RESPONSIBLE SILK – A PLAN OF ACTION FOR EILEEN FISHER

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ABSTRACT

For apparel companies, agriculture is connected but often far removed. For EILEEN FISHER, being a socially conscious clothing company does not stop at the finished garment level. The company has been tracing its raw material supply chains for a few years, and is interested in expanding its human rights and environmental sustainability work to include the wellbeing of farmers and the land. In recent years, the company has started engaging suppliers and other external stakeholders at the agricultural level for cotton, wool, and man-made cellulosic. Silk is one of the top five fibers at EILEEN FISHER, representing 8% of its total materials in 2018, but one that is not well studied by the company. Grounded in literature review, this paper examines the different dimensions of the silk agricultural supply chain; the people, the land, and the silkworm. A review of the company's silk supply chain revealed that 100% of its 2018 silk fiber comes from China, but little is known about its supply chain beyond the yarn spinner level. In collaboration with the company, a survey is conducted with its silk suppliers to trace the origin of silk cocoons within China. Findings indicates that the company's silk originates from the provinces of Jiangsu and Guangxi. The paper concludes with a five- year plan of action; detailing the steps that the company should take in its engagement with suppliers and other stakeholders to promote a responsible silk supply chain in China.

BIOGRAPHICAL SKETCH

Luna H. Lee pursued the MPS in International Agriculture and Rural Development at Cornell University during 2018 to 2019. Since 2010, she has led the supply chain human rights work on the social consciousness team at EILEEN FISHER, a women's clothing and design company for eight years. She has extensive volunteer and leadership background in the women's movement with the YWCA, as well as multi-stakeholder engagement experience through Social Accountability International, Nest, and the Sustainable Apparel Coalition. Luna is interested in bringing the science of agricultural production together with social, environmental, and economic systems. She would like to further the work upstream into the fiber supply chains and explore potential multi-stakeholder collaboration between the food and fashion industries at the agriculture level to maximize impact. She holds a Bachelor of Arts degree in Communication from SUNY-Buffalo and is very interested in catalyzing the work through consumer engagement. Originally from Malaysia, Luna speaks Chinese, Bahasa Malaysia, and English. During her spare time, she enjoys plants, cats, and playing the ukulele.

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LIST OF ABBREVIATIONS

DHE	Dragon head enterprises
EF	EILEEN FISHER
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse gas
HRS	Household Responsibility System
ISF	Individual silk farmers
MMC	Man-made cellulosic
OSF	Organized silk farmers
SOE	State-owned enterprises
TE	Textile Exchange
U.S.	United States of America

CHAPTER 1

INTRODUCTION

For apparel companies, agriculture is connected but often far removed. For clothing and design company EILEEN FISHER (EF), being a socially conscious company does not stop at the finished garment level. The company has been actively tracing its raw material supply chains since 2014, and is interested in expanding its human rights and environmental sustainability work to include the well-being of farmers and the land. In recent years, the company has started engaging suppliers and other external stakeholders at the agricultural level for cotton, wool, and man-made cellulosic (MMC). Silk is one of the top five fibers at EF, representing 8% of its total fiber weight in 2018, but one that is not as well studied by the company compared to other fibers.

Silk was first developed in ancient China, with the oldest sample discovered in tombs that date back 8500 years in Henan, China (Shi & Xin, 2016). 80% of the world's silk is from China, with India being the second largest producer at 18% (International Sericultural Commission, 2017). In the past half century, China has emerged as the world's second largest economy. Agriculture is a vital sector of China's burgeoning economy, and the country is a leading producer of major food, fiber and animal products (FAO, n.d.). Unfortunately, China's growing role as a global producer and supplier of food and fiber products has been accompanied by a growing reputation for environmental degradation and social injustices within those same supply chains.

A recognized leader in the field of corporate social responsibility, EF has started to expand its social consciousness work in its agricultural supply chain partners in recent years. Expanding the work into silk, one of its core materials, will further position the company as a leader in the textile and apparel industry, inspiring other brands and silk supply chain partners in creating system value through responsible economic development.

This project paper provides an in-depth and holistic review of the dimensions involved in the definition of responsible silk. As a relatively small apparel company with 2018 annual sales of US$429 million, this paper will discuss the challenges and opportunities for EF in creating system value in its silk supply chain in China, a country with unique social, political, economic, and cultural circumstances. The project paper ends with an actionable plan for EF with its silk supply chain in China.

1.1 Research Questions

EF wants to strengthen its position as a thought leader in corporate social responsibility by expanding its work into its silk agricultural supply chain, jointly creating system value that would benefit the company, supply chain partners, and silk farming communities. However, what are the challenges and opportunities faced by an apparel company in operationalizing sustainable economic development at the agriculture level? Focusing specifically on EF's silk supply chain in China, the following topics are explored:

1. Mapping of the EF silk supply chain
2. Political economy of Chinese agriculture
3. Effects of mulberry (*Morus alba*) agroecosystems
4. Ethical considerations for silkworm (*Bombyx mori*)
5. Evaluation of existing industry efforts in silk supply chains

The foundation provided by the five topics above informs a plan of action for the company to engage responsibly with its silk supply chain at the agriculture level with the hopes of creating system value with silk farming communities. The plan of action lays out the steps that EF should take for the next five years, detailing the processes and considerations that EF should take into account as it furthers its engagement with silk suppliers and other stakeholders such as the Chinese government, industry groups, and universities.

1.2 Methods

This paper examines the different dimensions of the silk supply chain in China: the people, the land, and the silkworm. Literature review was conducted on the political economy of agricultural systems in China. The understanding of this macroenvironmental context is important, as China functions very differently compared to other nations, with direct social, environmental, and financial implications. Literature review was also conducted on the various ways mulberry is cultivated in agroecosystems around the world, and its ecological and social impact is reviewed extensively. Ethical deliberations on the welfare of silkworm is conducted in a systematic way, using the Campbell's ethics assessment process and backed by scientific facts. In collaboration with the EF supply chain transparency team, a survey is conducted with its silk suppliers to trace the origin of silk cocoons within China, as the company only has visibility up to the yarn spinner level. Interviews are conducted with key partners at EF teams to gather further insights related to supply chain transparency and business outlook. Findings from the literature review and supplier survey along with EF company business data are used to inform the plan of action for responsible silk.

CHAPTER 2

THREE DIMENSIONS OF RESPONSIBLE SILK

Silk was first developed in ancient China and is a lucrative trade commodity, inspiring the name of The Silk Road. 80% of the world's silk is from China, with India being the second largest producer at 18% (International Sericultural Commission, 2017). Sericulture is a highly skilled agricultural sector. It comprises the cultivation of mulberry trees, the rearing of silkworms, and post-cocoon activities leading to the production of silk yarn. Mulberry is traditionally cultivated for silkworm rearing, in which the silkworms feed on mulberry leaves. Silkworms are caterpillars of silk moths. They are reared in captivity and feed on mulberry leaves harvested by silk farmers. A mature silkworm spins a cocoon as part of its short life cycle and the silk farmers then harvest the cocoons for sale. Long protein fibers are then unraveled from the cocoons to produce silk yarns.

China is the most populous country in the world with 1.38 billion people and is currently the world's second largest economy. China's gross domestic product growth has "averaged nearly 10% a year - the fastest sustained expansion by a major economy in history - and has lifted more than 800 million people out of poverty" (The World Bank, 2018). The "rapid economic ascendance has brought on many challenges as well, including high inequality; rapid urbanization; challenges to environmental sustainability; and external imbalances" (The World Bank, 2018). Leaders of the Chinese Communist Party and the country's government have stated an aspiration to make China into a "moderately prosperous society" by 2020 and the country's 13th Five-Year Plan (2016-2020) laid out a plan of addressing these issues, highlighting "the development of services and measures to address environmental and social imbalances, setting targets to reduce pollution, to increase energy efficiency, to improve access to education and healthcare, and to expand social protection" (The World Bank, 2018). China is notorious for its poor human rights records. The Human Rights Watch claims the "broad and sustained offensive on human rights that started after President Xi Jinping took power five years ago showed no sign of abating" (Human Rights Watch, 2018). This chapter aims to discuss the three major dimensions of responsible silk in the Chinese context – the people, the land, the silkworm. A holistic understanding of these dimensions will provide a foundational definition of a responsibly produced silk garment.

2.1 The People: Political Economy of Chinese Agricultural Systems

Arable land per capita in China is 0.09 hectare (The World Bank, 2016). To put things in perspective, the United States of America (U.S.) is four times less populous and has five times more arable land per capita than China at 0.47 hectare. Despite land scarcity and high population, China leads the world in agricultural output, producing an impressive amount of food, fiber, and animal protein that the world needs. According to The World Bank, China food production index is 139.0, above the world's average performance of 125.6. This impressive level of agricultural productivity has come at an immense cost to China. Environmental degradation is cited as one of the top concerns by its citizens (Shapiro, 2016). Soil degradation, water pollution, and biodiversity loss are some of the environmental challenges faced by China. Worse, agricultural land productivity level in China has shown to be decreasing due to such degradation. There is also a heightened concern around clean drinking water and safe food products among its citizens. China has been urbanizing and industrializing at a fast rate during the past forty years. The lure of living a modern life has led the young and able to migrate to the cities since the 1990s. Villages are often populated by the elderly, women, and left behind children.

China is a large country, with a complicated governance structure. The central government in Beijing determines the political, social, and economic paths for the country, but implementation of programs and policies happen at the provincial, county, and local level. Tension exists between central government and local governments, as even though Beijing would like to exert strong centralized policy, local officials enjoy a tremendous amount of political autonomy (Shapiro, 2016). Therefore, it is important to recognize that the central government does not have absolute control over local governments, which in some cases have chosen to diverge from the national strategy when conflicting situations that arose prove to be more beneficial for them (Alpermann & Augustin-Jean, 2014).

In the following subsections, the notion of Chinese capitalism, its land tenure system, and the development of sericulture industry in both new and emerging regions of China will be reviewed. This section will end with a summary of the implications of Chinese political economy on people and their interactions with the environment.

Chinese Capitalism

Economic development experienced dramatic growth in China as the country went through several courses of economic and agrarian reform. The development of Chinese capitalism defies the basic principles of many Western European and American theories of market development. The "huge and continuing role the Chinese government has played in economic development, the lack of the creation of effective legal institutions to govern transactions of all kinds, and the apparent lack of bottom-up countervailing political forces to ensure that the gains of economic growth are not siphoned by the people who control either corporations or the government" are the elements in Chinese capitalism that challenge conventional market theories (Fligstein & Zhang, 2011). The market economy in China is state-led. *Merriam-Webster* defines capitalism as “an economic and political system in which a country's trade and industry are controlled by private owners for profit, rather than by the state.” In fact, it is a misnomer to call the economic system in China capitalism due to the fact that the financial market is not entirely governed by market forces. It is worth noting, however, that the idea of a free market is a conjured idea, as all markets are regulated in one way or another (Ashwood & Bell, 2016). When examined carefully, the Chinese government plays an important and surprisingly welcomed role in its market economy, which in many ways resembles a typical capitalist society. For example, subsidies are often provided to large agribusinesses called ‘dragon head enterprises’ (DHE) in the hopes of promoting economic development; which is similar to the approach by the U.S. government. A concrete way of illustrating how the market works is by looking at how the Chinese government handles property rights, which is considered one of the key foundations of a market economy. The land tenure system in China provides important context as it has significant social implications on the livelihood of farmers.

Land Tenure System

Agricultural activities in China are closely linked to its land tenure system. Property rights look very different in China compared to, say, the U.S. Land in China is categorized as either urban or rural land. With the establishment of the People’s Republic of China, land is either state-owned or collectively owned. After 1978, the Household Responsibility System (HRS) shifted the Chinese land system completely from collective ownership and cultivation to the household contract system, granting households decades-long land use rights (Q. F. Zhang & Donaldson, 2013). Urban land is still owned by the central government, and rural land is neither owned by the central government nor the farmers themselves, but rather by rural collectives; which are administrative villages with leaders selected through open, and often imperfect elections (Q. F. Zhang & Donaldson, 2013). It should be noted that only citizens with rural *hukou* (household registration; akin to an internal passport system in China) are entitled to land use rights.

When the HRS was implemented, it brought changes to rural women's lives, though specific impact of the system was not well studied (Linxiu Zhang, Liu, Liu, & Yu, 2008). The system allocated small plots of land households based on number of household members. As a result, the system transferred authority over women's labor from the production team back to the head of the household (Linxiu Zhang et al., 2008). Farming decisions that were previously made by the state, such as what to plant and whom to sell it to were transferred to the farmers themselves. For a few years after implementation, the HRS narrowed the income gap between urban and rural China (Q. F. Zhang & Donaldson, 2013). From the farmer's perspective, even though they do not own the land and cannot sell it, the use rights and residual income rights offer benefits such as a sense of security and giving them a means to earn a return on their labor through farming if they choose to do so (Linxiu Zhang et al., 2008). This land use access is "economically inalienable – farmers would not be stripped of their land rights no matter how poor they were or how much debt they had" (Q. F. Zhang & Donaldson, 2013).

The HRS resulted in the existence of many farmers with small and fragmented pieces of land. Chinese smallholder farmers are often poor, and unable to invest in new technology. Even if they could afford it, it simply does not make sense to use big machines on small and fragmented pieces of land. Land transfer used to be prohibited in China. In light of massive urban to rural migration and the increasingly abandoned and derelict farmland in rural China, land transfer is now highly encouraged by the government as a way of increasing farm size (Schwoob, 2018). As a result, land transfer is "seen as a way of achieving scaling up and promoting a technocratic, mechanized, specialized and standardized agriculture" (Ye, 2015). The latest land reform in 2016 allows farmers to collectively transfer their land use rights in exchange for annual payments while retaining the ownership of their land contracts. The *Financial Times* reported that with this new land reform, China has cleared the path for corporate farming (Hornby, 2016). Businesses can now take over management of collective land while providing employment and revenue to villagers. As elderly farmers can no longer farm their land, transferring land use rights to a corporation will allow them to receive an income. In addition, the Chinese government can realize higher agricultural yield and advance food security objectives in China. As this is a relatively recent development, the impact of this latest land tenure reform on farm livelihood and the environment is yet unveiled, and is expected to vary across regions of China.

Sericulture Industry Development

The Chinese agricultural system also went through significant changes since the HRS was put in place. As a traditional agricultural sector, the sericulture industry has also transformed. At around the same time when HRS was put in place, state-owned enterprises (SOE) called DHE were appointed by the Chinese government as leaders for modernizing the agricultural industry and making it more efficient (Schneider, 2017), encouraging vertical integration along the value chains (Alpermann & Augustin-Jean, 2014). DHE were selected because of their potential to improve farm incomes and to develop production or marketing systems for local farmers (Guo, Jolly, & Zhu, 2005). In the 1990s, SOE went through privatization due to the change in financial policy of China, but many maintained close connections with local government officials.

Sericulture is an important agricultural sector in developing countries, providing an important source of farm income and therefore playing an important role in preventing migration of rural people to urban area in search of employment (International Sericultural Commission, 2017). Sericulture is unique in the sense that it is considered a highly skilled agricultural activity, and efforts to bringing this unique sector to areas that are not traditionally sericulture regions have been challenged by low product quality, which has a negative effect on farm income (Ni & Hisano, 2014). Sericulture has traditionally been dominated by a large number of small-scale silk farmers. This is due to the high labor requirement of silkworm rearing, making it unsuitable for large scale farming (Ni & Hisano, 2014). DHE and silk companies play a key role in the development of sericulture industry. It is important to first have a basic understanding of the silk value chain. Figure 2.1 depicts the commodity chain and structure of sericulture in China.

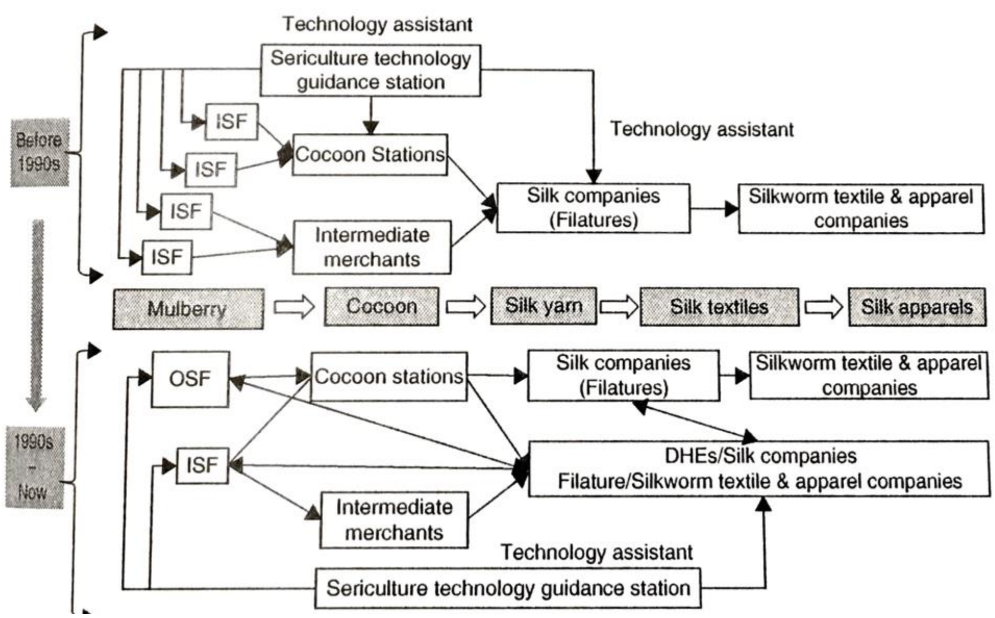


Figure 2.1 Sericulture industry structure before and after 1990s (Ni & Hisano, 2014)

Prior to the 1990s, the cocoon supply chain was considered inefficient and individual silk farmers (ISF) had limited market access. Farmers' organizations started to form in the 2000s due to promotion by DHE and local governments so that the system could function more efficiently.

Today, organized silk farmers (OSF) and ISF sell their cocoons to the cocoon stations, which are either run by DHEs, OSF, or private enterprises (Ni & Hisano, 2014). As a result, these OSF are not the type of farming cooperatives that are traditionally found in other parts of the world. They serve merely as cocoon gathering points and do not represent the rights of the farmers when it comes to collective bargaining. In cases when farmers do not have easy access to the cocoon stations, cocoon intermediary merchants are used. However, these intermediate merchants tend to purchase cocoons at much lower prices compared to the cocoon stations, and do not compensate silk farmers with higher prices based on the higher quality of the cocoons (Ni & Hisano, 2014), breaking the government price regulation on silk cocoons. Subsequently, when cocoon intermediary merchants are involved, silk farmers have no incentive to provide high-quality cocoons, which caused unevenness in silk quality in the industry. Technical guidance to farmers is provided through sericulture technology guidance stations, which often operate under local and regional government. Silk companies then purchase the cocoons for further processing.

Due to the large number of small-scale silk farmers, contract farming has evolved as a management practice in the silk industry to facilitate better efficiency. The Food and Agriculture Organization of the United Nations (FAO) defines contract farming as an agricultural production system carried out according to an agreement between a buyer and farmers, which establishes conditions for the production and marketing of a farm product or products (Pultrone, da Silva, & Shepherd, 2012). Contract farming, depending on the terms and conditions, could be either advantageous or oppressive to the farmers involved. In industries that are highly consolidated, farmers lack negotiation power and buyers get to name any terms and conditions they want, leaving farmers no choice but to accept oppressive terms (Carolan, 2016). The political economy plays a big role in shaping the interactions between businesses and farmers. It is therefore important to consider the distinctive context of the Chinese political economy (Zhang, 2012). As described earlier, the market economy in China is state-led and much more regulated by the Chinese government. Consequently, its different land tenure system and active state support for agriculture makes contract farming different when compared to those in other parts of the world. This is in sharp contrast to countries in Africa and Latin America where trade liberalization policies were adopted, resulting in reduced government support for agriculture (Zhang, 2012). In the past, contract farming appeared to be the only way for corporations to ensure a consistent supply of agricultural raw materials (Zhang, 2012). However, this could now shift with the latest land tenure reform in 2016, allowing companies to lease land from farmers to conduct commercial farming, and hiring farmers as farm laborers instead.

Traditional vs. Emerging Sericulture Regions

China's Western Development Policy in the mid-1900s encouraged regional transfer of sericulture from the east to the west to promote economic development and poverty alleviation in Western China. The vastness of China means that sericulture industries development could take very different paths depending on the circumstances. Below, two case studies presented by Ni and Hisano in 2014 on the Chinese sericulture industry are reviewed, distinguishing between the different industry structures (Appendix A) and practices in a traditional sericulture region such as Jiangsu province and an emerging sericulture region such as Guangxi province. Table 2.1 summarizes the findings by the authors.

The authors conducted this research prior to the 2016 land tenure reform and focused their study on contract farming. It is interesting to see the monopolistic market structure in Jiangsu as opposed to the more democratic market structure and practices in Guangxi. The authors indicated that the local government in Guangxi plays an important role in balancing the power dynamics between silk farmers and the DHE, having learned from the situations in traditional sericulture regions. However, as contract farming is also cited as a way to help improve the cocoon quality and capacity in Guangxi, the government would need to pay attention so that the balanced power relations could be maintained. Currently, Guangxi provides raw materials for processing in traditional sericulture regions, where high processing capacity exists. However, if DHE in Guangxi starts to develop bigger processing capacity, it will become more vertically integrated, and therefore, more powerful. In that case, Guangxi would likely be moving in the same direction as traditional sericulture regions.

	Jiangsu (Traditional)	Guangxi (Emerging)
Market structure and power dynamics	Closed and integrated market. Silk companies are large and powerful, led to unequal power relations with other stakeholders.	Open market. Few silk companies but collaborative culture allows for more balanced power dynamics between stakeholders.
Farm extension	Research and technical guidance by technical guidance stations is run by businesses in collaboration with Jiangsu University.	Research and technical guidance is run by government technical guidance stations in collaboration with Guangxi University.
Government-business relations	Close connections to between government and silk companies (ex-SOE). Businesses are able to influence government decisions on land use policy and displacing food crops.	Government and businesses work together to promote sericulture industry and economic development. Businesses enjoy autonomy from government.
Silk farmers relations with others	No real farmers' organizations and lack bargaining power. Inputs are supplied by, and farm practices are dictated by silk companies. Potential farmer exploitation by companies. Farmers' engagement with companies happen through cocoon contracts only, without other market outlets but enjoy price stability and market access. Government has a hands-off approach with silk farmers.	No farmers' organizations and risk of lower income due to inferior cocoon quality. Able to purchase farm inputs from open market. Farmers' engagement with companies happen through cocoon contracts, but can also sell cocoons in open market. Government has close relations with farmers and often help with price negotiation with silk companies.
Silk processing and cocoon quality	Vertical silk operations. High cocoon processing capacity but lack raw materials in home region. Higher silk cocoon quality due to centuries of knowledge.	Limited cocoon processing facilities. Supply 80-90% of its cocoons to traditional regions for processing. Lower silk cocoon quality due to recent industry development.

Table 2.1 Characteristics of traditional and emerging sericulture regions (Adapted from research conducted by Ni & Hisano, 2014)

In Jiangsu, powerful DHE are able to have a strong hold on silk farmers and are able to influence local government officials in decision making. For example, the close connections between DHE in Jiangsu has allowed them to influence local land use plans, and some villages have become ‘no grain villages’ where no farmers produce food crops for their consumption and have to purchase food from the local market instead, potentially leading to regional food insecurity. This is concerning, as the central government land use policy was meant to promote a balance in the agricultural production of cash crops and food crops. In addition, DHE in Jiangsu also started looking for new cocoon sources in western China, potentially displacing local farmer income in the east in the future.

Summary

The unique political economy context in China provides an important backdrop to the rest of this chapter. It explains the interests and values held dear by the Chinese government, its market structures, the evolution of its unusual land tenure system, and how all of these factors influence the development of the sericulture industry in China. As China is a vast country, any companies conducting business there should note the complexities of central-local relations, in order to understand the true picture in which their supply chains operate. This was clearly demonstrated in the comparison between sericulture industry in traditional and emerging regions. In the next section, we will explore how the political economy impacts the way land is cultivated in sericulture, and its implications on farm livelihood and environmental sustainability.

2.2 The Land: Sericulture-Based Mulberry Agroecosystems

The cultivation of mulberry is the first step in the production of silk. A native of China, white mulberry (*Morus alba*) has been cultivated and naturalized all over the world in various landscapes. Agricultural products of mulberry come from its leaf, bark, trunk, root, and fruit, and range from fresh and dried fruit, juice, wine, tea, medicine, vegetables, to wood. In 2000, the FAO called mulberry “an exceptional forage available almost worldwide” during its ‘Mulberry for Animal Production’ internet conference (Sánchez, 2000). As a multipurpose crop, mulberry is considered an important cash crop, mostly due to sericulture and its high income potential relative to other crops. Since the focus on mulberry cultivation and breeding has been around sericulture, the ecological roles of mulberry plant have traditionally been neglected.

Mulberry is a hardy perennial plant with a very strong root system. Its roots form a greatly tangled and dense network in the soil, with level roots in the top soil up to 9 meter in length, and vertical tap roots of up to 8 meter in depth (Qin, He, Wang, & Xiang, 2012). Mulberry is a highly adaptable plant with a wide range of biophysical limits; altitudes of 0 to 3300 meters, mean annual temperatures of 0 to 43 degrees Celsius, and mean annual rainfall of 1500 to 2500 mm (Orwa et al., 2009). Mulberry has also shown to have high endurance to waterlogging, surviving inundation of 20 days during their growth period (Qin et al., 2012). Pests such as larvae of *Ascotis selenaria, Cacoecia micaceana, Diacrisia indica, D. obliqua, Metanstria hyrtaca* defoliate the tree (Orwa et al., 2009), which would be devastating to silk farmers. Mulberry is also affected by fungal diseases such as heart rot, spongy rot, leaf spot, stem rot, powdery mildew, rust and stem canker (Orwa et al., 2009). In addition, porcupines damage young mulberry plants and mealybugs breed on them (Orwa et al., 2009). As one of the earliest woody plants cultivated, great progress has been achieved in developing mulberry varieties and improving cultivation with better pests and disease control (Qin et al., 2012).

Mulberry provides all four categories of ecosystem services of provisioning, regulating, supporting, and cultural. Mulberry is a good carbon sink, with “1 mu mulberry trees able to absorb about 4162 kg of carbon dioxide (equivalent to 135 kg of carbon) and release 3064 kg of oxygen each year (1 hectare = 15 mu)” (Qin et al., 2012). It also improves air quality, acting as a pollutant absorber for chlorine, hydrogen fluoride, and sulfur dioxide (Qin et al., 2012). Due to its vast root system, mulberry plays an important role in water conservation, soil consolidation, and nutrient cycling. For example, in Sichuan province (a traditional sericulture region), the soil under mulberry tree hedgerow was considerably less eroded with improved soil structure; soil aggregation degree and status of top soil were increased by 25.2% and 50.6%, runoff volume and runoff coefficient were reduced by 10.34% to 20.00%, and erosion was lowered by 55.23% to 67.84% (Qin et al., 2012). Mulberry's beautiful tree form, leaf color, growth vigor, tenacity, and resistance makes it an ideal plant in city landscapes, beautifying roadsides, public parks, and other recreational places (Qin et al., 2012). In China, silk was one of its oldest trade commodities, representing an important part of its cultural heritage. Although mulberry has been cultivated primarily for silk production, the plant can also produce other agricultural products such feed, fruit, wine, juice, tea, medicine, vegetable, and wood. From the livelihood perspective, mulberry is an important source of income due to its various products; especially its leaves for silk production, reducing rural to urban migration and preserving rural livelihood (Giacomin et al., 2017).

Even though mulberry requires very little care in natural ecosystems, irrigation and fertilizer application are helpful in achieving desired yield when planted as a crop (Huo, 2002). In sericulture-based mulberry agroecosystems, insufficient nitrogen will affect the crude protein content in mulberry leaves and hence, silk cocoon quality (Astudillo, Thalwitz, & Vollrath, 2014). Therefore, nitrogen fertilizers are crucial in order to achieve high quality silk. In most sericulture-based agroecosystems, mulberry trees are trained, pruned, and harvested throughout the year for maximum leaf production with high planting density and low or medium trunk training (Huo, 2002).

Depending on the way in which mulberry is cultivated in sericulture-based agroecosystems, negative environmental impacts could occur; leading to issues such as significant greenhouse gas (GHG) emissions, soil fertility reduction, and biodiversity loss. As a woody perennial plant, mulberry is a natural candidate in agroforestry systems. Figure 2.2 illustrates the various types agroforestry systems.

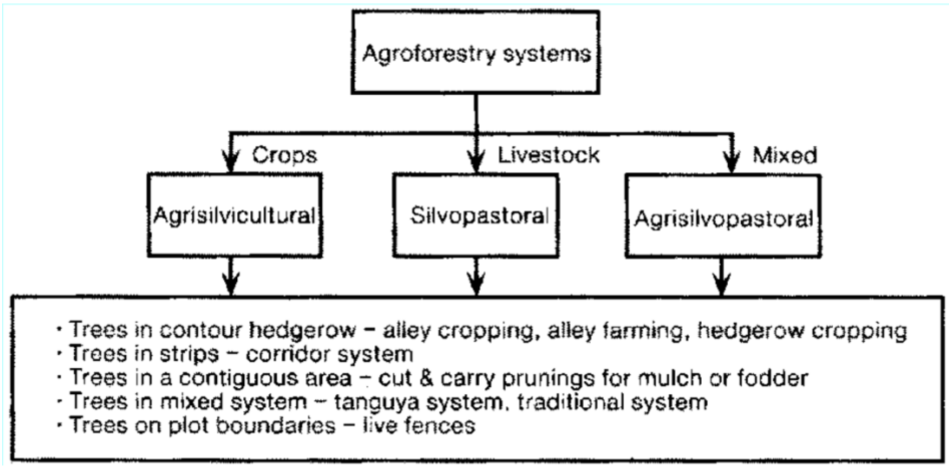


Figure 2.2 Types of agroforestry systems (United Nations University)

This section of the paper aims to identify and review different sericulture-based mulberry agroecosystems that are currently practiced around the globe, and their positive and/or negative impacts on the environment and farm livelihood. During literature review, four distinct sericulture-based agroecosystems are identified. One of the agroecosystems is the monoculture mulberry plantation. Two of the agroecosystems are agroforestry-based systems; intercropping system (agrisilvicultural) and traditional mulberry dike and fish pond system (agrisilvopastoral). The fourth agroecosystem identified is the scattered planting system. These individual agroecosystems will be reviewed, and their environmental and social impact will be discussed.

<u>Monoculture mulberry plantations</u>

In this system, mulberry trees are planted exclusively in an agricultural field or newly reclaimed land for the main purpose of leaf production (Figure 2.3). This intensive method can achieve higher land productivity and labor efficiency through scientific measures and management (Huo, 2002) such as fertilizers and irrigation (Chen, Lu, Zhang, Wan, & Liu, 2009;

Huo, 2002). Planting density, fertilization, irrigation, pruning, and harvesting are prescribed in order to achieve maximum leaf yield. Depending on the mulberry variety as well as soil and climatic conditions, planting density varies greatly, from 10,500 plants to 120,000 plants per hectare (Huo, 2002). As previously mentioned, nitrogen is important as it affects the crude protein content of the leaves; the primary food of silkworm. Therefore, organic (green and animal manure) and chemical fertilizers are often used in maximizing the quantity and quality of leaf yield. Generally speaking, in order to produce 100kg of leaf, 1.5 to 2kg of nitrogen (3.26 to 4.3 kg of urea) are required (Huo, 2002). Combined NPK fertilizers are also commonly used in China (Huo, 2002). Evapotranspiration from mulberry leaves can be especially high (8 to 9 kg of water from 1 kg of mulberry leaves) during the growing seasons, therefore, irrigation is crucial for the growth of mulberry trees during that time (Huo, 2002).

Figure 2.3 A mulberry plantation in Guangxi province (China Daily)

An environmental life cycle assessment on silk concluded that fertilization represents a majority of environmental impacts of silk cocoon production (Astudillo et al., 2014). In India, mulberry has been profusely fertilized historically (Astudillo et al., 2014). In Sichuan province, cases of unbalanced fertilization have been reported; with excessive nitrogen application and insufficient phosphorus and potassium application (Luo et al., 2010). Due to its high inputs nature, this agroecosystem can contribute to pollution, leading to algae bloom and soil acidification. In addition, leaf litter is greatly reduced as they are harvested, thereby also reducing soil fertility (Wang & Cao, 2011). Monoculture mulberry plantation also negatively impacts soil bacteria community; as the relative abundances of Proteobacteria, Actinobacteria, and Firmicutes were significantly lower in monoculture mulberry than in intercropping mulberry with alfalfa (M.-M. Zhang, Wang, Hu, & Sun, 2018). In Hangzhou, Zhejiang province (another traditional sericulture region), mulberry cash crop plantations expanded by 126.5 hectare between 2004 and 2014 into non-marginal land of flat areas with low elevation, replacing paddy, woodlands, and forests (Su, Zhou, Wan, Li, & Kong, 2016). The land use change from woodlands and forests is ecologically disruptive with increased GHG emissions and biodiversity loss.

Due to the low economic return in the agricultural sector and the rising cost of rural labor, farmers are gradually substituting the more labor intensive organic manure with fertilizers (Gao, Sun, & Zhang, 2006). The increase in monoculture mulberry plantation could also be attributed to the higher land-to-labor ratio created by a small population due to urban migration and low birth rate (Q. F. Zhang, 2012). In addition, due to the relatively low labor requirement compared to other crops such as paddy rice, mulberry is a cash crop of choice for women and the elderly, as young male members of the family migrate from rural to urban cities in search of better job opportunities (Su et al., 2016). Some villages in sericulture region have become ‘no grain villages’ where no farmers produce food crops for their consumption and have to purchase food from the local market instead (Ni & Hisano, 2014). This is not necessarily a negative for the farmers, as long as they are able to afford food using income from silk cocoons. At the regional level, however, this is concerning, as the local governments are supposed to make a macro land use plan that promote a balance in the agricultural production of cash and food crops (Ni & Hisano, 2014). In traditional sericulture regions such as Zhejiang and Jiangsu Provinces, the DHE were previously SOE. As a result, the close connections between silk companies and local government has allowed them to influence local land use plans (Ni & Hisano, 2014), leading to the unintended consequences of food insecurity. Specifically, mulberry cultivation expanded at the expense of farmland with high soil quality and displaced food crops (J. Li et al., 2018).

<u>Intercropping system (agrisilvicultural)</u>

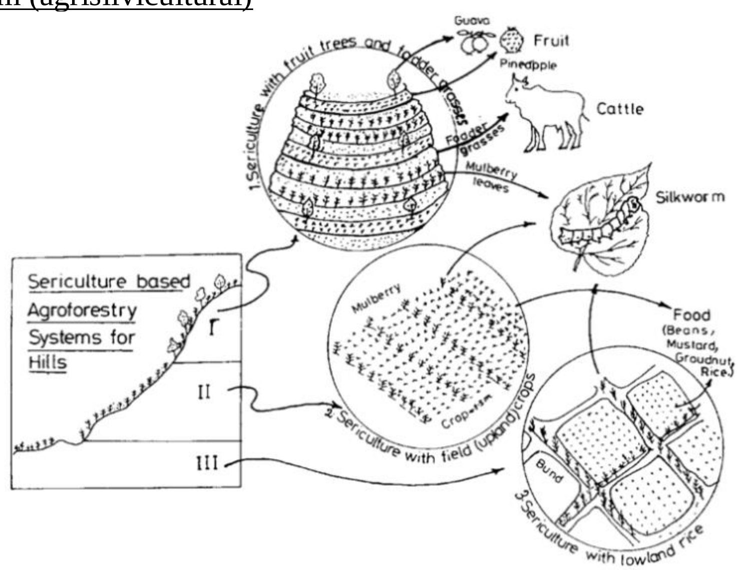


Figure 2.4 Sericulture-based agroforestry systems in north eastern hill region of India (Dhyani et al. 1996)

Mulberry intercropping systems often take the form of agroforestry system. Agroforestry systems are known to maintain soil organic matter and promote nutrient cycling. (Wang & Cao, 2011). In China, mulberry trees are intercropped with grain crops in Liaoning Province, white chrysanthemum in Zhejiang Province, and winter vegetables in Guangdong Province (Huo, 2002). In India, mulberry is intercropped with French bean, groundnut, mustard, and vegetables for valley land, and with rice for low lands, as illustrated in Figure 2.4 (Dhyani, Chauhan, Kumar, Kushwaha, & Lepcha, 1996).

Figure 2.5 Mulberry intercropped with grass on slope land in Shaanxi province (Qin et al., 2012)

Agricultural expansion in Sichuan Province of China on sloping land causes serious soil erosion. Hedgerow intercropping was introduced in the early 1990s as a solution. It involves the planting of double hedgerows of nitrogen-fixing plant with a cash or food crops in between, in the 'alley.' (Sun, Tang, & Xie, 2008). This method is usually done in areas with sloping lands with the intention of reducing soil erosion, contributing to water and soil conservation, increasing land productivity, and providing more income generation options to farmers. Alley cropping of mulberry between nitrogen fixing plants improves the yield and quality of mulberry leaves for sericulture and the need for chemical fertilizer input decreased (Sun et al., 2008). This has implications on biodiversity as above ground biodiversity is increased due to having more than one crop. Below ground interactions was not as understood when Sun et al. wrote the article in 2008. However, subsequent research conducted showed that intercropping mulberry with soybean increased bacterial diversity (X. Li, Sun, Zhang, Xu, & Sun, 2016). Intercropping mulberry with alfalfa, a nitrogen-fixing legume, showed a significant increase in bacterial diversity and richness when compared to monoculture mulberry plantations, with planting pattern explaining 26.7% of the bacterial community variation using variance partitioning analysis (M.-M. Zhang et al., 2018). Soil fertility is improved in this system due to the significant increase in available nitrogen, phosphate, potassium, and total carbon in the rhizosphere soil (M.-M. Zhang et al., 2018). In Shaanxi Province (Figure 2.5), mulberry intercropped with alfalfa has played important roles in reducing soil erosion, collecting rainfall water, increasing soil moisture containment, and gathering fertilizers (Qin et al., 2012).

Cropping patterns	Items	N (kg/hm^2)	P_2O_5 (kg/hm^2)	K_2O (kg/hm^2)	Total fertilizer application (kg/hm^2)	$N:P_2O_5:K_2O$
Intercrop (n=72)	Minimum amount	134.4	19.5	0.0	194.2	-
	Maximum amount	1526.7	612.3	841.9	2267.0	-
	Average amount	632.7	139.1	134.2	905.9	100.0:22.0:21.2
	Chemical fertilizers	480.4	89.3	24.3	594.1	100.0:18.6:5.1
	Organic fertilizers	152.3	49.8	109.8	311.9	100.0:32.7:72.1
	Chemical fertilizer %	75.9	64.2	18.1	65.6	-
Monocrop (n=21)	Minimum amount	115.8	4.3	0.0	199.4	-
	Maximum amount	993.6	561.6	344.9	1697.2	-
	Average amount	481.4	171.1	80.3	732.7	100.0:35.5:16.7
	Chemical fertilizers	365.9	131.7	6.8	504.4	100.0:36.0:1.9
	Organic fertilizers	115.4	39.4	73.5	228.3	100.0:34.1:63.7
	Chemical fertilizer %	76.0	77.0	8.5	68.8	-

Table 2.2 Fertilizer application amount in monoculture and intercropping farms (Translated from Luo et al., 2010)

Fertilizer application frequency	Monoculture mulberry farms		Intercropping mulberry farms		Total	
	Sample size	Percentage	Sample size	Percentage	Sample size	Percentage
1	9	42.9	0	0.0	9	9.7
2	10	47.6	7	9.7	17	18.3
3	1	4.8	20	27.8	21	22.6
4	1	4.8	26	36.1	27	29.0
>4	0	0.0	19	26.4	19	20.4
Total	21	100.0	72	100.0	93	100.0

Table 2.3 Fertilization frequency in monoculture and intercropping farms (Translated from Luo et al., 2010)

In an interesting study conducted, nutrient management status of mulberry agroecosystems in Sichuan Province was investigated (Luo et al., 2010). Average NPK fertilizer application (Table 2.2) was higher in the intercrop system (905.9 kg/hm2) than in the monoculture system (732.7 kg/hm2) (Luo et al., 2010). Fertilizer application frequency (Table 2.3) is also higher in intercropping systems (90.3% 3+ times/year) than in monoculture systems (90.5% 1-2 times/year) (Luo et al., 2010). However, fertilizer application frequency in intercropping systems varies and depends on the type of crops that mulberry is intercropped with; with 2 to 3 applications when intercropped with corn, 1 to 2 applications with wheat, and 1 or 0 times with sweet potatoes (Luo et al., 2010).

Even though alley cropping or contour hedgerow intercropping has many environmental benefits, its adoption has been slow due to lack of visible and direct income. The incorporation of mulberry in alley cropping solved this problem, as it brings additional income from the sericulture industry through silk cocoon production (Ya, Yan-Zhou, Jia-Sui, & Hui, 2003) and encouraging the adoption of this agroecosystem to prevent soil erosion. As soil erosion is reduced and soil fertility is increased, agricultural risks in the depressed mountainous regions is also reduced due to improved productivity and increased farm income, resulted in better farm livelihood (Sun et al., 2008). An integrated sericulture-based mulberry agroecosystems with guava, pineapples and fodder grasses in India (Figure 2.4) also confirmed that sericulture increases employment and livelihood, increasing the profitability of agroforestry systems (Dhyani et al., 1996).

Traditional mulberry dike and fish pond system (agrisilvopastoral)

Figure 2.6 Traditional mulberry dike and fish pond system - aerial (insideflows.org)

The Mulberry dike and fish pond system (Figures 2.6, 2.7, and 2.8) has been declared as a FAO Globally Important Agricultural Heritage Systems and is heralded as an agroecological case study for sustainable agriculture (Food and Agriculture Organization of the United Nations, 2017). This integrated sericulture and aquaculture farming system is an ancient practice in China that originated 2500 years ago. An aerial view of this system shows a beautiful chessboard like landscape. The dike and pond networks were originally dug as a flood control mechanism in the low-lying areas where flood disasters were common in Zhejiang province (The People's Government of Nanxun District 2017). Mulberry trees are planted on dikes and different types of fish are cultured in the pond, each occupying specific niche areas in the body of water. Mulberry leaves are fed to silkworms, silkworm feces are fed to fish, fish excrements enrich pond mud which are then dredged and piled on the dikes to fertilize mulberry trees. In addition, animals such as chickens, pigs, and ducks, and plants such as rice, sugarcane, and vegetables were often also grown in this type of traditional agroecosystem, as evident in the Zhujiang or Pearl River Delta in Guangdong province (Ruddle & Zhong, 1988).

Figure 2.7 Traditional mulberry dike and fish pond system – close-up (Elma Okic Photography and Video)

This system was named by several sources as one that generates no environmental pollution and promotes sustainable livelihood (The People's Government of Nanxun District, 2017; Zhong 1982). It appears to be a circular agroecosystem that is highly productive, with a closed-loop nutrient cycle that maintains soil fertility. Mud from the pond is claimed, containing about 5% organic matter, which was claimed to be better than chemical fertilizers and serves as weed killer as it retards water evaporation (Ruddle & Zhong, 1988). However, a modern life cycle assessment of this system showed that it is not as perfect as it seems, based on the analysis on the GHG emissions from the pond and the role of human labor (Astudillo, Thalwitz, & Vollrath, 2015). The study quantified on-farm methane and nitrous oxide emissions and indirect emissions embedded in inputs; which are waste from silkworm rearing and manure from livestock, and sometimes humans. Methane emissions occur during anaerobic mineralization of organic carbon from waste through photosynthetic activities of phytoplankton (Astudillo et al., 2015). Nitrous oxide emission from pond is less significant compared to methane, but not negligible (Astudillo et al., 2015).

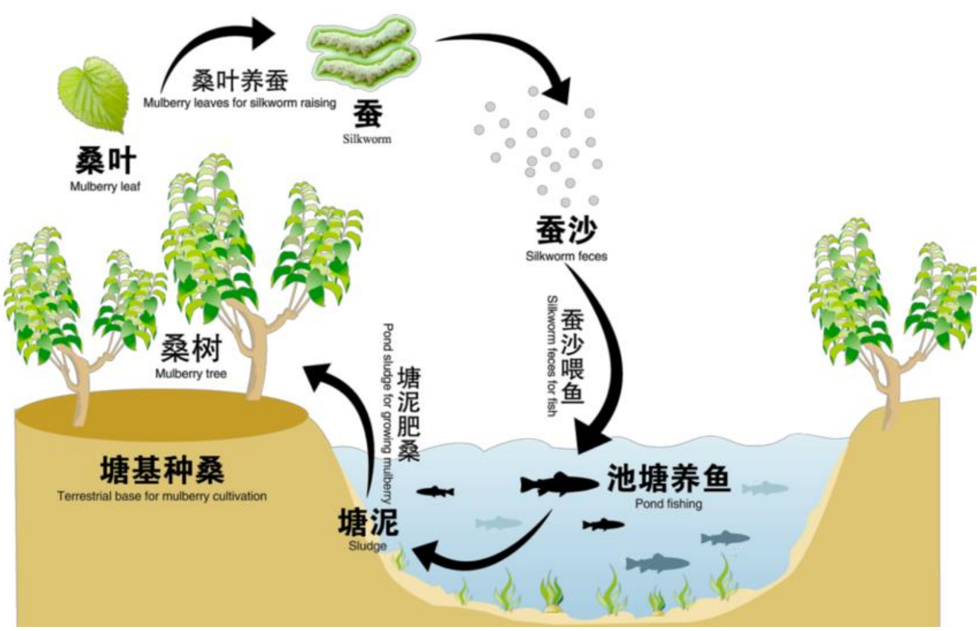


Figure 2.8 Traditional mulberry dike and fish pond system - graphical representation (The People's Government of Nanxun District, 2017)

Improving sustainability in such systems will require a better understanding of GHG emissions from waste-fed aquaculture ponds (Astudillo et al., 2015). As an agroecosystem with very high labor intensity, the import of food for farmers into the system has been suggested as a major inflow of nutrients, with indirect GHG emissions related to labor ranging from 11% to 22% (Astudillo et al., 2015). Astudillo, Thalwitz, and Vollrath suggested mechanization as a way of potentially lowering the physical demand of this system to thereby reduce indirect GHG emissions.

From a social perspective, this system produces higher economic returns than other agrarian practices, as farmers received much higher income from fish and silk cocoons than from rice and sugarcane (Zhong, 1982). Due to its multiple outputs, this agroecosystem also provides food diversity to silk farmers. Unfortunately, this traditional agroecological system is getting abandoned due to its high labor requirement, changing the farming landscape and nostalgia associated with silk heritage. As sericulture becomes more profitable, many farmers converted their land to cultivate mulberry exclusively (Ni & Hisano, 2014). In Guangdong Province, urbanization displaced traditional land where this agroecosystem is located (Astudillo et al., 2015).

<u>Scattered planting system</u>

In the scattered planting system, mulberry trees are grown on odd pieces of land and do not compete with the other crops in cultivated land (Huo, 2002). Due to its high adaptability to various soil and climate conditions, mulberry can be grown in diverse environments. In China, mulberry trees are sometimes grown by the road, around houses and fields, and along irrigation canal (Huo, 2002). In Sichuan Province, millions of mulberry trees are scattered in the hilly and mountainous areas for the purpose of sericulture (Huo, 2002). Also in Sichuan, mulberry trees are grown in the stony desert areas (Figure 2.9) in the form of “rocky hole mulberry” to control stony desertification (Qin et al., 2012). Mulberry leaves are used for raising silkworms, generating an important source of income for rural livelihood (Qin et al., 2012). This form of agroecosystem combines the control of stony desertification and improvement of livelihood through the development of a sericultural industry. One drawback of this system is in its labor intensity, as it is more difficult to harvest mulberry leaves from a scattered system than a monoculture system, decreasing the labor productivity due to an increase in time spent for harvesting. At the farm scales, it is worth noting that these two types of agroecosystems are not directly competing with each other - land that is suitable for monoculture will not be suitable for scattered planting. The positive reinforcement from the income generated through sericulture is important in the prevention of stony desertification in the area suitable for scattered planting, making it an environmentally and socio-economically beneficial agroecosystem to the community.

Figure 2.9 Mulberry trees growing in stony desert areas in Sichuan province (Qin et al., 2012)

<u>Summary</u>

Based on the literature review conducted, Table 2.4 summarizes the positive and negative social and environmental impacts of the four sericulture-based mulberry agroecosystems. All

	Environmental		Social	
	Positive	**Negative**	**Positive**	**Negative**
Monoculture	• Higher land productivity • Lower indirect GHG emission (labor)	• Higher fertilizer usage • Lower biodiversity (above/ below ground) compared to intercropping • Higher GHG emission (land use)	• Lower labor requirement • Increased income	• Regional food insecurity as mulberry displaces food crops (land use) • Potential oppression of silk farmers (contract farming)
Intercropping (agrisilvicultural)	• Lower soil erosion • Higher soil fertility • Lower fertilizer usage (N-fixing crop) • Higher biodiversity (above/ below ground)	• Higher fertilizer usage (non N-fixing crop)	• Lower agriculture risk (with reduced soil erosion and increased soil fertility) • Increased income	• N/A
Traditional (agrisilvopastoral)	• Pond mud as fertilizer • Flood control • High biodiversity	• Methane emission (pond) • Higher indirect GHG emission (labor) • Nitrous oxide emission (pond)	• Increased income • Higher food security • Diversified diet • Increased employment • Cultural heritage, beautiful landscape •	• High labor requirement (pond)
Scattered	• Lower soil erosion & stony desertification	• N/A	• Increased income • Increased employment	• High labor requirement (harvest time)

Table 2.4 Summary table of four sericulture-based mulberry agroecosystems

four systems appear to generate positive economic benefit for the silk farmers as silk cocoons are a high value commodity compared to other crops and the development of sericulture industry increases employment opportunities (Dhyani et al., 1996; Giacomin et al., 2017; Sun et al., 2008; Ya et al., 2003; Zhong, 1982). Due to the higher planting density in monoculture mulberry plantations, labor productivity is higher in that system compared to the other three systems as harvest time is decreased. However, this highly productive system is displacing food crops, increasing food insecurity in sericultural regions (J. Li et al., 2018; Ni & Hisano, 2014). In addition, contract farming of monoculture mulberry plantation could translate into the oppression of silk farmers, as they have little negotiation power with silk companies (Ni & Hisano, 2014). Monoculture system also has negative environmental impacts due to low biodiversity, high fertilizer usage (Luo et al., 2010), and higher GHG emission due to land use change (Su et al., 2016).

The sustainability of intercropping system is largely dependent on the type of crops mulberry is grown with, as intercropping mulberry with a non-nitrogen fixing plant would lead to higher environmental impact than monoculture due to fertilizer usage (Luo et al., 2010). In regions of China where intercropping of mulberry happens on hilly regions, mulberry helps reduce soil erosion and prevent stony desertification, reducing agricultural risk of farmers as soil fertility increases (Sun et al., 2008). It is worth noting that the income from sericulture has encouraged the adoption of intercropping method in the hilly regions to prevent soil erosion (Ya et al., 2003). In addition, intercropping system had "positive impacts on soil quality by changing soil physicochemical properties and promoting soil beneficial bacterium participating soil nutrients cycling" (M. Zhang et al. 2018).

In the integrated traditional mulberry dike and fish pond system, farmers are able to generate multiple outputs, increasing their income and food diversity. However, labor intensity is especially high because farmers need to dredge the pond mud and pile it on the mulberry dike as fertilizers, a physically demanding task (Astudillo et al., 2015). The indirect GHG emission due to the increase in food consumption by silk farmers along with methane and nitrous oxide emissions from fish pond means that this system is not as circular as one might hope (Astudillo et al., 2015). The scattered planting system appears to have no negative environmental impact but would likely require more harvesting time as the mulberry trees are scattered, which translates into lower productivity level.

In conclusion, the less intensive systems appear to be more socially and environmentally sustainable than the intensive monoculture mulberry plantations. However, it is important to note that the system itself is not sufficient in determining the ultimate sustainability level of a system, as evidenced by the differences in results between intercropping mulberry with nitrogen-fixing versus non-nitrogen-fixing crops. It is therefore important to pay attention to the actual practices in the farm, as practices such as crop choices and fertilizer application have significant impacts on the environment. From the livelihood perspective, it is important to balance the income potential of sericulture with food security and fair treatment of silk farmers.

2.3 The Silkworm: Ethical Considerations

Silk is a protein fiber produced by mulberry silkworm (*Bombyx mori*) caterpillar. 90% of the world's silk is produced by mulberry silkworms (International Sericultural Commission, 2013). The domesticated silkworm is dependent on human care and intervention for survival and its genetic diversity is dependent on breeders. In order to preserve the long filament spun during the creation of the pupa stage, silkworms are stifled (killed) in their cocoons during silk production. In light of an anti-silk campaign by the People for the Ethical Treatment of Animals (PETA), claiming that silk production causes painful deaths for silkworms, this section looks into the animal welfare aspect related to silk production. Does silk production really cause painful deaths to silkworms? If it does, what should EF do? The six-step Campbell's ethics assessment process will be applied to this case, systematically incorporating ethical deliberation into a scientific discussion surrounding animal welfare in silk production.

Step 1: Problem-seeing

The foundational question is: Is it ethical to kill silkworms for the production of silk? The first step of the Campbell's ethics assessment problems identifies the stakeholders on the topic and their respective interests. In this case, five key stakeholders are identified; silkworms, silk producers, EF, PETA, and other animals. In Table 2.5, the interests, values and motivation of each stakeholder are discussed in detail.

Stakeholder	Interests
Silkworms	As it is not possible to ask the silkworms about their interest, it is assumed that like all organisms, silkworms prefer to live a normal life and go through all four stages in the silkworm lifecycle; egg, larva, pupa, moth.
Silk producers	Sericulture is an important industry and provides income that supports millions of people in developing countries. Due to the high labor intensity of sericulture for mulberry cultivation, silkworm rearing and processing, 8.9 million people are employed in the silk industry in China and India, where 98% of the world's silk comes from (International Sericultural Commission, 2017).
EF	The clothing company was founded on the usage of natural fibers, and silk is one of its top 5 fibers. Silk is an expensive fiber, and the motivation for the inclusion of silk is quality and comfort. As a socially conscious company, the company tries to do what is right for people and planet. EF recently released a document called Responsible Sourcing: Animal Products (Appendix B), which has 3 main components; animal welfare, land management, traceability, but silk is not covered in the document. Like any clothing company, a PETA campaign against silk could be concerning to brand image.
PETA	PETA is an animal rights organization, aim to stop animal abuse worldwide. One of the organization's four area of focus is the clothing industry, with a campaign against silk (People for the Ethical Treatment of Animals, n.d.).
Other animals	In ecosystems, actions carried out during the production of silk have an impact on other animals in the system. Just like the silkworms, other animals also prefer to live normal lives and go through all life stages. Therefore, the interests of other animals will be considered in this exercise as it relates to animal welfare.

Table 2.5 Interests of various stakeholders on the topic of silkworm welfare

Step 2: Ethical detective work/fact–finding

A key question we need an answer to is: "Do silkworms experience pain and emotions?" In this section, the most complete and available literature is reviewed in order to answer this question. The silkworm (*Bombyx mori*) is a member of the family Bombycidae (order Lepidoptera, class Insecta, phylum Arthropoda) and has been a part of the history of silk in China for at least 5000 years (Goldsmith, Shimada, & Abe, 2005). Originally believed to be derived from *Bombyx mandarina*, silkworm is considered a fully domesticated insect and has been exploited by human beings. The human study of the biology and genetics of silkworm is the most advanced of any lepidopteran species, with complete genomic sequence, physical and linkage maps and express sequence tag data housed in two silkworm genomic databases in China and Japan (Omkar, 2017).

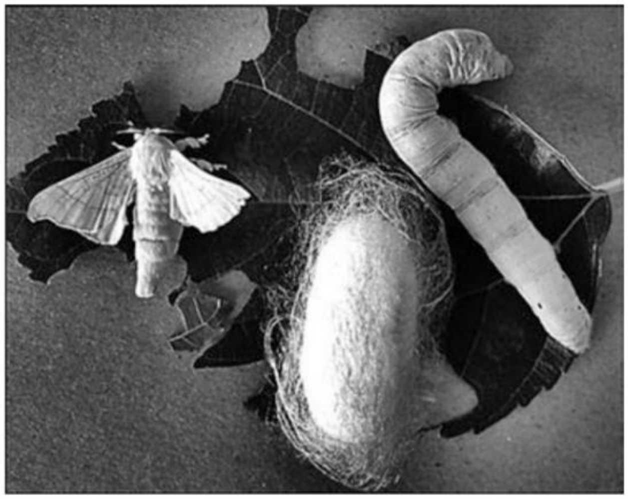


Figure 2.10 Silk moth, silk cocoon, and full-size silkworm larva (Omkar, 2017)

There are four distinct stages in the life cycle of a silkworm (Figure 2.10), which take place in around 40 to 45 days total. A silkworm hatches from an egg and spends around 25 days in the larval stage in which it grows significantly larger in size. Silkworm larva is provided with mulberry leaves and cared for by silk farmers and go through four molts and five instars. Towards the end of the larval stage, the silkworm spins a cocoon within three days before going through metamorphosis inside the cocoon. There is a short pre-pupa stage in which the dissolution of larva organs and formation of adult organs occur. During the pupa stage, the resting silkworm develops eyes, antennae, wings, and legs.

In a natural setting, the adult moth pierces and emerges from the cocoon, mates, lays eggs (if female), and lives for about a week before it dies. Due to heavy domestication, the adult silk moth has lost the ability to live naturally in the wild; it cannot fly, find its own mate, or eat, relying on food consumed during the larval stage for survival. Industrial silk production interrupts the natural life cycle of the silkworm. The pupa is stifled in its cocoon shell, most commonly using hot air in order to preserve the continuous fiber of the silk cocoon for reeling into raw silk yarns. Other stifling methods include sun drying, steam stifling, X-ray radiation, infrared radiation, and poisonous gas chambers. Pierced cocoons are considered undesirable due to the multiple breaks in silk filament, potentially making them unreelable. 3000 cocoons are needed to produce 1 kg of silk, depending on the quality of silk (Fritz & Cant, 1986).

The silkworm has a brain and nervous system, as depicted in Figure 2.11. Nociception is ubiquitous in the animal kingdom (Adamo, 2016). Even though the biology and genomics of the silkworm is most understood of all the lepidopterans, no research has been done on nociception, pain, and emotions of silkworms. Scientists and philosophers have long debated the link between nociception and the experience of pain in non-humans. Just because one experiences nociception (a pre-wired and objective physical reaction) does not mean that one experiences pain (a subjective affective experience). For example, a human patient who received painkillers may not have any physical pain, but could still experience a sense of suffering (Adamo, 2016). This void in our understanding between nociception and pain is known as the "hard" problem of consciousness (Adamo, 2016).

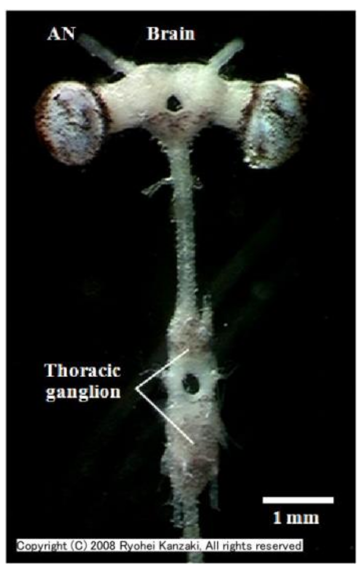


Figure 2.11 Brain and thoracic ganglion of *Bombyx mori* (Mizunami, 2009)

Experiments have been conducted on other members in same class as of silkworms, such as honeybees (class Insecta). In one experiment, honeybees were electrically-shocked and their stinging responses measured (Núñez, Almeida, Balderrama, & Giurfa, 1997). Some of the bees were injected with morphine and shocked again, and the measured stinging responses decreased. The results seemed to suggest that morphine, a painkiller reduced the pain level in honeybees, and therefore the stinging response is reduced. In an example given by Michael Tye in his book *Tense Bees and Shell-Shocked Crabs,* if one grabs the leg of a bee, its other legs will try to pry it loose. Is the bee reacting this way because it feels pain, or simply trying to survive? Tye went further by saying that a decapitated bee will continue to struggle for hours to free its leg. Like silkworms, bees have a brain and nerve centers call ganglia. Signals from the stimuli mostly travelled to the closest ganglia, with very little stimuli going to the brain. This results in instant kicking, a jerking movement that may not have anything to do with pain (Tye, 2017). These two cases together made it difficult to conclude that bees experience pain.

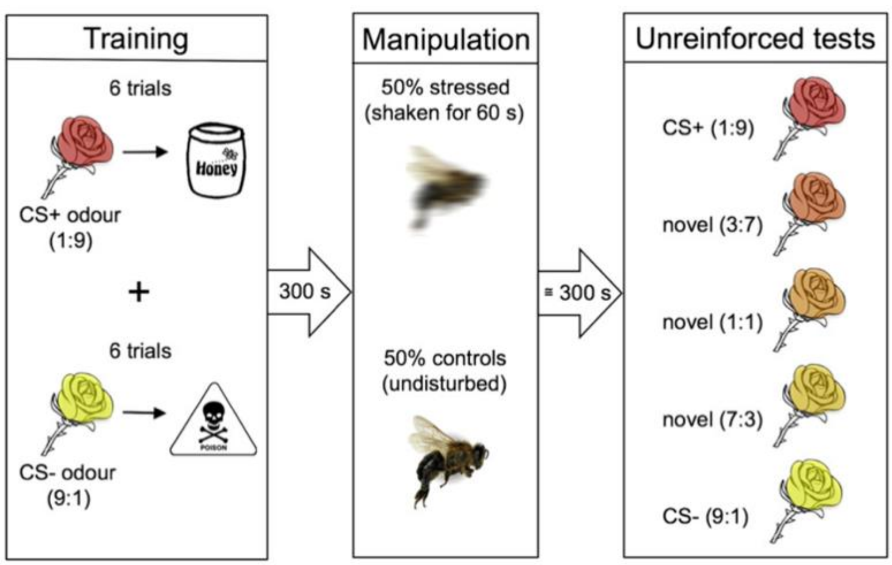


Figure 2.12 Experiment protocol of Bateson, Desire, Gartside, & Wright (2011)

In addition to the connection between nociception and pain for bees, Tye also discussed whether or not bees experience emotions such as fear or anxiety based on another experiment by

Bateson et al. (Figure 2.12). The results showed that shaken (stressed) bees displayed signs of pessimism as they did not react more negatively to a neutral stimulus as the non-shaken bees. This was not because the shaken bees are disoriented, as both shaken and unshaken bees reacted positively to positive stimulus. The experiment did reveal, however, that the shaken bees had decreased levels of serotonin and dopamine, just like anxious human beings. Bateson et al. concluded by saying that even though agitated bees "displayed negative emotional state" but said that they could not "claim the presence of negative subjective feelings in honeybees." Based on these experiments, it appears that the scientific community is unsure about the ability of honeybees to experience pain or emotions.

The conclusions from the experiments conducted on honeybees are puzzling due to the denial of honeybees' ability to feel pain when they seem to show both biological and behavioral signs of pain. With regards to silkworms, as they are stifled during the stage of complete metamorphosis (holometabolous), one could wonder if they are able to experience anything at a point when their internal organs are going through total transformation. It is important to recognize that the lives of silkworms are prematurely shortened in the production of silk. Adamo posed a very interesting question; "Are insects more like little people or complicated robots?" Since no true determinations can be made, using the precautionary principle, it would be better to err on the side of more protection for the silkworms by believing that they do experience pain and emotions when they are stifled in the cocoons.

<u>Step 3: Moral imagination</u>

As an expensive fiber, the motivations for the inclusion of silk in a clothing collection is not financial, but quality and aesthetics. Are there viable alternatives that could be considered by EF in order to achieve its aesthetics and ethical values as well as satisfying the interests of the various stakeholders? Table 2.6 presents the six alternatives that could be considered and their descriptions; regular silk, Ahimsa silk, organic silk, man-made silk, polyester, and MMC (such as viscose, rayon, Tencel™ and cupro).

Alternative	Description
Regular silk	Stay with regular silk, silk moths are killed inside cocoons.
Ahimsa silk	Wild silk, empty cocoons are harvested once silk moths has emerged.
Organic silk	Silk moths are killed inside cocoons. Organic farming is better for the environment. Also has a traceability component due to certification.
Man-made silk	Bio-based man-made protein material. Engineered to mimic spider silk. Made from yeast, salt, sugar (from genetically modified corn). No silkworms involved.
Polyester	Petroleum-based synthetic material with silk-like quality. No silkworms involved.
MMC	Cellulose-based material. Made from wood pulp, bamboo, cotton linter, and other plant-based raw materials. No silkworms involved.

Table 2.6 Silks and silk alternatives

Step 4: Ethics Jam

Values	Interested stakeholder(s)
Animal welfare: Five Freedoms (AW)	PETA, silkworms, EF, other animals
Responsible land management (LM)	EF, silk producers, other animals
Traceability (T)	EF
Farm livelihood (FL)	Silk producers, EF

Table 2.7 Values and interested stakeholders

EF recently released a statement (Appendix B) on the responsible sourcing of animal products (EILEEN FISHER Inc., 2018). Based on that document and the company's values to uphold human rights, the values of animal welfare, responsible land management, and traceability are identified in Table 2.7. Values of the other stakeholders are also added; PETA's concerns for animal abuse is covered under animal welfare. Farm livelihood is added as an important value for silk producers and EF. Animal welfare is the values that satisfy most of the stakeholders. Even though responsible land management appears to only be of interest to EF, positive benefits could extend to ecosystem and communities living in the area where raw materials are sourced, including silk producers and other animals. It is important to note that the list of values is not ranked by importance.

Step 5: Moral Justification

For this step, options from step 3 are tested against the values determined in step 4. Based on Table 2.8, it appears that organic silk satisfies most of the values, but the welfare of silkworms will not be upheld as they will be killed during the pupa stage inside the cocoons. Ahimsa silk satisfies both the farm livelihood and the animal welfare requirements. Regular silk provides livelihood to farmers, but does not satisfy other values as it tends to come from monoculture mulberry fields.

Alternative	Value(s) embedded
Regular silk	FL
Ahimsa silk	AW, FL
Organic silk	LM, T, FL
Man-made silk	AW
Polyester	-
MMC	AW? T? LM?

Table 2.8 Moral justification of silks and silk alternatives

Man-made silk and polyester do not involve silkworms or other animals, however, petroleum-based fabrics such as polyester release microplastics during the laundering process, which harms humans as well as marine animals (United States Geological Survey, 2016). Therefore, it was decided that it does not satisfy animal welfare values. Traceability and land management could be possible for man-made silk if the raw materials such as corn is sourced from farmers with responsible farm practices with evidence of material chain of custody. Since there are many types of MMC materials, it is difficult to make a determination as to what values are satisfied. For example, viscose, Tencel™, rayon, and cupro are all MMCs. Tencel™ is made from sustainably harvested trees, and could satisfy the traceability and land management values.

It also would satisfy the animal welfare values as it does not involve silkworm and does not harm other animals due to its closed loop process. Viscose, on the other hand is created using a chemical intensive process that is not closed loop and could be highly polluting to the water system, harming people and the environment. In that case, viscose would not satisfy any values.

Step 6: Moral Testing

In the final step of the Campbell's ethics assessment process, the alternatives are evaluated based on following six moral tests, and results from the moral tests are summarized in Table 2.9.

- Harm - Does the alternative do the least harm to silkworms and other animals?
- Practicality - Can the alternative be realistically implemented?
- Publicity - Would EF be comfortable with this decision being published?
- Collegiality - Can EF defend the decision to its peers?
- Reversibility - Would EF accept the decision if it were the silkworm and other animals?
- Theoretical - Is there an ethical theory that supports the decision?

Alternative	**Moral test(s) passed**
Regular silk	Practicality, collegiality
Ahimsa silk	Harm, publicity, reversibility, theoretical
Organic silk	Harm, publicity, collegiality, theoretical
Man-made silk	Harm, reversibility
Polyester	Practicality
MMCs	Practicality, collegiality. Harm? Reversibility? Publicity?

Table 2.9 Moral testing of silks and silk alternatives

Ahimsa silk passed four moral tests but is unfortunately not practical due to its low volume and not easily available on the market. Organic silk also passed four tests, as it could protect other animals from harm due to better land management and less pollution, though it does not protect the silkworms. Regular silk and man-made silk are the medium performers. Regular silk is readily available on the market and it would be easy for EF to defend the use of regular silk to its peers. Man-made silk is an innovative idea and causes no harm to silkworms. However, it is a new technology that has not reached commercial scale yet. In addition, its raw material is genetically modified corn, which is a monoculture crop and has other negative environmental consequences such as eutrophication and biodiversity loss. Until this technology is able to obtain a sustainable raw material source and reaches economy of scale, it is not a viable alternative. MMC passed the practicality and collegiality tests, but depending on the type of MMC, it could potentially also pass the other tests. Polyester is considered practical as it is a widely available material. However, petroleum has too many negative environmental consequences that could lead to the loss of welfare of other animals.

Regular silk, man-made silk, and polyester are the poorest performers in both step 5 and step 6. Therefore, it is reasonable to eliminate these three options. The elimination of these two alternatives leaves three other options, which will be deliberated in the summary.

Summary

Based on the Campbell's ethics assessment process, results from steps 3 through 6 are summarized in Table 2.10. Organic silk appears to be the top choice amongst the alternatives as it satisfies all stakeholders except PETA. It upholds the greatest number of values as well as passing the most moral tests. According to Textile Exchange, there are currently only five organic silk suppliers in the world, which means that volume of organic silk is very limited (Textile Exchange, 2017). Ahimsa silk and MMC could satisfy PETA's wish of not harming silkworms, but MMC could potentially harm other animals depending on its manufacturing processes. Due to the fact that Ahimsa silk represents a tiny percentage of the available silk worldwide, it would not be commercially viable to replace regular silk at the moment. In addition to quantity, clothing brand Stella McCartney also experienced problems with quality when it comes to Ahimsa silk (Stella McCartney, n.d.). MMC is commercially viable and could potentially have many positive qualities.

Alternative	Stakeholder(s)	Moral justification	Moral testing
Ahimsa silk	EF, silk producers, PETA	2 values	5 passed
Organic silk	EF, silk producers, other animals	3 values	4 passed
MMC	EF, PETA, other animals	0-3 values	2-5 passed

Table 2.10 Campbell's ethics assessment process summary

Even though organic farming does not directly satisfy PETA's wish of protecting silkworms from harm, its methods indirectly protect many other animals that PETA also cares about. Based on the utilitarian approach of doing the least harm for all who are affected, it would be rational to prioritize all other animals over silkworms alone. Of course, this would mean that EF is taking a risk of having PETA campaigning against the company, but it is the most holistic alternative out of all of the options. It is worth noting that even though the Campbell's ethics assessment process offers a foundation on which ethical decision making could be made in a systematic manner, there is an element of subjectivity that is embedded in the process. The strength of the frameworks lies in the fact that decisions are made in a systematic manner, which allows its user to review and potentially re-evaluate the situation in the future.

2.4 Summarizing the Dimensions

People, land, and silkworms are the three major dimensions of silk supply chain. China, where 80% of the world's silk comes from, is a vast country with unusual political, social, economic and cultural contexts. In addition, China has difficult environmental challenges and it is notorious for human rights abuses. As a foreign company conducting business in China, it is important for EF to understand this dimension in order to be effective in its engagement with silk supply chain partners. Due to the fact that situations differ from region to region, it would be crucial for EF to understand the geography of its silk supply chain within China, as that could have implications on the way land is farmed based on local land tenure and silk industry structure. In traditional sericulture regions where the silk industry has close ties to the local governments, increased corruption may be a business reputation risk. Emerging sericultural regions, though more democratic, have lower quality silk cocoons which could be risky to EF product quality. Depending on the difference in power dynamics between silk farmers and silk businesses, human rights violations is a possibility, with issues ranging from forced migration and disposed farmers, oppressive contract farming terms, and poor working conditions of farm laborers.

The political economy in China also impacts the way land is cultivated for mulberry with implications on farm livelihood and environmental sustainability. Integrated mulberry agroecosystems appear to be more socially and environmentally sustainable than intensive monoculture mulberry plantations. Small-scale, integrated agroecosystems that are typically more sustainable are in conflict with the Chinese government's promotion of agricultural modernization and the push for land consolidation in preparation for more efficient and technocratic agriculture. A confluence of factors has led to the drive for agricultural modernization in China – increased population, food security concerns, and demographic shifts in rural communities. However, agroecosystem type alone is not sufficient in determining environmental impact, as large-scale agriculture could also be sustainable if managed correctly.

Even though there remains inconclusive evidence as to whether or not silkworms experience pain and emotions, it can be said that their lives are cut short in the production of regular silk. Precautionary principle is applied and it was determined that the welfare of silkworms is not safeguarded in the production of silk. An internal discussion on the topic of silkworm welfare should be conducted at EF and ideally with important external stakeholders, ideally using the Campbell's ethics assessment process or another systematic ethical decision making tool. Currently, the company's animal welfare statement does not mention silkworms. Since silk represents a significant portion of the company's product, a position should be taken on the welfare of silkworm. However, it is important for EF to consider the concept of animal welfare from a macro level, as silk alternatives could come with unintended social and environmental consequences, threatening the welfare of other animals as well as society in general.

A holistic understanding of these dimensions has provided a foundational definition of a responsibly produced silk product. In the next chapter, the specifics within these dimensions will be explored within the realm of the EF silk supply chain in China.

CHAPTER 3

EILEEN FISHER SILK VALUE CHAIN

As stated on EF's Vision 2020 plan, the company has a commitment to supply chain transparency. EF started actively mapping its global supply chain in 2014, currently dedicating two full-time staff members to trace its global supply chains. In addition, the company also has a textile chemist on its fabric research and development team focusing on reducing its environmental impact. In partnership with the supply chain transparency and fabric research and development team members, silk supply chain information is obtained from the company databases: specifically, EF's seasonal material Request for Information and its Materials Ranking Tool.

In 2018, EF sourced 138 metric tons of silk, representing 8% of its total materials by weight (B. DiBenedetto, personal communication, July 10, 2019). Around 178,000 metric tons of silk was produced in the world in 2017 (Textile Exchange, 2018b). Silk is EF's fifth most used fibers after cotton, MMC (viscose and Tencel™ lyocell), linen, and wool (M. Meiklejohn, personal communication, August 6, 2019). A decision was made to focus on the supply chain information of 100% silk products and not the blended silk products - examples include silk-cotton, silk-linen, silk-cashmere products - which represent 81.72% of the total silk procured by weight. Due to a recent shift in sourcing (EILEEN FISHER Inc., 2019), in order to obtain supply chain information that is most relevant for future planning, the full year of data from the clothing seasons of Resort 2018, Spring 2019, and Fall 2019 is analyzed.

Based on the information gathered from the company, a summary of EF's silk supply chain information is presented in Figure 3.1. For the seasons of Resort 2018, Spring 2019, and Fall 2019, EF sourced its 100% silk products through twelve fabric mills or vendors that are located in China, India, and Japan. A total of seventeen dyehouses, finishing and printing facilities in China, India, and Japan are involved in the processing of these 100% silk products. Depending on the design of the products, the dyeing process could happen either at the garment or fabric stage. Nineteen fabric weavers or knitters are located in China and India, converting silk yarns into silk fabrics. These fabric weavers and knitters source their raw materials from eight silk yarn spinners that are located in either China or India. EF does not currently have any information in its databases on where the silk yarn spinners obtain their raw materials from. In terms of fiber of country of origin, it appears that all of EF's 100% silk products have a fiber country origin of China. It is worth noting that Figure 3.1 represents the best available information on EF's silk supply chain, as some fabric mills and vendors did not complete all of the information requested by EF on a seasonal basis.

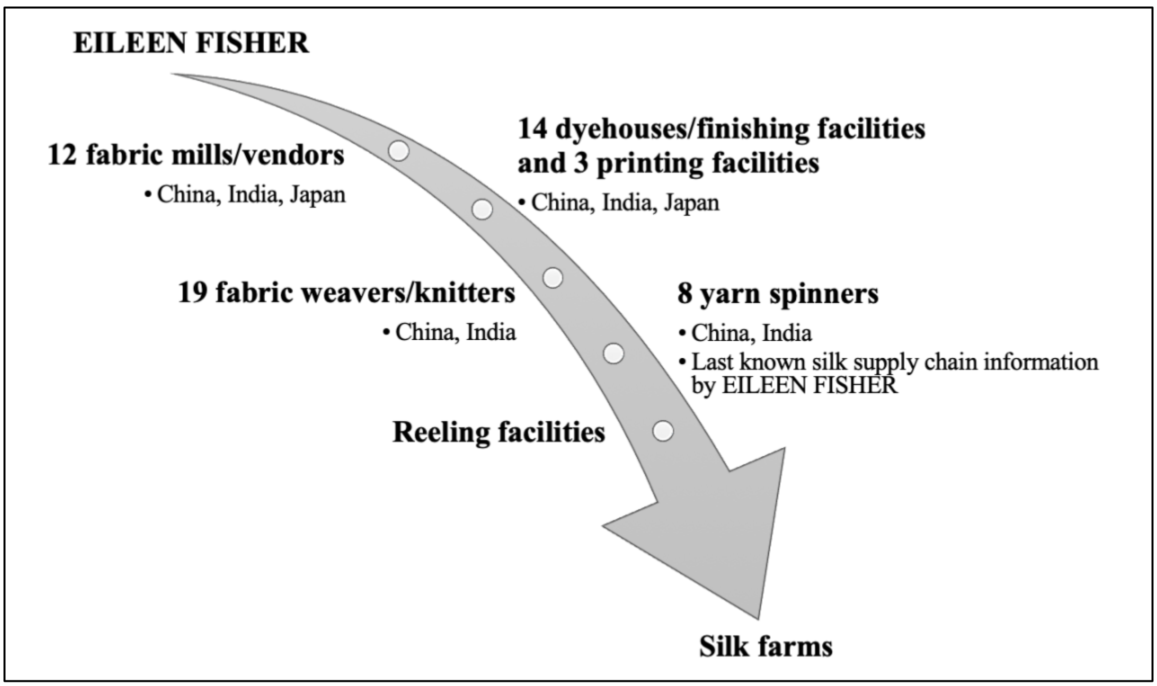


Figure 3.1 EF silk value chain information for Resort 2018, Spring 2019, and Fall 2019

To further understand its silk supply chain as well as the social, environmental and animal welfare impact of its 100% silk products, a bilingual (English and Chinese) Silk Reeling

Facility Survey (Appendix C) is created in partnership with the company to be shared with the silk yarn spinners. Out of the eight spinners, a decision was made to survey only seven of them that are located in China, as they represent 94% of the 100% silk products. The remaining 6% of products are sourced from one known yarn spinner in India and many unknown yarn spinners. Due to the low and fluctuating volume of business for these remaining 6% of 100% silk products, the survey is not sent to the spinner in India, as this type of supply chain exercise requires a lot of time and resources of the suppliers. Without the appropriate business volume, this particular supplier in India will have little leverage to obtain detailed supply chain information from its distant supplier in China, making it a futile exercise.

The transparency team members think that the survey is a good first step at getting a baseline and enhancing EF's learning on silk value chain. Fabric mills and vendors typically fill in the same silk supply chain information season after season (M. Meiklejohn, personal communication, May 9, 2019). In an attempt to verify that the information is still valid, an email communication was sent to them, asking them to verify that the seven spinners (four in Zhejiang province, two in Sichuan province, one in Jiangsu province) are still active suppliers of EF. It proved to be a worthy step, as only two out of the seven yarn spinners are still active suppliers of EF, and four new spinners are added to the spinner list. With the contact information obtained from the fabric mills and vendors, the Silk Reeling Facility Survey was created on the company's platform and disseminated via email to six spinners; two in Zhejiang province, two in Guangxi province, one in Jiangsu province, and one in Henan province. The spinners are given three weeks to pass the survey to their suppliers for completion. Fabric mills and vendors are copied on all communication and assisted in nudging the spinners to complete the survey on a timely manner.

3.1 Silk Reeling Facility Survey Results

It came to light during the survey period that one of the six spinners located in Henan province is actually not a silk yarn spinner, but a synthetic yarn spinner; reducing the number of spinners surveyed to five. EF works indirectly with the five yarn spinners through three partners; namely MGF, LF and Asai Shibori. Asai Shibori is an accessories vendor of EF that is based in Japan, and despite repeated communication between Asai Shibori with the yarn spinner Guangxi Hengye Silk Group Co., the survey was not completed. A total of four survey responses are collected; an 80% response rate. At first glance, MGF suppliers responded with the most complete information, whereas LF suppliers responded with slightly less complete information. This will be discussed in greater length below.

Agent-Mill/Vendor	EF Fabric Code(s)	Silk Spinner	Reeling Facility				
				Vertical Operation	Years in Business	Relationship with Spinner	Business % with Spinner
MGF-Senchuang	GC, GT, HN, SC, WVW, ZQL	Guangxi Guihua Silk Co. Ltd, Heng County, Nanning City, Guangxi Province	Guangxi Guihua Silk Co. Ltd., No. 212, Yunbiao Town, Heng County, Nanning, Guangxi Province	No	19 years	16 years	60%
		Jiangsu Fuan Cocoon and Silk Co. Ltd; No. 105, South Street, Fuan, Dongtai, Jiangsu Province	Jiangsu Fuan Silk Co. Ltd., Fuan Town, Dongtai City, Jiangsu Province	Yes	34 years	23 years	40%
LF-Chinamine	GK, PUQ	Hangzhou Hangzhou China Silk, No. 18 Street, Jianggan District, Zhejiang Province	Guangxi Longlin Jiali Silk Co. Ltd. Xinzhou Town Industrial Park, Longlin County, Baise City, Guangxi Province	Yes	7 years	No response	No response
LF-Tungtex	CEB, ES, HN, ORI, QYV, SD, SM, VE, ZRE, ADA, HII, VL	JinFuChun Holdings Co. Ltd; No. 100, Linfu Road, Linqiao Town Fuyang City, Zhejiang Province	Hangzhou Jinfuchun Silk Technology Co. Ltd. No. 18, Huanxi Road, Lingqiao Town, Fuyang District, Hangzhou, Zhejiang Province	Yes	8 years	20 years	1%

Table 3.1 EF silk supply chain relationships based on survey results

Table 3.1 summarizes the relationship between the agents, mills and vendors, spinners, and reeling facilities in relations to EF fabric codes. All but one reeling facility (Guangxi Longlin Silk Co. Ltd.) have the same or similar names as their respective yarn spinners. This is often an indication of a vertically integrated supply chain. The verticality of supply chain will need to be verified during the follow-up with suppliers. It is interesting to see Guangxi Guihua Silk Co. Ltd. as one of the yarn spinners, as a silk company of a similar name has been studied by Ni and Hisano (2014). The yarn spinners associated with MGF-Senchuang appears to have long working relationship with their respective reeling facilities. In addition, they also appear to be significant clients; representing 60% and 40% of the respective reeling facilities' business. In contrast, results from LF-associated yarn spinners seem to have newer working relationships with their respective reeling facilities, as information gathered appears to be in conflict with each other or incomplete. For example, Hangzhou JinFuChun Silk Technology Co. Ltd. stated that it has been working with JinFuChun Holdings Co. for twenty years despite having only been in business for eight years.

Reeling Facility	Silk cocoons Annual Purchase Volume	Silk Cocoons Source(s)
Guangxi Guihua Silk Co. Ltd.	6,000,000 kg	Contract silk farming Silk farmer cooperatives Open silk market Silk cocoon stations
Jiangsu Fuan Silk Co. Ltd.	600,000 kg	Contract silk farming Silk farmer cooperatives Open silk market Silk cocoon stations
Guangxi Longlin Jiali Silk Co. Ltd.	3,000,000 kg	Silk farmer cooperatives
Hangzhou Jinfuchun Silk Technology Co. Ltd.	500,000 kg	Open silk market Other: silk company

Table 3.2 Silk cocoon sources and purchase volume by reeling facilities

The sources of silk cocoons and annual purchase volume of the four reeling facilities are represented in Table 3.2. Facilities are given six options; contract silk farming, direct silk farming, silk farmer cooperatives, open silk market, silk cocoon stations, and other. Three out of the four silk reeling facilities stated that they source from silk farmer cooperatives and open silk markets. Two of the facilities source from silk cocoon stations and through contract farming. None of the facilities stated that they obtained silk cocoons via direct silk farming but curiously, three of the suppliers completed additional information under the direct silk farming section. One facility stated that it sources silk cocoons from other silk company.

Table 3.3 presents the silk cocoon source location information by the different reeling facilities. It is immediately clear that reeling facilities that disclosed additional information source their cocoons from places that are relatively local (within their own provinces) to them, regardless of the types of sources and provinces. Hangzhou Jinfuchun Silk Technology Co. Ltd., reeling facility of LF-Tungtex did not disclose any additional information. Based on email communication with staff member of agent LF, the facility is unable to provide the additional information. This makes sense, as it sources its silk cocoons from open silk market and other silk companies, adding another layer of middlemen between the reeling facility and the silk farmers.

Reeling Facility	Contract Silk Farms	Direct Silk Farms	Silk Farmer Cooperatives	Open silk Market	Silk Cocoon Stations
Guangxi Guihua Silk Co. Ltd	Yunbiao Town, Heng County, Nanning City, Guangxi Province	Guangping Village, Yunbiao Town, Heng County, Nanning City, Guangxi Province	Huilong Village, Guangpeng Village, Yunbiao Town, Heng County, Nanning City, Guangxi Province	Huilong Village, Guangpeng Village, Yunbiao Town, Heng County, Nanning City, Guangxi Province	Huilong Village, Guangpeng Village, Yunbiao Town, Heng County, Nanning City, Guangxi Province
Jiangsu Fuan Silk Co. Ltd.	Fuan Town, Dongtai City, Jiangsu Province	Fuan Town, Dongtai City, Jiangsu Province	Fuan Town, Dongtai City, Jiangsu Province	Fuan Town, Dongtai City, Jiangsu Province	Fuan Town, Dongtai City, Jiangsu Province
Guangxi Longlin Jiali Silk Co. Ltd.	Shuidong Village, Longlin County, Baise City, Guangxi Province	Shuidong Village, Longlin County, Baise City, Guangxi Province	Shuidong Village, Longlin County, Baise City, Guangxi Province	Guangxi is all open	Shuidong Village, Longlin County, Baise City, Guangxi Province
Hangzhou Jinfuchun Silk Technology Co. Ltd.	Not applicable	Not applicable	Not applicable	No response	Not applicable

Table 3.3 Locations of silk cocoon sources by reeling facilities

Table 3.4 details the additional land and farm practices information provided by the reeling facilities under the contract silk farming and direct silk farming sections of the survey. Guangxi Longlin Jiali Silk Co. Ltd., reeling facility of LF-Chinamine provided less detailed information compared to Guangxi Guihua Silk Co. Ltd. and Jiangsu Fuan Silk Co. Ltd., the two reeling facilities of MGF-Senchuang. All three facilities have land leases of ten to thirty years. In total, the three silk reeling facilities source their silk cocoons from a total land area of 125,975 mu (8398 hectare) through 59,200 contract silk farmer households. Again, Hangzhou Jinfuchun Silk Technology Co. Ltd. is unable to provide this information.

Reeling Facility	Mulberry Farm Types (Direct and Contract)	Number of contract silk farmers	Conditions named in silk cocoon contract	Amount of land for direct silk farming	Direct silk farm land lease length
Guangxi Guihua Silk Co. Ltd	Pure mulberry plantation	19,200 households	The density is 6300 plants/hectare (1 hectare = 15 mu; 420 plants/mu), and the spacing between each plant is 20cm x 80 cm. Organic fertilizers such as manure, compost, pond mud, green manure, and a small amount of organic fertilizer and trace element fertilizer. Drip irrigation and subsurface irrigation. Annual output of 3000 kg/ha. The quality requirement is 90%, the upper rate is over 90%, and the layer rate is 21%. The average price is 45 RMB/kg.	45,975 mu	30 years
Jiangsu Fu'an Silk Co. Ltd.	Pure mulberry plantation	40,000 households	Density 2200 plants/mu (33,000 plants/hectare), spacing 40cm x 80cm. Natural fertilizer, organic fertilizer, and trace element fertilizer. Adopting irrigation, the annual output is 250 kg/mu. The quality requirement is 93%, the upper rate is 92%, the layer rate is 23%, and the average price is 53 RMB/kg.	60,000 mu	30 years
Guangxi Longlin Jiali Silk Co. Ltd.	Pure mulberry plantation	No response	Ten batches of delivery per year	20,000 mu	Most of them are their own land, and they have 10 years of rent.
Hangzhou Jinfuchun Silk Technology Co. Ltd.	Not available	Not available	Not available	Not available	Not available

Table 3.4 Additional details on land and practices of silk farms

In terms of the conditions named in the contracts, the silk cocoon quality requirement is higher in Jiangsu Fuan's contract compared to Guangxi Guihua's contract. Consequently, the average price for silk cocoons stated in the contract is also higher in Jiangsu Fuan (53 RMB/kg) compared to Guangzi Guihua (45 RMB/kg). Three of the reeling facilities reported sourcing from pure mulberry plantations, with additional information on agronomic terms and conditions provided by two of them. The planting density is significantly higher in the Jiangsu Fuan contract (2200 plants/mu) compared to the Guangxi Guihua contract (420 plants/mu). This information will need to be verified in person during visits to silk farms, as it appears to be wrong – the planting density does not match the plant spacing stated. In addition, the planting density also seems much lower than what was reviewed in Chapter 2. Fertilization and irrigation requirements are also named in the contracts. It is also curious to find that Guangxi Guihua uses pond mud as fertilizer, as that is usually indicative of the existence of the traditional mulberry dike and fish pond agroecosystems located in traditional sericultural regions in Zhejiang and Guangdong provinces.

All four facilities indicated that silkworms are stifled using steam. All of the facilities also stated interests and awareness in farm sustainability, as well as willingness to engage with EF on further conversations on the topic.

3.2 Implications for Responsible Silk

Survey results indicated that Jiangsu Fuan Silk Co. Ltd. and Hangzhou Jinfuchun Silk Technology Co. Ltd. are located in the traditional sericultural region, whereas Guangxi Guihua Silk Co. Ltd. and Guangxi Longlin Jiali Silk Co. Ltd. are located in the emerging sericultural region. Based on the information reviewed in Chapter 2, it would be important for EF to pay attention to the power dynamics between the silk farmers and silk companies in order to assess its human rights risks. In traditional sericultural region of Jiangsu province, silk farmers often have little to no bargaining power when engaging in contract farming with the highly consolidated silk industry. In the emerging sericultural region of Guangxi province where the silk market is supposed to be more democratic, it would be important for EF to understand the specifics of its silk supply chain there. If the survey results is indeed true and the cocoon processing from silk farms in Guangxi is now happening within the province itself, then it could mean that vertical integration has happened in the EF supply chain there. A highly concentrated and vertically integrated silk supply chain in Guangxi province could have the same power dynamics that are unfavorable to silk farmers as those in the traditional sericultural region.

Details on contract farming terms should be studied in greater detail during field visits. According to results gathered from the Silk Reeling Facility Survey, EF indirectly sources from 59,200 silk farmer households. This is not a small number as it is estimated that around 300,000 households are involved in global raw silk production (Textile Exchange, 2018b). Even though no reeling facility stated that they are involved in direct silk farming, it would be good to verify that during field visits since the facilities completed the information under that section. If direct silk farming is indeed involved, EF should further understand the environmental and social impact as it relates to land management and working condition of laborers.

As all of the facilities indicated that silk cocoons are sourced from pure mulberry plantations, the environmental impact of EF’s silk at the farm level definitely requires some additional due diligence. Monoculture mulberry plantations are not ideal for the promotion of biodiversity, and not in line with the direction of other EF agricultural supply chain that focuses on organic and regenerative agriculture practices. Other potential negative impacts of monoculture mulberry plantations include GHG emissions due to higher fertilizer usage and land use change. The environmental sustainability of silk farms is definitely going to be a challenge for EF. It would be important for EF to understand the specifics around farm practices and explore if the monoculture farms are willing to move towards more restorative farming methods such as regenerative or organic agriculture in the future. In order to accomplish that, it would be important to explore if sericultural guidance stations in Jiangsu and Guangxi have the expertise in this area to help train farmers on better agronomic practices, transitioning them towards organic or regenerative agriculture. In terms of animal welfare, silkworms are stifled in the cocoons with steam, which means that organizations such as PETA could potentially wage a campaign against EF for silkworm cruelty. As a company that chooses to focus on natural fibers, it would be important for EF to evaluate the trade-offs between using silk or other natural fiber silk alternatives in preparation for potential reaction from organizations like PETA.

The goal of the Silk Reeling Facility Survey is to obtain additional information beyond the silk yarn spinner level. The supply chain transparency team thought that this exercise is a good first try at breaching the topic of traceability with the company's key silk suppliers. However, information would need to be verified via in-person field visits in China, especially since many of the questions that were asked in the surveys are new to the suppliers. Some of the answers obtained from the survey are questionable. For example, based on literature review, there is no open silk market in Jiangsu province. However, Jiangsu Fuan Silk Co. stated that it sources some of its silk cocoons through local open markets there. According to the supply chain transparency team, similar to their efforts in tracing other fiber supply chains, a lot of mutual education and trust is required to achieve transparency in supply chains, and real progress is always only made when people meet face-to-face. It is very possible that the survey results will be different than the ones collected once the mutual understanding and trust is established.

Due to the EF's small procurement volume from various suppliers, the focus should be placed on like-minded suppliers: those who are already progressive and willing to invest in their silk farms. In order to determine the suppliers with whom EF has higher potential business leverage, additional information is gathered from EF's Vendor Matrix and Vendor Volume Reports produced by the global sourcing team. There are several 100% silk fabric codes in Table 3.1 that are repeated season after season. For example, some of the fabric codes such GC, GK, GT, SM, SD, SC, HN, and ES are considered core silk fabrics (B. DiBenedetto, personal communication, July 23, 2019). Therefore, it would be important for any plan of action to focus on the reeling facilities that supply core silk fabrics to EF. Since the core silk fabrics are spread amongst the four reeling facilities that responded to the survey, a meeting was held with the global sourcing team to obtain further insights. It appears that EF's business with LF-Tungtex and LF-Chinamine is smaller and slightly uncertain, whereas EF's business with MGF-Senchuang is larger and more stable from season to season. Therefore, it may be prudent to focus the efforts on the two reeling facilities that are associated with MGF-Senchuang; Guangxi Guihua Silk Co. Ltd. and Jiangsu Fuan Silk Co. Ltd.

When compared to the other top 5 fibers at EF: cotton, MMC, linen, and wool, silk is definitely the least known and likely the least responsible of all. The details learned through the Silk Reeling Facility Survey painted a picture that is far from pretty. EF has a lot of work to do in order to have an ideal agricultural silk supply chain in China – one that protects the land as well as the welfare of people and animals living in and around it.

CHAPTER 4

PLAN OF ACTION

In this concluding chapter, a plan of action for how EF could create a responsible silk value chain is proposed. First, a review is conducted to understand industry efforts that exist around the silk supply chain. Then, the concept of creating system value in China is discussed. This is followed by the proposed five-year plan of action for responsible silk.

4.1 Existing Industry Efforts in Silk

Everlane, a clothing brand that stated its way as “Exceptional quality. Ethical factories. Radical transparency” launched a Clean Silk campaign in August 2018. The company claims that it is working with its partners to revamp its entire silk supply chain, from soil to shirt (Everlane, 2018), covering both the agricultural and manufacturing aspects of the value chain (Figure 4.1). It is unclear how Everlane would be able to meet the animal welfare requirement of the Regenerative Organic Certification™ standard, as silkworms are likely harmed in the production of their silk. Stella McCartney, a luxury clothing brand with strong commitment to animal welfare uses a combination of traditional and Ahimsa silk. In order to uphold its animal welfare commitment, the brand is working with Bolt Threads, a biotechnology company that is trying to create man-made silk, specifically, artificial spider silk from yeast, sugar from genetically modified corn, and water.

Textile Exchange (TE) is a non-profit organization that works on driving transformation in the textile industry towards preferred fibers and materials. Silk represents less than 1% of the global fiber production in 2017, compared to polyester at 51% and cotton at 24.5% (Textile Exchange, 2018b). A preferred fiber or material is defined by TE as one that is “ecologically and/or socially (social covers both human and animal welfare) progressive and has been selected because it has more sustainable properties in comparison to other options" (Textile Exchange, 2018a). In the organization's Preferred Fiber and Materials Market Report, it was evident that silk is not as much of a focus when compared to materials such as cotton, MMC, down, and wool (Textile Exchange, 2017, 2018b). TE recognized organic silk, Ahimsa silk, fair trade silk, and recycled silk as preferred silk (Textile Exchange, 2017, 2018b). The organization also shared a short list of five organic silk suppliers, with only one of those suppliers, OTEX, located in Sichuan province, China (Textile Exchange, 2017). OTEX works with 205 smallholder farmers, producing 30 metric tons of silk filament a year and converts it into GOTS certified organic clothing (Textile Exchange, 2017, 2018b). Using this figure, it is deduced that EF could potentially work directly with 943 smallholder farmers to obtain 138 metric tons of silk the company sourced in 2018.

Figure 4.1 Everlane's Clean Silk campaign

For its silk supply chain, EF partnered with one of its key silk dye houses in Suzhou, Jiangsu province, China to reduce its environmental footprint for silk, reducing water and energy usage, as well as toxicity levels. In 2012, the dyehouse achieved bluesign® certification, and EF introduced the world's first bluesign® certified silks. Even though the company is no longer working with this dyehouse in Suzhou, its current main silk dyehouse also has bluesign® certification. The company relies on certifications as a chain of custody tool for tracing its raw materials. Currently, organic is the only available certification program for silk at the agricultural level, and none of EF's silk is organically certified.

4.2 Creating System Value in China

The concept of corporate social responsibility (CSR) initially entered China in the 1980s through the activities of multinational corporations as a need to satisfy their stakeholders regarding business practices worldwide (Lusteau, Barth, & Jaussaud, 2018). One of the core traditional Chinese cultural values is harmony, which emphasizes a "balanced coordination between all things" (Zhang, 2013). The principles behind CSR do not appear to be in contradiction with Chinese values. Historically, CSR in China is widely government-driven due to tight political control and weak civil society (Lusteau et al., 2018). It is important to note that nonprofit organizations working on environmental issues seem to be regarded as helping to solve a crucial concern in the country whereas the organizations working on human rights issues are regarded as potentially subversive (Lusteau et al., 2018). Knowing that the right kind of government regulation can encourage companies to pursue shared value (Porter & Kramer, 2011), there is an opportunity for the Chinese government to put forth policies and programs to support the creation of a more harmonious agricultural system.

The shared value model (Appendix D) developed by Michael Porter and Mark Kramer takes CSR to the next level by integrating sustainability strategy into business operations, emphasizing joint value creation between businesses and communities. According to the shared value framework, companies can create economic value by creating societal value (Porter &

Kramer, 2011). In 2017, EF joined Future-Fit Foundation as its Development Council member. The Future-Fit Benchmark takes the shared value model even further (Figure 4.2), guiding companies on how to create system value by holistically considering their social and environmental impacts, set the right social and environmental ambitions (Appendix E), and take better day-to-day actions. The result is that companies will create system value that contributes positively to a future that is fit for flourishing for all. Amy Hall, EF's VP of Social Consciousness said that "As a Certified B Corporation with a holistic approach to business, Eileen Fisher, Inc.'s partnership with Future-Fit is a natural next step. We hope that our vision for a sustainable apparel industry, complemented by the Future-Fit Benchmark, will lead to shared learning and practical solutions for all apparel businesses. The time is now." (A. Hall, personal communication, May 18, 2017).

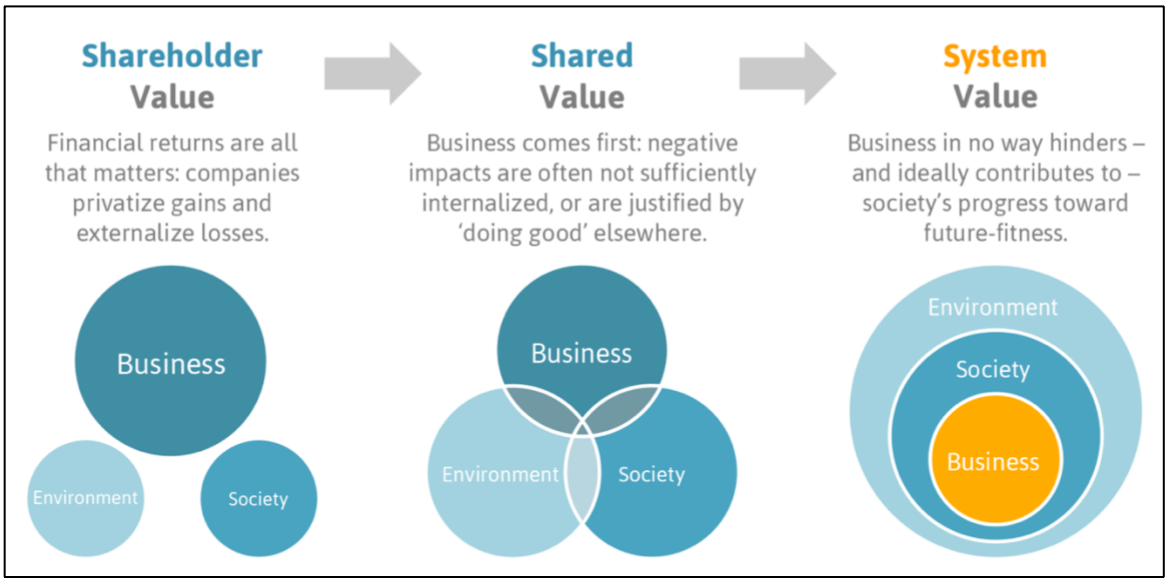


Figure 4.2 From shareholder value to system value (Future-Fit Foundation, n.d.-c)

As a socially conscious apparel company, EF has started to move towards creating system value for raw material value chains. For example, the company worked closely with TE, The Savory Institute, and Ovis 21 (a network of producers, technicians and professionals) in Argentina, to implement regenerative agriculture practices that restore ecosystem in its wool supply chain (Future-Fit Foundation, n.d.-a). This resulted in the introduction of the first Responsible Wool Standard certified products in 2018. EF also committed to procuring cotton from Alvarez Farms in New Mexico, U.S. as they transitioned from conventional to organic farming practices, lowering the economic risks of the farmer while remaining true to its commitment to reducing its environmental impacts (EILEEN FISHER Inc., n.d.).

In the case of sericulture in China, the industrialization and modernization of the industry has brought some prosperity to silk farmers through increased income, but at the cost of environmental degradation, potentially oppressive contract farming arrangements, and regional food insecurity. The way in which the sericulture industry currently operates is therefore discordant with silk farming communities. Would it be possible for the company to create value in the Chinese sericulture industry, generating positive social and environmental impacts that will benefit silk farming communities? In the next section, using these two frameworks as inspiration, a five-year plan for responsible silk is proposed for consideration.

4.3 Five-Year Plan towards Responsible Silk

EF is known for its commitment to responsible fibers. It is not surprising that the company decided to look into the social and environmental impacts of silk, its fifth most used fiber. EF is not a complete stranger to its silk value chain, as the company has done some work with its former silk dyehouse in reducing environmental impact. However, creating a responsible agricultural supply chain is no small feat, especially for a relatively small company like EF. Understanding its limitations from small procurement volume and concerns around business leverage, it is important for EF to have like-minded partners as it embarks on its journey towards responsible silk. This approach is supported both by the Future-Fit Benchmark guidance around using EF's presence to promote drivers that could propel the company and society towards an environmentally restorative, socially just, and economically inclusive society.

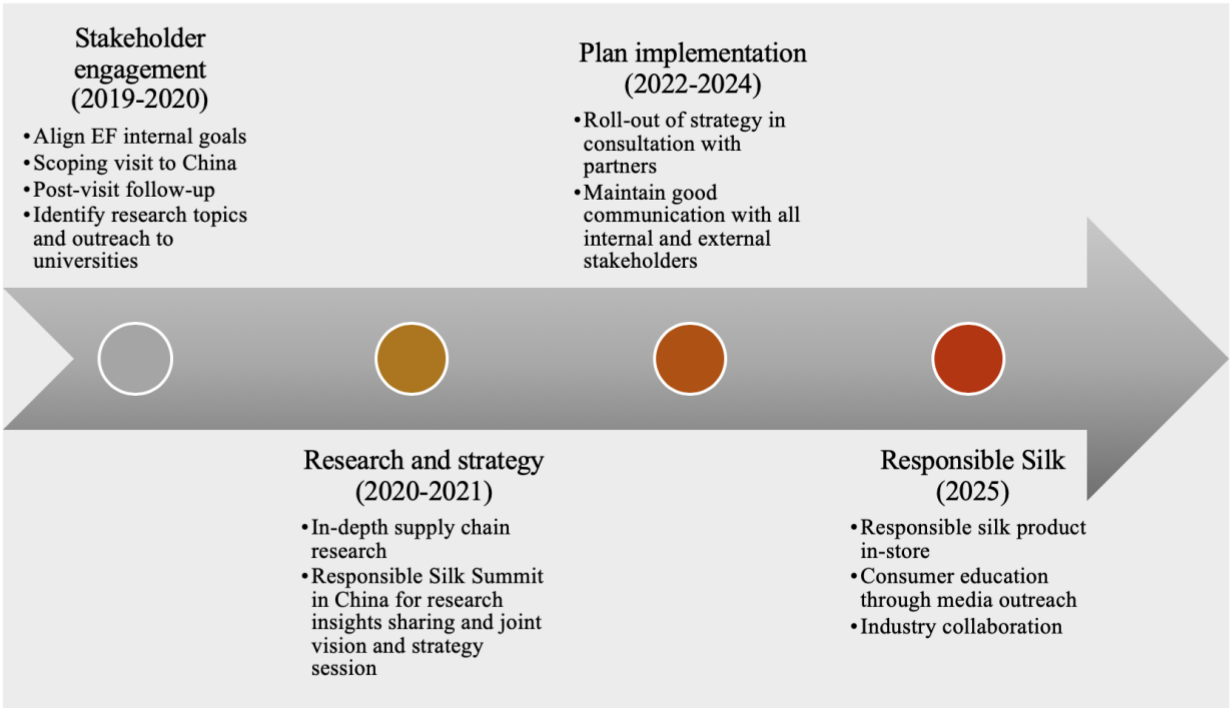


Figure 4.3 Five-year plan towards responsible silk

A timeline of actions for EF's five-year plan towards responsible silk is articulated in Figure 4.3. In the immediate future (2019-2020), findings from this paper should be communicated to the relevant teams at EF. It is important for EF to align its internal goals; what would a responsible silk supply chain look like to EF? What elements should responsible silk encompass: responsible land management, well-being of workers and silk farmers, welfare of silkworms and other animals, quality of silk products? This is especially timely, as EF is wrapping up its Vision 2020 work, and is beginning to think about what the company should commit to in the future. Vision 2020 encompasses eight main areas; four on environmental (materials, carbon, energy, water) and four on social (conscious business practices, fair wages and benefits, worker's voice, worker and community happiness). Agricultural work is not currently specified in Vision 2020, and represents an area of opportunity for the company.

Findings from this paper should also be communicated to the supply chain partners who helped get the Silk Reeling Facility Survey completed.

A scoping visit to China should be conducted by EF teams as a follow-up the Silk Reeling Facility Survey to begin establishing rapport with its silk supply chain partners, from sewing factory to silk farms. If possible, it would be ideal for EF to start meeting with some important local stakeholders in China such as government agencies, sericulture technology guidance stations, local universities, and silk companies. This step is important for EF, as it would allow the company to start the conversation in China, identify the farm extension support structure on the ground, and meet potential like-minded partners on its journey towards responsible silk. During and after the trip, verification of supply chain data and follow-up in-depth conversation with suppliers should be conducted to further understand the true scope of its silk supply chain as well as its social and environmental impacts. It will also help EF identify questions that requires more in-depth field research, such as the impact of contract farming arrangements on livelihood and government support for sustainable silk farming practices in the provinces where EF sources from. A second visit should be conducted as well to further establish the rapport with potential local supply chain partners and gain an even better understanding of its silk supply chain. It would also be beneficial for EF to visit OTEX in Sichuan province, the only certified organic silk farm in China with some of its more progressive supply chain partners as a source of inspiration.

Research and strategy development would happen in the years of 2020 and 2021. By the middle of 2020, the company should have identified research questions in need of further study. This could be accomplished by partnering with universities. Efforts should be made to reach out to university professors and students who may be interested in conducting research on the social and environmental sustainability of silk supply chains in China. In exchange, academics would have access to EF company data and connections to its supply chain. It is important for EF to keep its supply chain partners engaged during the process, as they will be integral partners before, during, and after the research. Research results should be shared with all parties through a Responsible Silk Summit in China, likely at the end of 2021, allowing the researchers to share findings and recommendations for the creation of a responsible silk supply chain. During the same summit, a strategy working session will be held in which all stakeholders (EF, agents, mills, vendors, spinners, reeling facilities, silk farmers, DHE, Chinese government, academics) jointly create a shared vision that would be meaningful for all. A good facilitator will be crucial in the success of this summit. The outcome of this strategy session should be the creation of a three-year strategy to build a responsible silk supply chain with named experts to support relevant areas of the work. For example, TE could potentially be a key partner for EF, as they have worked a good working knowledge of the textile industry and have partnered with EF on other raw material supply chain work. Universities could potentially stay involved as partners after the research phase is completed. Three years are the minimum amount of time required for a farm to convert from conventional to organic or regenerative practices. As a company that is committed to sustainable farming practices, it is highly likely that EF will want to move in that direction. Based on the survey results indicating that EF is sourcing from monoculture mulberry farms, it is likely that the farms will require that length of time to transform their practices. A similar length of time could be needed as well to develop farmer cooperatives that truly represent the interests of the farmers. Strong local support will be required to train farmers on organic farming techniques as well as setting up meaningful farmer cooperatives. It is also possible, of course, for EF to explore sourcing some of its silk from OTEX, which is already a certified organic silk farm.

As previously mentioned, EF is a relatively small company, and could potentially only work with a small number of silk farmers (less than 1000 smallholder farmers) to supply all of its silk. Therefore, it would be prudent to begin with a small pilot before scaling it during the later stages of the three-year plan. It would be important for EF to remember that a stable sourcing relationship is crucial to the success of the plan. Therefore, the design and global sourcing teams should be brought on board, and ideally be present at the summit so that there is an internal procurement strategy that will support the build-out of a responsible silk supply chain. As previously mentioned, the relationship with MGF-Senchuang appears stable in terms of business volume due to the production of core silk fabrics; it may be good to include the silk farmers who supply to their reeling facility as part of the initial pilot. Stable and recurring purchase orders will help reduce the economic risks for the silk farmers as they make agronomic investments in the farms during the three-year transition period. During the three-year plan implementation phase (2022-2024), transparent communication between and within internal and external stakeholders would be crucial as social and environmental practices are tested and evaluated. Monitoring and evaluation systems should be in place so that progress can be assessed along the way. During this phase, annual visits should be conducted by EF teams, especially those on the social consciousness and supply chain transparency teams.

In 2024, EF's marketing and sales team should be brought on board, as the product lifecycle at EF takes about a year from idea to store. Therefore, if responsible silk products were to be sold in 2025, these customer-facing teams would need to be aware as well. It would be prudent for EF to update its animal welfare statement to include silk prior to the release of responsible silk products. At the end of the implementation phase, EF should celebrate the success with its supply chain partners in China. Results should also be shared with other stakeholders as well as the media in China in the hopes that the efforts could be scaled in the country. In 2025, if everything goes according to plan, responsible silk products should be in EF retail stores, with a supportive selling and storytelling strategy. If universities were part of the three-year strategy implementation phase, a case study should be published in partnership with universities for educational purpose. EF should also share its responsible silk journey with other brands through industry conferences. This will encourage increased demand for silk that is environmentally restorative, socially just, and economically inclusive.

4.4 Summary

In summary, EF's journey towards responsible silk will be a long one. The plan of action presented in the section above is rather vague, and represents more of a step-by-step process guide. The actual plan itself will emerge during the process of engaging with stakeholders. It must be jointly created in partnership with stakeholders and experts as local ownership of the work is extremely important for the success of the plan itself. More insights will be gained once EF teams conduct their initial scoping visit at the end of 2019. Some initial questions that EF may want to find answers to include:

- Is there a way to grow mulberry that can create positive environmental impact through regenerative and organic agriculture, or could mulberry only be grown in a way that minimize the harmful effects? In other words, is it possible for silk production to be restorative to the earth instead of being less bad?
- In the process of setting up organic or regenerative agriculture systems, how could the rights and welfare of silk farmers be ensured; how could their voices be heard and taken

seriously in the process? If true farmers' cooperatives (ones that promote the voice of farmers to collectively bargain for contracts with favorable terms) are to be created, who would be organizing the farmers and how is that going to be done without being perceived as a social threat by the Chinese government? How could EF and its suppliers practically encourage a beneficial arrangement for silk farmers?

- If EF were to find a way to create an organic and regenerative agroecosystem for silk, would it ever be Regenerative Organic Certified™? It is unclear based on the certification framework as to how the welfare of silkworms will be evaluated, as silkworms die in the process of silk production. Currently, the framework itself does not mention silk specifically. It would be worthwhile for the company to reach out to the organization for more information on this topic.

EF should definitely collaborate with industry experts and universities in conducting research, as that is a competency that is lacking internally in the company. As the silk farms move away from monoculture agroecosystems, it would be likely for the farmers to also cultivate other crops, increasing biodiversity within the farms and potentially leading to cross-industry partnerships between the food and clothing industries. The successful implementation of the responsible silk plan will further position EF as a thought leader in the industry, defining what it means to be a responsible clothing brand and catalyzing positive social change in global supply chains.

APPENDICES

APPENDIX A

Sericulture Industry Structures in China

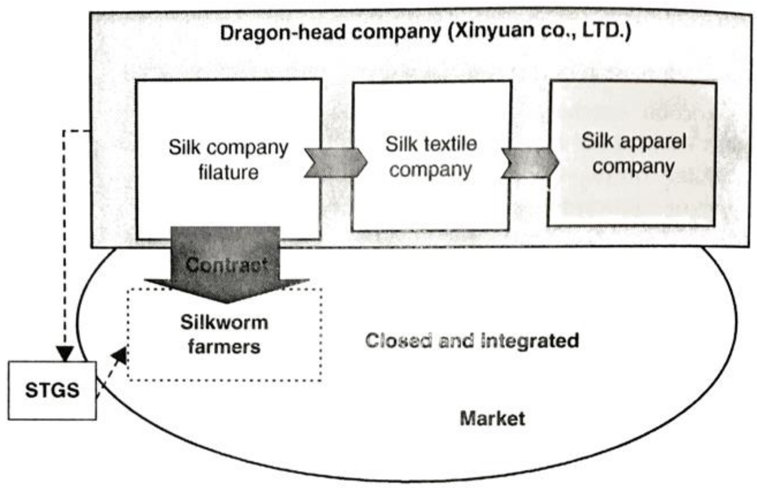


Figure 9.5 Sericulture structure of Xinyuan Company
Source: This figure is based on Ni's fieldwork in Zhejiang and Jiangsu in 2005.

Sericulture structure of Xinyuan Company in Jiangsu province (Ni & Hisano, 2014)

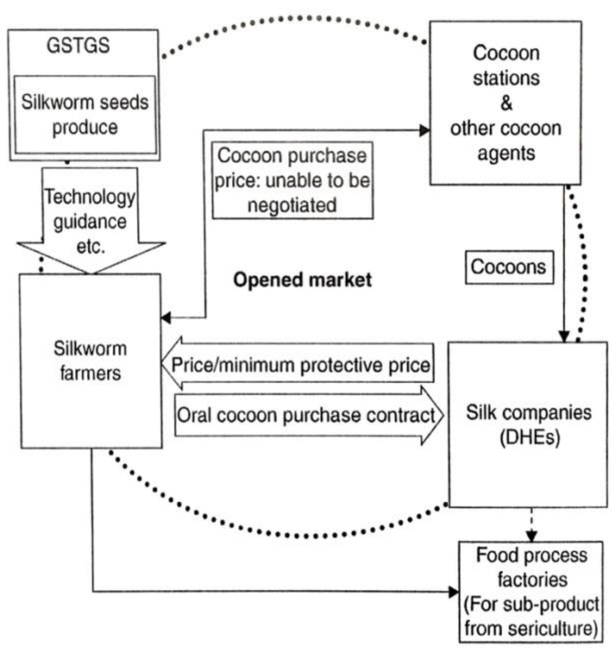


Figure 9.7 Sericulture structure in Guangxi
Source: This figure is based on Ni's fieldwork in Guangxi in 2009.

Sericulture industry structure in Guangxi province (Ni & Hisano, 2014)

APPENDIX B

Responsible Sourcing: Animal Products

Responsible Sourcing: Animal Products

Our commitment to animal welfare, responsible land management and a traceable supply chain

In sourcing our materials, both plant and animal based, we consider good stewardship as important as good quality. That's why we require relevant suppliers of the materials listed below to support:

- the highest standards for animal welfare.
- the best practices for responsible land management.
- the traceability of materials at each step of production, from the farm to the finished product.

How We Evaluate Responsible Suppliers

- **Certifications.** We require suppliers to support the Responsible Wool Standard and similar standards that require third-party audits and chain of custody documentation. They are the best way to verify animal welfare and environmental management practices.
- **On-site visits and research.** Wherever possible, we conduct research. Our teams interview farmers, staff and experts and observe the practices in place at the farm level.

Our Commitment to Collaborating to Create Change

We are part of a diverse set of stakeholders—brands, nonprofits, academics and animal welfare organizations—who are shifting the clothing industry's approach to animal-based materials.

- We supported the development of the Responsible Wool Standard and are currently engaged in the Responsible Leather Round Table, created to find ethical and sustainable solutions for leather sourcing.
- Both of these industry initiatives are being spearheaded by the nonprofit Textile Exchange. EILEEN FISHER team members have been part of its board since 2013.

Animal Welfare Requirements

We require suppliers to support the Five Freedoms of Animal Welfare. Defined by the Farm Animal Welfare Committee, these are internationally accepted standards for animal care that ensure:

- freedom from hunger, malnutrition, and thirst.
- freedom from fear and distress.
- freedom from physical and thermal discomfort.
- freedom from pain, injury, and disease.
- freedom to express normal patterns of behavior.

Responsible Land Management Requirements

Our definition of responsible land management includes:

- minimizing or eliminating the use of pesticides, herbicides and synthetic fertilizers.
- protecting soil, rivers, waterways, habitats, natural areas, native vegetation, fish and wildlife.
- protecting areas that are vulnerable to land degradation and desertification.

Additionally, we give preference to suppliers who use holistic management techniques and have an annual grazing plan in place.

APPENDIX B

Responsible Sourcing: Animal Products (continued)

Traceability Requirements

We do not source our animal products directly from farmers. Instead, we rely on mills to provide a chain of custody that documents each step of production, all the way back to the farm. This ensures that animal welfare and land management practices meet third-party certification requirements.

Our Prohibited List

We strictly prohibit the use of:

- Furs or hair of any kind, excluding hair-on-hide from goats, sheep and cows.
- Angora and other rabbit hair.
- Any animals raised in cages for fiber or skins.
- Exotic skins, including (but not limited to) alligator, crocodile, lizard, snake, cheetah, elephant, rhinoceros, leopard, lion, ostrich, shark, rays, fish and marine mammals.
- Leather or skin taken while the animal is alive or from aborted animals.
- Leather from illegally forested areas in the Amazon Biome.
- Any material that comes from domesticated or feral dogs or cats.
- Protected, threatened or endangered species, including (but not limited to) species appearing in:
    - Convention on International Trade in Endangered Species (CITES),
    - International Union for Conservation of Nature (IUCN) red list as Critically Endangered, Endangered or Vulnerable and
    - Endangered Species Act (ESA).

Our Products and Our Progress

We depend on animals for the materials below, which make up approximately 15%* of our product.

Wool

Our Objective: All suppliers will source wool that meets the Responsible Wool Standard (RWS), an independent, voluntary global standard that requires farms to:

- implement the Five Freedoms of Animal Welfare.
- ban mulesing, the practice of removing skin from the sheep's buttocks to prevent blowfly parasites.
- participate in audits to verify that responsible animal welfare and land managements practices are implemented.
- provide chain of custody documentation that enables us to trace product back to the farm and verify that our wool comes from RWS-Certified suppliers.

Our Progress: In Fall 2017, the first season we introduced responsible wool, approximately 40% of our wool product met or exceeded the Responsible Wool Standard.

Cashmere and Mohair

Our Objective: All suppliers will source goat fiber that ensures the Five Freedoms of Animal Welfare, protects land and soil health and eliminates overgrazing. The increased demand for cashmere has led tc overgrazing and desertification in parts of China and Mongolia.

Our Progress: Finding traceable supply chains is important to us. We have taken several research trips to investigate farms and mills, but more work is required. In the meantime, we have reduced our reliance on virgin cashmere by using recycled yarns.

- Recycled cashmere accounts for approximately 25% of the cashmere we sold in 2017. It's spun in Italy using leftovers from the production of fine cashmere garments.

Alpaca

Our Objective: All suppliers will source alpaca that ensures the Five Freedoms of Animal Welfare, protects land and soil health and eliminates overgrazing.

Our Progress: Most of our alpaca comes from Peru where herds graze high in the Andes. Based on our visits and research, the animals are primarily raised in small herds tended by families. Third-party verification would be the next step.

Down and Feathers

Our Objective: All suppliers will source down and feathers that meet the Responsible Down Standard (RDS).

Our Progress: 100% of our down is RDS certified. We use down as a fill in a select number of coats.

APPENDIX B

Responsible Sourcing: Animal Products (continued)

- An independent, voluntary global standard, RDS bans cruel practices, including live plucking and force-feeding birds, and ensures their ethical treatment by requiring suppliers to adhere to the Five Freedoms of Animal Welfare.
- RDS also includes a robust chain of custody system to document every step from farm to finished product, ensuring that the feathers in the product come from RDS-certified suppliers.

Leather

Our Objective: All suppliers will source leather that ensures the Five Freedoms of Animal Welfare and protects land, particularly from deforestation.

- Leather and skins must be sourced from by-products of the meat industry.
- Animals may not be raised exclusively for their skins.
- In addition, all suppliers will source leather from tanneries that are Gold or Silver rated by the Leather Working Group (LWG) or have other third-party verification meeting equivalent ecological criteria.

Our Progress: We are working with Textile Exchange's Responsible Leather Round Table to develop industry solutions that promote animal welfare and environmental and social responsibility. The majority of the leather for our shoes comes from tanneries that are LWG rated for their environmental impact. We're working to make sure more of our leather products meet this important verification.

Laws and Regulations

In addition to the criteria outlined in this policy, our suppliers must comply with all global, country and local laws and regulations.

* This animal products policy does not currently cover silk. Policy publication date: August 2018.

EF's animal welfare statement (EILEEN FISHER INC., 2018)

APPENDIX C

Silk Reeling Facility Survey

EILEEN
FISHER

Silk Reeling Facility Survey

EILEEN FISHER is a socially conscious women's clothing company in the United States. As a company, we have been mapping our supply chain since 2014, as supply chain transparency is important to us. We are increasingly interested in knowing where our raw materials come from, and what our social and environmental impact at the agricultural level might be.

Silk is one of our company's top five fibers, and silk garments and accessories are an important part of our collection. We would like to know more about the story behind our silk, and you have been identified as a key partner of ours in helping us trace where our silk comes from. Supply chain partners are important to us, and we would like to work in partnership with you to learn about and perhaps even improve the way our raw materials are grown.

To achieve this goal, we would like to ask that you help us complete the attached survey. The survey is meant to be completed by the silk reeling facility; the factory that converts the silk cocoons to raw silk yarns. The goal of the survey is to identify where the silk cocoons come from, and if possible, the social and environmental story associated with them.

We know that this is an unusual request, and understand the hesitation in providing this information. We see this survey as the beginning of our journey towards understanding our silk supply chain, and you are a key partner of ours. We would appreciate it if you could return this survey to us by July 10, 2019.

We look forward to having more in-depth conversations with you about it once we have reviewed the answers. If you have any questions or concerns, please do not hesitate to contact Luna Lee at llee@eileenfisher.com.

EILEEN FISHER是一家在美国具有社会意识的女性服装公司。作为一家公司，我们自2014年以来一直在绘制供应链，因为供应链透明度对我们很重要。我们越来越有兴趣了解原材料的来源，以及我们对农业水平的社会和环境影响。

丝绸是我们公司的五大纤维之一，丝绸服装和配饰是我们系列的重要组成部分。我们希望了解更多关于丝绸背后的故事，并且Xin Xiang Bai Lu Chemical Fiber已被确定为我们的关键合作伙伴，帮助我们追踪丝绸的来源。供应链合作伙伴对我们很重要，我们希望与您合作，了解甚至改善我们原材料的种植方式。

为实现这一目标，我们想请您帮助我们完成所附问卷：
https://app.smartsheet.com/b/form/36832f213a7e4d7a90264278576f1046。这问卷旨因该由将丝绸茧转化为生丝的工厂完成。问卷的目的是确定丝绸茧的来源，如果可能的话，还有与之相关的社会和环境故事。

我们知道这是一个不寻常的请求，并理解提供此信息时的犹豫。我们认为这项调查是我们了解丝绸供应链的开始，您是我们的重要合作伙伴。如果您能在2019年7月10日之前将此问卷完成给我们，我们将不胜感激。

一旦我们审核了答案, 我们期待与您就此进行更深入的对话。如果您有任何问题或疑虑，请随时通过llee@eileenfisher.com与李芳琪联系（李小姐会写中文）。谢谢。

Silk Reeling Facility Name 厂名 *

Name of the facility that converts silk cocoons to raw silk yarns 将丝绸茧转化为生丝的工厂名称

APPENDIX C

Silk Reeling Facility Survey (continued)

Address 地址 *

Contact person 联系人 *

WeChat/Phone number 微信/电话号码 *

Factory establishment year 工厂成立年份 *

Is your facility owned by a larger silk company? 您的工厂是否由一家大型丝绸公司拥有？ *

- ○ Yes 是
- ○ No 不

Silk cocoons purchased annually (kg) 每年购买的丝茧（公斤）*

Silk spinner *

Name of the spinner that sends you this survey 向您发送此调查问卷的公司名称

- ○ Guangxi Guihua Silk Co. Ltd.
- ○ Guangxi HengYe Silk Group
- ○ Hangzhou Hangzhou China Silk
- ○ Jiangsu Fuan Cocoon and Silk Co.
- ○ JinFuChun Holdings Co.
- ○ Xin Xiang Bai Lu Chemical Fiber

% of business with spinner 与该公司的业务比例 (%)

For the past 12 months

Years of business relationship with spinner 与该公司的业务关系长度(年)

Silk Cocoon Origin 丝绸茧起源

APPENDIX C

Silk Reeling Facility Survey (continued)

Silk Cocoon Origin 丝绸茧起源

For the past year, where did you source silk cocoons from?
在过去的一年里，您从哪里采购丝绸茧?

- ☐ **A. Contract silk farming 合同农业**
- ☐ **B. Direct silk farming 直接耕种**
- ☐ **C. Silk farmer cooperatives 农民合作社**
- ☐ **D. Open silk cocoon markets 开放式茧市场**
- ☐ **E. Silk cocoon stations 茧站**

F. Others (please explain) 其他(请解释)

Please provide additional information on silk cocoon origins in the appropriate section(s) below. 请在下面的相应部分提供有关丝茧起源的其他信息。

A. Contract Silk Farming 合同农业

Please complete this section if you purchase silk cocoons through contract silk farming. 如果您通过合同丝绸种植购买丝绸茧，请填写此部分。

Silk cocoons obtained through contracts (in kg) 通过合同获得的丝绸茧(公斤)

Number of silk farmers contracted 丝绸农民的数量

Location of contract silk farmers 合同丝绸农民的地点

Village, township, county, province 村, 乡, 县, 省

Conditions named in silk cocoon contract 丝绸茧合同中指定的条件

Please name the categories of terms and conditions that are named in the silk cocoon contract (eg. agronomic practices such as planting density, fertilization, irrigation, harvest rate, cocoon prices, quality requirement, delivery date, etc.). 请列出丝绸茧合同中指定的条款和条件的类别（例如，种植密度，施肥，灌溉，收获率，茧价格，质量要求，交货日期等农艺实践）。

APPENDIX C

Silk Reeling Facility Survey (continued)

Mulberry farm type(s) 桑农场类型

Select all that apply 选择所有符合的条件

- ☐ **Pure mulberry plantation 纯桑树种植园**
- ☐ **Mulberry + other plants 桑树+其他植物**
- ☐ **Mulberry + other plants + animals 桑树+其他植物+动物**

B. Direct Silk Farming 直接耕种

Please complete this section if your facility is involved in silk farming directly.

How much land (in mu) is used to conduct silk farming? 用于丝绸养殖的土地(亩)有多少?

How long is your land lease (years)? 土地租赁期限(年)?

Farm location(s) 农场农场

Village, township, county, province (please list all farm locations) 请列出所有农场 (村, 乡, 县, 省)

Mulberry farm types 桑农场类型

Select all that apply 选择所有符合的条件

APPENDIX C

Silk Reeling Facility Survey (continued)

- ☐ **Pure mulberry plantation 纯桑树种植园**
- ☐ **Mulberry + other plants 桑树+其他植物**
- ☐ **Mulberry + other plants + animals 桑树+其他植物+动物**

C. Silk Farmer Cooperatives 农民合作社

Please specify cooperative names and locations (village, township, county, province) 农民合作社名称和地点 (村, 乡, 县, 省)

D. Open Silk Cocoon Markets 开放式茧市场

Please specify names and locations of open silk markets (village, township, county, province) 请说明开放式茧市场 (村, 乡, 县, 省) 的名称和位置

E. Silk Cocoon Stations 茧站

Please specify names and locations of cocoon stations (village, township, county, province) 请注明茧站的名称和位置 (村, 乡, 县, 省)

3. Sustainability 可持续性

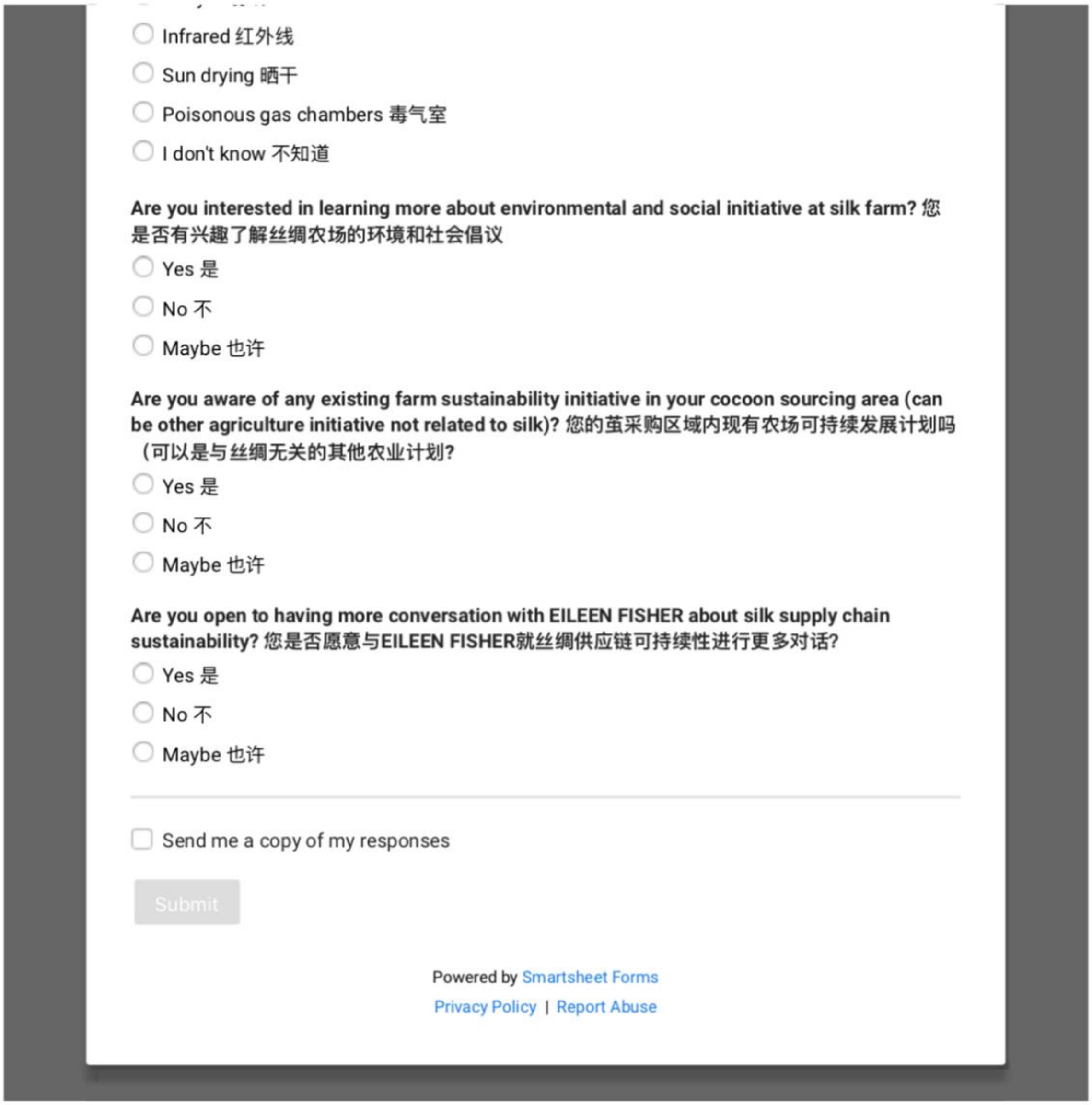
What method of cocoon stifling is used? 使用什么方法茧窒息?

How are silkworms killed in their cocoons? 如何在茧中杀死蚕?

- ○ Hot air 热气
- ○ Steam 蒸汽
- ○ X-ray X-射线

APPENDIX C

Silk Reeling Facility Survey (continued)



Infrared 红外线

Sun drying 晒干

Poisonous gas chambers 毒气室

I don't know 不知道

Are you interested in learning more about environmental and social initiative at silk farm? 您是否有兴趣了解丝绸农场的环境和社会倡议

Yes 是

No 不

Maybe 也许

Are you aware of any existing farm sustainability initiative in your cocoon sourcing area (can be other agriculture initiative not related to silk)? 您的茧采购区域内现有农场可持续发展计划吗（可以是与丝绸无关的其他农业计划?

Yes 是

No 不

Maybe 也许

Are you open to having more conversation with EILEEN FISHER about silk supply chain sustainability? 您是否愿意与EILEEN FISHER就丝绸供应链可持续性进行更多对话?

Yes 是

No 不

Maybe 也许

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APPENDIX D

Creating Shared Value Framework

HOW SHARED VALUE DIFFERS FROM CORPORATE SOCIAL RESPONSIBILITY

Creating shared value (CSV) should supersede corporate social responsibility (CSR) in guiding the investments of companies in their communities. CSR programs focus mostly on reputation and have only a limited connection to the business, making them hard to justify and maintain over the long run. In contrast, CSV is integral to a company's profitability and competitive position. It leverages the unique resources and expertise of the company to create economic value by creating social value.

CSR	CSV
› Value: doing good	› Value: economic and societal benefits relative to cost
› Citizenship, philanthropy, sustainability	› Joint company and community value creation
› Discretionary or in response to external pressure	› Integral to competing
› Separate from profit maximization	› Integral to profit maximization
› Agenda is determined by external reporting and personal preferences	› Agenda is company specific and internally generated
› Impact limited by corporate footprint and CSR budget	› Realigns the entire company budget
Example: Fair trade purchasing	Example: Transforming procurement to increase quality and yield

In both cases, compliance with laws and ethical standards and reducing harm from corporate activities are assumed.

From CSR to CSV (Porter & Kramer, 2011)

APPENDIX D

Future-Fit Benchmark

Future-Fit Business Benchmark

Break-Even Goals

What every company *must* strive to do to *avoid slowing down* society's progress toward future-fitness

Energy	**Energy** is from renewable sources
Water	**Water** use is environmentally responsible and socially equitable
Natural Resources	**Natural resources** are managed to respect the welfare of ecosystems, people and animals
Pollution	**Operational emissions** do not **harm** people or the environment
	Operations emit no **greenhouse gases**
	Products emit no greenhouse gases
	Products do not **harm** people or the environment
Waste	**Operational waste** is eliminated
	Products can be **repurposed**
Presence	**Operations** do not **encroach** on ecosystems or communities
People	**Community health** is safeguarded
	Employee health is safeguarded
	Employees are paid at least a **living wage**
	Employees are subject to **fair employment terms**
	Employees are not subject to **discrimination**
	Employee concerns are actively solicited, impartially judged and transparently addressed
	Product communications are honest, ethical, and promote responsible use
	Product concerns are actively solicited, impartially judged and transparently addressed
Drivers	**Procurement** safeguards the pursuit of future-fitness
	Financial assets safeguard the pursuit of future-fitness
	Lobbying and corporate influence safeguard the pursuit of future-fitness
	The right **tax** is paid in the right place at the right time
	Business is conducted **ethically**

Future-Fit Business Benchmark

Positive Pursuits

What any company *may* choose to do to *help speed up* society's progress toward future-fitness

Energy	Others **depend less on non-renewable energy**
	More people have **access to energy**
Water	Others **contribute less to water stress**
	More people have **access to clean water**
Natural Resources	Others **depend less on inadequately-managed natural resources**
Pollution	Others generate **fewer greenhouse gas emissions**
	Greenhouse gases are removed from the atmosphere
	Others generate **fewer harmful emissions**
	Harmful emissions are removed from the environment
Waste	Others generate **less waste**
	Waste is reclaimed and repurposed
Presence	Others cause **less damage to areas of high social or cultural value**
	Areas of high social or cultural value are restored
	Others cause **less ecosystem degradation**
	Ecosystems are regenerated
People	More people are **healthy and safe from harm**
	People's capabilities are strengthened
	More people have **access to economic opportunity**
	Individual freedoms are upheld for more people
	Social cohesion is strengthened
Drivers	**Governance** is strengthened in pursuit of future-fitness
	Infrastructure is strengthened in pursuit of future-fitness
	Market mechanisms are strengthened in pursuit of future-fitness
	Social norms increasingly support the pursuit of future-fitness

Break-Even Goals and Positive Pursuits (Future-Fit Foundation, n.d.-b)

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