CH₂O) is a pure compound consisting of pungent and colorless gas. It is used to disinfect silkworm rearing rooms and rearing materials prior to rearing. Among

the respondents, 88.9% (32 farmers) and 61.1% (22 farmers) were reported using formalin for disinfection from the Seri-continued and discontinued farmers (Table 67).

Table 33. Use of disinfectants by Seri-continued and discontinued farmers in silkworm rearing house

		Continued		Discontinued	
SN	Means of disinfection	Frequency	Percent	Frequency	Percent
1	Formalin				
	No	4	11.10	14	38.90
	Yes	32	88.90	22	61.10
	Total	36	100	36	100
2	Bleaching power				
	No	5	13.90	21	58.30
	Yes	31	86.10	15	41.70
	Total	36	100	36	100
3	Sanitek				
	No	30	83.30	35	97.20
	Yes	6	16.70	1	2.80
	Total	36	100	36	100

Source: Field survey, 2079

Similarly, bleaching powder /Calcium hypochlorite/Ca (ClO)₂ is also a disinfectant used in silkworm rearing. Table 68 shows that 86.1% of Seri-continued farmers are using bleaching powder, while about 2/5th of the discontinued farmers (41.7%) were using it to disinfect floor & walls of rearing rooms. It is necessary to make this disinfectant available in every rearing house for timely disinfecting rearing room and appliances.

Sanitech is a surface sanitizer and broad spectrum disinfectant used in silkworm rearing house and rearing materials, which is capable of eliminating 99.99% viruses and bacteria within 30 seconds after spraying. It has immense importance in disinfection of silkworm rearing, however even Seri-continued farmers lack knowledge and only 16.7% used it, while 83.3% are not aware about this disinfectant (Table 68). The importance and usage of Sanitech among farmers was very low, i.e. 2.8% by discontinued farmers to 16.7% by Seri-continued farmers.

None of the farmers in both categories had done crop insurance, which is true that there is no sericulture insurance policy in the country. Some farmers having livestock were aware of the facts of animal insurance. Although silkworms are also small animals and considered as micro-livestock, but farmers are still deprived of micro-livestock insurance policy.

Table 34. Silkworm crops insurance of Seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Insurance	Frequency	Percent	Frequency	Percent
1	Yes	00	0.00	00	0.00
2	No	36	100.0	36	100.00
	Total	36	100	36	100

Source: Field survey, 2079

Regarding training of farmers, 83.30% of seri-continued farmers and 58.39% discontinued farmers received training in sericulture (Table 69). Sericulture is not a traditional agriculture activity in Nepal. Its technologies have been imported from other countries. Therefore, training is a pre-requisite for starting sericulture enterprise.

Table 35. Training received by seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Training received	Frequency	Percent	Frequency	Percent
1	Yes	30	83.30	21	58.30
2	No	6	16.70	15	41.70
	Total	36	100	36	100

Source: Field survey, 2079

Table shows that 83.30% seri-continued farmers expressed their views on the need of training, while only 25% discontinued farmers expressed the need for training (Table 70). This could be the reason of leaving sericulture and diverting to other agri-activities.

Table 36. Training need for silkworm rearing of seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Training need	Frequency	Percent	Frequency	Percent
1	Yes	30	83.30	9	25.00
2	No	6	16.70	27	75.00
	Total	36	100	36	100

Source: Field survey, 2079

Training areas/themes for Seri-farmers include mulberry garden establishment, CRC silkworm rearing, grown up silkworm rearing, post cocoon processing, silk cloth weaving etc. Accordingly, farmers have felt the need of training in small and large silkworm rearing by 41.70% and post cocoon training by 44.40% of the Seri-continued farmers (Table 71). Even among the discontinued farmers 8.30% needed training in silkworm rearing and 13.90% in post cocoon processing, which could be due to their interest again to start silkworm rearing and post cocoon processing.

Table 37. Areas of training need of seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Training areas	Frequency	Percent	Frequency	Percent
1	No	5	13.9	28	77.80
2	Rearing (small, large silkworm)	15	41.7	3	8.30
3	Post-cocoon	16	44.4	5	13.90
	Total	36	100	36	100

Source: Field survey, 2079

Sericulture being a new introduced agriculture sector, it is natural to emerge/have different problems in government organizations, farmers' communities and particularly silkworm rearing farmers and post-cocoon processors. Table 72 shows various problems encountered by both continued and discontinued farmers. Major problem of 66.79% of the discontinued farmer was cocoon market and price. Among the seri-continued farmers, 52.80% responded combined complex problems of cocoon market and price, technical knowledge and sericulture support service of the government.

Table 38. Suggestions for improvement in sericulture by seri-continued and discontinued farmers

		Continued		Discontinued	
SN	Suggestion for improvement	Frequency	Percent	Frequency	Percent
1	Market and price	8	22.2	24	66.70
2	Technical Knowledge	3	8.3	2	5.6
3	service by government	6	16.7	1	2.80
4	All of the above	19	52.8	9	25.0
	Total	36	100	36	100

Source: Field survey, 2079

It was clear from the Table that 1/3rd of the discontinued farmers were satisfied from technical service in sericulture (Table 73). Among the seri-continued farmers, 19.40% were not satisfied from sericulture services of the government.

Table 39. Satisfaction of seri-continued and discontinued farmers on technical supports

		Continued		Discontinued	
SN	Satisfaction	Frequency	Percent	Frequency	Percent
1	Yes	29	80.60	12	33.30
2	No	7	19.40	15	41.70
3	Unknown	0	0.00	9	25.00
	Total	36	100.0	36	100

Source: Field survey, 2079

Very few farmers were satisfied from financial support in sericulture. It was clear from the Table 74 - 76 that there were few loan providers like NIC, ADB, Sanima to small farmers, and only one farmer from discontinued and 5 farmers from seri-continued categories received loan in sericulture. The amount of loan ranged between 5 lakhs to 40 lakhs and the interest rate ranged between 12 to 16%, which is quite was high for agriculture.

Table 40. Satisfaction of seri-continued and discontinued farmers on financial supports

		Continued		Discontinued	
SN	Satisfaction	Frequency	Percent	Frequency	Percent
1	Yes	8	22.2	1	2.80
2	No	28	77.8	36	97.20
	Total	36	100	36	100

Source: Field survey, 2079

Table 41. Source of finance of seri-continued and discontinued farmers on technical supports

		Continued		Discontinued	
SN	Source of finance	Frequency	Percent	Frequency	Percent
1	None	28	77.80	35	97.20
2	NIC Asia Bank Limited	1	2.80	0	0.00
3	Agriculture Development Bank Limited	5	13.90	1	2.80
4	Sanima Bank Limited	2	5.60	0	0.00
	Total	36	100	36	100

Source: Field survey, 2079

Table 42. Amount of finance received and interest rate of seri-continued and discontinued farmers

SN	Loan details	Continued		Discontinued	
		Amount (Rs in lakh)	Interest rate (%)	Amount (Rs in lakh)	Interest rate (%)
1	Minimum	15.00	12.00	0.00	12.00
2	Maximum	25.00	16.00	40.00	12.00
3	Mean	1.81	1.17	1.11	0.33
4	Std-dev	6.14	3.90	6.57	1.97

Source: Field survey, 2079

Table 77 suggests that the silkworm eggs supplied by SDC, Khopasi was of poor quality, which caused disease incidence during fifth instar rearing. This is one of the major problems of sericulture in Nepal. This was verified in the full audit of SDC, Khopasi that there were 31 parental lines and old junior staff was looking whole system of maintaining parental line, eggs production and distribution in the absence of breeding expert and sericulture officers. In field discussion, farmers expressed their similar views that the eggs supplied by SDC, Khopasi was not pure rather mixed up larvae were observed by seri-farmers in their rearing house. Other mixed responses were from both categories of farmers such as irregular supply of eggs, no irrigation facility no separate house etc. Those were the cause of leaving sericulture by discontinued farmers.

Table 43. Major problems in sericulture as perceived by seri-continued and discontinued farmers

SN	Major problems	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Disease including fifth instar	8	22.20	4	11.10
2	Quality eggs and regular supply	13	36.10	5	13.90
3	Irrigation	6	16.70	4	11.10
4	Rearing house	3	8.30	2	5.60
5	More than two	6	16.70	21	58.30
	Total	36	100	36	100

The seri-problems were further aggravated due to low level of production, low cocoon price, poor marketing, and inadequate technical services etc (Table 78). All of the factors as responded by the farmers affected farmers' performance, cocoon and silk production and productivity. Farmers responded that some of them did not get timely technical services during silkworm rearing while some others sold cocoons to private collectors but were still waiting to receive payment. In addition, some farmers complained that cocoon production was of low quality due to poor quality eggs in spite of their efforts. Government needs to initiate in formulating national policy, plan, and governing institution such as Board to bring good impact from sericulture enterprise.

Table 44. Causes of declining sericulture as perceived by seri-continued and discontinued farmers

SN	Causes of decline	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Lower production and price	8	22.20	25	69.40
2	Irrigation	6	16.70	1	2.80
3	Marketing problem	4	11.10	0	0.00
4	Poor Technical Service	6	16.70	0	0.00
5	Quality eggs	12	33.30	4	11.10
6	All of above	0	0.00	6	16.70
	Total	36	100	36	100

Source: Field survey, 2079

In terms of subsidies, none of the discontinued farmers and 69.40% from Seri-continued groups did not receive any subsidies from federal/ provincial/ local governments during mulberry gardening and silkworm rearing (Table 79). Subsidies, and Seri-promotion rewards are stimulating factors to motivate farmers to undertake this enterprise.

Table 45. Subsidies received from federal/provincial/local governments by seri-continued and discontinued farmers

SN	Satisfaction	Continued		Discontinued	
		Frequency	Percent	Frequency	Percent
1	Yes	11	30.60	0	0.00
2	No	25	69.40	36	100.00
	Total	36	100	36	100

Source: Field survey, 2079

In order to evaluate the relation and analyze the factors affecting the continuation of sericulture, quantitative analysis was undertaken which is given below.

8.2 T-test Analysis

There existed significant differences between the Seri-continued and discontinued farmers ($p \leq 0.05$) among different variables such as total landholding, worm rearing frequency, price of cocoon, initial/current mulberry coverage, family member involvement, initial/current mulberry plants, diseases, wild animals, egg hatchability, rearing materials, disinfectant, training and mulberry transplanting methods (Table 80). Among them, rearing frequency, cocoon price, mulberry coverage, family member involvement, damaged by wild animals, drought, egg hatchability, rearing materials, disinfectant and trench transplanting were highly significant ($p \leq 0.01$). The statistically significant values clearly indicate the contribution of each variable in sericulture and should be taken into consideration in planning and strategic development of sericulture.

Table 46. T-test statistics for seri-continued and discontinued farmers

Parameters	t-test statics	Significance (2-tailed)	Mean difference	Standard error difference
Total landholding (Ropani)	2.047	0.044*	11.028	5.387
Mulberry coverage (Ropani)	3.618	0.001**	14.944	4.131
Mulberry transplanting in trench (Freq)	3.276	0.002**	0.361	0.110
Disease management (Freq)	2.190	0.032*	0.389	0.177
Damage by wild animals (Freq)	-4.183	0.000**	-0.444	0.106
Drought affecting mulberry garden (Freq)	5.538	0.000**	1.250	0.226
Family member involvement (No)	4.867	0.000**	1.972	0.405
Farmers receiving training (No)	2.393	0.019*	0.250	0.105
Rearing slab/rake use (Freq)	3.354	0.001**	0.333	0.099
Disinfectants use (Freq)	2.833	0.006**	0.278	0.098
Low-hatchability of silkworm eggs (%)	3.030	0.003**	0.750	0.248
Silkworm rearing/year (Freq)	-4.128	0.000**	-1.000	0.242
Price of cocoon/kg (Rs)	7.275	0.000**	235.972	32.435

*= Significant at 5% level of significance; **= Significant at 1% level of significance

Source: Field survey, 2079

8.3 Correlation Analysis

Pearson correlation analysis is presented in Table 81. The correlation analysis reveals that there are many variables showing significant to highly significant relationships which are highlighted with asterisk marks, like landholdings, mulberry coverage, total mulberry plants, family member involvement, numbers of egg boxes, rearing frequencies, cocoon production, and income as important factors affecting continuation of sericulture. Considering each of these variables in planning and strategic development of sericulture would help to improve the performance of sericulture.

Table 47. Pearson correlation analysis indicating factors to continuation of sericulture

Variables	Upland holding	Lowland holding	Total land holding	Rearing frequency	Total No of egg boxes	Cocoon prod per box	Cocoon prod per year	Cocoon price per kg	Cocoon sale income	Initial planting	Current planting	Member engage	Member engage	Total member engage	Total mulberry plant	Existing mulberry plant
Upland holding	1															
Lowland holding	-.176	1														
Total landholding	.348**	.859**	1													
Rearing frequency	-.083	.129	.087	1												
Total No of egg boxes	-.018	.410**	.379**	.222	1											
Cocoon prod per box	.099	.060	.120	.113	.062	1										
Cocoon prod per year	-.045	.405**	.361**	.243*	.958**	.169	1									
Cocoon price per kg	.090	.148	.191	-.502**	.109	.428**	.123	1								
Cocoon sale income	-.048	.426**	.379**	.222	.982**	.136	.992**	.139	1							
Initial planting	.059	.840**	.825**	.101	.709**	.018	.680**	.234*	.706**	1						
Current planting	.049	.673**	.662**	.035	.808**	-.008	.769**	.262*	.802**	.902**	1					
Member involve	.366**	.180	.349**	-.213	.214	.203	.175	.401**	.197	.222	.214	1				
Member involve	.083	.293*	.316**	-.274*	.158	.065	.116	.410**	.144	.318**	.303**	.651**	1			
Total member involve	.254*	.258*	.367**	-.255*	.207	.159	.164	.440**	.191	.290*	.275*	.920**	.893**	1		
Total mulberry plants	.039	.601**	.590**	.146	.924**	.016	.882**	.166	.913**	.878**	.918**	.169	.208	.203	1	
Existing mulberry plant	.030	.493**	.482**	.093	.952**	.002	.908**	.183	.942**	.794**	.915**	.193	.205	.214	.971**	1

*= Significant at 5% level of significance; **= Significant at 1% level of significance

Source: Field survey, 2079

8.4 Probit Regression Analysis

The factors affecting the continuation of sericulture enterprise by the seri-farmers analyzed by using the probit model is presented in Table 82. The dependent variable is a binary variable with a value of 1 if a farmer is continuing sericulture and 0 otherwise. The log-likelihood ratio chi-square value was highly significant implying a good fit of the model with included explanatory variables. The pseudo R² was 0.63 indicating that nearly 2/3rd of the continuation of seri-enterprise contributed by these factors.

Table 48. Probit regression indicating factors to continuation of sericulture by the farmers

Variables	Coefficient	Marginal effects ¹
Constant	-2.425	-
Education of HH head	-1.099	-0.309***
Landholding size	0.034	0.010**
Number of family members engaged in sericulture	0.538	0.152***
Sericulture in group/cooperatives (dummy)	1.130	0.252**
Perception of receiving lower price (dummy)	-0.523	-0.142 ^{ns}
Irrigation facility availability (dummy)	1.775	0.254**
Training on silkworm rearing and post-cocoon management (dummy)	1.583	0.450**
Technical support receiving (dummy)	1.377	0.452*

¹ Marginal effects refer to the partial derivatives of the expected value with respect to the vector of characteristics; ***, **, and * represent significant at 1%, 5% and 10% level, ns means non-significant; Log Likelihood Ratio Chi² (8) = 62.25; Prob > Chi² = 0.00001; Log likelihood = -18.784; Pseudo R² = 0.63.

With one-unit increase in the size of land holding, the probability of continuation would increase by 1 percent. Similarly, with additional one-member increase in the household, the probability of

adoption will be 15 percent. The probability of continuing sericulture is higher by 25.2% for those households that have undertaken sericulture in a group and cooperative than the individual members. The probability of continuation would be higher for farmers receiving irrigation facility by 25.4% than the non-receiving households. Similarly, the probability for farmers receiving technical support and training on silkworm rearing and post-cocoon management would be higher by 45% than farmers not receiving training and technical support.

All the included explanatory variables are significant with their expected sign except the perception on receiving a lower price, for which the coefficient is negative. It shows the size of the landholding, number of family members engaged in sericulture, sericulture undertaken in a group and cooperatives, availability of irrigation facility, receiving training on silkworm rearing post-cocoon activities, and receiving technical support influenced the continuation of sericulture, while lower price of cocoons distracted them. The education (level of schooling) of the household head also negatively influenced the continuation of sericulture activities. For a unit increase in level of schooling, the likelihood of continuation decreased by 30.9 percent. It means the probability of discontinuation of sericulture would be higher for educated members, which could be due to their attraction to other job opportunities.

8.5 Major collectors and processors of silk in Nepal

Study team visited, observed and discussed with some silk cocoon collectors and processors in Nepal. In the initial period of farming, Government of Nepal used to adopt a practice of purchasing the cocoon from the producer farmers directly and sell to processors and traders. Later on in 2070 BS, Government changed its policy and drop out to purchase cocoons from farmers, then they used to sale their cocoon to the private entrepreneurs. It was the one of the major factors for declining sericulture production in Nepal. Now, there are very limited silk cocoon collectors (Table 83) found and they were also involved in silk processing. The study team observed the processing plant and discussed with processors in the related subjects. In discussion with processors they said that Nepalese silk has good quality and pure silk is highly expensive but market is more competitive. So, they used damaged or low grade cocoon and weaving them in charkha and then mixed with domestic silk fiber or imported ones from abroad particularly from China. They were working with limited staffs in their small processing plants. It is also known that the most saleable sericulture items produce in Nepal are shawls, plain clothes, sarees, ascots, carpet, purse etc. when we analyze the value chain perspective of products. Data shows that the cost of silkworm rearing was higher than the revenue received while processing/value adding with processed goods (Products) had positive net income/revenue.

Regarding the support provided by government to processor, they do not have received any support from government and they requested to support in manpower development (post cocoon training), processing plant installation and technology development and export base incentives. Cocoons are collected from Chitapol, Bhaktapur and four handmade reeling machines have been used in reeling cocoons to thread yarn.

Family labors are used to reel cocoons with capacity up to 500-700 kg cocoons reeling a year. It produces 10-15 kg / month fiber production and silk fibers are supplied to Kala Guthi, Lalitpur.

Table 49. **Name** of consulted processors

SN	Name of Firm	Proprietor	Address	Contact No.
1	Laxmi Handicraft Industry	Krishna Shrestha	Panauti, 10	9841470130
2	Sworgadwari Silk Development Research & Processing Center	Mahes Datta Adhikari	Gadhawa Municipality	9866415262
3	Impower international Expert Group/Nepal Silk	Mohini Maharjan/Gita Shrestha	Nayabazar, Kathmandu	9851035104
4	Nepal Creative Kala Guthi Textile & Sericulture Institute	Urmila Upadhaya	Dhobighat, Lalitpur	01-5444243/ 9841560737
5	Gandaki Handicraft	Pushpa Devi Kumal	Gorkha	956043220

Problems/constraints

- No subsidies or other supportive program from Government to the processor (traditional reeling machine, twisting etc).
- Irregular and low volume of cocoon received from farmers.
- Scattered pockets, weak grading practice and all sort of cocoon coming from farmers.
- Lack of well-trained manpower for weaving and designing.
- Long process taking to export products.
- Lack of research and development support (technology transfer).
- Expensive wages @Rs.800/day.
- Competition with Chinese and Indian yarns.

Suggestions

- Government support needs in processing plant installation and technology development.
- Encourage farmers to produce bulks of silk cocoons.
- Strengthen the cocoon grading system and price fixing as per standard.
- Support in the involvement of private sectors in whole value chain system.
- Export base incentives, subsidies in the pre- and post-cocoon production including weaving machines.

8.6 Focus Group Discussion

The study team visited nine districts as per given ToR and discussed with seri-farmers, local leaders and technicians about present practice, major constrains and possibility of promoting sericulture in future. Silkworm rearing (former and present) farmers, local leaders, former representatives of the group, cooperative members, institutional representatives and entrepreneurs were accommodated in the focus group discussion (**Appendices....**)

Problems/constraints

1. Poor quality of silkworm eggs, low hatchability and mixed larval types occurring during rearing.
2. Damage of infrastructure by earth quake (CRC and worm rearing house or room including building)
3. Poor technical services of the government after earthquake of 2072 and Covid-19.
4. Farmers have small size farms, production cost of cocoon is high and price of cocoon is low.
5. Heavy disease incidence in the 5th instar larval growth period.

6. Lack of trained manpower and no training on post-cocoon production activities.
7. Difficulty to sale cocoons and lack of drying and storage facilities.

Suggestions

1. Government should maintain quality eggs and supply high quality eggs timely and regularly.
2. Subsidies have to be provided for construction of CRC and worm rearing houses.
3. Price of cocoon should be increased **in comparison to that is provided by** neighboring countries.
4. Farms and farmers should be categorized as commercial and non-commercial types.
5. Quality control of cocoon and market assurance including post cocoon training are necessary

8.7 Municipality Level Discussion

The study team visited different Municipalities, their representatives and discussed about sericulture program. Among the discussed municipalities included Chairman of Sahid Lakhan Rural Municipality Gorkha, Vice Chairman and Ward Chairman of the Myegang Rural Municipality of Nuwakot, Vice chairman of the Gadawa RM of Dang, Chairman of Madi Municipality of Chitwan. Some of the representatives were found to be unaware about the sericulture program running in their area, which may be due to recently elected new faces in the offices. However, after the discussion, they were highly enthusiastic over the sericulture program and farmer income generation activities. The Megang Rural Municipality of Nuwakot and Shahid Lakhan Rural Municipality of Gorkha are willing to invest budget in sericulture if the farmers demanded.

The study team visited Madi Municipality, Chitwan, Dhankuta Municipality, Dhankuta, Panauti Municipality, Kavre, Megang Rural Municipality, Nuwakot, Shahid Lakhan Rural Municipality, Gorkha, Illam Municipality, Illam, Mandandeupur Municipality, Kavre and Gadawa Rural Municipality of Dang districts and discussed with agricultural officers/ technicians working in respective municipalities. The team studied about the agricultural programs run by municipalities, and existing manpower and scope of sericulture in the municipalities. During the discussion it was revealed that except Gadawa and Shahid Lakhan Municipalities all remaining Municipalities do not have any program related to sericulture. As in case of Gadawa and Sahid Lakhan Rural Municipalities, they are providing subsidies to the farmers for nursery establishment and mulberry plantation. Regarding the technical knowledge on the part of technicians, no one is getting training in sericulture but have little knowledge on sericulture (**Appendix**).

8.8 Provincial Workshop

Study team participated in Provincial Workshop on restructuring of sericulture program organized by CIED with the coordination of **Ministry of Agriculture** of Koshi and Gandaki Province. A zoom meeting was organized to discuss on restructuring of sericulture in Lumbini Province and phone contacted with secretary at Bagmati Province. The program was chaired by Agricultural Minister of respective provinces. The outcomes of the workshops are summarized (**Appendices**).

The discussions revealed that sericulture is not the priority program of provincial government. The reasons for declining the sericulture are several but one of the important reasons is its highly

technical and complex [job nature](#). At the same time, [shortage of technical manpower](#), availability of quality eggs, infestation by disease, problem in marketing and low price of cocoon are major ones. Regarding the role and responsibility at the changed context, responsibilities varied at different levels, such as quality eggs and manpower development at federal level, processing and technical back-stopping at provincial level and program implementation by the local government. At the same time, province may play coordinating role between federal and local level in program implementation, monitoring and evaluation. In this regard, involvement of provincial technicians to participate in meeting conducted by CIED seems imperative to be aware of various sericultures.

Gandaki province has expressed views to establish structures and maintain parental lines of silkworm breeds in Industrial Entomology Development Center, Bandipur, Tanahu, with the help of [Sericulture Development Center](#), Khopasi. However, there is a huge gap of technicians especially in sericulture, so CIED take lead in human resource development of both farmers and technicians.

8.9 AKC/ADO Visits and Discussion

As per given ToR, the study team visited Agricultural Knowledge Centers (AKC's): Illam, Dhankuta, Sunsari, Nuwakot, Gorkha, Nawalpur, Tanahu and Chiwan ([Appendix](#)). During the visit, working team discussed with officials of respective AKCs. It was found that except Sunsari and Dhankuta remaining districts do not have direct linkages with sericulture farms and CIED. However, sometimes sericulture farms have requested to select nominees of both technicians and farmers for sericulture training. In the case of Agricultural Knowledge [Center](#), Dhankuta and Sunsari, previous sericulture farm of Itahari and Dhankuta have been assimilated to the respective AKCs. After the restructuring of sericulture farms, separate unit has been established to run the sericulture development program at respective AKCs. These two offices are implementing and supporting to implement various program on sericulture. However, the ToR and guidelines are not yet developed. There are limited staffs (technicians) in the office to provide technical services to the farmers. The main activities include collection of mulberry saplings and silkworm eggs demand, providing young age silkworm in coordination with SDC, collection of cocoons and organizing training, which are performed by AKC Dhankuta and Sunsari.

Problems/Constraints

- Working as sericulture unit without [clear guidelines](#) with limited staff under Dhankuta and Sunsari AKC.
- Sericulture pockets are located in remote inaccessible areas that cause difficult in monitoring and supervision.
- Eggs supplied by Khopai is of poor quality. Very limited farmers are rearing silkworms and most of the farmers have left sericulture due to low price of cocoon and less profitable than other crops.
- The earth quake of 2072 has destroyed most of the CRC buildings and farmers' rearing house.
- They ensured the study team that if the price of cocoon is increased to Rs 1000/kg, they can re-emerge in silkworm rearing in their pocket areas.
- By evaluating the quality of Nepalese silk cocoon, some Indian buyers have shown interest to buy Nepalese silk cocoons. They are ready to supply eggs to the growers, if agreements can be made with growers.

Suggestions

- National sericulture policy with **clear guidelines** for sericulture development should be pursued.
- Seri-farmers cluster/community, groups with mulberry garden, CRC and worm rearing houses should be developed
- High quality of double hybrid eggs with excellent hatchability should be supplied.
- Cocoon marketing, grading and pricing as per recent standard in comparison to other countries need to be developed and adopted.
- **Strong linkage** and coordination among all stakeholders should be established.

8.10 Key Informants Discussion

Study team **visited and interacted with** sericulture experts personally and collected information through email as well. Regarding the restructuring of sericulture program mixed types of views were received from the informants (**Appendix**).

8.11 Experts' Suggestions

- Identify sericulture technicians in Nepal, maintain their roster and mobilize in proper places.
- Develop human resources as per need and initiate their retention strategy.
- Stakeholders' commitment & dedication to sericulture development in all sectors to be maintained.
- Strengthen monitoring and evaluation mechanism by concern authorities and creating an enabling environment with transparent motivational packages.
- Implement the sericulture program/activities in cluster approach, and demonstration to aware, understand and create interest among stakeholders.
- Properly conserve & maintain parental silkworm races (Kin, Shu, Sho, Wa and other promising races) at SDC-Khopasi as well as high yielding mulberry varieties such as S-34, S36, V-1, Kosen, G-2, etc available at SDC- Khopasi, NMC- Bhandara & SPC-Itahari, all at NMC, Bhandara, Chitwan.
- Develop infrastructure and technology packages like mulberry cultivation, silkworm rearing, post cocoon activities etc.
- Domesticated Silkworm Genetic Materials (bi-voltine & multi-voltine) being the legal concern of International Sericulture Association/ISC, assure the silkworm strains better maintained condition at SDC, Khopasi, which otherwise are degenerated.
- Develop private sector to supply quality inputs (disinfectants, cheaper mounting materials) and make available to the farmers.
- Launch the sericulture development program by defining the categories of the producers – like livelihood support for small farmers and commercial production in case of large commercial farmers.
- Improve training quality and enact proactive extension strategy.
- Identify suitable silkworm races and mulberry varieties for plains and hills for farming by the farmers.
- Rear young age worm at CRC and distribute minimum/reasonable prices to the farmers.

- Use separate silk worm rearing houses at the farm level.
- Provide research support in different aspects (mulberry, silkworm races, disinfectants, mounting materials, post cocoon activities etc) of sericulture to the concerned institutions such as governmental as well as private sector.
- Initiate production-based incentive program for the farmers and entrepreneurs.
- Set target to produce >100 tons of cocoon per year and proceed at increasing rate at the farmers' level.
- Integrate sericulture to other sector of agriculture (silk and milk, fish and silk, agro-forestry) and forestry (integrated approach) to increase farm income and also to support livelihoods of the farmers.
- Stop cocoon purchasing by the government with declaring minimum support prices of cocoons.
- Improve sericulture extension program by integrating with district level agriculture offices (AKC) responsible for its extension.
- Government role to be focused to silkworm breed maintenance, mulberry varieties development, linkage and coordination enhancement and policy support to facilitate related sectors.
- Carry out the value chain analysis in sericulture and intervene to the necessary steps.
- Monitor and make necessary arrangements regarding gap analysis in silkworm seed, parental stock, mulberry, silkworm and post cocoon research and demonstration.
- Increase functional linkage and coordination with national institutions (research and education).
- Improve adherence urgently for international technology transfer (Membership of ISC).
- Think for [forming Silk Board Concept](#) to boom sericulture in the long run.

SAN President's Suggestions (Mr. Shankar Pandey)

- Silk work was more in early days but now almost in hibernation.
- Sericulture is a viable product but it could not be commercialized in Nepal.
- It was introduced in project form but could not get pick up and established at farmer's levels.
- Earlier cocoon production was praise worthy, but there was market problem, now there is national/ international market but production is negligible.
- There is sharply hike in silk yarn price. Before 10-12 years, it was Rs 1200/kg but now it is Rs 8000/kg.
- After state restructuring, it is further deteriorated and this sector is being ignored,
- Central Silk Board is famous in India. Such Board is needed to for silk related policy making and implementation. Government should support and work in quality maintenance and research specially to distribute quality eggs, high yielding mulberry varieties and double hybrid disease tolerable silkworm races.
- Government should also support in processing plant, dying and reeling of silk yarn.
- Now carpet industry consumes most silk which is about 200-300 mt. coarse silk yarn.
- Sericulture started in scattered area selecting small farmers with low level cocoon production. Private sector only enters in this business when it is commercially viable and supported by government.

- Hence, it is necessary to understand the government to go to needy people with favorable national sericulture policy development in a fast track and gradually reduce reliance on silk import.

Seri-expert's Suggestions (Dr. Narahari Prasad Ghimire)

- Maintain seed production and distribution chain by the government.
- It is high time to be serious in pure line maintenance of silkworms for quality egg production.
- Sericulture sub group should be under Plant Protection Group up to class II level without diverting their concentrated efforts in sericulture.
- Incentive to the technicians working in sericulture including health checkup and insurance facility.
- Involvement of AKC should be made for program extension at the district level.
- SRDP emphasized to implement program through NGO; impact is measurable; it is a learning lesson.
- Leaders' expertise and reflection was visualized in JICA program implementation; Chujuro was leader activities were smoothly running, but when Kanoo's leadership revealed conservative approaches.
- PMAMP sent budget to make sericulture block in Gadawa Dang, but was not realized as the targeted program. Therefore, budget dispersion with commitment of the local level is needed.
- Success stories are not highlighted. Program should be headed through success pocket as demonstration to farmers.
- The program should not be drop out, consider for community selection and continuity.
- Agriculture and industries should be made unbreakable chain to benefit all sectors with value addition
- Funding for farm, and research should be made by federal government.

Mr. Tej Prasad Adhikari's suggestions

- Transparent approach should be adopted in program implementation.
- Personal interest has made program miserable (from Itahari, cocoons were send to India intentionally, weighing of cocoons also was questionable).
- Training in sericulture should be organized at the field level to minimize cost.
- Many silk threads pass through informal route/channel, so difficult to give right answer by businessman.

SAN Seri-officer's Suggestions (Mr. Suman Sekhar Manandhar)

- It is a product having greater scope to reduce poverty.
- Role clarification should be made between government and private sectors.
- Government must support cocoon buying/reeling to handle by the private sectors.
- Government role must be concentrated in breed and egg maintenance, silkworm/mulberry development, research with short-term to long-term national plans and policies.
- Program should be run from capacity of reeling machine to the backward linkage.
- At the beginning wrong information was provided to private entrepreneur. Government report was conservative to private sector.

- When Maggi Shah installed reeling machine in Birtamod targeting Ilam silk, it was difficult to collect cocoons (over months in different seasons) and full-fledged factory running with necessary volume of cocoons. The machine could run only in 30% of its capacity. At the same time, interest of NGO (Luthern World Service) and entrepreneur could not be matched.
- In early days, eggs were brought from outside, and likewise, silk twisting was done outside. Seri-chain from mulberry garden to silk product is not complete in Nepal.
- Input based subsidy should be transferred to output based performers to motivate them.
- Cocoon were brought without following grading technique, indiscrimination in pricing made a sort of conflict in cocoon valuation.
- Chain of activity should be in harmony from production to reeling, e.g. A grade 5 kg cocoon can produce 1 kg of thread. Similarly, in 1:7 ratios, if 10 mt of target is set for thread cocoon needed is 70 mt, so planning for rearing should be made accordingly.
- Varietal character of mulberry and silkworm, rearing season should be adjusted.
- Unfair activities should be removed in the chain (even at farmer level – they used to take 5 box worm which have capacity of only 2 boxes, they use 3rd of 4th instar larva as feed to poultry).
- Cluster cooperative and revolving fund should be managed to make transection during rearing and cocoon collecting time.
- Unlike Chulthai silk in Thailand or some company from China can be invited to increase production and productivity of cocoons.

NARC Consultation and Suggestions

The study team visited to NARC Entomology Division and consulted with Mr. Bishnu Neupane, Senior Scientist of the Division. Right now, Entomology Division does not have infrastructure and facilities for Sericulture research. The expectation of carrying out research in sericulture from NARC is not possible at the present context. The study team also visited to National Gene Bank of NARC Khumaltar and consulted with Program Chief Dr. Balkrishna Joshi, who responded positively for preservation of the silk egg in the gene bank. The eggs should be hatched in every two years, so the mulberry garden and rearing facilities should be either developed or should have agreement with Government to use the present facility of SDC for the same purpose.

8.12 Sericulture Development Farms

The study team visited SDC Khopasi under federal government and rest eight other sericulture farms under the provincial government. Their mulberry coverage and staff are shown in [Table 84](#). Visual observation, participatory discussion, office ToR and approved program budget for the sericulture development activities were reviewed. Interaction and discussion were made with office chief, supporting staffs, office ToR and Programme budget were also studied. The experiences of the staffs were shared. As per the ToR it had to perform the technical audit of SDC [Khopasi](#). For this purpose, the team visited Khopasi three times to observe sericulture programs and activities.

Table 50. Mulberry coverage and office staff of seri- farms

SN	Name of Farm	Address	Contact person	Total area (Ropani)	Mulberry area (Ropani)	Total technical staff	
						Trained	Untrained
1	Sericulture Development Center	Khopasi Kavre	Yam Kumar Shrestha	126	30	2	2
2	Prajanan bij koya Shrot Kendra	Dhunibesi, Dhading	Sudhir Paudel	200	100	4	2
3	Byabashayik Grainage Kendra	Chitapol Bhaktapur	Sulochana Shrestha	75	30	1	3
4	Resham Bikas Kendra	Bhandar, Chitwan	Prnima Chhetri	320	120	1	3
5	Bagbani bikas shrot kendra	Pokhara	Govinda koirala	100	10	1	6
6	Krishi Bikas Shrot Kendra	Syanja	Sudip Regmi	41	25	1	4
7	Byabashayik Kit Bikas Kendra	Bandipur, Tanahu	Bhabanath Devkota	140	20	2	1
8	Kishi Gyan Kendra	Dhankuta	Nagendra Bdr Rana	40	20	1	7
9	Krishi Gyan Kendra	Itahari, Sunsari	Nil Prakash Singh	93	27	1	6
Total				1135	382	14	34

The study shows that the total area covered by sericulture farms in Nepal is 1135 Ropani (56.57 ha) and area under mulberry cultivation is about 362 Ropani (18.1 ha). Among these farms, only Sericulture Development Center, Khopsi is under the Federal Government and remaining eight farm centers are under the jurisdiction of Provincial government. There are no prescribed direct linkages among federal and provincial farms but they have functional linkages such as human resources development, supply of eggs and mulberry saplings. The Sericulture Development Farm, Khopasi provides eggs and technical back stopping to all of them.

Regarding the technical knowledge of the staff on sericulture, out of 34 staffs working in different sericulture farms only 14 (41.17%) have received general training in sericulture. Sericulture itself requires special knowledge e.g. breeding, rearing, pest management, post cocoon etc. which lacks among recent working staffs.

Problems/constraints

- Transfer of seri technicians to other agriculture sectors.
- Lack of post-cocoon activities in the center.
- Small and large size farms and farmers.
- Parental line maintenance infrastructures and Breeder/Experts
- Scattered production area and low volume of production (many districts with low volume cocoons)
- No incentive for technicians working in sericulture (job is from morning to late night).
- SRDP only emphasize the involvement of NGOs, while private sectors are not attracted without government supports. Therefore, role not specified between government and private sectors.
- Scope of technicians is limited as there is no diversity in and incomplete chain of activities.

Suggestions

- Retention of seri-trained staff in sericulture offices and farms.
- Maintenance of parental lines and grainage including silkworm breeder for producing quality eggs.
- Organizing farmers' cluster programs with high yielding mulberry varieties and rearing house for high quality cocoon production and productivity.
- Farmers training in mulberry gardening, silkworm rearing and post-cocoon processing.

8.13 Demand and Supply of Silkworm Eggs

Table 85 depicts the situation of silkworm egg distribution in different seri-command areas in relation to the government run Sericulture Development Center (SDC) and Sericulture Development Offices (SDOs).

Table 51. Egg supply to seri-farms and seri-farmers for silkworm rearing and cocoon production

SN	Districts	62/63	63/64	64/65	65/66	66/67	67/68	68/69	69/70	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79	79/80
1	Dhunibesi	617	150	619	535	463	275	365	297	95	490	350	160	175	50	59	35	18	12
2	Syangja	199	159	120	113	76	78	125	225	85	35	95	105	128	171				
3	Pokhara	52	85	61	57	80	41	71	45	50	65	155	55	55	25				
4	Bandipur	273	284	268	219	200	190	180	55	177	110	150	70	44	20				
5	Itahari	621	390	450	447	267	225	243	440	752	430	398	305	240		120	100	65	24
6	Bhandara	981	731	714	696	465	342	333	290	345	322	293	395	300	65	100	50		
7	Dhankuta	95	156	128	112	80	66	53	45	19	33	16	21	20	15	15	25	10	20
8	Chittapol	12	12	16	6	6	2	16	8						5	5	5	5	8
9	Kavre	21	71	140.5	125	131	106	150	134	180	63	5	5.5	17	2		5		
10	Dang															113	230	200	60
11	Nawalpur																	20	
12	Gorkha																		6
	Total	2871	2038	2517	2310	1768	1325	1536	1539	1703	1548	1462	1117	979	353	412	450	318	130

Source: SDC, 2079

There were differences in number of egg boxes produced in Khopasi and distributed to farmers in seri- command districts as learned from the field visits and discussion. It also revealed a gradual decline in demand and supply of silkworm eggs starting from fiscal year 2062/63 to 2079/80 (Figure 7). From the fiscal year 2076/77 onwards, 6 out of the 12 silkworm rearing districts, i.e. Syangja, Pokhara, Bandipur, Bhandara, Kabhre and Nawalpur had no demand/supply of silkworm eggs. This discontinuation could be attributed to the handover of different SDOs to the provinces. Previously, Bhandara had the highest level of demand/supply of eggs followed by Dhunibesi.

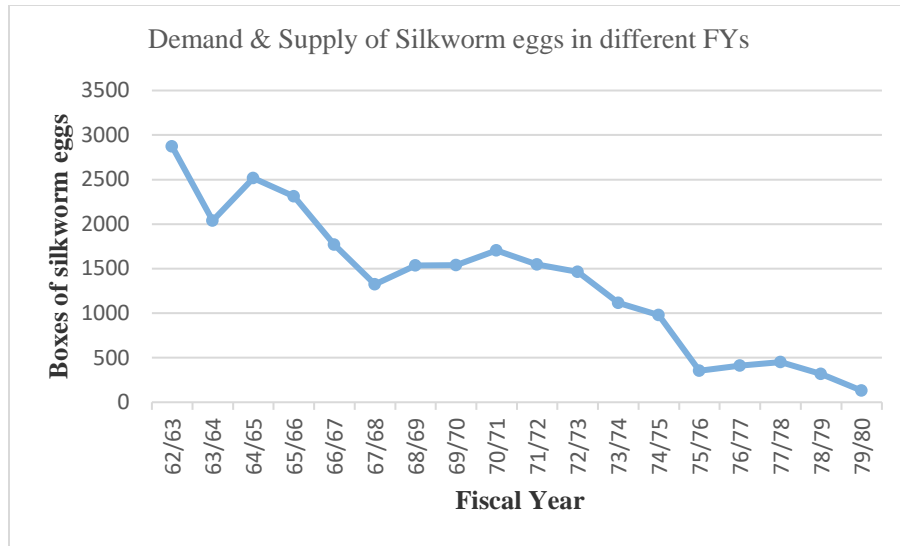


Figure 1. Demand and supply of silkworm eggs (boxes) from 2062/63 to 2079/80

As there was JICA funded project in sericulture development sector from fiscal year 2062/63, first year showed influx of demand and supply of eggs. Then, sericulture could not catch feeling and concerns of farmers and entrepreneurs, the demand of eggs declined afterwards. Although it was seen slight revival from fiscal year 2067/68 to 2070/71, again it started declining after 2071/72. Discontinuation of grant in sericulture sector from this fiscal year caused falling in demand and supply of eggs. After disaster of the earthquake in 2072 BS also caused negative effect in this sector, when many of the sericulture infrastructures of SDC/SDOs, farmers' houses and silkworm rearing structures including CRC buildings were destroyed. Farmers seriously felt that they hardly received the technical assistance from sericulture extension services after the earthquake and their attraction in the sericulture also declined due to lower to cocoon price as compared to its cost of production. The effect aggravated again due to Covid-19 pandemics. Demand and supply of eggs and service to farmers and incentives were not tied up with necessary supports by the government such as link and assistance from different donor funded projects. In the current fiscal year (2079/80), silkworm egg supply reached to merely 130 boxes as compared to 2871 boxes in fiscal year 2062/63, which is just 4.52 percent of the fiscal year 2062/63.

8.14 Organization Linkage

The challenges in promotion of the sericulture development in Nepal are numerous. Among them the lack of basic data on sericulture is important one. After the promulgation of new constitution of Nepal 2015, country entered into federal system with three-tiered structure as federal, provincial and local government. With the change in the governance and administrative structure, the organogram of the Ministry of Agriculture and Livestock Development also changed. As a result, roles, and responsibilities of the sericulture development have been changed. Out of total 9 sericulture firms, only SDC Khopasi is under federal system and remaining other farms are under the respective provincial government. There is no direct linkage among federal, provincial and local level government, and no working facilitation rules are enacted.

8.15 Import/Export of Silk and Related Products

Silkworm rearing results in diversified important valuable value chain products. Import and export statistics of sericulture products in Nepal reveals the diverse types of cocoon and silk import in

Nepal (Table 86). From silk cocoons to different silk yarn and raw silk products of 9 different items valued Rs 8439,89 thousand was imported during the first 11 months of the fiscal year 2079/80BS. Among them the least imported is the silkworm cocoon because of with the least value addition. Different readymade silk products with value addition worth of Rs 7,35,94 thousand was exported from Nepal in the same fiscal year (Table 87).

Table 52. Import statistics on silk and related products Based on Annual data of FY 2078/79 (Mid July 2021 to Mid July 2022), (Import Value and Imports Revenue are in Rs. Thousands)

HS Code	Description	Unit	Quantity	Import value (000)	Import revenue (000)
50010000	Silk-worm cocoons suitable for reeling	Kg	20	49	6
50020000	Raw silk (not thrown)	Kg	8687	19196	3581
50030000	Silk waste (including cocoons unsuitable for reeling, yarn waste)	Kg	431	1012	189
50040000	Silk yarn (excluding spun from silk waste), not put up for retail sale	Kg	49084	356543	66094
50050000	Yarn spun from silk waste, not put up for retail sale	Kg	131472	371584	66015
50060000	Silk yarn & yarn spun from silk waste, put up for retail sale; silk-worm gut	Kg	7058	20065	3725
50071000	Woven fabrics of noil silk	M ²	7754	12144	218
50072000	Woven fabrics of silk, containing >85% weight of silk/of silk waste	M ²	24232	38953	825
50079000	Woven fabrics, containing <85% weight of silk or of silk waste	M ²	141230	24443	6401
	Total (Rs)			843989	147053

Source: TEPC. 2023. Trade & Export Promotion Centre. Ministry of Industry Commerce and Supplies, Kath., Nepal

Table 53. Export statistics on silk and related products as (up to 11 months of FY 2089/80)

HSCode	Description	Unit	Quantity	Import value (000)	Import revenue (000)
62061000	Women's or girls' blouses, shirts, shirt-blouse of silk or silk waste	Pcs	36490	37642	
62141000	Shawls, scarves, mufflers, mantillas, veil, etc, of silk or silk waste	Pcs	28358	35952	
	Total (Rs)	Pcs		73594	

Source: TEPC. 2023. Trade & Export Promotion Centre. Ministry of Industry Commerce and Supplies, Kath., Nepal

At present, the mulberry acreage and cocoon production statistics indicate a very miserable situation of sericulture in Nepal. However, evaluating past efforts and future opportunities shows that there is very good scope and great potential of sericulture in the country, and hence, huge amount of money could be retained within country if sericulture sector could be developed and produced quality cocoons and silk yarn involving rural mass in this Seri-enterprises.

As known from the private entrepreneurs most of the silk yarn imported in Nepal is used in carpet making. Up to the 300 mt of silk thread is used in carpet making in a year. Likewise, considerable silk volume is used in Pashmina industry. Commerce policy 2065 of Nepal states the promotion of sericulture in Nepal. The objective of the policy aims to reduce the import expenditure of the nation in silk and related products. However, investment in mulberry and silkworm promotion work in not seen in practical field from commerce/trade sector.

About 68 silk related importer/industries are listed in Nepal ([Appendix](#)) however most of them [shutdown their business](#) after earthquake and covid-19. [Table 88](#) shows some entrepreneurs are involved in import and export business of silk and silk related products. In the interaction with entrepreneurs it was difficult to track in matter of silk transaction. This may be because of their business secret. This is one of the facts that study team realized why sericulture is so important in Nepal. Ministry of Agriculture [and Livestock Development](#) is primarily focused on production of raw agricultural products but profit maximization occurs through value addition. The poor farmers' hard work and national endeavors should be oriented towards product diversification and linking business for the promotion of quality silk cocoon production and post cocoon processing in the country.

Table 54. List of consulted importer /exporters

SN	Name of the Firm and address	Contact person	Phone	import (silk)	Price /kg	Export items	Major market	Demand (kg/annum)
1.	Shangrila Silk and Pasma , sundarbasti, Budhanilkantha municipality(1988)	Kamal Bista	4370776	1 ton pure silk from China	117 euro/kg	shawal, khasto	Germany	1000
2	Everest Fashion craft ,pv.ltd lajimpat Kathmandu	Ram Prasad shrestha	4510806	Nepali and Chinese	Rs 10000-12000/kg	shawls,	USA	300
3	Nepal Pasma udhog kalimati Kathmandu/ matatirtha	anupam shrestha	9802015890	Chinese	NRS7000-8000/kg	Mixed with pasmina and cotton	France , Japan	500
4	Silk Fabric Nepal, Bhultar, Dhading	Ram nath adhikari	9841165626	Indian	-	Nepalese Silk and silk products	Local & India	-

8.16 Cost of Cocoon Production

Sericulture refers to chain of activities from field- mulberry gardening to cocoon production, post-cocoon processing, and final seri-products marketing. Preliminary estimated costs and benefits of mulberry cultivation, silkworm rearing, cocoon production and post-cocoon processing are given in [Tables 89-97](#). [The cost and return](#) is based on [4 Ropani of land](#).

Table 55. Cost of cultivation of Mulberry gardening in 4 Ropani land for the first year

SN	Particular	Unit	Quantity	Rate (Rs)	Total (Rs)	Remarks
1	Trench/pit preparation (120 pit/person)	No	20	500	10000	Home labor can be utilized
2	Compost (2 kg/pit)	kg	5600	4	22400	Can be used own product
3	Chemical fertilizer (DAP, MoP, urea mixed 10g/plant)	kg	28	40	1120	
4	Mulberry saplings	No	2800	2	5600	
5	Transplanting cost	No	7	500	3500	
6	Interculture and pruning	No	6	500	3000	
7	Spade, peak	No	2	700	1400	
8	Secateurs	No	2	1000	2000	
9	Miscellaneous				2000	
Total fixed cost in the year of transplanting (Rs)					51020	

Table 56. Rearing house construction and other essentials for the second year

SN	Particular	Unit	Quantity	Rate (Rs)	Total (Rs)	Remarks
1	Grownup worm rearing shed construction with local materials				100000	Can be used for 10 years
2	Bamboo rake construction				20000	Can work for five years
3	Thermometer	No	1	500	500	
4	Sprayer	No	1	4000	4000	
5	Jute bags for racks				2000	
6	Mounting materials for worm				10000	
7	Others				2000	
Rearing shed construction & other essentials (Rs)					138500	

Table 57. Current expenses for garden maintenance and silkworm rearing second year onward

SN	Particular	Unit	Quantity	Rate (Rs)	Total (Rs)	Remarks
Mulberry garden management						
1	Pruning, hoeing, Manuring labor	No	12	500	6000	Home labor can be utilized
2	Compost	kg	5600	4	22400	Household FYM can be used
3	Chemical Fertilizer (DAP, MoP, Urea mixed 10g/plant)	kg	28	40	1120	
Silkworm rearing						
1	CRC worm rearing	box	6	100	600	
2	CRC rearing (3 times in a year)	days	51	500	25500	Employment in home
3	Sanitation and disinfectants				3000	
4	Worm mounting, cocoon picking	days	9	500	4500	
From second year onward, total current expenses (Rs)					63120	

Table 58. Income from silkworm rearing in the first year

SN	Particular	Unit	Quantity	Rate (Rs)	Total (Rs)	Remarks
1	Cocoon production (30kg/box)	3 boxes	90	700	63000	
2	Co-production (Excreta 25kg/box)	3 boxes	75	25	1875	Used as animal feed
3	Remaining leaves after worm rearing	Kg/year	1000	7	7000	Sale or animal feed
4	Fuel wood from mulberry pruning	Bhari	10	175	1750	
Total income (Rs)					73625	

Table 59. Income from silkworm rearing from the second year

SN	Particular	Unit	Quantity	Rate (Rs)	Total (Rs)	Remarks
1	Cocoon production (30 kg/box)	6 box	180	700	126000	
2	Fuel wood & staking for gourds	Bhari	25	175	4325	
3	Worm excreta	25kg/box	150	25	3750	
4	Remaining leaves and tender shoot after worm fed	kg	2000	7	14000	
Regular income from second year onward (Rs)					148,075	

Table 60. Investment and income from silkworm rearing in two years

SN	Particular	Unit	Quantity	Rate (Rs)	Total (Rs)	Remarks
1	Fixed investment in the first year				51020	
2	Bank interest for two years @ 15%				15300	
3	Fixed investment in the second year				138500	
4	Bank interest for one year @ 15%				20,775	
5	Current expenses from 2 nd year				63120	

Total fixed investment current expenses from two years and onwards	288,695	
Income Side		
Income in the first year	73625	
Income from second year	148,075	
Income in the first two years	221,700	
Total investment including fixed & current in the first two year	288,695	
Investment and income differences in the business including fixed assets in the first two years	66,995	
Income in the third year	148,075	
Income & investment (Fixed & current) cost up to third year	148,075 – 66995 = 81080/	profit starts
Profit from 4 th year Rs 148,075		Self-employment & local resources use Profit starts from 3 rd year with mulberry planting and cocoon production

Comparison with maize and millet crop is shown in Tables 95-96.

Table 61. Comparison of traditional maize millet production with silkworm rearing in 4 Ropani land

SN	Particular	Unit	Rate (Rs)	Quantity		Total (Rs)	Remarks
				Maize	Millet		
1	Plowing & land preparation	oxen pair	2000	5	-	10000	
2	Land preparation	Hr (No)	800	-	8	6400	
3	Compost	Doko	60	100	-	6000	
4	Chemical fertilizer	kg	35	40	10	1750	
5	Seed (maize)	kg	120	5	1	720	
6	Nursery preparation	No	500	-	1	500	
7	Seeding	No	500	2	-	1000	
8	Transplanting	No	500		8	4000	
9	Interculture	No	500	5	4	4500	
10	Picking, harvesting	No	500	4	6	5000	
11	Threshing, seed separating	No	500	4	8	6000	
12	Carrying, cleaning	No	500	2	2	2000	
13	Others					2000	
Total expenditure (Rs)						49,870	

Table 62. Income from maize and millet in 4 Ropani of land

SN	Particular (main production)	Unit	Rate (Rs)	Quantity		Total (Rs)	Remarks
				Maize	Millet		
1	Grain Maize	kg	60	612	-	36720	
2	Grain millet	kg	80	-	250	20000	
3	Straw	Bhari	40	100	-	4000	
4	Straw	Bhari	100	-	50	5000	
5	Husk and khoya					2000	
Total income						67720	
Profit 67720 – 49870 = Rs 17850							

Profit from sericulture is realized more than four times in third year of plantation and more than eight times from fourth year onwards as compared to traditional maize and millet cultivation.

In general, to rear one box eggs and produce cocoon, it needs 600-700 kg of mulberry leaves. Further costs are added to produce silk from raw cocoons, and silk to weaving and fabrication, such as production of sarees, shawls, ascots etc. The estimated costs incurred in the various processes are presented in Table 97.

Table 63. Cost of production of 1 kg of silk and value added products

SN	Particular	Unit	Needed	Unit cost (Rs)	Total (Rs)	Return (Rs)	Net profit (-/+)
	Processing cost						
1	Sorting, drying, boiling	day	1	800	800		
2	Reeling by Jaguri	days	1/2	800	400		
3	Cocoon	kg	6	500	3000		
3	Weaving	day	1	800	800		
	Total cost				5000		
4	1 kg of Pure silk profit	kg	1		80000	(8000-5000)=3000	3000.0
5	Sharees (70:30 mix ratio) cost with wages	kg	260 gm		6100		
	Price per piece sharees	1			10000	(10000-6100)	3900.0
6	Sawals one piece cost with wages	1	100 gm		1300		
	Price per piece	1	100 gm		3500	(3500-1300)	2200.0
7	Askot cost with wages	kg	200 gm		2000		
	Price per piece askot				4000	(4000-2000)	2000.0

In discussion with the processors, they responded that Nepalese silk is of good quality, pure silk is highly expensive and market is very competitive. So, they usually buy damaged or low grade cocoon and weave them in charkha and then mixed with domestic silk fiber or imported ones from abroad. During the discussion it was clear that the common saleable sericulture items were shawls, plain clothes, [scarfs](#), sharees, ascots, carpet, purse etc. with the value added perspective of products. Data shows that the cost of silkworm rearing is high, which is almost same as labor charge or even less, while processed goods (products) can generate more income. The total cost of [cultivation](#) for one kg cocoon is estimated about Rs 826 while the price of per kg cocoon in the market is Rs 500.0 in the market. Similarly, when we compare the production cost of silkworm with processing of the products there is about Rs 3000 net income from one kg of processed silk. This situation justifies the promotion of value chain of silk from cocoon to preparing silk products. [The value addition of products was about Rs 3900.0, Rs 22000 and Rs 200 net return in shares, shawal and askot, respectively.](#)

9. STUDY REPORT AS PER SPECIFIC OBJECTIVES

9.1 Extensively review the past and present efforts in the past and present changed context

Sericulture started in China and spread to become valued activities in a range of other countries. Today, more than 62 countries are rearing silkworms and producing cocoons. China and India are the leading producer of silk, followed by other Asian countries, Europe, Brazil and Colombia. Zambrano-Gonzales et al. (2017) reported literature on sericulture from Scopus and Web of Science for last 124 years, but 93% of records were from 1990 onwards (Figure 8). It means sericulture is an increasing area of research. Of the 1,930 records gleaned, 531 were from the years 1892 to 2000, and 1,399 from the years 2001 to 2016. The country with the largest research output was India, with 1,242 records, much higher than the next two, Japan with 185 and China with 182. These three countries published 81.9% of the sericulture records found, and the ten most active countries produced 90% of the research (Figure 9).

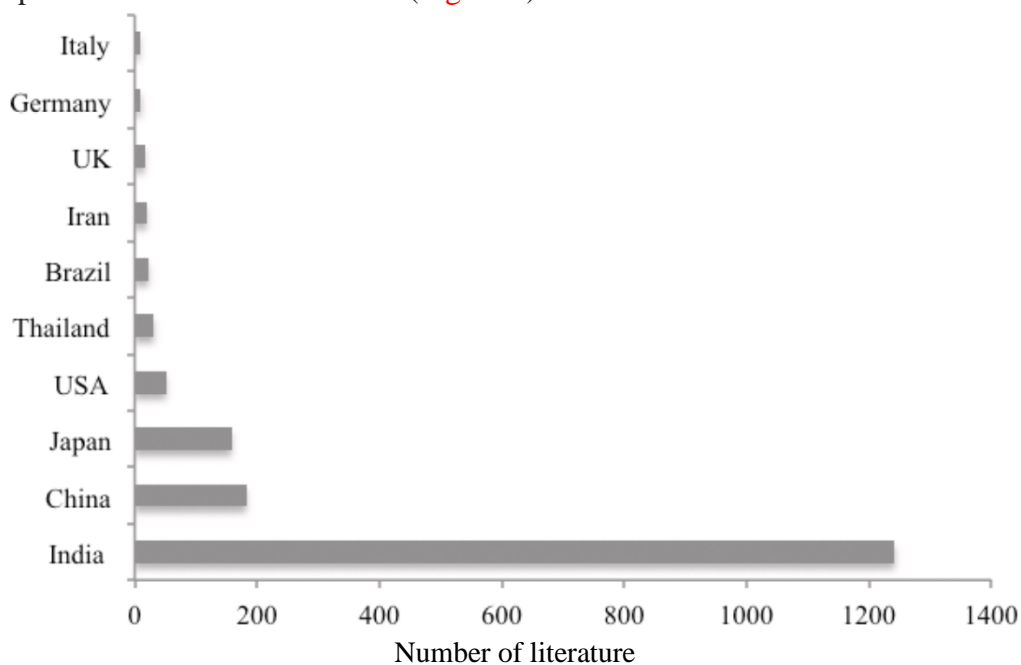


Figure 8. The top ten most active countries in sericulture research between 1892 and 2016

During the search, ten most frequently occurring sericulture words one after another were: silk (740), silkworm (572), *Bombyx mori* (481), mulberry (401), cocoon (288), India (230), breeds (187), economic condition (177), genetic (167), and developing (152). Their relationships in sericulture research is shown in Figure 9.

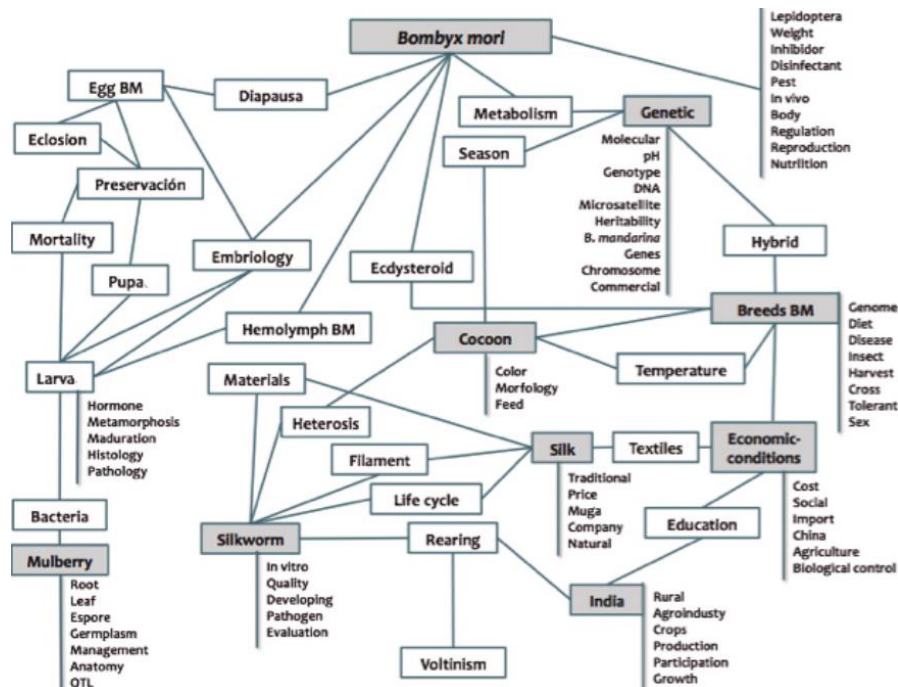


Figure 9. Relationship between the topics surrounding Seri cultural research mentioned in publications between 1892 and 2016

This finding is just an outcome of mainly one indexing Scopus. There are many indexing tools available, which can reveal additional meaningful scholarly articles. Such reviews open an array of research and development in sericulture, importance of research and innovation on advanced line of technology generation to establish national seri-industry and to compete the seri-products in the global market.

9.2 Review the performance of sericulture sub-sector and critically assess the reasons behind its poor performance

Silk is the natural textile fiber and accounts for 0.2% of the textiles in the world. It is an important means for the socio-economic development of the rural masses and provides an ideal opportunity for the developing countries having a major rural sector. There is strong market for the silk and silk goods in the national and international arena. Research is a basic requirement and is a continuous process for the development of any industry and it is very crucial for sericulture. The directory of completed sericulture projects and sericulture experts of India contains the information on published literature furnished by the sericulture experts who are listed in the Directory of Indian Sericulture Experts of India (Part II). Review of Indian research is more applicable in the Nepalese context. Different categories of documents available in India and Nepal are presented in Table 98. India is rich in documentation and information dissemination. A total of 7665 in seven categories covering all the fields of sericulture is included in this directory. It contains 3580 citations of research articles under mulberry sericulture (2843) and non-mulberry sericulture (635) and silk technology (101) out of total 7665 citations; 877 articles published in proceedings (mulberry 660, non-mulberry 205 and silk technology 12 articles); 53 review articles (mulberry 47, non-mulberry 6); 165 books (mulberry 142, non-mulberry 20 and sericulture technology 3); 80 edited books (mulberry 75, non-mulberry 4 and sericulture technology 1); 299

articles in edited books (mulberry 266, non-mulberry 27 and sericulture technology 4) including 2613 technical articles in all categories (mulberry 2074, non-mulberry 385 and sericulture technology 154).

Table 98. Literature in sericulture

SN	Category	Subject areas	India		Nepal	
			No	Total	No	Total
1	Research articles	Mulberry sericulture	2843	3580	<100	<100
		Non-mulberry sericulture	635			
		Silk technology	102			
2	Proceedings articles	Mulberry sericulture	660	877	<50	<50
		Non-mulberry sericulture	205			
		Silk technology	12			
3	Review articles	Mulberry sericulture	47	53	<5	<5
		Non-mulberry sericulture	6			
		Silk technology	0			
4	Authored books	Mulberry sericulture	142	165	<12	<12
		Non-mulberry sericulture	20			
		Silk technology	3			
5	Edited books	Mulberry sericulture	75	80	<3	<3
		Non-mulberry sericulture	4			
		Silk technology	1			
6	Edited book articles	Mulberry sericulture	266	297	<12	<12
		Non-mulberry sericulture	27			
		Silk technology	4			
7	Technical articles	Mulberry sericulture	2074	2613	<100	<100
		Non-mulberry sericulture	385			
		Silk technology	154			
	Total			7665		<300

Source: Muniraju, 2008; Thapa and Sharma, 2006.

The literature includes both mulberry and non-mulberry sericulture, however, publications on non-mulberry silk production is negligible in the Nepalese condition (Thapa and Sharma, 2006). There are very limited research documents in government, teaching and research institution, NGOs/INGOs etc. Even among the seven categories, mulberry sericulture and silk technology documents (articles, proceedings, review articles, books, book articles, and technical materials are useful and all of these together highly dominate the world of sericulture documentations by Indian sericulture information. The necessary and useful information are included from the beginning to final way out of the report. Overall literature reviews indicated many problems, constraints and reasons of declining sericulture in Nepal. **The main problems are cocoon price and marketing, egg quality and diseases, silkworm races and mulberry varieties, CRC and farmer's rearing house, field irrigation, post-cocoon activities, training and technical extension services.**

Other related aspects identified through literature reviews are listed as follows.

- Sericulture is a highly technical, complex and complex agro-industry, as revealed from international and national literature reviews.
- Experiences from past and from other countries clearly indicate that sericulture has good potential due to favorable agro-climate in the country.
- This sector is labor intensive and can generate excellent opportunity to employment and income preventing migration of local people.

- In terms of research, external support projects have achieved their project objectives but no planned research activities have been there neither from the government nor from research institutions. Some research activities have been accomplished as part of teaching and training by the Universities/institutions as requirement for their requirement in postgraduate programs.
- Continuous research and value chain process in mulberry field and silkworm rearing house, well-trained human resource, farmers training, extension support, quality eggs supply and post cocoon activities are very weak.
- Therefore, for good achievements, strong commitment and support especially from the government is needed including good linkage/coordination of stakeholders to run field level activities in sericulture.

9.3 Conduct value chain analysis and assess the first hand information and opinion from the value chain actors across the value chain including enabling institutions and experts

Sericulture is the chain of silvo-industrial activities starting from mulberry planting (leaf production), silkworm breeding (caterpillars seed/egg production) silkworm cultivation (cocoon production), cocoon handling (processing) spinning (yarn production), designing and weaving (silk fabric production) to the marketing of silk fabrics and so on. In each of the processes, it is assumed that, value of the product increases in the chain giving opportunity of better margin to the producer. In this assignment, the study team has analyzed the activities of the sericulture value chain from inbound logistic activities to post-service delivery services (Stobierski, 2023).

Information was collected through interviews and discussions with group actors involved in sericulture value chain such as producers, collectors, processors, importers and exporters. A total of 121 respondent sericulture value chain actors were interviewed as key informants (Table 99). Their distribution varies from minimum numbers in silkworm importer/exporter (3) to the highest sample representatives of silkworm rearer (72). The findings are presented as per value chain activities and actors evolved during the study.

Table 99. Number of respondents according to value chain actors

SN	Types of respondents	Number of respondents	Remarks
1	Silkworm rearer	72	
2	Silkworm processor	5	
3	Silkworm importer/Exporter	4	
4	Silk work Expert	16	
5	Provincial offices	4	
	AKC	5	
	SDO	9	
	Municipalities	5	
	Total	121	

Sericulture Value Chain Activities and Actors in Nepal

Present study showed that the sericulture value chain actors are similar in line with the one presented by Sharma et al. (2021). Some features of the value chain have been adopted from Stobierski (2023) as well. It includes primary value chain activities directly related to silvi-

enterprise—from input supply to product marketing to the consumers, and secondary value chain activities from procurement to infrastructure support for silvi-enterprises.

Primary Sericulture Value Chain Activities and Actors

Supply of Sericulture Inputs: Sericulture value chain starts with [the supply](#) of inputs to the related stakeholders. Mulberry sapling suppliers, silkworm egg suppliers, nurseries/farms, pesticide and other input suppliers, [processor and extension](#) service providers are the major actors involved in input supply. Mulberry sapling distribution and supply of silkworm eggs is mainly a government entity till date, although mulberry saplings are recently practiced by private nurseries as well. This study revealed that collection of cocoon and its marketing as well as extension services to the farmers were sole responsibility of government until recent back, but now some private entities have also evolved in the field which directly deal with seri-farmers.

Silkworm Eggs Production and Distribution (Granges)

In Nepal, production of silkworm eggs is a mandatory task of government which is handled by Sericulture Development Center (SDC), Khopasi, Kavre. It has also responsibility of maintaining parental lines of silkworm and mulberry. The SDC currently has 31 parental lines of silkworm imported from Japan, Korea, China and India maintained in Khopasi. The Government of Nepal has also established a well-equipped Grainage Center at Chittapol, Bhaktapur for the same purpose, however, it has not yet started Grainage activities.

The SDC, supplies eggs to farmers free of cost. However, demand for silkworm eggs is declining sharply. There are various reasons for decline sericulture however low price of cocoon, difficulties in cocoon marketing and quality of eggs are major ones.

Silkworm Rearing

In the past, silkworm rearing and cocoon production covered more than forty districts of Nepal. Now it is practiced in limited districts. Major reasons for decline was reported as lower market price of cocoon, lack of technical support, earth quake of 2015 and Covid-19 pandemic. Initially, the cocoon produced by farmers were collected and marketed by the Government (to the silk processor). After 2014, government stopped buying cocoons. Currently, farmers are selling cocoons directly to the collectors or processors or local reelers usually @ Rs 390-500/kg.

Cocoon Reeling

After collection, the fresh cocoon goes to the processors for silk extraction. In Nepal, raw silk is either extracted by the cocoon producers themselves, who sells it to the silk processors (mainly weavers) or they sell fresh cocoons to the private processors (reelers or weavers). Reeling is mostly by using local Charkha. Some reelers have started using Zaguri (Japanese reeling machine), which was made available during JAICA Proect. The Government of Nepal has established a well-equipped reeling machines in SDO, Itahari, Sunsari. Unfortunately, the factory is not in operation these days. During the field visits, the team realized the farmers' interest to reel the silk thread themselves. Seri-farmers were interested to buy Government subsidized reeling machines and receive training in post-cocoon processing. The price of the reeled silk varied from Rs 3000 to Rs 4500/kg depending upon the thickness of silk fiber.

Silk Possessing

It includes specific activities such as cleaning, silk washing, boiling, spinning, dyeing, shorting and packaging. Generally, this aspect is managed by private enterprises these days or seri-textile industries better handle silk processing activities in an organized way.

Silk Weaving

In Nepal silks are available from two sources - raw silk produced in Nepal or imported from abroad; mostly China and India. This part of sericulture value chain is mainly a private entity nowadays. Weaving is done in both hand looms and power looms. Due to lack of well-trained manpower and technology most of designing works is done by Indian expert. The major products made from silk are plain clothes, shares, sawals, aascot and purse etc; these products are made of usually from 70% imported and 30% local produce silk, which also have to face market competition with Chinese and Indian silk fabrics.

Silk Product Marketing/Trading

Trading of silk fabric is done by wholesalers and retailers. Generally, products transfer from whole sellers to retailers, while some traders directly manage from the fabric producers themselves. Likewise, some of the wholesalers are exporters too. The exporter are those actors responsible for exporting silk fabrics and product to the international market. In Nepal Sericulture Association of Nepal (SAN) was the one of the major exporter of silk and silk products. This organization doesn't have formal existence now. Private companies are exporting sericulture products in limited quantities, however there is no formal record about quantities and value transaction. The silk fabric products from Nepal are mainly exported to Japan, America, Europe, India, China, etc. After discussion with traders, it became clear that there was more demand of hand made products of sericulture in international market. Wholesalers and retailers are the final actors linking the product to the consumer in the market. There is limited scope of marketing of seri products in domestic market in absence of formal national sericulture policy.

Silk Product Consumers

Silk consumers mostly are in the international market. However, domestic market also prevails with product diversification based on the consumer demand. All actors (producer to consumers) in seri-value chain are presented in detail in [Table 100](#).

Table 100. Main actors of the primary value chain activities

Value chain activity	Main sub-components	Main actors
Inputs supply	Mulberry sapling suppliers	✓ SDC/SDO ✓ Private Nurseries
	Silkworm egg suppliers	✓ SDC, Khopasi a sole supplier in Nepal ✓ Transportation is free all over Nepal.
	Pesticides suppliers	✓ Agro-vets/SDOs
	Capital availability	✓ Personal Borrowing ✓ Financial Institution ✓ Very less accessible to local enterprises
	Extension (Technical) service providers	✓ SDC/SDO ✓ AKCs ✓ Agriculture Sections of the Municipalities
Cocoons production	Mulberry leaf production	✓ Individual Farmers
	Cocoon Production	✓ Farmer groups/cooperatives ✓ Farm Enterprises
Cocoons collection		✓ Government farms (Until 2014) ✓ Collectors ✓ Local reelers ✓ Processors

Extracting /Thread processing (reeling)		<ul style="list-style-type: none"> ✓ Local reelers ✓ Processors ✓ SDC/SDOs
Threads dyeing		<ul style="list-style-type: none"> ✓ No separate entities ✓ Done by the reelers or the weavers
Designing/Thread silk weaving		<ul style="list-style-type: none"> ✓ Mainly private firms
Marketing	Domestic market	<ul style="list-style-type: none"> ✓
	International market	<ul style="list-style-type: none"> ✓ Previously Sericulture Association of Nepal (SAN) was the one of the major exporter ✓ Now only private companies in small quantities

Secondary Value Chain Activities of Sericulture

In sericulture, the value chain refers to primary activities to produce the final product- the silk fabrics. Apart from those activities, there are other secondary value chain activities, if they are properly managed through procurement, technology development, human resource management, and infrastructure support (Stobierski, 2023), production of quality products benefits various sectors. Procurement activity and its prevalent mechanism is mentioned including the study findings related to technological development (Table 101).

Table 101. Technological status according to primary value chain activities

Value chain components	Main sub-component	Current technology	Technological gap
Inputs supply	Mulberry sapling suppliers	<ul style="list-style-type: none"> ✓ Mainly SDC/SDOs ✓ Recently, private nurseries as well 	<ul style="list-style-type: none"> ✓ Market not able to attract more private sectors
	Silkworm egg suppliers	<ul style="list-style-type: none"> ✓ Only Government ✓ Single supplier 	<ul style="list-style-type: none"> ✓ Market not able to attract private sectors
	Pesticide suppliers	<ul style="list-style-type: none"> ✓ Mostly chemical pesticides 	<ul style="list-style-type: none"> ✓ Affects in silk worms farming ✓ Organic alternative
	Capital availability	<ul style="list-style-type: none"> ✓ Limited access ✓ Not tied with the enterprise 	<ul style="list-style-type: none"> ✓ Credit schemes for needy seri-farmers ✓ Voucher system
	Extension (Technical) service providers	<ul style="list-style-type: none"> ✓ SDC/SDO led supports ✓ Scattered service not specialized according to value chain demand ✓ Currently, reduced service linkage 	<ul style="list-style-type: none"> ✓ Linked institutional framework ✓ Coordination committees at appropriate levels
Cocoon production	Mulberry leaf production	<ul style="list-style-type: none"> ✓ Both indigenous and exotic varieties used ✓ Common variety: Kanva -2 	<ul style="list-style-type: none"> ✓ Introduction and local testing of better varieties is lacking
	Cocoon production	<ul style="list-style-type: none"> ✓ 33 parental lines from Japan, Korea, china and India maintained at SDC, Khopasi ✓ Three main varieties ✓ Bi-voltine is common ✓ <i>Bombax mori</i> L. 	<ul style="list-style-type: none"> ✓ Very less new effort for technology introduction and dissemination. ✓ Least involvement of private sector's, NGO's CBo;s, farmers groups/ cooperatives
	Cocoon collection	<ul style="list-style-type: none"> ✓ Collected by government ✓ Private sector involvement is limited 	<ul style="list-style-type: none"> ✓ Involvement of private traders is limited
Extracting /Thread		<ul style="list-style-type: none"> ✓ Common: Charkha 	<ul style="list-style-type: none"> ✓ Lack of modern technology

processing (reeling)		✓ Recently: Zaguri, a kind of Japanese reeling machine is used by some processors	✓ No use of automatic machines of different scales ✓ Automatic facility of SDO, Itahari not operational
Threads dyeing		✓ Done by the reelers themselves or the weavers	✓ No specific record of technology advancement
Designing/ Thread silk weaving		✓ Private firms' led activities ✓ No specific record of technology ✓ Final products are sarees, shawls, waistcoats, mufflers, etc.	✓ Lack of well train manpower ✓ Least support from government entity

Another secondary value chain activity supportive for the enterprise is available human resource. Quality of human resource affects overall system and production performance. The study team observed poor condition in relation to technology development and human resource management in the SDC, Khopasi, a lead sericulture government organization in Nepal (Table 102).

Table 102. Human resource situation of SDC, Khopasi, Kavre

Type of human resource and status	Situation
Specialist- with sericulture degree	None
Postgraduates in Industrial Entomology	None
Graduates in Industrial Entomology (Breeding)	None
Postgraduates in Agriculture	None
Graduates in Agriculture	Yes
Agri-economist/economist	None
Agriculture Extension Officers/ Technicians	Yes
Silk processing Experts/Technologists	None
Silk Textile experts/Technologists	None
Technicians with Advanced training in sericulture (>1 Month)	Yes
Facilitator lead farmers with advanced sericulture trainings	Yes
Prevalence of Sericulture Networks/Associations at National/Provincial/Local level	None

The lead institution responsible for sericulture sector development and promotion itself doesn't have expert manpower for its development. Although agriculture experts could be appropriate for mulberry cultivation and cocoon production, cocoon, silk processing and fabrication demands well trained human resources with good knowledge and practical skills.

Likewise, study team also assessed organization and infrastructure situation of the sericulture sector. For sericulture related service provisions, the Government of Nepal has established different Sericulture Development Centers (SDCs) and Sericulture Development Offices (SDOs) in different geographical locations for sericulture development (Table 103).

Table 103. Sericulture related Government offices in Nepal (Adapted from PQCPPP, 2011)

SN	Name of the office	Tier under Federalism	Main functions
1	Commercial Entomology and Industrial Insect Development Centre (CEIIDC)	Federal	<ul style="list-style-type: none"> • Central Policy making, planning body. • Linkages and coordination among Federal, provinces and local municipalities and other stakeholders,

2	Sericulture Development Center, Khopasi, Kavre	Federal	<ul style="list-style-type: none"> • Manpower Development • maintaining parental stocks of silk worm and mulberry
3	Parental Stock Seed Cocoon Resource Center, Dhunibesi, Dhading	Province	<ul style="list-style-type: none"> • production mother seed cocoon • mulberry sapling/Nursery • Farmers ' Training
4	Parental Stock Seed Cocoon Resource Cantered, Bandipur	Province	<ul style="list-style-type: none"> • production mother seed cocoon • mulberry sapling/Nursery • Farmers ' Training
4	Sericulture Development Program, Pokhara	Province	<ul style="list-style-type: none"> • Almost close and established new office named as Horticulture resource center
5	Sericulture Development Program, Shyangja	Province	<ul style="list-style-type: none"> • Almost closed and established as seed production resource center
6	Sericulture Development Program, Dhankuta	Province	<ul style="list-style-type: none"> • Unit established in AKC
7	Silk Processing Center, Itahari	Province	<ul style="list-style-type: none"> • Unit established in AKC
8	Mulberry Sapling Management Center, Bhandara, Chitwan	Province	<ul style="list-style-type: none"> • Mulberry Nursery • Training
9	Commercial Grainage Center, Chitapol	Federal	<ul style="list-style-type: none"> • Silkworm egg production(not function yet)

Centers for Industrial Entomology Development (CIED) under the Department of Agriculture (DOA) is responsible for the overall program implementation coordination and sericulture development in Nepal. It has 9 sericulture related farms/offices to provide sericulture related services. With the enactment of new constitution 2072 of Nepal, the organogram and administrative linkage has been very weak. Only SDC, Khopasi, Kavre is under the jurisdiction of federal government. Others are under different provincial governments. This negatively affected the linkage among the sericulture development offices which were originally established as complementary resource centers necessary for sericulture development in Nepal. The problem of congruence in the provincial/local priorities also diverted their role in favor of other agriculture activities simply ignoring the supportive roles of sericulture offices. Some of the seri-farms in some provinces reached at the collapsing stage, which were converted into other type of farms thus impacting performance of sericulture sector as a whole. As a result, the area and production of mulberry as well as scale of silkworm rearing and silk production is gradually declining every year. This is not improving despite comparative profitability of sericulture sector in comparison to the traditional regular crops.

Profitability Scenario

Comparison of profit from traditional maize and millet production with silkworm rearing in 4 ropani land was evaluated by Sharma et al. (2021). The study showed that sericulture was more than four times profitable in the 3rd year of plantation and more than eight time better from fourth year onwards as compared to traditional maize and millet system. Here, per year profit of traditional maize millet system in a 4 ropani plot of land was Rs 17850 in 2021 AD. Sericulture in the same plot size was profitable (Rs. 81080) from 3rd year, and from the 4th year onwards, income was nearly double (Rs. 148,075) of the 3rd year income. Likewise, profit margin analysis of seri-activity value chain based on cost and price data from Sharma et al. (2021) is presented in [Table 104](#).

Table 104. Profit margin along the value chain activities in sericulture

Product	Price	Cost	Margin after cost	Comparative value addition
Raw cocoon	Rs 500 / kg	Rs 635	Rs 135	Rs 135/kg
Reeled silk (After degumming/soap boiling)	Rs 4000 / kg	Loss- 300gm = Rs 923 Expenditure Rs 30/kg Cum. Cost: Rs 1453	Rs 2543/kg	Rs 2043/kg
Dyeing	Rs 4225 / kg	Rs. 225/kg Cumulative cost: Rs 1678	Rs 2543/kg	Rs 0/kg
Product with simple design	Rs 9000 / kg	Rs. 3000/kg Cumulative cost: Rs 4678	Rs 4322/kg	Rs 1779
Product with embroidering and special designs	Rs 9000 - Rs 25000/ kg	Variable	Variable	Variable

Source: Adapted from Sharma et al. (2022)

Sericulture reveals maximum profit margin with reasonable effort when the seri-farmers could sell the silk yarn after reeling (also after degumming/soap boiling). Table 104 showed around Rs 2543 margin per kg of silk yarn. This could be more at the designer product stage, but further processing becomes more complex. However, sole activity of sericulture (up to cocoon production) among small farmers was a business of loss. The cocoon price even couldn't meet the production price.

Economic Efficiency of Actors in Sericulture Value Chain

The economic efficiency of seri-value chain is presented in Table 105. In Vietnam, raising one box of silkworm eggs, young silkworm rearing farmers will get a gross profit of US\$5; grown up silkworm rearing farmers will get US\$183.60 followed by thread extracting and silk weaving farmers. This part of accounting doesn't include family labor. It is known that grown up silkworm raising household use the most family labor, so although the gross profit margin is high, in terms of index of gross profit/labor, it is US\$10-11/working day. This level of wages is lower than that of workers in industrial factories and service workers. This is why proportion of young workers participating in the sericulture value chain is decreasing, and most of the workers are middle aged and elderly people. With the same input unit of young silkworm, the grown up silkworm raising actors earn higher gross return (Duan et al., 2022).

Table 105. Economic efficiency of seri-value chain- silkworm rearing to silk weaving (1 box)

SN	Seri-activity	Intermediate cost (\$)	Revenue (\$)	Gross profit (\$)
1	Young worm rearing	16.70	21.70	5.00
2	Grown up worm rearing	90.30	273.90	183.60
3	Cocoon collecting	286.60	293.50	6.80
4	Thread extracting	249.70	371.30	21.60
5	Thread processing	377.40	385.40	8.10
6	Silk weaving	525.70	550.00	24.30

Source: Doan et al., 2022.

Further efficiency can be enhanced by maintaining good linkage between research, production and consumption organizations and efficient technology transfer, consolidating cooperatives and farmers' groups, proper channeling to cocoon collecting, dyeing, printing, designing and fabricating thus promoting each actors' role and responsibilities including product marketing.

Issues Related to Sericulture Value Chain

Sericulture is not in the priority of the Government of Nepal. This sector has not been succinctly mentioned in Agriculture Development Strategy and 15th Plan of Nepal (MOAD, GoN, 2015; NPC, 2019).

According to MoAD (2015), major areas that require attention include: market information, quality inputs, credit facility, production and processing technology, regulation and certification, infrastructure, research, extension services and marketing skills. It also states that the most of the studies and initiatives are bias towards production. Less attention is paid to improving quality and marketing issues. Also, there is need to have pronounced focus on working with farmers to “push” products than on working with farmer, traders or businesses to ‘pull” products into markets. The issues and constraints responded by the value chain actors related to sericulture are summarized in the **Table 106**.

Table 106. Constraints related value chain actors

Silkworm egg supply	Mulberry sapling supply	Cocoon production	Processing	Trading	Consumption
Irregular supply of worm eggs	No competitiveness	Poor grading and quality	Traditionally/ lack of well-trained manpower	Limited traders	Low domestic consumption
Poor quality of eggs	Poor extension service delivery	Low price of cocoon	Limited number	Varieties of products	Export
Poor infrastructure	Less private sector involvement	Low volume of production	Private sectors only	Lack of market information	Designs and pattern
Government sole responsibility	Unorganized farmers	SDC, Khopasi as main facilitator	Very weak Entrepreneurship development (weaver)	Expensive	Choice option/ branding
Poor research and extension	Small size, low volume	No linkages with traders	No quality control mechanism of produce	Sustainability	Expensive
No credit and insurance facilities	Production cost high	Incentives to production	Irregular supply of raw material	Highly competitive with Chinese and Indian products	Lack of promotional activities made by government

The present study highlights some pertinent issues in the sericulture development sector of Nepal. They are as follows.

- There are problems from beginning to final stage of sericulture value chain.
- The problems are aggravated after restructuring and splitting ownership of its facilities in different tiers of government. Currently overall management of sericulture development sector is scattered, weak and confused. There is lack of consolidated effort with unified vision, mission and goal.
- Management and technical handling of sericulture sector (including government offices at different levels) is in the hands of agricultural generalists who don't have specialized knowledge and skill of sericulture and its value chain analysis.

- Innovation development process is not well internalized and very weak, therefore, this sector as a whole is jeopardized to move forward and even for its continuity. Sericulture extension support system is not able to build up confidence among sericulture producers, silk processors, and traders.
- Efforts so far are more biased towards mulberry and silkworm production in a scattered manner. No value chain and integrated approach being considered. Processing and marketing aspects are ignored and not connected with the industrial sector.
- Cost of cultivation of silkworm production is more than it earns per kilogram of cocoon production. Thus, until cocoon production, sericulture can be considered profitable only in terms of family labor employment, rather than benefitting from value addition of the produce.
- Silvi-enterprise is profitable only after raw silk yarn production or even after reeling, weaving, and marketing, i.e. entering through a complete chain from production to end product marketing.
- This sector is not able to operate on modern and updated technology due to lack of research advances and revolutionary mechanization, credit facility, insurance policy, and above all sericulture board and national policy.
- Sector is not being able to operate in value chain level. Mulberry and cocoon production is separated from cocoon processing and onwards. Up to this stage, farmers are just labor than sharing value addition benefits from sericulture. This lead to reluctance in the seri-farmers which ultimately affected silvi-industry itself.
- Community level involvement of farmers' is very less.

Those issues are not only pertinent to sericulture sector but in value chains of other commercial agricultural commodities as well.

9.4 Carry out detail technical audit of Sericulture Development Centre, Khopasi and general technical audit and review of changed context of other sericulture farmers in the country

Scope and Rational of Silkworm Breeding

Silkworm Breeding aims to attain better performance of following components as:

Egg Yield

Silkworm egg yield and fecundity increased from 300-450 eggs in the 1930s to 450-650 eggs in the 1960s by a single female moth. Hybrids of 3 or 4 way crossings are often used for the sake of overcoming the higher mortality and poor fecundity. Unfortunately, farmers and raw silk producers still have less uniform larval and cocoon traits. Although egg yield increased significantly for the egg producers, the cost associated with irregularity and loss of heterosis are affect seri-farmers when F_1 is recycled for F_2 egg production and used in turn for cocoon production.

Cocoon and Raw Silk Yield

Cocoon yield increased from about 9-12 kg per 10,000 larvae in the 1910s to 16-19 kg in the 1930s and to 20-24 ks at the present time. This is at least a twofold increase. The raw silk rate per cocoon was 15% in 1936, and current varieties have attained a rate as high as 22%. Raw silk yield per 10,000 larvae has almost tripled in the period 1930-1970, from less than 2 kg per 10,000 larvae to

about 4.5 to 5.5 kg. This improvement is not caused by any single factor, but it is a composite of results due to many factors in each step of cocoon and raw silk production, such as improved mulberry leaf quality, renovated tools and machines, better hygienic practices, new rearing methods, integrated disease and pest management, and better handling of harvested cocoons, as well as high yielding improved varieties. The breeders have achieved the hereditary capability for higher productivity in the improved varieties. Application of various production techniques have resulted in increased genetic potential possible.

Reliability

Resistance and feed preference of the silkworm are important factors in this category. The varietal resistance to or tolerance of diseases and adverse physical or environmental conditions is important for stable cocoon crops in annual or seasonal production cycles. Another major factor is the genetic capacity of a silkworm to withstand diseases pests or an extreme condition in an environment that kill it or reduce the growth. This has contributed to increased cocoon crop stability, especially for bi-voltine rearing in tropical or sub-tropical regions. Further, cocoon production, silkworm breeding in all seasons, etc. is possible by evolving silkworm strains which feed better on low cost artificial diets.

Expansion of Cocoon Production in New Areas

The biological system of silkworms must adjust to subtle environmental differences as they are reared in new geographic areas of the world. Progress in this direction for silkworm breeding has not been documented much in the past, although adaptation of temperate bi-voltine to tropical areas can be considered as an example. Introducing a diversity of genetic resources into new areas can play an important role in determining how soon such adjustment be achieved without significant loss of a varieties' original performance.

Silk Quality

Raw silk quality has improved greatly, especially through development of hybrid varieties with bigger cocoons and higher cocoon shell ratios, along with longer cocoon filament lengths, from 5000 meters to 1500 meters. Such raw silk characteristics as neatness, reelability, degumming rate and lousiness have been significantly improved. Neatness has improved to an average level higher than 90 points. There has been more than a 70% improvement in continuous filament, a reduction of degumming to lower than 26% and lousiness has improved to a level a level better than 75 points. Breeding aims have also been set recently to meet the specific needs of consumers. For instance, varieties have evolved with filament size thinner than 2 denier, or as thick as 4.5 denier.

Additional Aims of Silkworm Breeding

The conservation and maintenance of silkworm races for breeding and hybrid vigor exploiting in different countries are presented in [Tables 107-108](#). Breeding aims should be set according to the natural and socio-economic situation while also depending on the stage of sericulture development in a country. In addition to the natural purposes of breeding for health and robustness, high yield and good quality when selecting or developing strains, examples of other breeding aims are:

- Specific physical properties related to size and other quality control characteristics of silk filament;
- Capability to have polyphagous feeding habits by accepting low-cost artificial diets or taking foliage other than mulberry;

- Ability to resist or tolerate diseases, pests and adverse environmental conditions;
- Development of some behavioral traits more suitable to new practices in rearing and handling, including mechanization of cocoon production.

Table 1. The conservation of silkworm races in different countries

SN	Country	Bi-voltine	Multi-voltine	Total
1	Japan	1542	30	1572
2	India	450	150	600
3	China	580	20	600
4	Russia	500	0	500
5	South Korea	300	6	306
6	North Korea	281	5	286
7	Bulgeria	183	0	183
8	Brazil	65	10	75
9	France	53	0	53
10	Iran	50	0	50
11	Italy	30	0	30
12	Thailand	25	5	30
13	Vietnam	20	5	25
	Total	4079	231	4310

Source: FAO Manual, 2003.

Table 2. Silkworm races obtained from different countries and preserved in CSGRC, Hosur, India

SN	Country	Bi-voltine	Multi-voltine	Total
1	Japan	64	3	67
2	India	207	63	270
3	China	40	4	44
4	Russia	19	0	19
5	South Korea	1	0	1
6	Bangladesh	0	3	3
7	Iraq	1	0	1
8	Brazil	3	0	3
9	France	11	0	11
10	Poland	3	0	3
11	Ukraine	3	0	3
12	Thailand	4	0	4
13	Vietnam	3	0	3
14	Indonesia	1	0	1
		359	73	432

Status and Prospect of Sericulture in Nepal (as of April, 2023 AD)

- Industrial Entomology Program started at Khopasi, Kavre during 1975/76 (35 km far from Kathmandu) under the Department of Agriculture (DOA).
- Currently, nine sericulture farm stations are providing services to seri- farmers under the guidance of Centre for Industrial Entomology Development (CIED) and MoLMAC of each provincial government except province # 7, 6 & 2.
- Cocoon and mulberry acreage production are declining year after year owing to various factors.
- Bi-voltine sericulture is the most profitable and common practice of Nepalese farmers.

- The common practice is pure line maintenance and F₁ egg production. For this, 31 races (30 bi-voltine and 1 multi- /poly-voltine) are maintained in Khopasi ([Annex-e](#))
- Maintenance of phenotypic uniformity is through the larval marking cocoon shape and size.
- Qualitative individual cocoon selection is based on cocoon weight, shell weight, shell ratio, denier & renditta.
- KS i.e. J₁₂X C₁₂ was released in 2000 for commercial farming.

Total allocated Budget for 2079/80

Total allocated budget for **2079/80** is Rs. 355.88 lakhs and .out of which 46 lakhs is allocated for Retention wall (400 meter).

Proposed area required for the construction of National Mushroom Research Centre: 54 Ropani out of 125 Ropani.

Budget scenario of SDC for in different fiscal years are; (Rs 316.53 lakhs) in 2076/77, (Rs 433.6 Lakhs) in 2077/78, (Rs 411.17 lakhs) in 2078/79 and (Rs 355.88 laks) in 2079/80, [respectively](#).

Source: SDC, Khopasi: Account [Section \(2022\)](#).

Staffs

1. Chief: Mr Yam Kumar Shrestha SPPO
2. 3rd class officers: Mr Binod Lamichhane (2 vacant)
3. JT: Mr Guddu Chaurasia (2 vacant) Mr Nirajan Pande just transferred
4. JT Assistant: Ms Tara Devi Timilsina
5. Assistant Accountant/ store keeper: Mr Janarjan Bhatta (promoted to Lekhapal, vacant)
6. OA: Mr Sanu Pode
7. OA: Mr Ratna Bahadur Khadka
8. OA: Mr Hari Prasead Dhital
9. OA Mr Prem Bahadur Waiwa
10. OA: 1 vacant

Current Sericulture Problems in SDC, Khopasi (as of April, 2023 AD)

A. Mulberry Field

- Mulberry leaf production is rapidly decreasing. The high yielding varieties are available in India under different climatic conditions ([Table 109](#)).
- Most of the mulberry plants have died due to water logging condition and poor intercultural operations.
- Mulberry plants are very old and hence need re-plantation.
- Mulberry germplasms have to be well maintained otherwise valuable germplasms may be lost forever.
- High yielding varieties, like V- series and S₃₆, which are available in SDC, Khopasi have to be multiplied and high yielding varieties, like G₂ & G₄ have to be imported from India and multiplied for increasing mulberry leaf production, for which cost and necessary saplings including transportation estimate is necessary in advance.
- Currently, mulberry nursery consists of 5000 plants. Emphasis should be given on establishing good mulberry nursery within the premises of SDC, Khopasi for re-plantation/gap filling, and parental line rearing and maintaining purpose.

- Emphasis should be given on establishing mulberry nursery within the premises of SDC, Khopasi for re-plantation/ gap filling. (3500 plants) if possible v1 varieties
- **Note: Estimation** of Budget for gap filling: NRs 100000.0(Required sapling X Rate per sapling plus transportation costs incurring).

Table 3. Mulberry varieties available in CIED/SDC, Khopasi, Kavre

SN	Name	Origin	Remarks
1	S-34	India	Good yield (Irrigated condition)
2	S-36	India	Good yield (Irrigated condition)
3	Kanva-2	India	Medium yield (Practiced Terai - hills)
4	V-1	India	High yield (low belt under irrigated condition)
5	Mysore local	India	Low yield, small compound leaf
6	Ichinose/Ilchire	ROKorea	Scarification in sand followed by IBA treatment
7	Gariyu	Japan	Serpentine- decorative purpose
8	Khuwa Ichigo	Japan	Fruit mulberry
9	Mitsu Siduri	Japan	Good yield - palatable leaves, high yield
10	Mitsu Tagadi	Japan	Good yield- palatable leaves, high yield
11	Yukiii Masari	Japan	Snow & Frost tolerant, coarse leave
12	Yukii Tagami	Japan	Snow & Frost tolerant, coarse leave
13	Lun-40	Thailand	Suitable for young silkworms
14	Husan	China	Suitable for rootstock –grafting
15	Kavre local	Nepal(Kavre)	Compound leaf, low yield
16	Dhading local	Nepal (Dhading)	Compound leaf, low yield
17	Syangja local	Nepal (Syangja)	Compound leaf, low yield
18	Samalbunge	Nepal (Ilam)	Big leave, coarse
19	Bhote kimbu	Nepal (Ilam)	Big leave & coarse
20	Chinese Hybrid	China	Fast growing, large leaves but coarse
21	Khopasi-1	China	Hard stem, coarse thick leaves
22	Khopasi-3	China	Hard stem, medium coarse leaves

B. Grainage Unit

1. Problems from farmers' side

Grainage and egg supply

- Farmers are receiving poor quality F₁ silkworm eggs from SDC, Khopasi.
- Egg hatchability is poor, i.e. less than 80 percentages on an average.
- Heterogenity is seen during larval rearing and marking and shape of cocoons.
- There is high occurrence of diseases during rearing, i.e. Grasserie/NPV.
- Many farmers complain failure of producing cocoons during early autumn and summer rearing.
- About 70 kg or approximately 6000 boxes of F₁ silkworm eggs has remained as a stock and creating problem of disposing.

Cold room situation

- One cold room meant for F₁ silkworm egg preservation is out of function.
- Power supply to cold room is directly due to unable to supply power though Stabilizer. It is not functioning even if technicians tried many times. Repair and maintenance of stabilizer and cold room is needed as far as possible.

- Compressor and fans of the cold room are out of function.

Condition of building

- Water seepage from the wall of the roof, which is causing great problem during raining. Repair and maintenance is necessary as far as possible.

Egg laying sheet to make loose eggs

- Currently, there is shortage of egg laying sheets to prepare loose eggs.

Non availability of purchasing loose eggs sheets in the market. Therefore, there needs coordination with CSRTI Mysore/JICA or other related organizations to administer the required amount of egg laying sheets for loose egg production

Human resource

- Inadequate trained/skilled government staffs.
- Lack of sericulture training to existing staffs regarding silkworm breeding, silkworm pathology, grainage handling, mulberry breeding, silkworm rearing and post-cocoon processing.
- Lack of higher education on sericulture as a major subject (silkworm breeding, silkworm pathology, grainage handling, mulberry breeding). Vacant positions of staffs are due to retirement of all skilled/trained/core human resources.

Recommendations

- Provision of sericulture training to staffs especially in silkworm breeding, pathology, commercial egg production and mulberry research and advancement.
- Provision of higher studies (BScAg, MScAg, PhD) in sericulture in areas of silkworm breeding, pathology, egg production, mulberry breeding & post-cocoon processing.
- Mechanism of retaining trained staffs in sericulture (Government Policy) creating Plant Protection Sub-Group- Sericulture.
- Outsourcing/hiring skilled human resource to solve existing problem along with allocation of required budget.

Parental Silkworm Stock Maintenance

- Rearing of silkworm strains continues in new building consisting of 8 rooms. Because of unavailability of sufficient room after an earthquake in 2072 BS, more than single strain are reared in a single room, causing chances of mixing one strain to another while handling silkworm larvae during rearing and destroying pure lines. Therefore, rearing of single pure line strain in a single room is necessary under the direct involvement of silkworm breeder and his subordinates.
- There are many crevices in the wall of rearing rooms resulting in water seepage during rainy season and repair and maintenance of those affected rooms is needed as soon as possible

Pure Line Strains Maintained in SDC, Khopasi

- In SDC, maintains 31 strains (30 bi-voltine and 1 poly-voltine) as of April, 2023.
- Two multi-voltine became extinct dated 2019 (Khopasi-1) and LMV (2021).

- Currently, J₁, J₂ (Japanese character) and C₁, C₂ (Chinese character) are the pure strains as received from Japan and maintained at SDC, Khopasi.
- There is a doubt of maintaining purities of the existing silkworm pure strains (J₁, J₂, C₁, C₂) as evidenced by variation in farmers rearing owing to various factors.
- Individual cocoon selection is carried out by observation method, and Pebrine test is not carried out.
- Unavailability of mulberry leaves for rearing multi-voltine strains during October to February (Kartik to falgun).

Correction Measures

- Follow up of back cross practice of existing parental stocks up to 6 generations by a skilled silkworm breeder to maintain purity by maintaining phenotypic homogeneity (3-4 years by adopting AT in HCl) for maintaining homogeneity in terms of larval marking, cocoon shape.
- Strictly follow up of individual selection mechanism by using computer software.
- Construction of poly-house for producing mulberry leaves to rear multi-voltine strains during the month of September to February (Kartik to Falgun).
- Strictly follow up of Pebrine test mechanism in each rearing.

Present Condition of Cold/Chilling Room

- One cold room that was used to maintain a desired temperature ranging from minus 2.5⁰C to 25⁰C is not functioning now. Its repair and maintenance is immediately needed.
- Power supply to cold room is directly from source since stabilizer is out of function.
- Power supply is fluctuating (Input: 150 Volt - 350 Volts). This has created the problem of maintaining desirable temperature in the cold room.
- In coming days, fluctuating power supply can damage the cold room. Therefore, supply the power via stabilizer into the cold room after maintenance/purchase of stabilizer is necessary.

Alternative Ways

- There is possibility of import of parental lines from abroad through bi-lateral coordination and harmony with ISC/ISA, JICA, KOICA, India. Thus imported parental lines should be maintained under the direct supervision of skilled breeder/technicians.
- Seed distribution of SDC, Khopsi races, is also possible, like N₁₀₉ x N₁₁₂, N₁₀₈ x N₁₁₂ which are superior to J₁₂ x C₁₂ during early autumn rearing (Based on the result of Multi Location Rearing Performance), and during late spring & summer rearing, Cross Breed Nepal₋₁ x J₁₂ and Khopasi₋₁ x C₁₂ -Multi-voltine x Bi-voltine silkworm eggs can be distributed to the farmers.
- Import of F₁ bi-voltine silkworm eggs from neighboring country, India and distribution to farmers or Import and distribution of all season improved breed seeds from India (all seasons: PM x CSR₂, CSR₂ x CSR₄, FC₁ x FC₂; spring & autumn: SK₆ x SK₇, summer & autumn: Nisthari x NB_{4D2}). For such alternative adjustment, budget have to be estimated and prepared in advance based on the egg boxes x rate per box including transportation costs.

- Based on observation and technical audit of SDC, [Khopasi](#), it is suggested to downsize its program activities and the Proposed Plans, Strategies & Recommendations are; **(Appendix)**:

Name of section	Plan type	Duration (year)	Strategies	Recommendations
Parental line maintenance section, SDC, Khopasi	Plan-A (Immediate action)	within 6-12 months	1.0 An Immediate action will be carried out to repair & maintenance of non-functional cold room and stabilizer which are currently out of function.	1.1 One cold room that was used to maintain a desired temperature ranging from minus 2.5 degree Celsius to 25 degrees Celsius is not functioning now. 1.2. Power supply to cold room is directly from source since stabilizer is out of function. 1.3. Power supply is fluctuating (Input: 150 Volt - 350 Volts). 1.4. Fluctuating power supply has created the problem of maintaining desirable temperature & RH inside the cold room
			2.0 Emphasis will be provided on immediate arrangement of Individual Egg Laying Card	2.Procurement of Individual Egg Laying Card from India or other countries whichever is accessible due to unavailability of buying in local market is unavailable.
			3.0 Great emphasis will be focused on maintaining available 31 Silkworm Pure-line Strains at SDC, Khopasi under the direct supervision of skilled manpower in order to avail of existing silkworm races in coming days.	3. Currently, there exists only 31 Parental Line Silkworm Races out of 35 Pure-line strains. Reduction of budget ceiling in respect with Parental Line Silkworm Race Maintenance shall have to retrenched by 11 %. Four (4) strains have already died. Proposed budget cut-off: 1. Budget heading: 2.7.3.53 : Labor cost for parental stock maintenance (existing Nrs 1003000 to proposed Nrs 888371/-) 2. Budget heading: 2.7.3.54: Purchase of chemicals & materials for the maintenance of parental stocks (existing Nrs 600000 to Nrs 531429/-)

	Plan-B (Short term)	1-3	<p>1.1 Repair & maintenance of rearing rooms, cellings and walls of old building will be carried out for rearing parental lines, egg production activities</p> <p>1.2 Individual cocoon selection will be carried out by software by computer instead of observation method</p> <p>1.3 Plastic tunnel houses will be constructed for the availability of mulberry leaves during winter season (Marg to Chaitra) as well.</p> <p>1.4 Back-crossing techniques will be carried out to maintain purity of J₁, J₂, C₁ and C₂.</p>	<p>1.1 Since rearing of silkworm strains (31 strains) in a newly constructed building consisting of 8 rooms there by resulting possibility of mixing one strain with another. Rearing of more than single strain into a single room is due to un-availability of sufficient room after an earthquake that happened in 2072 BS. There are many crevices in the wall of rearing rooms there by resulting water seepage during rainy season. Hence, it is recommended to repair and maintenance of those affected rooms as soon as possible.</p> <p>1.2 Strongly recommended to follow individual cocoon selection of each pure-line strains by the aid of software based computer rather than currently followed observation method</p> <p>1.3 Recommended to construct plastic tunnel houses for the availability of mulberry leaves all-round the year to rear & maintain multi-voltine strain. Unavailability of mulberry leaves for rearing multi-voltine strains. (Note: Two multi-voltine extincted dated 2019 (Khopasi-1) and LMV (2021) due to lack of mulberry leaves for rearing).</p> <p>1.4 Recommended to carry out back cross techniques to maintain purity of existing silkworm pure strains (J₁, J₂, C₁, C₂) since farmers as well as seed cocoon producer farms have the</p>
			<p>1.5 Relevant training to the staffs involved at parental line strain maintenance activity will be provided.</p> <p>1.6 Provision of higher education in sericulture to concerned staffs will be managed.</p> <p>1.7 A policy of retaining trained skilled manpower</p>	<p>grievances of un-uniformity of silkworm larvae (phenotypically observed different kinds of larval markings during rearing. (a suspicion of maintaining their purities owing to various unknown factors). J₁, J₂, C₁ and C₂ strains possesses superior quality in terms of cocoon & silk yarn . These strains are not available even in India.</p>

			<p>i.e. right man at right place will be requested to concerned authorities.</p> <p>1.8 Cross breed seeds will be made available for rearing during summer & early autumn rearing.</p> <p>1.9 Vacant posts of staffs will be fulfilled. Besides, skilled retired core manpower will be contracted for the proper continuity of parental-line maintenance.</p> <p>1.9 Promotion of Agro-tourism through Sericulture: Initiate Silkworm Science Program will be started as per the scope of students studying at Universities, colleges and schools.</p>	<p>1.5 Recommended to train existing staffs on silkworm breeding in India/China as there is lack of trained/skilled silkworm breeder and subordinates. Besides, training on Silkworm pathology, Commercial Egg Production, post cocoon management and Mulberry Breeding is imperative to the staffs.</p> <p>1.6 Recommended to have higher studies (B.Sc.Ag., M.SC.Ag. Ph.D,) to the staffs currently involving in the field of sericulture development in respect to silkworm breeding, silkworm pathology, commercial egg production, post cocoon management and mulberry breeding.</p> <p>1.7 Recommended to create sub-group of sericulture under Plant Protection faculty so as to retain skilled manpower of sericulture.</p> <p>1.8 Recommended to produce & distribute Cross Breed Silkworm Eggs (Bi X multi voltine or Multi X Bi-voltine eggs during summer and early autumn season rearing since the CBs are tolerant to high temperature & humidity during these seasons compared to Bi-voltine breeds . Occurrence of disease in CB is minimum compared to Bi-voltine breeds.</p> <p>1.9 For additional revenue collection, promotion of Agro-tourism through Sericulture: Initiate Silkworm Science Program is recommended to start.</p>
	Plan-C (Medium term)	4-5	<p>1.1 An attempt will be made to import Parental lines silkworms from abroad by keeping coordination and harmony with ISC/ISA, JICA, KOICA, India,</p> <p>1.2 Imported or domesticated pure-line strains will be</p>	<p>1.1 Recommended to be a permanent member of ISC/ISA for buying silkworm genetic materials from ISC. Silkworm breeds currently handling at SDC, Khopasi might be degenerated owing to various factors. Hence, there is an exigency of importing the pure-line strains as an alternative from abroad for the</p>

			<p>maintained under the direct control & supervision of skilled breeder/technicians. For this, silkworm breeding training will be provided to concerned staffs.</p> <p>1.3 Multi-varietal, multi-locational & multi-seasonal varietal trials will be carried out and best variety will be recommended as per its best performance depending on different rearing seasons.</p>	<p>sustainable development of sericulture in Nepal.</p> <p>1.2 Recommended to maintain imported silkworm genetic material under the direct supervision & control of skilled breeder.</p> <p>1.3 It is imperative to conduct multi-varietal, multi-seasonal and multi-locational trials of selected hybrids of silkworm existed at SDC, Khopasi . Recommended to distribute best varieties rendering best performances as per rearing seasons and locations.</p>
Grainage Section	Plan-A: (Immediate action)	6-12 months	<p>1.1 Dysfunctional/ out of function cold room meant for F₁ silkworm egg preservation cold room will be repaired</p> <p>1.2 Stabilizer which is not functioning will be repaired or substituted.</p> <p>1.3 Compressor and fans of the cold room which are out of function will be repaired.</p> <p>1.4 Water seepage from the joined point of wall of the roof during raining will be repaired soon.</p> <p>1.5 Loose egg production sheets will be made available very soon.</p> <p>1.6 Fulfillment vacant posts will be managed and skilled manpower will be hired from retired staffs, if available.</p> <p>1.7 Commercial silkworm egg production will be reduced to 30% of existing capacity since there is very low amount</p>	<p>1.1 There is an urgency of repairing dysfunctional/ out of function cold room meant for F₁ silkworm egg preservation and strongly recommend to repair.</p> <p>1.2 Recommended to repair / substitute the mal-functioning Stabilizer as soon as possible.</p> <p>1.3 Compressor and fans of the cold room which are out of function must repair very soon.</p> <p>1.4 Repair water seepage from the crevices/joined point of wall as soon as possible.</p> <p>1.5 Try to obtain these materials from neighboring country India.</p> <p>1.6 Hire the retired skilled manpower if there is possibility of hiring on contract basis.</p> <p>1.7 Cut-off 70 % budget regarding commercial silkworm egg production of F₁ hybrid eggs (materials , chemical & labor costs , etc) because of the facts that: Production: 60868 boxes from 2005/06 to 2017/18 and distribution 27712 boxes i.e 45.53 % in the same period. After COVID- 19 incidence, the silkworm egg demand has drastically reduced resulting about</p>

			of egg demand from farmers.	11.78 % demand of total eggs produced. (production: 27700 boxes and disbursement: 318 boxes) . Proposed Budget cut-off 1. Budget heading: 2.7.3.51 : Labor costs existing Nrs 975000 to proposed Nrs 292500/- 2. Budget heading: 2.7.3.52: Purchase of chemicals & other materials to produce F1 silkworm eggs existing Nrs 600000 to proposed Nrs 180000/-
Mulberry field section	Plan-A (Immediate action)	6-12 months	1.1 Gap filling of dead plants will be carried out immediately. 1.2 Mulberry nursery will be established so as to support the necessity of saplings .	1.1 Gap filling should be done every year. Old plants should be removed. 1.2 Suggested to establish mulberry nursery as per need.
	Plan-B (short term)	1-3	2.1 Multiplication of high yielding varieties such as S-34, S-36 , V-1 etc. will be multiplied by establishing mulberry nursery for sapling production required for Khopasi.	2.1 Suggestion of the multiplication of high yielding varieties such as S-34, S-36 , V-1 within the premise of SDC, Khopasi.
Sericulture Extension	Plan-B (Short term)	1-3	1.Support /subsidy to repair & maintenance of CRC and S/W rearing houses to the farmers residing at Bakhatigaun-Mandandeupur Municipality-Kavre will be continued. 2. Training activities to staffs & farmers will be Cut-off .	1. Support /subsidy to repair & maintenance of CRC and S/W rearing houses to the farmers residing at Bakhatigaun- Mandandeupur Municipality-Kavre will be continued after field visit by SDC, Khopasi staffs which was found complete destroyed during our field visit as a result of devastating earth quake that happened in 2072 BS. 2. Budget allocated for training to staffs & farmers on sericulture should be totally cut-off. a). Budget heading: 2.6.1.9.1: Training to SDO staffs (existing Nrs 1350000/- to zero). b). Budget heading: 2.6.4.154: 35 days Farmers' training (existing Nrs 1295000 t0 zero)

9.5 Assess the stake, ownership and priority of the three tiers of Governments towards sericulture research and development

In September 2015, Nepal's constituent assembly passed a new constitution aiming to transform Nepal from a unitary country to federal republic system with three tiers of government: The federal (central), province and local government. With the change in unilateral to federal structure, the organizational structure of Ministry of Agriculture and Livestock Development (MOALD) also has been changed. Under the new constitution adopted by Nepal, the old organizational structures and functions of federal system such as Program Directorates of Department of Agriculture (DOA) at federal levels and Regional Agricultural Directorate (RAD) in five regions, District Agricultural Development Offices (DADO) in 75 districts and Agricultural Service Centers (ASC) in each districts have been dismantled and new institutions have been set up comprising of 7 provinces consisting of 77 districts and 753 local governmental bodies each with their own legislative, judicial and executive power. The scope of Ministry of agriculture and livestock (MOALD) also has down sized and authority for various agricultural and livestock activities have been shifted from central (ministry of agriculture and livestock development) to provincial and local level by laws and province and local level bodies with delegation of authority to develop and implement their own prioritized activities and formulation of policies for agriculture development.

As documented in the constitutional schedules of power (6, 8, 9, and the [LGOA \(2017\)](#), the Federal level has 14 concurrent functions in relation to national level, legal/policy, regulatory, quality control, international trade, research, and coordination with development partners. The province has mandated to take responsibility for 20 functions related to agricultural and provincial level policies and regulation, whereas the local government is responsible for delivery of agriculture extension service at the local level. These changes have significant impacts on establishing institutional mechanism, formulating local policies and program, resource allocation, and mobilization of human resources to deliver specific agricultural services to the farmers.

With the changes in organizational structure, Ministry of Land Management, Agriculture and [Cooperatives \(MoLMAC\) or alike](#) has been established in each province and under which the separate Directorate of Agriculture and Livestock, Agri-business and Training Center, Fish Development Center at provincial level and Agricultural [Knowledge Center](#) (AKC) and Veterinary Hospital and Livestock [Expert](#) Service Center (VHALESC) have been established at district level. Beside this, Seeds lab, Soils Fertilizer Testing Lab, Plant Protection Lab, Sericulture Development Center, Livestock Disease Lab, Food Technology and Quality Control Offices and commodity farms, such as Dry Fruit Development Farm and Vegetable Germplasm and Seed Production Center have been set up at provincial level.

The new Constitution has provided the local governments to full authority, autonomy and accountability on agricultural service delivery and local agricultural development activities. Each rural municipalities and urban municipalities have been created a separate agriculture and

livestock section with limited technicians, mostly temporarily staff such as one village one technician (OVOT) to look after agricultural extension and other services delivery to the farmers within municipality.

Besides this, various producer associations, such as milk, silk, meat, seed, feeds, fish, and private companies as agro traders, agro-vets and community based organization like farmers group, cooperatives and NGOs are also involving in agricultural system directly or indirectly.

The functional elaboration of the sector indicates that the Province would remain the focal point for technical backstopping, [regulating activities](#) and resource management functions for overall agricultural development activities of the provinces where as local government has full responsibility to deliver agricultural extension services at the local level.

At the local level, a few agricultural staff members have been assigned to deliver extension services under local government. In each local government level, there are separate sections for agriculture, livestock and fishery development. However, this section lacks adequate staffs to serve the need of larger number of farming communities. Apart from this, the extension agents working at the local level /section have limited technical expertise with [weak linkages with](#) provincial level agricultural development offices. There is no any reporting mechanism of the program activities carried out at the local level to provincial and federal organization.

The agricultural sectors are under the concurrent responsibility of all three levels of government except agricultural extension service delivery which is now the sole responsibility of local government. The major components of agricultural development as agricultural research and education both are [placed under](#) provincial and federal government. But the regulatory and quality control measures [such as plant](#) quarantine, seed quality control measure, seed certification, animal quarantine and food safety still fall under the responsibility of federal government. Whatsoever, the structural and functional linkages as mandated by new constitution, in reality, each level of government is doing [independently in trms of formulating](#) policies and strategies, and setting priorities without coordination, which resulted in poor performance of agriculture.

Present Structure and Work

Ministry of Agriculture and Livestock Development (MoALD) is the federal ministry responsible to implement agricultural development activities including silkworm in Nepal. Under the federal ministry, Department of Agriculture (DoA) works for overall coordination and monitoring of agricultural development work including silkworm. Centre for Industrial Entomology Development is the focal point to promote sericulture in the country. Centre for Sericulture Development is a major technical backup office to run sericulture development activities/work in the country. Current status of seri-offices, their role, responsibility and recommendation for sericulture development is presented in [Tables 110-119](#).

These agencies have institutional set up, human resources, designated ToR and annual program budget as well. The institution is working since last four decades to introduce and establish the sericulture in Nepal. In the due course of time, government has invested financial and other resources to develop sericulture in Nepal. Foreign agencies, private sectors, non-governmental organizations were also involved to uplift the sericulture in Nepal. Different studies were made, which provided valuable recommendations to run the program effectively.

As mentioned earlier, with the change in structure of DoA, the current name and structure of Directorate of Silk and Industrial Entomology having 9 sericulture farms also have been changed as Center for Industrial Entomology (CIED) consisting of a single farm SDS, Khopasi, and, remaining 3 farms in Chitapol- Bhaktapur, Dhunubesi- Dhading and Bandipur- Tanahu fall under provincial government, 2 farms Itahari and Dhakutta come under Agriculture Knowledge Center (AKC) of respective district and remaining 2 farms in Pokhara and Syangja have been dismantled.

Now, it has [been more than 35 years](#) of implementation of sericulture in Nepal, and in due course of time, there are many issues raised in sericulture program, and chances exist for improvement. [However, concerns are in terms](#) of what sort of restructuring needed to establish and expand sericulture with evidences is the basic theme of the present study. Few landmark achievements in the sericulture sector are reported.

Local [Governance Operation Act 2017](#) has the provision to coordinate development including agricultural development activities among the agencies under federal, provincial and local level government. However, the linkages among CIED, research center (NARC), provincial sericulture development farms and AKC and in some cases local government is very poor and performing activities independently. Some of pertinent issues related to sericulture development are summarized as follows:

Issues /Challenges

- The agricultural knowledge centers (AKC) based in district headquarters often implement program without clear mandate and without well-trained staff in sericulture. There is no direct linkage with CIED and local municipalities. Even in some cases local government do not send participants to [attend training/](#) workshop/ meeting organized by AKC.
- The coordination among three tiers of the government has challenges for policy implementation that will affect agricultural policy formulation, program implementation agricultural research, extension and implication of rules and regulation for standard and quality produce. To address these problems, it is essential to establish vertical coordination unit within MoALD probably at (DoA) as [federal level](#) and horizontal across the provincial and local levels.
- Local government has greater autonomy over planning and budgeting for spending on agricultural priorities. However, sericulture has not been prioritized by the local government/communities which requires due attention in budgeting and proper handling of program with trained human resources.
- Lack of coordination and collaboration between the three tiers of the government and line agencies has resulted in poor extension services delivery, specially, technical services and inputs to the farmers.
- Agricultural advisory services are the most important knowledge delivery institution for accelerating the adoption of advanced technology to enhance farmers learning abilities for their implementations. There is no direct linkage [between/among](#) educational institutions, research institution and private service providers.

- Local government in most of the cases are running programs with limited extension staffs and ignoring sericulture at the local level, i.e. doing non-professional works rather than as a technician.
- Mostly, local governments are hiring extension staffs on contract basis, who are working in the situation of poor linkages, low responsibility and accountability.
- Federal government are implementing their program directly at local and provincial level while provincial government are implementing their programs without consulting the local body and other provincial institutions and are asking recommendation to local body for payment of the programs without notice in advance.
- Federal and provincial levels formulate guidelines and directives based on program and policies over lapping/duplication without knowing prioritized program in one side and legality and accountability on other side due to **lack of coordination**.

Program Implementation Modality

- A. Program implementation modality on three tiers of government structure with respect to their responsibilities.
- Establishment of **Industrial Entomology Implementation Unit** under DOA by involving Ministry of Industry and Commerce-1, Ministry of Forest and Environment-1, Ministry of Local Administration and Federal Affairs-1, MOLMAC-4, Private sectors/traders-1, NARC -1, IAAS/AFU-1, representative from farmers group/ company-1
 - Program should go through MoU with Federal Government
 - Department of Agriculture leads to overall implementation of the sericulture program

1. Federal Government

- a)) Formulation of Vision, Policies, Strategies, plans and guidelines/ procedures
- b) capacity building, Research & extension services
- c) Facilitation, implementation and coordination with concern stakeholders like JICA, KOICA, FAO, ISC, ISA, SAN and I/NGOs and sericulture advanced countries,
- d) support services to the farmers
- e) Monitoring & evaluation

2. Provincial Government

- a) Provincial Agriculture Development committee leads the overall sericulture development Program in respective provinces.
- b) Create Coordination and harmony among government and private resource centers, and local levels
 - c) Establishment of resource centers (Eggs and mulberry sapling)
 - d) Strengthening and capacity building of extensional personal and farmers
 - e) Fixing program target, Selection of beneficiaries, agreement and release of grant/subsidy
 - f) Make financial arrangement to Local levels as stipulated by Federal body
 - g) Regular monitoring, technical back stopping, evaluation and reporting
 - h) Coordination with Federal government, Local bodies, I/NGOs, CBO's private traders/processor working in province

3. Local Government (Rural/Municipal/Metro Municipality)

- A) Municipality is responsible for overall program planning and implementation at local level
- b) Bearing ownership on Programmed expansion:
- c) Facilitation on cluster identification & selection
- d) Facilitation on beneficiary selection
- e) Facilitation on the Flow of Technical services
- f) Make financial support to Local level farmers who were unable to facilitate from g) provincial government activities & budget
- h) Monitoring & feedback
- i) Coordination with Federal government, Provincial Government, Local I/NGOs, etc

Table 4. Current status of CIED, role, responsibility and recommendation for sericulture development

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
1	Center for Industrial Entomology Development	Hariharbhawan, Lalitpur	Federal	<ul style="list-style-type: none"> Formulate National Policy, strategy, action plan, modalities under the direct supervision of MoALD. Deliver directives to SDCs. 	As per TOR	<ul style="list-style-type: none"> Forge strong linkage & coordination with 3 tiers of government.

Table 5. Current status of SDC, role, responsibility and recommendation for sericulture development

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
2	Sericulture Development Center	Khopasi, Kavre	Federal	<ul style="list-style-type: none"> Pure line maintenance (P₃, P₂ & P₁ level) Delivery of P₁ level eggs to provincial owned seri-farms for seed cocoon production. Collection of seed cocoons from seri-farms Production of F₁ eggs. Preservation of eggs. Distribution of F₁ eggs as per demand. Conduction of multi-locational multi-varietal testing trials. Release of silkworm variety for good quality performance Coordination among MoALD, CIED, provincial MoLMA&C, regional Agriculture directorate, provincial bodies. Accomplishment of Other sericulture related activities. 	<ul style="list-style-type: none"> Currently, no silkworm rearers/seri-farmers. No support to repair & maintain damaged CRC and S/W rearing houses of farmers after earth quake in 2072 BS 	<ul style="list-style-type: none"> Parental line /Strain maintenance by adopting standard measures of silkworm breeding Conduct multi-location multi- varietal trials in different seasons & release best silkworm varieties for farmers' field after testing. Support to farmers for construction of CRC and rearing sheds, rearing racks, & using disinfectant, Repair & maintain buildings, cold room, stabilizers etc. Arrangement of Individual egg laying cards and loose egg production sheets. Management of old mulberry garden by gap filling every year. Construction of permanent poly- house for mulberry garden management for multi-voltine rearing during off-season rearing (Marg to Chaitra).

						<ul style="list-style-type: none"> ▪ Agro-tourism through Seri-Science Program
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Table 6. Current status of MNMC, role, responsibility and recommendation for sericulture development

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
3	Mulberry Nursery Management Center	Bhandara, Chitwan	Provincial-3	<ul style="list-style-type: none"> • Production of mulberry saplings for distribution as per national demand • Accomplishment of other sericulture related activities. 	Currently no silkworm rearers/seri-farmers.	<ul style="list-style-type: none"> • Coordinate with Provincial, Local Bodies, seri-farmer's group/cooperative to increase mulberry acreage & seri-farmers. • Nursery management of high yielding mulberry varieties like S-34, S-36, V-1, G-2, Kosen along with existing Kanva-2 and distribution to farmers. • Regular & effective monitoring of activities. • Technical/subsidy supports seri-farmer group of Nuwakot

Table 7. Current status of PSMCPRC, role, responsibility and recommendation for sericulture development

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
4	Parental Line Stock Maintenance & Seed Cocoon Production Resource Center	Dhunibesi, Dhading	Provincial-3	<ul style="list-style-type: none"> • No obligation to follow up Federal Government Directives. • Office activities run as per Provincial Government Rules & Regulations. • Seed cocoon production (100 kg) for F₁ egg production. • Accomplishment of other sericulture related activities. 	<ul style="list-style-type: none"> • Currently, integrating mushroom (Shitake & Oyster) and honey bees activities. • Current year, 1,00,000 mulberry saplings establishment • Presently, 5 seri-farmers in Deurali, Myagan RM-Nuwakot. 	<ul style="list-style-type: none"> • Regular monitoring of activities. • Technical & subsidy supports to seri-farmers group of Nuwakot. • Quality seed cocoon production. • Agro-tourism through Seri-Science Program.

Table 8. Current status of IEDC, role, responsibility and recommendation for sericulture development

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
5	Industrial Entomology Development Center	Bandipur, Tanahun	Provincial-4	<ul style="list-style-type: none"> • Seed cocoon production for F₁ egg production • Accomplishment of Other sericulture related activities 	<ul style="list-style-type: none"> • Currently, silkworm rearing in Shahid Lakhana Thapa Rural Municipality formed group members of seri-farmers. • Currently, office name has changed into Entomology Development Centre 	<ul style="list-style-type: none"> • Agro-tourism through Seri-Science Program. • Regular monitoring of activities. • Technical & subsidy supports to seri-farmers group of Gorkha & Tanahun.

						<ul style="list-style-type: none"> Quality seed cocoon production
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Table 9. Current status of SDC, role, responsibility and recommendation for sericulture development

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
6	Sericulture Development Center	Malepatan, Kaski	Provincial-4	<ul style="list-style-type: none"> As per the Gandaki Province decision of 2077.7.27 BS, SDO's name has changed into Horticulture Research & Resource Centre. Sericultural activities are totally abandoned. Almost all mulberry plants within the premises of Office have uprooted and removed. Activities on Horticulture Researches will be carried out as a source of hoticultural activities. 	<ul style="list-style-type: none"> u r r l r d s r - f r r e s 	<ul style="list-style-type: none"> Agro-tourism through Seri-Science Program

Table 10. Current status of SDC, role, responsibility and recommendation for sericulture development

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
7	Sericulture Development Center	Triyasi, Syangja	Provincial-4	<ul style="list-style-type: none"> As per the Gandaki Province decision of 2077.7.27 BS, SDO's name has changed into Agriculture Development Resource Centre. Seed processing equipment are already installed. Current Fiscal Year Budget for field management/sericulture activities amounts Rs. 3,00,000 for mulberry nursery management. A total of 40,000 mulberry sapling are being produced. Most of existing mulberry plants uprooted. 	<ul style="list-style-type: none"> Currently absence of seri-farmers. 	<ul style="list-style-type: none"> Agro-tourism through Seri-Science Program. Coordinate with Provincial, Local bodies, seri-farmer's group/cooperative to increase mulberry acreage & seri-farmers.

Table 11. Current status of SPC, role, responsibility and recommendation for sericulture development

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
8	Silk Processing Center	Itahari, Sunsari	Provincial-1	<ul style="list-style-type: none"> Started producing raw silk yarn from 2056 BS. Accomplishment of other sericulture related activities. Currently, SDO has the existence of sericulture unit of AKC, Sunsari where 3 staffs are working. 	<ul style="list-style-type: none"> No support to maintain CRC mulberry garden since last 3 years. 	<ul style="list-style-type: none"> Coordinate with Provincial, Local Bodies, seri-farmer's group/ cooperative to increase mulberry acreage & seri-farmers.

				<ul style="list-style-type: none"> • Total budget for the FY 2079/80 is 17 lakhs. • 2,00,000 saplings of mulberry nursery established. • Currently, 5 seri-farmers of Madhumalla, Morang are rearing silkworms (brushed 9 boxes for early spring 2079) • 9 boxes reared in Itahari Office. 	<ul style="list-style-type: none"> ▪ Budget not released for repair & maintain of damaged CRC after earthquake in 2072 BS. 	<ul style="list-style-type: none"> • Regular monitoring of activities. • Technical & subsidy supports to seri-farmers group of Ilam, Morang, Dhankutta and Udaypur. • Multiplication of high yielding mulberry saplings from existed mulberry variety. • Reeling based on cocoons volume in future.
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Table 12. Current status of SSD, role, responsibility and recommendation for sericulture development- Dhankuta

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
9	Sericulture Development Center	Dhankutta	Provincial-1	-	-	-

Table 13. Current status of SSD, role, responsibility and recommendation for sericulture development-Bhaktapur

SN	Seri-office	Location	Level	Activity/Responsibility	Existing	Recommendation
10	Commercial Grainage Center	Chitapol, Bhaktapur	Provincial-3	<ul style="list-style-type: none"> • Collection of seed cocoons from seed cocoon producer farms. • Production of loose eggs. • Preservation of loose eggs • Packaging loose eggs into boxes and distribution to seri-farmer as per demand. • Mulberry nursery management (75,000 sapling production target) 	<ul style="list-style-type: none"> • Activities as per ToR not in operation since its establishment i.e. commercial egg production activity. • Integration of mushroom activities. • Budget for current FY: 1.15 crore 	<ul style="list-style-type: none"> • Coordinate with Provincial, Local bodies, seri-farmers group/cooperative to increase mulberry acreage & seri-farmers. • Quality seed cocoon production

9.6 Critically assess the sericulture related support services from public community and private institutions

Sericulture Supports in Nepal

1911: Mulberry sericulture introduced by Indian Seri expert.

1940: Eri cultivation demonstrated by Tharu and Rajabanshi tribes.

1950: Mulberry plantation in Godavari initiated by training one HMG/N personnel in Bangalore.

1953-55: Plantation of mulberry within the premises of Cottage Industry, and starting of rearing silkworm by importing silkworm eggs from India by HMG/N.

1967-68: Carried out feasibility study on bi-voltine silkworm rearing by Agriculture Education & Research Department - HMG/N.

1969-70: Feasibility study by importing improved mulberry and silkworm eggs by Japanese expert.

1972-73: Industrial Entomology Project initiated at Khopasi, Kavre by HMG/N

1973-74: Feasibility study initiated at Khopasi by Korean expert bringing improved mulberry & silkworm eggs from Republic of Korea.

1975-76: Land 6.25 hectares procurement at Khopasi, Kavre by HMG/N.

1976-77: Mulberry Ichinose variety 12000 saplings grown received from Republic of Korea.

1977-78: Distribution of improved mulberry variety sapling to farmers by HMG/N.

1977-78: Sericulture Development Project initiated on behalf of KOICA- South Korea.

1984/85-1994/95: Sericulture Project in Ilam- Lutharan World Service / Germany.

1986/87: Acquirement of Multi-end Reeling Machine from Republic of Korea.

1993-95: Construction of Sericulture Center at Khopasi, Kavre- KOICA/Soth Korea.

1996: Established Sericulture Training Center at Itahari, Sunsari- KOICA/ South Korea.

1998-2002: Sericulture for Rural Development Program in 7 districts (Palpa, Syanja. Dhading, Chitwan, Kavre, Kathmandu and Ilam)- UNDP.

1998-2002: Sericulture Mini Project- Ministry of Agriculture, Forestry & Fisheries, Japan.

Project Title: Mini-Project- Technical Cooperation for Sericulture Promotion - Japan

- **Issue/Sector: Sericulture Cooperation** (Total cost: 187 million yen and duration 1 December 1999 - 30 November 2002)
- Partner Country's Implementing Organization: Industrial Entomology Directorate, Department of Agriculture, Ministry of Agriculture and Co-operatives.
- Supporting Organization in Japan: Agriculture, Forestry and Fisheries Ministry.
- Related Cooperation: "Sericulture Promotion" Expert Team Dispatch (long-term and short-term);

Inputs from Japanese Side

- Long-term Experts 3 Equipment 222,244US\$ (30 million yen)
- Production and control of silkworm eggs, pure line strain preservation and sericulture management, targeting engineers in the field of sericulture and model farms.

Project's Overall Goal

- To develop the production of cocoons in Nepal in quantity and quality so that the income of sericulture farmers increase.
- Local cost 426,877 Nepali Rupee (73 million yen)
- Trainees received from Nepal's side: Counterpart 23
- Land and facilities Local cost 51,799 Nepal Rupee (0.1 million yen)

Project Purpose

- To develop the institutional and technical capacities and capabilities of the government of Nepal
- To manage silkworm egg production, mulberry gardens, and silkworm rearing as well as model farmers to manage mulberry gardens and silkworm rearing.

Project outputs

Silkworm Egg Production and Management

- To develop techniques for breeding management and maintenance of pure line silkworm races suitable for Nepalese conditions.
- To improve techniques for silkworm egg preservation and production, and grainage management.
- To improve techniques for seed cocoon production in branch stations.

Sericulture Technology Development/ Extension

- To improve techniques for nursery and mulberry garden management, and cocoon production of sericulture development center and model seri-farmers.
- To improve extension systems and technical capabilities of a sericulture development center and branch offices and model sericulture.

Project Monitoring and Planning/Coordination

- To supervise and manage project activities successfully.
- To promote public information for raising sericulture development.

Advices to the Government of Nepal

- Improvement of sericulture development center.
- Data collection of seri-farmers and sericulture statistics.
- Establishment of the rules and regulations related to sericulture (silkworm eggs, cocoon grading and nursery sampling).
- Production of better quality raw silk.
- Development of the extension system.
- Establishment of the sericulture training center for technicians.
- Review long-term sericulture development plan.
- Legally joining to International Silk Association.

Evaluation of Project

Relevance

- Sericulture is referred to as a means of poverty alleviation and the development of hilly and mountainous areas.

- Sericulture is a means of cash income with comparatively small investment in hilly and mountainous areas where about a half of the Nepalese reside.
- Eventually, the increased production and quality of cocoons and the increase in income by the improvement of sericulture techniques matched with Nepalese farmers' needs. Hence, project was relevant.

Effectiveness

- Production of cocoons in Nepal increased from 13 metric tons to 41 metric tons (315.38% = 215.38 % increase).
- Number of mulberry planting farmers raised from 2,068 to 4,552 (220.12 % = 120.12 % increase).
- Likewise, the number of silkworm rearing farmers from 480 to 1,331 (277.29 % = 177.29% increase).
- Regarding the model farms, the production of cocoons per farmer augmented from 177 kg to 209 kg (118.08 %= 18.08% increase).
- Cocoon yield per box from 17.4 kg to 17.6 kg (101.15 % increase)

Recommendations

- In order to enhance the sustainability after the end of the project, the [Government of Nepal](#) should implement:
- Placement of "Right man at Right Place" / appropriate staff and allocation of budget for maintaining materials and equipment.
- Establish checking systems concerning silkworm egg production.
- Urgent conclusion of an outsourcing contract of extension staff.

In order to extend the project results, the [Government of Nepal](#) should conduct the followings:

- Formulation of realistic and strategic mid-term and long-term sericulture development plan.
- Securing revenue necessary for implementing above mentioned development plan.
- Development of staff, organizations and equipment required for implementing mid-term and long-term sericulture development program.
- Measures for farmers who have no land or small land.
- Preparation of laws and regulations.
- In addition, the evaluation team agreed on the necessity of the Japanese experts dispatch for carrying on the project activity.

Promotion of Quality Cocoon Production & Processing Project in Nepal (PQCPPP) Project completion report, November-2011

- The project purpose was formulated as: "The quality cocoon and silk production model is verified in the target area through capacity building and strengthening of the linkage among seri-farmers groups, Government technicians, private entrepreneurs and other stakeholders."

Annual Project Expenditure

The PQCPPP project was implemented in the Fiscal Years 2006 to 2011. The actual expenditure was **36,696,809 Nepalese Rupees**, as shown in [Table 120](#).

Table 14. Value of Current status of SSD, role, responsibility and recommendation for sericulture development

Value in NRs	JFY2006	JFY2007	JFY2008	JFY2009	JFY2010	JFY2011
Actual (Rs)	5324884	5922933	6354181	10212432	6308879	2573500

Source: PQCPPP, 2011.

Formulating National Sericulture Policy

- The draft of the National Sericulture Policy was prepared in July 2009 after discussing critical issues among policy makers, sericulture administrators, representatives from sericulture farms, DADO officials, as well as private sector and NGO representatives. Even though the National Sericulture Policy has not been approved yet, the Directorate of Industrial Entomology Development (DOIED) adopted some measures described in the policy draft in its 2009 budget. Those measures in the form of subsidies have proved effective in promoting private sector involvement in sericulture.

Sericulture Technology Transfer

- **Cocoon production** in Nepal has been decreasing year by year due to various reasons. Project tried to improve the situation by publishing technical manuals and conducting cascade training. At first, officers received cascade training for preparing the drafts of technical manuals. After publishing the manuals, those officers became resource persons and provided training to extension workers and silk mobilisers. Extension workers in turn facilitated technical training to seri-farmers in each group. Demonstrations on various subjects were also effective in raising awareness and reinforcing important tips on silkworm rearing.

Promotion of Zaguri Silk

- Project decided to promote Zaguri silk production as a mean for seri-farmers to raise their income as well as an opportunity for the private sector to have a larger stake in the sericulture value chain. For this, the project invested maximum resources in capacity development on Zaguri production technology and equipment extension of especially Zaguri silk reeling machines. Besides Zaguri reeling training, trainings on weaving, Zaguri equipment repairing were also conducted.

Project's Marketing Models

- to other private enterprises which produce final products. One such example is the Adhikari family in Bhaireni village.

Sericulture Farmers Organizations

- Nepal Government's sericulture offices have limited human and financial resources; their staff lack knowledge and skills in the area of institutional development of farmers groups. Hence, the project was designed to outsource the task of institutional development of sericulture farmers groups to an NGO. It is realized that the plan was very reasonable in terms of the size of the project and limited resources on the Government side.

- The project contracted Integrated Community Development Campaign (ICDC), based in Dhadingbesi, Dhading district. ICDC completed almost all the planned activities. The positive effects of those activities were noted in the spider-web evaluation and acted to increase the confidence level of sericulture farmers groups.
- The project proposed five models were implemented during the project period:

Cascading Training

- In this model, project used cascading training models to create technical manual. Training to develop technical manuals was oriented to officers so that they can produce similar publications using the same method in the future. Furthermore, project strongly recommends DOIED to continue cascading training every year within their capacity and revise the manuals whenever necessary.

Zugari Silk Marketing

- This model consists of two options: first, Seri-farmers, in order to increase their income, develop their skills and upgrade themselves to become Zaguri silk producers, and secondly, Strong coordination among the Government office, seri-farmers and the private sector is crucial. These types of models were implemented in Nalang and Salang villages. Another type of Zaguri silk marketing, seri-farmers focus on cocoon producers. In this model private reelers play an important role to link seri-farmers and private companies which produce final products. This model can be observed in Baireni village

Private Sector in Zaguri Silk Production

- In this model, creating entrustment between the Government and private sector was realized crucial. Otherwise mutual communication is not possible. The Project succeeded to stage such an entrustment and some private sector successfully sent out some new products into both international and domestic market.

Monitoring

- Various formats useful for monitoring were produced. Especially the Inspection Notebook proved useful to grasp the rearing situation of seri-farmers.

Statistical data collection

- Collecting sericulture related statistics is crucial for the sericulture administration to understand the trend and changes in sericulture activities. DOIED is advised to conduct data collection periodically using the statistical data formats developed during the project.

Main achievements

- Development of sericulture promotion policies by drafting National Sericulture Policy and Action Plan.
- Production of six technical manuals and implementation of training using cascading method.
- Zaguri silk product development and sales by four private entrepreneurs.

- Production of Zaguri silk by seri-farmer groups in Nalang and Salang and seri-farmer entrepreneurs in Bhaireni as well as sales to private sector.
- Capacity development of extension workers on facilitation skills through training and on the job training.
- Establishment groups and cooperatives of sericulture farmers.
- Production of various formats for sericulture statistics and surveys as well as analysis of collected data.

Recommendations

- The Ministry of Agriculture and [Cooperatives](#) is advised to approve the National Sericulture Policy at the earliest.
- DOIED is recommended to review the rearing time and frequency of silkworm rearing to increase productivity.
- The organizational structure of sericulture administration needs to be revised. The establishment of a Sericulture Research Center is required. Under an effective organizational structure, the capacity of technicians should be developed. Minimum requirements such as daily allowances, as well as required knowledge and skills should be set by the government.
- Incubation management should be improved since it affects hatching percentages as well as uniform growth of silkworm and productivity in general.
- DOIED is advised to devote more effort to post-cocoon activities especially promotion of Zaguri silk production. For that purpose, it may need to link with other agencies such as the Chamber of Commerce and Ministry of Industry.
- Maintenance of data collection for sericulture related statistics is recommended to be managed by DOIED. The Department is also expected to issue a more accurate annual review of sericulture in Nepal.

9.7 Approval of National Sericulture Policy

- A major focus of the project was the formulation of a national policy and strategy. In the course of the project period, the government, private sector, NGO and sericulture farmers agreed upon the contents of a sericulture strategy including the promotion of sericulture in general and private sector involvement into the industry. Consequently, DOIED revised and drafted a National Sericulture Policy based on the sericulture strategy. The policy however has not been approved by [the then MOAC](#). The government needs to clarify its position on sericulture promotion by approving the policy through MOAC, National Planning Commission and Ministry of Finance.

Review of Rearing Season and Frequency of Silkworm Rearing

In order to motivate farmers for taking up sericulture, it is important to stabilize production and to increase cocoon production. Sericulture income should become the core part of household income and should be steadily increased. As a measure to stabilize cocoon production, improving sericulture technology is needed but so is setting the right season and frequency of silkworm rearing in each production area. Rearing environment includes mulberry growth circumstances, air temperature and humidity, climate (raining season and dry season), labor availability in relation with other crops, etc. Taking these issues into consideration, the best rearing season and rearing frequency can be decided for stable and increased production.

Capacity Development of Technicians

- Currently the majority of technicians have insufficient experience in sericulture and opportunities to gain skills in sericulture are limited. Capacity development of technician is a major requirement for expanded sericulture production.
- Another requirement is the review of the organizational structure and the establishment of an institution specialized in sericulture. This will reduce the transfer of technicians and will lead to an increase in experienced technicians. In addition, establishing a sericulture research center is required to further develop mulberry cultivation and silkworm rearing technology and to improve the skill level of technicians and sericulture farmers.
- If the government expects JT/JTAs to contribute to the institutional development of farmer groups, they need to be equipped them with the required TADA, knowledge and skills.
- Human Skill Development training packages are available.

Appropriate Incubation Technology to be Re-inforced

- Incubation of silkworm seeds should be managed properly since it affects the hatching percentage and conditions to a great extent. Some of the current problems in incubation management include the fact that the containers used for incubation are too small, while temperature, humidity and light control and dark incubation before hatching are not appropriate. As a result there is a lack of uniformity in the size of silkworms while some are hatched during the next day of hatching. Proper incubation will result in increased cocoon yield per box.
- Proper incubation requires a container in which 20,000 silkworm eggs can be spread without be piled up. It further requires a temperature of 25°C and humidity of 75-80% during a 16-hour light and 8-hour darkness exposure. Complete darkness needs to be maintained for when over 50% of seeds reach maturity to brushing so that uniform, healthy silkworm are produced.

Zaguri Silk Production

Two models developed for Zaguri production. The models shown in [Figure 10](#) and [11](#) can be replicated in each sericulture farm under DOIED. However, to implement the model shown in [Figure 12](#), a sales promotion program for the private sector and appropriate other promotion measures are necessary. Linkage with the Chamber of Commerce and Ministry of Industry is required as well. The Project believes a government strategy to nurture and strengthen Nepalese products will further strengthen the production of Zaguri silk.

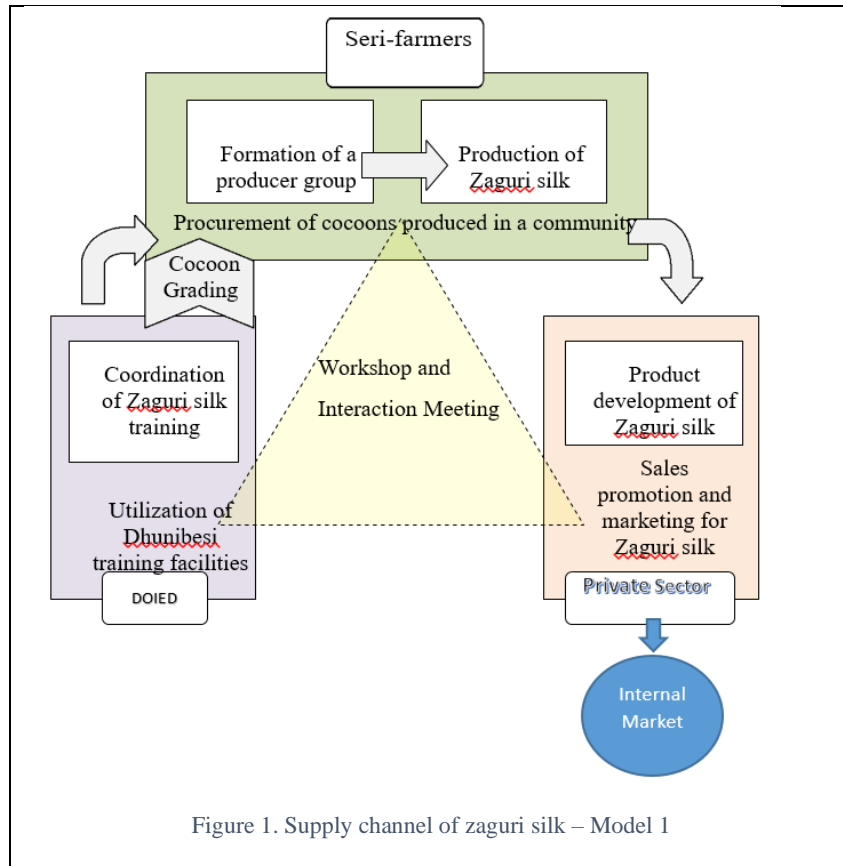


Figure 1. Supply channel of zaguri silk – Model 1

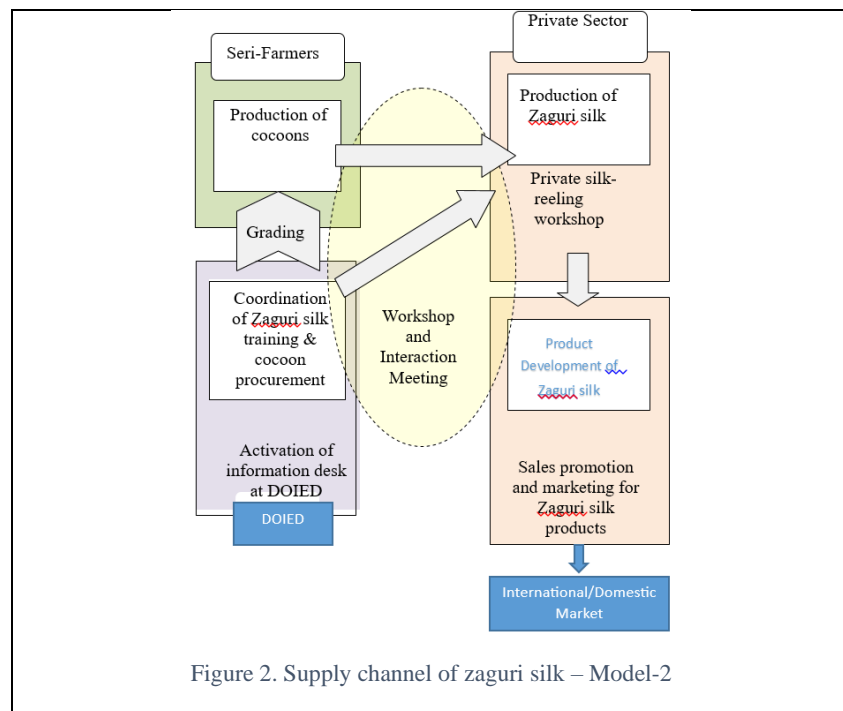
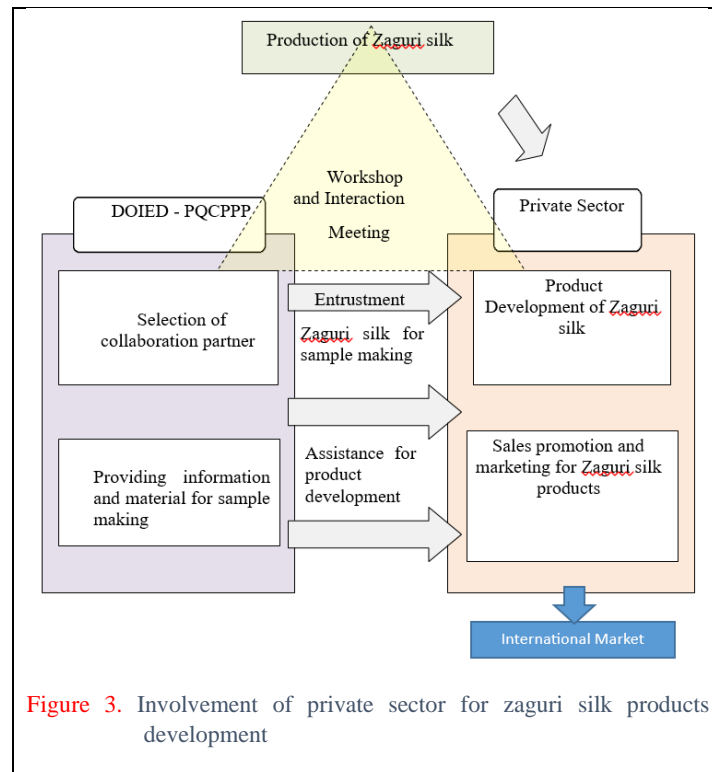


Figure 2. Supply channel of zaguri silk – Model-2



Restructuring Sericulture Related Statistics

- Maintaining sericulture related statistics is importance for DOIED as a foundation for a professional sericulture administration. With support from the Project, formats required for sericulture administration have been arranged and information collection using those formats has started. However, the capacity in collecting information at DOIED as well as sericulture farms is insufficient. In future, the accuracy of sericulture related information needs to be graded by the officer in charge of sericulture statistics at DOIED. The project encourages DOIED to update the contents of “Annual Review of Sericulture” and continue to publish it every year.

Donor's Involvement & Their Contributions

South Korea (1976): a) Donation of 6 sets of multi end machine, b) 12,000 plants of mulberry sapling (Ichinose), c) Dispatch of experts, d) Acceptance of sort- term trainees, e) Grant provision of silkworm seeds for 1976-1999.

South Korea (1994-1996): a) Construction of Itahari sericulture development office, b) Grants for the construction of incubation room, controlled CRC, c) Cocoon drying facility, d) Office building, e) Mulberry garden, and e) 14 sets of multi-end reeling machine

1969 (Japan) : a) A survey on possibilities of sericulture development was conducted by section officer of Department of Sericulture, the Ministry of Agriculture, Forestry and Fisheries.

1995 (Japan): a) JICA dispatched Short-term experts (Mr. Tsuzuku, Mr. Washida), b) Implementation of survey on possibilities of sericulture development, c) The survey proved that Nepalese climate and geography is suitable for mulberry cultivation and bi-voltine silkworm rearing and Japanese contribution

would contribute to income generation of farmers in middle hilly regions and improvement of women status in farming villages by introducing Japanese sericulture technology

1997 (JICA): a) JICA dispatched Long-term expert (Mr. Tsuzuku), b) Promoted sericulture through instructing Japanese “New Sericulture” technologies instead of Indian sericulture technologies by equipping facilities to DOIED and sericulture farms that are required for demonstrate.

1998 (JICA): a) JICA dispatched Sort-term expert (Mr. Miyazawa), b) Introduced quantity silkworm egg production technology.

1999-2002 (JICA mini project (Sericulture Promotion Plan): a) Improved rearing technology of quality silkworm species and maintenance technology of the race of silkworm, b) Improved production and maintenance technology of silkworm seeds, c) Management technology of silkworm seed production unit, d) Improved mulberry sapling production, e) Management of mulberry gardens and cocoon production technology on SDD, e) Improved mulberry garden management at SDOs, f) Cocoon production technology of sericulture model farmers.

Mini Project Achievement (2001): a) Cocoon production was 10 tons in 1998 whereas 33.5 tons in 2001, b) Sericulture farmers has expanded to 3,200 households.

2003/04 (JICA): a) JICA dispatched mini project follow-up expert (Mr. Kano, Ms. Nakahata), b) Investigation into the actual conditions on sericulture, c) Capacity development of extension workers, d) Support on development of Nepalese original silk products, e) Capacity development of sericulture NGO.

2005/06 (JICA): a) JICA dispatched long-term expert (Mr. Kano), b) Capacity development of government counterparts and extension workers, policy advice and instruction on developing sericulture promotion policy, c) Field work of sericulture, d) Seek for establishment of linkage between private sector and NGO Proposal submission for the present technical cooperation project (Sericulture promotion and extension).

1997-2001 (UNDP): Sericulture for Rural Development Program (SRDP): a) Capacity development of sericulture farmers with cooperation of NGO (establishing mulberry garden, mulberry plantation, self-harvesting method, young silkworm rearing, adult silkworm rearing, etc.), b) Involved NGOs are SAN, HOPE and CSDEL.

2003/04 (NGOs): a) Support on NECOSIDA activities (established NGO To develop Nepal original silk, silk products and cocoon buy and sell with private sector purpose), b) Forwarding the JICA subsidy on Nepalese original silk production and selling, c) SAN implemented Silk Network Model Project in the Dhading district by the support of JICA.

IN/NGO&GO Involved in Sericulture Development: a) Help Orphan and Protect Environment (HOPE), b) Center for Sustainable Development and Environment Improvement (CSDEI), c) Dapacha Sericulture Development Program (DSDP), d) Society for Community Development (SCD), e) Lutheran World Federation Nepal (LWF Nepal), f) Women Development Association, Regional Office, Ilam, g) Action Aid Nepal, h) CECI Baluwatar, i) LEADERS Nepal, j) CARE Nepal, k) Center for Poverty Alleviation, Kathmandu, l) Surya Silk Pvt. Ltd., m) CERES Nepal, n) Shivapuri Watershed Management Project, and o) Plan International Nepal are involved in sericulture development.

11. GAP ANALYSIS

From the past reviews of sericulture, recent sericulture offices/farms/field studies, and meeting/discussion with stakeholders at different levels, various problems and constraints responsible for declining of sericulture have been identified in Nepal, which are listed in **Box-7** and elaborated below.

Box 7. Causes of declining sericulture (current findings)

- Low cocoon price as compared to international market.
- Low cocoon productivity due to occurrence of Grasserie disease.
- Inaccessibility of cocoon selling, i.e. cocoons marketing problems.
- Inadequate and irregular technical supports from concerned service providers while rearing silkworm.
- Low hatchability of incubated eggs and mixed types of larvae occurring during worm rearing.
- Problem of wild animal (Dheduwa, monkey at Bakhati gagun, Mandandeupur Municipality#9, Kavre).
- CRC and rearing houses destroyed by devastating earthquake in 2072 BS.
- Lack of post-cocoons training, equipment and fabrication technology among farmers (lacking value chain).
- Death of senile citizens' accustomed and new generation without skills/experiences in sericulture.
- Destruction of mulberry plants as a result of constructing semi urban roads and urbanization.
- Seasonal rainfall/drought affecting mulberry garden management and quality cocoon production
- Confusions of ownership of sericulture in present three tiers of government system (no MoU).
- Dearth of trained manpower in government personnel's due to retirement, posting other Ag-sectors.
- Lack of plan and policy of Government and no priority in sericulture.
- Lack of MoU among Federal, Provincial and Local governments of their roles and responsibilities in development and sustainability of sericulture.
- Negligible involvement of I/NGOs,CBOs in mulberry nursery, silkworm rearing, post-cocoon activities etc.
- Lacking farmers' access to high yielding mulberry varieties and disease tolerant silkworm races.
- Some government farms have been running other agriculture activities than sericulture because of their untrained staff, unaware farmers and because of highly technical agro-industrial sector.
- Complete package for profitable sericulture and aggressive advocacy in program extension is lacking.

Sericulture is an eco-friendly agro-based industry and it is labor **intensive which requires** special care and management providing subsidiary income and employment within short period to the rural people particularly small and marginal **farmers. In addition**, the industrial production of raw silk and fabric employed large number semi- literate and semi-skilled workers in many post-cocoon activities such as reeling, weaving, twisting, printing, dying and silk waste processing. It is the only cash crop that gives return within the 30 days. Silkworm is an industrial enterprise. It is **the most** successful enterprise in our neighboring countries. It was introduced 40 years back in Nepal. Mulberry production and cocoon production testing has proved to be successful in Nepal. National and international market of silk fiber and silk products is inspiring. Data reported by Department of **Customs** (2022) reveals that Nepal imported a worth of NRs 843989000.0 of raw silk and yarns from abroad and earned revenue of 147053000.0 (TPC,2022) At the same time silk products of NRs 7,35,94,000.00 exported from Nepal through the formal route of transaction. This Data could be higher given our open border and having many informal route of trade for these products. Despite its importance, its commercialization of sericulture **is still** questionable. There are many reasons and pertinent issues that are presented below.

11.1 Maintenance of Parental Lines

Sericulture development center, Khopasi has maintained different parental lines since 1990s. They were 35 parental stock of silkworm collected from different countries mostly from Japan, India, Pakistan, Bangladesh, South Korea and Lao PDR. Currently, there are only 33 races of silkworms, which are reared in a traditional house and maintained by non-technicians (office assistance) without proper record keeping system of production and distribution of silkworm eggs, and poor infrastructure for maintenance of silkworm races. There are high chances of losing these races as well as poor quality of eggs production as noticed by the farmers during silkworm rearing. Hence, due to inadequate and poor facility for silkworm germplasm collection and maintenance, the facility for P1 seed production and egg production, as well as P3 and P2 maintenance and multiplication are inadequate.

Therefore, in order to maintain parental lines and quality egg production the best solution may be posting of sericulture breeder/trained officer stationed in khopasi or collaboration with NARC and International Sericulture Association which provides germplasm of sericulture to its member countries.

Study team visited NARC Gene Bank and it was known that NARC gene bank has such facilities to store the parental lines but lacks technical staffs and mulberry garden to multiply these breeds and maintain in perfect state. In fact, Nepal should be a member of international association for getting support in maintaining silkworm races, providing both parental lines and technical back stopping.

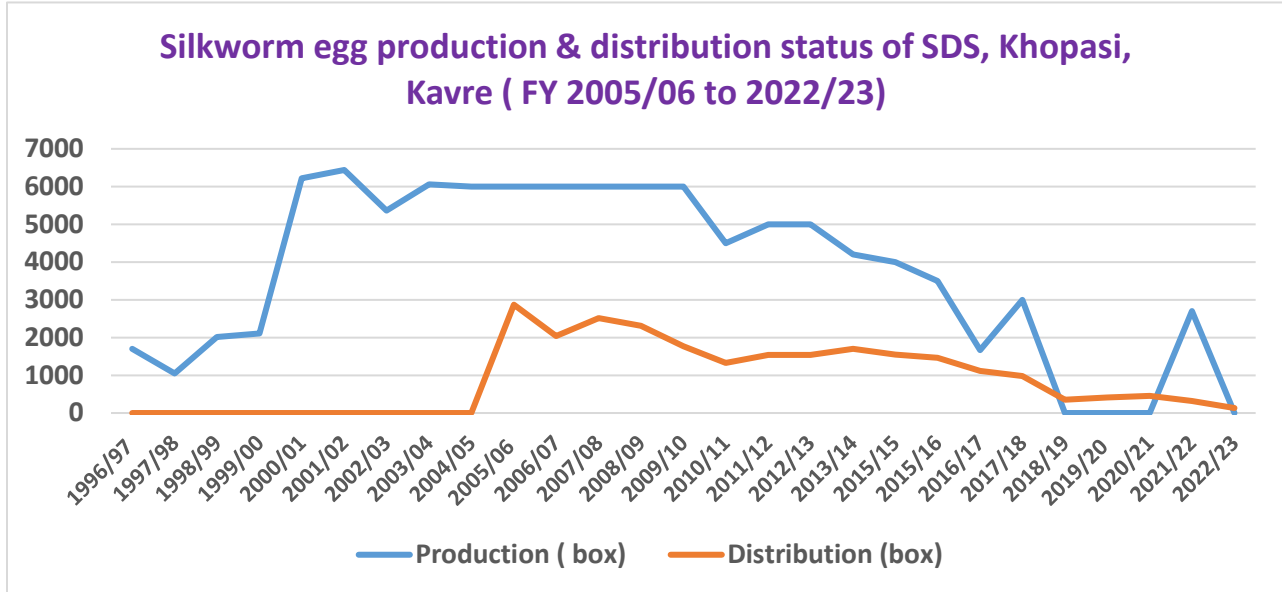
11.2 Status of silkworm egg production and distribution

Sericulture development center, Khopasi under CIED is only one center in Nepal to maintain parental lines and quality egg production. There are different races of silkworm rearing and cocoon production, but bi-voltine silkworms are commonly used by the farmers for quality cocoon production in Nepal. SDS, Khopasi has capacity of producing more than 6000 boxes of eggs per year.

The table shows drastic increase in area of mulberry cultivation from FY 2000/01 which remained stationary for about 10 years until FY 2009/10. A continuous drop could be seen afterwards reaching to 2700 boxes in 2021/22. Irrespective of the government efforts and more or less similar trend of expenditure the egg production had decreased to 40%. This indicates towards reduced priority after 2009/10. Also it is an indication of reduced interest from farmers' side. The egg production data is not available from FY 2018/19 due to covid-19 pandemic. Current production of silkworm egg is only around 50 percent of the production capacity of SC, Khopasi.

Data anomalies are seen for mulberry area to cocoon production, silkworm egg production to its distribution to the farmers and about productivity of silkworm egg to the silkworm cocoon production. This raises issues of data validity, sensitivity of the related personnel towards their responsibility and ultimately towards necessity of such institutions under similar management modality in the long run. For the moment, it is also questionable, whether, at the current level of performance, current level of programs and budget be continued or curtailed. Production and distribution level of silkworm eggs suggests for curtailing 70 % of existing budget of grainage section of SDC, Khopasi for commercial egg production. In this way, 11.45% budget reduction

could be logical for Parental Stock Maintenance Section, of SDC, Khopasi as they are currently



maintaining 31 parental strains only against original 35 strains (4 parental strains are lost).

Figure 14. Silkworm egg production and distribution status of DSC, Khopasi (1996/97-2022/23)

Although training is crucial for motivation and productivity increase, if not properly conducted, budget allocation in it could be total waste. Rethinking is necessary to realistically address such pertinent issues.

Solutions

- Proper maintaining of parental stock in Khopasi by posting breeders, improving infrastructures and importing high yielding silkworm varieties, as necessary importing from neighboring countries specially India and China.
- Performance study should be evaluated continuously through research and selecting varieties according to the agro-ecological suitability by supporting lead farmers, commercial and rural farmers with well identified characterized varieties;
- Egg production should be developed at least one at plain areas and other at mid/low-hill areas in Government Stations – with agro-ecology suitable varieties;
- The distribution system can be given to Private Sector with proper monitoring from Government Sector; Private Sector will develop themselves upon competition.
- Minimum support price should be fixed by the Government and further price will be fixed by Private Sector based upon their competition; subsidy on transportation vehicle can be supported to Private Sector by the Government.

11.3 Farms Site Selection

In the past, most of the sericulture farms were established without technical feasibility in commercial areas where land is much expensive and opportunity cost of the other crops is higher than sericulture. For example, sericulture development center, Khopasi, where climate is cold, high humid with clay soil, where single crop can be harvested in a year rather than 3-4 rearing in other suitable sites. Similarly, Gandaki province has three sericulture firms, while Lumbini, Karnali and Sudur paschim provinces, which are suitable for sericulture but do not have any sericulture farms. The data on demand of mulberry saplings and silkworm eggs shows that Dang, Gulmi, Arghakanchi, Palpa, Rolpa, Dailekh Achham kailali have increasing demand eggs on personal basis. Therefore, an establishment of new seri-farms probably in Lumbani province is necessary either by provincial government or private sectors.

11.4 Mulberry Plantation

Mulberry plantation, silkworm rearing and cocoon production are the major activities of sericulture and productivity and quality of cocoon largely depend on quality of mulberry. Farmers cultivate mulberry plants in infertile marginal land, without irrigation and without recommended inputs. Except few farmers' fields, overall mulberry garden management is poor, which results in poor quality leaf production of Kanva-2 and in turn low quality cocoon production with low productivity. Government provides subsidies on mulberry saplings and their transportation but due to lack of irrigation, proper care and management most of the saplings die every year. There is vast difference in mulberry saplings distribution and actual plant population in the farmer's field. Lack of proper technological packages for the small and marginal seri-farmers, small farm sizes and scatter farm land and poor transportation facilities created further problems for commercialization of sericulture. Therefore, following approaches are suggested for mulberry gardening.

- Mulberry nursery program should be managed by private sector and government can continue research and maintenance of high yielding improved varieties, with breeding and improvement program. However, Government should monitor the quality and distribution performed by the private sectors.
- Poor land, underutilized land with traditional varieties for the mulberry gardening should be changed with high yielding mulberry varieties(V1) in suitable lands with irrigation facilities.
- Advocacy on utilization of community forestry or government fallow land can help to convert such areas into mulberry plantation for carbon sequestration and silk cocoon production as well.
- Government support for clustering of land by providing subsidy or soft loan for leasing of private or public land for sericulture.

11.5 Capacity Development of Technicians/Farmers

Sericulture is one of the highly technical, complex and sensitive farming, and production activities, which require trained and highly skilled human resource. There is lack of trained manpower in sericulture in all sericulture development centers and farms, Agricultural Knowledge Centers and municipalities, are being handled by few technicians. For example, contracted staff as office assistance (Dainik Jyaladari) is maintaining parental lines of silkworm in SDC, Kopasi. In the community level, middle level technicians (JTA's) are working without any knowledge and training. As they are not trained and in return they cannot train the seri-farmers. Majority of technicians have insufficient experience and opportunities to gain knowledge and skills in

sericulture. There is no provision of higher study and training for employees working in sericulture farms. Therefore, capacity development of technician working in sericulture field is a major requirement for better handling and expanding sericulture production.

Similarly, technical services provided at farm level to farmer groups or individuals are poor because of lack of training activities, and untrained technicians. While, list of participants participated in training conducted by SDC, Khopasi shows repetition of participants and participant from non-sericulture areas. At the same time, there is lack of supervision by the technicians during silkworm rearing when the farmers are really in need of technical backstopping. Irregular transfer of employees from sericulture farm and limited scope after retirement (termination of professionalism) is also adversely affecting sericulture program. Therefore, government should give emphasis to capacity building of staffs as well as middle level technicians working in community levels.

11.6 Federal, Provincial and Local Level Linkage

With the promulgation of Nepal's constitution 2015, the governance system of Nepal has transformed into federal republic system with three tiers of government- the federal (central), province and local government. With the change in unilateral to federal structure, the organizational structure of Ministry of Agriculture and Livestock Development (MoALD) also has been changed in line to the spirit of new constitution. The scope of (MoALD) also has been **narrow down** and authority for various agricultural and livestock activities have been shifted from central (Ministry of Agriculture and Livestock Development) to provincial and local level by laws and province and local level institutions have authority to **devise and** integrate their own priorities and policies for agriculture development.

The agricultural **sector is under** the concurrent responsibility of all three levels of government except agricultural extension service delivery which is now sole responsibility of the local government. The major **component of** agricultural development as agricultural research and education are under provincial and federal government. But the regulatory and quality control measure as plant quarantine, seed quality control measure, seed certification, animal quarantine and food safety are still under the responsibility of federal government. The functional elaboration of the sector indicates that the province would remain the focal point for technical backstopping, enforcing regulations and resource management functions for overall agricultural development activities of the provinces, where as local government has full authority, autonomy and accountability on agricultural service delivery at the local level.

With the change in governance system the organogram, role and responsibilities of CIED also has been changed which created some sorts of problems to run sericulture program smoothly, which are summarized here:

1. Lack of coordination and collaboration between the three tiers of the government and line agencies resulted in less effective extension services delivery, specially, technical services and inputs to the farmers at field levels.
2. Local government has greater autonomy over planning and **budgeting, and** implementing the agricultural program and priorities. However, sericulture has not been prioritized by the local the government /communities during budgeting.

Solution

1. Role clarity in three tiers of governments in sericulture promotion (Federal Government- research and policy support, technology development, quality control,
2. Provincial Government- inputs support, technical backstopping, partnership development, infra-structure development, linkage and coordination,
3. Local Government- Farmers selection, land management, community mobilization, entrepreneurship development and subsidies or support activities related to production and marketing.

11.7 Cocoon Pricing and Marketing

Initially, there was no organized market for the cocoon sale in the country and all the cocoon produced by farmers were collected and marketed by the government, After 2070 BS, government stopped to procure cocoon from farmers and encouraged private sectors in post-cocoon activities. Since then, silk market become open for private traders but private traders could not invest to procure cocoon and wait long chain of post-cocoon processing to get their return and value added benefits. Farmers' instant payment like in government market was not possible while dealing with private sectors. They had to wait and like sugarcane farmers, small seri-farmers are waiting to receive their payment. As a result, cocoon market became unstable and farmers were deprived of anticipated benefits. This was one of the major turning **points to decline** sericulture farming in Nepal.

Involvement of private sectors (intermediaries) in cocoon marketing is beneficial to farmers. Cocoon collectors tend to purchase cocoons at lower prices and **sell to** silk processor/ traders at a higher price. However, there is problem of instant payment, low quality and prices of cocoon. It seems that there must be vertical coordination with local government and farmers in marketing and processing of cocoons.

Cocoon price was fixed before long time and has not been adjusted till today, while cost of producing of cocoon is increasing day by **day**. **So, farmers** would not get profit from sericulture as compared to other alternative **crops**. **Therefore**, it is necessary to adjust cocoon price comparing prevailing price at the national/international market. However, this did not happen before farmers swift over the sericulture. The study shows the cost of bi-voltine good quality cocoon in the international market is much higher (i.e. Rs 1000/kg A and above grade), while seri-farmers even cannot get minimum fixed price. **Concerned** government (Federal, Provincial and Local) should take initiative to adjust pricing of cocoon either by **fixing minimum** support price or providing incentives/subsides to fulfil **the cost return and market gap**.

Solution

- Cocoon collection, processing and marketing should be completely given to Private Sectors
- Government Sector have to fix the average price as per the cocoon quality as well as quality assurance should be monitored by the Government body (support committee).
- Post-cocoon handling (reeling and manufacturing) work should be given to Private Sectors, and an effort should be made by Government towards entrepreneurship development in sericulture particularly in post-cocoon training to the farmers so that they can handle cocoon properly, and also facilitate in inputs delivery and marketing of silk and silk products rather than cocoons.

- Export base incentives **should be provided** to the processors and exporters.
- Price guarantee and supporting mechanism by local government **should be pursued**.
- Provision of soft **loan be provided** to establish modern processing plants (Industry).

11.8 Research and Extension

For the development of sericulture, technology needs continuous research activities especially in the field of selection and maintenance of suitable mulberry germplasm; collection and maintenance of high yielding silkworm races; pest management techniques for mulberry and silkworm and other rearing and management techniques. Right now, these research institutions lack the facilities needed and also there is poor co-ordination among them. Agriculture Universities, Rampur/Tribhuvan University (IAAS), Kritipur have conducted research as requirement in post graduate studies rather than continuous need based studies for sericulture development.

Nepal Agricultural Research Council (NARC), the responsible institution for research in Nepal has not established separate unit and a single specialist exists there. There is hardly any research carried out by NARC on Sericulture. At the same time, there is no direct linkages with NARC and SDC, Khopasi in the field of collaborative research. It is known that NARC has Gene Bank facilities to store parental stocks which could be useful for storing parental lines of silkworm.

11.9 Farmers Supports

The CIED, under Department of Agriculture (DoA) is the responsible organization at federal level. The major responsibility of the CIED is to provide relevant extension services to the farmers/co-operatives in sericulture and mulberry cultivation through the Agriculture Knowledge Centers (AKC's) and technical support through the Sericulture Development Centers (SDCs). There are nine SDCs operating throughout the country, of which SDC, Khopasi is under federal government and remaining under the five provinces. The major task of the CIED is policy development, priority settings and coordinating at provincial and local levels. The other task of CIED is maintaining parental lines of silkworm, distribution of eggs and also as resources person on sericulture related survey, training and campaign program organized by the AKCs and municipalities, other institution. The CIED has developed guidelines and norm for sericulture development. However, AKCs and municipalities are running program without clear cut guidelines and norms. Gandaki and Lumbani provinces have developed guidelines and remaining provinces do not have any guidelines regarding the promoting of sericulture.

Solution

- Both mulberry varieties and silkworm breeds importation, improvement and maintenance program should be performed by the Government Sector.
- The egg production program must be handled by the Government Sector.
- The egg and mulberry sapling distribution can be taken by Private Sector upon quality monitoring by the Government Sector.
- Policy should be developed as per Rural and Commercial category.
- Cocoon business can be handled by Private Sector with the participation of local government.
- Government should make entrepreneur friendly policies. Subsidy should be focused to one-time establishment (transportation vehicle, establishment of reeling facilities, CRD, worm rearing house, commercial rearing facilities, cocoon storage facilities, etc.). Incentive and

rewards on yearly or regular basis are useful based on performance and extra additional production and productivity.

- Government should focus on core technical areas (maintenance, breeding and improvement of mulberry and silkworm varieties), input and output price fixation, quality monitoring and its assurance; formation of entrepreneur friendly silkworm policies.
- Government farms should be stationed as per agro-ecological areas (one each at plain and mid-hill areas) for core technical functioning; Some other Pilot Stations can be established as per need.
- Sericulture advocacy and extension can be part of local Government's role and responsibilities.
- There is lack of adequate knowledge in pest control measures at farmers' condition; the regular surveillance and monitoring of pests are lacking. Most of the farmers are mistaken whether it is insect, disease, any other organisms or injuries that inflict the mulberry or silkworm. IPM- seri-farm schools should be organized at farm level and technical knowhow on the management should be transferred to sericulture groups and involved technicians.
- The management and quality of rearing houses at farm level is very poor. Farmers do not have separate rearing houses to rear silkworms, also the caution measures and disinfectants to be used are not sufficient thus leading to high mortality of worms and low productivity of cocoons.

SECTION-C
(Restructuring Plan and Strategy)

12. RESTRUCTURING PLAN AND STRATEGY

Based on all above reviews, survey study findings and [gap analysis](#), the evidences are presented and restructuring finalized. Hence, Objectives 7 and 8 are summarized with restructuring [plan and strategy](#).

It is lucid that silk and silk products which are the lucrative items have greater importance in the domestic and international markets. In essence, its nature of short gestation period of harvesting handling in limited space and quick income generating agro-industry particularly for weak and poor section of rural community. The data from Department of [Customs Nepal 2022](#), shows that Nepal imports every year silk and silk products accounting a worth of more **than 10 million Nepalese currency from abroad and exported more than 7 karore** of silk and silk products formally and could be estimated higher because of open border and informal transaction. This indicates that there is greater scope of sericulture in Nepal in terms of import substitution and export promotion.

[Agro-climatic condition](#) and land suitability, past investment of government, established infrastructures in sericulture, farmer's knowledge, skills, employment generation and quick returns motivate rural farmers in continuation of the program. Considering the production and productivity trends of sericulture, past efforts made to establish infrastructures and investment, existing human resources yielding low volume of production, higher cost of cultivation, poor quality control, and problem of cocoon pricing, handling and marketing suggest the downsizing of [sericulture program](#) in the present context. At the same time, present federal structure of MoALD consisting of three tiers of structure, extension service delivery system plays a major [role](#). Hence the active role and responsibility of local body is equally important for restructuring of the sericulture in Nepal. The purposed Sericulture Development Model under Federalism is presented in [Figure 15](#). Regarding the restructuring, important considerations have been summarized as follows:

12.1 Primary Evidence

The [seri-farmers' versions](#) are:

- Transportation of cocoon to the market point is difficult, no secured markets for cocoon sale and low price of cocoon as compared to neighboring countries.
- SDC supplies silkworm eggs, which are of inferior quality resulting in low production and productivity and so production cost is higher than present selling price.
- Negligible supports by government with respect to technical and silkworm rearing infrastructures, such as construction of Community Chawki Rearing house, individual silkworm rearing sheds, rearing racks other necessary materials, and no support for the maintenance and or replacement of old mulberry garden.
- There is problem of post-cocoon activities like, storage, drying, reeling and twisting, weaving etc.
- Frequent occurrence of silkworm diseases like Grasserie, Flacherie and Muscardine during silkworms rearing, and also damage by insects- pests (stem borer, caterpillars) and wild animals in the mulberry fields.
- Spraying of pesticides in nearby mulberry garden for vegetable cultivation also adversely affects silkworm rearing.
- No national sericulture development policy.
- Land rent is high in Dhading and city areas for contract or lease farming.

The entrepreneurs' versions are:

- No quality assurance in cocoon: Farmers bring different kinds of cocoons, i.e. diseased and unsorted cocoons (good and bad cocoons mixed) for sale, which fetch low price.
- Limited volume of cocoon available from farmers, which is not enough to fulfill the demand of post-cocoon processors.
- Also there is lack of cocoon storage facility to store cocoons because post-cocoon processing requires time to go through the different activities- collecting, storing, sorting, reeling and twisting, dyeing, fabricating, marketing finished silk products etc.

The experts' versions are:

- Developing human resources as per need and retaining them in sericulture for smoothly running seri-activities.
- Program running in cluster approach i.e. egg hatching & young worm rearing in CRC and providing effective extensive supports during silkworm rearing in farmer's rearing houses for healthy worm rearing and quality cocoon production.
- Strengthening private sector in supplying quality inputs (disinfectants, cheap mounting means) and making them available to the farmers timely.
- Developing effective monitoring and evaluation mechanism and establishing transparent motivation packages to staff and seri-workers.
- Identifying seri-technicians in Nepal, maintaining their roster and mobilizing them in proper places to act promptly.
- Identifying suitable silkworm races and mulberry varieties for plains and hills (as known from Rajesh Kumar more than 100 mulberry silkworm germplasms for temperate regions are maintained in CSI and TI, Central Silk Board, Ministry of Textile, Government of India).
- Conducting the value chain analysis in sericulture and intervening the necessary steps for value addition.
- Integrating sericulture in other sector of agriculture ([silk and milk](#), [fish and silk](#), [intercropping with other feasible crops](#)) to increase farm income and to support livelihood of the farmers.
- Continuous research support in different aspects (mulberry, silkworm races, disinfectants, mounting means, post-cocoon activities etc) of sericulture.

Other related aspects for betterment of sericulture added by the experts are:

- Conserving silkworm races (Kin, Shu, Sho, Wa and other promising races) as well as mulberry varieties and developing infrastructure and technology packages for advanced seri-technology to compete at the national and international levels.
- Setting target to produce more than 100 mt of cocoon at the farmers' level and initiating production-based incentive programs to the farmers and entrepreneurs.
- Improving training quality and enacting proactive extension strategy for expanding sericulture.
- Performing gap analysis in silkworm seed, parental stock, research and demonstration.
- Increasing functional linkage and coordination with national institutions (research, education).
- Increasing international adherence for technology transfer (Membership of ISC is urgent) and exploring international market of developed silkworm strains and eggs supply.

- Concentrating Government focus in silkworm breed maintenance, mulberry varieties development, linkage and coordination, enhancement and policy support to facilitate private sectors.
- Declaring minimum support prices of cocoon by the government and facilitating private sectors in mulberry nursery, post cocoon activities etc.
- Launching sericulture development program in two categories – as livelihood supports, employment generation, rural agro-industry/agro-ecotourism, and as commercially high quality cocoon production.
- Improving sericulture extension program (make district level agriculture offices responsible for sericulture extension).
- Dedication and commitment to be ascertained in all parts of stakeholders.
- Thinking of special organization (In India Silk Board effectively functioning) concept to boom sericulture in the long run.

Khopasi technical audit: Technical audit of SDC, Khopasi shows the high potentialities of marketing of silkworm varieties which can be exported to foreign countries.

Export import data of raw silk: Import and export data of silk and silk products shows the great possibility of sericulture farming with import substitution of silk from other countries.

12.2 Secondary Evidence

- Past efforts ineffective due to project model of the programs with weak [long term strategy of sericulture development](#).
- Need of restructuring and power delegation from central to local level under federalism.
- Slow/no horizontal extension and least accountability of concerned agencies.
- Weak monitoring and supervision mechanism.
- Weak research and sericulture-technical extension service delivery.
- Least involvement of private sectors.
- No linkages with other ministries, textile industries, ministry of forestry etc.

The purposed Sericulture Development under Federalism with the role and responsibilities including good linkage and coordination of the different levels of the government is as follows.

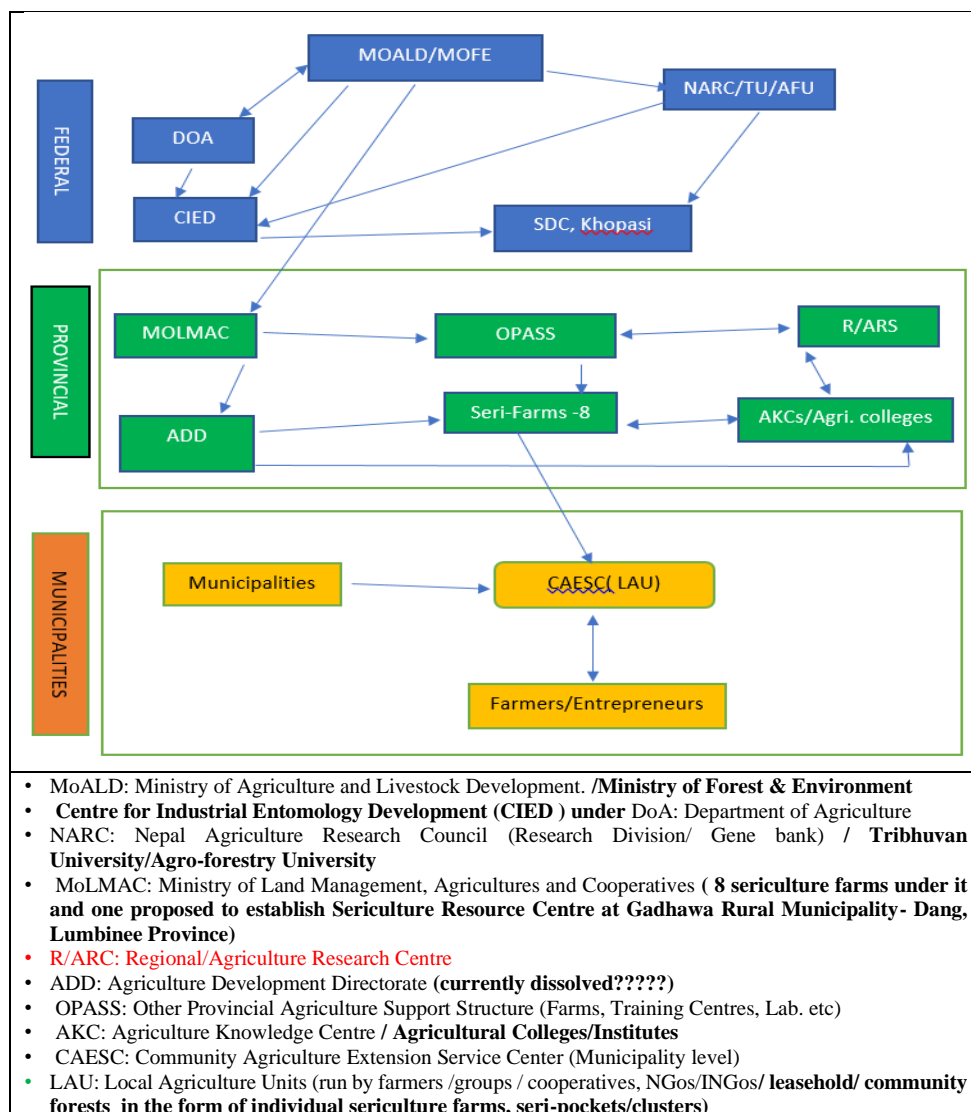


Figure 15. Restructuring model under federalism

12.3 Sericulture under Federal Government Structures

- Under Federal Government, three ministerial level, i.e. Ministry of Agriculture and Livestock Development, Ministry of Forest & Environment and Ministry of Education, Science & Technology and Ministry of industry, commerce and supply are the main responsible concerned ministries to formulate and implement sericulture and related policies, strategies, action plans etc.
- Department of Agriculture (DOA) has to play a key role of bridging MOALD and CIED for the sustainable development of sericulture and providing pertinent directives to prepare policies, plans and strategies to CIED.
- Likewise, Centre for Industrial Entomology Development (CIED), Harharbhawan and Sericulture Development Center, Khopasi under DoA are the main technical partners in line of silkworm breeding, production of quality silkworm eggs and disbursement to farmers as per famers' demand, back-stopping of modern sericulture technologies to the concerned stakeholders.
- Central Entomology Research Division and Gene Bank under Nepal Agriculture Research Council (NARC) are collaborative partners in regard to research and development of sericulture activities and recommendations of research findings.

- Similarly, Tribhuvan University and Agriculture and Forestry University affiliated institutes are the collaborative partners in Research & Development of Sericulture activities and higher studies in sericulture development.
- Program should go through MoU with Federal Government.

12.4 Roles and Responsibilities under Federal Government Structures

- Formulation of vision, policies, strategies, action plans etc.
- Formulation of program guidelines and procedures.
- Administration of technical services as required for program implementation and facilitation.
- Coordination with three tiers of government for promoting sericulture
- Monitoring & evaluation for effective accomplishment and achievement.
- Coordination with donor agencies like JICA, KOICA, FAO, ISC, ISA, SAN and I/NGOs and sericulture advanced countries.

12.5 Sericulture Development under Provincial Government Structures

Under Provincial Level of Government Structures, following organizations are responsible for the development of sericulture:

- MoLMAC: Ministry of Land Management, Agriculture and Cooperatives.
- Under MoLMAC, currently 8 sericulture development offices/ farms are fulfilling their roles & responsibilities.
- One new Sericulture Resource Center has been proposed at Gadhawa Rural Municipality- Dang, Lumbini Province #5).
- R/ARC: Regional/Agriculture Research Centers.
- ADD: Agriculture Development Directorate.
- OPASS: Other Provincial Agriculture Support Structure (Farms, Training Centers, Lab).
- AKC: Agriculture Knowledge Center /Agricultural colleges or institutes.

12.6 Roles and Responsibilities of Provincial Level Government

- Program expansion by establishing resource center.
- Selection of beneficiaries, agreement and release of grant/subsidy.
- Technical backstopping to sericulture farmers and human resource development.
- Maintaining linkage and coordination among government and private resource center at local levels.
- Financial arrangement to local levels as stipulated by Federal body.
- Regular monitoring, evaluation and reporting.
- Coordination with Federal government, Local bodies, and I/NGOs working in the province.

12.7 Sericulture Development under Local Level Government Structures

Under Local Level Government Structures, following organizations are responsible for development of sericulture in Nepal as:

- Concerned Rural Municipalities/Municipalities.
- CAESC: Community Agriculture Extension Service Center.
- LAU: Local Agriculture Units (run by farmers /groups / cooperatives, NGOs/INGOs/ leasehold/ community forests in the form of individual sericulture farms, sericulture pockets/clusters).

12.8 Roles and Responsibilities of Local Level Government

- Facilitation on cluster /pocket identification and selection, beneficiary selection and mulberry area expansion.
- Arrangement of technical manpower (especially skilled technician) in sericulture.
- Financial support to Local level farmers who are not supported from provincial government activities / budget
- **Further arrangement of sericulture** products (cocoon marketing, raw silk production, marketing of finished silk products).
- **Carrying out regular monitoring** and developing **feedback mechanism**.
- Coordination with Federal government, Provincial government, Local I/NGOs.
- Support for clustering of sericulture pockets by providing legal agreement to utilize public and private land on lease basis.
- Miscellaneous **activities** as felt necessary.

13. RESTRUCTURING MODELS

Based on field study, discussion with stakeholders, review of literature, and gap analysis, two restructuring models are presented for development of sericulture in Nepal.

Model-1, Conservation of earlier achievement and downsizing of current organizational structures, role and responsibilities and program activities

- CIED – Program advocacy – Technology dissemination, by using modern IT means, Linkage, coordination, business scheme development, High level human resource development
- Program implementation modality for three tiers of government structure with respect to their responsibilities will be establishment of **Industrial Entomology Implementation Unit** under DOA by involving Ministry of Industry and Commerce- 1, Ministry of Forest and Environment- 1, Ministry of Local Administration and Federal Affairs- 1, MOLMAC- 4, Private sectors/traders- 1, NARC - 1, IAAS/AFU- 1, representative from farmers group/company- 1.
-
- Khopasi – Role will be limited as resource center for maintaining parental lines and silkworm egg production and their conservation.
- Training – at three tiers (Agriculture Information and Training Centre Hariharbhawan– Officer level training (At federal level), Agriculture Business Promotion and Training Centre, Bhandara Chitawan (At the Provincial level)– Assistance technician level training for Sericulture; At the local level SW rearing farmers training at the community level.
- Establishment of silkworm and mulberry Resource Centers, capacity development and technical backstopping will be major responsibility of respective provinces.
- Facilitation, program planning and implementation and providing support services will be the responsibility of local government.
- Based on observation and technical audit of SDC, Khopasi, it is suggested to downsize administrative structure and its program activities (**Table 121**).

Table 121. Existing and proposed manpower for restructuring SDC, Khopasi

SN	Post	Existing		Proposed		Remarks
		Class	No	Class	No	
1	Office head	Gaz II	1	Gaz II	1	
2	Officers	Gaz III	3	Gaz III	2	Breeding + Mulberry Section (B+M) – 1 Grainage - 1
3	Junior Technicians	NG I	4		2	B+M – 1, Grainage 1
4	JTA	NG II	1		-	-
5	Accountant	NG I	1		1	Account+ store under same
6	Store Keeper	NG II	1		-	
7	Driver		1		1	
8	Office Assistant		11		7	B+M =4, Grainage 3
	Total		23		14	BScAg students and trade school intern can be mobilized

- With the change in organizational and administrative structures of SDC, khopasi following programs and budgets are proposed to be down sizes (**Table 122**).

Table 122. Proposed downsizing of program and budget of SDC, Khopasi

Section	Budget heading	Item	Unit	Existing Amount	Per unit (Rs)	Existing Budget (Rs)	Reduction by	New amount	New budget (Rs)
Training	2.6.1.9.1	Training to Local level staffs	Nos.			1350000	100 percent		0
Training	2.6.4.154	35 days training to farmers	Times			1295000	100 percent		0
TOTAL	A					2645000			0
Grainage	2.7.3.51	Labor cost for F1 egg production				975000	70 percent		292500
Grainage	2.7.3.52	Purchase of chemicals & other materials to produce F1 silkworm eggs				600000	70 percent		180000
Grainage		Egg carrying box	Nos.	3000	83	249000	70 percent	900	74700
TOTAL	B					1824000			547200
Parental stock maintenance	2.7.3.53	Labor cost for parental stock maintenance	Race	35	28657.14	1003000	11 percent	31	888371.4

Parental stock maintenance	2.7.3.54	Purchase of chemicals & materials for the maintenance of parental stocks	Race	35	17142.86	600000	11 percent	31	531428.6
TOTAL	C			3070	45883	1603000		962	1419800
Grand Total (A+B+C)						6072000			1967000
Administrative cost(as proposed ONM)						1000000			9000000
Total budget									10967000

In the FY 2079/80 the total allocated budget of SDC Khopasi for Salaries and office maintenance was 142.77 lakh and program budget for sericulture development work was 127.77 lakh. Under the proposed restructuring exercise, out of total 23 approved posts nine posts (including one officer and eight non officers) are projected to be reduced. Under the downsizing work program budget for SDC is proposed Rs 60.72 lakh. Likewise, administrative cost is estimated Rs 100 lakh in the new structure. From the administrative and program restructuring about 43% of administrative cost and about 48% of program budget estimated to be minimized and existing mother stock maintenance and conservation work continues.

In addition to the study of existing silkworm rearing practice, the exercise for program restructuring designed on the basis of approved program budget of SDC in the FY 2079/80. The silkworm rearing egg consumption pattern of SDC is not exceeding the 44% in the last decade (Table 122). Therefore, it is economical to reduce the egg production program just limiting the conservation of the parental resources. In the present federal structure, the mandate for officer level training can be performed by the Agriculture Information and Training Centre. At the Province level and Agribusiness Promotion Support and Training Centre is also functioning. Hence, the cut off training of officer level can be adjusted to the Agriculture Information and Training Centre. Likewise, middle level technicians and business oriented entrepreneurs training can be organized at Agribusiness Promotion Support and Training Centre at Bhandara, Chitawan. In the Bhandara Chitwan already established Sericulture farm is a good venue for practical work. Farmers' level training for silkworm rearing and mulberry cultivation can be organized at commercial production sites.

Model-2. Expansion of sericulture program in new areas

Nepal imports silk every year, and therefore, this model is proposed to expand sericulture in new areas and gradually reduce reliance on import of silk from other countries. It needs support of national government and international donors. The expansion of sericulture is based on the cluster approach to intervene in new seri-feasible areas expecting short-, mid-, and long term achievements (Table 123). The government is well experienced in sericulture development for the past more than 40 years and sees its high potentiality in the country. The proposed expansion is based on the ongoing sericulture development activities in the country.

- Considering over all information gathered from field and seri-stakeholders, at the present situation, it has been estimated 1500 ha mulberry acreage, and 500 seri-farmers with distribution of maximum 500 boxes of eggs, which usually yield on an average 20

kg cocoon per box of eggs rearing. Therefore, **Table 123** shows that with the slow and steady increase in mulberry acreage and seri-farmers (20% per annum), while production and productivity **keeping constant (at the present rate)**, Nepal can produce over 150 mt of cocoons after 15 years, i.e. in 2040.

- This productivity can be doubled simply with research, mechanization, and improved technological package of practices, and thus reducing cost of production to 50%.
- In addition, with the creation of the post-cocoon activities, this business can support to generate higher employment, high value addition to the seri-products and quality product can earn foreign currency contributing to the national economy **and increasing earning** of the farmers.
- Further exploring other multifold advantages of sericulture can diversify sericulture industry and add to income of farmers and prosperity of the nation.

Table 123. Mulberry acreage, seri-farmers and production planning for next 15 years

Plan	Year	Mulberry (ha)	Seri-farmer (No)	Egg (Box)	Cocoon (mt)	Silk (mt)
1. Short-term	2023-24 Base yr	1500	500	500	10	1
	2025-26	1800	600	600	12	1
	2026-27	2160	720	720	14	1
	2027-28	2592	864	864	17	2
	2028-29	3110	1037	1037	21	2
2. Mid-term	2029-30	3732	1244	1244	25	2
	2030-31	4479	1493	1493	30	3
	2031-32	5375	1792	1792	36	4
	2032-33	6450	2150	2150	43	4
	2033-34	7740	2580	2580	52	5
3. Long-term	2034-35	9288	3096	3096	62	6
	2035-36	11145	3715	3715	74	7
	2036-37	13374	4458	4458	89	9
	2037-38	16049	5350	5350	107	11
	2038-39	19259	6420	6420	128	13
	2039-40	23111	7704	7704	154	15

Base on the study, data reveal that there are hope for further expansion of sericulture program in some districts of Lumbini, Karnali and Sudur Paschim Province in near future, for which a new resource center in the new area is useful. Therefore, it is imperative to establish a new resource center (sericulture) in Lumbini province, most probably Dang either by province government or private sector or jointly both as ppp model. The tentative program activities, expected budget, outcomes and action plans are presented (**Appendix**).

Table 124. Proposed program, budget and expected outcomes of new areas

	Year	Rs '000										
Cost	1	2	3	4	5	6	7	8	9	10	11	12
Land Acquisition	14575											
Infrastructure Development		43400	4340	4774	5251	5777	6354	6990	7689	8457	9303	10233
Plantation of mulberry varieties 5 ha		350	525	700	1050							
Distbn of Mulberry sapling			300	600	900	1200	1500	1800	2100	2400	2700	3000
F1 silkworm egg prodn			7	16	24	32	45	54	63	72	81	90

Distbn silkworm egg				15	30	45	60	75	90	105	120	135
Purchase equipments			2534	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4
Irrigation Mgmt		10000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Administrative Cost		5500	6050	6655	7321	8053	8858	9744	10718	11790	12969	14266
Human Resources Devt		1650	1815	1997	2196	2416	2657	2923	3215	3537	3891	4280
Total Cost	14575	60900	16571	16010	18025	18775	20728	22839	25128	27614	30317	33257
Discounted Total Cost	14575	55358	13688	12023	12311	11659	11690	11716	11735	11709	11702	11840
Revenue												
Cocoon prodn	0	0	0	4200	9600	19200	25600	36000	43200	50400	57600	64800
Silkworm faecal/waste	0	0	0	135	270	405	540	675	810	945	1080	1215
Fuelwood	0	0	0	50	100	150	200	250	300	350	400	450
Total Revenue	0	0	0	4385	9970	19755	26340	36925	44310	51695	59080	66465
Discounted Benefit	0	0	0	3293	6810	12268	14856	18943	20693	21919	22805	23662
Present value of Cost	190007											
PF Benefit	318925											
BC Ratio	1.68											
Net Present Value	128918											
Per ha NPV	1289.179861											
Per ropani NPV	64.45899303											
Discount Factor	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.356
Break even	8.5-9 years											

After sericulture program project developed, and funding sources explored, implementation of new sericulture model, starting expected date (proposed base year 2023/24), the outputs for the FY 2039/40 are expected for Mulberry : 23111 ha, Seri-farmers: 7704 , Cocoon production: 154 mt, Raw silk production : 15 mt and cocoon production & revenue after 4th year (Base year: 2023/24) to 12th year expected to be 4200 kg & Rs 4385000 , 9600 kg & Rs 9970000, 19200 kg & Rs 19755000, 25600 kg & Rs 26340000, 36000 kg & Rs 36925000, 43200 kg & Rs 44310000, 50400 kg & Rs 51695000, 57600 kg & Rs 59080000, and 64800 kg & Rs 66465000, respectively even at the present production scenario. Employment generation for 2039/40 are about 13000 employees (@ 16 employment/ha) in terms of silkworm rearing activities. According to Bukhari et al. (2019) sericulture has good potential to generate employment up to 11 persons of every kg of raw silk produced, i.e. 15000 kg x 11= 165000-person employment for FY 2039/40.

Table 125. Action plan

SN	Activities	2023/24	2024/25	2025/26	2026/27	2027/28	Remark
1	Land Acquisition	X					
2	Mulberry plantation		X				
3	Germplasm maintenance			X	X	X	
4	Infrastructure development		X				
5	F1 silkworm egg production		X	X	X	X	
6	Mulberry area expansion			X	X	X	
7	Mulberry sapling distribution		X	X	X	X	
8	Silkworm F1 egg distribution				X	X	
9	Cocoon production			X	X	X	

10	Raw silk production				x	x	x	
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A strategic model to strengthen and promote sericulture in Nepal

The strategic model is presented in Figure 14 and overall plan, strategy and recommendations are summarized as follows.

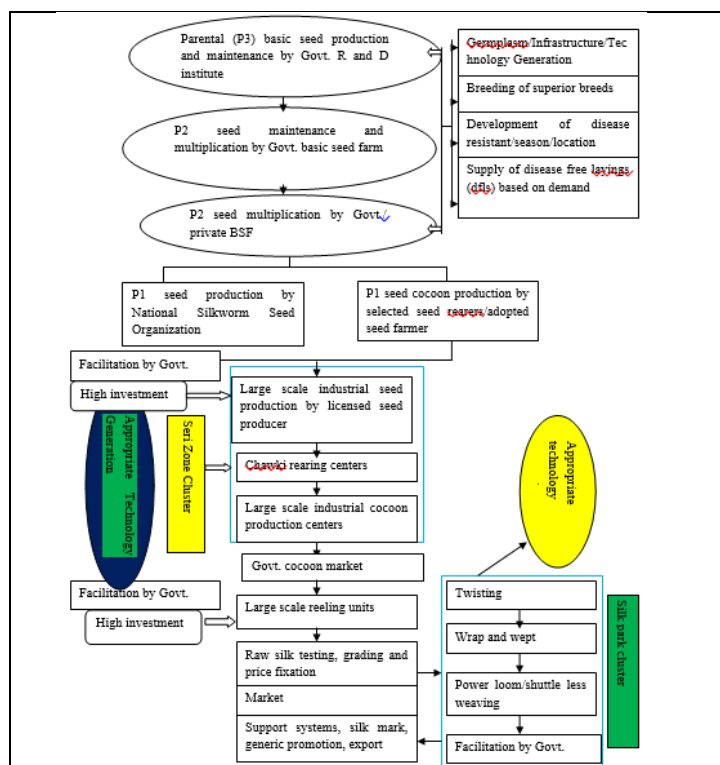


Figure 16. A strategic model to strengthen and promote sericulture in Nepal

The overall reviews and field studies have pointed out various dimensions as elements of strategies for long term development of sericulture. They are sorted, combined and grouped as follows:

Strategy for Silkworm Egg Quality Production

- Maintenance of parental lines available in Khopasi and exploiting their genetic potentials of double hybrid crosses.
- Seeking and using new silkworm germplasms races/strains with better quality by government.
- Establishment of breeding research centers in collaboration with /Universities /institutions and Pvt. Founders.
- Providing with other sources of silkworm eggs exporting from foreign countries.
- Region and season specific innovations by applying mulberry cultivation and silkworm rearing techniques.
- Coordination and cooperation with national/international related organizations.

Strategy for High Yielding Nutritive Mulberry Gardening and Management

- Maintenance of mulberry genotypes available in Khopasi/Bhandara and exploiting their genetic potentials.
- Seeking and using new mulberry genotypes with better quality and high yielding by government.

- Establishment of breeding research with /Universities /institutions and Pvt. Founders.
- Getting research materials from other sources/from foreign countries.
- Region and season specific innovations by applying mulberry cultivating and silkworm rearing techniques.
- Coordination and cooperation with national/international related organizations.

Strategy for Mulberry Gardening and Silkworm Rearing by the Seri-Famers

- Increasing farmers' awareness for the importance of mulberry farming and silkworm rearing.
- Forming of groups of seri- farmers and the cooperatives to assist them in cluster and increase farmers' ability.
- Improvement for quality productive sericulture activities with sample/demo-farming.
- Skills improvement of farmers through practical skill developing training programs.
- Establishment of cocoon collection center and cocoon storage facilities.
- Increasing mulberry coverage and the cocoon production volumes to substitute export in the long run.
- Short-term and long-term loan for the expansion of the efforts at rural and community level.
- Coordination and cooperation with national/international related organizations.

Strategy for Marketing of Seri-Products

- Conservancy quality product and quality service to demonstrate positive image.
- Working with silk producing materials and converting them to silk textile industry as value added products.
- Identifying and expanding markets to improve marketing at national and international level.
- Improving marketing promotion effectively and efficiently and maintaining quality product to face the competitor.
- Socializing pure silk product as national emblem or identity.
- Coordination and cooperation with national/international related organizations.

Strategies for National Policy and HRD Development

- Improving the employee skill through basic, refresher and advanced training.
- Retaining sericulture technical staff and experts at appropriate post and position to run program smoothly.
- Continuing member of ISC for mutual benefits in sericulture.
- **Preparing** National Sericulture Policy, Sericulture Board, short term- and long-term sericulture vision, goal and strategies.
- Designing UG&PG curricula, and studies in sericulture at the national Institutions/ Universities.
- Teaching, training and research collaborations with related government/Institutions/ organizations.
- Coordination and cooperation with national/international related organizations.

1A. Plan, Strategy & Recommendations (Included in SDC, Khopasi audit)

Seri-section	Plan type	Duration (yr)	Strategy	Recommendations
Parental line maintenance section, SDC, Khopasi	Plan-A (Immediate action)	Within 6-12 months	1.0 An Immediate action will be carried out to repair & maintenance of non functional cold room and stabilizer which are currently out of function.	1.1 One cold room that was used to maintain a desired temperature ranging from minus 2.5 degree celsius to 25 degree celsius is not functioning now. 1.2. Power supply to cold room is directly from source since stabilizer is out of function.

				1.3. Power supply is fluctuating (Input: 150 Volt - 350 Volts). 1.4. Fluctuating power supply has created the problem of maintaining desirable temperature & RH inside the cold room
			2.0 Emphasis will be provided on immediate arrangement of Individual Egg Laying Card	2. Procurement of Individual Egg Laying Card from India or other countries whichever is accessible due to unavailability of buying in local market is unavailable.

1B. Plan, Strategy & Recommendations

Seri-section	Plan type	Duration (yr)	Strategy	Recommendation
Parental line maintenance section, SDC, Khopasi	Plan-B (Short term)	1-3	<p>1.1 Repair & maintenance of rearing rooms, celings and walls of old building will be carried out for rearing parental lines , egg production activities</p> <p>1.2 Individual cocoon selection will be carried out by software by computer instead of bservation method</p> <p>1.3 Plastic tunnel houses will be constructed for the availabilty of mulberry leaves during winter season (Marg to Chaitra) as well.</p> <p>1.4 Back-crossing techniques will be carried out to maintain purity of J₁, J₂, C₁ and C₂</p> <p>1.5 Relevant training to the staffs involved at parental line strain maintenance activity will be provided.</p> <p>1.6 Provision of higher education in sericulture to concerned staffs will be managed.</p> <p>1.7 A policy of retaining trained skilled manpower i.e. right man at right place will be requested to concerned authorities.</p> <p>1.8 Cross breed seeds will be made available for rearing during summer & early autumn rearing.</p> <p>Vacant cant posts of staffs will be fulfilled. Besides, skilled retired core manpower will be contracted for the proper continuity of parentalline maintenance.</p> <p>1.9 Promotion of Agro-tourism through Sericulture: Initiate Silkworm Science Program will be started as per the scope of students studying at Univerities, colleges and schools.</p>	<p>1.1 Since rearing of silkworm strains (31 strains) in a newly constructed building consisting of 8 rooms thereby resulting possibility of mixing one strain with another. Rearing of more than single strain into a single room is due to unavalablity of sufficient room after an earthquake that happened in 2072 BS. There are many crevices in the wall of rearing rooms there by resulting water seepage during rainy season. Hence, it is recommended to repair and maintenance of those affected rooms as soon as possible.</p> <p>1.2 Strongly recommended to follow individual cocoon selection of each pureline strains by the aid of software based computer rather than currently followed observation method</p> <p>1.3 Recommended to construct plastic tunnel houses for the availability of mulberry leaves all round the year to rear & maintain multi-voltine strain.Unavailability of mulberry leaves for rearing multivoltine strains. (Note: Two multivoltine extincted dated 2019 (Khopasi-1) and LMV (2021) due to lack of mulberry leaves for rearing).</p> <p>1.4 Recommended to carry out back cross techniques to maintain purity of existing silkworm pure strains (J₁, J₂, C₁, C₂) since farmers as well as seed cocoon producer farms have the grievances of ununiformity of silkworm larvae (phenotypically observed different kinds of larval markings during rearing (suspicion of maintaining their purities) owing to various unknown factors). J₁, J₂, C₁ and C₂ strains possesses superior quality in terms of cocoon & silk yam . These strains are not available even in India.</p> <p>1.5 Recommended to train existing staffs on silkworm breeding in India/China as there is lack of trained/ skilled silkworm breeder and subordinates. Besides, training on Silkworm pathology, Coomercial Egg Production, post cocoon management and Mulberry Breeding is imperative to the staffs.</p> <p>1.6 Recommended to have higher studies (BScAg, MScAg, PhD) to the staffs currently involving in the field of sericulture development in respect to silkworm breeding, silkworm pathology, coomercial egg production, post cocoon management and mulberry breeding.</p> <p>1.7 Recommended to create sub-group of sericulture under Plant Protection faculty so as to retain skilled manpower of sericulture.</p> <p>1.8 Recommended to produce & distribute Cross Breed Silkworm Eggs (Bi x multi voltine or Multi X Bi-voltine eggs during summer and early autumn season rearing since the CBs are tolerant to high temperature & humididy during these seasons compared to Bi-voltine breeds. Occurrence of disease in CB is minimum compared to Bi-voltine breeds.</p> <p>1.9 For additional revenue collection, promotion of Agro-tourism through Sericulture: Initiate Silkworm Science Program is recommended to start.</p>

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1C. Plan, Strategy & Recommendations

Seri-section	Plan type	Duration (yr)	Strategy	Recommendation
Parental line maintenance section, SDC, Khopasi	Plan-C (Medium term)	4-5	<p>1.1 An attempt will be made to import Parental lines silkworms from abroad by keeping coordination and harmony with ISC/ISA, JICA, KOICA, India,</p> <p>1.2 Imported or domesticated pureline strains will be maintained under the direct control & supervision of skilled breeder/technicians. For this silkworm breeding training will be provided to concerned staffs.</p> <p>1.3 Multi-varietal, multi-locational & multi-seasonal varietal trials will be carried out and best variety will be recommended as per its best performance depending on different rearing seasons.</p>	<p>1.1 Recommended to be a permanent member of ISC/ISA for buying silkworm genetic materials from ISC. Silkworm breeds currently handling at SDC, Khopasi might be degenerated owing to various factors. Hence, there is an exigency of importing the pureline strains as an alternatives from abroad for the sustainable development of sericulture in Nepal.</p> <p>1.2 Recommended to maintain imported silkworm genetic material under the direct supervision & control of skilled breeder.</p> <p>1.3 It is imperative to conduct multi-varietal, multi-seasonal and multi-locational trials of selected hybrids of silkworm existed at SDC, Khopasi. Recommended to distribute best varieties rendering best performances as per rearing seasons and locations.</p>

2A. Plan, Strategy & Recommendations

Seri-section	Plan type	Duration (yr)	Strategy	Recommendation
Grainage Section	Plan-A (Immediate action)	Within 6-12 months	<p>1.1 Dysfunctional/ out of function cold room meant for F₁ silkworm egg preservation cold room will be repaired</p> <p>1.2 Stabilizer which is not functioning will be repaired or substituted.</p> <p>1.3 Compressor and fans of the cold room which are out of function will be repaired.</p> <p>1.4 Water seepage from the joined point of wall of the roof during raining will be repaired soon.</p> <p>1.5 Loose egg production sheets will be made available very soon.</p> <p>1.6 Fulfillment vacant posts will be managed and skilled manpower will be hired from retired staffs, if available</p>	<p>1.1 There is an urgency of repairing dysfunctional/ out of function cold room meant for F₁ silkworm egg preservation and strongly recommend to repair.</p> <p>1.2 Recommended to repair / substitute the malfunctioning Stabilizer as soon as possible.</p> <p>1.3 Compressor and fans of the cold room which are out of function must repair very soon.</p> <p>1.4 Repair water seepage from the crevices/joined point of wall as soon as possible</p>

1B. Plan, Strategy & Recommendations

Seri-section	Plan type	Duration (yr)	Strategy	Recommendation
Mulberry field section	Plan-A (Immediate action)	6-12 months	<p>1.1 Gap filling of dead plants will be carried out immediately.</p> <p>1.2 Mulberry nursery will be established so as to support the necessity of mulberry saplings</p>	<p>1.1 Gap filling should be done every year. Old plants should be removed.</p> <p>1.2 Suggested to establish mulberry nursery as per need</p>

2B. Plan, Strategy & Recommendations

Seri-section	Plan type	Duration (yr)	Strategy	Recommendation
Mulberry field section	Plan-B (Short term)	1-3	Support /subsidy to repair & maintenance of CRC and S/W rearing houses to the farmers residing at Bakhatigaun- Mandandeupur Municipality- Kavre will be continued.	1 Support /subsidy to repair & maintenance of CRC and S/W rearing houses to the farmers residing at Bakhatigaun- Mandandeupur Municipality- Kavre will be continued after field visit by SDC, Khopasi staffs which was found complete destroyed during our field visit as a

				result of devastating earth quake that happened in 2072 BS
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3. Plan, Strategy & Recommendations

Seri-section	Plan type	Duration (yr)	Strategy	Recommendation
Commercial Grainage Centre (CGC)	Plan-B (Short term)	1-3	1. Seed cocoon production will be started..	1. Since CGC- Chitapol possesses abundant mulberry garden, it recommended to start up seed cocoon production activity.

12. CONCLUSIONS

- The present findings and restructurings have presented two models of restructuring for sericulture development under federal system of Government with quality cocoon production and expansion of program in new areas. Followings efforts are necessary for smooth implementation and productive output of the program.
- Local government should help to promote value addition of farm produce by facilitating the development of markets and marketing infrastructures.
- It is necessary to enhance the feelings of ownership of the private sectors over sericulture activities and ensure the environment for investment with the role of the private sectors clearly spell out. The possible area for partnership may be in the establishment of resource center, development of value addition and timely delivery of inputs.
- As a multifaceted nature of agriculture, in general and sericulture in particular, different actors/ Institutions are involved directly or indirectly, therefore, there should be clear TOR with commitment for each institution for effective implementation of program and service delivery.
- Agricultural sector is always in priority for increasing production and productivity but with least attention to value addition and infrastructure development. As a result, farming always remains uncertain due to the problems in market and marketing of their farm produce and private sectors have least interest to invest in agriculture sectors due to the concern on profitability. Therefore, local government should develop policies which encourage local community / private sectors to invest in such activities.
- Research, extension and education system be driving factor in enhancing production and productivity. Hence, restructuring and strengthening of the program is the need of the time.
- To enhance the competitiveness of the farmers' in seri-business, government should provide incentive for silkworm eggs, mulberry saplings, CRCs, silkworm rearing house, cocoon production, pricing , processing and marketing by establishing separate entity, like National Silk Board or support committee under DoA by representation of concerned stakeholders.
- The extension workers with knowledge and skill of sericulture should be recruited as civil servant under a provincial public service commission (PSC) immediately.
- Downsizing present activities of Sericulture Development Centers, Khopasai by limiting only in maintaining parental lines with reduction of cost.
- Due to the its potentiality to earning foreign currency, expansion of its cultivation in new areas with complete packages is necessary.

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