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# Seri-Entrepreneurship: Current Status and Potential Opportunities

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### Abstract

The ability of a country or an area to prosper economically is largely depend on entrepreneurship, especially in light of the current unemployment crisis and anticipated technological advancements. The most important issues in the growth of entrepreneurship are not just how to offer chances to entrepreneurs, but also how to provide them substantial support so they may achieve greater success. To this, cultivating mulberry plants, production of disease-free layings, raising of young (chawki) and late-age silkworms for cocoon production, reeling of cocoons (silk reeling) for yarn production, throwing (spinning, warp, and weft production), wet processing (dyeing and printing), weaving (fabric production), modern (computer-aided) and traditional (textile designing) textile marketing and so on are just a few of the varied range of activities that make up the Indian silk industry. Additionally, sericulture products and by-products have become more significant in the biotechnological, pharmaceutical, and biomedical industries, in recent years, for the creation of high-value new goods. Therefore, there is a great deal of opportunity for successful business in the sericulture and seribiototechnology sectors to grow. These opportunities help young people and unemployed women to become successful business owners who both support the workforce and work for themselves. This can help address the issues of unemployment standards and in India's rural and urban areas as well as elevate socioeconomic levels.



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### Introduction

India's economy, which is classified as developing and has a GDP of USD 2.7 trillion, is the sixth largest in the world and is expected to grow at a

faster rate than other major economies in the fiscal year ending in March 2023.<sup>1</sup> However, the country's 8.3% unemployment rate and 33 and 67% of the total jobless rate in rural and urban areas per thousand

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people, respectively, prevent it from becoming the world's top.<sup>2</sup> As a result, it has been suggested that entrepreneurship development is one strategy for achieving the goal of encouraging entrepreneurship as a response to unemployment.<sup>3,4</sup> Gorgievski and Stephan,<sup>5</sup> define an entrepreneur as someone who starts a new business and bears the majority of the risks and profits associated with it. They are also regarded as national assets in order to achieve the best results. To close this gap, the Indian government launched the "Startup India" initiative, which aims to develop and provide significant assistance to entrepreneurs in creating a strong startup ecosystem and transforming India into a country where people create jobs rather than just seek them out. The most developed nations have emerged as "world leaders" in the world because of their vision, ingenuity, research, and entrepreneurship. The Department for Promotion of Industry and Internal Trade (DPIIT) has classified 92,683 enterprises as startups that registered with Startup India as of February 28, 2023, benefiting India's economic development, since their entrepreneurs have improved India's economic development.<sup>6</sup>

The phrase "new entry" refers to entrepreneurship, which is typically accomplished by founding a company that allows an individual or group to study a unique endeavour.<sup>7</sup> To be an entrepreneur, one needs to possess a thorough understanding of the opportunities that present themselves for doing amazing things. When new products, raw materials, services, organizational strategies, and procedures are used to sell a product for more than its manufacturing cost, an entrepreneurial opportunity, often referred to as a business opportunity, occurs.<sup>8</sup> The agricultural and industrial sectors offer a wealth of entrepreneurial potential, particularly in growing economies such as India, where agriculture and allied farm sectors account for 70% of GDP.<sup>8</sup> Sericulture, also known as "silk farming" is one such fascinating enterprise. It entails the industrial cultivation of lepidopteran insects to produce cocoons and silk for commercial use. This category includes both mulberry and non-mulberry sectors.

Silk industry, one of the oldest agro-based sectors in India is particularly successful in rural areas where agriculture remains the primary source of income.

India is the only country with diverse sericulture includes mulberry and Vanya sericulture covering an area of 2,35,001 and 2,04,085 hectares, respectively. The sericulture industry has been developed over time from a long-term sustainable seri-business to one that was largely dependent on subsidies. Businesses such as Kishan Mulberry Nursery Plant, Grainages, Chawki rearing centers, Sericulture Equipment Supply Centers, Seri-Shops, Seri-clinics, and Seri-resource centers are formed as different economic operations. Furthermore, sericulture has a tremendous potential to give a myriad of business prospects spanning from basic to advanced domains like the biomedical and pharmaceutical industries because it is known as the "Kalpavruksha," where nothing is discarded from soil to fabric operations. Additionally, the 7.6 million job prospects associated with the sericulture sectors make the post-cocoon industry is the hub of employment opportunities.<sup>9,10</sup> As a result, the sericulture sector is regarded as one of the most established one in India. Its industrial products and byproducts offer tremendous prospects to entrepreneurs around the country, and employment inside the companies in this sector is among the greatest. The tremendous opportunities that sericulture presents draw young people from all over the world to launch their businesses in this field. In order to establish firms that have the potential to enhance our nation and society we evaluate the most promising business opportunities within the sericulture sector under this scope.

### **Sector-specific Pathways for Indian Sericulture Entrepreneurship**

#### **Kisan Nursery**

Mulberry is primarily a perennial crop with the most common method of propagation being the vegetative portion of the plant, ideally the stem. However, mulberry plantations face limitations in achieving uniform gardens due to the failure of cuttings to sprout, resulting in gaps. Even if the gaps are filled with new cuttings or plants, there will be non-uniform growth of mulberry plants. To overcome this gap and establish uniform mulberry plantations, in recent years, the concept of growing mulberry saplings has come into practice. Realizing the significance and value of saplings, most of the farmers look forward for healthy saplings to kick off the mulberry plantation. The need to increase the demand and supply of saplings empowers large-

scale production of saplings commercially as a viable business venture. Eventually, recent research validated the returns and the cost for production of nursery saplings being Rs.2.02 and 1.94 per sapling, respectively, in Karnataka and Andhra

Pradesh. This suggest that establishing a mulberry nursery to generate healthy saplings for the seri-farmers in need will be a very profitable and successful business endeavor.<sup>11</sup>

**Table 1: Current mulberry plant-based products in the market and companies in India**

Sl. No	Companies	Locations	Products
1	Healthline Pvt. Ltd	Bengaluru, Karnataka	a. Sericha (Natural, Green Apple, Lemon Ginger flavour-based mulberry tea) b. Mulberry leaf drink
2	Tropicana herbals	Dindigul, Tamil Nadu,	a. Tropixx mulberry green tea (Dip bags /Loose Leaf Tea). b. Mulberry Leaves Tea cut
3	Phytotech Extracts Pvt. Ltd.	Bangalore, Karnataka	Multea
4	HerbsPro.com	Universal Herbs Inc Hayman St.	Absolute White Mulberry Leaf Tea
5	AmmaNutritions	Bengaluru, Karnataka	Amma Mulberry Tea
6	Mehwer Groups	Srinagar, Jammu & Kashmir	Organic mulberry dried Whole/Cut/ Slice leaves
7	Riddhi Traders	Vadodara, Gujarat	Herbal care soothing skin face wash with tea tree oil and mulberry
8	Tamek	New Delhi	Black Mulberry Juice
9	Botanic Healthcare Group	Hyderabad, Telangana	Mulberry leaf extract
10	Arishtam Probiotics	Bangalore, Karnataka	Mulberry Shahtoot Wine
11	Rhythm Winery	Pune, Maharashtra.	Mulberry Premium wines
12	Frutteto-Paradise Juice Pvt Ltd	Maharashtra,	Frozen Mulberry
13	GoingNuts Trading. India Pvt. Ltd	Bangalore, Karnataka	Dry Mulberries
14	Fresh India Organics	Lamington Road, Mumbai	Organic Mulberry fruits
15	Vinayak Ingredients (INDIA) Pvt. Ltd.	Mumbai, Maharashtra	Vinayak's Mulberry Leaf powder
16	Vrishti Bioscience	Bengaluru, Karnataka	Mulberry Green Tea
17.	Moringa India Health Care	Tirupur, Tamil Nadu	Organic Mulberry tea

#### **Mulberry as a Business and Industrial Entity**

Mulberry not only has a commercial value as a sole food for silkworms for the production of cocoons and silk but also has immense medicinal value. Leaves and fruit are rich in vital phytonutrients that support health, including minerals, vitamins, phenolics, fatty acids, carbohydrates, and amino acids.<sup>12</sup> Thus, to capitalize on these advantages,

mulberry-based products are being produced globally by numerous industries, including food, beverage, herbal, cosmetic, and pharmaceutical.<sup>13</sup> On the other hand, because of its importance for growth and metabolism, global industrialists are currently racing to manufacture commercial products like jams,<sup>14</sup> lollipops and jellies,<sup>15</sup> wines,<sup>16</sup> syrups<sup>17</sup> functional drinks, meals, food colouring, cosmetics,<sup>18</sup>

and so forth. Among them, wine, jam and mulberry fruits are highly sought after in industrialized nations like the West; hence, India needs to start producing more of them.<sup>19</sup> In addition, fresh mulberry berries have been more and more in demand in the United States in recent years, especially among high-end restaurant chefs in California. A pound of mulberries can fetch as much as \$10 to \$15.<sup>20</sup> Thus, over the past two decades, it has been seen that mulberry trees are being grown exclusively for large-scale production of fruits to meet this demand.<sup>21</sup> Given this, one of the prospective business ventures might be the establishment of mulberry tree plantations to supply the raw materials needed by industries or composite enterprises to manufacture healthy mulberry tea, jam, pickles, squash, juice, and other products on a commercial scale (Table 1).

Furthermore, it is well recognized that mulberry shoots leftover from silkworm rearing make an excellent medium for large-scale mushroom cultivation. Since mushrooms are seen as an alternate source of nourishment, there is currently a growing market need for them to combat the malnutrition issues that affect 113 million people worldwide in 53 different countries.<sup>22</sup> Since silkworm rearing produces about 15 MT of sericulture waste,<sup>23</sup> mulberry shoots make up a decent starting raw material for a mushroom-producing business. For entrepreneurs, growing edible fungi - such as oysters and buttons, mulberry shoot powder can yield significant financial rewards. Additionally, because mulberry leaves are tasty and simple for herbivorous animals to digest, they are used as the primary feed for ruminants in many countries, improving their nutritional status.<sup>24</sup> Moreover, Angora rabbits use mulberry leaves as a supplement in their diet to produce their distinctive wool.<sup>25</sup> Therefore, an integrated strategy for using mulberry and their byproducts could be a profitable venture that is currently unexplored. In addition, an integrated strategy for using mulberry and silkworm litter to produce compost and biogas gives entrepreneurs a source of additional revenue.<sup>26</sup>

#### **Grainage for Silkworm Grains**

A phrase states that "Grainages are the temple of Sericulture" and "backbone of Sericulture industry" as large-scale production of diseases free layings (silkworm grains or eggs) to meet the needs of all

seri-farmers for production of cocoons. India being the second largest sericulture occupation country has an importunate demand for silkworm grains around the year. The demand for BV hybrids seeds was 89.08% and MV x BV hybrids was 62.26%. Therefore, this venture has great demand allowing an investor to make one rupee in net profit for every rupee invested.<sup>27</sup> Additionally, it now has a new subsidiary or main business for the production of Chitosan from the leftover pupal cuticle, pupal oil and pupae as a raw material for production of poultry and fish feeds.

#### **Production of Chitosan**

The silkworm pupal cuticle and egg shells contain chitin and chitosan, which have potent antibacterial qualities. As a result, it is regarded as a long-term and renewable source of chitosan, which has promising properties for use in food and medicine. Because of its value, production expenses in Ecuador and Colombia range from \$10 to \$11/kg, and the product is sold for \$58, which is rather competitive in the marketplace.<sup>28</sup> In this case, chitosan shall be produced on a large scale using the pupal cuticle that is left behind after the moth's emergence in the grainage. This is a more lucrative and potentially more promising business venture for an entrepreneur.

#### **Silkworm Pupa for Oil**

It's interesting to note that silkworm pupae are underutilized in the country despite the fact that their oil has many industrial uses, including manufacture of biodiesel, cosmetics, soap, animal feed additives, surfactant synthesis, and food processing. About 75% of the unsaturated fatty acids and polyunsaturated acids found in silkworm pupal oil are alpha-linolenic acid (ALA), which makes up approximately 34.27% of the total.<sup>29</sup> People became aware of ALA's health benefits due to its ability to lower cholesterol, improve memory, and function as an antioxidant in the body to eliminate free radicals.<sup>30</sup> Consequently, a cost-benefit ratio of 1.57 has been demonstrated for the oil extracted from mulberry silkworm pupae using supercritical fluid extraction. Given this, any project aimed at developing pupa-based products<sup>31</sup> in India has the potential to be a successful business venture. Indian companies and product names are listed in Table 2.

**Table 2: Current Indian companies producing silkworm pupal products in the market.**

Sl. No	Companies	Location	Products
1	SLV International,	Bengaluru, Karnataka	Silkworm pupae meal and oil
2	Inlife Pharma Pvt Ltd	Himayatnagar, Hyderabad	Inlife Silk Oil Omega 500mg Liquid Filled Veg Capsule
3	Asif Silk Industrie	Chikkaballapur, Karnataka	Silkworm dried de-oiled, Edible silkworm pupae, Silkworm-dried de-oiled cake in pellets form, Frozen edible silkworm pupae, Silkworm machine dried pupae powder, Sterilized silkworm pupa
4	Bhat Silk Industries,	Jammu & Kashmir	Silkworm Canned Pupae

### **Commercial Chawki Silkworms Production Enterprise**

The first and second instars of the silkworms are considered infant or young-age silkworms commonly known as chawki worms. Rearing of young silkworms on a scientific basis is crucial, as it facilitates robustness and productivity that determine the successful harvest of cocoon crops. Thus, chawki rearing requires technical knowledge and skill which is lacking among most of the seri-farmers and most of them may not possess adequate equipment to culture young age silkworms by providing suitable environmental conditions. To overcome such limitations, in recent days, a major section of seri-farmers rely on chawki rearing centers (CRCs) for healthy batches of silkworms with assured cocoon crops. Consequently, the rise of young silkworms has developed into a business that employs young people in rural areas and generates a sizable income. Under this venture, ~800 CRCs are registered as per Central Silk Board amendment 2006<sup>32</sup> throughout the country in both mulberry and non-mulberry sectors. Therefore, it is also among the most profitable and cost-effective businesses.

### **Cocoon Production as an Enterprise**

Sericulture, an income-generating industry plays a socio-economic crucial role in transferring and redistribution of wealth among the populations, from the rich to the poor in particular. This enterprise can be taken up by all classes of people, either landholder or land less people, educated or uneducated, which gives a C:B ratio of 1:1.52 to 1.59,<sup>33</sup> 1.72,<sup>34</sup> 1.76,<sup>35</sup> 1.82<sup>36</sup> and 1.92.<sup>37</sup> Growing of

silkworms for production of cocoons/silk has been an undisputable profit oriented sustainable industry, which can be practiced even under drought-prone conditions as an assured income can be obtained in a span of 30 to 40 days. Thus, it is a well-accepted and highly potential business for unemployed youths.

### **Cocoon Banks/Warehouses**

In the northern states of India wherein there are only two cocoon crops per year with a huge gap between the two crops (rearing) leading to huge demand for cocoons in the off-season among reelers. Contrastingly, in the southern states, as copious amounts of cocoons have been produced around the year, demand for cocoons decreases in the market, thus there will be frequent cocoon price crashes. This critical situation necessitates farmers might have storage facilities, which is not possible for every farmer. To overcome such a situation and price crash, if cocoon banks are established it not only helps the reelers availing raw material throughout the year but also makes available cocoon storage facilities to farmers during this period.<sup>38</sup> Thus, it is an unexplored venture for an entrepreneur to establish a cocoon bank as a potential and profitable business.

### **Biocrafts and Artisans**

A new area of value addition in the sericulture sector is bio-crafts made from pierced or sliced cocoons, which employ people from lower socioeconomic groups and help them lead independent lives.<sup>39</sup> Bio-crafts made from pierced or cut cocoons have developed a niche market in addition to teaching

women, children in rural areas and people with disabilities new skills. The cocoon bio-craft has a cost-benefit ratio that ranges from 1:1.27 to 1: 5.54 (Table 3)<sup>40</sup> making it a potentially lucrative yet untested enterprise. However, as part of their efforts

to empower women, several non-governmental organizations are creating and selling amazing biocrafts. As a result, the production and promotion of biocrafts, which will be utilized in function as one of interior decorators, constitute a lucrative business.

**Table 3: The Cost and Benefit ratio of cocoon based bio-crafts**

Sl. No.	Name of the product	C: B ratio
1	Single flowers	1:1.66 to 1:4.12
2	Garlands	1:1.25 to 1:5.54
3	Bouquet	1:1.27
4	Vases (Bamboo, Plastic, and Glass pot)	1:1.19 to 1:1.42
5	Greeting Card – Small & Big	1:1.69 to 1:1.96
6	Hangings (Zoomers)	1:1.63
7	Wall Frames	1:1.30

#### Silk's Biomedical Industry

Fibrin, or silk strand, and sericin, or gum, which has amazing pharmacological and biological uses are the main ingredients of silk. To isolate independently, enzymatic or chemical processing is used. According to Lamboni *et al.* (2015),<sup>41</sup> sericin has uses in biotechnology such as supplementing culture media and in biomedicine for wound healing, anticancer effects, tissue engineering, and drug administration. Simultaneously, biomaterials such as nanofibers, nanoparticles, nanocoating tubes, composite scaffolds, films, hydrogels, sponges, and microspheres are being developed using fibroin that was extracted from the reverse-engineered method.<sup>42</sup> As silk protein biomaterials have extensive

applications in the medical sector, numerous businesses are creating these biomaterials and commercializing them; many of these are undergoing clinical trials, while a small number are still in research (Table 6).<sup>43</sup> The use of silk fibroin matrices in a variety of pharmacy and medical fields is being expedited by developments in biological science, engineering technology, and most recently, 3D printing. Due to the newfound significance of silk protein, entrepreneurs can use silk to create a variety of second-generation materials with prospective uses and medical suitability. In this regard, Tables 4 and 5 list businesses and their silk products for biomedical applications that are now available in the Global and Indian markets.

**Table 4: Businesses and their silk goods on the global market.**

Sl.No.	Companies	Location	Products
1	Sofregen Inc.	Medford MA, USA.	Silk Voice® Injectable Implants, SERI® Surgical Scaffold, SERI® Contour.
2	Vaxess Inc.	Boston MA, USA.	Encapsulating and stabilizing payloads for MIMIX™ therapies.
3	Silk Therapeutics Inc.	Medford MA, USA	Anti-ageing skin care.
4	Cocoon Biotech Inc.	Cambridge MA, USA	Silk-based drug delivery products - hydrogels, microspheres for ophthalmic and osteoarthritis.

5	Silk Technologies Ltd.	Plymouth. MN, USA	Topical ocular therapy for dry eye. (Silk-derived protein pharmacological active ingredient)
6	Oxford Biomaterials Ltd.	Oxford, UK	Vascular grafts.
7	Orthox Ltd.	Oxford, UK	FibroFix Meniscus.
8	AL.PRE.TEC. S.r.l.	San Donà di Piave, Italy	Dermatitisa and DermaSilka Textiles for skin diseases.
9	Suzhou Soho Biomaterial Science and Technology Co., Ltd.	Suzhou, Jiangsu Province, China	Sidaiyi wound dressing - biomedical use of other silk formats.
10	Zhejiang Xingyue Biotechnology Co., Ltd.	Hangzhou, China	HQ Matrix medical wound dressing and Soft Tissue Mesh (hernia repair).
11	Daewoong-Bio Inc	Seoul, South Korea	Tympasil silk patch for tympanic membrane perforation.
12	KraigBiocraft Laboratories Inc	Ann Arbor, MI, USA	Dragon Silk and Monster Silk lead products as ballistic shoot packs.

**Table 5: Businesses and silk products in the Indian market.**

Sl. No	Companies	Location	Products
1	Fibroheal Wound Care Pvt. Ltd	Bengaluru, Karnataka	<p>1. Active Wound Care Products</p> <p>a. Tissue Debridement Products: Tissue debridement products include Fibrozyme, Fibromoist Gel, Fibromoist Spray, and Fibrovid.</p> <p>b. Infection and Inflammation Controlled Products: These products are designed to control infection and inflammation and include D-Fibroheal Ag Sprinkling Powder, Fibroheal Ag Ointment, D-Fibroheal Ag, D-Fibroheal Ag Foam (Non-adhesive), D-Fibroheal Ag Foam Adhesive, and D-Fibroheal Ag Foam (Tracheostomy).</p> <p>c. Moisture Balance Products: To maintain moisture balance, products like D-Fibroheal Meshed, D-Fibroheal Foam, D-Fibroheal Ag Foam, and D-Fibroheal Foam Adhesive are available.</p> <p>d. Re-Epithelialization Products: These products aid in re-epithelialization and include D-Fibroheal, D-Fibroheal Sprinkling Powder, and D-Fibroheal Sprinkling Powder. Additionally, there are Scar Gel products such as Fibro-Scar Gel and Silk 'n' Soft Moisturizing Cream.</p> <p>2. Post-Operative Wound Care Products</p> <p>a. Anti-Microbial Adhesive Wound Dressing Products: These products are specifically designed for post-operative care and include D-FibrohealSuture Dress, D-Fibroheal Scarlite, D-FibrohealMicrogras, D-Fibroheal Wound Aid, and D-Fibroheal Wound Aid Port Dressing.</p> <p>3. Active Pharmaceutical Ingredient (API) Products</p>

			a. Commercially Available Products: The API products consist of Silk Fibroin Solution (5% W/W), Silk Protein Powder, Silk Sericin Solution (10% W/W) for cosmetic and hair care applications (<5 kDa), and Lyophilized Silk Fibroin Particles.
2	Silklon Ventures	Bengaluru, Karnataka	a. Hydrolyzed Silk Protein - Sericin Liquid and Sericin Powder. b. Custom Molecular Weight Hydrolyzed Silk Protein Powder.
3	Yogananda & Company	Mysuru, Karnataka	Sericin
4	Health Line Pvt Ltd	Bengaluru, Karnataka	Hydrolyzed Sericin Solution
5	Sugii Surgical India Private Limited	Bengaluru, Karnataka	Mendsilk - Black Braided Silk Surgical Suture
6	Ad+ Sericin	Jamshedpur, Jharkhand	Chemicals to extract pharmaceutical-grade Sericin and market it globally.

### Post Cocoon Sector

The industry that comes after cocooning comprises - silk reeling, throwing, wet processing, weaving, finishing, knitting, printing, and, in the end, fabric manufacture. Each of them has a high cost-benefit ratio for launching a business: for example, multi-end reeling of ten basins has a ratio of 1.09, cottage basins of ten basins have a ratio of 1.05, and silk reeling by Charaka of five basins has a ratio of 1.03.<sup>44</sup> More than 30 nations throughout the world are among the top buyers of Indian silk products, including the United States, United Arab Emirates, China, United Kingdom, Australia, Germany, France, Italy, Spain, Malaysia, Nepal, Japan, Belgium, Canada, South Africa, and Singapore. As of 2020–

21, the USA accounted for 29% of all imports of silk products from India. With a 10% stake, the UAE is the second-largest importer of Indian silk after the USA, with shares of 8%, 4%, and 4% going to China, the UK, and Australia, in that order. Exports of silk and related goods from the nation totaled US\$ 248.56 million in 2021–2022. Table 6 contains a list of some of the registered startups in India that are focused on textiles and clothing. The need for silk items abroad has increased by 25.3% in the past year. The post-cocoon industry is a promising and extremely profit-oriented business opportunity for an entrepreneur due to the enormous demand for silk and silk products.

**Table 6: Businesses and their silk goods available in the market.**

Sl. No	Companies	Focus Industry	Location
1	Manomayi Silk	Textiles & Apparel.	Thiruvananthapuram, Kerala
2	Sri Saranya Silks Private Limited	Textiles & Apparel.	Erode, Tamil Nadu
3	Kanakapura Silk Park Private Limited	Textiles & Apparel	Ramanagaram, Karnataka
4	Banaras Silk Boulevard	Textiles & Apparel	Varanasi, Uttar Pradesh
5	Dandgepaithani and silk saree	Textiles & Apparel	Aurangabad, Maharashtra
6	SILK	Textiles & Apparel.	Coimbatore, Tamil Nadu
7	Mahadurga Silk	Textiles & Apparel deal	Bengaluru, Karnataka

		silk yarn and 20 types of silk fabrics which include Crepe, Georgette, chiffon, Chinon taffeta, dupian, taby etc.	
8	Silk Cart	Agri-Tech, Tech-app to standardize and revolutionize operations in the Silk industry.	Bengaluru Urban, Karnataka
9	Vasthram Silk	Textiles & Apparel, an Online Saree store for hand-woven silk, kanchivaram, banaras, chanderi, cotton silk, tusser silk, and many more.	Bengaluru, Karnataka
10	<i>Bombyx mori</i> Silks and Textiles	Textiles & Apparel, Pure mulberry raw silk yarn, thrown mulberry silk yarn, pure silk fabric of all kinds, silk floss, pure silk fibre filling for silk quilts, pupae, silk waste.	Srinagar, Jammu and Kashmir
11	Aalayam Silks Private Limited	Fashion, Is one of the largest collections of silk sarees, exclusive designs and authentic silk brands.	Hyderabad, Telangana
12	Bhagalpuri Silks	Textiles & Apparel, To spread Bhagalpuri silks all over the world.	Bhagalpur, Bihar
13	Silkencial Apparel Co.	Textiles & Apparel.	South East Delhi, Delhi
14	Cotton & Silk Edition	Textiles & Apparel, Designer Store around the world in Natural Fabric and Hand Made products made by Indian artisans	Bengaluru, Karnataka
15	Abhinavsilk private limited	Promotes the whole value chain of Tasar Silk, provides good quality reeled tasar yarn which is used in warp during the process of fabric making.	Ranchi, Jharkhand
16	Kuchaai silk and apparel private limited	Fashion, It makes handloom apparel, reeling silk from silkworm cocoons.	Ranchi, Jharkhand

### **Associated Seri-business Paths for Indian Sericulture Entrepreneurship**

#### **Manufacturing of biofertilizers and biopesticides**

In India, bio-agriculture is the third largest biotech industry sector by the production of biofertilizers and biopesticides, which is accelerating the Indian agri-biotech market. Large-scale production of biofertilizers, biopesticides, and vermicomposting will be a potential startup since farmer-centered

and farmer-participatory Integrated Farming System Management (IFSM), Integrated Nutrient Management (INM), and Integrated Pest Management (IPM) programs aim to promote eco-friendly approaches to achieve sustained productivity and optimize resource utilization in sericulture.<sup>46</sup> Table 7, however, includes a summary of some of the industries this endeavour is involved in.

**Table 7: Current Indian companies and their seri input products in the market.**

<b>Sl. No</b>	<b>Companies</b>	<b>Location</b>	<b>Products</b>
1	Sericare - A Division Of Healthline Pvt. Ltd	Bengaluru, Karnataka	<ul style="list-style-type: none"> <li>a. Nutrients for Mulberry products - Poshan Seri Boost Plus.</li> <li>b. Rearing Equipment And Room Disinfectants – Sanitech, Sanitech Super, Seri Swachh, Seriswa chhInstant, and VetcareVijetha Supplement Plus.</li> <li>c. Bed Disinfectants - VetcareVijetha, Ankush, Vijetha Green, VetcareVijetha Supplement, Vijetha Forte, and VetcareVijetha Supplement Plus</li> <li>d. Silkworm Uzi Fly Management –Sericareuzinaash</li> <li>e. Silkworm Growth, Development - Serimore and Seri Sampoorna</li> </ul>
2	Seri Agro Vet	Kolar, Karnataka	<ul style="list-style-type: none"> <li>a. Seri-Fighter general disinfectant,</li> <li>b. Rexa powder</li> </ul>
3	Seri-Con & Seri-Gro	Bengaluru, Karnataka	<ul style="list-style-type: none"> <li>a. Asthra is a new generation powerful Disinfectant</li> <li>b. Ankush bed Disinfectant</li> <li>c. Poshan a new technology Folio Spray</li> <li>d. Ankur a Nutrient Supplement for Soil Fertility and Soil Health</li> <li>e. Samrudhi is a juvenile hormone that increases the size and weight of the cocoons</li> </ul>
4	Vrishti Bioscience	Bengaluru, Karnataka	<ul style="list-style-type: none"> <li>a. Samruddhi Mulberry Special Fertilizer</li> <li>b. White Silkworm Food</li> </ul>

#### **Promotion of Mechanization as a Business**

Being a labour-intensive business, sericulture is currently threatened by a workforce shortage, which calls for mechanization to both lower production costs and ensure the industry's prosperity. As a result, it gives a business owner plenty of room to develop and provide the right machine or machines, or appliances, to meet the needs of the seri-farmers.<sup>46</sup> However, purchasing such gadgets by a seri-farmer with a stable financial situation may be advantageous, but small-scale farmers find it prohibitive because of their precarious financial situation. If such a company exists, it could be profitable for an entrepreneur to contract them out to seri-farmers. To achieve this, a novel idea is being implemented, for instance, in Andhra Pradesh, women's self-help groups are popularizing the supply of inputs at farmers' doorsteps through Seri Poly Clinics, or One Stop Shops. Here, they purchase high-quality inputs at competitive prices, including disinfectants, raising equipment, biofertilizers, biopesticides, old newspapers, ropes,

and other materials, and then sell them to farmers with a profit margin of between 10 and 20%. As these ventures are becoming more and more popular in other states that practice sericulture,<sup>47</sup> they represent one of the most promising and lucrative business opportunities for an entrepreneur.

#### **Doorstep Assistance**

Supply chains primarily focus on and facilitate the flow of goods and information between member organizations in relation to the acquisition of raw materials, the conversion of raw materials into completed goods, and the delivery of those goods to final consumers. With an emphasis on quality and less so on safety, several corporations have established themselves in India and are investing in infrastructure and integrated supply chain management systems. As an illustration of this, the supply chain start-up called ReshaMandi is digitizing it through technological interventions and providing insights for the entire ecosystem along with the value chain. It provides farmers with weather and

soil quality updates and discusses how these factors may affect the production of cocoons. It also links the market for cocoons as input and yarns as output keeps ledgers updated, provides information on best practices, and allows weavers to buy machine tools. A vast network of procurement centers has been built nationwide, enabling farmers to communicate with their representatives via phone or in-person visitation with previous appointments. Farmers can use the app to place orders with the representative's assistance or they can pick up the inputs directly. Additionally, they ease the farmer's workload and facilitate the supply chain's logistical element, all of which contribute to the development of trust. By ReshaMandi setting up procurement centers around India's silk route, farmers may get around long-distance travel and deal with business-related concerns. This startup operates 20 to 25 Mandis, or large markets, across the states of Maharashtra, Tamil Nadu, Karnataka, and Andhra Pradesh.<sup>48</sup> Since there aren't many chain startups in India, this is a promising sector for entrepreneurs.

#### Silkworms as a host to produce cordyceps (mushroom) production

With a price tag of US\$ 2000/kg, the most valuable naturally occurring fungus on the surface of lepidopteran insects - the cordyceps mushroom - has a high demand in the US.<sup>49</sup> Commercial artificial culture techniques have been developed because of its great therapeutic potential and scarcity.<sup>50</sup> Many cottage companies in Korea manufacture Cordyceps in the form of pupae or silkworm powder, which is then used as a nutritional supplement or ingredient in food to enhance health.<sup>51</sup> An excellent supply of host for production cordyceps, offering a prospective and lucrative enterprise, is India, where ~139,162 MT of Mulberry, 18,660 MT of Tasar, and 5,782 MT of Muga fresh pupae are produced annually.<sup>52</sup> Table 8 lists the businesses and goods from India that produce cordyceps.

**Table 8: Indian businesses that make cordyceps.**

Sl. No	Companies	Location	Products
1	Umbrella Agro Farming	Lonavala, Maharashtra	<i>Cordycep militaris</i> Products, Dry <i>Cordyceps militaris</i> , Dry <i>Cordyceps sinensis</i> , <i>Cordyceps capsules</i> and much more
2	Himalayan Herbes	Dehradun, Uttarakhand	Yarsagumba, Dried KeedaJadi, Organic KeedaJadi, Natural KeedaJadi, Herbal KeedaJadi, and KeedaJadi.
3	Pravansh Biosciences Private Limited	GautamBudh Nagar, Uttar Pradesh	Kida Jadi
4	Nirup traders	Mangalore, Karnataka	<i>Ophiocordyceps sinensis</i>
5	Samridhi Herbs	Rudrapur, Uttarakhand,	Golden yellow <i>Cordyceps sinensis</i> ,
6	Vana Shrubs Pvt Ltd	Bardez, North Goa, Goa	a. CordyBoost is a <i>Cordyceps militaris</i> Mushroom Capsules Supplement (30 capsules of 500 mg). b. <i>Cordycep smilitaris</i> Mushroom (30 gms bottle). c. Dried <i>Cordycep smilitaris</i> (30 gms bottle).

#### Smartphone Apps and Disinfection Units

In the silkworm rearing house, disinfection is a standard technique followed to keep the level of pathogen recurrence as low as possible. Seri-farmers use disinfection procedures to reduce the incidence

of disease during the growing of silkworms, according to their non-scientific knowledge and practices.<sup>53</sup> Additionally, small farmers face certain challenges because they lack the funds to purchase the right equipment and prepare disinfection solutions using

simple and arbitrary measurements. As a result, there is a significant loss of cocoon harvest due to improper disinfection and the recurrence of pathogen-causing diseases in silkworms. SeriApp is a smartphone application designed to get around these limitations and guarantee appropriate disinfection.<sup>53</sup> Hence, creating a flexible mobile application that can advise seri-farmers suitably based on scientific recommendation, along with a mobile disinfectant and auxiliary units would be a profitable seri-business.

### **Conclusion**

The country is currently facing issues with unemployment, especially in rural and urban areas. As a result, the Indian government has launched six special programs - the Startup India Scheme, the Mudra Yojana Scheme, the Stand-Up India Scheme, the Atal Innovation Mission (AIM), the Electronic Development Fund (EDF), the PradhanMantri Mudra Loan Yojana (PMMY). Due to the enormous advantage that these flagship programs provide - such as tax exemption, self-certification compliances, and a dedicated special mobile app for registration - potential entrepreneurs can now launch their business from basic activities of the sericulture industry to biotechnological and biomedical sectors to produce high-value silk protein based products. In support, the sericulture sector is undergoing a transformation via the use of cutting-edge technology, automation, and supply chain management. This is creating a plethora of opportunities for new company ventures, job creation, and economic growth. In order to do this, unique

initiatives like "Startup India" have laid the foundation for the development of a new generation of entrepreneurs who are capable of both empowering themselves and significantly assisting in the resolution of India's unemployment problems.

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This article's original concept came from Professor Hosaholalu Boregowda Manjunatha, FRES. Harishkumar Jayaram created the basic draft of the manuscript, collected data, and handled data cutting and compilation. Likhith Gowda Mahadevegowda has provided organization and other feedback. Prof. Manjunatha did a thorough examination and editing of the paper. This article's comprehensive nature is a consequence of the writers' combined work.

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