SAVING THE SILKWORM: A PRACTICE THEORY-MLP INVESTIGATION INTO THE SILK INDUSTRY'S SUSTAINABLE TRANSITION IN INDIA'S NORTHEAST

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Abstract

The global textile industry faces critical challenges in its sustainable transition, including significant environmental externalities and social inequities. The Indian silk sector exemplifies these issues, with conventional production methods that exploit ecosystems and workers alike. Niche sustainable silk practices, however, rooted in traditional knowledge and currently only in production in India's northeast, offer a promising avenue for transformation. This study investigates the emergence and scaling of these practices within Northeast India, addressing a gap in sustainability transitions research, which has largely focused on consumer behaviors while neglecting producer practices.

This research employs an innovative theoretical framework that integrates social practice theory and sustainability transitions theory (STT), specifically the Multi-Level Perspective (MLP). Practice theory provides a lens for understanding the material, meaning, and competency elements of niche practices, and the MLP excels in contextualizing these practices within broader socio-technical systems. Together, these approaches enable an exploration of how niche practices interact with regime and landscape-level dynamics to drive systemic change. Key insights were operationalized through a dual-lens approach: "zooming in" to analyze the material, meaning, and competency elements of niche silk practices and "zooming out" to contextualize these practices within broader socio-technical systems. This dual perspective informed the analysis of barriers and opportunities for scaling sustainable practices.

The study combines 24 semi-structured interviews with silk producers, entrepreneurs, policymakers, and other stakeholders, with site visits and a literature review. A thematic analysis reveals that sustainable silk practices, are unified and made distinct by the meaning behind them, the *ahimsa* ethos. Key factors influencing scalability include gender dynamics, resource access for marginalized groups, and educational initiatives. These practices are hindered by market competition, policy inconsistencies, and socio-economic barriers, but supported by sustainability trends.

The findings demonstrate that niche sustainable practices have the potential to catalyze broader transitions within the silk industry, addressing pressing societal challenges related to environmental degradation and social inequity. By bridging practice-based insights with socio-technical systems thinking, this study contributes to sustainability transitions literature and offers practical recommendations for policymakers and industry stakeholders. These include fostering cooperative models to disseminate materials and competencies, implementing certification schemes to connect producers and consumers with aligned meanings, and supporting marginalized producers to scale sustainable practices effectively. This research underscores the importance of targeted interventions to transform entrenched systems and promote sustainable change in the textile industry and other industries in India and in other, developing nations.

Keywords

Sustainable transitions

Social practice theory (SPT)

Multi-level perspective (MLP)

Sustainable silk

Niche practices

Socio-technical systems

Silk industry in India

Equity and Development

Ahimsa silk

Textile sustainability

Gender dynamics

Traditional knowledge

Certification schemes

Scaling sustainable practices

Sericulture

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Table of Contents

1. Introduction

1.1 Problem Summary

A sustainable transition must address the wicked problem that is the unsustainable nature of conventional production systems. This problem has implications for the future of energy resources, water resource health, food security, and a less hospitable home planet as greenhouse gases drive climate change and its effects. Transitions of different sectors of the economy are playing out at different speeds and face unique challenges. Breaking down the drivers and implications of these sustainable transitions requires an understanding of how practices of production emerge and can be transformed. This research will seek to contribute to the broader reflection on sustainability transitions as it relates to the garment industry. Issues within this textile industry, a particularly pollutive sector, will be examined within this context using the case of niche silk producers in India analyzed through the combined lens of practice theory and sustainable transitions theory's STS. This study is novel in applying this framework to producer practices, diverging for previous work's focus on consumer practices' influence on sustainable transitions.

In examining this case, this research can contribute to a knowledge gap around how, within the scope of sustainable transitions, niche practices emerge, reproduce, and transform the socio-material contexts in which they are embedded. This applies to both the general, more theoretical, and broadly applicable study of how sustainable practices proliferate and contribute to sustainable transitions and to the specific contexts of the textile and silk industries. This expansion of understanding may relate to expanding or improving upon the toolbox of solutions available or to how these (improved) tools are applied given the social and material contexts around them. Thus, this research seeks to contribute to the understanding of sustainable transitions from an approach combining the theoretical lenses of social practice theory (SPT) and sustainability transitions theory (STT). Its focus on the producer side is novel as practice-based studies to date have focused predominantly on consumer practices (Shove et al., 2022, Keller, 2022). The topic choice for this case, the silk industry, has also been left unexplored from sustainability transitions and social practices perspectives with research in this area focusing largely on specific, technical innovations. This research will bring a practice theory analysis to previously unexplored areas: producers and the garment and silk industries, with the goal of expanding the body of knowledge around practice theory and its applications within sustainable transitions.

This introduction chapter sets the stage for understanding the sustainability transition within the garment industry, with a focus on India's silk sector as a case study. The chapter introduces the overarching concept of socio-technical systems and sustainability transitions, highlighting how industries like textiles operate within complex networks of actors, institutions, and resources. By employing practice theory and sustainable transitions theory together, the research explores how niche practices emerge and potentially transform socio-material contexts within the textile sector, particularly under unsustainable production pressures.

This chapter begins with a foundational overview of socio-technical regimes and transitions, providing context for how sustainability transitions have been traditionally conceptualized. This section introduces the reader to the theoretical backbone of the study, particularly the long-term and multifaceted nature of sustainable shifts. The following section delves into the textile industry, critically examining its unsustainable practices and the challenges inherent in promoting meaningful, industry-wide change. Here, the study identifies gaps in the sustainable transition of the garment industry, including a heavy reliance on consumer-focused solutions and the limited attention paid to the production side. The chapter then narrows its focus to the silk industry, emphasizing its historical context, environmental impact, and labor dynamics, while outlining the potential for sustainable practices rooted in traditional knowledge to address these issues.

The aim of this chapter is threefold: (1) to lay the theoretical groundwork for understanding sustainability transitions within socio-technical systems, (2) to contextualize the textile industry's unique sustainability challenges, and (3) to position the silk industry as a key case study for examining sustainable practices through the lens of SPT and STT. The chapter concludes by outlining the research questions and objectives that will guide the study, emphasizing the need for a deeper understanding of how niche sustainable practices can emerge, evolve, and influence broader industry transitions.

Industrial sectors, such as the textile industry, conceptualized as socio-technical systems consist of actors, institutions, material artifacts and knowledge (Geels, 2004, Markard, 2011, Weber, 2003). Actors in this context refers to networks of actors at the individual and organizational levels while institutions can be societal or technical norms, regulations, or standards (Markard, 2012). The mechanisms that cause a paradigm shift are explored within a socio-technical transition perspective. Such a transition, occurs over time spans of at least a half-century, involves implications across technological, social, economic, political, institutional, and organizational dimensions, and is driven by and affects a range of actors (Markard, 2012).

Borne out of the groundwork laid by socio-technical theorists, sustainability transition theory adds a novel dimension of examining socio-technical systems. Sustainability, for this study, will be defined using the 1987 Bruntland Commission's definition as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Sustainability transitions occur over similarly long periods of time and across multiple dimensions as socio-technical systems shift to sustainable methods of production and consumption (Markard, 2012). These sustainable transitions must be examined with a broad lens as they are inextricably linked to larger economic forces and institutional structures. Major issues preventing sustainable change, such as the rebound effect or green paradox cannot be explained without placing them in a broader, economic, societal, and institutional context. Sustainable transitions research seeks to analyze the dynamics of all these contexts from a functional perspective (van den Bergh et al., 2011). Sustainable transitions also introduce a governance dimension to the study of such a shift, with cooperation between many stakeholders coordinated to achieve targets. This study seeks to examine this transition in the

silk industry and link findings from a practice-based analysis to potential rationales, recommendations, and implications in the broader view of a sustainable transition.

Within the broader context of sustainable transitions, the garment industry's lack of concrete action to combat rampant environmental externalities stands starkly in contrast to the level of awareness around its environmental record. The garment industry is not unique in that its impacts are inextricably linked to the structural issues around rampant consumerism and waste inherent to conventional life of modern, developed economies. However, the impacts of the garment industry are among the most environmentally impactful and fundamentally unnecessary. The global fashion industry is the second-largest consumer of water worldwide, contributes to 20 percent of global wastewater production and 10 percent of carbon emissions. (UNEP, 2019). That 10%, if the fashion industry's current trajectory continues unchecked, is slated to become 26% by 2050 (Ellen MacArthur Foundation, 2017). Current emissions already amount to a share four to five times that of the aviation industry (IEA, 2021). The wastefulness of the garment industry is well documented and understood, yet efforts to rectify this have lagged. Awareness has not resulted in concrete action.

The lack of attention to, understanding of, and transparency in the various production processes around a wide variety of textiles has allowed manufacturers to take advantage of environmental externalities. Furthermore, the movement towards sustainable consumerism has been leveraged by the industry, through greenwashing, to peddle plastic alternatives to natural fibers. These plastic products have major impacts on human health and marine ecosystems that are only now starting to gain attention. 60 percent of clothing material is now sourced from plastic and much of that plastic ends up in lakes, rivers, and oceans, contaminating food supplies and damaging aquatic ecosystems. 1.4 million trillion plastic fibers now circulate in the world's oceans (UNEP, 2019). The shift to 'green,' plastic alternatives, is a socio-technical transition antithetic to that of the socially optimal sustainable transition of the textile industry.

With the sustainable transition of the garment industry failing to take flight, the assumptions underlying the expectation of a sustainable transition, for example that awareness leads to action, must be reexamined. Well-established lenses of sociological analysis, focusing on the structural or technocratic side and impact of a system on the one hand, or behavioral change and the agency of a (rational) actor on the other, have failed to account for the remarkably slow transition in the garment industry (Schatzki, 2001; Nicolini, 2012). Thus, a novel ontological lens, which attempts to understand the situated nature of this transition must be employed. While the phenomenon of consumer awareness of the impacts of their purchasing choices not translating into optimal actions has been well explored by recent advances in social practice informed research, the producer side of the equation has received less attention (Shove, 2022; Keller, 2022). This research will attempt to explore the gap in understanding around the lagging sustainable transition of the garment industry by analyzing producer practices using theory that moves beyond the structure- agency dichotomy. This gap will be explored through the case of the silk industry. Conventional silk production is currently a violent, extractive enterprise (Senthil Kumar & Saravanan, 2017). However, alternative methods

with far better environmental records and bases in traditional knowledge still exist. Examining how these niche production practices emerge, evolve, and proliferate can generate important insights with implications for the broader understanding of and action towards sustainable transitions.

Silk is a natural fiber extracted from the cocoons of silkworms. Mulberry silk, which has been the focus of sericulturists in India and China for thousands of years, is, by far the world's, and India's, most produced silk variety. Mulberry silk is so named because of the mulberry leaves that the silkworms feed on (Franck, 2001). More recently, industrialization, globalization, and an economy of scale have drastically altered production methods. The modern, industrialized silk production process results in externalities throughout the production process. This starts with the resource intensive cultivation of mulberry leaves to sustain the ravenous diets of the *bombyx mori* silkworms. Most mulberry production involves irrigation as the crop's water requirement is around 16,000 m(Interview with Sustainable silk entrepreneur, 2023)/ha/year (Ricciardi et al., 2021). Many of the areas producing or slated to produce large quantities of mulberry leaves already experience significant challenges in securing their water supplies and can expect greater variation in water availability, due to climate change (Ricciardi et al., 2021). Further complicating this issue, in India, the demand for water for a cash crop such as mulberry must compete with demand for water used for food production in a country with 222.4 million undernourished people, comprising 16% of the country's rapidly growing population (Food and Agriculture Organization, 2020). The same competition between food and cash crops for scarce water resources that are only projected to become scarcer can be seen in competition for land resources experiencing the same rising demand.

The demographic trend driving the increased demand for water resources for the irrigation of food resources also drives the increasing demand for land to grow the food needed to feed India's rapidly growing population, which is rapidly increasing its living standards. India is projected to see an approximately 50% rise in demand for most food types by 2030 from 2010 levels (Kumar et al., 2016). As demand for both land and water resources increase, the question of whether to prioritize either food or cash crop production will be raised more frequently and with greater stakes. This is further complicated by the pollutive impact of mulberry silk on water resources during the dyeing process, which has the potential to threaten food resources (Senthil Kumar & Saravanan, 2017).

An alternative to mulberry silk that is more frugal in its use of resources and less damaging to surrounding communities has the potential to free up valuable land and water to feed a population in need. Such sustainable alternatives include eri and mugga silks, both products of niche production practices. Sustainable silk alternatives fall into the category of *ahimsa* silks. *Ahimsa* philosophy stems from Hindu and Buddhist tradition and emphasizes causing no harm to other, living beings physically, vocally, or even mentally and values ecological stewardship, non-violence and social equity. In 2013, India produced 18,715 metric tons of mulberry silk and 119.17 metric tons of these alternative silks, of which 118.91 metric tons (99.7%) were produced in the northeast and 108.52 metric tons (91%) in Assam (North Eastern

Council, 2015). As a result, this study focuses on the northeast region and on Assam in particular.

In addition to extracting physical resources at the expense of the environment, industrialized silk production also extracts the fruits of labor of the industry's underprivileged workers without just compensation or empowerment. The industrialization of silk has resulted in the subjugation of sericulturists, weavers, and dyers as large companies with large operations seek to maximize profits in a country where labor, especially unskilled and semi-skilled, is cheap. This has major impacts at the local level and has resulted, in the worst cases, in bonded labor, particularly among children (Srivastava, 2005). In contrast with ancient sericultural traditions, current methods do not allow a sericulturist to sell her own silk cocoons to a weaver or, in turn, allow that weaver to sell to a dyer and so on. Vertically integrated production systems have divorced silk workers from the agency and choice they previously enjoyed and amalgamated them as cogs in an industrial machine. This is particularly so for women, whom the government has targeted in projects to subsidize female entrepreneurs. These projects have little to no impact as males with power put women's names on paper to gain access to the boons of these projects yet continue to hold the economic and social power intended to be equitably redistributed (Mayoux, 1993). At the local level, with government and financial officials enacting policy, women again face significant challenges, often needing to bring a man along to expedite the process. The industrialization of the silk industry has resulted in greater efficiency in production coming at the cost of equity for those who do the producing.

Indian silk competes with Chinese silk on the international market. This competition has been so stiff that the Indian government attempted to place antidumping tariffs, aimed to protect domestic producers from competition from imports below fair market value, on Chinese silk. Despite this, and the environmentally and socially extractive nature of industrialized production, Indian sericulturists struggle to produce with the same scale, reliability, and cost-effectiveness as Chinese producers. (Feng et al., 2009). Resultingly, India imports much of the raw silk it uses from China. Currently, even with the yuan's appreciation against the rupee, transportation costs, and high import duties, Indian silk remains around 150% of the price of Chinese silk. It is thus unlikely that more expensive, nonviolent methods will be widely adopted without new incentives. 71-79% of current Indian production is conventional mulberry production (Indian Silk Export Promotion Council, 2022; The Indian Silk Export Promotion Council, 2023). Given the dominance of mulberry silk, strong competition from Chinese imports, and the lack of clear, marketable alternative products, individual producers face significant barriers in making silk production more sustainable or ethical, at significant cost, voluntarily or at large scale. This means that the status quo of producing with significant social, environmental, and ethical externalities remains in place and the sustainable transition of the industry moves at a snail's pace.

The industry's response to increasing awareness about its environmental record has been to push plastic alternatives, such as rayon, nylon, viscose, and polyester. These 'vegan' alternatives to natural fibers are easy to produce reliably and at scale and require repeat purchasesby consumers due to their lesser durability (Farrer & Fraser, 2011). Consumers, due to

successful marketing campaigns, are duped by these claims, believing their purchase to be sustainable, ignoring the basic tenet of any increased consumption being inherently less sustainable, let alone one that involves increased plastic production. Other consumers simply value aesthetics far above sustainability concerns (Joy et al., 2012). This strategy has led to significant profits for the textile industry. Global clothing production doubled from 2000 to 2015 and coupled with a 40% drop in the amount of time an article of clothing was used over the same period (Ellen MacArthur Foundation, 2017). The textile industry's move to promote greenwashed alternatives to conventional products, rather than engage in a legitimate sustainable transition, underscores the need for greater research into how niche, sustainable practices, such as sustainable silk production, can be supported.

While previous analyses have extensively examined the practices of consumers, very little research has, up to this point, focused on the practices of (niche) producers. Building off the success of practice theory in generating valuable insights where analyses using theories espousing a traditional, hierarchical ontological lens have stalled out, practice theory has been increasingly employed in analyzing larger and more diverse social phenomena (Shove, 2022; Keller, 2022). The analysis of this research seeks to continue in this expansion of practice theory application into new frontiers. In applying practice theory into a new dimension, the producer side, this research addresses a significant gap in scientific discourse. The approach of this research follows a trail blazed by Nicolini (2009), Hargreaves (2011), Spaargaren (2016), Shove (2010, 2012, and 2022), and more, in meshing social practice theory (SPT) and sustainable transitions theory (STT) analyses to generate novel insights into sustainable practices and their recursive impact on sustainable transitions. In addition to a novel exploration of the producer side, this research brings this approach, and greater sociological discourse, to the silk industry, analyses of which have focused on technical, process-based approaches.

1.2 Research Aim

Within a heavily polluting textile industry inundated with non-durable, plastic products, the unique position of sustainable silks, allows for an opportunity to explore a novel and insightful area in the context of sustainability transitions. Niche producers in India offer a wealth of traditional knowledge of sustainable practices. These practices continue to survive in a developing economy with inconsistent environmental policy and regulation. This leads to a unique perspective stemming from addressing the potential transition of a deeply unsustainable sector from the lens of sustainable, traditional practices among niche actors in a developing economy. **This research seeks to break ground in exploring sustainable producers in relation to their situated practices, the potential of these niche practices, and the factors that support and hinder them in emerging and scaling. Furthermore, this research aims to contribute to the broader understanding of how sustainable practices and sustainable transitions evolve and can be supported.**

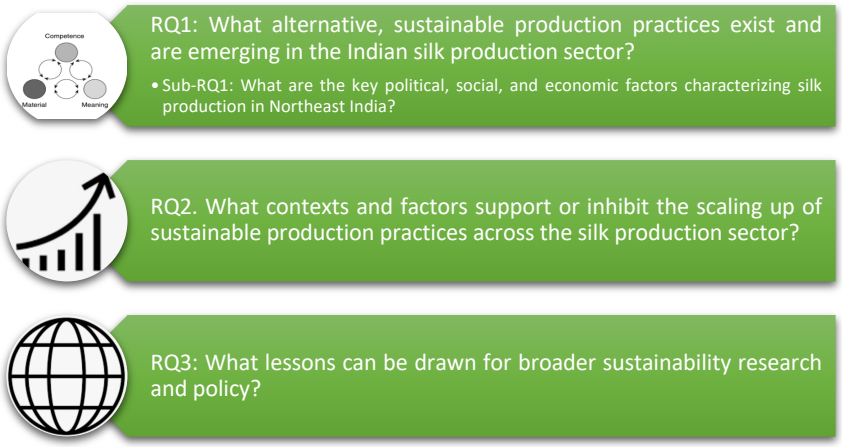
1.3 Research Questions

With the goal of examining how niche sustainable silk production practices emerge and scale, as well as their relationship to sustainable transitions, the overarching research question of this research is:

> **What alternative sustainable silk production practices are emerging and what factors can support their scaling up across the sector?**

Three research questions have been formulated that collectively attempt to answer the key research question above. They are presented below:

Figure 1.3.1 – Research Questions



Answering these research questions involves an investigation into the dynamics of sustainable silk producer practices. This investigation meshes social practice theory together with sustainable transitions theory, particularly leveraging Geels's (2002) multi-level perspective (MLP), as inspired by Nicolini (2009), Castelo (2021), and Spaargaren (2016) in developing an ontological framework to examine the silk industry. The first research question sought to identify and analyze current practices within their social, political, and economic contexts. Inspired by the MLP's framework of the roles of and interplay between niches, regimes, and landscapes, the sub-research question to the first research question seeks to complement an understanding of current conventional and niche practices with an understanding of the current regimes and landscape in which they exist.

Once this understanding was established, the second research question prompted a deeper dive into the elements and adjacent practices that are shaping the sustainable practices identified by the investigation in relation to the first research question. This step involved drawing on broader knowledge around how practices are co-created and evolve within their fluid sociotechnical contexts (Shove and Walker, 2009). Understanding the dynamics around

sustainable practices that (re-) define their scope of adoption is key to understanding how they can be expanded.

Lastly, the third research question highlighted patterns and insights around how sustainable practices are promoted and scaled that are applicable to further studies into sustainable transitions, leveraging the lens of practice theory (Shove, 2022). The following chapter discusses how, using practice theory's unique lens, the emergence, proliferation, and transformation of practices framed this investigation. This conceptual framework was applied to the silk industry with a particular focus on those niche practices of sustainable production occurring in India's northeastern states.

Following this introductory framework, the thesis is organized as follows: Chapter 2 establishes the theoretical foundation by exploring how SPT and STT intersect to analyze sustainable transitions by focusing on niche sustainable silk practices. This chapter delves into the strengths of each theory, highlighting how SPT's focus on the micro-dynamics of everyday practices and STT's macro-level perspective on socio-technical systems can together offer a comprehensive lens for studying a complex industry's transition. Niche practices and their interactions with other practices and socio-technical systems serve as the areas where these theoretical lenses will be deployed.

Given the reader's potential unfamiliarity with the exceptionally complicated country that is India, the third chapter provides a socio-political, economic, and environmental contextualization of India's garment and silk industries, with a focus on the unique challenges in the northeastern region. This chapter examines the cultural and historical significance of silk production in India, the economic pressures of globalization, and the environmental impact of conventional production methods, setting the backdrop for sustainable alternatives and helping place recommendations made in the discussion section in context.

Next, in Chapter 4, the research methodology is outlined, describing the mixed-methods approach that combines in-depth, semi-structured interviews together with site visits and an extensive literature review. The chapter details the selection process for interview participants, including silk producers, industry experts, government officials, and NGO representatives, to capture a range of perspectives within the sector. Additionally, the chapter explains how thematic analysis was applied to identify patterns within the data, integrating empirical findings with theoretical insights from SPT and STT to create a nuanced analysis of the factors influencing sustainable silk practices in Assam. The chapter concludes with a short discussion on ethics, anonymity, and the limitations of this study design offered in the context of the study area.

Chapters 5 and 6 serve as the results sections. Chapter 5 offers a detailed exploration of sustainable silk production practices, examining both conventional and alternative methods. This chapter identifies the key elements of sustainable practices, such as materials, meanings, and competencies, and illustrates how these elements differentiate sustainable silk production

from mainstream practices. It also investigates how traditional knowledge contributes to sustainable methods.

Chapter 6 analyzes the supportive and hindering contexts for sustainable silk practices, covering factors such as gender dynamics, access to resources for minority groups, and the role of educational institutions. The chapter also examines the policy landscape and the influence of both foreign and domestic interests on the sustainable silk sector, shedding light on the systemic challenges and opportunities for sustainable practices.

The discussion chapter, chapter 7, focuses on the broader implications of the research findings for sustainability policy and academic research. This chapter revisits the study's key research questions and interprets the results through the lenses of both SPT and STT, offering insights for policymakers on how to foster niche sustainable practices within the textile sector. Practical implications for industry stakeholders are also addressed, with recommendations for scaling sustainable practices in silk production. Additionally, Chapter 7 discusses the study's theoretical contributions, illustrating how a practice-based approach can bolster sustainability transitions research and suggesting avenues for future research to address identified limitations.

Finally, Chapter 8 synthesizes the main insights of the thesis, offering concluding reflections and recommendations. This closing chapter emphasizes the significance of supporting niche sustainable practices within the textile industry and proposes actionable steps for advancing sustainable transitions in the silk sector and beyond.

2. Theoretical Framework: Practice theory as a means to explore the sustainable transition of the textile industry

This section begins with an introduction to the central theories to be used in this research: practice theory and transitions theory. It then sequentially delves into the depths of practice theory, explaining its components, applications, dynamics, and influence on sustainable transitions. Subsequently, these theoretical discussions are situated in the context of textile and silk industries, examining the challenges, niche practices, and the roles of niche actors in these sectors. Niche practices and actors are presented as driving forces linking quotidian practices and sustainable change. It concludes with detailing how this research seeks to engage in a situated analysis of producer practices to develop insights for governance, explaining how these theoretical and practical insights integrate to offer insights and directions for the sustainable transitions in the silk industry.

This research is situated within sustainability transitions research, which examines, from a broader perspective, how sustainable change occurs within economic, societal, and institutional contexts (van den Bergh, 2011). A comprehensive analysis of the multidimensional shift towards sustainable production and consumption requires a bird's eye view perspective to encompass the various forces shaping that shift (Markard, 2012). A practice theory approach, situated within the larger context of sustainable transitions and the sustainable transition of the silk industry, can generate new knowledge from an on-the-ground, performative perspective (Shove, 2010). Practice theory asserts that social change arises at the interface of individual action and structure and presents this interface as the fluid dynamics of life (Shove et al., 2012). Using both transitions and social practice theory involves the meshing of two, distinct ontological lenses that could be interpreted as contradictory, but that are utilized in this study as complementary. Social practice theory can be leveraged to examine the dynamics of niche practices, the elements that make them, and how they interact with other practices (Shove et al., 2012). STT and the multi-level perspective (MLP) will be employed to examine the dynamics of these niche practices or innovations as well as how they can result in regime transformation (Geels and Schot, 2007). The meshed approach utilizing these two theories has been applied in several studies, including Nicolini (2009), Hargreaves (2011), and Keller (2022). The theoretical framework of this study builds on this work.

2.1 Meshing Social Practice and Transitions Theories: A complementary approach applied to a novel study area

STT and SPT have distinct ontological lenses that may be interpreted as contradictory. A potential point of conflict of combining SPT and STT lies in the tension between individual agency and structural constraints. Some argue that the flat ontology of practice theory is a limitation in its ability to capture broader contextual factors and systemic changes nestled within a sociopolitical hierarchy (Reckwitz, 2002). Seyfang and Gilbert-Squires (2019, p. 231)

elucidate such points of conflict, presenting them more as points of confluence of SPT and STT stating: "(a) transitions in regimes (through niche development) are obstructed by embedded practices and (b) transitions in practices are obstructed by incumbent regimes. [The] goal is to understand how to transform these points of constraint into points of opportunity, thereby informing policymakers and practitioners aiming to support sustainability transitions." In meshing SPT's flat ontological lens, with STT's hierarchical approach, the (potential) impact of (emerging) niche practices can be explored as phenomena considered within their nexuses of practices as well as sociotechnical and political contexts. These two theories, when taken together and focusing on niche practices and innovations can generate unique insights from a hierarchical approach as well as a quotidian practice level perspective. SPT studies are increasingly expanding their focus, often with an approach that complements the MLP, onto wider socio-technical contexts and how they shape practices. Keller et al. (2022) in a literature review found 118 peer-reviewed articles and book chapters using a meshed MLP-SPT approach from 2010-2011, with a significant weight towards the amount of such literature produced in the latter years. Complementing practice theory with sustainability transitions theory and its multi-level perspective, bolsters this analysis in exploring regime-level influences on silk production and is essential for contextualized, relevant results. When used in conjunction, these theories can illuminate different aspects of change in silk production by examining niche practices driving the sustainable transition in a dominant production system. An analysis of the sustainability of the silk production process is novel, and the scope of this analysis necessitates an understanding of both the everyday practices of producers and the external, societal forces that act upon them.

While these two theories have different ways of analyzing reality, they each lend a useful perspective in understanding this specific case. Practice theory will focus on practices at the producer level, leveraging this zoomed in approach to examine the impact and potential of niche practices and elucidate broader contextual factors and systemic changes. Given the rapid changes occurring in the Indian government and economy, contextualizing niche practices within this broader system is crucial to developing relevant results. STT would be critical in this spatiotemporal contextualization and development of a comprehensive understanding of the socio-cultural dynamics, power relations, and transformative processes that inherently influence silk producers. Shove (2022) brings practice theory analysis into a novel arena of larger phenomena, conceptualizing larger, societal trends as resulting from social practices interacting across space and time. The incorporation of SPT, which will focus on the everyday lived experiences of niche producers, will broaden the scope of this investigation (Hargreaves et al., 2011). STT's ability to map phenomena through historical and hierarchical pathways will be used to complement this expansion in SPT's scope into production practices (Spaargaren, 2016). Recent literature such as Spaargaren et al. (2016) and Shove (2022), as will be discussed, propose new directions in integrating these two approaches.

A strategy of incorporating the distinct perspectives afforded by STT and SPT has been adopted by several studies. Hargreaves (2011) discusses the integration of these two theories directly, arguing that the value of incorporating the two theories in generating insight from complementary top-down and bottom-up approaches outweighs the ontological contradiction

inherent to combining these two theories. Nicolini (2009) uses a zooming in and zooming out approach to practices that employs switching theoretical lenses to analyze a study on telemedicine. It is the theoretical framework presented in Nicolini's research that inspires the one that will be used in this study. This will involve zooming in on specific, niche practices of sustainable producers, up to the point where practices develop into nexuses of practices, enabling further insight into the links and dependencies between everyday practices. To develop contextualized and broadly relevant results, zooming out to see the effect of external effects on these nexuses of practices is necessary. Castelo (2021) uses such a dual framework to successfully examine food practices, arguing that 'zooming out' is necessary to understand the external influences on practice nexuses. While that analysis at the 'zoomed out' level uses a distinct theory, the concept of leveraging practice theory together with a hierarchical model to analyze effects on (insights generated through analysis of) practice nexuses is key. Nicolini (2009) argues that using multiple theoretical traditions offers a way to move around the limitations of different theories and is in line with the nature of practices, arguing: "the rationale for my intended eclecticism is programmatic: to the extent that practice is a multifaceted and multi-dimensional phenomenon, it can only be approached through a toolkit-logic and a collage, heteroglossia, or even carnivalesque, approach (Bakhtin, 1981; Belova et al, 2008)." This toolkit approach to multifaceted issues has been expanded upon and formalized in more recent literature.

Spaargaren et al. (2016) takes a deeper dive into examining the role of practice theory in examining larger social phenomena, incorporating several of the aforementioned developments to date and laying out a framework for the use of practice theory moving from its success with and beyond its initial beginnings in small-scale, analyses of the quotidian. If practices are seen as the basis of social life and reality, it follows that large scale changes result from changes in the connections that make up practices and connect individual practices to each other. Changes in interconnections of practices particularly impact large scale change (Shove, 2022). This view does not exclude consideration of the influence of macroprocesses on the meanings, competencies, and materials that make up practices or the connections between practices that constitute practice nexuses (Spaargaren et al., 2016). Shove and Walker (2009) and Spaargaren et al. (2012) both draw on transitions studies concepts such as co-evolution, socio-technical innovations, non-liner processes of change, multi-actor processes, and analyses of pathways of change, showing the relevance of transition governance to SPT and STT theories alike (Spaargaren et al., 2016). This leads to the conclusion that social practice and transitions theorists can build off the respective strengths of each other's approaches despite their contradictory ontological lenses. Spaargaren (2016, p. 236) builds a bridge across this ontological divide leading to a more robust understanding of the social world stating:

> *As transition theories are strong on mapping historical pathways of change in large phenomena, and practice theories are strong on showing the open, undetermined character of the reproduction and innovation of both small and large practice-arrangement bundles, both approaches could profit from a rapprochement and constructive dialogue on how to understand and govern transitions in social life.*

This proposed reconciliation, across the ontological spectrum, gives practice theorists additional reach into the vertical and horizontal layers of larger phenomena and allows transitions theorists to leverage a deeper understanding of connections between practices, from micro to macro scales, and their influence in the wider social context (Keller et al., 2022; Shove, 2022).

In integrating these two, distinct perspectives, both the everyday practices that shape sustainability and the larger system-level changes required for sustainable transitions can be effectively analyzed. This allows for a more holistic understanding of how changes in practices can influence and be influenced by broader transition processes. Sustainable transitions theory emphasizes interactions between landscape, regime, and niche levels, while social practice theory examines the interconnections between individual practices, social structures, and cultural contexts. By integrating these perspectives, this research can "zoom in" to analyze how changes at the micro to macro levels of practices contribute to or are constrained by the macro-level dynamics of sustainability transitions. Furthermore, in "zooming out" the analysis of transformation at the individual, practice level, of nexuses of practices, and at the regime level can elucidate social change on a broader and more accurate scale. This would serve to better enable a contextualized understanding of the interdependencies and barriers that drive or hinder the uptake of practices driving sustainable change in the context of silk industry in India.

2.2 Zooming in on dynamic niche production practices

The use of practice theory to analyze production processes is a novel approach that seeks to generate insights into sustainable transitions within a dynamic, global context. This framework treats both zooming in and out as processes that integrate concepts from SPT and STT to capture multiple dimensions of niche and dominant practices.

In this framework, zooming in focuses on the detailed, ground-level elements of sustainable practices within niche production, analyzing the components that constitute these practices, including material resources, meanings, and competencies specific to sustainable silk production. By breaking down these individual elements, a nuanced understanding of how niche practices are sustained, transmitted, and evolve within localized contexts is gained. This approach highlights the agency of niche actors in shaping sustainable practices, even within constraining socio-economic environments.

On the other hand, zooming out involves contextualizing these niche practices within the broader socio-economic and institutional framework of the textile industry, examining how niche practices are influenced by, and potentially influence, the dominant regime. This broader view considers how relationships between niche and regime-level practices shape, challenge, or reinforce existing production paradigms. By integrating elements of STT and SPT in both the zooming in and zooming out processes, this analysis avoids the rigid binary of niche versus regime and instead emphasizes the fluid interactions and co-evolution between different scales of practice. "Zooming-in" refers to examining the specific elements of niche practices, practices

themselves, and practice bundles, while "zooming out" explores how these practices and practice bundles interact with and relate to the dominant socio-technical regime and landscape factors that affect them and the regime.

Both Nicolini (2009) and Castelo (2021) employ this dual lens framework to examine niche practices, the nexuses of practices they are embedded in, and the influence of external regimes on both. Practice theory conceptualizes the world as a network of social practices. These routinized practices are shared among participants and enacted over time, with recursive actions reinforcing their continued existence. While individuals are carriers of practices, practices themselves involve the active integration of various elements: material aspects like technology and infrastructure; symbolic meanings such as ideas and norms; and skills, or competencies (Shove et al., 2012). According to practice theory, these elements, along with adjacent practices, continuously evolve and co-shape one another, transcending the traditional structure-agency dichotomy and instead seeking to find meaning in their relationship.

Traditional theories around sustainability and environmental change have often relied on either a techno-centric, supply-side, structure-based approach or an agency-centered, demand-side approach. These dominant models have faced challenges in effectively analyzing sustainable change. The structural approach, which views environmental problems through a technological lens, often overlooks consumption issues, allowing gains in one area to be offset by losses in another (Shove et al., 2012). For instance, while technological improvements might enhance production efficiency, they rarely address the root causes of high consumption, leaving the demand side of resource use unchecked. Meanwhile, the agency-behavior-change model on the demand side fails to account for the impact of institutional structures and the intention-action gap among individuals.

Practice theory, by focusing on routinized everyday practices, offers a more comprehensive framework that transcends this dichotomy. It provides an additional layer of analysis, centering on the dynamic interplay between the structural and agentic aspects of practices. By analyzing the ways in which sustainable practices are embedded in and interact with larger systems, practice theory enables us to identify impactful insights and potential solutions that go beyond the traditional limitations of structure versus agency.

Drawing from Giddens' (1984) structuration theory, which posits that agency both creates and is enabled by structure, practice theory emphasizes the ongoing, recursive nature of practice performance. This perspective employs a "flat ontology," breaking from the hierarchical approach seen in traditional theories like STT, which is often rooted in the structure-agency dichotomy. Instead, practice theory focuses on the interconnectedness of practices, examining how they interact as part of an integrated nexus rather than viewing them as separate, hierarchical levels.

By applying this nuanced, multi-scalar framework to the silk industry, this study seeks to understand how niche sustainable practices emerge, evolve, and potentially interact with the dominant regime. Zooming in will capture the specificities of niche practices, while zooming out

will reveal how these practices relate to broader systemic dynamics. This dual perspective aims to uncover the interdependent factors that drive or hinder sustainable transitions, contributing to a richer understanding of how sustainability can be achieved within complex socio-technical systems.

Practice theory asserts that social change occurs at the interface of individual action and structure. Thus, to understand social change, one must understand this interface, and this interface is the fluid dynamics of everyday life (Shove et al., 2012). While the initial use of practice theory was limited to studies of quotidian life, its use in analyzing systems and networks is growing. Its usage in this context produces a networked, connected understanding of how practices connect and evolve together in time and space (Spaargaren, 2003).

To accurately examine the dynamics of everyday life and the practices that define it, practices are characterized as routine, shared among peers, and performed, enacted, and reinforced over time. Nicolini (2012) sets forth five key characteristics of a practice theory approach represented in Figure 2.2.1 below.

Figure 2.2.1 – Characteristics of a practice theory approach

These principles start from the basic idea that to understand the social world, which is made up of social practices, one must understand what people actually do, in practice and in social, spatial, and historical context. These practices that make up the social world are made up of three elements: material things, such as technologies and infrastructure; meanings, or the ideas and norms behind an element; and skills, or forms of competence. While it is people who are the drivers and carriers of practices, knowledge and meaning are understood as part of practices and they are understood as dynamic and critical to determining the success of the proliferation of a particular practice. Practices (re)produce power dynamics as relationships between different actors are defined by distinct, routinized, either dominant or dominated, logics and ideologies (Nicolini, 2012).

Practices come into being, evolve, and devolve through linkages between the aforementioned three elements: material, meaning, and competence. In Figure 2.2.2 below, from Shove et al. (2012), illustrates the dynamics between these elements and the resulting implications for the practices they constitute.

Figure 2.2.2 – The elements that make up practices: materials, meanings, and competencies

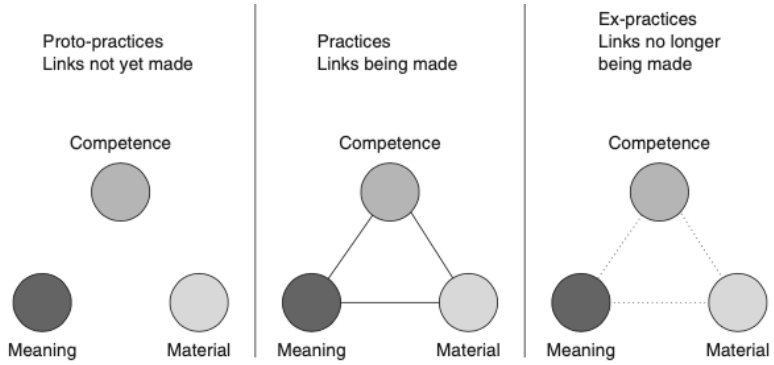


Figure 2.2.2 above shows how materials, meanings, and competencies, when linked together, form practices. Individuals situated within their own socio-material dynamics constantly integrate these elements into practices. The figure also provides insight into how practices evolve. They devolve when links are broken, but just as the elements themselves and the linkages between them change, so too can the practices they constitute (Shove et al. 2012). Understanding the dynamics of these changes and the subsequent evolution of practices is key to understanding how and where (sustainable) change in practices can be affected.

Another key area where potential avenues for change can be identified is in bundled practices. This refers to practices embedded within a system of practices where connections are determined by shared elements and linkages over time and space. These systems of interconnected, routinized practices make up the social world (Nicolini, 2012). In exploring the dynamics of linkages between practices and the shared elements within them, areas key to affecting change can be discovered.

The strategy of using practice theory involves focusing on exploring key areas where change in practices can be influenced. Practices change when the elements that make them up change and change in one practice can affect change in another, connected practice, eventually resulting in changes in nexuses of practices or regimes. Thus, examining how changes in elements drive change in practices and how changes in practices drive changes in connected practices is key to a practice-based analysis. Practices become locked in when they become built into infrastructure, expectations, and conventions (Shove et al., 2012). Breaking this lock is extremely difficult and requires an accurate understanding of where to apply pressure in implementing technologically sound and socially applicable interventions. Niche practices in practice theory play a similar role to niche innovations in STT, serving as potential lock pickers in these systems of practices (Geels and Schot, 2017). These niches have the potential to challenge and transform elements of social practices, practices themselves, practice nexuses,

and resultingly, regimes as they evolve and gain momentum and influence (Hargreaves et al., 2013).

Disrupting the status quo and generating change starts from the understanding of practices as embedded, routinized, and unreflective. Intervening in these practices is further complicated by the coevolution of socio-material systems with practices generating the aforementioned lock-in effect (Shove et al., 2012). As illustrated by the knowledge-action gap, simply changing attitudes among individuals, the drivers behind the integration of elements that define practices, is unlikely to result in a concrete impact, especially at the speed and scale necessary, given the imminent need for sustainable change. Therefore, a practice theory analysis strives to affect change by targeting elements of practices, considering their spatial and historical contexts, linkages with other elements and interconnectedness with tangential practices. This shift away from targeting changing attitudes as agency focused analyses have, leads to novel questions and interventions missing from a traditional analysis of environmental governance. In expanding the practice theory framework to larger phenomenon, the same logic and analytical lenses behind examining bundles of practices, albeit on an extended spatio-temporal scale, applies (Nicolini, 2012; Schatzki, 2001, Shove, 2022).

Nicolini (2009) sets forth a concrete strategy for zooming in and out to examine the dynamics of practices, their connections to other practices, and the elements that constitute them. This strategy, executed through the lens of social change, involves zooming in on practices and connecting that analysis to a zoomed-out analysis of connections with transformational niche practices as well as the pathways by which those connections develop.

In zooming in to the practice level, the evolution of practices can be discerned alongside the mechanisms causing changes through the introduction of new ideas, materials, or goals. These changes manifest in the form of splitting or fusing practices, through the changing dynamics of the competencies, meanings, and materials that they consist of (Shove et al., 2012). Additionally, the process of emergence and development of new practices and the extinction of old ones can be examined. Analysis from a zoomed-out perspective, examining the implications of these insights into practices at larger scales, and considering the factors that influence them within their contextualized situations, will develop via a dive into transformative, niche practices. The proliferation of revolutionary practices exhibited by niche actors that diverge from the socio-technical norm bridges the gap between the zoomed in and zoomed out perspectives of this study (Geels and Schot, 2007; Seyfang and Haxeltine, 2012). As the next section will detail, these niche actors and their practices link interconnected practices with transformational, sustainable change.

2.3 Bridging the Gap: Niche practices as catalysts of change

In this study, practice theory is employed to uncover insights around why sustainable practices have struggled to gain traction and how change might be induced within the textile industry. This research investigates how dominant practices have become entrenched within neoliberal norms and structures, and how niche practices and their proliferation could serve as

catalysts for sustainable change in the industry. Using a dual lens framework centered around transformations driven from niches, this study examines sustainable production practices at the micro level, mapping and analyzing the elements of these practices along with the adjacent practices that shape their evolution over time and space. By focusing on niche practices within a network of interconnected practices, this research leverages both practice theory and sustainability transitions theory to explore how sustainable practices might proliferate within the silk industry and beyond.

In this context, niche practices represent novel, alternative approaches that diverge from mainstream production methods and challenge established socio-technical regimes. These practices are often "protected spaces" where innovations can develop outside the pressures of the dominant system (Seyfang & Smith, 2007). From a practice theory perspective, niches are defined by unique configurations of materials, meanings, and competencies that distinguish them from mainstream practices (Shove et al., 2012). Meanwhile, STT's multi-level perspective positions niche innovations as small-scale experiments that have the potential to influence regime-level practices over time (Geels, 2002). By combining these perspectives, this research gains a nuanced understanding of how niche practices can both evolve within their own contexts and interact with wider systems, serving as potential drivers of regime transformation.

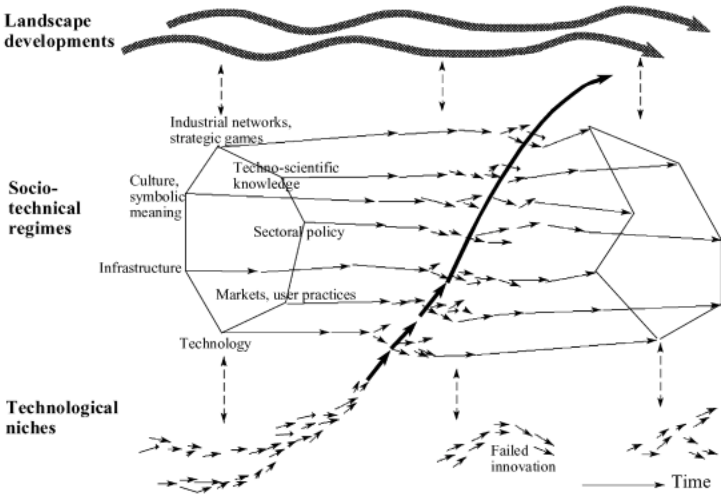
Niche actors develop potentially revolutionary innovations that diverge from the existing socio-technical regime. Due to the lock-in nature of the current regime and the potential incompatibility of niche practices with the dimensions of it, niche actors and their practices face major scalability challenges (Geels, 2011). Kemp et al. (1998) and Schot and Geels (2008) put forth three processes of niche development:

1. The articulation (and adjustment) of expectations or visions, which provide guidance to the innovation activities, and aim to attract attention and funding from external actors.
2. The building of social networks and the enrolment of more actors, which expand the resource base of niche-innovations.
3. Learning and articulation processes on various dimensions, e.g. technical design, market demand and user preferences, infrastructure requirements, organizational issues and business models, policy instruments, symbolic meanings.

These dynamics are essential for the growth and maturation of niche practices, allowing them to attract attention, resources, and legitimacy. As more actors adopt these practices and contribute to their development, the potential for their expansion into broader nexuses of practices increases. Once these practices reach a critical mass, their path towards mainstream adoption is self-sufficient (Rogers, 1962; Shove, 2010). Geels and Schot (2007) and Shove (2010) suggest that niche innovations have a window for opportunity in growth when the established regime is destabilized. Despite the many challenges they face in growing adoption, niche practices, and the actors that engage in them, are the key drivers behind change in a socio-technical regime. Geels (2002) introduces the concept of the multi-level perspective with STT as a means to analyze how socio-technical systems change over time. Visualized below in Figure 2.3.1, the MLP conceptualizes systemic change as occurring across three interrelated levels: the

niche, regime, and landscape levels. Each level represents different scales and dynamics, and their interactions can drive or inhibit transitions in socio-technical systems.

Figure 2.3.1 – Niche innovation dynamics within socio-technical regimes



From Geels, 2002, p. 1263

At the niche level, radical innovations and alternative practices emerge within spaces that allow experimentation without immediate pressures from the mainstream system (Smith and Raven, 2012). These niches, often supported by dedicated actors or small markets, foster new ideas and practices that may challenge the status quo, and, under the right set of circumstances, can influence the broader system (Seyfang and Smith, 2007). In this research, alternative silk production practices represent niche innovations.

The regime level represents the dominant socio-technical system where established practices, rules, and technologies reside. This level is characterized by stability and resistance to change, as the interconnected infrastructure, institutions, and actors reinforce existing norms and practices (Geels, 2002). In the silk industry, the regime level is defined by conventional, industrial-scale silk production methods that prioritize efficiency and profitability, eschewing environmental and social sustainability. These dominant practices are locked in due to factors such as established supply chains, regulatory frameworks, and consumer expectations, making it challenging for sustainable alternatives to break through.

Above the regime level is the landscape level, which includes broad, external forces that shape the environment in which the regime and niches operate. These forces, such as economic trends, environmental crises, political shifts, and cultural changes, are beyond the direct control of niche and regime actors and typically evolve slowly over time. However, significant shifts at the landscape level, such as increasing awareness of environmental degradation or stricter regulations on resource use, can create openings for niche innovations (Geels and Schot, 2007). In the case of sustainable silk production, a growing global focus on sustainability and climate

action at the landscape level could create conditions that allow niche sustainable silk practices to gain traction and influence the dominant regime.

Together, these three levels interact to drive transitions, with niches potentially moving from protected spaces to influence regime practices if they align with favorable shifts at the landscape level. The MLP framework thus provides the lens this study will employ to understand how niche innovations in sustainable silk production could challenge and eventually transform the conventional, unsustainable practices of the silk industry.

Given the lack of a meaningful, sustainable shift in the textile industry, an examination of these niche practices within the communities of niche actors and with the advent of the MLP can provide insight into why the silk and garment industries' sustainable transitions lag conventional production presently as well as how they could proliferate within the larger garment industry. Key to understanding how innovative niche practices may proliferate given social, political, and technical contexts are the MLP and STT's framework for understanding transition pathways. Through the combination of practice theory's micro-level focus and STT's macro-level framework and a focus on the key confluence point of niche practices and innovations, this study examines how niches can function as entry points for systemic change, disrupting established practices and influencing broader socio-technical configurations.

2.4 Zooming Out: Niche dynamics and regime change within a socio-technical context

While zooming in on niche practices reveals their unique elements and potential for innovation, a zoomed-out perspective is necessary to understand how these practices interact with and challenge the dominant regime. Within the broader socio-technical context of the textile industry, niche practices exist in a dynamic relationship with established production paradigms, influenced by factors such as policy, market forces, and social norms. This perspective situates niche practices not just as isolated experiments but as active participants in a network of practices that collectively define the regime.

Sustainability transitions theory emphasizes the role of multi-level interactions—between niche, regime, and landscape levels—in driving systemic change. Niche practices, though initially shielded from dominant pressures, can gradually gain traction within the regime if they align with broader societal trends or respond to shifts in the external landscape, such as environmental crises or policy changes (Geels & Schot, 2007). When conditions in the dominant regime become destabilized—due to factors like resource constraints or regulatory shifts—niche practices have a window of opportunity to influence or replace established practices. Through this process, niche innovations can catalyze shifts in the socio-technical system, either by prompting incremental adjustments or by driving more radical transformations.

Effective governance and intervention strategies can play a crucial role in facilitating this transition. Spurling and McMeekin (2015) outline three pathways for influencing practice change at the regime level: re-crafting practices, substituting practices, and changing how practices interlock within socio-technical systems. In applying these pathways to the silk

industry, as is done in section 7.1, this research examines how targeted interventions might leverage niche practices to foster sustainable change within the dominant production regime. By integrating SPT's focus on everyday practices with STT's macro-level view of systemic change and leveraging insights from Geels's (2002) multi-level perspective, this approach provides a comprehensive understanding of how niche practices can disrupt the status quo, reshape socio-technical arrangements, and promote a sustainable transition in the textile industry.

This dual perspective allows for a holistic analysis of sustainable transitions, recognizing that change does not occur in isolation but within a complex web of practices, structures, and institutional arrangements. By linking niche practices with the regime they aspire to transform and the landscapes in which they both exist, this research contributes to a deeper understanding of how sustainable practices can scale within entrenched systems, offering insights into the governance mechanisms necessary to support transformative change.

2.5 Conclusion

This chapter has established the theoretical foundation for analyzing sustainable transitions within the textile industry, with a specific focus on silk production, by integrating practice theory with sustainability transitions theory's MLP framework. Through an exploration of practice theory, the chapter examined how everyday practices within niche sustainable silk production can drive change by altering the configurations of materials, meanings, and competencies. SPT's flat ontology allows for a detailed view of these practices, shedding light on how they interact, evolve, and sustain themselves within the constraints and opportunities of their socio-material environments. In doing so, this analysis emphasizes that sustainable transitions are not merely the result of technological advancements or market forces, but rather deeply embedded in the cultural, social, and institutional fabric of niche communities, making them potential catalysts for broader systemic change.

The MLP provides a complementary perspective, illustrating how interactions between niche practices, dominant regimes, and overarching landscape pressures influence the pace and direction of transitions. This chapter outlined the three levels of the MLP—niche, regime, and landscape—and demonstrated how each level contributes distinct dynamics to sustainability transitions. At the niche level, alternative practices emerge within protected spaces, such as the Assamese hills where sustainable silk production practices can be found today, fostering innovations that challenge the prevailing socio-technical regime. The regime level represents the dominant production practices in the silk industry, characterized by industrialized, unsustainable methods, which are often resistant to change due to strong institutional, economic, and social lock-ins. Finally, the landscape level encompasses broad societal, economic, and environmental trends that shape the contexts in which both niche and regime practices operate, creating conditions that may open windows of opportunity for regime transformation.

This chapter also discussed the alignment of niche and regime practices as a crucial factor for sustainable transitions. The combination of SPT and MLP enables this research to

“zoom in” on micro-level practices within sustainable silk production and “zoom out” to contextualize these practices within larger socio-technical systems. This strategy reveals how niche innovations could influence or transform the dominant silk production regime over time. Insights from previous studies, such as those by Geels, Shove, Castelo, and Nicolini, provided a foundation for applying this meshed framework to the context of sustainable silk practices in India.

In linking the everyday practices of niche producers with regime-level dynamics and landscape pressures, this study aims to contribute a nuanced understanding of the barriers and facilitators of sustainable practices in the textile industry. The results thus offer practical insights for policymakers and stakeholders seeking to promote sustainable transitions in sectors characterized by entrenched practices and resistance to change.

The following methodology chapter will outline the specific approaches employed in this research, including a combined strategy of interviews, site visits, and a literature review. This chapter will describe how data was gathered on niche practices in the silk industry in Assam and explain the method of thematic analysis used to synthesize this information. It will also discuss the ethical considerations and limitations encountered in conducting this research, setting the stage for a rigorous and contextualized examination of sustainable transitions in silk production.

3. Methodology: *A mixed- method approach to niche practice analysis*

This practice-informed case study leverages insights from sustainable transitions theory and practice theory to ground an investigation and analysis of the sustainable transition of the silk industry. This study zooms in on the niche, sustainable practices with to drive to generate insights that can help to accelerate the change towards sustainable production systems in the broader regime. As outlined in previous chapters, the sustainable silk production practices that are the focus of this study are concentrated in protected spaces in the northeast of India and performed by niche, small-scale producers. Interviews with these producers, and site visits to production facilities, as well as conventional producers, elucidate the dynamics of production practices within their nexuses and the broader silk industry. These interviews also shed light on the conditions supporting or hindering sustainable silk production practices. Interviews were supplemented with a literature review, which also formed the backbone of the first results chapter, chapter 4, focusing on the context, at the regime and landscape levels, in which these practices exist. The literature review was also the basis from which the theoretical framework of this research is based.

Combining interviews, site visits, and observations with a literature review allowed an in-depth study of a specific, niche target area to remain grounded within broader social, economic, and political factors. The insights generated from all three modes of data collection have important implications in understanding potential avenues for sustainable transitions of the silk and garment industries.

3.1 Data collection methods: Interviews complemented by a literature review

Interviews can offer insights into the experiences and practices of individuals and organizations experiencing a sustainable transition, implementing sustainable innovations, and making decisions within broader cultural and socio-material structures. Interviews seek to explore the dynamics of social change from the perspective of individuals, through their quotidian practices, interfacing with structure (Shove et al., 2012). By conducting interviews, researchers can explore how practices are enacted, reproduced, and transformed in everyday life (Hitchings, 2012). Key informant sampling enables interviews to be conducted with knowledgeable participants (Young et al. 2018). Interviews investigate the motivations, constraints, and dynamics that influence the conscious and unconscious performance of a practice, as well as the wider social structures that support or hinder it (Giddens, 1986). Furthermore, interviews allow for reflexive learning as the interviewer can clarify ambiguities or deepen understanding in key areas by gently asking directed, probing questions during the interview to uncover deeper layers of meaning (Martens, 2012; Hitchings, 2012).

Interviews were semi-structured to balance flexibility in deepening understanding beyond the surface level in key areas and reliability in results generation. Hitchings (2012) emphasizes the strength of interviews in examining changes in practices by having participants reflect on their own shifts between practices. Specific attention was paid to having participants, especially sustainable silk entrepreneurs, reflect on changes in their practices over time. The

study targeted stakeholders at multiple levels of and from different perspectives within the silk production system to achieve a holistic picture of the social and material structures around it (Pink, 2012). To complement and further contextualize and triangulate interview data, site visits gave the researcher a direct view of sustainable silk production practices in action (Hitchings, 2012). This allowed for a more complete understanding of the routines, competencies, and materials that make up these practices. Given the range of stakeholders interviewed, questions were tailored by stakeholder groupings. Open questions were added at the end of interviews to attempt to deepen and flesh out insights gleaned from the interview process. The study interviewed 24 respondents. Table 1 provides details about these respondents and can be found in the interview selection section (3.3), which also describes how these respondents were chosen. A sample format of interview questions can be found in the appendix.

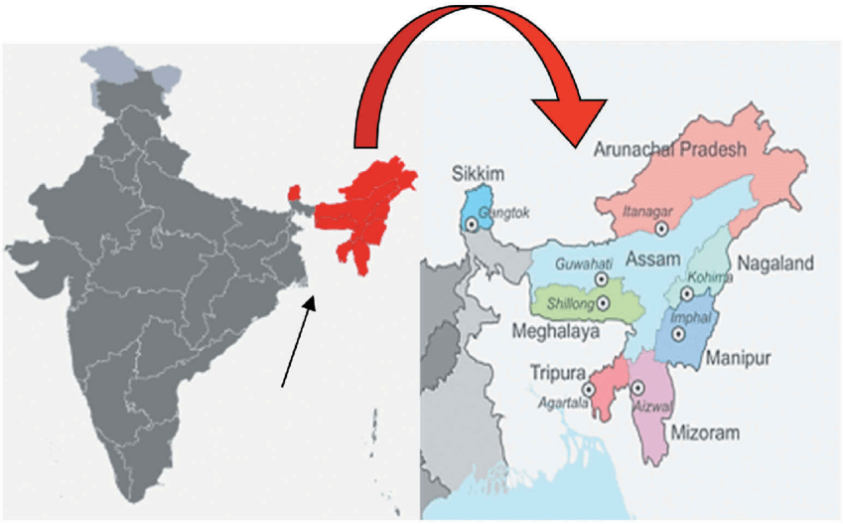
The literature review grounded the study within the existing body of knowledge. This enabled the use of relevant theories, concepts, and frameworks from various disciplines that have examined similar practices or related phenomena (Snyder, 2019). This process aided in comparing different studies, perspectives, and empirical findings related to practices.

The literature review supplemented insights from interviews, placed them in context, and contributed to the theoretical underpinning of these analytical structures in practice (Snyder, 2019). The literature review provided the theoretical basis for the analytical framework of the case study and insights into how the study of sustainable practices in the study area connects to the broader study of sustainable practices, sustainability transitions, and general sustainability research. The literature review was the primary data collection tool behind chapter 4's examination of the socio-economic and political contexts around silk production in India. In developing the background presented in chapter 4 that sets the stage for further insights, the literature review involved an informed review of the historical and present dynamics behind India's social, cultural, economic, and political contexts.

3.2 Study Area: India's northeast with a focus on the state of Assam

The study area for the investigation into sustainable silk practices was the northeast of India. The eight states that comprise this region, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, are shown below in Figure 3.2.1 within the context of the entire nation.

Figure 3.2.1-Map of India's 8 northeastern states



From Patra et al., 2019

This project focuses on Assam as it has a high concentration of a diverse array sustainable silk producers and a rich history of sustainable silk practices. In 2013, India produced 18,715 metric tons of mulberry silk and 119.17 metric tons of alternative silks, of which 118.91 metric tons (99.7%) were produced in the northeast and 108.52 metric tons (91%) in Assam (North Eastern Council, 2015). This study focused on Assam given its global dominance in sustainable silk production. Eri, mugga, tassar, and mulberry silks all have thousands of years of history in Assam and the northeast region with traditional knowledge being passed from generation to generation. Sustainable production practices were defined as those producing with significantly reduced harm to the environment throughout the production process as compared to conventional mulberry silk producers. This involved considering the entire silk cloth production chain, including the feed used to raise silkworm and the treatment of silkworms in the harvesting of silk fibers from cocoons, as well as the dyeing, weaving, and finishing processes at the end of the silk production process.

Assam is the safest, most accessible, and most economically developed province in this region. The northeastern region has largely been left behind in the meteoric economic development that has taken place in India in the past few decades, but it is rapidly catching up. Chapter 4 will elaborate on this trend, describing the northeast's economic development and placing in the context of India's socio-economic and political situation and silk production in the country. Targeting this region resulted in insights taken from historically resilient practices in a dynamic region with applications expected to be fit for a range of other contexts. This study focused on the northeast of India as it targeted producers employing a diversity of sustainable practices across silkworm breeds. These producers and their diverse practices are concentrated in this region. An investigation of sustainable producers was contrasted with an investigation into conventional practices throughout India aimed at deepening the understanding of the industry's current regime and the landscape factors that shape it.

3.3 Interview selection

24 Interviews were conducted with entrepreneurs, industry experts, producers at all levels of the supply chain, educators, and officials from government and NGOs to enable a full picture of sustainable silk production in the region. Respondents were recruited through a variety of ways. Requesting existing acquaintances and family members with connections in the target area to make introductions yielded several initial contacts that led to further contacts within the silk sector. One acquaintance also set up site visits and a visit to a textile institute. At site visits, several interviews were organized with additional ones being conducted on the spot. Cold emails to entrepreneurs engaged in both sustainable and conventional production yielded a few respondents as well.

While these semi structured interviews were tailored to the role of respondents, most interviews followed a similar set of themes for discussion. A sample set of interview questions is included in the appendix of this document. Interviews were conducted with a promise of anonymity. The sample of respondents included 11 women and 13 men and focused on operations in Assam with some respondents providing insights on production practices, particularly conventional ones in other states. Interviews were conducted, when necessary, with the help of a translator fluent in Assamese (as well as English, Hindi, and Bengali). The language used in interviews varied and often switched during conversations, as is common in the region. A table detailing the interviewees, is provided below. As anonymity was promised to all respondents, insights and quotes from interviews are cited by the sector designation they were given.

Table 3.3.1 – Interview List

Designation	Production Type	Role	Gender	Supply Chain Position	Location	Ref Code
Entrepreneur	Eri and Mugga	Director	F	Entire supply chain	Assam	1
Entrepreneur	Eri	Director	F	Entire supply chain	Assam (silk production) and Kashmir	2
Entrepreneur	Eri	Director	F	Entire supply chain	Assam (silk production) and Tamil Nadu	3
Entrepreneur	Eri and Mugga	Director	F	Entire supply chain	Assam	4
Production manager	Mulberry	Manager	F	Processed silk to export	Maharastra and West Bengal	5

Designation	Production Type	Role	Gender	Supply Chain Position	Location	Ref Code
Entrepreneur	Mulberry	Director	F	Processed silk to retail	Maharastra and West Bengal	6
Entrepreneur	Eri and mulberry	Director	M	Entire supply chain	West Bengal	7
Industry expert	All textiles	Director	M	Entire supply chain	Mumbai	8
Market expert	N/A	Director	M	N/A	West Bengal	9
Market expert	N/A	Consultant	F	N/A	West Bengal	10
Educator	All textiles	Director	M	Education	Assam	11
Educator	All textiles	Professor	M	Education	Assam	12
Educator	Eri, Mugga, and Mulberry	Professor	M	Education	Assam	13
Educator	Eri, Mulberry, and Cotton	Professor	F	Education	Assam	14
Educator	Eri, Mugga, and Mulberry	Professor	F	Education	Assam	15
Silk producer and processor	Eri and Mugga	Director	M	Feed to processed silk	Assam	16
Cocoon producer (silkworm rearer)	Eri and Mugga	Producer	M	Feed to cocoon	Assam	17
Entrepreneur	Eri, Mugga, Tassar, and Mulberry (conventional and *ahimsa*)	Director	M	Cocoon to export/ retail	Assam	18
Dyeing facility operator	All textiles	Manager	M	Dyeing	Assam	19

Designation	Production Type	Role	Gender	Supply Chain Position	Location	Ref Code
Dyeing facility operator	All textiles	Manager	M	Dyeing	Assam	20
Government coop director	Eri and Mugga	Director	M	Feed to cocoon	Assam	21
Silk processor	Eri	Processor	F	Processing	Assam	22
Silk processor	Eri and Mugga	Processor	F	Processing	Assam	23
Textile incubator director	All textiles	Director	M	N/A	West Bengal	24

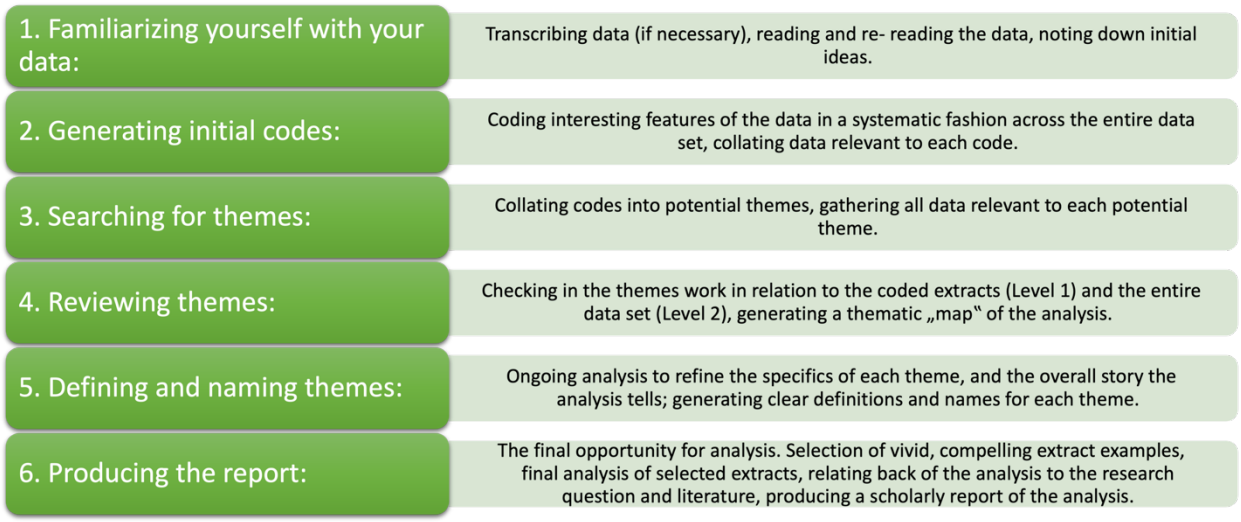
Table 1 shows the wide variety of participants interviewed. This research involved participation from educators, on-the-ground workers, entrepreneurs, industry experts, and government officials. Participants included thirteen male and eleven female respondents. These respondents came from various organizational levels, from processors to directors to independent consultants, involved, respectively, at all levels of the silk supply chain. The study focused heavily on recruiting respondents in India's northeast engaged in sustainable practices, but a few respondents fell outside this scope, broadening the study's contextualization within the diverse array of silk production practices in the region and in the country.

3.4 Data Analysis and Synthesis: Insights from a thematic analysis presented in context

This study involved a qualitative, case study research design exploring the key question of how silk production can be made more sustainable and ethical. Primary source data from interviews was analyzed in conjunction with insights from secondary data in a thematic analysis of the emergence and proliferation of sustainable practices within their socio-material contexts and adjacent practices that intertwine with them to facilitate or impede their emergence.

The research employed a qualitative approach, using thematic analysis to interpret the data. This method was selected due to several factors: the dispersed nature of knowledge among diverse stakeholders, the absence of an established body of scientific literature on this specific topic, and the need for a flexible analytical approach. Furthermore, a thematic analysis provided the adaptability required to synthesize insights from varied data sources and apply the theoretical frameworks of both practice theory and the MLP to support a robust analysis. A stepwise plan for this thematic analysis, taken from Braun and Clarke (2006), is presented below.

Figure 3.4.1 – Thematic analysis stepwise plan



The thematic analysis began with developing a set of codes from patterns identified in the data during and after collection. Data exhibiting the same pattern was coded together and collated. Once codes were defined and collected, these codes were sorted under themes and subthemes. Potential theoretical underpinnings, given the meshed lens framework of this analysis, to interpret and present these themes were noted. These themes and subthemes then formed the main ideas on which the results and, subsequently, discussion sections are based.

The themes identified from the data are presented in the results section within the specific context of this issue. The data extracted from a broad range of stakeholders were adapted into applicable knowledge for the broader context of sustainable transitions from the complex issue of sustainable silk production in India.

3.5 Study Validity and Reliability

Ensuring the validity and reliability of qualitative research is essential to produce credible and dependable findings. In this study, the validity was supported through a combination of methodological triangulation, reflexivity, and transparency in data interpretation. Methodological triangulation was achieved by collecting data from multiple sources—semi-structured interviews, site observations, and literature review—to ensure a comprehensive understanding of sustainable silk practices within India's northeast (Denzin, 1978). By integrating these different data collection methods, the study aims to corroborate findings and enhance the depth and credibility of the analysis.

Reliability was reinforced through consistent interview protocols, ensuring that each interview followed similar themes and allowed for comparison across diverse respondents. Lincoln and Guba (1985) emphasize the importance of reliability in qualitative research, highlighting consistent methods and documentation as key factors in achieving dependability. Additionally, maintaining a reflexivity journal throughout the data collection and analysis

process helped identify and mitigate potential researcher biases. Finlay (2002) discusses the role of reflexivity in addressing subjective biases, noting that reflective practices are essential in maintaining transparency and enhancing reliability in qualitative research. This reflexive approach ensured that personal interpretations were acknowledged and controlled, thereby enhancing the dependability of the research findings. Furthermore, the thematic analysis followed a structured, stepwise approach, as per Braun and Clarke (2006), which allowed for transparency and replicability in the process of coding, categorizing, and analyzing the data.

3.6 Ethical Considerations

Ethical considerations were central to this research, given the sensitive socio-economic context and potential power dynamics involved in interviewing producers, experts, and government officials within India's silk industry. Prior to conducting interviews, informed consent was obtained from each participant, ensuring they understood the purpose of the study, the voluntary nature of participation, and their right to withdraw at any time without penalty. Anonymity and confidentiality were also guaranteed, particularly as some interviewees shared sensitive insights about industry practices and government policies that could have personal or professional implications. Maintaining confidentiality and ensuring participant trust in that confidentiality is vital in studies where participants might be discussing sensitive information, such as topics that may involve criticism of authorities (Ryen, 2004). To protect their identities, each participant was assigned a reference code used in data analysis and reporting.

Cultural sensitivity was a critical aspect of the ethical considerations in this study. Cross-cultural research requires heightened awareness and respect for cultural norms to avoid misunderstandings and establish trust (Liamputtong, 2008). Conducting interviews in the participant's native language, with the help of a fluent translator, when necessary, helped to build trust and foster an environment where participants felt comfortable sharing their perspectives openly. This approach aimed to minimize any potential cultural misunderstandings or biases that could affect the integrity of the data. Kvale (2006) highlights the importance of addressing power dynamics and ensuring that the interviewer respects the cultural context of participants to maintain ethical integrity in qualitative research. Accordingly, the research ensured that data collection and analysis processes were conducted respectfully and responsibly, prioritizing the welfare and rights of all participants involved.

3.7 Limitations of the Research Design

This research is not without limitations, many of which stem from the challenges inherent in conducting qualitative research within a specific socio-economic and cultural context. One notable limitation is the potential for subjective interpretation in thematic analysis, which relies heavily on the researcher's perspective in coding and categorizing data. Although a reflexivity journal was maintained to document biases and reflections, complete objectivity cannot be guaranteed in qualitative studies (Morse, 2015). Of note is the potential

for an observer-expectancy effect, the mitigation of which will be reflected on later in the discussion section. Rosenthal's (1966) work on the observer-expectancy effect suggests that researcher awareness and reflection are essential to reduce unintended influences on participant responses.

The fact that the author comes from a foreign, western context, and conducting interviews largely in languages associated with a power imbalance, Hindi and English instead of local ones has an effect on interviews, especially interviews in rural communities. The power dynamic inherent in these conversations compounded with deferential communication patterns in the rural, northeastern contexts. As highlighted by Hammersley and Atkinson (2007), such power imbalances and cultural dynamics can shape interview responses and may lead participants to conform to perceived expectations of the researcher. Self-deprecating humor, a friendly demeanor and smile, open body language, and clear communication sought to reduce these impacts at the outset of interviews. Erin Meyer's *The Culture Map* (2015) was a valuable resource in approaching and reflecting on communication between the author's default western approach and communication patterns and expectations in India. Questions were formulated to minimize blunt phrasing and allow for nuanced answers in the context of a nation with uniquely high-context communications, an aversion to direct conflict, and a propensity to tell people, especially those viewed as guests or as having a higher social standing, what they want to hear. In interviews conducted in local languages (Bengali and Assamese) with the help of a translator, as the author has little understanding of these languages, the translator was helpful in interpreting and clarifying nuanced answers. While using translators in cross-cultural research can help bridge language barriers, it also introduces complexities in accurately capturing participants' perspectives (Liamputtong, 2008). The observer-expectancy effect was difficult to control in this study, given the power dynamics and cultural communication patterns. Awareness and reflection of these issues led to nuanced question formation, an emphasis on active listening and reading nuance in answers, sometimes with the help of a translator, and strategies to develop trust and make the interviewer more approachable.

The study's geographic focus on Assam and the northeastern region of India may limit the generalizability of findings to other regions or contexts within the silk industry. While these areas provide valuable insights into niche sustainable practices, the specific socio-political and economic conditions in Assam may differ significantly from those in other parts of India or in China, the world's largest silk producer, where different practices, challenges, and incentives may be present. Additionally, the relatively small sample size, though sufficient for a qualitative study, restricts the breadth of insights and may not capture the full diversity of practices within India's silk sector (Maxwell, 2012). Notable among sustainable silk varieties not included in this study are wild silks, such as tussar silk, which are produced from the cocoons left behind by wild moths. These silks are among the most sustainable and ethically produced, as they utilize materials naturally available in the environment. However, their reliance on wild moths results in a limited and inherently restricted supply, which presents an impassable scaling challenge.

Another limitation is the reliance on self-reported data in interviews, which may be subject to social desirability bias or selective memory. Participants may portray their practices in

a more favorable light, particularly regarding sustainability aspects, or may recall details selectively, potentially resulting in a social desirability bias (Smith and Osborn, 2008). Despite these limitations, this study provides meaningful contributions to the understanding of sustainable transitions in niche production practices within the textile industry.

3.8 Conclusion

This chapter has detailed the methodological framework used to explore sustainable niche practices within the silk industry of northeast India, emphasizing a multi-method approach grounded in practice theory and sustainable transitions theory. Through semi-structured interviews, site visits, and an extensive literature review, this study aimed to understand both the micro-level practices of individual producers and the broader socio-economic and political landscape shaping these practices.

Section 3.1 discussed the data collection methods, with a focus on interviews as a means to access first-hand insights from diverse stakeholders, including silk producers, industry experts, and government officials. The flexibility of semi-structured interviews allowed the research to delve deeply into the motivations, constraints, and competencies that shape sustainable silk production. Site visits and direct observations complemented these interviews, providing an immersive view of sustainable practices in action, while the literature review helped to situate these empirical insights within a broader theoretical and contextual framework.

Next, in section 3.2, the study area was defined, focusing on the northeast of India and specifically Assam, due to the province's dominance in global sustainable silk production and historical and cultural ties to silk production. The rich diversity of silk varieties and sustainable practices in Assam provided a unique context for examining the dynamics of niche production within a rapidly evolving economic and social landscape.

Section 3.3 then explained the selection of interview participants, highlighting the diversity of perspectives sought to capture a holistic view of the silk production supply chain. Sampling from various roles and operational levels, the research ensured that the viewpoints of entrepreneurs, educators, government officials, and on-the-ground workers were represented, providing a multifaceted understanding of sustainable practices.

Data analysis and synthesis, covered in section 3.4, was conducted through a thematic analysis following Braun and Clarke's (2006) structured approach. This method enabled the research to identify and organize themes emerging from the data, facilitating a systematic analysis of both individual practices and their interconnections within the broader industry. The thematic analysis allowed the integration of insights from practice theory and the multi-level perspective, supporting a robust examination of sustainable transitions in the silk industry.

Section 3.5 addressed the study's validity and reliability, emphasizing methodological triangulation, reflexivity, and consistency in interview protocols. Triangulating data from interviews, site visits, and literature added depth and credibility to the findings, while the use of

a reflexivity journal and structured analytical steps helped enhance transparency and dependability.

The ethical considerations discussed in section 3.6 were essential to conducting research in this socio-economically sensitive context. Informed consent, confidentiality, and cultural sensitivity were prioritized throughout data collection to ensure respectful and responsible engagement with participants. The study's attention to cultural norms and the use of native languages in interviews were crucial for building trust and gathering authentic perspectives.

Finally, section 3.7 outlined the limitations of the research design, recognizing the inherent challenges in cross-cultural qualitative research, such as potential observer-expectancy effects, cultural power dynamics, and the limited generalizability of findings. These limitations, though mitigated through careful methodology and reflection, are acknowledged to provide a balanced view of the study's contributions.

Together, these methodological components form a solid foundation for exploring sustainable silk practices and their potential to influence larger transitions within the textile industry. By integrating interview and observational data with insights from a literature review, this methodology provides the groundwork, together with theoretical insights from practice theory and sustainable transitions literature for analyzing how niche practices in the silk industry can contribute sustainable transformation. Now that the premise and goals, theoretical framework, and methodology of this study have been laid out, the following chapter, will begin the presentation of results, beginning with a contextual exploration.

4. The garment industry in India: A political, social, and economic contextualization

This chapter is the first of four chapters presenting answers to the research questions set out in chapter 1. It provides essential contextualization for understanding the complexities surrounding sustainable silk production in India, particularly in the northeastern regions. By examining the political, social, and economic factors that shape the garment and silk industries, the chapter sets the stage for a nuanced analysis of sustainable practices within the sector. Specifically, it explores how regional characteristics and national policies interact to influence the adoption and scalability of sustainable silk production. This context is pivotal for interpreting the role of niche sustainable practices within the broader socio-technical system of silk production, using the framework of the MLP, as these practices aim to address the environmental and social downsides of conventional methods. Through this exploration, the chapter highlights how sustainable silk production aligns with and benefits from landscape pressures, such as climate change and global shifts in demand towards environmentally conscious production as well as a greater focus on equity and social sustainability.

By situating sustainable practices within this framework, this chapter builds a foundation for the analysis in subsequent chapters, where niche practices, co-analyzed through the lens of the MLP, attempt to influence and potentially transform the broader regime of the silk industry. This chapter will outline the key characteristics that define the experiences of silk producers, both sustainable and conventional, and are critical to understanding their practices in context. Key political, societal, economic, and environmental issues that frame this issue are presented.

4.1 The silk industry within India's larger political situation

India is a rapidly developing nation that has recently surpassed China as the world's most populous country. India's Hindu nationalist Bharatiya Janata Party (BJP) has a stranglehold on the central government and controls most of the country's state legislatures, including all but one of the legislatures in the seven northeast states. The means the party has a stranglehold on power at both the national and state levels with federal and state coffers and police apparatuses in their hands (Jaffrelot, 2021). The BJP has embraced nationalism, from a Hindu point of view, which has driven and resulted from deep, religious conflict in India (Chatterjee et al., 2019). The BJP's nationalist vision for India's future is highly contentious. It has exploited and deepened preexisting divisions in Indian society to drive voters to the polls in record numbers and secure an unprecedented level of political security. With this security, the BJP has been unrolling a manifold agenda. Among the party's key priorities are economic development and neoliberal reform, moving away from decades of a more controlled economy, infrastructure development, welfare schemes, and agricultural reform (Ruparelia, 2015). These policy priorities have had major impacts on industries, including the silk industry, in India and particularly in BJP-controlled northeastern states. One major policy area affecting the silk industry is in India's ambition to compete with Chinese silk and protect its silk industry from imports (Roy, 2016). As a result, the government imposes high tariffs on imported silk and has several schemes in place

to promote silk production nationwide. The focus of these policies is on increasing quantities of production, which has led largely to investment in mulberry silk.

India's silk industry, the world's second-largest producer, holds an esteemed position within both the nation's economy and its cultural heritage (Central Silk Board, 2021). The northeastern region, plays a major role in this industry, encompassing both traditional and contemporary practices. The political situation in India has significantly influenced the development and sustenance of the silk industry, particularly in the northeastern states. Various governmental initiatives, like the North East Region Textile Promotion Scheme (NERTPS), have been implemented to support sericulture in these areas.

The NERTPS and other, similar development initiatives, aim to facilitate the growth of the textile industry in the northeastern region (Ministry of Textiles, 2019). The globalization, economic development aid, and investment that follow these initiatives, present a double-edged sword as it facilitates the introduction of niche practices into the broader regime (Geels, 2002). While it opens new markets for northeastern silk products it also poses risks to the preservation of traditional techniques and local culture, as increased, globalized demand incentivizes mass production of easily standardized products. The results of these initiatives align with the landscape level, broader political agenda of stimulating economic growth and promoting regional integration, but their effect on the stated objective of preserving the unique heritage of the northeastern states' sericulture is more ambiguous (Ministry of Textiles, 2019).

The unique challenges the northeastern region faces, including insurgencies, and disputed territorial claims, stemming from ethnicity-based conflict, have hindered the industry's progress (Guha, 2008). Limited infrastructure development and bureaucratic challenges further compound these issues. The nature of India's northeast as being on the periphery of India geographically, ethnically, linguistically, economically, and culturally, has led to it lagging behind the Indian heartland in government attention and support for an economy that is far less developed than that of the rest of India (Baruah, 2007). The northeastern states have their own distinct culture(s) with distinct languages, traditions, economies, and social norms. While these issues are now starting to be addressed, the legacies of long-term oversight and violent conflict continue to majorly influence the situation today (Baruah, 2007).

The ethno-religious tensions that have plagued the northeast of India for decades are prevalent, albeit in varied forms, throughout India. Tensions between Hindus and Muslims have been brewing for years and are increasingly influencing lawmaking in Delhi and regional capitals (Varshney, 2019). This tension influences hiring and business practices and greatly disrupts the flow of services and goods when it comes to a head, as it has countless times during India's 75-year history (Guha, 2008). This societal division and the current lawmaking that is furthering and reinforcing it, further exacerbates the disenfranchisement of India's historically disadvantaged castes, ethnic groups, and Muslims (Varshney, 2019).

In response to the northeast's lagging economy, both the central and state governments are actively pursuing policies to enhance the region's connectivity, secure investment, and

promote inclusive growth (Mishra and Upaghyay, 2017). Flights to the region are heavily subsidized by the government, and crores of rupees are being poured into development projects, including those seeking to help the silk industry, with over 32 billion rupees being invested into the agricultural industry, including silk production, in 2015 (North Eastern Council). By recognizing the silk industry as not just an economic asset but also a symbol of cultural identity, the political leadership can leverage sericulture as a tool for social cohesion and regional development integration (Varadarajan, 1988). Any exploration of 'sustainable' industry must include social sustainability, which, in India, is predicated upon understanding this backdrop.

4.2 The silk industry's socio-economic context in India and the northeast

The silk industry is an important part of the larger economy and is significantly affected by the larger macroeconomic conditions and policies that the country experiences. The Indian economy is among the world's largest and most dynamic with a wide distribution across agriculture, services, and heavy industry. In the northeast of India, the agricultural and industrial services dominate. India's diverse economy is one of the world's fastest growing, posting real GDP growth of 5.9% in 2023 (IMF, 2023). India's economy has far outpaced, in terms of GDP growth, the average of developing economies over the last 50 years and is projected to be the world's fastest growing major economy for the rest of the decade (IMF, 2023). The world's most populous nation is rapidly becoming an economic juggernaut, and millions are being lifted out of poverty and into the middle class, which doubled in size between 2005 and 2012 and now amounts to more than half of the country's population of around 1.4 billion (Krishnan and Hatekar, 2017). While industry, including textiles (responsible for 23% of GDP), and, especially, agriculture (responsible for 15.4% of GDP) together employ 70% of Indians, the service industry contributes most heavily to GDP (61.5%) (CIA, 2023). India is rapidly developing, rapidly urbanizing, and, for the educated and wealthy, transitioning to a service economy.

While the economic future for many Indians is bright, the picture is significantly dimmer for uneducated and underprivileged Indians, especially those from minority groups. Additionally, the northeastern states all consistently rank right at the bottom of the list of India's states by GDP (Ministry of Statistics & Programme Implementation, 2023). The places of unskilled and disadvantaged workers in the Indian economy, as well as women, who constitute less than 20% of the labor force, is in jeopardy in this economic transition. A truly sustainable enterprise must thus address the social, political, and economic factors behind these trends, while also considering environmental issues that are beginning to majorly impact India's health and wealth. Sustainable silk has the potential to provide dignified jobs to these communities, which have been the traditional knowledge centers around these practices and lag far behind India as a whole in economic development.

Four major potential internal limitations to India's economic growth are: the gender gap in underemployment of its female population; low levels of educational attainment; societal divisions along ethnic, class, and religious lines; and climate change. The remainder of this section will discuss the three socio-economic issues, and the following section will address the

(potential) impact of climate change. These issues are discussed with a goal to understanding their impact on the (sustainable) silk industry, the talent pool it can source from, and its potential to provide undereducated and marginalized groups with well-paying jobs if they can be engaged in sustainable silk practices.

Large-scale instability, which India's socio-economic divisions have the potential to spark if left unaddressed or repressed, has obvious, negative impacts on all businesses and the institutions that allow them to flourish. Disadvantaged castes, ethnic groups, and religious sects are often excluded from economic opportunities and support (Guha, 2008). Sustainable silk practices have been developed by ethnic minority groups in poor parts of the country (Karthik and Rathinamoorthy, 2017). Empowering workers and entrepreneurs in these communities has the potential to allow disenfranchised peoples to engage with the rapidly growing Indian economy, providing for greater economic and social sustainability in the pursuit of developing a more environmentally friendly product.

Women face significant challenges in Indian society, particularly in economic matters. With one of the lowest levels of female participation in the workforce in the world, India's economic potential is massively underutilized and its female population, particularly in the more patriarchal, northern parts of the country is far removed from equality in economic opportunity. From an early age, women are less likely to attend school, despite better performance from female students, resulting in a gender gap in the literacy rate in Assam of 11.6%, with female literacy standing at 66.3% compared to a 77.8% rate for males. The gender gap in urban areas is 6.9% and in rural areas it rises to 12.4% (North Eastern Council, 2015). This lack of opportunity for women, particularly in rural areas, continues into adulthood, making finding a quality job, and, with it, financial independence, very difficult to come by. In Assam, the work participation rate for men stands at 53.6% and only 22.5% for women (North Eastern Council, 2015). This massive gap, while tragic and unjust, leaves behind a vast pool of untapped talent that could be leveraged in the scaling up of niche sustainable silk practices. Women are and traditionally have been responsible for most of the production processes of sustainable silks, particularly eri silk (Varadarajan, 1988). Women also form an outsize proportion of entrepreneurs in this space. Involving women at management levels of the business has a major impact on the non-financial targets and distribution of benefits within an organization (Terjersen et al., 2016). Initiatives to enhance sustainable silk practices therefore have the potential to empower women who have been historically disadvantaged in the region.

Although girls face significantly greater challenges, education is a major issue for male and female students alike. India's human capital, possibly its most valuable asset entering this decade, is vastly underutilized due to low levels of education, with a 49.7% school dropout rate (North Eastern Council, 2015). This issue will persist in plaguing India's future as undereducated pupils today will grow into the underprepared citizens of tomorrow. Even before the pandemic, which saw massive setbacks in educational attainment, due to lack of attendance, only about 50% of Indian ten-year-olds can read a simple text and a paltry 30% can divide numbers (AESR, 2019). The 50% of pupils educated in private schools fair slightly better, with about a 20% higher chance than those in government schools of meeting these benchmarks (AESR, 2019). The

poorest students, those who are most dependent on government schools, are the most vulnerable. Most of India's population today is not prepared for jobs that would be seen as desirable in an advanced, service-based economy and the massive, ongoing failure of the education system guarantees that this situation will continue into the medium to long term. The supply of workers seeking a job that provides a livable wage and dignified work environment and that is accessible to undereducated people is thus slated to grow rapidly in the coming years. Sustainable silk practices create jobs that are accessible to undereducated people willing to learn new skills on the job.

As India's government focuses on its development into an advanced economy, it must also provide desirable jobs for the hundreds of millions of uneducated workers under its charge today, while considering the impact of almost 500 million people under 20 years of age entering the labor market with abysmally low educational achievement rates over the next 30 years (AESR, 2019). Industries like the silk industry, and especially the more labor-intensive sustainable silk industry, can be a key source of employment for this contingent of Indians. As is discussed in the research's findings, in the context of northeast India, trade-specific education for adults and young adults, will be of importance for the accessible, relatively well-paying, and sustainable jobs offered by sustainable silk production. While the issues affecting educational attainment may or may not be effectively addressed today, the legacy of ineffective education policy in India will persist for the generations that are now in and have past schooling age. These people, and the skills they have to offer, must not be left behind. The labor-intensive sustainable silk industry is a potential avenue for livable, long-term employment among currently more disadvantaged Indians and those with lower levels of educational attainment.

In addition to low educational attainment and a wide gender gap in economic opportunity, another major threat to India's rise are its social divisions along lines of religion, race, caste, tribal background, socio-economic status, and more (Guha, 2008; Varshney, 2019). Tensions between Hindus and Muslims have plagued India since its inception as a secular nation in 1947 (Varshney, 2019). As discussed, these tensions have worsened significantly in the recent years under the rule of the Hindu nationalist BJP. The caste system, while far from having the impact in rigidly stratifying society it once commanded, still plays a role in segregating society, particularly in rural communities (Jaffrelot, 2021). People from tribal backgrounds, who until this decade were denoted with the government classification of "backwards," make up 80-90% of the population of four of the northeastern states and a significant (between 10-30%) portion of the population of the other four states and face major discrimination in social and economic matters (Baruah, 2007). Furthermore, racism against groups outside of one's identity is extremely common. India was created as a political body only in 1947. In the following 76 years, a strong Indian identity has developed, yet it is still amorphous and manipulable (Guha, 2008). This identity has not yet developed to the point where it overshadows these societal divisions. India's northeast is unique as it is home to high concentrations of Muslims, who have long been heavily involved in the textile industry, people of tribal backgrounds, among whom several groups attempted to carve their own sections of the northeast out of India to create independent states, and ethnic groups that are distanced from those traditionally holding power in Indian society and government (Baruah, 2007).

The religious context of the northeast, despite divisions, also presents opportunities for sustainable silk as Muslims have traditionally been involved in the textile industry, particularly downstream in the value chain, while the production methods satisfy the *ahimsa* values espoused by both Hinduism and Buddhism (Interview with silk production manager, 2023; Interview with market expert, 2023). While deeply rooted in a variety of ancient, religious traditions, the northeast lacks modern educational infrastructure with the major destination for higher education for students from the region being Kolkata, in the state of West Bengal, hundreds of miles away (Interview with market expert, 2023). A more technical education around the crafts related to sustainable silk production, particularly given the statistics on the demographics of the population previously presented, would be more accessible to most people in the northeast, both geographically and intellectually. These crafts are rooted in traditional knowledge, to which a commensurate economic value is finally being ascribed.

In the arduous and ongoing task of holding together the socially, economically, ethnically, culturally, religiously, and linguistically diverse country that is India, the northeast is a region that requires attention. By far India's poorest region, it is home to the country's most diverse population sets and has experienced decades of violence perpetrated by separatists (Baruah, 2007). The development of the sustainable silk industry offers an avenue for economic opportunity to leap over these gaps into the hands of these marginalized groups, rural dwellers and women. This economic opportunity would be welcomed with open arms by the most vulnerable communities in the 8 poorest states in India by GDP (Ministry of Statistics & Programme Implementation, 2023). Sustainable silk practices have roots in regions of the country inhabited by people with tribal backgrounds and other minorities with the work historically being primarily carried out by women. Thus, they the potential to leverage the untapped, overlooked potential of these marginalized groups and their traditional knowledge, leading to equitable and sustainable development. Chapter 6 examines this phenomenon further, before chapter 7 explores means to bring these historically marginalized peoples through niche practices into the forefront of the sustainable transformation of the silk industry's regime.

4.3 The influence of climate change on silk production

Climate change poses an existential threat to India's development. The Indo-Gangetic plain is one of the world's most vulnerable areas to climate change (Ricciardi et al, 2021). The region is extremely densely populated, experiences massive inefficiencies in production and distribution of staple goods, and is uniquely exposed to risks of climate disasters, particularly flooding, drought, heat waves, and crop failures (Ricciardi et al, 2021). Pollution and overuse of water resources in India is a major threat to public health and food resources (Gupta and Deshpande, 2004). Resultingly, to provide for a sustainable future, adaptations, particularly in land and water use, must be invested in and embraced (Indian Ministry of Environment, Forest and Climate Change, 2021). Chapter 5 will show how sustainable silk practices contribute to this adaptation as they do not need the use of arable land, irrigation water, fertilizers or pesticides and utilize indigenous plant species for feed. As the effects of climate change and population

growth increasingly pressure on conventional silk production, through food-feed competition and a less hospitable environment for mulberry production, sustainable production will be increasingly attractive, particularly if government policies promote sustainable methods (Schipper et al., 2022).

The northeast, like the rest of India, is vulnerable to the impacts of climate change (Indian Ministry of Environment, Forest and Climate Change, 2021). The life-sustaining yet untamed Brahmaputra River runs through the heart of the region. Extreme weather events, particularly droughts and flooding are becoming more common and making water and arable land resources, for which competition is steep and steepening, less stable (Ricciardi et al, 2021). This, in turn, means crops, such as mulberry, which are grown on arable land and require irrigation will become increasingly risky. The following chapter will discuss how, in contrast, Eri, Tussar, and Mugga silks are grown from wild or endemic feed sources that are more resilient to change and that do not require irrigation water or fertilizer (Karthik & Rathinamoorthy, 2017). Sustainable silks offer a more resilient and less resource intensive alternative to conventional production that offers inherent opportunities to women, rural dwellers, believers in minority religions, and racial minorities in the poorest region of India.

4.4 Conclusion

This chapter outlined the socio-political and economic conditions that impact India's silk industry, with a specific focus on the northeastern region's unique challenges and opportunities. This contextualization, necessary in underpinning deeper insights from the results and discussion sections, reveals the layers of influence that affect the regime of the sustainable silk industry, from regional policies and economic disparities to the landscape pressures of climate change and resource scarcity. Such factors underscore the potential of sustainable silk practices as adaptive responses to these pressures, offering a more resilient and less resource-intensive alternative to conventional methods. This chapter justifies the need for an in-depth examination of niche practices in sustainable silk production as they attempt to scale within a regime dominated by conventional production methods. In conjunction with the MLP, this contextual background allows for a comprehensive analysis of how niche practices can interact with and potentially reshape the existing regime, paving the way for broader sustainability transitions within the silk sector. This understanding is critical for the forthcoming results and discussion chapters, where sustainable silk practices are further analyzed as viable pathways toward sustainable transformation and social change.

5. Sustainable silk practices in the Indian silk sector

The subsequent three chapters address the research questions introduced in Chapter 1. This section integrates insights derived from interviews and the theoretical foundation laid in Chapter 2, as well as the contextual understanding developed in Chapter 4, to articulate answers to the first research question.

Chapter 5 begins by mapping out the landscape of sustainable practices within the Indian silk sector, providing a comparative context with conventional methods. Then, it analyzes sustainable practices through the lens of meanings, materials, and competencies, identifying key elements that constitute these practices. This analysis then informs an examination of the intersections between various practices and the connections formed through overlapping elements. Three main themes emerged in response to the first research question: "What alternative, sustainable production practices exist and are emerging in the Indian silk production sector?" These themes focus on:

1. The diversity of alternative silk production practices that contrast significantly with conventional approaches.
2. The meanings, competencies, and materials that underlie both alternative and conventional practices.
3. The relationships among production practices and the segmented nature of practice bundles.

Through these focal points, this chapter offers an overview of sustainable silk production practices and discusses the elements of and interlinked bundles between these practices. This chapter also bridges the transition to Chapter 6, wherein the *ahimsa* philosophy is highlighted as a pivotal motivator for linking sustainable practices with broader adoption efforts. This philosophy underpins the observed segregation between conventional and sustainable practices, with meanings associated with practice bundles often contributing to this divide. Chapter 6 will expand on this groundwork by detailing the primary factors identified during research as influential to the emergence and adoption of sustainable silk practices in various contexts.

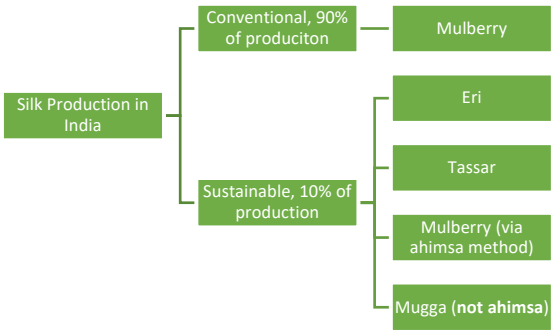
5.1 Silk production practices: An overview of conventional and alternative practices from an on-the-ground study

India’s non-conventional silk production, though comprising less than one-fifth of its overall silk production, positions the country as the largest global producer of non-mulberry silk (International Sericultural Commission, 2023). This study focused on sustainable, niche practices in mugga and eri production, predominantly in rural Assamese communities where traditional competencies have been preserved. While conventional mulberry silk still dominates, non-violent mulberry production, a process omitting the boiling of silkworms before they emerge as moths, has become more common. This approach, though more ethical, still utilizes fertilizers

and pesticides, offering limited progress toward environmental sustainability (Interview with processing professor, 2023).

India's three main non-mulberry silk types are eri, tassar, and mugga silks, with eri silk comprising 72% of production, tassar 27%, and mugga 1% (Indian Silk Export Promotion Council, 2022). Tussar silk, collected from wild silk cocoons, stands out as a sustainable alternative but faces constraints in scaling due to its dependence on wild silk sources and diffuse production processes (Uzumcu, 2019). Consequently, this study focused on eri and mugga silks, whose alternative practices signify both a sustainable transition and a return to ancient methods of silk production. These practices not only reduce environmental impacts but also enable local artisans to retain cultural heritage in silk craftsmanship (International Sericultural Commission, 2023). Figure 5.1.1, below, shows silk types in production in India in relation to each other.

Figure 5.1.1 – Silk Production Types in India



Eri, mugga, and tussar silks are produced using indigenous plants to feed native silkworm species without the use of irrigation, fertilizers, or pesticides. These plants typically grow on land unsuitable for traditional cropping, further enhancing their sustainability (Karthik & Rathinamoorthy, 2017). India, the world's most diverse silk-producing country, allocates around 80% of its non-conventional production to *ahimsa* mulberry silk, 14% to eri silk, 5% to tussar, and about 1% to mugga (International Sericultural Commission, 2023; Indian Silk Export Promotion Council, 2022). In 2013, India produced 18,715 metric tons of mulberry silk and 119.17 metric tons of alternative silks, of which 118.91 metric tons (99.7%) were produced in the northeast and 108.52 metric tons (91%) in Assam (North Eastern Council, 2015). This makes Assam the ideal place for site visits and interviews examining the practices that produce these silks. In some regions, the silkworms themselves are considered a delicacy and serve as a valuable protein source. While this practice diverges from the non-violent philosophy of silk production, it addresses protein deficiency in a country where malnutrition is prevalent. Moreover, traditional dyeing methods and the avoidance of large-scale, water-intensive processing reduce the environmental impact, especially concerning water pollution, air pollution, and competition for food and feed resources, which are common in conventional mulberry silk production.

The sustainability of these traditional practices is under threat from industrial pressures, pushing them to the brink of extinction (Karthik & Rathinamoorthy, 2017). Rural communities, skilled in these ancient techniques, often regard silk production as an art form. However, these artisans are increasingly driven to urban areas, far from their ancestral lands, to pursue other livelihoods (Interview with Sustainable silk entrepreneur, 2023). The pressure to increase yields and standardize production has led to excessive pesticide, fertilizer, and water use, fostering a monoculture of mulberry plants that jeopardizes both environmental and social sustainability (Interview with Sustainable silk entrepreneur, 2023; Interview with Silk processor, 2023; Ricciardi et al., 2021).

Conventional mulberry silk production, however, remains dominant, overshadowing other silk types by a factor of five (Senthil Kumar & Suganya, 2017). Other silk varieties, each unique in their feed, production methods, and originating moth species, continue to be cultivated in India using methods preserved over centuries.

Eri silk, often called "*ahimsa* silk" or "peace silk," represents the region's sustainable approach. Produced from *Samia ricini* silkworms, which feed on castor plants of the Ricinus genus, eri silk is native to Meghalaya in northeastern India (Indian Silk Export Promotion Council, 2022). Known as ‘peace silk’ because of its non-violent production method, eri silk moths are allowed to mature and emerge from their cocoons naturally. Their empty cocoons are then collected, and the broken silk strands are spun together into usable fiber (Interview with Government coop director, 2023).

Mugga silk, exclusive to Assam, comprises less than 1% of global silk production and provides employment to thousands within the state (International Sericultural Commission, 2023). Historically reserved for royalty, mugga silk is a niche product (Franck, 2001). While its production entails the death of the silkworms, except for those reserved for breeding, it relies on sustainable methods. Mugga silk is cultivated by smallholders with generational expertise, often supported by government-funded cooperatives. Indigenous plants, often growing wild, are used without irrigation or fertilizers, and pest control methods are as simple as using slingshots and tree nets to ward off predatory birds, as pictured in Figure 5.1.2 on the following page (Interview with Silk producer and processor, 2023).

Figure 5.1.2 – Photos from eri and mugga production site visit

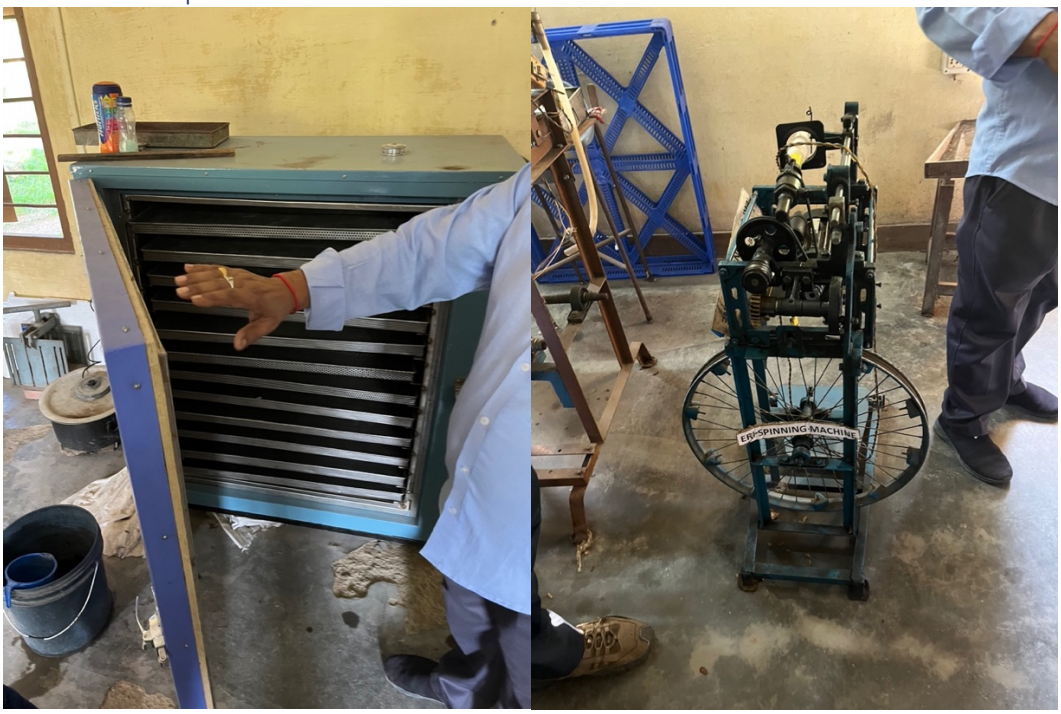
Clockwise from top left: The author controlling for pests; tree nets; mugga silkworms; eri silkworms

The silkworms shown above will, after weeks of consuming feed, spin themselves into silk cocoons. Each cocoon, when unwound, can yield up to 300 meters of fiber (Interview with silk producer and processor, 2023). These cocoons are then harvested, and the silk fiber is extracted. In conventional silk production, as well as in mugga silk production, the inhabited cocoons are boiled to prevent the worm from damaging the precious fiber as it exits as a moth (Interview with silk producer and processor, 2023; Interview with sustainable and conventional silk entrepreneur, 2023). Figure 5.1.3, below, shows the golden-colored cocoons of mugga silkworms contrasted with the white cocoons of eri silkworms.

Figure 5.1.3 – Mugga and eri cocoons

These golden, mugga cocoons are coffins for the silkworms that produced them. Only the select few chosen to propagate the next generation of worms are allowed to survive. In eri production, the worms are allowed to eat their way out of their cocoons and complete their natural lives. The cocoons that eri moths leave behind are also boiled and treated to loosen and prepare the fibers for the spinning process and then dried, either in the sun or in a drying machine, pictured on the following page in Figure 5.1.4 (left). The broken strands of eri silk are then spun together with a special machine, pictured below in Figure 5.1.4 (right) or by hand by an expert (Interview with Cocoon producer, 2023). On the following page, the machines used to spin broken strands together and dry cocoons are presented.

Figure 5.1.4 – Eri silk production materials



Hand-spinning is a step in an ancient craft still practiced in rural areas. Low-tech mechanical tools, like those pictured above, contribute to making sustainable silk production less reliant on weather conditions and slightly reduce the labor intensity required (Interview with sustainable silk entrepreneur, 2023; Interview with cocoon producer, 2023). The cocoon dryer shown above helps to eliminate weather and labor as variables that impact the time needed to dry cocoons. Despite these low-tech advancements, sustainable production of eri and mugga silk, from feed production to dyeing, remains more labor-intensive, complex, and costly than both conventional and *ahimsa* mulberry silk production (Interview with sustainable silk entrepreneur, 2023). It demands in-depth knowledge of traditional techniques, such as the skill to spin broken eri silk strands into a stronger fabric (Interview with sustainable silk entrepreneur, 2023). Once the cocoons are unraveled, treated, and spun, they can be dyed using natural, non-toxic dyes and then woven on handlooms into finished garments (Interview with weaving machines professor, 2023; Interview with sustainable and conventional silk entrepreneur, 2023). These processes, while costlier, are less burdensome on water, energy, and land resources and result in lower pollution levels.

Later in the production process, dyers color the silk fabric. Sericulturists who employ sustainable, traditional silk production methods are more likely to use traditional dyeing processes and materials, though this is not always the case (Interview with sustainable silk entrepreneur, 2023; Interview with dyeing facility operator, 2023). As observed in a site visit to a conventional facility, pictured below in Figure 5.1.5, conventional dyeing methods use significantly more water and rely on harsh chemicals, which are often discharged directly into waterways (Jadeja et al., 2022). Figure 5.1.5 (left) shows wastewater used in the dyeing process that contains toxic chemicals being released into a small stream. The effluent released here

flows directly to a river that serves as a water source for the area. Regulatory enforcement to protect India's degraded waterways is highly limited, particularly in semi-urban and rural areas (Interview with sustainable and conventional silk entrepreneur, 2023). As with fertilizers and pesticides, conventional producers are not held (financially) responsible for the environmental impacts of their dyeing practices (Interview with government coop director, 2023). The images below depict a conventional dyeing facility located on the outskirts of Guwahati, Assam's capital.

Figure 5.1.5 – Chemical effluent and combustion residuals at a conventional dyeing facility

Figure 5.1.5 (right) above shows the remnants left after burning husk to produce heat for the dyeing process. This conventional process is also far more energy-intensive, fueled by burning fossil or biofuels, as chemical dyes require longer exposure at higher temperatures in the dyeing process (Interview with dyeing facility operator, 2023). While the term "conventional" might conjure images of large, heavily industrialized facilities, these pictures depict the diffuse nature of silk production, both sustainable and conventional, as well as the impact diffuse, conventional processes can have on a local level. Just across the street, another dyeing facility employed more sustainable, traditional dyeing methods (pictured below).

Figure 5.1.6 – Sustainable dyeing facility pictures

The orange fabric shown on the left of Figure 5.1.6 was dyed with turmeric, a natural and sustainable yet relatively expensive product, compared to chemical dyes, in the process depicted on the right. The facility was multiuse with dairy cows being raised next to the drying area for silks. Silk production facilities using sustainable methods, such as this dyeing facility, are generally smaller and are more likely to be multiuse compared to a conventional, industrial facility (Interview with dyeing facility operator, 2023). This facility also uses conventional dyes and fabrics, and they reported that they rarely receive requests to dye mugga and eri silks with conventional dyes (Interview with dyeing facility operator, 2023). Eri retailers confirmed that they attempt to make their dyeing processes commensurately sustainable with their fabric production processes (Interviews with 3 sustainable silk entrepreneurs, 2023). For example, the bright orange color in the fabric pictured in Figure 5.1.6 is the result of exposure to turmeric, and onion skins can be used to generate purple coloring. The use of these natural products results in no harmful, chemical effluent but is more labor, time, and cost intensive to produce (Interview with sustainable silk entrepreneur, 2023). These dyeing facilities are the only part of the production chain where sustainable and conventional silk practices converge and could be a point where niche practices could be supported into the regime. While mulberry and other feeds can sometimes be grown together, conventional and sustainable practices do not converge until finished fabrics reach trading houses, with the exception of the dyeing process.

Through the production process, from feed cultivation to the dyeing process, the traditional methods employed in eri and mugga production generate far fewer environmental externalities than conventional production. These practices are based in traditional knowledge predating conventional methods and coincide with more equitable distributions of profits and greater social sustainability (Interviews with 4 sustainable silk entrepreneurs, 2023). Now that the production processes involved in these sustainable practices have been laid out, the next subsection will discuss the competencies, meanings, and materials that make up these practices in depth before the next chapter discusses the factors influencing and resulting from these elements of practices and the bonds between them.

5.2 The elements of sustainable silk practices in the northeast: Meanings, competencies, and materials

Chapter 2 discussed how practices are made up of meanings, competencies, and materials and the links between them (Shove et al., 2012). In this section, these element tenets of practice theory will be leveraged to analyze sustainable silk practices and contrast them with the conventional processes to which they are alternatives. Specifically, it outlines and contrasts the competencies, meanings, and materials involved in conventional and sustainable sericultural practices. Throughout the production process, sustainable practices leveraging traditional knowledge involve a higher cost to produce, fewer externalities, and more diffuse benefit sharing as artisans along the production process are paid in accordance with the rarity and quality of their skill (Interviews with 4 sustainable silk entrepreneurs, 2023). Table 5.2.1 below presents an overview of the differences in the meanings, materials, and competencies between alternative and conventional production practices that will be elaborated on in this section. Insights into the meanings and competencies behind sustainable practices derive largely from interviews while insights into materials come from both interviews and the literature review.

Table 5.2.1 – Elements of silk practices

	Conventional	Alternative (eri and mugga)
Materials	• Only *bombyx mori* species • Industrial scale machinery for production, processing, dyeing, weaving, and finishing • Greater (fossil) energy use, fertilizers, pesticides, etc. • High levels of financial capital needed to acquire machinery and inputs and scale sufficiently to recover upfront costs	• Several silkworm species • Marginal land use for feed cultivation, sustainable fertilizers and pest control methods • Natural dyes • Traditional, low tech machines using low/no fossil energy and resources: handlooms, hand-spinning machines • Weather and labor dependent
Competencies	• Plug and play production: less reliant on factors like weather and (skilled) labor • Relies on regime practices • Understanding of running an industrial business at scale	• Traditional knowledge of production practices • Labor intensive • Skilled work necessary for sensitive cultivation and processing practices
Meanings	• Profit-driven, resulting in externalization of costs	• *Ahimsa* movement • Accessible to all

	• Standardization of products • Reinforcement of social stratification in hierarchical work environment	• Small-scale and labor intensive: more diffuse benefit and profit sharing • Cooperative knowledge and skill sharing

5.2.1 Materials

The material aspects of conventional and sustainable silk practices differ significantly, beginning with their physical tools. Conventional silk production employs a standardized, input-intensive approach featuring extractive agricultural practices, a single domesticated silkworm species, violent harvesting, and toxic processing and dyeing techniques (Interview with textile industry expert, 2023). This method is capital-intensive and must operate on a large scale to offset these capital demands. By contrast, the production of eri and mugga silks follows a radically different process.

Eri and mugga silk production uses diverse feed sources that are adaptable as conditions require. These feeds are often grown on steeper hillsides or other marginal lands unsuitable for staple crops, without irrigation, fertilizers, or pesticides that can damage water resources and local biodiversity (Ricciardi, 2021; Interview with sustainable silk entrepreneur, 2023; Interview with dyeing facility operator, 2023). The eri silk harvesting process, in particular, allows silkworms to complete their life cycles or be used as a protein source in a protein-deficient region (Interview with textile institute director, 2023). Eri silk is then dyed with natural dyes, such as turmeric for orange or onion skins for purple (Interview with sustainable silk entrepreneur, 2023). Broken strands are hand-spun or processed using manual machines, and both eri and mugga silks are woven on handlooms, requiring minimal upfront capital, energy, and resources and producing few externalities (Site visit to government coop, Guwahati, 2023; Interview with sustainable silk entrepreneur, 2023; Interview with sustainable and conventional silk entrepreneur, 2023).

The final eri and mugga products differ from conventional mulberry silk products, which have a distinct sheen and shimmer that Indian consumers value highly, especially in formalwear (Interview with sustainable silk entrepreneur, 2023; Interview with sustainable and conventional silk entrepreneur, 2023). Eri and mugga silks are heavier with a more subtle sheen. While standardized mulberry practices yield uniform finished products, the diverse feeds, natural dyes, and hand processes in sustainable practices lead to product variations that carry unique meanings. These differences will be explored further in the next section, following a discussion of the competencies involved in these practice bundles.

5.2.2 Competencies

Just as these contrasting bundles of practices require different materials, they also require distinct competencies. From feed production to cocoon processing, the standardized, "plug-and-play" conventional route provides greater stability. These production practices are less affected by inclement weather and less reliant on manual labor, particularly in feed cultivation and cocoon processing stages (Interview with sustainable silk entrepreneur, 2023; Interview with Cocoon, 2023). The competencies required for alternative production practices differ significantly from those in conventional silk and textile production. Alternative practices leverage traditional knowledge from rural communities, rooted in techniques carried out by women for thousands of years (Interview with sustainable silk entrepreneur, 2023; Interview with Silk production manager, 2023).

Feed cultivation in alternative production is more sensitive due to the lack of pesticides, fertilizers, irrigated water, and the use of marginal lands with a variety of possible feed crops (Interview with government coop director, 2023; cite-ag). Sericulturists must have a deep understanding of agricultural practices for these crops to ensure success amid increasingly variable weather and soil conditions. While cocoon drying for eri and mugga silk can use cocoon ovens, it is generally done by sun-drying the cocoons, which can be disrupted or even ruined by rainfall if mismanaged (Interview with sustainable silk entrepreneur, 2023; Interview with government coop director, 2023).

The most skill-intensive part of the process is hand-spinning broken strands of eri silk into stable, workable fibers, a task performed by rural women whose expertise has been passed down through generations (Interview with sustainable silk entrepreneur, 2023). The processing of these silks into finished garments using handlooms and non-powered machines requires a far greater degree of skill than standardized, machine-made conventional silk products (Interview with sustainable silk entrepreneur, 2023). From feed production to garment processing, alternative practices demand deep expertise to perform labor-intensive tasks and offset the lack of standardization and climate risks. These practices depend on the specialized skills of rural, mostly female practitioners, creating a unique hierarchy in the production process. The meanings behind these contrasting bundles of practices and the social dynamics they produce will be explored in the next section.

5.2.3 Meanings

Conventional production is characterized by a strictly hierarchical structure that subjugates those performing the labor of silk production, both socially and economically (Interview with sustainable silk entrepreneur, 2023). In contrast, alternative production emphasizes diffuse benefit sharing, cooperative knowledge and skill exchange, and social sustainability (Interview with sustainable silk entrepreneur, 2023). Today's Indian industry—and the stark wealth inequality it has created—perpetuates a hierarchical structure inherited from centuries of monarchical and colonial rule (Interview with market expert, 2023). This

conventional model stands in sharp contrast to alternative production processes, which, in both meaning and practice, are revolutionary. This alternative model addresses the social and environmental externalities of unchecked capitalism in India.

Conventional production is inherently profit-driven, with profits accruing to those at the top of the organizational structure who invested in the costly machinery, inputs, and other up-front expenses needed to sustain this model (Interview with market expert, 2023; Interview with textile industry expert, 2023). The rewards go to those who invested capital, not labor (Interview with sustainable silk entrepreneur, 2023; Interview with sustainable and conventional silk entrepreneur, 2023; Interview with market expert, 2023). Sericulturists who produce silk and weavers who transform it into finished products experience this hierarchy in their wages and workplace atmosphere. Conventional production facilities reflect traditional Indian working environments, where individuals from various social strata within the production process receive privileges aligned with their social standing (Interview with silk production manager, 2023; Interview with textile industry expert, 2023). For instance, in one garment production facility observed during a site visit, all tailors, who were Muslim, worked on a separate floor under a head tailor titled “master.” The office staff, all Hindu and responsible for quality checks, logistics, and finances, occupied a separate space. Aside from the master tailor, the Muslim workers, who were the majority, had to use a distant, less hygienic restroom shared with other businesses (Site visit to conventional facility, 2023). On payday, the Hindu office staff earned double the salary of Muslim tailors, even at a relatively high-paying workshop. Muslim holidays were observed, but bonuses were awarded only on Hindu holidays, with office workers receiving significantly more (Site visit to conventional facility, 2023). The management's racist and classist attitudes were apparent, with Islamophobic and classist language toward lower-ranking workers used repeatedly in interviews with the phrase “they [Muslims] are taking over,” being exclaimed repeatedly in reference to both the office and India as a whole (Interview with silk production manager, 2023). Conventional practices and their underlying meanings reinforce India's worsening social and economic divisions along class and religious lines. Alternative production, with its reliance on skilled rural laborers, offers an opportunity to break away from this hierarchy.

The traditional skills required for alternative silk production confer a degree of agency on practitioners who work in fields that do not require high up-front investments. Only those with these rare skills, or a willingness to learn them, can engage in these practices, making them indispensable. Economic and social rewards are generally more widely shared, as the unique skills and labor invested align more closely in value with the investment needed to sustain alternative silk production (Interview with sustainable silk entrepreneur, 2023; Interview with market expert, 2023; back up). As a result, alternative silk producers—from feed cultivation to weaving and finishing—can and do demand a larger share of the overall value. The size of this more egalitarian pie is also growing, due to increasing foreign interest in these products, as will be discussed in the next chapter.

The non-violent, or *ahimsa*, movement that underpins the popularity of eri silk, particularly in foreign markets attuned to ethical and environmental concerns, defines the

meaning behind eri silk production. The *ahimsa* movement resonates with Buddhist, Jain, and Hindu philosophies that seek to minimize harm to living beings (back up). Due to their non-violent nature and lack of standardization, eri practices yield unique garments. Some may view deviations from standards as flaws, while others see them as distinctive characteristics to be valued (Interview with sustainable silk entrepreneur, 2023). Standardized products from conventional models target an established, mainly domestic customer base, whereas alternative practices cater to niche markets in India and, predominantly, abroad.

5.3 Links between silk production practices

The practices behind both conventional and alternative silk production are linked to each other, within their respective practice bundles, through shared elements: the materials, meanings, competencies that make them up (Shove et al., 2012). This section will outline the links between practices in both conventional and alternative production practices. The commonalities in meanings, competencies and materials for alternative practices and linkages between them will be discussed before those of the conventional system are discussed within the context of their locked-in nature.

Alternative silk practices from feed production to weaving are skill- and labor- intensive. Producing feed for these silkworms without input-intensive modern agricultural methods requires high levels of specialized expertise, like spinning broken strands of silk or dyeing using natural dyes do. Practitioners with these skills, working outside the conventional system must work together down the production line to produce a viable product. The traditional knowledge required to produce specific feed varieties, rear specific silkworm species, and turn (broken) cocoons into a marketable garment through fickle dyeing, weaving, and processing practices, unites sericulturists engaged in alternative production practices (Interview with Sustainable silk entrepreneur, 2023; Interview with Sustainable silk entrepreneur, 2023; Interview with Director Textile Institute, 2023). The linkages between the materials and competencies in using those materials of these niche, alternative practices allow them to persist without incorporating elements of conventional production, which would challenge the meanings behind these production practices, chiefly among them a commitment to *ahimsa* values. *Ahimsa* values come from Hindu and Buddhist philosophy and emphasize minimizing harm to others, the environment, and animals. Subscribers to these philosophies avoid eating meat and seek to minimize their impact on others and the earth.

Diffuse benefit sharing, a result of paying laborers a fair wage, which their skilled labor can command, distinguishes these *ahimsa* practices, from an economic and social hierarchy perspective, from conventional production and allows for greater agency among participants in niche practices (Interview with Sustainable silk entrepreneur, 2023); (Interview with Sustainable silk entrepreneur, 2023). This, in turn, allows them to continue to choose to engage in these practices, particularly as the *ahimsa* ethos and social sustainability they embody generates attention and revenue from foreign and domestic niche markets. This ethos, among entrepreneurs that integrate several or all these practices in-house, goes hand in hand with a

management style that supports social sustainability through challenging the social hierarchy ingrained into Indian (working) culture. Site visits to sustainable silk production facilities showed a flatter working culture, in contrast to the strict hierarchies seen in conventional facilities. The driving force behind this social sustainability that stems from diffuse financial benefit sharing and a less rigid social hierarchy seems to be a commitment to a more diverse set of objectives than solely profit. In an interview, one sustainable silk entrepreneur (2023) stated, "I don't know where they would be living and working without [our organization]." Her organization houses employees and pays them a fair wage for fair work. Another sustainable silk entrepreneur in an interview (2023) discussed her frustration with her previous job in conventional production's hierarchy stating "when I had kids, I knew I had to get out." In reflecting upon her motivations in changing practice bundles, she pointed to the experience of having children as a point where she gained empathy for laborers in the industry and sought to build a business of her own with a deeper meaning (Interview with sustainable silk entrepreneur, 2023). Another sustainable silk entrepreneur whose family has roots in rural Assam, in an interview (2023) mentioned her passion for "reviving a dying art that has persisted in these hills for generations." Family tradition in alternative production and an established skill set were the most frequently mentioned motivations for sericulturists who were born into this work, however, some the entrepreneurs interviewed came from outside the (sustainable) silk world into this work (Interviews with 2 sustainable silk entrepreneurs, 2023). Sustainable silk production practices were united, as reported by those engaged with them and triangulated via site visits, in their motivations in transcending profit and focusing on deeper meanings, most notably the *ahimsa* philosophy, which stresses doing good for others, animals, and the planet.

Conventional practices are also strongly bundled and linked to each other. Many of these practices, in and of themselves, constitute a 'locked-in' process with high upfront costs for machinery necessitating scaled-up, externality generating production (Interview with textile industry expert, 2023; Shove and Walker, 2010). When the linkages between these practices are considered, the lock-in nature of conventional sericulture is on full display. The conventional agricultural practices that generate mulberry feed rely on fertilizer, pesticide, and water inputs that require upfront and seasonal investments in applicators and materials (Interview with sustainable and conventional silk entrepreneur, 2023). These practices strip soil of their nutrients and require inputs to keep crops growing (Lal, 2001). With poor soils and thus a reliance on inputs, a lock-in of conventional practices is created as shifting to sustainable agricultural practices requires patience and a deep knowledge of regenerative soil practices (Lal, 2001). The use of mulberry feed and mulberry silkworms are also strongly linked as they are both suited only to each other. Mulberry silkworms are strongly domesticated and will only consume mulberry leaves (Franck, 2001). Down the value chain, the focus on profit leads to extractive practices and environmental externalities. This is most prominent in input intensive agriculture, the boiling of live silkworms, and the use of toxic and water intensive dyeing processes (Interview with government coop director, 2023; Interview with dyeing processes professor, 2023; Kumar and Saravanan, 2017). The machines and inputs required to produce conventional silk necessitate capital investment that requires large scale production to offset these costs and, often, the cost of borrowing capital (Interview with Textile industry expert, 2023). Shifting to a sustainable model, and breaking this lock-in, is extremely expensive and

near impossible for a producer heavily invested in a conventional model. The meanings behind conventional practices regarding the reinforcement of social hierarchies are also linked through the production process (Interview with Market expert, 2023). Those investing capital are rewarded while those laboring are paid far less (Interview with Sustainable and conventional silk entrepreneur, 2023). In contrast with alternative models, the scarcity from which value is derived is not of labor, given that these processes are not as skill intensive, but rather of capital. Conventional production is a profit-driven enterprise with the drive being to accumulate profit for owners, with social sustainability becoming a far less important goal, if not something to avoid (Interview with Sustainable silk entrepreneur, 2023); (Interview with Silk production manager, 2023).

A consequence of this reinforced social hierarchy is an observable lack of agency, both real and perceived, among workers, which allows owners to pay lower wages and perpetuate this status quo. A shift to a social sustainable model, in addition to the physical and financial hurdles, would be difficult to grasp for most business owners in India with a rigid view of social strata that has perpetuated through millennia and a variety of ruling regimes and philosophies (Guha, 2008).

5.4 Conclusion

This chapter established a detailed landscape of silk production in India, juxtaposing conventional practice (nexuses) with sustainable alternatives, focusing notably on mugga and eri silk. It revealed, despite the dominance of conventional practices, that there is a rich and diverse tapestry of sustainable methods rooted deeply in tradition in the rural communities of the northeast, and particularly Assam, which produce 99.7% and 91% of ahimsa silk, respectively. Sustainable practices leverage traditional knowledge, foster environmental balance, and support equitable labor practices. This stands in contrast to conventional practices, which emphasize large-scale production, efficiency, and profit often at significant environmental and social costs.

The findings of this chapter underscore sustainable silk practices' embodiment of a distinct ethos, the *ahimsa* ethos, which emphasizes causing no harm to other, living beings physically, vocally, or even mentally and values ecological stewardship, non-violence and social equity. This manifests in methods that eschew chemical inputs, favor local knowledge, and prioritize fair labor. The *ahimsa* ethos, deeply interwoven with indigenous traditions, presents a viable alternative model within the silk sector. These differences in meanings were linked to differences in materials and competencies, and reflect broader themes within the sustainability discourse, where profit-oriented models are increasingly being scrutinized in light of their environmental and social impacts. This exploration also highlighted how sustainable and conventional practices remain distinct, indicating that while there is potential for sustainable practices to integrate with and influence conventional systems, for example at dyeing facilities in Assam, substantial barriers remain, particularly in material resources, competencies, and production philosophies.

In conclusion, Chapter 5 laid the groundwork for a nuanced understanding of the Indian silk sector's dichotomy between conventional and sustainable production practices, with the exception of some dyeing facilities. It sets the stage for a deeper investigation into the drivers and barriers to adopting sustainable silk production, which will be the focus of Chapter 6. The transition to more sustainable practices, while laden with challenges, is not only a return to traditional roots but also as a progressive step towards a more socially and environmentally conscious form of industry. As such, the following chapter contributes valuable insights into the potential pathways for the silk sector's sustainable transition, a theme that will be further explored in the subsequent chapters of this thesis. Sustainable silk has been shown to be profitable as it has persisted for centuries. This then begs the question of what factors influence people in and out of the industry in taking up sustainable production.

6. Supporting and hindering contexts and practices in sustainable silk production

This chapter focuses on answering the second research question (What contexts and factors support or inhibit the scaling up of sustainable silk production practices across the silk production sector), examining the key factors affecting the uptake of sustainable production practices. The insights from this chapter were largely elicited via interviews with literature review sources aiding the analysis of broader, institutional factors. The key insights from this analysis of sustainable silk niche practices can be distilled into six themes, which are laid out in Table 3 below. The following chapter, chapter 7, includes a section with recommendations on how these pathways can be paved.

Chapter 6 continues with an analysis of the distinct motivation (the *ahimsa* ethos) that chapter 5 elucidated as unifying and underpinning niche sustainable practices in Assam and leading to their distinct nature, throughout the production practice, from conventional practices. The difficulty of shifting from conventional to alternative production practices in the context of this disconnect in meanings behind the practices is highlighted. Sections 6.2 and 6.3 discuss the demographic trends that have been observed to affect uptake of these practices among emerging entrants are presented with practitioners' experiences given their unique demographic perspectives. The process of moving away from solely examining practices involving an analysis of the institutions that affect them, requiring the use of both practice and sustainable transitions theories, begins in earnest in this second subsection of the chapter. Sections 6.4, 6.5, and 6,6 examine the educational, policy, and consumer preference trends surrounding conventional and alternative silks. These educational, policy, and demand contexts affect conventional producers shifting to sustainable practices and new entrants alike. The following table (6.1) lays out the dimensions through which the second research question (What contexts and factors support or inhibit the scaling up of sustainable silk production practices across the silk production sector) will be answered in this chapter through analysis of five key themes identified in the data.

Table 6.1 – Key insights into the scaling of niche silk practices

Section	Key Findings
6.1 - The *Ahimsa* Ethos	*Ahimsa* ethos as the driving force behind the sustainable silk practices and their uptake
6.2 - Women in the silk industry	Women as predisposed to the *ahimsa* ethos
6.3 - Rural dwellers and minorities in the silk industry	Rural dwellers and minority groups as predisposed to the *ahimsa* ethos
6.4 - Educational institutions and their role in silk production practices	Educational institutions as siloed centers of knowledge and the potential to create linkages between groups of (future) practitioners

Section	Key Findings
6.5 - Sustainable silk practices and their policy contexts	Current policy as benefiting conventional producers and those traditionally holding power and having the potential to empower previously untapped potential
6.6 - Foreign and domestic interests in sustainable silk	Foreign demand as a potential catalyst for sustainable silk practice uptake

These six key findings constitute a comprehensive understanding of the factors affecting the scaling and hindering of niche practices within the current regime of the silk industry as well as landscape factors, such as public (policy) attention and demand trends in the fashion industry. These insights, together with insights into the elements making up and linkages between practices from chapter 5 and their contextualization within India's broader socio-economic and political dynamics for the groundwork for chapter 7. Chapter 7 seeks to answer the third research question, discussing methods of supporting alternative production practices within the industry's regime, explore lessons for understandings of other, similar sustainable transitions, and offer insights for similar theoretical approaches to the one used in this research.

6.1 The *ahimsa* ethos: the key factor in dividing production practices

This subsection builds from the results of chapter 5's dive into the first research question's examination of the meanings behind practices. It examines the linkages between practices at the nodes of the meanings that can and do bundle them together. The meanings behind views of the different materials produced through different production practices, and their impact on motivations for production are examined. The *ahimsa* philosophy, reducing environmental impact, and a focus on social sustainability are suggested as key motivating factors binding practices together. Drawing on insights from Chapter 5, the analysis here falls within the framework of combined lenses from practice theory and the multi-level perspective to explore how meanings associated with sustainable practices, coupled with material and competency barriers, shape the uptake and scalability of these practices within the socio-technical regime of India's silk industry.

Sustainable practices have been around for centuries and remain viable for those who engage in them. This begs the question of 'why more sericulturists and entrepreneurs don't take up sustainable practices?' Sustainable silk entrepreneurs, when asked about the slow uptake of sustainable practices and dominance of conventional production, reflected on a disconnect on the part of conventional producers with the phrase "they [the conventional producers] just don't get it [sustainable production]" being repeated in one form or another (Interview with sustainable silk entrepreneur, 2023). The philosophical differences resulting in the uptake of different production methods was further clarified by one entrepreneur saying: "the people doing 'normal' production view us [sustainable producers] as not serious business (Interview with sustainable silk entrepreneur, 2023)." The resistance to a shift to alternative practices

transcends the materials and competencies needed to engage in these practices. While sustainable silk products are materially different and have a different target demographic, they can be profitable and their market share, particularly in export markets, is growing (Interview with market expert, 2023). The motivation behind resisting this shift lies in the meanings behind these practices and the philosophies that underlie them. Another entrepreneur remarked regarding the attitudes of conventional producers: "they just want to make their money easily and move on. It doesn't occur to them that their [employees] may be struggling day in and day out or that their behavior is harmful to [the] environment (Interview with Sustainable silk entrepreneur, 2023)." The *ahimsa* philosophy coupled with a commitment to social sustainability, through paying workers a fair wage and having a less rigid hierarchy in the workplace or organization, embodies a radically different business strategy and keeps this bundle of practices distinct.

Entrepreneurs routinely brought up the philosophical difference between sustainable and conventional bundles of practices. This difference is seen most starkly when their respective aims are considered. While conventional producers seek profit above all else, sustainable producers have broader aims. A silk entrepreneur who used to work in conventional production reflected on this difference in aims stating: "I have a whole community of people who rely on me and that I have to talk care of… between the weavers, growers, tailors and so on, I have to worry about them all (Interview with Sustainable silk entrepreneur, 2023)." This entrepreneur has employees in three states and expressed both pride and concern at her responsibility for their livelihoods. She also contrasted the stark difference in living conditions for employees of conventional and sustainable silk enterprises. Expressing the dismay she felt seeing how her charges in her role in her previous, conventional enterprise were living and their difficulties supporting their children, she reflected on her own experience raising children and her gratitude to be able to provide for them and help others provide for their children. Another entrepreneur, with production in both Assam and Kashmir, expressed her pride in being able to provide a living wage for her employees saying, in reference to both her silk and wool producers: "It's really the best part of what I do: seeing smiling faces… and helping them to provide for their own families (Interview with Sustainable silk entrepreneur, 2023)."

The differences in materials and competencies described in the previous chapter represent barriers to a shift towards sustainable production. Interviews with entrepreneurs, however, suggested that the meanings associated with practices are the key factor dividing bundles of conventional and sustainable production practices and serve as the major barrier to shifting between them ("they just don't get it"). This trend conflates with the relative importance placed on materials by most consumers, especially domestic ones, who value the sheen and form-fitting, draping qualities that conventional silk displays (Interview with Sustainable silk entrepreneur, 2023).

Competencies can be developed and exported, and materials can be subsidized and made more broadly available, especially with a rising demand for sustainable products and a boom in the wedding industry in India. However, without a shift in the ethos driving alternative production, such efforts would be in vain. In the long-term, barring major technological

breakthroughs, a slow process shifting motivations in production will need to occur to get conventional producers to shift between bundles of practices. To facilitate that, in the short term, the lack of awareness and distorted view of sustainable practices will need to be addressed alongside the greater (perceived) risk of switching, often within the lens of the ethos of current, conventional production. The economic value of sustainable production needs to be shown alongside its social and environmental principles to demonstrate to conventional producers that, in switching to these practices, they can still run profitable businesses. In luring new entrants to the textile industry to sustainable production practices, the existing alignment with the ahimsa ethos held in demographic groups to be explored in the following chapter can be leveraged.

6.2 Gender and development:

The previous section outlined how the ahimsa ethos drives alternative practices and keeps them distinct from conventional ones. Sections 6.2 and 6.3 examine the alignment with this ahimsa ethos that is far more prevalent in women, racial minority groups, and rural dwellers than in demographic groups that have historically dominated the silk industry. These three demographic groups have historical relationships to alternative practices and face societal barriers to engaging in conventional practices. Silk production intersects in this way with gender norms and broader social hierarchies that are especially rigid in the Indian context. Increases in agency and economic opportunity of these groups will contribute to the uptake of sustainable silk practices. This subsection will discuss the experiences of women in the sustainable silk industry, their predisposition to these practices, and the intersectionality of gender issues with silk production practices. Strategies to provide these *ahimsa* aligned populations with the agency and opportunities they need to engage with sustainable silk practices will be discussed in chapter 7.

Women in India, as discussed in chapter 3, face significant challenges in finding work outside of the home, where they bear a significantly larger share of responsibilities, and face significant barriers in progressing up the ladder when they do. Conventional practices, in the silk industry and in other Indian industries, rooted in a traditional, hierarchical socio-economic system tend to exclude women and minority groups, with particular divergences seen at top positions and in the agricultural sector (Das, 2000; Unni and Rani, 2003). As a result, India has one of the lowest rates of female participation in the economy in the world. In Assam, the work participation rates are similar to those seen in the rest of India and stand at 53.6% for men and only 22.5% for women (North Eastern Council, 2015). Sustainable silk processes are more process oriented and less profit centric, providing diffuse benefit sharing and a dignified working environment. Socially sustainable business practices have been shown to appeal to women more than men, particularly within a culture where men are expected to earn money and provide for their families and their financial needs (Jamali (2009); Interview with 2 sustainable silk entrepreneurs, 2023). Women, in general, looking at the sustainable silk industry face twin incentives of simultaneously being pushed away from the discriminatory practices associated with conventional production and attracted to more inclusive, sustainable practices.

While a bundle of production practices within a space protected from practices dominant in a regime characterized by rigid social hierarchy may be more attractive and inclusive, women engaging in them still face challenges. When moving outside of the protected environments of these practices, these challenges become apparent, illustrating both the value of these practices to women as well as the uphill battle still to climb. One female entrepreneur engaged in this work described her experience in engaging with government and bank officials in depth, underscoring repeatedly the difficulties she faces in being taken seriously. She described her strategy for loan or government grant application interviews saying, "I take along a junior, male employee that can't speak Hindi or English just to sit next to me during meetings (Interview with sustainable silk entrepreneur, 2023)." Saying nothing and simply lending the legitimacy that his maleness provides, boosted prospects for a loan application or application for a government grant targeted at female entrepreneurs. While alternative practices may be more attractive to women who are excluded from or subjugated within conventional production practices, at ground level, they still face unique challenges once engaging with them that are typical to the Indian context and the regime of the Indian textile industry.

The relative attractiveness of these sustainable practices to women was illustrated by a silk entrepreneur who made the crossover from conventional to sustainable silk production. She described the disconnect she felt with her previous employer and her work in conventional production, the connection between her domestic responsibilities and her decision to switch between practice bundles, and her motivations and experiences in her current work. As she spoke about her current work, she beamed with pride in discussing her ability to provide a dignified work environment and livelihood for her tailors, weavers, and silk producers. She remarked: "I do what I do for them (Interview with Sustainable silk entrepreneur, 2023)." That ethos of working for a goal greater than self or profit was apparent. She reflected on the moral disconnect she experienced with her previous employer and described her current work as "far more fulfilling (Interview with Sustainable silk entrepreneur, 2023)" and discussed this in relation to her experience as a mother raising children. She highlighted her heightened sense of empathy for her employees and their children after having children of her own as well as her experience as a working mother. She detailed her experience as a working mother in India stating:

> *I'm responsible for everything every day. From the moment I wake up, I'm getting the kids ready for school and directing the household [staff]. Then I have all my responsibilities here [at work]. And I'm still expected to make sure dinner is ready and take care of my children's grandparents. (Interview with Sustainable silk entrepreneur, 2023)*

This sense of responsibility demonstrates the interplay between gendered social expectations and entrepreneurial practices. This responsibility, cultivated through her domestic roles, informs her workplace ethos, fostering inclusive goal setting and benefit sharing structures. As Jamali (2009) notes, female entrepreneurs in developing countries are more likely to prioritize socially responsible business practices, aligning their goals with broader community

well-being. This ethos is reinforced by the cultural and economic barriers women face in conventional industries, which push them toward sustainable practices that provide more equitable opportunities (Das, 2000). Such practices reflect an extension of the caregiver role into the professional domain, where female entrepreneurs leverage their values to create dignified and supportive workplaces. These findings underscore the transformative potential of women's participation in sustainable industries like silk production, where their leadership can shape not only business outcomes but also social sustainability.

The broader benefit sharing that comes from this ethos was also apparent in the operations of a German silk entrepreneur with operations in both Kashmir and Assam. She doesn't have children or the responsibilities that come with being a mother in an Indian family, yet her focus on providing livelihoods for employees is clear. The same shared ethos shone through her discussion of the benefit she can provide for her employees. She stated "I'm not sure where they would be without us [her business]. There really are not that many good opportunities here for people, especially for work where they are respected. […] It really makes me happy that we can give them a fair wage and shelter (Interview with sustainable silk entrepreneur, 2023). This commitment to social sustainability dovetails with the environmentally sustainable practices used to produce their alternative silk products. The gendered behavioral conditioning that leads women to be more inclusive and in line with the ethos behind sustainable production practices is manifested in the examples of female entrepreneurs presented above (Jamali, 2009). The female entrepreneurs interviewed in this study all highlighted the opportunities they provide to (rural) women working throughout their supply chains as silkworm rearers, weavers, dyers, and processers. This, combined with their exclusion from conventional practices, predisposes women to these groups and places them in a key role in supporting the uptake of these practices in Assam and beyond. By contrast, a factory visit to a female-owned conventional production facility showed no women working in the production process and only 2 of 20 workers in the office being women (Interview with Conventional silk entrepreneur, 2023).

In addition to a shared ethos, the female entrepreneurs interviewed in this study identified similar challenges in their work due to gender-based discrimination in India. Avenues to address these challenges and channel this shared ethos will also be explored in chapter 7. The knowledge base for alternative practices, particularly the unique practices around the spinning of eri silk and the weaving and finishing processes, lies with rural dwellers and racial minorities, and mostly within the women of these communities. These groups are thus essential in the production of alternative products. Following the exploration of the experiences of female entrepreneurs in this space, the next section will examine the impact of the experience of rural and racial minority groups on the scaling of the industry.

6.3 Minority groups and access to resources

The rural women holding the bulk of the traditional knowledge base of these practices largely belong to racial and tribal minority groups located on the edges of the periphery of power in India. The northeast is already, by far, the poorest region in India, and the rural areas

within this region form the most disadvantaged parts of the northeast (Ministry of Statistics & Programme Implementation, 2023; North Eastern Council, 2015). The ethnic and tribal groups in the northeast are distinct from the ethnic groups originally from the north and central areas of the country that dominate its politics and its socio-economic hierarchy. These scheduled tribe groups, as they are recognized by the government, are indigenous peoples who have been historically disadvantaged (Gupta, 2017). These marginalized groups have and have had limited access to resources and opportunities in conventional industry, including in conventional silk production (Interview with Sustainable silk entrepreneur, 2023; Interview with Market expert, 2023). This, together with the traditional knowledge they hold, can predispose them towards alternative, sustainable practices. This subsection will discuss the experiences of these groups in sustainable silk practices and their effect on the uptake of sustainable silk practices. Chapter 7 will discuss means to promote agency for these groups and greater access to these practices and the potential, subsequent impact on the sustainable transition of the silk and garment industries.

Several government schemes have been set up to rectify the gap in economic opportunity these groups experience, but the on-the-ground reality is that these groups experience great difficulties in accessing the resources these schemes promise due to language gaps, corruption, unnecessarily complex application processes, and layers of bureaucracy (Interview with Market expert, 2023; Interview with Market expert, 2023). Schemes designed to address the inequality faced within these groups center around reserving places in universities and private enterprises for members of scheduled tribes and castes. However, such schemes tend to pass over those with the least amount of education that may not be literate, aware of the schemes, or aware that they can avail themselves of such resources.

Rural dwellers live far from the government offices, located in urban areas, that are designed to serve them. The difficulty presented in transporting oneself to these locations repeatedly to complete the complex processes needed to secure government subsidies is enough to discourage many from attempting it (Interview with Sustainable silk entrepreneur, 2023). Both geographical and socioeconomic class divides play a role in this. For rural dwellers, traveling away from a small settlement to an unfamiliar city to meet a government bureaucrat, who may or may not speak their language, is a daunting task. If they make it that far, they are met with stringent regulations, corruption, time delays, and no guarantee of receiving aid they may be entitled to (Interview with Sustainable silk entrepreneur, 2023; Interview with Market expert, 2023).

When rural dwellers and minority groups do encounter government officials or conventional producers with the capacity to bolster their agency, they often face racial, socio-economic, religious, or caste-based discrimination (Interview with Sustainable silk entrepreneur, 2023; Interview with Sustainable silk entrepreneur, 2023; Interview with Market expert, 2023). The power dynamic that has held them at the periphery of society is reinforced as they are locked out of economic opportunities within conventional production, due to high startup costs for potential entrepreneurs, or discrimination, in the case of potential employees. In looking

towards government initiatives intended to promote agency for these groups, severe discrimination is once again a hindrance.

Two radically different views on this power dynamic were on display in two Interviews, one with a female entrepreneur in sustainable silk working in rural communities in Assam, and another with a male entrepreneur working in a more industrialized context in two major cities, Kolkata and Siliguri, with both eri and conventional mulberry silks. The aforementioned female sustainable entrepreneur engaged with rural communities took an extremely skeptical view of the government and its outreach to these disadvantaged groups, alleging corruption, severe discrimination, and stating: “they [state and local governments] simply don’t care” (Interview with Sustainable silk entrepreneur, 2023). By contrast, the male entrepreneur located in an urban context expressed his trust in the government, its environmental initiatives (mentioning the Clean India initiative), a reduction in corruption, and access to small amounts of state support (Interview with Sustainable and conventional silk entrepreneur, 2023). India has undoubtedly changed in the past few decades with corruption, at a local level, seeing a decline and environmental initiatives beginning to take form (Interview with Market expert, 2023; Interview with Market expert, 2023). These differing views highlight the uneven reach of governmental support, favoring those closer to urban centers and political power while excluding those on the periphery.

Unlocking the potential of rural sericulturists and minority groups requires dismantling systemic barriers at multiple levels. At the niche level, promoting access to sustainable practices can help bridge the gap between traditional knowledge and broader industry participation. At the regime level, targeted interventions, such as simplifying subsidy applications and reducing corruption, are necessary. Finally, at the landscape level, broader societal shifts toward equity and sustainability can be leveraged. Chapter 7 will discuss recommendations to achieve the unlocking of this potential.

6.4 Educational institutions

Given that the skills needed to participate in alternative silk practices are relatively complex, people considering becoming involved in them that do not have an established background in them need an avenue for skill development throughout the production process. Interviews with educators in the textile sector sought to uncover possible avenues to support the paving of these avenues. If sustainable silk practices are to be scaled, the infrastructure needed to support them must buy in and be scaled as well.

Practical education in the textile industry is heavily involved in the education of future weavers, dyers, and entrepreneurs. These institutions support conventional production through skill development. Given the budding trend of sustainable production methods, more attention is being given to sustainable production methods. This attention, however, is more concentrated in coops that directly interface with current alternative producers than in institutes training new producers and entrepreneurs that come to study in a more formal degree program. The head of

a textile institute in Assam's provincial capital that educates thousands in dyeing, weaving, spinning, and other practices expressed support of the movement towards sustainable production, citing its recent success in generating revenue abroad. He also mentioned his and his friends' affinities for eating eri silkworms "fried with salt and spices" (Interview with Director Textile Institute, 2023). He also expressed some skepticism for sustainable silk's potential for scaling. While the institute largely focuses on conventional practices, courses incorporating sustainable processes were being added. The dyeing department, which teaches practical lessons on the chemistry of the dyeing process, had incorporated lessons on the use of natural dyes. In speaking with a professor in charge of instructing students in the weaving process, a main point of pride, and the subject of his book, which he was kind enough to gift the researcher a copy of, dealt with the construction and use of the traditional Assamese handloom (Interview with Weaving Machines Professor, 2023). Other professors around the campus were eager to discuss their work in detail, and students were tangibly excited about the work they were doing (Interview with Dyeing Processes Professor, 2023; Interview with Weaving Professor, 2023; Interview with Processing Professor, 2023). The textile institute focuses on the art of processing textiles with a minor emphasis on the agricultural practices that produce them (Interview with Director Textile Institute, 2023). Government cooperatives, set up by the state government around the region, seek to promote these practices.

Several government-led cooperatives around rural Assam were visited as well. These cooperatives are set up to produce eri and mugga silk and disseminate information around them (Interview with Silk Producer and Processor, 2023). Silks are not woven into garments at these facilities as the practices they engage in end with the processing of silk cocoons (where the textile institute begins its work) to be sold to textile manufacturers. The process of growing feed, rearing eri and mugga silkworms, and harvesting fibers was on display (Interview with Silk Producer and Processor, 2023; Interview with Cocoon Producer, 2023). Community engagement at the hyperlocal level, in the form of teaching sessions given for local sericulturists, aimed to promote these practices. Examples of practical knowledge being transmitted included how to fertilize and protect feed plants with natural mulches, how to substitute different feed sources when castor plants were not available, and how to support silkworms throughout their life cycle (Interview with Government Coop Director, 2023). Another employee was in charge of the processing of the silk and demonstrating the process to new entrants (Interview with Silk Processor, 2023). These cooperatives varied greatly in size. One cooperative located in a rural town was an educational and community outreach facility, consisting of two small buildings, one for housing silkworms gorging on feed plants and another for meetings. Another facility, the size of several hectares, located just down the road from the textile institute in a semi-urban location, in addition to interacting with the community, produces enough eri and mugga silks to make it one of the largest sustainable silk producers in the region (Interview with Silk Producer and Processor, 2023). It also housed several educational buildings designed to showcase production practices. It is located adjacent to the head office of the Assamese Central Silk Board, which regulates, measures, and supports silk production throughout the state. One head of such a coop, after a tour of his facility, shared: "The [local] government is very interested in eri and mugga production. They set up farms like this one all over the area to generate money

for it [the government] and help others [external producers in the industry]" (Interview with Silk Producer and Processor, 2023).

In both the government coops and the textile institute, employees were eager to share knowledge and put their work on display, especially for a foreign researcher. The textile institute, while still part of a trade school, was a significantly more academic institution than the cooperatives. The languages used at the textile institute and the cooperatives gave significant insight into the groups of people engaging in specific practices. In the cooperatives focusing on agriculture and silkworm rearing, the employees communicated primarily in the local language, Assamese. The cooperatives utilized more community outreach sessions and one-off educational sessions rather than long-term curricula. Higher-level employees spoke some Bengali, the language of the neighboring and far more prosperous state of West Bengal, which has a great deal of influence in the region. English was nonexistent except for signs, and Hindi, the lingua franca of India, was rarely heard as well. English, at the highest level, and Hindi are the languages in which business is generally conducted in India. These languages, especially in peripheral states such as those in the northeast, are rarer to hear and connotate education and social statuses.

The textile institute had administrators and professors who could communicate effectively in English, and classes were largely in either English or Hindi. Assamese could be heard in communication between students, but it was not the primary language of instruction. Learning was also far more standardized, with students donning uniforms, carrying schoolbooks, and paying fees to the institute for their studies. The contrast in learning atmospheres highlighted by the instructional languages suggests that the more creative and more lucrative practices taught at the textile institute were reserved for a certain category of practitioner already possessing a degree of privilege demonstrated by their education level and the money to pay school fees. This gap in accessibility for rural or undereducated people who, due to a lack of transportation resources or language skills, cannot engage in the education needed to learn these practices must be addressed to scale alternative practices.

Simultaneously, the students at the textile institute, despite the proximity of a large coop, are not exposed to the agricultural basis from which the materials they are being trained to work with are produced (Interview with Director Textile Institute, 2023; Interview with Processing Professor, 2023). As the implementation of alternative practices depends on an understanding of the entire production process, and given the ahimsa ethos driving the convergence of alternative practices, breaking down the siloed nature of these educational systems could have a compounding effect. Encouraging and facilitating contact between the target groups of the textile institute and the coops would allow for the diffusion of information and skills and connect potential partners.

While promoting female engagement in alternative practices, especially at the entrepreneur level, seems to positively impact the uptake of socially sustainable alternative practices, the involvement of rural people in production practices higher up the value chain will increase the talent pool of potential entrepreneurs and allow for scaling from the bottom up.

Connecting people predisposed to the ethos behind alternative silk practices would facilitate partnerships with the potential to catalyze the transition to alternative practices. The potential for scaling these practices will be further discussed in Chapter 7.

The motivations and specifics of policy decisions that promote these cooperatives and the textile institute will be explored in the next subsection. The policy context that supports these niche practices is discussed within the context of the sustainable transition they have the potential to usher in.

6.5 Sustainable silk practices and their policy context

Despite the increased attention alternative silk practices are receiving, they are still niche practices. Policy and broader economic shifts have the potential to greatly impact the uptake of these practices and their subsequent ability to contribute to a sustainable transition. The signals that the regional and federal governments give, through policy, impact the attractiveness of practices by altering the capital and other materials needed to engage in them, the ability to gain competencies, through education related to them, and their meanings, through real and perceived accessibility barriers. At present, the policy context in India heavily favors conventional production. India's silk-producing states are regulated by central silk boards specific to each state. These silk boards assist, financially and practically, with silk production, focusing almost entirely on conventional silk, the most popular and lucrative silk in India (Interview with Textile Industry Expert, 2023). These silk boards are set up to promote economic development and focus on generating profit with little regard given to sustainability initiatives (Interview with Market Expert, 2023). Financial assistance schemes are available to silk producers, to female-owned businesses, and to businesses owned by minority communities. However, accessing these schemes requires onerous levels of paperwork and patience in return for a small chance at assistance (Interview with Sustainable Silk Entrepreneur, 2023; Interview with Sustainable Silk Entrepreneur, 2023). For women and minorities applying for grants that target them, they can still be subject to intense discrimination by government bureaucrats that handle their applications (Interview with Sustainable Silk Entrepreneur, 2023). Enterprises employing sustainable silk practices have significantly higher labor and material costs, making them less attractive to a lending institution evaluating them with an orthodox mindset (Interview with Sustainable Silk Entrepreneur, 2023).

The ahimsa philosophy, within the context of the current Indian government, has the potential to impact policy. This philosophy was espoused by India's patriarch, Gandhi, and dovetails with the hardline philosophy of the emboldened Hindu nationalist right currently in power. The BJP has been very successful in implementing extremely controversial policies at the federal and state levels, providing an unprecedented level of attention and follow-up in policymaking and enforcement, down to the local level (Interview with Market Expert, 2023). The BJP has outlawed beef consumption in several states in decisions based upon their (controversial) interpretation of Hindu philosophy. A policy based on restrictions or limitations on certain practices, due to the morals (meanings) behind them, could have a massive impact on the conventional silk industry. Given the popularity of conventional silk in Indian culture, and

the demagogic nature of the party, this will be difficult to achieve. However, the actions of an extraordinarily effective political organization built around a religious ideology opposed to the harm of animals and subject to a cult of personality around an extremely influential and popular leader are difficult to predict (Interview with Sustainable Silk Entrepreneur, 2023; Interview with Market Expert, 2023).

Policy has the potential to steer practice emergence, and socially and environmentally optimal practices will need support to emerge and scale. The factors that determine how policy can encourage production methods that involve fewer externalities for conventional producers and new entrants, at the practice element and linkages level, will be discussed in Chapter 7.

6.6 Foreign and domestic interests in sustainable silk

Demand for silk products plays a significant role in determining the practices producers engage in. Demand has shifted over the past decade and a half as alternative practices have become more attractive in foreign markets and the overall size of the silk industry has grown (Interview with Textile Industry Expert, 2023). The economy can be conceptualized as shaped by interlinked practices across the demand and supply divide. An examination of consumer behavior in the consumption of sustainable silks, silks in general, or luxury goods are all subject areas warranting entire research projects. This section aims to provide a brief analysis of demand trends as they relate to sustainable silk to allow for a better-informed discussion of the future of the silk industry and its sustainable transition in the following chapter. Demand is a difficult concept to measure and predict, particularly for the garment producers dependent on it, yet it remains one of the most important factors in producers' decision-making processes.

Demand for Indian silk products will be analyzed into two distinct groups: foreign and domestic. These two demand trends have different motivations and projections, with foreign demand exhibiting greater interest in sustainable products. Demand must also be divided between demand for conventional, mulberry silk and demand for alternative silks. Demand for both is growing, but the degree to which their respective growths will continue in the long term is dependent on several factors, including the factors affecting the uptake of alternative practices that have been explored previously.

A major determinant of silk demand, especially for alternative silks, is foreign demand. Alternative silks are dependent on foreign demand due to the higher price of these products that wealthier, foreign customers are more prepared to pay; a greater appreciation of the understated and unique characteristics of alternative silks; and a more conscious approach to the environmental and social impacts of production practices and the ethos behind them. Foreign customers have capital, a material element of purchasing practice; a competency of sustainable production practices themselves; and a meaning shown in their preference for goods that are produced sustainably. The segment of foreign customers for whom these three elements of purchasing practices of alternative silks come together is the target market for these products at present. The major barrier for growth within this target group is awareness of

the existence and details of these products within a garment market that is saturated with fabrics (Interview with Sustainable Silk Entrepreneur, 2023; Interview with Sustainable Silk Entrepreneur, 2023). One silk entrepreneur, in an interview just before she left on a trip to Germany to promote her brand, described the challenge of introducing unfamiliar consumers to sustainable silks, their distinctiveness, and their value (Interview with Sustainable Silk Entrepreneur, 2023). She expressed a deep frustration in developing a consumer base in India and discussed how this was much easier in the West, where consumers typically value sustainability and unique products more. Another entrepreneur mentioned her success in partnering with art museums in Western Europe, leveraging the sustainability and ancient craftsmanship involved in this work (Interview with Sustainable Silk Entrepreneur, 2023). A pathway to generating additional foreign revenue would be to raise awareness regarding the ethos and impact of sustainable production practices, especially when compared to conventional silk practices. Altering the materials of foreign consumers would not be feasible, but altering preferences via the meanings that underlie them is achievable over time through making the ethos and impact behind the products clearer.

Demand for alternative silks is more difficult to promote at the domestic level. Firstly, increasing awareness about the existence of the product will generate fewer returns as these products are better known in their country of origin, and the materials, competencies, and meanings behind alternative products are less compatible with those of Indian consumers. At the material level, the Indian consumer is very price-conscious, rendering a (finished) product that can cost around 30-50% more unaffordable (Interview with Market Expert, 2023). In general, Indians are less likely to question or place value on the production practices behind products than foreign buyers, with an exception being strict adherents to certain religious groups, some of whom abstain from animal products altogether. At the meaning level, the sheen that conventional silk displays is valued highly, especially for sarees for weddings. Weddings are opportunities for Indian families to show their wealth and opulence (Interview with Sustainable and Conventional Silk Entrepreneur, 2023). The silk saree and its aesthetic are deeply ingrained into Indian culture (Interview with Textile Industry Expert, 2023). Therefore, at the material, competency, and meaning levels, alternative silk products are less compatible with domestic consumers than foreign ones. This disconnect suggests that the already small domestic customer base is unlikely to grow. Niche markets within India have been identified by some entrepreneurs, mostly in the wealthy, highly educated Delhi suburbs where denizens have tastes, spending habits, and values that mirror those of consumers in the United States, Western Europe, Japan, and South Korea (Interview with Sustainable Silk Entrepreneur, 2023).

As most Indian silk is sold domestically, conventional practitioners with established links to domestic retailers and an understanding of the tastes of their customer base will be unlikely to transition to alternative practices. Connections to foreign customers are difficult and expensive to generate and fall outside of the direct competencies of these producers due to language barriers and unfamiliarity with the market and its aesthetic. Conventional practitioners doing well will thus require deep incentives to transition in the face of these obstacles, and new entrants would benefit greatly from forming connections with foreign buyers.

6.7 Conclusion

The transition to sustainable practices is multifaceted, involving a complex interplay of motivations, barriers, and socio-economic factors. Despite the proven viability and growing market share of sustainable silk, the uptake among sericulturists and entrepreneurs remains limited, primarily due to philosophical divergences and entrenched conventional business strategies that focus on profit maximization and standardization. The *ahimsa* ethos and commitment to social and environmental sustainability differentiate sustainable practices, and these values clash with conventional production priorities. Entrepreneurs' insights underscore a resistance to alternative practices, not just in terms of materials and competencies, but more significantly in their underlying meanings, philosophies, and resulting business strategies.

Demographic factors, particularly the overrepresentation of women and minority groups in sustainable silk production, highlight an alignment of alternative practices with the values and circumstances of these populations. The gender and development subsection illustrates how sustainable silk production intersects with gender norms, offering women and minorities opportunities that are often denied in conventional practices. The role of educational institutions and policy context is critical, as they can provide the necessary skills, interface across traditionally siloed groups of practitioners, and policy support to facilitate the transition to sustainable practices. However, accessibility to these resources remains a challenge for rural and minority communities.

The subsections on minority groups, educational institutions, and policy contexts emphasize the need for inclusive policies and educational support to unlock the potential of these groups. The interlinked nature of the economy, policy, and demand dictates the success of sustainable practices. While foreign demand for sustainable silk is driven by ethical and environmental considerations, domestic demand is hindered by cultural preferences and price sensitivity.

The chapter sets the stage for Chapter 7, which will synthesize the results and discuss strategies for promoting sustainable silk practices on a broader scale, ensuring that the economic, environmental, and social benefits are realized. The need for a paradigm shift in production ethos among conventional producers and the amplification of sustainable practices' economic value are pivotal for this transition. The promotion of sustainable practices must therefore be multifaceted, targeting not only the material and competency barriers but also the philosophical and informational disconnects that currently inhibit the widespread adoption of these practices.

7. Implications for Broader Sustainability Policy and Research

Building on the insights from Chapter 6, which analyzed the regime and landscape level factors shaping the adoption of sustainable silk practices, this chapter turns to the third research question by synthesizing these findings into actionable policy recommendations and lessons, offering a roadmap for scaling these practices within India's silk industry and fostering a sustainable transition. These recommendations are offered through the dual lenses of social practice theory and sustainability transition theory's MLP The MLP is leveraged to analyze pathways to support niche practices as they come into contact with the industry regime and adapt to landscape factors. Following the discussion of these practical implications for the silk industry's sustainable transition, this chapter pivots to discuss the academic contribution of this study. Section 7.2 outlines the academic contributions of the study by demonstrating how it advances from empirical, theoretical, and methodological perspectives in the fields of sustainability transitions and social practice theory.

Sustainable, niche practices contrast sharply with the industrialized, resource-intensive practices prevalent in the larger silk industry. The study also highlights the potential role of cooperatives and local governance structures in supporting sustainable transitions, as well as the socio-political barriers, such as access to resources and educational support, that limit their widespread adoption. With these findings in mind, this discussion aims to synthesize the lessons learned for broader sustainability research and policy, as well as to suggest future areas of research that could enhance the understanding and effectiveness of sustainability initiatives in similar industries.

7.1 Practical Implications

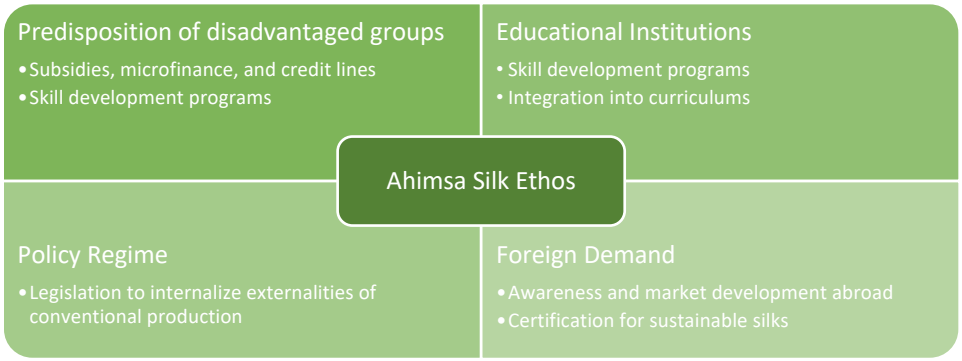
This study provides insights into the sustainable silk production practices in India, which hold significant implications for policymakers, practitioners, and stakeholders within the silk and textile industry. Chapter 6 highlighted alternative silk production practices, the competencies, meanings, and materials that constitute them, the practices with which they are linked, and the factors affecting their uptake, this chapter will now present and discuss lessons for the sustainable transition of the silk industry as well as lessons for other, similar academic studies.

As Geels (2002) describes, in the multi-level perspective, sustainability transitions require systemic changes that involve multiple stakeholders. This research calls for strategic niche management (Kemp et al., 1998), where alternative silk production can be supported through policies that provide for greater awareness, practical support, access to financial tools, and financial incentives. Having analyzed the dynamics of current practices and identify opportunities for growth, this section will zoom out to discuss niche production processes in the established regime and landscape (Nicolini, 2009, Castelo, 2021). These niches must be supported at the practice level and as practices scale up to challenge the industry's regime. Spurling and McMeekin (2015) suggest three pathways to achieving this: re-crafting practices,

substituting practices, and changing how practices interlock within socio-technical systems. Following from these pathways, supports for niche practices have the potential to catalyze change in the established regime within silk production (Geels and Schot, 2007).

The analysis in this chapter is predicated on insights from interviews with silk producers and industry, policy, and educational experts analyzed with together with a comprehensive understanding, generated through the literature review, of the policy, economic, and educational contexts and available tools. The integration of policy, educational, and economic initiatives comprises a comprehensive strategy for sustainably transforming the Indian silk sector. These initiatives, when applied holistically, create a robust framework for not only encouraging, but also sustaining the shift towards more environmentally friendly and socially responsible silk production practices. The figure below traces the key findings from the investigation in chapters 5 and 6 through to the recommendations, presented in bullets below each finding, with the *ahimsa* silk ethos centered as the driving force of these niche practices.

Figure 7.1.1 – *Linking key findings to recommendations*



Following from the key findings of chapters 5 and 6, which detailed current niche and conventional (regime) practices, and the holistic look at the Indian textile sector's context in chapter 4, the six interventions in Figure 7.1.1, above, aim to promote the sustainable growth of alternative silk practices. These six interventions form this study's answer to the policy part of the third research question, "What lessons can be drawn for broader sustainability research and policy," as it relates to the Indian textile industry and its regime. Four of the six interventions center around leveraging and growing currently existing silk production coops around the northeast to better promote sustainable silk practices. The keystone of these four recommendations is the expansion of coops that could serve as hubs to distribute materials, in the form of financial aid, physical tools, and inputs as well as competencies, in the form of knowledge sharing, with groups predisposed to the *ahimsa* ethos. This would serve to recraft and substitute practices for participants (Spurling and McMeekin, 2015). Knowledge sharing will also be reflexive with educational institutions as potential entrepreneurs and innovators connected, via these coops, to practitioners in the field. These coops can also serve as hubs for a certification scheme where product can be collected for export and production practices checked for adherence to standards.

After exploring the potential of these coops to influence the silk industry's existing regime, two avenues to increase the attractiveness of participating in them are presented in the sections 7.1.2.1 and 7.1.2.2 based on the current and projected dynamics of landscape level factors. The implementation of effectively enforced policies designed to internalize these externalities in the silk industry would change how governance and business practices interlock, and push (potential) conventional silk producers towards substituting these practices for other, sustainable ones (Spurling and McMeekin, 2015). Further developing interest in foreign markets with a greater willingness to pay for sustainable products is also suggested to increase potential profits and thus attractiveness for potential participants in these coops.

When interwoven, these initiatives have the potential to create a framework to support for sustainable silk production. The combined effect of favorable policies, better educated and skilled producers, and strong financial support can transform the Indian silk sector into a model of sustainable industry. This comprehensive approach ensures that sustainability will represent not just a temporary trend but a fundamental shift in the silk production paradigm, supporting a transition that is both environmentally responsible and economically viable. While this chapter sets forth a detailed overview of recommendations to increase the uptake of sustainable practices, future studies and lessons learned in practice should determine the exact nature of policy tools to be implemented. For example, the precise mechanisms for financial assistance, disseminating information or establishing and enforcing certification standards will need to be determined through experience and further studies.

7.1.1 Building out robust coop models

Cooperatives, when built out, have the potential to disseminate and facilitate the sharing of materials and competencies for sustainable silk production. Under the model proposed in the following four sections, existing coops would be expanded upon to serve as a central link between sustainable silk practitioners and the outside world for their inputs and skill development as well as the distribution of finished garments. At present, cooperatives are run by the state government's silk board in Assam and seek to promote eri and mugga silks due to their cultural heritage in the region. These cooperatives also often have small, well run silkworm rearing operations aimed at generating a supplemental revenue stream (Interview with silk producer and processor, 2023, Interview with Government coop director, 2023). The scale of such operations varies greatly between cooperatives. Leveraging their practical knowledge and networks is a highly efficient way to spread awareness around these practices. Currently, such cooperatives function more as cultural heritage centers than centers for business development. They offer exposure to those who seek them out, yet do not leverage their networks and provide equipment, in-depth education, and capital needed to convert current producers or attract new entrants. Therefore, broadening the strategy of these coops and expanding their footprint would position them to serve as bases for capital allocation via subsidies and microfinance, the development and enforcement of certification schemes, and education and skill development. This outline is presented in Figure 7.1.1.1 below.

Figure 7.1.1.1 – *Expanded cooperative models*

This graphic shows cooperative models as the centerpiece of and mechanism for supporting niche practices in challenging the industry's regime. Subsidies and microfinance have the potential to provide physical resources to those disposed to the *ahimsa* ethos that have long been denied them. Skill development programs seek to disseminate competencies that allow new entrants to confidently enter sustainable practices and existing producers to vertically integrate their production. Integration into the curriculums of educational institutions will allow for reflexive knowledge sharing between professors, students and rural practitioners, with the potential of inspiring and distributing technological advancements. A certification system aimed at increasing awareness and value in lucrative foreign markets and organizing these coops, is uniquely suited to promoting sustainable silk production practices, given coops' positions in communities with populations that share the *ahimsa* ethos and that have historical and cultural ties to (sustainable) silk production.

These government coops also employ people who can communicate in Hindi as well as local languages given their function as community liaisons for cultural heritage preservation (Interview with silk producer and processor, 2023; Interview with cocoon producer, 2023; Interview with government coop director, 2023; Interview with silk processor, 2023). Given their on-the-ground presence in relevant communities, expertise in sustainable practices, and linguistic, educational, and logistical capabilities, these coops can play a critical role in disseminating information, financing, organization, and skill development to potential sustainable silk practitioners predisposed to the *ahimsa* ethos. The following four subsections will detail the aspirations of expanding coops.

7.1.1.1 Microfinance, credit facilities, and subsidies

Government cooperatives can play a pivotal role in addressing financial barriers for marginalized producers in sustainable silk production. Rural silk producers, particularly women and minority groups, often face limited access to traditional financial institutions due to geographical isolation, societal discrimination, and bureaucratic complexities (Interview with

sustainable silk entrepreneur, 2023). This lack of access impedes their ability to adopt sustainable practices, which frequently require upfront investments in materials, equipment, or training.

Providing financing via smartphone platforms would circumvent the need for traditional, brick-and-mortar banks to serve these communities and the barriers they represent (Interview with 2 sustainable silk entrepreneurs, 2023). Availing the services of a traditional bank would also require travel from rural areas to urban ones, which can be logistically difficult, expensive, and intimidating, especially for members of the target demographic. Once there, interacting with bank officials, in the context of a hierarchical culture laden with vestiges of the caste system, in a business lingua franca with which one may not be comfortable, presents further barriers. Traditional banks are far less economically efficient in dispersing capital earmarked for these target groups given the fixed costs of traditional models (Interview with market expert, 2023). Therefore, dispersing grants or loans via online banks would be most effective in reaching the target demographic and provide the most cost-effective way of dispersing earmarked funds

Despite the access advantages that smartphone-based fintech solutions may provide, financial and digital literacy as well as access to smartphones in rural, northeast Indian communities remain major barriers. Given the role of existing government coops as trusted and embedded knowledge and resource hubs for silk producers, they could serve as hubs to disseminate knowledge around available subsidies and provide access to smartphones and internet banking services (Interview with market expert, 2023). These coops could bridge the divide across distant or unfamiliar financial concepts by explaining, through a trusted community member in the local language, the utility and instructions for these financial tools as well as providing the physical tool of a smartphone and internet access to those who lack it.

Subsidies for new entrants to sustainable silk as well as conventional producers making a switch will give potential *ahimsa* producers access to the capital they need to invest in materials needed in *ahimsa* production as well as potentially providing a way to mitigate risks. Such government initiatives would serve as a carrot to complement the stick provided by regulation and will work in tandem with certification programs to provide products consumers can be confident are sustainable at prices they can afford. In offering tax breaks and reduced rates for sustainable farming supplies, the government can lower entry barriers, making sustainable practices more economically feasible for new entrants and conventional converts alike throughout the production chain.

A grassroots effort to empower smaller producers would result in greater social sustainability and prevent an unfair market dynamic if subsidies were to be collected by larger, well-established firms with greater access to information and resources. This could also serve to stifle the proliferation of sustainable silk production practices at the rural level and reduce innovation and competition in the market. To combat this, a subsidy scheme could make use of the existing government coops and reliable, smartphone based fintech apps, building off the United Payments Interface, India's already well established, government-run online payments scheme (UPI) to disseminate and track subsidies. Coops would assist in reaching the target

demographic of female and minorities in rural communities, and leveraging India's robust digital infrastructure would allow, in addition to the dispersing of funds, the ability to track transactions on parameters of equity.

7.1.1.2 A certification scheme for sustainable silks

A certification program would serve to build a trustworthy bridge between sustainable producers and buyers who prioritize social and environmental sustainability in their purchases. This would serve to align meanings in consumption and production practices. Certifications for sustainably produced silk would signal quality and sustainability to consumers at home and abroad, leading to increased marketability and higher price points, satisfying both ethical and economic objectives. Such a scheme would need to be reliable and recognizable enough to provide value for consumers as well as standardized and adaptable enough to be accessible to producers producing a variety of sustainable silk materials. Therefore, one, clearly identified, certification label of sustainable silk products should be presented to consumers with specific production parameters for each sustainable silk type enforced on the back end, given the intricacies of each production process. For example, wild silks, such as tussar silk will differ extensively from eri and mugga silks in certification parameters as they are produced from different silkworms and feeds and harvested in a completely different manner.

Ensuring high quality standards across several disciplines is a complex task that will require incorporating voices involved in several different types of production, as well as from regulatory entities, such as local silk boards, and educational institutions. These stakeholders will be key to developing a certification that is accessible for producers, effective on environmental and social standards, and trustworthy for buyers. Expanded coops are proposed as hubs for such a certification scheme. Given their preexisting knowledge and staff working in sustainable silks, these coops are uniquely positioned to serve as certifiers of standards and collection and distribution hubs for producers seeking to reach lucrative markets, should they choose to sell under the certification.

7.1.1.3 Sustainable silk skill development programs

With coops serving as hubs for distributing financial and other material assistance to niche producers and certification schemes connecting producers and consumers with a shared ethos, skill development programs seek to leverage coops to disseminate competencies. Together with the integration of sustainable silk practices into the curricula of educational institutions, these initiatives seek to provide competencies for (potential) sustainable silk production, complementing initiatives to align meanings and distribute materials (Shove et al., 2012). These programs, centered around hands-on skills in sustainable sericulture, will build practical capabilities in new entrants and converts alike. The hands-on educational initiatives they are positioned to provide can bridge the gap between traditional practices and modern

sustainability requirements. Coops also serve as proofs of concept and stewards of ancient artistic traditions that have been passed down through generations (Interview with sustainable silk entrepreneur, 2023; Interview with sustainable silk entrepreneur, 2023; Interview with conventional silk entrepreneur, 2023). Potential new entrants and converts will be much more likely to engage in these practices when they are given exposure to a coop demonstrating these practices in action in their communities (Shove et al., 2012). Such coops will provide practical information on how they can engage in these practices themselves and exposure to examples of people from similar backgrounds that speak a common tongue that are engaged in these practices.

Training on sustainable production practices could focus on sustainable agricultural practices for both mulberry and castor feeds, silkworm rearing techniques, silk spinning for nonviolent silks, silk processing, weaving, and dyeing with sustainable materials (Interview with director textile institute, 2023). The most complex, novel, and technically skilled of these processes is the silk spinning process involving recombining the broken strands of a cocoon left behind by a metamorphosized moth (Interview with sustainable silk entrepreneur, 2023; Interview with sustainable silk entrepreneur, 2023). Each of these processes is a critical part of the sustainable silk production chain, but particular emphasis should be placed on training more spinners of these silks, as this skill-intensive process has few current practitioners given its exclusivity to the ahimsa process as it is not required in conventional production (Interview with sustainable silk entrepreneur, 2023); (Interview with sustainable silk entrepreneur, 2023).

Dyeing, weaving, and processing sustainable silks require slight modifications to accommodate thicker, recombined strands of silk treated with environmentally friendly chemicals and dyes (Interview with sustainable silk entrepreneur, 2023); (Interview with cocoon producer, 2023). Agricultural practices that do not involve chemical fertilizers and pesticides, and limit or eliminate irrigation, are also more labor and knowledge intensive. Training on the intricacies of dyeing and feed production practices can serve to fill needs in the value chain of sustainable silk production and mitigate the risk of failure among both new entrants and converts. Such practices, where value is derived from the higher skill level needed to produce feed or dye garments with fewer, non-polluting inputs, result in less stress on environmental resources and a higher wage for a more skilled laborer. Connecting practitioners with educational institutions and the professors, students, and researchers affiliated with them can serve to inspire innovation, both technical and social, in these ancient practices with the potential to expand these benefits.

7.1.1.4 Integration into curricula

While training programs and workshops offer immediate benefits by upgrading the skills of current producers, the long-term future of sustainable practices within the industry needs to take its place in the minds of future sericulturists, textile entrepreneurs, and textile engineers. The role of education is pivotal in ensuring the longevity of sustainable silk practices. Developing a curriculum that includes sustainable silk production not only educates the next generation of

sericulturists, but also embeds sustainability into the sector's DNA. Collaboration with educational institutions is key in this regard, integrating traditional knowledge with innovative sustainable practices. Coops can serve as a link between educational institutions and on-the-ground practitioners, allowing practitioners access to newly developed techniques and affiliates of knowledge centers avenues to test new techniques and theories.

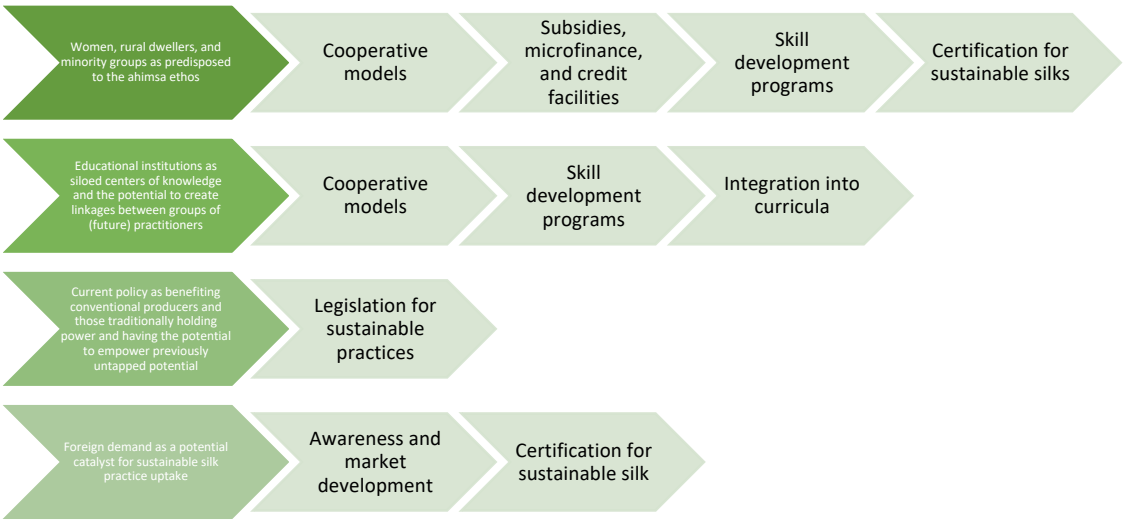
Supporting the success of the transition of this industry involves promoting the integration of sustainable silks into research on production practices and the development of blended and improved fabrics. Given silk's unique tensile strength, extensibility, and biocompatibility, it is being investigated as a promising component of medical products serving as advanced bandages or filters (Interview with weaving professor, 2023). Leveraging these characteristics of silk in novel, blended fabrics are also a key area of interest. Given, the differences, at the strand level, of the variety of sustainable silks available, including sustainable products in curricula would promote research into new applications of these products in fashion, medicine, and beyond.

As these coops take shape, having social scientists involved in developing and studying their structure will also allow for reflexive learning. Coops can gain insight into effective methods of benefit sharing, knowledge dissemination, and community engagement, while researchers would benefit from access to a potentially insightful and impactful case study in leveraging existing infrastructure. This would serve to generate further insights about the coop model relevant for other sustainable transitions and allow for further refinement of the sustainable silk coop model.

7.1.2 Making coop models more attractive

The previous four subsections outlined the form of an effective system of leveraging and expanding coops to disseminate materials and competencies to sustainable producers and connect them with consumers with aligned meanings. These initiatives would support niche practices in challenging the industry regime. Connections to educational institutions would help to refine this model, facilitate insights into the technical advancement of silk fabrics, and connect this model to other sustainable transitions. To deliver these materials and competencies to people predisposed to the meaning behind sustainable silk practices, recommendations will need to engage bureaucratic and hierarchical systems of governance in India. The following two subsections will focus on recommendations intended to leverage two landscape factors, increased domestic attention on sustainability and shifts in foreign demand for sustainable silks, to make coops more attractive. Figure 7.1.2.1 below presents the key results from this investigation and traces them through to the recommendations presented in chapter 7.

Figure 7.1.2.1 – *Key findings linked to recommendations*



The bottom two lines trace the last two key findings presented in chapter 6 to the initiatives that aim to catalyze the growth of these cooperatives by addressing landscape factors. The MLP will be operationalized to address these policy and economic issues that impact sustainable silk practices and the silk industry regime alike. The first recommendation external to the coops is implementing, and, importantly, given the Indian context, reliably enforcing legislation aimed at internalizing the externalities of silk production. The second is complementing this stick with a carrot in the form of cultivating demand in lucrative foreign markets. Cultivating foreign demand is linked with the development of a sustainable silk certification to inform potential buyers and help build brand value for sustainable silks and the coop model outlined in the previous chapter. Together, the formation of a strong, supportive coop network, with induced behavioral shifts will serve to generate a more societally optimal, environmentally friendly silk industry.

7.1.2.1 Legislation to internalize the externalities of conventional production

Legislation to promote a more sustainable, ethical silk industry seeks to address the harmful externalities of conventional silk production, using government regulation as a tool to promote the uptake of sustainable practices. In enforcing regulations that limit environmentally harmful activities, such as the misuse of pesticides and water pollution, producers are compelled to reconsider their production practices. Stricter environmental standards may necessitate investment in sustainable practices, aligning environmental stewardship with regulatory compliance. Regulatory interventions addressing the externalities of conventional production would even the playing field for sustainable producers and deliver a more societally optimal outcome. Such an outcome would be societally optimal because the costs to the state and populations in production areas of effluent from dyeing facilities, excessive water and fertilizer usage, and more would be internalized.

This command-and-control method targets conventional producers, who, as described in chapter 6, are largely not aligned with the ethos of sustainable production and generate significant financial benefits from conventional practices. They are also rarely in contact with sustainable producers, unlikely to take them and their practices seriously, and thus unlikely to change their own practices without external pressure (Shove et al., 2023). That pressure can be exerted by accurately pricing conventional goods and preventing externalities. While an investigation of the most effective ways to implement and enforce these policies could be the subject of another, standalone research project, potential areas where change could be affected were presented in chapter 4. Water, pesticide, and fertilizer use for mulberry production, effluent and energy use originating in dyeing facilities, and the killing process of the silkworms could and should be addressed by regulation. The introduction of subsidies and access to foreign markets, as previously discussed, would introduce a carrot to complement this stick, and a certification scheme for sustainable products could afford consumers more informed choices, cementing distinction in the market between conventional and sustainable products.

Such socially optimal policies designed to safeguard threatened water and soil resources when both are becoming degraded and scarcer, given climate change and increased food demands, are likely to emerge. The enforcement of these policies will be key to determining the emergence and withdrawal of bundles of practices.

Given the cultural context into which these policies would be enacted, enforcement and buy-in must be considered. While India has made major strides in combatting corruption and reducing pollution in some cities and regions, bribes and illegal point source, in the textile industry, and non-point source, in agriculture, remain very common (Interview with Sustainable silk entrepreneur, 2023; Interview with Market expert, 2023). As explored in chapter 4, initiatives of India's ruling party have made reporting and penalizing corruption in state and local officials easier and more commonplace (Interview with Market expert, 2023). To leverage these gains, playing on the *ahimsa* ethos and its link, in the form of its non-violent nature, to Hindu philosophy, could serve to win the hearts and minds of enforcement officials as well as people with the newfound ability to report them and hold them accountable.

Through effective policy implementation, new entrants to silk production as well as converts would be nudged towards sustainable practices via increased barriers placed on conventional products together with policy incentives towards sustainable production. This signal, especially if complemented with the coining of a reliable certification scheme would promote new entrants to sustainable production in addition to influencing existing, conventional producers to move towards sustainable practices.

7.1.2.2 Market and awareness development in target markets

Expanding the ability of sustainable silks to reach new, lucrative markets is key to its success. Without consumers willing to pay higher prices for more sustainably produced

products, especially in the industry's fledgling state, the movement towards sustainable production will not be able to sustain itself. Awareness campaigns, coupled with a certification system to build recognition and trust, will address the need for generating consumer interest among potential buyers who believe in the *ahimsa* ethos, the meaning, of sustainable silk products. Expanding market access to small, sustainable producers in the northeast is key to providing supply to satisfy the demand awareness campaigns seek to generate. This initiative focuses on the lot of small producers, which this research identified as most likely to engage in sustainable production, especially in the infant stages of the adoption of these practices. Setting aside a select few exceptions of well-connected actors, small producers need access to buyers that can only be achieved through aggregating their products with other producers. Establishing conduits, through the coop structure and bypassing trading houses and their markups, between local producers and international markets can ensure that sustainable practices translate into economic rewards, even at lower scales of production, making these practices more attractive to new entrants and small practitioners.

Using coops as trading hubs, could take many forms. These include communities merging their products under a given fashion label to leverage a brand and provide a greater product range or communities selling processed, sustainable silk to a distributor who requires quality standards and large volumes. In any such strategy, small producers will gain access and negotiating power by pooling their numbers.

Awareness campaigns play a dual role in educating the public and adding to a consumer base that values sustainability. These campaigns should focus on targeting consumers who are aligned with the *ahimsa* ethos, the meanings behind sustainable silk products. Through these campaigns, the environmental and economic benefits of sustainable silk, as well as the ethical and environmental issues with conventional silk, can be communicated to a wider audience, fostering a market that demands sustainable products. Two sustainable silk entrepreneurs (2023) interviewed discussed their own marketing campaigns in Germany and the Netherlands and others all remarked on their priorities in developing customer bases abroad.

Awareness campaigns to benefit sustainable silk practices should focus on markets in communities with the potential to appreciate the unique history and characteristics of *ahimsa* products and the social, ethical, and environmental impacts they make. Target markets also need to be able to pay a premium for these products for the industry to generate the revenue needed to shed the need for government support and become self-sustaining. Identifying the highest potential markets for these products and how to engage them could be the subject of entirely new studies, but the overarching message from producers from this research was clear in describing the target consumer demographic as wealthy, progressive, and understated in style (Interview with 2 sustainable silk entrepreneurs, 2023). The sheen of sustainable silks is much more muted than conventional silk, making sustainable products less ostentatious. Target markets that value this aesthetic and have the money to pay for it have been accessed by producers in Western Europe, the United States, and Japan. One producer also added that she had a small, yet loyal client base in upscale areas of Delhi and had trouble selling in other major Indian cities as consumers there preferred the sheen of conventional silk products, but that

potential in India remains limited (Interview with Sustainable silk entrepreneur, 2023). The starting points for awareness campaigns, which could take the form of lectures, trade fairs, fashion shows, etc., would be in these already identified markets.

7.2. Academic Contribution

This research contributes to academic discourse on sustainable transitions and practice theory by addressing gaps across three key dimensions: empirical, theoretical, and methodological.

Empirically, this study provides a comprehensive exploration of sustainable silk production practices in India's northeast, focusing on niche actors in the silk industry—a sector that has received limited attention in sustainability research. By documenting and analyzing the practices of producers, particularly those rooted in the ahimsa ethos, this research highlights the complex interplay of ethical, cultural, and material factors shaping sustainable production. Unlike prior studies, which predominantly focus on consumer practices, this research underscores the producer's role in driving sustainability transitions. Previous work in practice theory has focused largely on consumer behavior. This study follows in the vein of Shove (2022), expanding practice theory beyond the scope of its initial beginnings and moving away from the Reckwitz's (2002) narrower view of social practice theory. The findings demonstrate how niche practices like ahimsa silk production challenge entrenched socio-technical regimes, contributing unique insights into how traditional knowledge can align with modern sustainability objectives.

Theoretically, in meshing flat and hierarchical ontologies, this study follows the examples set by Walker and Shove (2007), Pantzar and Warde (2016), and Watson (2012), among a growing body of research employing this technique, making a critical academic contribution by integrating insights from practice theory and sustainability transitions theory. It extends the understanding of how sustainability transitions occur in traditional industries such as silk production by analyzing competencies, materials, and meanings as elements of practice theory (Shove et al., 2012), while contextualizing these niche practices and their transformative potential within the broader regime of the silk industry and subject to the dynamics of landscape factors (Geels, 2002; Geels and Schot, 2007). By examining silk production through this dual lens, the study addresses the critique that the multi-level perspective often neglects the role of everyday practices and local knowledge (Walker and Shove, 2007). Keller (2022) advocates for a dual-lens methodology involving zooming in and zooming out to examine transformative niche practices and their interactions with regimes and landscape factors. This study follows in that vein but adds methodological depth by incorporating a mixed-methods design (semi-structured interviews, site visits, and thematic analysis).

Methodologically, this research demonstrates the value of meshing flat and hierarchical ontologies to study sustainability transitions. In integrating qualitative methods, comprising semi-structured interviews, site visits, and thematic analysis, with a theoretical framework that integrates practice theory and the MLP, the study provides a nuanced understanding of the factors supporting or hindering sustainable practices. This approach enables a detailed

examination of practices while situating them within the broader regime and landscape that influences their scalability (Nicolini, 2009; Castelo 2021; Keller, 2022). Additionally, the research provides a framework for examining social change and transitions in other industries, particularly in a non-Western context. The methodology of zooming in on practice-level elements and zooming out to examine regime and landscape level dynamics that this study builds upon offers a robust tool for researchers exploring the intersection of local practices and global, sustainable transitions.

7.3 Conclusion

The cooperative model discussed in Chapter 7 is a key tool for scaling sustainable silk practices, offering a platform for microfinance, skill development, and resource distribution. Currently underutilized in Assam, coops could be revitalized to connect rural producers with educational institutions, enhance technical competencies, and support marginalized groups, particularly women. Domestically, demand for sustainable silk faces challenges due to price sensitivity and limited consumer awareness, while international markets show greater interest, driven by ethical and environmental considerations. Policy frameworks must move from their current state as skewed toward conventional silk production, with bureaucratic barriers and limited support for sustainable initiatives. This would require the internalization of externalities. To drive meaningful change, policies must prioritize targeted subsidies, streamlined certification systems, and enhanced market access for sustainable producers. Expanded cooperatives, coupled with supportive policy and demand alignment, can play a transformative role in sustainably transitioning the Indian silk industry.

Empirically, the study expands its theoretical framework to address production practices. Theoretically, it builds upon foundational works of Shove (2012; 2022), Nicolini (2009), Castelo (2021) and others in meshing ontological lenses. These contributions are not only theoretical but also contextual, highlighting the cultural and ethical dimensions of sustainable transitions. The centrality of the ahimsa ethos underscores the role of values in shaping niche practices, offering insights that are both locally specific and globally relevant. Methodologically, the study demonstrates the importance of bridging micro-level practices with macro-level systemic analysis, providing a replicable framework for examining sustainability transitions in other industries

As this discussion of academic contributions concludes, the focus now shifts to the broader implications of these findings. Chapter 8 will expand on the contextual relevance of the study, critically assess its limitations, and propose avenues for future research, ensuring that the theoretical advancements and practical insights presented here are situated within a broader scholarly and applied context.

8. Discussion

Chapter 8 follows on from the discussion chapter 7 left off, synthesizing the findings of this research and situating them within the broader academic and practical contexts of sustainability transitions. By reflecting on the research questions and analyzing theoretical and contextual implications, this chapter aims to highlight the study's contributions to the fields of practice theory and STT. It delves into the specificities of sustainable silk production in Northeast India while proposing insights and frameworks applicable to broader sustainability transitions.

The chapter begins by revisiting the research questions to evaluate how the findings address the study's overarching objectives. It then discusses the theoretical implications, particularly the novel integration of SPT and STT in examining producer-centric sustainable practices. Contextual relevance is explored to place the results in dialogue with existing literature and global trends in sustainability transitions. Subsequently, the impact of the study's limitations is critically analyzed, followed by a reflection on how these could inform future research directions. Lastly, the chapter outlines new questions raised by this investigation, offering a roadmap for continued scholarly inquiry and practical engagement.

8.1. Revisiting the Research Questions

This study aimed to address the dynamics of sustainable transitions in the Indian silk production sector through three key research questions, each tackling distinct but interconnected dimensions of sustainability. Below, these questions are revisited, synthesizing findings from the results before discussing their broader implications.

Chapter 4 addressed the contextualizing sub-RQ1: What are the key political, social, and economic factors characterizing silk production in Northeast India? It explored the political, social, and economic factors shaping niche and conventional practices in India and highlighted the intricate interplay of local governance structures, resource availability, and market dynamics. This section emphasized the experiences of marginalized groups in the region, backdropping these groups' alignment with the *ahimsa* ethos. The insights from this chapter served to contextualize the analysis of sustainable silk practices in the region.

The study then went on, in Chapter 5, to zoom in on niche practices and address the overall first research question: What alternative, sustainable production practices exist and are emerging in the Indian silk production sector? The key insight of this chapter, which looked at the meanings, competencies, and materials that make up practices and the practices they are linked to, was the elucidation of the *ahimsa* ethos that runs through alternative practices. This research question was answered through interviews and site visits and revealed a range of sustainable practices being adopted by niche producers in the Indian silk sector, particularly in Northeast India. Practices such as sustainable feed production, non-violent silk harvesting, eco-friendly dyeing, and the use of traditional knowledge systems showcased the sustainability and

diversity of alternative silk practices in Assam. Furthermore, this section highlighted the social sustainability of alternative practices.

The key findings around niche practices in the silk industry developed in chapter 5 laid the groundwork for chapter 6's interview-based exploration of the second research question: What contexts and factors support or inhibit the scaling up of sustainable production practices across the silk production sector? This chapter presented the *ahimsa* ethos as the driving force behind niche, sustainable practices and further analyzed the experiences of historically marginalized groups, their ties to these practices and the barriers they face in the current socio-technical regime. The entrenched dominance of industrialized, cost-efficient production methods creates structural challenges for smaller, sustainable producers to compete (at scale), particularly when they do not have access to the foreign buyers interested in these products and willing to pay for them. The chapter also brought in the impact of educational as well as landscape factors, political attention and foreign demand, on the scaling opportunities for sustainable silks.

Chapter 7 zoomed out and began the discussion of this study in answering the third research question: What lessons can be drawn for broader sustainability research and policy? First, the practical implications of the study were discussed largely with the MLP's frame, with recommendations being presented to support sustainable silk practices within the industry's socio-technical regime. Expanded coops would provide materials and competencies to local communities where these practices have been traditionally based, linking these coops to educational institutions to provide for knowledge sharing and further refinement, and developing a certification scheme that connects producers and consumers aligned behind the meaning of the *ahimsa* ethos. The analysis of practical implications also involved analyzing the landscape dynamic of the silk industry in India and potential political and economic initiatives to help catalyze the effectiveness of expanded coops. Lastly, chapter 7 presented the academic contribution of the study and lessons for broader sustainability research that this study generated at empirical, theoretical, and methodological levels. Most notably, this study explored a gap in academic literature on the sustainability of the silk industry and, in doing so, expanded the scope of practice theory applications to producer practices in influencing sustainable transitions, whereas previous studies have overwhelming focused on consumer practices.

In aggregate, the answers to these research questions answer the overarching research question and discuss implications from a practical and academic perspective. An academic discussion of this study, situated in context, will follow before the study concludes.

8.2 Theoretical Implications

This research supports and extends existing theories of practice theory and sustainability transitions. In line with Shove et al. (2012), the study demonstrates how sustainable silk production practices are shaped by the meanings, materials, and competencies associated with them. In applying practice theory to production practices, this study serves as a proof of

concept for future practice theory analyses looking to expand the body of PT research into production practices in other industries experiencing a sustainable transition.

The findings of this study both challenge and leverage the multi-level perspective (MLP) in the pursuit of a more holistic understanding of the transition of the silk industry by illustrating that sustainable transitions are driven not only by niche innovations but also by social movements and traditional knowledge, which play a more prominent role than typically acknowledged in Geels' (2002) MLP. Furthermore, the study suggests that policy interventions must move beyond technological innovation and address the social hierarchies and power dynamics that prevent the scaling of sustainable practices (Coenen et al., 2012).

This study builds upon the theoretical foundation of meshing flat and hierarchical ontological lenses refined, among others, by Nicolini (2009), Castelo (2021), and Keller (2022). This study aligns significantly with Keller's (2022) employment of a combined practice theory and MLP framework and zooming in and zooming out to enable a nuanced understanding of how everyday practices interact with systemic changes in exploring niche practices and their place and influence within the industry regime and broader, landscape factors.

This study expands on the aforementioned studies that mesh these ontological lenses and gaps they leave. While these studies touch on the socio-material elements of practices and their role in transformation, this study goes further in examining the cultural values influencing these elements. It demonstrates how the ahimsa ethos shapes the meanings, materials, and competencies of sustainable silk production alongside the interlocking of production practices into distinct bundles. Furthermore, by focusing on production practices, the study fills a theoretical gap that a consumer-oriented lens leaves unexplored, showing how production-side practices can disrupt socio-technical regimes. Lastly, Keller (2022) discusses the need for systemic changes to support niche practices. This study advances that discussion in identifying specific political, social, cultural, and economic barriers and proposing actionable pathways for scaling sustainable practices in the silk industry.

8.3. Contextual Relevance

The study's findings provide novel insights into sustainable silk practices, positioning them within the global sustainability discourse and offering a nuanced understanding of their relevance in both local and international contexts. By highlighting the influence of cultural, economic, and political factors in Northeast India, the research aligns with and expands upon existing literature in sustainability transitions, practice theory, and literature that meshes the two.

This study underscores the critical role of landscape factors, such as political attention and economic demand, in shaping sustainable practices, contrasting with Reckwitz's (2002) notion that practices are predominantly local phenomena. The international demand for ethically produced silk, driven by global sustainability movements and consumer consciousness, if grown and connected to supply, can incentivize producers in Northeast India to align their

practices with such values. This finding resonates with insights from Strengers and Maller (2015), who emphasized the infrastructural and market conditions enabling sustainable transitions. The study highlights how the support of foreign markets, when connected are more receptive to sustainable products, while domestic consumers prioritize cost and aesthetic factors like the sheen of conventional silk and are less likely to purchase alternative silk products. However, while previous work using a similar theoretical framework work primarily focuses on consumer driven transitions, this study expands the lens in prioritizing production practices.

The structural barriers for marginalized groups within the silk industry, and recommendations presented to address them, identified in this study mirror findings from Coenen et al. (2012), who argued for policy interventions to address systemic inequities in sustainable transitions. This study goes deeper in illustrating how these barriers are compounded by localized factors, such as the marginalization of rural and minority communities. Unlike prior studies that emphasize technological innovation as the primary driver of transitions (e.g., Geels, 2002), this research highlights the socio-cultural and economic barriers that must also be addressed.

These insights suggest a global-local interplay that needs further exploration in practice theory and STT. The findings also emphasize the value of a utilitarian, heteroglossia approach involving meshing lenses (Belova et al., 2008). In this research, the approach allowed the research to focus on the key issues affecting producers and their quotidian decision-making before these issues could be examined within their larger socio-economic contexts, allowing the consideration of important economic, political, and cultural trends in a country that is rapidly growing, changing, and internationalizing.

8.4. Impact of Limitations

This section builds from and reflects on the section on limitations presented in chapter 3. The geographic focus on Assam and the northeastern region of India provided an ideal significant setting for the study of niche sustainable silk practices. However, the specific socio-political and economic conditions of this region may limit the generalizability of findings to other regions in India or globally. For example, while the ahimsa ethos emerged as a critical driver of sustainable practices in Assam, similar philosophical or cultural motivators might not hold the same weight in other parts of India or I the world's largest silk producer, China, which operates within vastly different cultural and industrial contexts. This limitation could influence the study's broader applicability, particularly in the scalability of sustainable silk production practices at a global level. Future comparative studies across a diversity of regions could better capture the heterogeneity within the silk industry and offer a more nuanced understanding of global scaling challenges.

From a methodological perspective, the study's sample size, participant demographic, and reliance on quantitative methods limit the study as well. Although the qualitative design ensured a deep exploration of practices and perspectives, the relatively small sample size

restricted the breadth of insights. A focus on rural, minority communities was chosen to highlight niche practices, but this may have overshadowed the perspectives of larger, more industrialized producers, whose insights could provide a fuller picture of the barriers to and opportunities for scaling sustainable practices. The reliance on a purposive sampling approach means that the study prioritized depth over representativeness, although efforts were made to understand and contextualize conventional practices at elemental and bundled levels.

The study's reliance on qualitative methods, such as interviews and site visits, while appropriate for exploring nuanced practices and contexts, inherently limits its ability to provide quantitative evidence of sustainability impacts. For instance, while the study offers compelling narratives about the environmental and social benefits of sustainable silk practices, the absence of quantifiable data on metrics such as carbon emissions or water usage leaves a gap that a mixed-methods approach could have addressed. Operationalizing such an approach, would have gone beyond the resources of this study and would have pulled the focus away from its current theoretical framework.

The research faced challenges in cross-cultural communication and the use of translators for interviews conducted in local languages. These dynamics may have introduced subtle biases or misunderstandings in participant responses, especially given the hierarchical cultural context of rural Assam, where respondents or the translator might have been inclined to provide socially desirable answers. While efforts were made to mitigate these effects, using strategies outlined in Meyer (2015) relating to cultural sensitivity and trust-building, the potential for observer-expectancy effects cannot be fully discounted. This limitation, together with the scope of the study being shared with participants before meeting, may have influenced the accuracy of some findings, particularly regarding participants' descriptions of their practices and motivations. Opportunities to address these limitations are presented in the following section.

8.5. Future Research Directions

Given the insights generated by this study, this section will discuss implications for future studies. It begins with exploring how the aforementioned limitations can be addressed in future research/ It then goes on to detail new questions this study has raised before presenting broader implications for research that could explore limitations of, and new questions raised in this study.

8.5.1. Addressing Limitations

To address the limitations identified in this study, future research should aim to expand its geographic scope and participant diversity while refining its methodological approaches to balance depth and representativeness. The geographic focus on Assam and the northeastern region of India, while valuable for exploring culturally driven sustainable practices such as the ahimsa ethos, limits the generalizability of the findings to other parts of India and the global silk industry. Future research could conduct comparative studies in other regions of India or other

major silk-producing countries, most importantly, China. This would capture the diversity of cultural, industrial, and market contexts influencing sustainable practices, offering a broader understanding of scalability challenges and opportunities.

Participant diversity is another area for improvement. While this study focused on rural, minority communities to illuminate niche practices, including larger industrial producers, traders, exporters, and policymakers in future studies would provide a more comprehensive picture of the barriers and opportunities for scaling sustainable practices across the silk production regime. This would better contextualize how niche practices integrate into larger industrial systems and regimes. Balancing depth and representativeness in sampling is another area for refinement. Future studies could use stratified sampling methods to ensure a more diverse range of voices is represented, capturing perspectives across different levels of the silk production hierarchy

From a methodological perspective, incorporating mixed-methods approaches would significantly enhance the study's rigor and applicability. While qualitative methods provided valuable narratives, future research could include quantitative techniques such as life cycle assessments, carbon footprint analyses, and water usage metrics to quantify the environmental and social benefits of sustainable silk practices. Combining qualitative depth with quantitative breadth would strengthen the evidence base, improving the prospects of action being taken, and policy relevance of the findings.

Finally, mitigating the potential for social desirability bias is essential in hierarchical societies like India's. Future research could adopt deeper participant observation methods, refine interview questions through pilot testing to encourage more honest and accurate responses, and keep the hypothesis of the study closer to the chest.

8.5.2. New Questions Raised

This research has provided valuable insights into the sustainable silk sector in Northeast India, and also highlights several areas where further exploration is needed. These questions not only emerge from the study's findings, but also reflect the limitations and evolving dynamics within the field of sustainability transitions. Addressing the following questions in future research could deepen understanding of niche practices and their scalability, while also advancing theoretical and methodological frameworks.

The study underscores the critical role of the ahimsa ethos in shaping sustainable silk production practices in Assam. However, it remains to be seen whether similar cultural or ethical motivators exist in other regions or industries, and how they might influence sustainability transitions. The framework used in this study could be expanded to similar investigations exploring this dynamic of cultural factors and meanings in sustainable transitions. In India, where the same cultural motivators are present, do other traditional industries in India, such as handloom weaving or organic tea cultivation, also rely on cultural values in driving sustainability? On the other hand, in China, where industrial-scale silk production dominates

absolutely, are there similar ethical or cultural frameworks that could support sustainable practices? This study raises a broader question regarding how values and ethics, which differ greatly across cultures, influence sustainability in other contexts., which could be investigated with a similar framework.

The study points to the need for tailored policy interventions to address the structural barriers faced by niche producers. This raises questions about which policy frameworks are most effective in promoting scaling that addresses economic, social equity, and environmental sustainability. This study touched on microfinance and subsidies, but further exploration is needed into the tailored financial mechanisms for this study area and others. Additionally, understanding how policies ensure that scaling efforts do not inadvertently marginalize smaller producers or erode the cultural values that underpin sustainable practices is of critical importance.

Although this study focuses on production-side dynamics, it raises questions about the role of consumer behavior in supporting the sustainable silk transition and transitions in other industries. While studies such as Shove et al. (2012), Hargreaves (2011), and Geels et al. (2015) explore consumer behavior's effects on sustainable transitions, questions remain around how consumers perceive and value sustainable silk practices, and how their preferences influence scaling efforts. Furthermore, understanding what types of marketing strategies are most effective in increasing consumer awareness and demand for sustainable products could bolster efforts to provide an impetus for increasing supply. Investigating the interplay between production and consumption dynamics could provide a more holistic understanding of sustainability transitions.

8.5.3. Broader Implications

At a narrower, more practical level, Chapter 5 presented results detailing the current landscape of sustainable silk practices. The understanding of the technical process behind sustainable silk production revealed potential avenues for developing sustainable methods through technological innovation as well as potential further applications in fashion as well as in medicine, building off current successes. Potential avenues for improving sustainable silk production practices include improvements in feed production and rearing techniques, particularly regarding exploring more climate resistant feeds and rearing techniques that improve silkworm health and cocoon size.

The key policy recommendation for promoting sustainable silk practices in this study is the expansion of government coops. If this were to be undertaken, research and monitoring of the success of these coops, and their expanded geographic and service footprints, would be key in determining whether such a model could be expanded to other industries. Linking these coops to educational institutions would facilitate this. Key areas of interest would be in designing effective curricula for the coop's educational programs and refining the dissemination of materials, especially financial assistance to be as equitable and efficient as possible. This research also raises questions about the types of policy instruments, subsidies, certification

schemes, or market access programs, that are most effective in promoting sustainability equitably in underdeveloped regions.

Switching gears to a more theoretical context, while this study focused on the cultural, economic, and political dynamics specific to Northeast India, further research could explore sustainable silk production in other geographic contexts, particularly regions with differing socio-cultural and industrial systems. China, the world's largest silk producers, operates within different regulatory frameworks and market structures. Valuable insights could be generated in building off of this study and examining how cultural values such as the ahimsa ethos in India compare with other drivers of sustainability in China. Exploring these dynamics could contribute to a global understanding of how niche practices emerge and interact with dominant regimes under varying conditions (Geels, 2002; Spaargaren et al., 2016). In examining sustainable transitions in other developing countries, addressing their social sustainability will be key. Hargreaves et al. (2013) could inform policies and practices that promote inclusivity.

Building on the practice analysis of consumer behavior, future research can undertake a comprehensive market analysis to identify and segment consumer profiles that are most likely to adopt sustainable silk. Future studies could investigate consumer awareness, preferences, and willingness to pay for sustainably produced silk. Additionally, understanding the influence of marketing strategies and certifications on consumer choices could inform efforts to create demand-side pull for sustainable silk. Existing research on ethical fashion (Joergens, 2006; Shaw et al., 2006) provides a framework for exploring these dynamics and their role in shaping transitions. This study could utilize practice theory to dissect the routine purchasing behaviors, the meanings consumers attach to sustainability, and the competencies required for making informed choices. By examining the interconnectedness of these elements, researchers can identify strategies to shift consumer practices towards sustainability (Shove et al., 2012). In having a holistic understanding of consumer practices, such a study could link to the insights on producer dynamics in this study, considering landscape factors as well. In doing so, such a study would follow the same meshing lenses framework that this study employed. Such an analysis could be particularly insightful in developing targeted marketing campaigns that align with consumer values and practices, thus fostering a market environment that is conducive to the growth of sustainable silk.

8.6 Conclusion

This chapter has provided a comprehensive analysis of the research findings, situating them within both theoretical and practical contexts. By revisiting the research questions, it demonstrated how sustainable silk production practices in Northeast India reflect broader dynamics of niche practices within socio-technical transitions. The discussion of theoretical implications underscores the value of combining practice theory and the MLP to examine production-side dynamics, while the exploration of contextual relevance highlights the global significance of culturally embedded sustainability practices.

Acknowledging the study's limitations, this chapter emphasized the need for further exploration of diverse geographic contexts, quantitative sustainability metrics, and interdisciplinary approaches to scaling sustainable practices. The identification of new research questions, such as the role of consumer demand and collaborative governance in driving transitions, offers a fertile ground for advancing knowledge in this field.

By addressing these broader implications and proposing directions for future research, this chapter underscores the significance of supporting niche practices in achieving sustainable transitions. It advocates for a nuanced approach that integrates analyses of practices with socio-technical systems to drive sustainable and equitable change.

9. Conclusion

This thesis explored the sustainable transition within India's silk industry through the dual lenses of practice theory and sustainability transitions theory's MLP. In focusing on niche silk producers in the northeastern region, the research aimed to understand how traditional and alternative sustainable practices emerge, evolve, and scale within the broader socio-political and economic landscape. The findings from this study demonstrated that the path to sustainability in the silk industry requires systemic support at both local and institutional levels, as well as a deeper understanding of the everyday practices that sustain production.

The primary conclusion of this research is that the sustainable transition of the silk industry hinges on a combination of factors: the empowerment of (potential) niche producers aligned with the *ahimsa* ethos, the promotion of cooperative models to serve them, and the alignment of government policies with the goals of social, environmental, and economic sustainability. Traditional silk production practices, rooted in indigenous knowledge, offer valuable lessons for creating sustainable silk products, but they must be supported by policies that enhance resource access, address socio-economic, gender, and geographic disparities, and provide educational and technical support. Without such systemic interventions, the transition toward sustainability will remain slow, particularly for underprivileged groups.

This research emphasized the importance of considering both the micro-level dynamics of production practices and the macro-level forces that shape the silk industry. While local producers play a critical role in maintaining sustainable practices, their success is heavily influenced by external factors such as market demand, global competition, and government interventions. The combination of practice theory and the MLP has proven effective in capturing these complex dynamics, offering a comprehensive framework for analyzing sustainability transitions in industries beyond silk.

Finally, the broader implications of this research extend to sustainability transitions in other sectors. The lessons learned from this exploration into India's silk industry can inform strategies for other industries facing similar challenges in balancing traditional practices with modern sustainability goals. The research underscores the need for a comprehensive and collaborative approaches that bring together producers, policymakers, consumers, and other stakeholders to facilitate sustainable and equitable transitions for industries worldwide.

References

Baruah, S. (2007). Durable disorder: Understanding the politics of Northeast India. Oxford University Press.

Braun, Virginia & Clarke, Victoria. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology. 3. 77-101. 10.1191/1478088706qp063oa.

Chandan, Roy. (2016). Inclusive trade in Indian silk industry during post-globalized era. In International Trade and Inclusive Development: Emerging Issues and Enlarging Debate (pp. 127-146).

Chatterji, A., Hansen, T. B., & Jaffrelot, C. (2019). Majoritarian state: How Hindu nationalism is changing India. Hurst & Co.

Denzin, N. K. (1978). The research act: A theoretical introduction to sociological methods (2nd ed.). McGraw-Hill.

Devi, T. S., Ramasamy, C., Gurunathan, S., & Menaka, S. (2008). Estimation of the negative externalities of textile dyeing industry effluents on crop productivity and value of farm lands in Tamil Nadu. Indian Journal of Agricultural Economics, 63.

Ellen MacArthur Foundation (2017). A New Textiles Economy: Redesigning fashion's future.

Erin Meyer. (2015). The culture map: Breaking through the invisible boundaries of global business. PublicAffairs.

Farrer, J., & Fraser, K. (2011). Sustainable "V" unSustainable: Articulating division in the Fashion Textiles Industry. Anti-Po-Des Design Research Journal, 1.

Feng, L., Shimin, S., & Xianjuan, Q. (2009). China-Indian Silk Trade: Current Production and Future Prospects. Chinese Journal of Population Resources and Environment, 7(2), 91–96.

Finlay, L. (2002). "Outing" the researcher: The provenance, process, and practice of reflexivity. Qualitative Health Research, 12(4), 531-545.

Food and Agriculture Organization. (2020). Prevalence of undernourishment (% of population) - India.

Franck, R. (2001). Silk, Mohair, Cashmere and Other Luxury Fibres. Woodhead Publishing Limited.

Gazull, L., Gautier, D., Montagne, P., 2019. Household energy transition in Sahelian cities: an analysis of the failure of 30 years of energy policies in Bamako, Mali. Energy Policy 129, 1080–1089. https://doi.org/10.1016/j.enpol.2019.03.017.

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. Research Policy, 31(8-9), 1257-1274.

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. Research Policy, 33(6), 897-920. doi:10.1016/j.respol.2004.01.015

Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. Environmental Innovation and Societal Transitions, 1(1), 24-40. doi:10.1016/j.eist.2011.02.002

Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. Research Policy, 36(3), 399-417.

Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. Research Policy, 36(3), 399-417. doi:10.1016/j.respol.2007.01.003

Giddens, A. (1984). The constitution of society: Outline of the theory of structuration. Cambridge: Polity Press.

Giora, D., Marchetti, G., Cappellozza, S., Assirelli, A., Saviane, A., Sartori, L., & Marinello, F. (2022). Bibliometric Analysis of Trends in Mulberry and Silkworm Research on the Production of Silk and Its By-Products. Insects, 13(7). https://doi.org/10.3390/insects13070568

Gupta, B. G. (2019). Impact on Surface Water and Human Health Due to Toxic Waste Water Released From Bleaching and Dyeing Units at Maheshtala Textile Cluster, West Bengal, India. SSRN.

Gupta, R. (2017). India After Gandhi (10th Anniversay Ed.). Picador Pan Macmillan India.

Gupta, S. K., & Deshpande, R. D. (2004). Water for India in 2050: First-order assessment of available options. Current Science, 86(9), 1216-1224.

Hargreaves, T., Longhurst, N., & Seyfang, G. (2013). Up, down, sideways: Navigating regimes, niches, and transitions in community energy projects. Environment and Planning A, 45(7), 1519-1536.

Hitchings, R. (2012). People can talk about their practices.

Hui, A., Schatzki, T., & Shove, E. (Eds.). (2016). The Nexus of Practices: Connections, constellations, practitioners (1st ed.). Taylor & Francis.

Indian Silk Export Promotion Council. (2022, November). Silk Industry and Export in India. India Brand Equity Foundation.

International Energy Agency. (2021). India Energy Outlook. World Energy Outlook Special Report.

Jadeja, N. B., Banerji, T., Kapley, A., & Kumar, R. (2022). Water pollution in India – Current scenario. Water Security, 16, 100119. https://doi.org/https://doi.org/10.1016/j.wasec.2022.100119

Jaffrelot, C. (2021). Modi's India: Hindu nationalism and the rise of ethnic democracy. Princeton University Press.

Jamali, D. (2009). Constraints and opportunities facing women entrepreneurs in developing countries: A relational perspective. Gender in Management: An International Journal, 24(4), 232–251.

Joy, A., Sherry, J. F., Venkatesh, A., Wang, J., & Chan, R. (2012). Fast Fashion, Sustainability, and the Ethical Appeal of Luxury Brands. Fashion Theory, 16(3), 273–295. https://doi.org/10.2752/175174112X13340749707123

Karthik, T., & Rathinamoorthy, R. (2017). Sustainable silk production. In S. S. Muthu (Ed.), Sustainable Fibres and Textiles (pp. 135–170). Woodhead Publishing. https://doi.org/https://doi.org/10.1016/B978-0-08-102041-8.00006-8

Keller, M., Sahakian, M., & Hirt, L. F. (2022). Connecting the multi-level-perspective and social practice approach for sustainable transitions. *Environmental Innovation and Societal Transitions, 44*, 14–28.

Kemp, R., Schot, J., & Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. Technology Analysis & Strategic Management, 10(2), 175-198. doi:10.1080/09537329808524310

Krishnan, S., & Hatekar, N. (2017). Rise of the new middle class in India and its changing structure. Economic and Political Weekly, 52(25-26).

Kumar, P., & Saravanan, D. (2017). Environmental impact of textile industries and its assessment through life cycle assessment. Textile Science & Engineering, 7(2).

Kumar, P., Joshi, P. K., & Mittal, S. (2016). Demand vs supply of food in India-Futuristic projection. Proceedings of the Indian National Science Academy, 82(5), 1579–1586.

Kvale, S. (2006). Dominance through interviews and dialogues. Qualitative Inquiry, 12(3), 480-500.

Lal, R. (2001). Soil degradation by erosion. Land Degradation & Development, 12(6), 519-539.

Liamputtong, P. (2008). Doing cross-cultural research: Ethical and methodological perspectives. Springer.

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. Research Policy, 41(6), 955-967. doi:10.1016/j.respol.2012.02.013

Martens, L. (2012). Practice 'in talk' and talk 'as practice': Dishwashing and the reach of language. Sociological Research Online, 17(3), 1-13.

Maxwell, J. A. (2012). A realist approach for qualitative research. SAGE.

Mayoux, L. (1993). Gender Inequality and Entrepreneurship: the Indian Silk Industry. Development Policy Review, 11(4), 413–426. https://doi.org/10.1111/j.1467-7679.1993.tb00050.x

Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. (2021). India: Third biennial update report to the United Nations Framework Convention on Climate Change (UNFCCC).

Mirsaatov, R., & Khudoyberganov, S. (2022). Development of a non-destructive method determination of the maturity of Mulberry cocoons. AIP Conference Proceedings, 2432, 40018.

Mishra, R., & Upadhyay, S. (2017). Rethinking economic development in Northeast India.

Morse, J. M. (2015). Critical analysis of strategies for determining rigor in qualitative inquiry. Qualitative Health Research, 25(9), 1212-1222.

Nicolini, D. (2009). Zooming in and out: Studying practices by switching theoretical lenses and trailing connections. Organization Studies, 30(12), 1391-1418.

Nicolini, Davide. (2013). Practice Theory, Work, and Organization. An Introduction.

Nicolini, Davide. (2017). Practice Theory as a Package of Theory, Method and Vocabulary: Affordances and Limitations. 10.1007/978-3-319-52897-7_2.

North Eastern Council. (2015). Basic statistics of North Eastern region. North Eastern Council, Government of India.

Padaki, N. v, Das, B., & Basu, A. (2015). Advances in understanding the properties of silk. In A. Basu (Ed.), Advances in Silk Science and Technology (pp. 3–16). Woodhead Publishing.

Patra, Gautam & Al-abodi, Hiba & Sahara, Ana & Ghosh, Subhamoy & Borthakur, Sonjoy Kumar & Polley, Shamik & Behera, Parthasarathi & Deka, Abhijit. (2019). Prevalence of parasitic fauna of pigs in North-Eastern region of India. Biological Rhythm Research. 51. 1-18. 10.1080/09291016.2019.1573460. (figure only)

Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. Health Services Research, 34(5 Pt 2), 1189.

Pink, S. (2012). Researching practices, places and representations: Methodologies and methods. SAGE Publications Ltd, https://doi.org/10.4135/9781446250679

Pink, S. (2012). Situating everyday life: Practices and places. SAGE Publications.

Ricciardi, L., Chiarelli, D. D., Karatas, S., & Rulli, M. C. (2021). Water resources constraints in achieving silk production self-sufficiency in India. Advances in Water Resources, 154, 103962.

Rogers, Everett (1962;2003). Diffusion of Innovations, 5th Edition. Simon and Schuster.

Rosenthal, R. (1966). Experimenter effects in behavioral research. Appleton-Century-Crofts.

Roy, A. (2022). Azadi: Facism, Fiction and Freedom in the Time of the Virus (Expanded Edition). Penguin Random House Ireland.

Ruparelia, S. (2015). Divided we govern: Coalition politics in modern India. Oxford University Press.

Ryen, A. (2004). Ethical issues. In C. Seale, G. Gobo, J. F. Gubrium, & D. Silverman (Eds.), Qualitative research practice. SAGE.

Schatzki, T. (2015). The Spaces of Social Practices and of Large Social Phenomena. Schot, J., & Geels, F. W. (2008). Strategic niche management and sustainable innovation journeys: Theory, findings, research agenda, and policy. Technology Analysis & Strategic Management, 20(5), 537-554. doi:10.1080/09537320802292651

Schatzki, Theodore, Knorr-Cetina, Karin, von Savigny, Eike (2001). The Practice Turn in Contemporary Theory. Psychology Press

Senthil Kumar, P., & Saravanan, A. (2017). Sustainable wastewater treatments in textile sector. In S. S. Muthu (Ed.), Sustainable Fibres and Textiles (pp. 323–346). Woodhead Publishing. https://doi.org/https://doi.org/10.1016/B978-0-08-102041-8.00011-1

Senthil Kumar, P., & Suganya, S. (2017). Introduction to sustainable fibres and textiles. In S. S. Muthu (Ed.), Sustainable Fibres and Textiles (pp. 1–18). Woodhead Publishing.

Seyfang, G., & Smith, A. (2007). Grassroots innovations for sustainable development: Towards a new research and policy agenda. Environment and Planning A, 39(5), 1173-1194.

Seyfang, Gill, Gilbert-Squires, A., 2019. Move your money? Sustainability transitions in regimes and practices in the UK retail banking sector. Ecol. Econ. 156, 224–235. https://doi.org/10.1016/j.ecolecon.2018.09.014.

Shove, E., & Walker, G. (2010). Governing transitions in the sustainability of everyday life. Research Policy, 39(4), 471-476. doi:10.1016/j.respol.2010.01.019

Shove, E., Pantzar, M., & Watson, M. (2012). The dynamics of social practice: Everyday life and how it changes. SAGE Publications.

Shove, E. (2022). Connecting Practices: Large Topics in Society and Social Theory (1st ed.). Routledge. https://doi.org/10.4324/9781003275107

Smith, A., & Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. Research Policy, 41(6), 1025-1036.

Smith, J. A., & Osborn, M. (2008). Interpretative phenomenological analysis. In J. A. Smith (Ed.), Qualitative psychology: A practical guide to research methods (pp. 53-80). SAGE.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. Journal of Business Research, 104, 333-339. doi:10.1016/j.jbusres.2019.07.039

Spaargaren, G., Lamers, M., & Weenink, D. (2016). Introduction: Using practice theory to research social life. In G. Spaargaren, D. Weenink, & M. Lamers (Eds.), Practice Theory and Research: Exploring the Dynamics of Social Life (pp. 3-27). Routledge.

Spaargaren, Geert. (2003). Sustainable Consumption: A theoretical and environmental policy perspective. Society and Natural Resources (pp. 687-701)

Spurling, Nicola & Mcmeekin, Andrew. (2015). Interventions in practices: sustainable mobility policies in England. Beyond Behaviour Change. 78-94.

Spurling, Nicola and McMeekin, Andrew and Southerton, Dale and Shove, Elizabeth and Welch, Daniel (2013) Interventions in practice: reframing policy approaches to consumer behaviour. Sustainable Practices Research Group, Manchester.

Srivastava, R. S. (2005). Bonded Labour in India: Its Incidence and Pattern.

Terjesen, S., Couto, E. B., & Francisco, P. M. (2016). Does the presence of independent and female directors impact firm performance? A multi-country study of board diversity. Journal of Management & Governance, 20(3), 447-483.

The Indian Silk Export Promotion Council. (2023). Statistics.

United Nations Environmental Programme. (2019). Fasion's tiny hidden secret. Cities and Lifestyles.

Unni, J., & Rani, U. (2000). Women in informal employment in India. International Labour Organization (ILO).

Van den Bergh, Jeroen C. J. M., Truffer, B., & Kallis, G. (2011). Environmental innovation and societal transitions: Introduction and overview. Environmental Innovation and Societal Transitions, 1(1), 1-23. doi:10.1016/j.eist.2011.04.010

Varadarajan, L. (1988). Silk in Northeastern and Eastern India: The Indigenous Tradition. *Modern Asian Studies, 22*(3), 561–570.

Varshney, A. (2019). Ethnic conflict and civic life: Hindus and Muslims in India. Yale University Press.

Young, JC, Rose, DC, Mumby, HS, et al. (2018). A methodological guide to using and reporting on interviews in conservation science research. Methods Ecol Evol. 2018; 9: 10– 19.

Appendix: Interview questions for sustainable silk practitioners

1. What does your typical workday look like?
2. Can you describe your method of production to me? (followed by probing 'how questions' around worm cultivation, feed cultivation, spinning techniques, dyeing/ weaving techniques, marketing/ sales, etc.)
3. What technologies and materials do you use in production?
4. What do you seek to achieve in your work? Why do you do what you do? What do you value in your work?
5. How is your knowledge and understanding of silk production represented in your production process?
6. How does your production process differ from that of others you know?
7. Have you considered any alternative methods in your production process? Why adopted or not?
8. How did you become a silk producer? How did you start producing with these (sustainable) practices?
9. Who do you sell your products to? How did you get in contact with them?*

   Break

10. How is your business doing? Expanding/ struggling?
11. What are your main challenges in production? Sales? Other challenges?
12. What are your ambitions for your business? Is there anything holding you back from expansion (capital, knowledge, connections, bureaucracy, etc.- elicit via probing questions)
13. What is your experience with local government like? (If applicable) Does being a _____ (woman, rural person, textile farmer) affect how the government treats you? (Phrase as: How do you think the government sees you; *does the local government care about your wellbeing and that of your business?)*
14. How do you view your relationships with other silk producers?
15. What parts of your work are you proud of?

Deepening questions