LUND UNIVERSITY
School of Economics and Management

Environmental Sustainability in the Indian Dairy Value Chain

Moving towards a Sustainability Transition – A Case Study

by

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Abstract

The dairy industry has a noteworthy environmental footprint, specifically on global warming and resource depletion. Yet, environmental challenges also adversely impact the sustenance of many dairy value chain stakeholders. This is problematic not only in terms of livelihood for more than 70 million rural households but also considering the growing population and hence the increasing dairy demand. Therefore, this study aims to explore how the Indian dairy industry responds to the environmental sustainability transition. This is to identify challenges and opportunities for the reduction of the industry's environmental footprint and to ensure a sustainable dairy supply. To gain context-rich insights, the researchers undertook travels to India and conducted a qualitative multi-method research design, including 19 semi-structured expert interviews. Therefore, the unit of analysis is the Indian dairy value chain. An adapted sustainability transition framework was utilised to provide a distinctive guideline for this dissertation. Key findings revealed the Indian dairy value chain to demonstrate only little effort towards a sustainability transition. Some changes are visible but are mainly economically motivated. Most prominent challenges deemed to be the lack of education leading to high unawareness, strong path-dependency, price sensitivity and lacking responsibility from the government. Contrary, opportunities mainly constitute of the development of technical solutions within renewable energies, water recycling techniques, waste recycling and segregation. Lastly, this study suggests a minor revision of the utilised framework, which it argues to be applicable to the Indian context and possibly to other similar emerging markets.

Keywords: Environmental Sustainability; Sustainability Transitions; Multilevel Perspective; Emerging Markets; India; Indian Dairy Value Chain

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List of Abbreviations

BDS	-	Business Development Services
BMC	-	Bulk Milk Coolers
CSR	-	Corporate Social Responsibility
CSV	-	Creating Shared Value
DVC	-	Dairy Value Chain
ES	-	Environmental Sustainability
FDI	-	Foreign Direct Investment
GHG	-	Greenhouse Gases
GOI	-	Central Government of India
MLP	-	Multilevel Perspective
MNE	-	Multinational Enterprise
NGO	-	Non-Governmental Organisation
NIS	-	National Innovation System
NMSA	-	National Mission for Sustainable Agriculture
R&D	-	Research and Development
SNM	-	Strategic Niche Management
ST	-	Sustainability Transitions
TCE	-	Transaction Cost Economics
TM	-	Transition Management

1 Introduction

1.1 Background

India has maintained its position as largest milk producing country globally now for more than 18 years and has also become the largest milk consumer globally (Groot & Hooft, 2018). Over the past ten years, India's milk production has increased at a compound annual growth rate of 4.8% while India accounts for approximately 19% of the total milk production worldwide (Government of India, 2018a). Total milk produced in India has grown from 146.3 million tons in 2015 to 176.3 million tons in 2018 and is expected to further increase to 300 million tons by 2022/23 (National Dairy Development Board, 2018a; Government of India, 2018a). Reasons for such development are primarily India's increasing population, its rapid industrialisation, urbanisation and westernisation, as well as India's growing middle class (WWF, 2019a; Janssen & Swinnen, 2019). This increased dairy production, however, is intensifying the competition for natural resources and puts enormous pressure on the environment on a global scale (Hart & Milstein, 1999; Lubin & Esty, 2010). According to Gerber, Steinfeld, Henderson, Mottet, Opio, Dijkman, Falcucci and Tempio (2013), livestock globally is responsible for 14.5% of total greenhouse gas (GHG) emissions whereof the dairy sector contributes 2.7% (FAO, 2010). These 2.7% include emissions from milk production, processing and transportation of milk and value-added products. However, research also finds that developing countries have higher emission rates compared to industrialised countries and that methane emissions are most significant contributors to global warming (Rojas-Downing, Nejadhashemi, Harrigan, & Woznicki, 2017; FAO, 2010). For instance, India's capital New Delhi is experiencing enormously high pollution rates, which have already caused many deaths due to noncommunicable diseases (Gurjar, Sharma, Agarwal, Gupta, Nagpure, & Lelieveld, 2010). While GHG emissions through cattle and their manure produce are of major importance, often pointed out as the most crucial environmental impact of dairying with far reaching effects, this study also highlights the broader range of environmental consequences (Levin & Stevenson, 2012). These include water pollution and scarcity as well as biodiversity loss through land degradation (Rojas-Downing et al. 2017; Steinfeld, Gerber, Wassenaar, Castel, Rosales, & de Haan, 2006; FAO, 2010). The United Nations Food and Agriculture Organisation also claims that the dairy industry to have a substantial environmental footprint (Gardiner, 2015). A more detailed display of dairying impacts on the environment can be found in Appendix A.

In light of a strongly growing population and demand for dairy products, India has introduced a National Dairy Development Plan (NDDP) to promote domestic milk production and hence to ensure food-security as well as to double the farmers' income (Intodia, 2017). Due to agriculture and livestocks' impact on the environment, the herd size cannot significantly be increased as India's emissions are already exceeding its limits, accounting for 6.5% of the global emissions (Liu, 2016; Nagpure, 2014). Therefore, the primary means to increase production is to increase the animal's productivity, which thus far is very low (Nagpure, 2014). While in India the average milk yield ranges from 2.5 to 7.2 kg per day, depending on the breed, milk yield in the U.S., for instance, ranges between 22 and 28 kg per day (Intodia, 2017). The author further explains India's low cattle productivity to be based on low genetic potential, insufficient veterinary access and inadequate water availability and feed and fodder resources. However, increasing such productivity also requires more resources, which stresses the environment further and contributes to global warming (WWF, 2019a). This, in turn, causes additional heat stress, drought and flooding events, which have become more severe in recent years and which have adverse impact on crop and livestock productivity (Herrero, Thornton, Gerber, van der Zijpp, van de Steeg, Notenbaert, Lecomte, Tarawali, & Grace, 2010; WWF, 2019b). Other initiatives in the NDDP include "breed- and genetic improvement; artificial insemination; fodder development and expansion of milk procurement systems at the village level" (Intodia, 2017, p.3).

Nevertheless, for the Government of India (GOI), environmental impacts are only of secondary concern (Groot & Hooft, 2018). Their primary interest is the industry's high potential for economic growth and to benefit the poor, which is strongly supported by the GOI (Janssen & Swinnen, 2019). 67% of the output of livestock value is attributed to dairying (Ministry of Agriculture and Farmers Welfare, 2018). Livestock positively contributes to food and nutritional security and to poverty reduction as it provides employment and income for large parts of the population, especially for the bottom-of-the pyramid in the rural areas of India as well as for women. There are more than 70 million rural households that are involved in dairy production, often partly for self-consumption as well as for additional income (Janssen & Swinnen, 2019). Another reason explaining the large milk production and consumption is the large proportion of vegetarians in India, which is often culturally or religiously motivated based on the sanctity of the cow. Therefore, dairy products are heavily promoted as compared to meat and are a major source of protein (Fourat, Kapadia, Shah, Zararia, & Bricas, 2018).

While the dairy industry has a substantial environmental footprint, the environmental issues also adversely impact the dairying sector and hence risk the livelihoods of many farmers (Khanal & Mishra, 2017). Global climate change and resource depletion hamper the livestock production as these factors reduce the water availability for the animals but also for the growth and quality of feed and fodder, cattle health, milk production and biodiversity for instance (Rojas-Downing et al. 2017). This is further stressed due to increasing animal water consumption by a factor of three as a result of global warming, according to Rojas-Downing et al. (2017). Reoccurring and more severe environmental disasters, such as droughts or floods, which cause water scarcity or crop failure, are a consequence of global warming (Sadanandan, 2014). This impacts domestic but also global food security and negatively influences the output and income for dairy value chain (DVC) stakeholders but farmers specifically (Khanal & Mishra, 2017). For farmers to sustain their dairy operations during those times, they take on debts, which they often cannot repay. Hence, this is said to have affected the suicide rate among Indian dairy farmers, which has significantly increased in recent years, totalling 16.000 farmers each year (Merriott, 2016). Various studies agree upon indebtedness of farmers to be the most predominant reason often caused through such environmental disasters (e.g. Sadanandan, 2014).

One of the key challenges for India will be to sustainably meet the intensified dairy demand while facing major environmental impediments or risks (Levin & Stevenson, 2012). Hence, India and the dairy sector need to foster sustainability solutions that are environmentally friendly, resistant towards climate change effects. Furthermore, they are ought to utilise natural resources more efficiently and sustainably. Research also addresses innovation's ability to drastically counteract the adverse environmental impacts that are primarily created by a growing global population (Tukker, 2005). Such trends indicate the urgent need for firms but also the government to incorporate environmental sustainability (ES) as a central element in their long-term strategy (Lubin & Esty, 2010; Falcone, 2014). Therefore, a sustainability transition (ST) of the DVC seems highly critical.

1.2 Sustainability Transitions

ST are considered as long-term transformation processes in which an established system transfers production as well as consumption towards a more sustainable system (Geels & Schot, 2010 cited in Falcone, 2014). In order to sustainably meet the increasing dairy demand in India,

profound changes among several dimensions are required. Usually, such ST evolve over a long period of time as various actors, like firms, organisations and farmers as well as different institutions in form of policies, schemes and regulations play an important role (Markard, Raven & Truffer, 2012). To reduce the environmental impact in the long run, collaboration among several actors is necessary (Markard, Raven & Truffer, 2012). Therefore, ST, especially in developing countries, prove to be very difficult. To successfully accomplish such transitions, the society needs to enhance their understanding of accompanied policies, schemes and politics (Markard, Raven & Truffer, 2012). Also, technological developments are essential prerequisites to effectively transform towards sustainable aspirations (Rogge & Reichardt, 2016).

1.3 Dairy Industry Structure

The Indian dairy industry is highly fragmented and scattered. About 70% of Indian dairy farmers live in rural areas all across India, often hours away from milk cooling centres or processing plants (Purushottam, 2013). Furthermore, the dairy market is divided into an unorganised and an organised sector, as displayed in Figure 1.

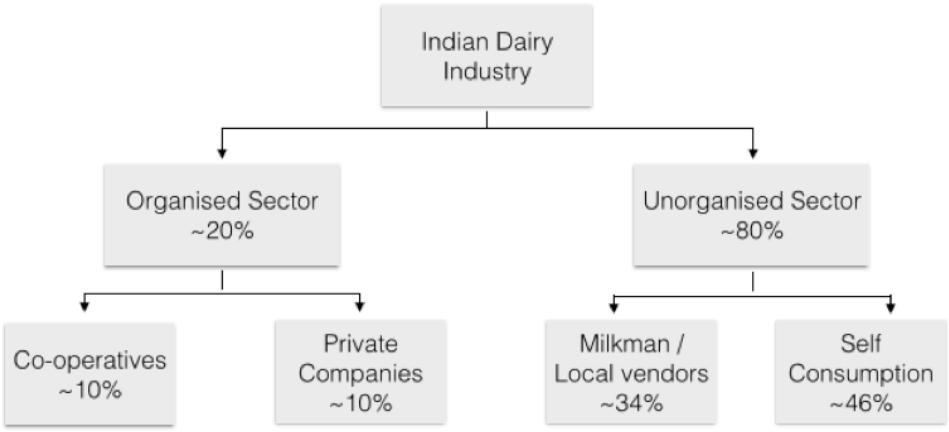

Figure 1 Organised vs. Unorganised Sector (Business Wire Inc., 2018)

The unorganised sector accounts for about 80% of milk production in India and consists largely of marginal farmers in rural districts who commonly own one to three cows. Roughly 50% of these farmers' milk produce is for self-consumption while the remaining 50% is sold to either the local market or someone else in the village for direct consumption. The organised sector accounts for only about 20% of milk production and is divided into private/commercial sector (10%) and cooperatives (10%). Cooperatives are either operated by farmers themselves as

shareholders (e.g. Amul) or through the government (e.g. Mother Dairy). These cooperatives collect the milk from thousands of marginal farmers and then test, cool, process and distribute the milk through formal channels such as wholesalers and retailers (MART, 2017; Purushottam, 2013). For this research, the value chain consists of six stages, namely farming, transporting, processing, distributing, retailing and consuming. However, considering that research finds many environmental issues to be related to feed production, this study includes also the inputs necessary for the DVC (Eshel, Shepon, Makov, & Milo, 2014). Figure 2 displays the Indian DVC in a more visual manner.

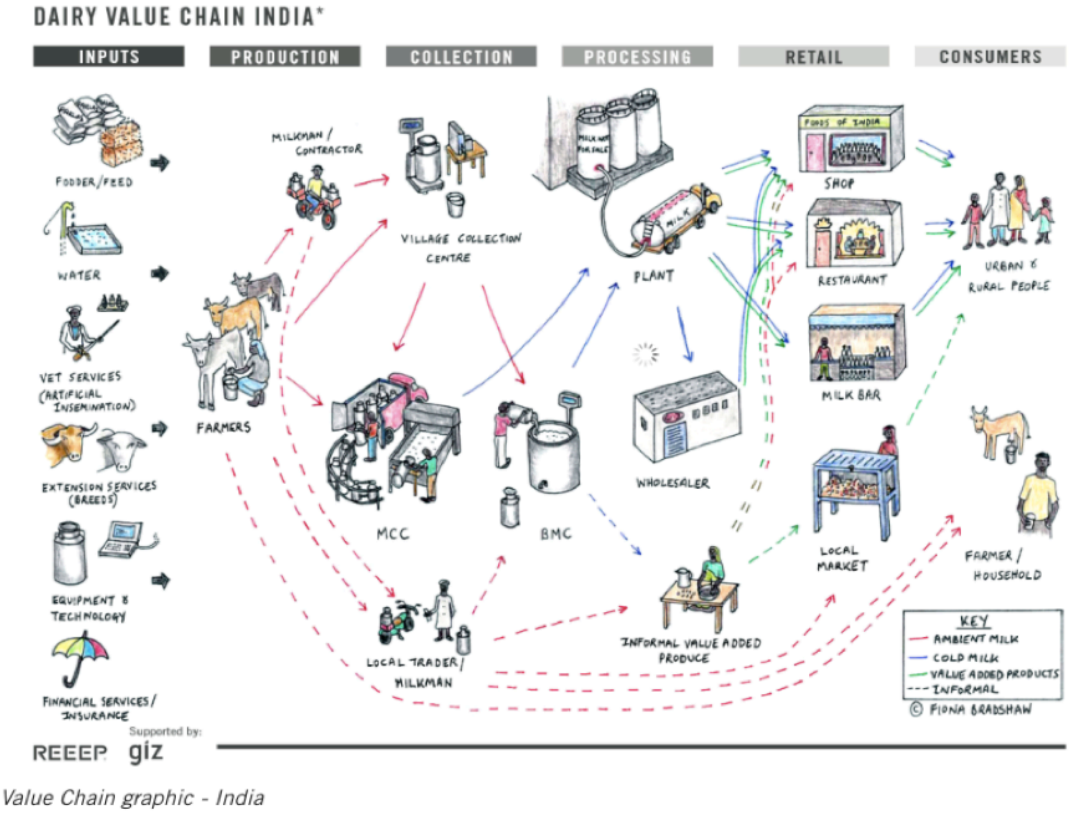

Figure 2 The Indian DVC Structure (Recheis, 2017)

This industry structure is relatively unique and only similar to few other developing countries. Developed countries, on the contrary, often pass 90% of their surplus milk through the organised sector (Business Wire Inc., 2018). As the industry is largely dominated by the unorganised sector, efficiency is suffering, also considering the difficulty of reaching economies of scale (Ohlan, 2016). Also, unlike globally where specialised farming systems are already manifested, mixed farming is still dominating the Indian crop-livestock systems (Marton, Zimmermann, Kreuzer, & Gaillard, 2016). Crop remains can be reutilised as forage for animals, which in turn produce exposures serving as fertiliser for the crop. Especially as the

majority of farmers in India own one to three cows and only small hectares of land, mixed farming enhances the livelihood of farmers, specifically in rural areas (MART, 2017; Thomas, Zerbini, Parthasarathy & Vaidyanathan, 2002). Despite mixed farming being a closed system, it is admittedly very favourable in terms of ES (Thomas et al. 2002).

1.4 Aim and Objectives

The dairy industry has a noteworthy environmental footprint, having the second largest environmental impact after beef production, according to a U.S. study (Eshel et al. 2014). Considering the growing Indian population, especially the food industry is urged to address the topic of ES to meet the growing demand (Sharma, Mangla & Patil, 2019). While resource depletion is more of a national problem, methane and CO2 emissions leading to climate change are of global matter. Hence, national but also international stakeholders of the value chain as well as support functions, such as the government and institutes, need to raise their awareness and mitigate environmental impact to sustain future operations. They should be encouraged to invest in opportunities to provide for a more sustainable dairy industry and a cleaner world for future generations while making profits. This is further triggered by more and more saturated developed markets, which make investments in emerging markets, such as India, increasingly interesting (London & Hart, 2004).

The purpose of this study, therefore, is to explore and comprehend the Indian DVC to identify opportunities for the reduction of the environmental footprint to sustain future operations. This is to further enhance the economic situation for stakeholders and to meet the growing dairy demand. Considering the size of the Indian DVC, India has huge potential for the mitigation of environmental impact. This study also enables stakeholders of the value chain to proactively prepare for change to make valuable and strategic decisions. Lastly, it shall present impactful and value-creating opportunities for multinational enterprises (MNE) located in India or eager to enter the Indian dairy market. While it is difficult to determine an explicit start or an end to environmental impacts or consequences related to the dairy industry, this study aims to address the major issues found through empirical research.

Consequently, to address the purpose of this study, the research- and sub research questions are as follows:

"How does the Indian dairy industry respond to the environmental sustainability transitions?"

- How does the industry impact the environment and how is it impacted by these environmental challenges?
- What are current environmental sustainability trends within the dairy value chain?
- What are main challenges as well as opportunities in achieving a ST?

Considering the on-going and vast changes within the Indian dairy industry, it is important to continuously review its environmental progress to identify opportunities and challenges. While literature often discusses entry strategies for MNEs in emerging markets or business opportunities at the bottom-of-the-pyramid, opportunities specifically for the dairy industry in terms of ES have not sufficiently been addressed. A transition approach was chosen for this study to display the complexity and interplays of processes and how they constitute to the bigger and systematic picture (Wieczorek, 2018). This research aims to extend current literature on ST to further enlarge analytical refinement. By analysing the current transformative change in India, one can identify change patterns and hence possible action opportunities to stimulate further change and direct strategy formulation as suggested by Wieczorek (2018). The utilisation of transition frameworks facilitates the analysis of the interaction between factors that either impede or foster the ST in emerging economies, especially on the various levels of policy implementation (Wieczorek, 2018). While this study solely addresses the Indian dairy industry, which is highly unique in itself, the country's size and economic potential offers a global significance to our research.

1.5 Outline of the Thesis

This thesis is composed of five chapters. The introduction contains contextual information and a thorough background about the Indian dairy industry and how it impacts as well as how it is impacted by environmental challenges. Following, a literature review is presented that provides a theoretical fundament and addresses main concepts such as ES, ST, innovation, emerging markets as well as the value chain model. Based on such concepts, a theoretical framework is presented which serves as a structure for the analysis. The subsequent chapter describes the methods utilised to approach and conduct the research. The fourth chapter displays and analyses empirical findings while the final discussion chapter explains practical and theoretical implications on which grounds further research and practical recommendations are suggested.

2 Literature Review

The theoretical literature review serves to identify and evaluate previous research conducted on ST in emerging countries. To better understand the interlinkages among the DVC stakeholders, the value chain concept was also reviewed. Furthermore, innovations and the effect of globalisation were inspected considering their importance for ST. For this review, a concept-centric approach was used to synthesize the literature in a logical manner. The unit of analysis throughout the literature review is the Indian DVC. Ultimately, a conceptual model was derived to expand current concepts regarding this study's research purposes (Webster & Watson, 2002). This review presents a thorough theoretical background for this study to establish a gap in previous work with the goal to further refine the topic.

2.1 Sustainable Development

Nowadays, there are many reasons to care about sustainability, primary reasons however are: climate change, resilience, natural capital, and stakeholders (Chandler, 2016). Literature proposes various definitions and interpretations of the concept of sustainable development. Most commonly, however, it is associated with the Brundtland Report "Our Common Future", which was published in 1987. Accordingly, sustainable development is defined as fulfilling present needs while assuring to not dismantle resources that are necessary to fulfil needs of future generations (Keeble, 1988). Additionally, sustainable development is considered to support the preservation of fundamental eco-friendly processes (McKenzie, 2004). Sutton (2004), on the other hand, points out that sustainable development describes desired continuity. Meaning, certain things about the world can be maintained while other things desire change. Further, in order to satisfy human needs, Keeble (1988) argues that ES needs to be more emphasised. Lélé (1991) addresses the issue and difficulty of sustainable development as it is subjective in nature. Environmental degradation as well as poverty as such have not been fixed by definition, thus, perceptions of these issues greatly differ and can ultimately lead to discrepancies when it comes to policy design. Also Robert, Parris and Leiserowitz (2005) discuss the openness and dynamic within the concept of sustainable development.

While this study acknowledges the diversely utilised term in literature, it refers to sustainable development as an objective towards maintaining future needs while capturing the triple-bottom-line: people, planet and profit.

2.2 Environmental Sustainability

Goodland (1995) has established the concept of ES in which he distinguishes between social, economic, and ES. The main goal of social sustainability is to reduce poverty, which is further increasing despite continuous economic growth. To achieve such social sustainability, focus needs to be directed towards "moral capital" which refers to community cohesion, sodality, tolerance, as well as the generally acknowledged standards of laws, discipline and honesty. Contrary, the economic approach of sustainability rather focuses on allocating natural resources, which adds to the production process of physical outputs. Therefore, the scarcity of natural resources has resulted in economical attention on natural capital such as air and forests. ES can be seen as a prerequisite of social sustainability as it focuses on providing sources of raw materials used to satisfy human needs. Special attention, therefore, is directed towards preventing damage to humans and improving their well-being by moving in the direction of more sustainable production as well as consumption. This means on the one hand side, the sink side, to keep waste emissions low while on the other hand side, the source side, to make use of renewable and non-renewable resources (Goodland, 1995). Morelli (2011) accepts and verifies Goodland's argumentation. Yet, he argues that ES adds more depth to the human activity of meeting the present demand without putting the demand of future generations at risk. Hence, Morelli (2011) defines ES "as a condition of balance, resilience, and interconnectedness that allows human society to satisfy its needs while neither exceeding the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs nor by our actions diminishing biological diversity" (p.5). Furthermore, Sutton (2004) expresses that society became more aware that the environment is threatened by severe degeneration. Therefore, he defines ES as a competence to manage everything that is valued in the physical environment, referring to land, waters, physical resources, buildings and roads. The physical environment directly influences the society and thus sustaining surroundings also adds to social sustainability. The link between economic sustainability and ES is even more straightforward as the economy needs environmental resources to work effectively (Sutton, 2004). Even though Goodland's concept of ES was initially established over 20 years ago, it is still widely accepted among researchers. Hence, newer concepts of ES do not greatly differ from Goodland's point

of view but rather extend it. ES for this study is the maintenance of resources by indefinitely improving production and consumption. Major environmental issues such as climate change and resource depletion will be addressed by means of more environmentally friendly solutions. Further, ES will be investigated throughout the DVC as the six different steps may offer opportunities to reduce the environmental footprint in the long run.

Creating a sustainable business also requires firms to view their value proposition (Bocken, Short, Rana, & Evans, 2013). Richardson (2008) defines value proposition as "what the firm will deliver to its customers, why they will be willing to pay for it, and the firm's basic approach to competitive advantage" (Richardson, 2008, p.138). Furthermore, a firm's value proposition provides information on customers motives to buy a product or service. Patala, Jalkala, Keränen, Väisänen, Tuominen and Soukka (2016) argue that a sustainable value proposition is a firm's agreement to deliver economic, social, as well as environmental benefits to their customers and the society while also taking short-term returns and long-term sustainability into account. Figure 3 displays a holistic perspective on sustainable value entailing the three main aspects of the ES concept, namely social, economic, and ES (Evans, Vladimirova, Holgado, Van Fossen, Yang, Silva, & Barlow, 2017).

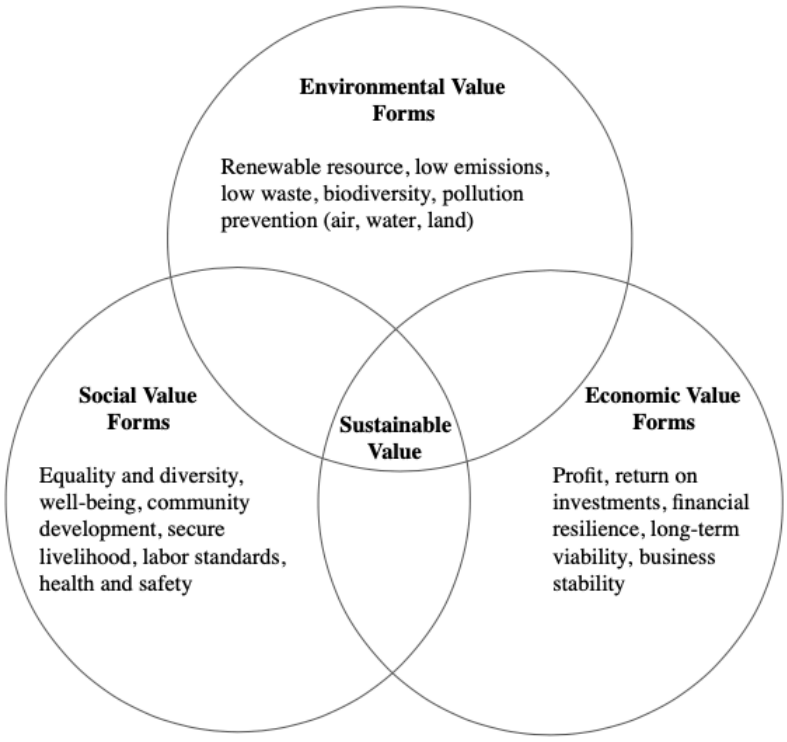

Figure 3 Sustainable Value (Evans et al. 2017)

Although researchers have argued value proposition to be too broad to be used for innovation, the study of Lindič and Marques da Silva (2011) concludes the opposite. Customers have high purchasing power and thus innovation should align customers' preferences emphasising managers' necessity to take on a customer perspective. Generally, many authors view value proposition as a core element of a business model, however, this study aims to investigate the ES value for the Indian DVC and takes its subjective nature into account. While this research acknowledges that value proposition is taking the firm as unit of analysis, this research takes a more customer oriented view and evaluates to what extent ES adds value to them and increases their willingness to pay extra.

2.3 Sustainability Transitions

Much of the literature on this topic has shifted from a more general systems transition approach to address societal challenges and how to govern these within established systems. Alkemade, Hekkert and Negro (2011) define a transition as "a fundamental change in the fulfilment of societal needs that can take 25–50 years to complete" (p.125). Loorbach and Rotmans (2010) define transitions in slightly more detail as "the fundamental changes in structure (e.g. organisations, institutions), culture (e.g. norms, behaviour) and practices (e.g. routines, skills)" (cited in Falcone, 2014, p.63). Schot and Kanger (2018) argue that the concept of ST has been established on the grounds of the complex interplay of environmental challenges on a global scope. They advocate that radical change in systems is needed for the benefit of society and future generations. Specifically climate change plays a central role in light of its impact on ecosystems as well as loss of biodiversity or resource depletion due to unsustainable and inefficient production and consumption (Falcone, 2014; Geels, 2011). Geels (2011) further underlines that the necessary environmental improvements can only be achieved through fundamental changes in system structure, especially in transport, energy and agri-food. This study follows the definition from Geels and Schot (2010 cited in Falcone, 2014) who are both widely recognised scholars within this field. They argue that ST are considered as long-term transformation processes in which an established system transfers production as well as consumption towards a more sustainable system. This transition, according to the authors, needs to occur on multiple levels, including technological, material, organisational, institutional, political, economic and socio-cultural change. Geels (2011) refers to these as socio-technical regimes, which require the knowledge of technology, policy, markets, consumer practices, infrastructure, cultural meaning and scientific in order to achieve a transition. Falcone (2014)

argues that ST address social necessities, such as the need for agriculture, energy or transportation, and will contribute towards meeting the needs of future generations. He adds that inefficient production as well as consumption designs often have the consequence of pollution and thus need to be redesigned involving a long-term transition towards more sustainable processes. According to Geels (2011), ST differ from classical transitions in three main aspects. Firstly, they are goal-driven as compared to emerging from economic opportunities. As these purposive transitions are mainly benefitting the collective good, there is often little incentive for the private sector to engage in ST. Therefore, the author emphasises the dependence of successful ST on public authorities. Secondly, sustainable solutions often do not clearly demonstrate individual user benefits as they tend to have a weaker price/performance ratio when comparing it to conventional solutions. Again, Geels (2011) argues the need of policy changes in terms of subsidies, tax-systems, or regulations, which he recognises however, is commonly constrained by power struggles and change resistance. The last particularity of ST addressed by Geels (2011) is that the necessary environmental solutions are commonly developed by small-scale pioneers within niche markets rather than by incumbent firms. While these have a larger pool of resources, which provide opportunity to upscale innovations developed by niches, they are often still guided by a pure conventional economic orientation supporting traditional systems.

Wieczorek (2018) addresses another issue, namely the target- and subsidy-orientated state program. She explains that mere financial means are insufficient for long-term learning and for the development of self-efficient systems, which requires education and long-term investments. Based on such insufficiency, however, alternative interventions for sustainability have emerged through new business models, new funding schemes by financial institutions, or protomarkets (Wieczorek, 2018). De Soto (2000) as well as London and Hart (2004) also discuss that countries with the majority of its population being at the bottom-of-the-pyramid, commonly need to rely on informal institutions since formal institutions such as the government are often weak.

ST involve the interplay of various players where guidance and support from the government play a central role (Markard, Raven & Truffer, 2012). Especially in countries like China and India, governments have substantial power to introduce policies that alter structures and systems, reallocate resources and stimulate environmental friendly solutions, also among financial institutions and the private sector (Wieczorek, 2018). For transition theory to be

successfully applied, Wieczorek (2018) highlights the necessity to recognise the socio-economic, political and historical context. She adds that these can be highly unique across borders and hence the operationalisation of the transition process requires local adaptation. Nevertheless, especially the structural modifications and adjustments can be difficult as existing and unsustainable systems are often culturally rooted. These can be characterised as lock-in mechanisms which mostly tailor cost reductions (Wieczorek, 2018). Customer preferences and behaviours commonly adapt to these mechanisms, usually accompanied with path-dependency which often impedes structural change needed to achieve ST (Geels, 2011). Path-dependency is repeatedly pointed out as major barrier to ST, especially in developing countries with a colonial history (Wieczorek, 2018). Wieczorek (2018) also found in her studies that the perception of sustainability substantially varies across nations, which leads to a missing consensus on problems and possible solutions. She further emphasises that ST are most successful when initiated from within and driven by demand rather than pushed externally. The process can also be facilitated through international developments and their influence, especially on developing countries, she claims.

2.3.1 Conceptual Frameworks for Sustainability Transitions

There are various transition models trying to explain the ST process. Three main transition frameworks are widely recognised, namely the multilevel perspective, (MLP), strategic niche management (SNM), and transition management (TM) (Wieczorek, 2018). The MLP model originally developed by Geels in 2002 and displayed in Figure 4 is most fundamental and often builds the basis for other models, according to Wieczorek (2018).

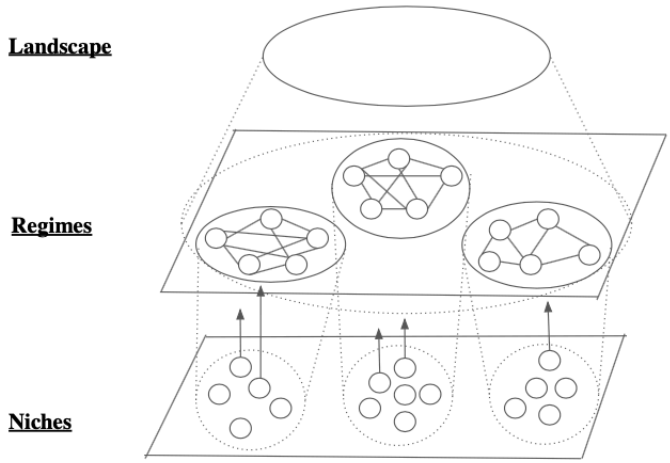

Figure 4 A Multiple-Level Perspective (MLP) Transition Framework (Geels, 2002)

The **MLP** model by Geels (2011) describes the transition process as a non-linear and unique process as it highlights the interconnectedness of the following three dimensions: According to him, **regimes** are the focal point of the model and consist of established rules and routines, which govern people's behaviour and actions. Such rules (e.g. shared beliefs, capabilities, lifestyles or regulations and contracts) on the one hand cater stability but on the other hand also act as lock-in mechanisms. **Landscape**, the second major element of this model, comprises exogenous elements such as urbanisation, demographic shifts, or macroeconomic patterns, for instance. It impacts both the niche level as well as the regime by forcing them to foster or adjust to change. This level of the framework demonstrates the external environment in which the transition takes place and which neither regime nor niche can change in the short-term. Long-term change, however, is dependent on the **niche** level to offer available alternative solutions that offer similar societal benefits. Such solutions are developed in niches or protected spaces that bring about innovations through experimentation. Overall, such system transition is facilitated by change agents and "occurs in the outcome of mutually reinforcing contextual, landscape pressures, internal regime destabilisation processes and upscaling of innovations developed in niches" (Wieczorek, 2018, p.204). An important aspect of MLP is its multiple dimensions at multiple levels which have an interlinked causal relationship, which Geels (2011) refers to as "circular causality".

SNM largely focuses on the niche establishment, often with technological focus, and how to strategically guide such development (Wieczorek, 2018). This author further points out that important elements include learning, networking, visioning, and the interplay between local and global projects. The third approach, **TM**, has a much more practical orientation and aims to facilitate the coordination of a smooth transition process with focus on change agents (Wieczorek, 2018). Considering that this research aims to study the DVC from a more holistic perspective, analysing a broad range of influencing factors impeding or stimulating the ST, a MLP approach will be applied. The SNM and TM model are both too narrow in scope and would not display the full context. Geels (2011) has later extended his original concept to a more sophisticated model, see Figure 5.

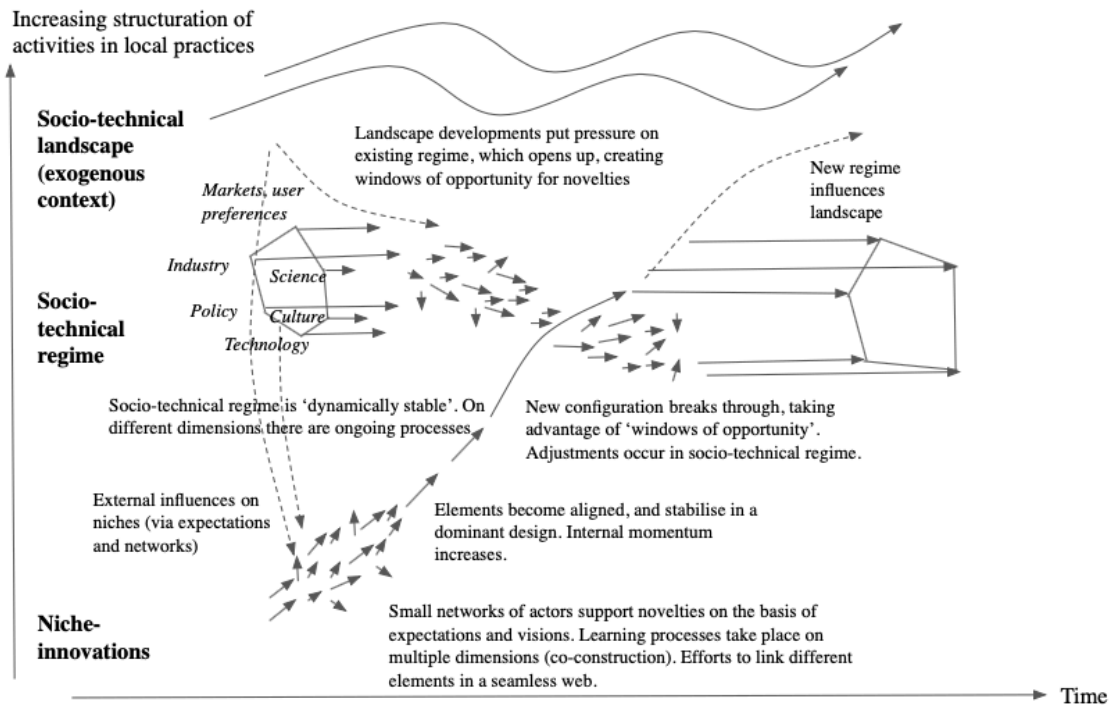

Figure 5 Multiple-Level Perspective (MLP) on Transitions (Geels, 2011)

While it seems suitable in content, the level of detail goes beyond the scope of this dissertation. Therefore, other scholars who have utilised and adapted Geels' model were reviewed which has inspired the development of this study's conceptual framework, presented in section 2.9. As the MLP does not narrowly define the scope of the unit of analysis, this research can apply this model for the entire DVC. The MLP concept has already been applied in various ST studies, e.g. in electricity systems, biogas and co-combustion or organic food and animal welfare. However, as no study has covered the Indian dairy market using this model, this study can add to the stream of literature by analysing network dynamics and its challenges and opportunities.

Besides sustainable transition frameworks there is also a significant strand of literature on a similar field, namely technological innovation systems. However, despite some similarities, this framework discusses how certain technologies and knowledge is diffused and applied rather than displaying a holistic picture of the transformation process, which this study aims for (Wieczorek, 2018). Development literature, specifically leapfrogging and catch-up literature, is another related field of research. It addresses similar topics, such as the cross-country interconnectivity and trade as well as technology transfer, for instance (Wieczorek, 2018). While relevant for this study, it will only be touched upon as the Indian dairy industry is largely domestically operated with restricted imports and exports.

2.4 Emerging Markets

Van Agtmael firstly introduced the term of "Emerging Markets" in 1981. According to him, these markets represent countries with high stock-market potential offering fast investment growth (Sharma, Luk, Cardinali, & Ogasavara, 2018). Luo and Tang (2007) also agree that countries showing fast national economic growth and hence undergo a powerful restructuring are referred to as emerging markets. In spite of the weakened and volatile legal systems, they are commonly considered promising markets. Especially within the last two decades, emerging markets represented rapid growth and exceptional transformation. Interestingly, despite the rapid growth and compelling social as well as economic progress, a large amount of emerging markets still face difficulties from recurrent economic downturn and financial crises. Nonetheless, as income and thus living standards are rising within emerging markets, the original significant difference between developed and undeveloped countries is decreasing (Sharma et al. 2018).

According to Shukla, Garg, Dhar and Halsnaes (2007), developments and priorities also still differ within emerging markets due to the contrast of life circumstances between urban and rural areas. Whereas urban areas demonstrate many similarities to developing countries, consumer behaviours and priorities in rural areas greatly differ. Shukla et al. (2007) further argue, despite current policies addressing poverty mitigation as well as basic needs, policies are not yet influenced by environmental matters. Considering that the phenomenon under study takes place in India, an emerging market, it is important to include the differences of living conditions and priority setting among the population. As ST literature states, information on ST in developed countries cannot directly be transferred to developing countries due to substantially different context. Therefore, it is important for this study to illuminate emerging markets when talking about long-term ST.

As stated in the World Investment Report of 2005, India as an emerging economy is, amongst other countries, one of the most attractive global business locations (Luo & Tang, 2007). Presently, foreign players have only low market shares due to a lack of basic infrastructure within emerging countries. To approach emerging markets, instead of primarily focusing on economic aspects, MNEs should focus on both social and economic conditions in order to promote sustainable growth (Sharma et al. 2018). Internationalisation has already significantly

benefited emerging economies as they have collaborated with global players and thus have shared organisational knowledge as well as technological skills (Luo & Tang, 2007).

2.4.1 Concept of Shared Value (CSV)

In the past, people viewed generating profits and running an efficient business as contributing to society and social benefits. However, with increasing competition, globalisation and cost pressures, companies felt the need to restructure current operations and procedures. Hence, Porter and Kramer (2011) established the concept of creating shared value, implying the importance for companies to simultaneously create social- as well as economic value. These companies can help less sustainably developed countries to reduce waste, energy consumption and to use resources more efficiently. Thereby, rather than sharing their value they can expand value for all parties involved - a fundamental element of the concept. Another fundamental detail is that the concept of shared value is relatively close to a "strategic philanthropy approach" as it puts social value in relation to costs (Spitzeck & Chapman, 2012). Thus, the concept encourages to view decisions and opportunities through the lens of creating shared value. Further, the concept describes three ideas on how to create shared value: Reconceiving products and markets, redefining productivity in the value chain, and building supportive industry clusters at the company's locations (Porter & Kramer, 2011). The DVC demonstrates potentialities to positively influence water usage, natural resources and energy. Spitzeck and Chapman (2012) summarised that the shared value concept not just refers to operating practices or policies but also enhances a firm's competitiveness while positively contributing to society. Porter and Kramer (2006) also state that tackling these social problems, companies can positively impact productivity and expand markets while not automatically increasing costs. They argue for quite the opposite, namely that these strategies can save costs in the long run with such strategy incorporated in a business model due to enhanced technologies, resource utilisation or procurement.

Although the concept of CSV has a number of important strengths, it is also accompanied by an array of shortcomings. These include, on the one hand, the unoriginality due to noticeable parallels to the concept of corporate social responsibility (CSR). On the other hand, the neglecting of trade-offs between the social and economic value creation by claiming CSV moves beyond such trade-offs (Crane, Palazzo, Spence, & Matten, 2014). Additionally, the authors find the concept of CSV to be fairly naive regarding challenges of business compliance as it is built on the premise that compliance with the law and ethical standards are pre-existing.

Nevertheless, the concept does, to a certain extent, add value to society. It implies various implications which can make a sensible and practical application challenging. Instead of taking solely the firm as unit of analysis, as described in the concept, this research goes beyond by also encompassing the cooperatives as well as the GOI to identify challenges and opportunities of ES that could potentially lead to creating shared value.

2.4.2 Globalisation as a Vehicle for Change in Emerging Markets

The term globalisation has become a buzzword and has received tremendous attention over the past decades as it has led to rapid growth and increasing productivity in the world economy (Salvatore, 2010). Globalisation is often defined as a process that improves cross-border linkages and therefore guarantees values, people, money and also ideas to easily circulate across domestic borders (Hurrell & Woods, 1995). The main driving forces for globalisation are technology as well as policy liberation (Erixon & Sally, 2010).

The integration of emerging markets into the global economy displays both opportunities as well as challenges. Qureshi (1996) states globalisation has various opportunities for developing countries such as far-reaching markets for trade, easier access to technological advancements and also increasing foreign direct investments (FDI). The steady increase of FDI within emerging economies is owed to the liberalisation of government policies as well as to the loosening of regulations relating offshore investments (Luo & Tang, 2007). Many scholars also argue these investments to be one of the most important factor supporting developments in many countries (Little & Green, 2009). Furthermore, globalisation seems to result in an increase of efficiency as well as productivity, making emerging markets more attractive and ultimately improving the economic situation of these countries. However, these opportunities also imply challenges. For emerging countries to fully integrate into the international network, it is necessary to adopt a liberal trade as well as an investment system, consequently making the management of macroeconomics more complex. Additionally, globalisation will lead to an increase of competition between policy regimes. Hence, policy makers are often urged to control and keep confidence in domestic as well as international integration markets (Qureshi, 1996). In general, developing countries face the challenge of opening up their global economy as well as dealing with the outcomes of globalisation that evolved in the developed countries (Oman, 1996).

Despite globalisation leading to economic growth, the concern about globalisation threatening not just social but also ES is increasing. Whereas the process of globalisation increasingly expedites, Borghesi and Vercelli (2003) state the rise of environmental issues such as global warming, resource depletion and deforestation. Martens and Raza (2010) argue that the interplay between globalisation and sustainable development is difficult to measure as environmental challenges and consequences are not constrained by national borders. Meaning, for instance, negative environmental consequences caused by one country can be experienced more heavily somewhere else. However, the prevalence of advanced technologies positively influences environmental dismantling. In the long-term prevailing globalisation processes do not positively contribute to sustainable development. Thus, actions need to be taken to reduce the environmental impact in the long-term such as introducing new policies for sustainability development or lowering trade barriers of developing countries (Bhorgesi & Vercelli, 2003). For this research project, globalisation is conceived as a process advocating ST and drives the adoption of ES solutions. Therefore, it is assumed that globalisation is a vehicle for change towards sustainability innovation. Furthermore, globalisation can be seen as a powerful tool for creating similarities across borders, which possibly indicates this study's relevance for other countries under certain criteria.

2.4.3 Leapfrogging

Thus far, little attention among researchers is directed at imitative innovation that is developed somewhere else compared to where it is employed, especially important for developing countries (Metcalfe & Ramlogan, 2008). The conceptualisation of leapfrogging varies among researchers. In its simplest form it most often refers to developing countries accelerating their industrial development by adapting modern practices from industrialised countries and thereby skipping intermediate stages of the process. Often, it is also associated with the mitigation of environmental footprint by skipping specifically the dirty stages of the industrial development and by directly utilising more efficient and clean technologies (Perkins, 2003; Binz, Truffer, Li, Shi, & Lu, 2012). Sauter and Watson (2008) refer to this process as "environmental leapfrogging", which will be adopted for this research. Narrowing down the definition of leapfrogging, the focus will be on Tukker (2005) who defines leapfrogging as situations in which developing countries "learn from the mistakes of developed countries and directly implement more sustainable systems of production and consumption" (p.66), based on innovative and ecologically more efficient approaches. Researchers within this field also argue that successful leapfrogging does not only require technological capabilities but also requires

other areas to leapfrog such as policy or organisational structures, as supposed by Sauter and Watson (2008). They claim innovations to be ingrained in the socio-institutional context, also emphasised by Tukker (2005). He advocates for the necessity of simultaneous institutional adaptation when leapfrogging technologies, which can deem challenging as existing institutions often hold behaviour deeply rooted in path-dependency, hence are reluctant to change.

2.5 Innovation

Nowadays, the term innovation is no longer indispensable in our global world but is yet often not fully understood. The OECD (2010) also emphasises the potential for innovation to positively impact social challenges such as climate change or resource depletion. Within the marketplace, innovation is considered to be a critical factor for survival of economic actors and viewed as an ongoing learning process to implement new design, production and marketing of goods new to the individual/organsation/firm (Metcalfe & Ramlogan, 2008). The authors add that innovations do not necessarily have to be new to others, neither in the domestic nor in the foreign market. It is argued that the degree to which some nations or sectors are innovative largely depends on "institutional differences in the mode of importing, improving, developing and diffusing new technologies, products and processes" (Metcalfe & Ramlogan, 2008, p.20).

Many researchers directly link innovation to a technological or scientific context, which most often has commercial returns as primary objective. However, this research refrains from such narrow definition as it recognises many sources of innovation (Sawhney, Wolcott & Arroniz, 2007). While there is no consensus among research as to how to define innovation, the researchers refer to innovation as a newly introduced product, process or technique in the marketplace for commercial but also non-profit seeking purposes. However, the essential economic process should not be neglected which is necessary to transform inventions into innovations (Metcalfe & Ramlogan, 2008). While the generation of knowledge is essential for the process, this thesis will rather focus on innovation adoption and application as India is known for leapfrogging rather than developing innovations themselves.

2.5.1 Innovation Adoption and Application

For innovations to be successful, the ILRI (2009) claims the knowledge adoption and utilisation to be most essential rather than the knowledge creation per se as innovation can come from anywhere, including from across countries. To foster the adoption and application of

innovations within an ecosystem, a stimulating environment is important. This should not merely include the introduction of policies but rather the fundamental alteration of society's perception for the urge for change and innovation. Thus, the ILRI suggests substantial investments in innovation capacity, which constitutes of "the context specific range of skills, actors, practices, routines, institutions and policies needed to put knowledge into productive use" (Ayele, Duncan, Larbi, & Khan, 2012, p.625). Investments in innovation can be classified into two types: innovation capacity and enabling environments. The latter referring to investments that foster stakeholders engagement and collaboration within the sectoral value chain by providing appropriate incentives, innovation platforms, funding, collaboration structures or by enhancing knowledge management to enable more effective use of knowledge (ILRI, 2009). Metcalfe and Ramlogan (2008) direct attention to the stakeholders who are responsible for or are able to adopt innovations. These key stakeholders are largely firms that can combine different types of knowledge and resources that are required in order to transform inventions into innovations. Generally, the innovation capacity of firms is essential for change and the innovative success within value chains.

2.5.2 National vs. Global Impact on Innovation

Some researchers argue that innovation is constrained by national borders due to its nation specific institutions, policies, technologies, cultures, language or norms (Metcalfe & Ramlogan, 2008). Other researchers go further to argue for innovation to be bound to characteristics of institutions that govern certain systems (Metcalfe & Ramlogan, 2008). However, literature recognises the limited knowledge base of developing countries, which often hinders firms in these countries to establish their own national innovation system (NIS). Hence, these developing countries are often dependent on foreign innovations. Generally, literature recognises a trend of how globalisation enforces its power on developing countries' national innovation systems and how they potentially transition to a global innovation system (Metcalfe & Ramlogan, 2008). The researcher are interested to what extent foreign innovation trends in ES impact the Indian dairy industry.

2.6 Disruption Theory

Disruptive innovation has become a buzzword in today's world, often used to describe how products or services drastically turn around industries or even entire economies. However, reviewing disruptive innovation theory reveals a much narrower concept. When Schumpeter

first introduced the term “creative destruction” it was one of the earliest contributions in the field of disruption theory. According to Schneider (2017), Schumpeter referred to entrepreneurs developing and marketing new products or services, which radically change operations of its competitors and other marketplace members’ activities. While the term “creative” refers to the entrepreneurial creativity in identifying the opportunity to develop something new, “destruction” refers to the fact that companies continuously try to outperform each other by introducing innovations - forcing some businesses to exit the market. Creative destruction by Schumpeter is much more of descriptive nature, concerned with the reaction of the market agents and the subsequent changes in processes (Schneider, 2017). Contrasting to this approach, Christensen (1997) firstly introduced the concept of “disruptive innovation” in 1997, in order to provide more practical insights for firms and managers to trigger or cope with disruptions (Schneider, 2017). According to Schneider (2017), Christensen defines the concept more precisely, claiming disruptive innovation to be a process rather than a finished product or service. Within this process, entrepreneurs first develop basic, good enough products or services for the low-end customers and then move up towards the high-end market, ultimately challenging or even pushing established competitors out of the market. These disruptive innovations serve a new market or new set of customers, which have been neglected by the established firms due to their focus on the most profitable, high end customers (Christensen, Raynor & McDonald, 2015). Compared to Schumpeter’s concept, Christensen defines innovations to be more technology driven, having relatively simple architecture and serving only basic needs valued in emerging markets yet not considered by customers in developed markets. However, once these innovations improve in performance, they rapidly scale and gain access to higher customer segments, subsequently outperforming established competitors. Christensen differentiates between two types of disruptions, ‘low-end disruptions’ and ‘new-market disruptions’. The former referring to disruptions targeting customers with basic needs who are not willing or able to pay for the performance offered to the high-end market while the latter ‘new-market disruptions’ serve unmet customers’ needs (Schneider, 2017).

A study of Yu & Hang (2010) moves beyond Christensen's original concept of disruptive innovation by distinguishing ‘low-end’ disruptions from ‘high-end’ disruptions. They argue that initially, high-end disruptions are more expensive. However, in the course of time such technologies are further developed and upgraded, which in turn makes these technologies more affordable and accessible to the market. Such phenomenon can also be explained by the theory of the technology s-curve, a framework displaying the life-cycle of innovations in form of their

performance in regard to time and effort (Schilling, 2017).When a technology is first introduced to the market, it typically shows slow improvement of performance. Once it receives more attention among various players, the performance further accelerates as more actors invest in research and development (R&D). Finally, when a technology's limit has been reached, performance slows again (Christensen, 2009; Schilling, 2017). Over this period of time the technology becomes more affordable as well as accessible due to the decrease in costs. However, technologies can be discontinued at any time even before reaching the maturity stage. At this juncture, a new technology may arise disrupting the current technology (Schilling, 2017).

While the described theories are partially applicable, they are viewing the concept of disruption too narrow for the purpose of this study, especially since they take the firm as unit of analysis rather than the value chain. As Christensen's definition is solely concerned with technological innovations and does not serve as a navigator for managers on how to deal with disruptors or how to become one, it is not suitable for this research purpose. While the concept of creative destruction by Schumpeter is more applicable for this research, it is motivated based on competition among commercially oriented firms or entrepreneurs, which for this study is again too narrow. Hence, disruption for this study's purpose is defined as a new product, process or technique, which drastically changes the operations of any stakeholder along the DVC or drastically changes the industry's structure.

2.7 The Value Chain

Literature proposes a series of different definitions for the value chain concept. The most widely recognised concept of the value chain was introduced by Porter back in 1985. He defines the value chain as "the linked set of value-creating activities all the way from basic raw materials sources for component suppliers through to the ultimate end-use product delivered into the final consumers' hand" (Shank & Govindarajan, 1993, p.13). While he explains the individual firm value chain, he also emphasises the view external to the firm. He underlines the importance of understanding that each firm is only a part of the larger system of value-creating activities performed by other members of the value chain, which is also emphasised by further scholars (Wang & Li, 2011; Shank & Govindarajan, 1993). Consequently, firms do not operate in a vacuum but instead are interdependent. Bellú (2013) similarly defines the value chain as a set of "interdependent economic activities' and a 'group of vertically linked economic agents"

(p.3). Kaplinsky and Morris (2001) go beyond just vertical linkages to incorporate intra-chain linkages, which refer to a two-way flow. Meaning, not only upstream activities influence downstream activities but also vice versa and not necessarily in a successive manner.

Porter refers to the analysis on firm level as the 'narrow scope' that explains how competitive advantage for the individual firm is created. However, since this study's unit of analysis is the industry, we are more interested in what Porter describes as the broader scope. This refers to the industry's interrelationships and how these can enhance competitive advantage for stakeholders of the value chain (Porter, 1985). Therefore, Porter's value chain system can also be utilised to analyse industries and the relationships among the various stakeholders. It is also important to note that Porter mainly utilises the value chain to identify competitive advantage which this paper does not aim to do.

The classical concept of the value chain has expanded to incorporate the ES component and is often referred to as the 'Green Value Chain'. Neven (2014) introduces a comprehensive definition applicable for this study by focusing on agri-food and the inclusion of economic, social and environmental elements. It refers to the:

> full range of farms and firms and their successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular food products that are sold to final consumers and disposed of after use, in a manner that is profitable throughout, has broad-based benefits for society, and aims to reduce the environmental footprint (p.4).

Furthermore, this definition entails preventive strategies for effective and efficient resource utilisation and strategies for water, carbon or food waste reduction as well as ecosystem and biodiversity conservation, for example. Research has shown that the implementation of ES initiatives along the food value chain offers opportunities for economic growth through better technologies and innovative solutions as well as various social benefits. Compared to other definitions, this concept points out the market-driven dynamics from a vertical integration perspective. Also, it can be used holistically - covering country-wide product sectors where sustainability and the added value through such are crucial elements (Neven, 2014).

This study requires a broad and encompassing view of the industry, hence, the entire DVC will be investigated. This is important as changes anywhere in the value chain can have substantial impacts on firms up- or downstream of the chain. These changes can of course range from being incremental to being disruptive and altering entire business models - changing the patterns of the value chain fundamentally. Nevertheless, it is important to note that this study does not aim to display the relationships among stakeholders but rather their potential impact on each other as well as to what extent collaboration among the value chain fosters the adoption of ES solutions. This can be important as literature finds such interaction or the coordination of the chain to have the potential to trigger innovation anywhere along the chain (ILRI, 2009).

2.7.1 Value Chain Analysis

When analysing value chains, the ILRI (2009) suggests to focus on most influential factors impacting the value chain due to the large number of stakeholders and actors involved in sectoral value chains. They refer to such key initiatives that have most far reaching potential for impact as leverage. Sources of leverage can be best identified when analysing three components: geographic clusters - to reach many actors of the value chain with minimised effort; stages of the value chain where large amounts of product pass through only a few actors; and policies that propose regulations affecting a wide range or actors spread across far distances regardless of size (ILRI, 2009).

While most value chain analysis approaches and research in this field aim to enhance the chain's efficiency or productivity or to reduce poverty, increase income levels an economic growth, this study instead aims to identify potential opportunities and challenges for ES developments. The value chain can further be utilised as an analytical tool to comprehend the environment in which firms and stakeholders operate and also in understanding how these are embedded within the global economy (Kaplinsky & Morris, 2001). Further, it serves to understand how industries react to certain changes in market conditions, technologies or policies (ILRI, 2009). Lastly, it can also be utilised as a tool to identify opportunities for innovation or development, which this study at hand aims for. Furthermore, such approach is beneficial to identify how changes and trends in one stage can influence another (ILRI, 2009).

2.7.2 Value Chain Governance and Collaboration

Applying the value chain approach in agriculture is a relatively recent development and is often applied for development initiatives (ILRI, 2009). The same research shows that the better the

various stages of the value chain are coordinated, the more likely will product quality and production efficiency increase, resulting in fewer waste. Such enhanced coordination is beneficial especially for perishable agricultural commodities to reduce uncertainty and risks. Mechanisms for such coordination mainly consist of institutions and arrangements from governments, associations or other agencies. Nevertheless, research recognises that some value chains are not equipped with strong governance structures and may also be exerted through the chain actors themselves, communities or associations (ILRI, 2009). Hence, the vertical integration and communication of the various stages of the value chain is critical for its productivity and efficiency. Kaplinsky and Morris (2001) note that in practice there are often several sources of governance that enact conflicting regulations competing for power.

Another important factor in the value chain analysis and important for this study are business development services (BDS), which can range from infrastructure services to production or storage services over to financial or policy service. These services are often necessary for actors within the value chain to develop necessary skills and to be provided with crucial market information in order for the entire value chain to operate more efficiently (ILRI, 2009).

2.8 Transaction Costs and the Interdependence of Economic Activities

The production of final goods (and services) requires various interdependent economic activities. According to a significant number of scholars, including pioneers like Coase or Williamson, the organisation of such activities and how they are performed is a matter of transaction costs (Müller & Aust, 2011). Williamson (1981) claims "a transaction [to] occur when a product or service is transferred across a technologically separable interface" (p.552) from one activity to another. Hence, the cost that arises from such transaction, often involving activities such as writing and negotiating of contract or the enforcement and monitoring thereof, is referred to as transaction cost. In other words, transactions costs are the costs for running an economic system, either an organisation or the relationships within an industry or even among national borders (Rindfleisch & Heide, 1997; Arrow, 1969).

Transaction costs economics (TCE) theory was originally first introduced by Coase in 1937, who argued this to be the very reason for the existence of firms. To organise transactions, inherent in any sector or industry, Coase differentiates specifically between two governance

structures, the market and the firm. Williamson (1988), a strong advocate of TCE, later adds a third governance structure, the hybrid form - organising transactions both between private and public organisations. For a firm to decide which economic activities to perform themselves and which ones to source from or leave to the market, transaction costs play a fundamental role, according to TCE. When buying goods from the market becomes too expensive, firms are often organised to produce a good themselves in a more cost efficient manner (Rindfleisch & Heide, 1997). This also relates to vertical integration, which refers to the "firm's decision to either backward integrate into the supply chain or forward integrate into distribution and sales" (Rindfleisch & Heide, 1997, p.32). Hence, a firm can decide to include upstream or downstream activities in their operating portfolio when it believes it can perform these activities more cheaply or leave them to the market otherwise. Scholars refer to this also as the "efficient boundaries" of an operating unit, which for the purpose of our study will be applied to industries or nations. How an industry or nation is organised is also impacted by the prevalent institutions as they affect transaction costs (Edquist & Johnson, 2006). While the unit of analysis for TCE is the transaction itself, transaction costs occur on a number of different levels, ranging from firm level to industry, all the way to state level. Therefore, transaction costs also impact the choice of introduced policies and regulations in a country as well as the degree to which stakeholders from different nations collaborate, for instance (McCann, Colby, Easter, Kasterine, & Kuperan, 2005; Zoltán, Bakucs, Fertő, & Szabó, 2013).

Also important for the make and buy decision is the firm's competitive advantage or core capabilities, as more thoroughly explained by Porter (1985). Individual firms usually do not perform all activities necessary from raw material sourcing to consumption but instead specialise in few activities to efficiently utilise their often limited resources and to reduce transaction costs. While these activities are technically separate from each other, they are yet interdependent as the input of one firm is almost always the output of a proceeding firm.

2.9 Conceptual Framework

The establishment of a conceptual framework provides a distinctive guideline for the research at hand. Comparing and reviewing the three main concepts of ST, namely MLP, SBN and TM, MLP was identified most suitable for this study. ST have not yet been researched within the Indian dairy industry, an industry of high potential to mitigate global environmental impact. To fill this gap, this research attempts to provide a macro level understanding of the topic and to

identify a suitable framework for the investigation thereof. This research may further contribute to future researchers aiming to investigate certain elements in more depth. The conceptual framework used for this research, portrayed in Figure 6, is mainly drawing on the multilevel perspective on system innovation from Geels (2002) and his adjusted framework of 2011. However, due to the scope of this research it was partially simplified and further specified. Considering the abstract but encompassing level of this framework, various concepts had to be reviewed which contributed to the understanding of ST concept and its interlinkages among various elements.

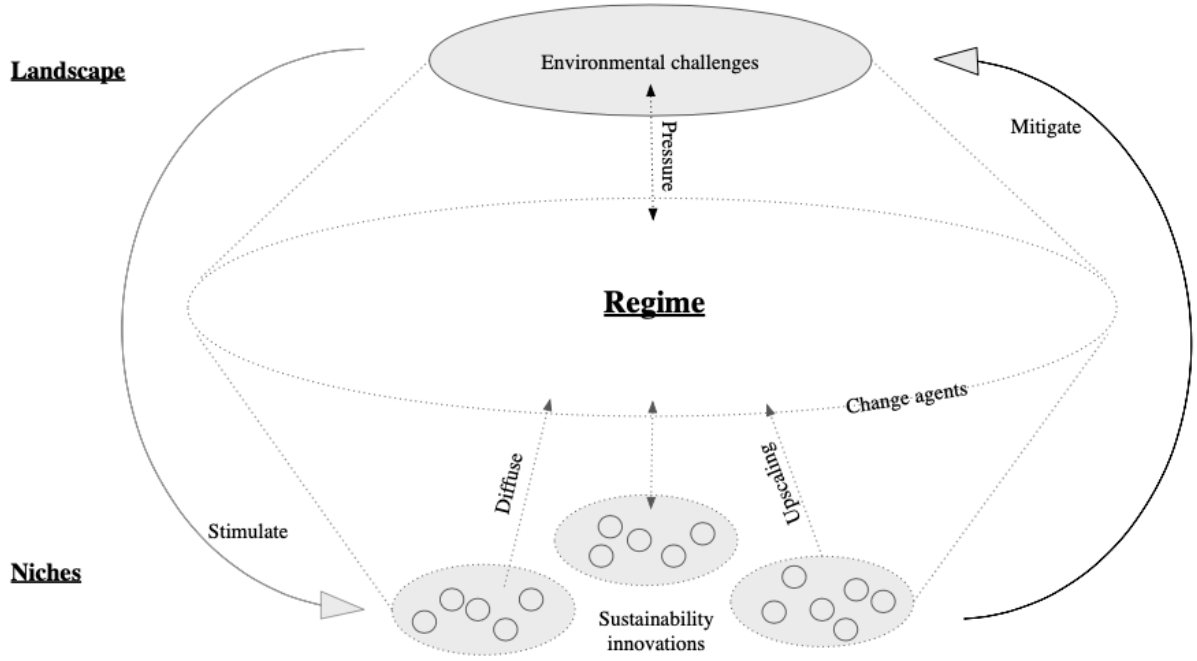

Figure 6 Theoretical Framework (adapted from Geels, 2002)

Whereas Geels (2002) relates the element "landscape" to components such as urbanisation, demographic shifts, or macroeconomic environment, "landscape" for this research is associated with environmental challenges fostering changes at regime level. Based on literature, it is assumed that environmental challenges force the DVC to undergo a ST to maintain resources for future demand. To further underline the impact of environmental challenges on regimes, Chang, Zuo, Zhao, Soebarto, Zillante and Gan (2017) specifically highlight this pressure to cause tensions as well as destabilisation of such. Thus, the displayed framework further specifies the cause-and-effect relationship between these two elements. As literature finds innovations to evolve when problems emerge, it can be assumed that environmental challenges stimulate the emergence of sustainability innovations. Considering that these environmental challenges seem pressing for many dairy operations, DVC actors or external niches can be

expected to transform these challenge into business opportunities. Besides, substantial change at regime level relies on available alternative solutions developed at niche level. While Geels (2002) refers to experiments when addressing the niches, this study further specifies alternative solutions with sustainability innovations. As these have the potential to reduce environmental challenges, the government should be incentivised to foster the upscaling of such and allow for system change. Based on the framework of Chang et al. (2017), the cause-and-effect relationship between niches and regimes was specified to highlight the opportunity of sustainability innovations to diffuse into the destabilised regime. Ultimately, based on the researchers understanding, it seems realistic to anticipate sustainability innovations to mitigate environmental challenges as these can have major potential to reduce resource depletion and global warming in the long-term.

3 Methodology

This chapter provides a description and reasoning of the utilised research approach and design as well as research methods, which have served as a facilitator to address the research questions. Therefore, focus lays on how data was collected and analysed as well as what implications researchers choices have on reliability and validity of this study. Ethical considerations are also pointed out as well as limitations to recognise for potential shortcomings.

3.1 Research Approach and Methodological Choices

The research approach is of explorative nature as it aims to understand an unknown phenomenon, which may cause the direction of research to change depending on the revelation of new insights. As this investigative research seeks to understand individuals' views and perceptions about a social problem, a pure qualitative research choice was applied. A qualitative study is specifically suitable when pursuing to produce new insights rather than testing existing knowledge, often with the use of emerging, open-ended research questions (Creswell, 2014), all which this study at hand does. More specifically, the collected non-numeric data consists of research participants' knowledge, observations, experience, and opinions. These accounts are collected in the form of interview recordings and their subsequent transcripts as well as written observation notes. Interviews were the main source of primary data as they "provide opportunities for mutual discovery, understanding, reflection, and explanation [and] elucidate subjectively lived experiences and viewpoints from the respondents' perspective" (Tracy, 2013, p.132). This thesis can be classified as a multi-method qualitative study considering that besides interviews also notes of observations as well as reports and documents, provided by research participants and research institutes, were analysed.

This thesis focuses on India as the focal country with an industry level of analysis. The various units of analysis are all independent individuals either direct stakeholders of the DVC, part of support functions like NGOs and other institutions or professionals in environmental sustainability. These units of analysis were chosen as they could provide a broad but encompassing insight of the value chain and mostly have an understanding of ES.

Choosing a suitable research approach is essential as it decides upon the researchers reasoning and how findings were developed (Saunders, Lewis & Thornhill, 2016). Saunders, Lewis and

Thornhill (2016) differentiate between a deductive approach, which aims to test propositions or hypotheses, and the inductive approach, which commences with the empirical examination of a situations and categorises findings into key themes along the research process to arrive at a concept (Khan, 2014). Since both approaches by itself are not ideal for this study, a hybrid approach was applied using elements of both. This study commenced with theory by reviewing academic literature but continued with data collection not to test existing theory but to investigate a new situation to identify patterns without the development of theory or frameworks. Furthermore, this research followed an evolving, iterative methodological design to enable the emergence of themes and to move back and forth between empirical findings and theory. Consequently, our thesis was subject to emerging research questions, which changed along our process of empirical research.

3.2 Research Design

Selecting a suitable research design provides the opportunity to yield extensive data and to consider most important and applicable aspects for the study (Creswell, 2014). A case study was evaluated as most appropriate design for this study to obtain in-depth information. A case in this research design can refer to various units such as an individual, a group, a society or a change process, for instance (Saunders, Lewis & Thornhill, 2016). For this particular research, the DVC is the case under study. Further, this research design provides rich information as they collect data from various sources including archival data, interviews, observations, or survey data (Eisenhardt & Graebner, 2007). It also allows to study the dynamics and interlinkages of the topic, which occur in a real-life setting and within a specific context (Saunders, Lewis & Thornhill, 2016). However, using this design usually also imposes the difficulty for generalisability, lacks scientific precision and yields extensive amounts of data which are subject to interpretations by the researchers (Easterby-Smith, Thorpe & Jackson, 2015). Case studies can be further defined based on two dimensions: single vs. multiple case and holistic vs. embedded case (Baxter & Jack, 2008). Since this study aims to look specifically at one main unit of analysis, the Indian DVC, solely focusing on experts within the field, this is a single case study. A holistic case refers to the investigation of a single case taking a multiple perspective whereas an embedded case study considers several units from a more narrow perspective (Saunders, Lewis & Thornhill, 2016). Hence, while this study aims for a holistic case by investigating the entire DVC from different angles, time and resources only allowed for an embedded case study.

Prior to the empirical data collection, the researchers have conducted a literature review and learned about the Indian DVC on the internet to obtain a contextual understanding. Their ex ante conception, however, was only partially confirmed by on-site observations and conversations and was lacking sufficient depth in context. Hence, ex post, both researchers agree that not having visited India personally would have sacrificed the quality of this paper substantially.

3.3 Data Collection Method

Primary data for this study was obtained through 19 semi-structured expert interviews. While data saturation was reached somewhere after 13 interviews, the researchers have conducted additional interviews to ensure a multi-perspective, sophisticated investigation considering the complexity of the topic. Interviews lasted approximately 45 minutes each and were mostly conducted face-to-face as the researchers have travelled to India for one week. Semi-structured interviews, as compared to structured- or unstructured interviews, were considered most suitable for this study. They allow for flexibility to probe where necessary in order to absorb as much relevant and in-depth data as possible, important for this study (Saunders, Lewis & Thornhill, 2016). Instead of using a standardised set of questions, an interview guide was utilised (found in Appendix B), guiding the researchers through main topics to be covered. Additionally, semi-structured interviews intend to gather specific opinions and views from participants, thus, allowing different perspectives on the studied field (Saunders, Lewis & Thornhill, 2016). However, while interviews are highly effective in gathering rich empirical data, they are generally claimed to be strongly subjective and hence biased in nature (Eisenhardt & Graebner, 2007). Nevertheless, interviewing independent actors in different locations lowered the risk for bias on the research participants' side. Prior to the data collection, a pilot interview was carried out. It helped to refine topics to be researched and questions to be addressed so that other interviewees have no difficulties to provide applicable information (Saunders, Lewis & Thornhill, 2016). The pilot interview highlighted the necessity to further clarify the concept of ES as the definition and perception of such greatly differs in India compared to other countries but also among individuals. While the majority of interviews was conducted face-to-face, some were conducted via Skype. All interviews were audiotaped given the interviewees' consents, while also handwritten notes were taken in the event of recording failures as suggested by Creswell (2014). Subsequently, each interview was transcribed. As

English was not the native language neither of the interviewees nor of the researchers, edited transcripts were created rather than verbatim. Meaning, the researchers have adjusted the language and hence structure of sentences where applicable while retaining the integrity of the audio. Some interviews, however, were not considered as they were not directly adding to the focal point of our study.

The selection of suitable interviewees was based on researchers' judgement. Probable interview candidates were either contacted via Email or via LinkedIn. In total, approximately 300 interview inquiries were sent out. Accordingly, the researchers were able to select interviewees based on their profession, background, and experience within the DVC. After having conducted some interviews, further interviewees were recommended. Hence, this research partially utilised snowball sampling. Due to the country's size and limited time and resources to span the entire country, primary data was collected mainly in Mumbai and Delhi with few exceptions. While it was recognised that these two cities are not the most dairy intensive states nor most impacted by ES issues, these two cities were chosen because of two main reasons. Firstly, most dairy experts with a holistic perspective on the DVC are located in Mumbai or Delhi and secondly, most responses for interview inquiries came from these two cities. It was the aim to interview stakeholders from each step in the DVC, however, it was difficult to receive responses from stakeholders within transporting, distributing and retailing. Despite reaching out to various government officials, unfortunately no responses were received. Nevertheless, the researchers were able to gain a profound understanding of the DVC based on the observations and conducted interviews as presented in Table 1. The same table shows the categorisation of interviewees based on their occupation for the reader to be able to directly put the information into context.

Table 1 Interviewee Details

Interviewee Category (Nr.)	**Interviewees Occupation (Seniority)**	**Method / Time**	**Date**	**Location**
Dairy Consultant 1 **- C1** (1)	Independent Consultant – Sustainable Energy (> 10 years)	Pilot interview / 36 min	02 April 2019	Bangalore
Dairy Expert 1 **- DE1** (2)	Venture Partner at Omnivore (< 1 years), Advisor for Tata Trusts (> 1 year)	Skype call / 1h 8 min	03 April 2019	Delhi
Research Institution 1 **- RI1** (3)	Climate Tagger Product Manager and Knowledge Management at REEEP-Renewable Energy and Energy Efficiency Partnership (> 8 years)	Skype call / 30 min	10 April 2019	Austria
Research Institute 2 - **RI2** (4)	Dairy Market Researcher at IFCN Research Center (> 4 years)	Skype call / 34 min	12 April 2019	Germany
Foodtech Expert 1 **- FT1** (5)	Founder & Managing Partner of Global RIFF - Integrated Innovation Investment Platform for the Food Tech Industry (> 5 years) Founder of FoodBytes! (Rabobank) (> 3 years)	Skype call / 22 min	18 April 2019	CA, USA
Sustainability Expert 1 **- SE1** (6)	Sustainability Advisor (7 years)	Skype call / 53 min	20 April 2019	Mumbai, Maharashtra
Sustainability Expert 2 **- SE2** (7)	Director at Clean Environmental Technologies (16 years)	Face-to-face interview / 1h 15 min	22 April 2019	Mumbai, Maharashtra
Dairy Expert 2 **- DE2** (8)	Secretary at the Indian Dairy Association & Prabhat Dairy Advisor Milk Procurement (> 15 years)	Face-to-face interview / 1h 5 min	22 April 2019	Mumbai, Maharashtra
Dairy Expert 3 **- DE3** (9)	Dairy Advisor – Cattle Nutrition & Management (> 8 years) Indian Dairy Association (> 12 years)	Face-to-face interview / 1h 6 min	22 April 2019	Mumbai, Maharashtra
Dairy Consultant 2 **- C2** (10)	Dairy consultant (> 40 years) Ph.D. (Dairy & Food) from National Dairy Research Institute; Technical Adviser Food & Dairy at Indian Dairy Association	Face-to-face interview / 54 min	22 April 2019	Mumbai, Maharashtra
Dairy Consultant 3 **- C3** (11)	Founder 360 degree dairy consultancy (> 6 years)	Face-to-face interview / 1h 12 min	24th of April 2019	Noida, Uttar Pradesh
Dairy Expert 4 **- DE4** (12)	Managing director at Creative Agri Solutions (> 9 years) Ph.D., value chain specialist (> 1 year)	Face-to-face interview /51 min	24 April 2019	New Delhi, Delhi
DVC Stakeholder 1 **- Stk1** (13)	Founder of Cowboys (> 8 years)	Face-to-face interview / 32 min	24 April 2019	New Delhi, Delhi
DVC Stakeholder 2 **- Stk2** (14)	Founder of Indicow (> 2 years)	Face-to-face interview / 38 min	25 April 2019	Haryana
Research Institute 3 **- RI3** (15)	GIZ, Indo-German Energy Programme Access to Energy in Rural Areas, Technical Expert (> 2 years)	Face-to-face interview / 1h 53	26 April 2019	New Delhi, Delhi
Processor 1 **- P1** (16)	CEO at Amrit Foods (> 12 years)	Face-to-face interview / 1h 36 min	26 April 2019	Noida, Uttar Pradesh
Sustainability Expert 3 **- SE3** (17)	COO - CII-ITC Centre of Excellence for Sustainable Development (> 11 years)	Skype call / 54 min	3 May 2019	New Delhi, Delhi
Private Sector 1 **- PS1** (18)	Procurement Dairy & Ingredients (MNE) (> 2 years)	Skype call / 1h	4 May 2019	New Delhi, Delhi
Dairy Consultant 4 **- C4** (19)	Chief Thinking Officer at Think Dairy Inc. (unit (> 9 years)	Skype call / 25 min	17 May 2019	Noida, Uttar Pradesh

Moreover, observations complemented the empirical data collection. Saunders, Lewis and Thornhill (2016) distinguish between participant observation, a qualitative approach to discover the reasons of people's' actions undertaken, and contrary the structured observation, a

quantitative approach in which the frequency of actions is the main concern. Thus, on-site participant observations allowed the researchers to better grasp the context in which the research took place. Apart from this, it enabled to see first-hand how the value chain operates today, outlining potential opportunities or challenges not noted in literature nor mentioned by interviewees, intentionally or unintentionally. Besides general and context specific observations, three plants were visited which are described in Table 2. For all observations made, field notes as well as photographs were taken to reduce the possibility of bias. Photographs are included in Appendix C.

Table 2 Details of Field Research

Company/ Village Name	Observation field
Lal Pur Village	· A rural village two hours north of New Delhi with about 600 inhabitants · Several farmers holding 2 to 3 cows each
Indicow Organic Farm & Processor	· An organic dairy plant holding approximately 100 cattle and producing roughly 4,500 litre of milk each day · Rohit grows feed and fodder themselves · Plant with an automated and traceable milking machinery · Products are processed and packaged in-house · Distribute own products
Amrit Foods Processor	· Processing plant · Processes about 45,000 – 50,000 litre a day · Supplies to buyers, such as McDonalds, Starbucks, Café Coffee Day

Secondary data also supports the data collection and was mainly gathered from archival data or academic journals. These were accessed mostly through computerised libraries such as the LUBsearch, web search engines like Google Scholar or reports released by governmental organisations or institutions. Secondary data is highly beneficial in terms of cost and effort but also to incorporate data for which primary access was denied, for example government representatives for this study (Cowton, 1998). As secondary data often cannot address the study focus as precisely as primary data and may limit internal validity of research findings, according to Bhattacherjee (2012), it only served as a complementary source. Lastly, public available documents such as industry reports and private documents like personal articles were used.

3.4 Data Analysis

The data analysis occurred alongside the data collection process and while writing up of research findings. Considering the richness of qualitative data gathered from interviews, the researchers “winnowed” the data, which according to Creswell (2014) indicate the need to confine the data to its relevant parts. To facilitate the analysis, the qualitative computer data

analysis program Atlas.ti was utilised to organise and code the data. “The excellence of the research rests in large part on the excellence of coding” (Strauss, 1987, p.27). Therefore, detailed codes were developed based on gathered data, as displayed in Appendix D. An exhibit from the utilisation of the tool is displayed in Appendix E. In turn, codes enabled authors to prevent bias as both researchers coded findings together. Afterwards, categories were established to sort and narrow down the available data. Lastly, empirical findings were put into context to existing literature.

3.5 Validity, Reliability and Ethical Considerations

The following discusses the study’s validity and reliability as well as its ethical considerations. Validity referring to the extent to which the findings can be evaluated as accurate and reliability meaning the extent to which this research approach is consistent with other researchers or research projects (Creswell, 2014).

To ensure qualitative validity, multiple procedures were taken to safeguard the accuracy of the findings and to mitigate biases. These can occur at each step of the research process on sites of the researcher or participant (Creswell, 2014). Firstly, the data was triangulated by using multiple sources of data, namely interviews, observations and private as well as public documents. Secondly, it was ensured that both, the confirming but also the discrepant evidence was included to display a truthful picture of the topic and to avoid confirmation bias. This adds to the degree of validity as findings become more realistic, argued by Creswell (2014). Thirdly, the researchers have undertaken travels to India for a week to obtain a richer understanding of the context in which the study takes place and to increase the researcher’s judgement about participants’ shared information. This is specifically important considering that participants, especially directly involved stakeholders of the value chain, seem to have been sensitive to expose information that indicates no environmental initiatives or concerns and hence a negative image. These may have been reluctant to always be honest in order to favourably portray either their business or country. Lastly, it should be considered that the researchers of this study and hence their interpretations of results is influenced by several factors such as their culture, background, socioeconomic origin or history. However, the researchers in this study have neither been exposed to the research subject beforehand nor have any connection to the country or industry, which can be expected to mitigate several types of bias and foster objectivity. To enhance the study’s reliability, the researchers have made detailed protocols and databases to

enhance the traceability of the study (Creswell, 2014). The definition of codes was documented in writing and created by both researchers involved to ensure consistency and to prevent a shift in meaning, suggested by Creswell (2014).

Considering the extensive number of conducted interviews in five different states of India, the sample is possibly representative for the entire Indian DVC. When addressing generalisability, it generally refers to external validity in the sense that the conducted research at hand could also be applied in other research settings, such as other industries and countries (Saunders, Lewis & Thornhill, 2016). While this research has merely focused on India and is thus unable to make concrete claims about generalisability across other industries and countries, one can expect countries with similar criteria to be able to learn from this particular case.

As research involves the collection of personal data and opinions, ethical considerations are very important (Creswell, 2014). It was ensured that no information shared in this study harms any of the participants or displays them in a negative light, as advised by Creswell (2014). Therefore, to avoid any potential conflicts, research participants were anonymised.

3.6 Limitations

There are various potential limitations recognised for this study. Firstly, the researchers of this study had to take interviewees information and their opinion at face value, which may be accompanied by various biases such as selective memory or exaggeration (USC Libraries, 2019). Furthermore, since this study tailors the Indian dairy market in which the German researchers have no affiliation or experience and no established network, gaining access to some relevant sources of information or interviewees, such as the government, was challenging. Besides, most findings were collected from participants of Indian heritage, who seem to have strong ties to their home country and thus might be subject to bias. This may have influenced interviewees' response for more critical topics, especially when addressing initiatives taken by the GOI. Additionally, a deficiency in fluency of language may have further impeded the study. While English is an official language in India, some interviewees seem to have struggled to fully express themselves, which can be expected to have hindered them to share their full account of information. Lastly, while this study was aiming for a holistic case study, only an embedded case design could be executed due to time and access constraints.

4 Findings and Analysis

The following chapter presents and analyses all relevant empirical findings of this qualitative study. These were obtained through 19 semi-structured interviews and were complemented with secondary data where applicable. Furthermore, this chapter establishes a link to theory, specifically addressing how the concept of ST can be applied. Interviewees were categorised based on their occupation and level of experience for the reader to directly put the empirical findings into context. Categories are as follows: Dairy Consultant - **C**, Dairy Expert - **DE**, Sustainability Expert - **SE**, DVC Stakeholder - **Stk**, Research Institute - **RI**, Foodtech Expert - **FE**, and Processor - **P**. The structure of this chapter will follow the sequence of the DVC, commencing with farming, followed by transportation, processing, retailing, distribution, ending with consuming. While all steps were investigated, most findings were gathered within farming, processing and consuming, which are discussed in more detail. This chapter closes by revising the utilised conceptual framework of ST.

4.1 Understanding of Environmental Sustainability

Sustainability among interviewed stakeholders was found to be perceived very differently. This is not surprising as literature claims sustainability to be subject to interpretation (Markard, Raven & Truffer, 2012). Nevertheless, some interviewees are in accordance with literature that sustainability encompasses various aspects, namely the social-, economic-, and environmental aspect (SE1; C1; SE3; Goodland, 1995). However, while most literature highlights topics such as resource depletion, waste management, water scarcity, land availability or air pollution, interviewees have explained that most stakeholders of the DVC, specifically towards the front-end, associate this concept more strongly with long-term economic stability (e.g. Rojas-Downing et al. 2017). RI2 also emphasises that "for developed countries, ES is more sustainable whereas for undeveloped countries, like India, economical sustainability is more sustainable."

One could argue that the missing environmental focus can be explained through Maslow's (1943) hierarchy of needs theory, which addresses the different priorities of people depending on their living conditions. This would imply that the poorer Indian population may only be concerned with the first level of the hierarchy, primarily food and shelter. However, this seems paradox as protecting the environment will ultimately ensure sustainable food production and

supply. Therefore, another possible explanation can be derived from the fairly low education levels among the Indian rural areas (Little & Green, 2009), as further elaborated in one of the following sections. Hence, it can be assumed that many DVC stakeholders, especially farmers, are not yet fully knowledgeable and aware of resource depletion or environment's effect on production systems. Empirical findings show processors to have a better understanding of the impact of environmental challenges on long-term business operations, which again may be explained by higher education levels at this step of the value chain.

4.1.1 Perception and Awareness of Environmental Sustainability

Overall, awareness was recognised to a certain degree, however, this was much more so in urban than in rural areas and more in younger- than in older generations (RI2). Literature also confirms that there still are significant differences among rural and urban areas based on different economic positions and education levels (Shukla et al. 2007). As younger generations seem more aware, they can be expected to further encourage sustainable innovations while also placing more pressure on the national system to act more environmentally responsible.

Often, people believe "sustainability is somebody else's problem, not their [own] problem." (DE1). The responsibility to act environmentally friendly is often shifted towards other industries such as the automobile or coal industry as well as to the larger industry players (RI2; DE1). RI3 also points out that people often do not believe their contributions towards sustainability to be impactful as most others do not act likewise. Furthermore, the perception of sustainability is not anticipated to change if sustainable solutions do not yield economic returns (SE2). As empirical findings show economic growth to be a major driving force in India, it can be expected that unless sustainable innovations generate economic returns, these are not supported by the government. Furthermore, considering that the perception of ES in India seems only at a very nascent stage and is not yet understood as a severe problem, according to many interviewees, it comes natural that suitable solutions have not yet sufficiently been developed. Research explains that many problems are long hidden and first need to be understood in order to be able to find appropriate solutions (Felin & Zenger, 2014). FT1 underlines such research, claiming technical solutions to follow identified problems. Especially as many farmers have not yet directly or visibly been impacted by ES issues, they do not see the need to act upon it (C1). Despite the earnestness of ES, the effects of climate change surely suggest uncertainty. According to Morton, Rabinovich, Marshall and Bretschneider (2011) "people are reluctant to take action in response to information that comes with uncertainty" (p.103). Thus, it can be

assumed, especially in India as a developing country, that the society thus far is hesitant to change habits and current behaviours. Furthermore, cows are perceived as holy and as always giving in India (RI2; DE1). Hence, based on this perception, it can be assumed that Indians are sceptical to believe that cows could negatively impact the environment.

4.2 Farming

Farming in India is still very scattered, as the majority of farmers own one to three cows. As a result, it is challenging to provide farmers with comprehensive management to advance milk output. Additionally, farming is for large parts of India's population the primary source of livelihood and thus plays an important role (Landes, Cessna, Kuberka, & Jones, 2017). This section addresses challenges impeding and important factors facilitating the achievement of a ST.

4.2.1 Unawareness

A major challenge is the unawareness among farmers (C3). The level of awareness, however, differs among farmers as urban farmers seem more educated and aware compared to rural farmers (SE1). Unless the basic needs of food security, health services, and education are not covered, farmers will not be concerned about the environment as such (C1). However, as mentioned earlier, a shift towards more ES ensures such basic needs in the long-term. Hence, creating more awareness about environmental challenges and their impact may accelerate ST. In many instances, the cattle of a farmer is the main source of income. Farmers roughly earn 20 euros a months to feed their family of five to six people (RI3). Hence, "the maximum that they would change is adding maybe another cow" (Stk1). As dairying is a farmers day-to-day sustenance, it can be assumed that environmental issues are not a major priority.

SE2 highlights that "people are not directly aware how milk production is leading to environmental concerns", which was further confirmed by DE4. Also, C3 points out that people seek help only when they are aware of the problem, which thus far is only about 30% of the people. Many interviewees agreed that sustainability needs to be communicated and linked to cost efficiency for farmers to understand and to ultimately reduce the environmental footprint produced at the front-end of the value chain. "Now, it comes in handy that those solutions are not only good for the environment, they are also an economic option" (RI1). Overall, farmers are still very unaware of the sustainability concept as their main concern is to fulfil their basic

needs. Such unawareness can majorly impede the ST as with no awareness for the problem, fewer innovations are triggered and little incentive is given for the regime to change. However, with growing income for farmers as an initiative by the NDDP, one can expect education levels to rise.

4.2.2 Education

As already addressed, farmers seem to be largely unaware of the environmental impact of dairying and the issues arising as a matter of such. SE1 mentioned that "it is very difficult to find an educated farmer in this country" while also PS1 explained that "these farmers have never gone to school". PS1 even claims missing education on farm level to be one of the main issues hampering environmental implementations. Besides, literature demonstrates the immense effect of education on productivity in agriculture (Phillips, 1994). Many interviewees attributed farmers' unawareness to two main factors. Firstly the missing education in most rural areas and secondly, the priority of other needs such as food and survival, as mentioned before (PS1; SE1). Again, unless the basic needs of food and security cannot be met, it seems difficult for farmers to be concerned about ES.

When educating farmers, sustainable behaviour is not taught as such but instead in an indirect manner. Topics of focus related to ES seem to be the recycling of by-products and the reuse of such (DE4), irrigation and consumption of water including how to grow less water intensive crops for feed and fodder (SE3), reduced handling of plastic, and how to produce clean milk (PS1). Often, these topics are addressed in order to ultimately increase the milk yield of animals (PS1; C3). C3 also added that for farmers to really understand new farm management practices, visual and physical demonstration is necessary. This is also advocated by Sokoloff and Thornton (1997) or Basheer, Hugerat, Kortam and Hofstein (2016), whose studies proved demonstration to enhance the learning effect. Little and Green (2009) find education to positively impact sustainable development. They claim that it helps change the "attitudes, behaviours and values" (p.171) to incorporate a stronger sense for environmental, social and economic sustainability. Therefore, the regime should be encouraged to foster education not only in urban but also in rural areas to strive for a more sustainable production system.

<u>Educational Provisions</u>

According to DE2, village training programs are provided where all farmers come together for about two or three hours and are trained either by a teacher or an audio visual. Additionally, he

mentioned field teams to provide need-based assistance who also enhance overall environmental awareness. Farmers are mostly connected through software somehow and most farmers possess a smartphone nowadays, which was confirmed by the researchers' field observations. This facilitates the distribution of instruction videos and messages that are shared through the application "WhatsApp". DE2 advocates this to have an even larger reach and impact than physical meetings or trainings. The smartphone also exposes farmers to social media and media in general, which enhances overall education levels (DE2). PS1 also explains that the large cooperatives and MNEs, together with the veterinarian offices, provide small training camps approximately every two weeks in villages, from which they source the milk from. Some interviewees also point out the increased investment in training and education by the organised sector due to rising quality and safety concerns among consumers (DE4; C2; PS1). This, although indirect, is likely to have a positive impact on ES awareness. Generally, trainings are usually undertaken by either the government, NGOs, corporations or co-operatives (DE4; DE2). The GOI has introduced the National Mission for Sustainable Agriculture (NMSA), which is supposed to promote sustainable agriculture at farm level. At present NMSA encompasses eight schemes aiming for farming systems to increase productivity, sustainability and also the resilience to climate change (Government of India, 2019a).

However, DE4 points out that still large parts of the private sector are not educating the farmers and that they are often merely interested in buying and selling the milk. SE1 in similar context underlines the responsibility of the government to improve education because farmers often do not properly understand the available solutions and the ecosystem. Meaning, they do not know any contact person to reach out to for help. PS1 explains that while by 2035 a higher level of farm education and understanding of sustainability can be expected, it will still not be possible to educate all farmers by then.

A change in education efforts can be recognised and can be assumed to lead towards more awareness for environmental challenges among farmers. However, differences among states in terms of technical advancement and dairy intensiveness were highlighted through informal on-site conversations with locals. This indicates the constrained diffusion of these initiatives across the entire country. While these educational initiatives overall seem fruitful in theory, these need to be implemented and enforced on a larger scale for impact to happen.

4.2.3 Farm Management

For a farmer to yield high economic returns through increased productivity, proper farm management is essential. This encompasses various areas while this research specifically focuses on feed and fodder, breeding management, clean milk and resource depletion. These practices are important ultimately to increase productivity and hence to reduce the country's number of cattle, which in turn reduces the environmental impact. Despite available ES innovations and technologies, the uncertainty whether these will sufficiently and timely pay off often poses a strong implementation barrier for farmers with low income levels (Janssen & Swinnen, 2019; Shiferaw, Okello & Reddy, 2009; PS1; C3). Additionally, PS1 emphasised farmers' narrow mindedness. The interviewee explains that many farmers are firmly convinced of their working routines and traditional methods, which makes them reluctant to change and thus hinders more environmental solutions to be deployed. Such attachment to traditions demonstrates path-dependency and thus making ST more challenging.

<u>Feed and Fodder</u>

Feed and fodder, to a large extent, influence a cows' productivity as well as methane emissions (C3). According to literature, much of environmental issues can be associated with the production of such (Eshel et al. 2014). At present, cows are underfed and hence, unable to produce the desired outcome (C2). Since productivity of cattle is generally low in India (Nagpure, 2014), some farmers compensate the outcome by increasing their herd size (C3). Consequently, the increased number of animals requires larger food intake despite low forage availability (C3). RI3 summaries " the population is increasing the number of cattle is meant to increase, which means more CO2 emissions, which means more fodder now, which means more water for the cattle to drink and for the fodder to grow". Furthermore, quality feed and fodder is said to positively influence productivity as well as economic returns while reducing methane emissions due to better digestion (DE2; C3). Therefore, a feed concentrate was developed, "which contains all nutrients in the appropriate proportion required for cattle to have proper digestion and better conversion ratio" (DE2; C2). However, considering the low-income levels among farmers, the diffusion of such may be relatively low as these concentrates are costly. Yet, based on the s-curve innovation theory (Schilling, 2017), one can expect that prices for the innovations decrease the more mature and diffused they become in the market. Thus, feed concentrates may also become more affordable and diffused in the future. Nevertheless, due to

poor education levels, such cause-effect relationship of quality forage may not yet be recognised among many farmers.

In India, mixed farming is a very common practice since many farmers have little land and few cattle. Therefore, crop remains are often fed to the cattle while in turn, the cow urine and dung is used to fertilise the fields (DE4; Marton et al. 2016). This results in the majority of feed and fodder coming from husk and straws as only few crops are specifically grown for feeding cattle. Farmers usually feed whatever is available to them without considering required nutrition (DE2). From an environmental perspective, this can be seen as beneficial since feeding remaining crops eliminates crop waste. On the other hand, however, it also burdens the environment due to higher gas and methane emissions caused through improper animal digestion (DE2).

CO2 and Methane Emissions

"Everybody talks about [CO2] but the real problem is methane. Every time a cow bulges [methane is emitted to the environment]" (SE2). C3 further underlines that methane has a much bigger impact than CO2, which is also stated in literature (e.g. Rojas-Downing et al. 2017). Johnson and Johnson (1995) state methane emissions generated from ruminant animals can be between 250 and 500 litres per day and thus contributes to substantially to global warming (Climate & Clean Air Coalition, 2019). Moreover, methane significantly impacts human health as it largely contributes to harmful air pollution (Climate & Clean Air Coalition, 2019). It can be presumed that rising awareness, education and income might expand the adoption of quality feed and increase cattle productivity. In turn, methane emissions per cow might be reduced, however, as long as cows exist methane emissions cannot be eliminated completely.

4.2.4 Breeding Management

Breeding Management has become a major trend in the Indian dairy industry. It aims to increase productivity, feed-conversion ratios and to control for diseases (DE4; C2; SE1), all of which can have a positive indirect effect on the environment. While the indigenous Indian breed is best adapted to the Indian environment, requires least resources and is highly immunised, they also provide the smallest quantity of milk (DE2; RI3). Whereas the native breed gives approximately 5-7 litres, the Holstein and Jersey breeds yield around 23-25 litres a day (C2). Nevertheless, they also require significantly more medical care and forage. From this perspective they are less environmental friendly, especially in a country with scare land and

water availability. Yet, they produce substantially more milk ultimately resulting in a reduced herd size (SE1). Despite a trend towards native breeds (DE4; SE1), it is unclear which breed is more environmentally friendly. A related trend mentioned by many interviewees is cross breeding and genetic upgradation to raise cattle that is high in productivity with little resource utilisation and little medical care (DE2). SE1 also emphasises the need for more genetic research on this topic to make animals more productive, healthy and least environmentally damaging. DE2 anticipates 50% of future cattle to be cross-breed and explains their positive environmental impact. DE1, SE2 and C2 have also addressed another technique called sex semen. This is a method used in artificial insemination to increase the female ratio among cattle. This enhances productivity and counteracts the issue of useless male cattle disposal (C2). Despite these innovations being motivated by the desired rise in productivity, they have indirect potential to mitigate the environmental footprint of the DVC. Hence, they can be regarded as fruitful sustainability innovations with more future potential to foster the ST.

4.2.5 Milk Quality and Hygiene

Since many farmers are poor they often reach for cheap solutions to produce more milk, which often results in adulterated milk. To maintain yields of milk when cattle is falling sick, many farmers feed pesticides and other pharmaceuticals or treat cattle with antibiotics, unapproved chemicals, preservatives or hormones (PS1; SE2). According to RI3, “the levels of pesticides, fertilisers and pharmaceuticals are way over the limit”. However, these products often hamper the animals’ long-term productivity as it ultimately damages their health and impedes proper digestion, again, causing higher methane emissions (DE2). Furthermore, milk containing large proportions of these product remains is considered contaminated. Most interviewees have pointed out such quality issues. SE2 even claims “in India the problem is always quality”. Since testing milk at village level is too expensive, contaminated milk is often only detected at processing level where large quantities of milk are blended together (C4). This is an environmental concern as the milk is unproductively used despite the employed resources for the production of such - resulting in high wastages (PS1).

Producing clean, high quality milk has now become a priority especially for the private sector as safety and health consciousness in urban cities is rising (C2; DE2). Since quality issues also impact human health, the GOI should be more incentivised to act upon the issue and stimulate quality control. This again would indirectly mitigate the environmental footprint of the DVC

through less wastage. However, thus far no safety regulations for milk standards and milk quality have been implemented yet (Janssen & Swinnen, 2019).

Large numbers of cattle in India are sick as a consequence of lacking hygiene, not able to produce milk for human consumption (SE2). Janssen & Swinnen (2019) emphasise farmers' unwillingness to invest in better hygiene, especially if prices for improved milk quality are not guaranteed to rise and quality measurement systems are still missing. The failure to adopt such technologies can be assumed to not only affect farmers, but the entire DVC. Dairy processors may not be able to collect the expected quantity and quality of milk, leading to consumers not receiving products they desire. Therefore, dairy companies have an incentive to support farmers in adopting such technologies. Nevertheless, dairy companies are not always secured to receive return on investments as it might be of use for competitors or farmers breach existing contracts by further selling their products to other buyers (Janssen & Swinnen, 2019). This can also be related to TCE theory. Based on this theory, an industry is structured in a particular manner, aiming to keep transaction costs as low as possible for the interrelated stakeholders involved. Therefore, the present Indian DVC can be assumed to be established in the most efficient manner from a TCE perspective, given its current technologies, demand or infrastructure, for instance. However, if future developments enhance infrastructure or enable more efficient ways of production by reaching higher economies of scale, then TCE predicts industries to adapt, so as to achieve the lowest possible transaction costs. For the processing stakeholders within the organised sector it seems beneficial to backward integrate and hence to take over the farming and transportation step of the DVC. This would reduce transaction costs, increase milk quality and ensure steady supply. Nevertheless, taking the uniqueness of the Indian DVC into account, such change in structure may deem difficult to realise in a scattered country like India.

Lacking hygiene, however, leads to unproductive cattle that regardless consume resources and emit emissions. These animals' rumination or digestion is often flawed and increases emission rates even further (DE2). DE2 adds that preventive health care thus far is largely missing. As education levels are expected to increase, farmers can be assumed to become more aware of the consequences of lacking hygiene. This could lead to more sustainability initiatives taken on farm level to increase hygiene levels which subsequently improves overall animal's health, enhances milk quality and reduces environmental footprint. This further can be linked to Goodland's (1995) concept of ES. The introduction of more initiatives by the GOI promotes the well-being of the society as milk quality would improve and thus social sustainability can

be achieved. Besides, such initiatives may increase hygiene levels and in turn inflate output, hence yielding higher economic returns. Ultimately, these aspects would positively mitigate waste emissions and thus amplify meeting present demand without diminishing future demand.

4.2.6 Water

Dairying at farm level consumes large quantities of water (SE2). As milk consists 87% of water, water consumption for cattle is high. Water is also essential for cattle to upkeep their organs and to facilitate digestion and the absorption of nutrients (Ward & McKague, 2019). Besides drinking, water is also used for other activities such as the growing of crops to provide forage, for keeping the animal cool especially in times of heat as well as for cleaning (SE2). All interviewees agreed that water scarcity is the greatest challenge for the dairy industry as groundwater levels are drastically decreasing. "Reports expect average water levels to half over the next ten years" (RI3). DE1 explains "people have not yet understood and recognised the seriousness of the water issue". In many parts of India, water is still used with no caution. While in some urban cities you pay for the volume of water used, "70% of the country does not have metered water, you can use any amount" (SE2). On the other hand, in extreme water stressed states, some farmers struggle to maintain their operations due to insufficient water availability (Stk1). Water levels differ depending on the state but are especially low in the centre of the country as visualised in Figure 7.

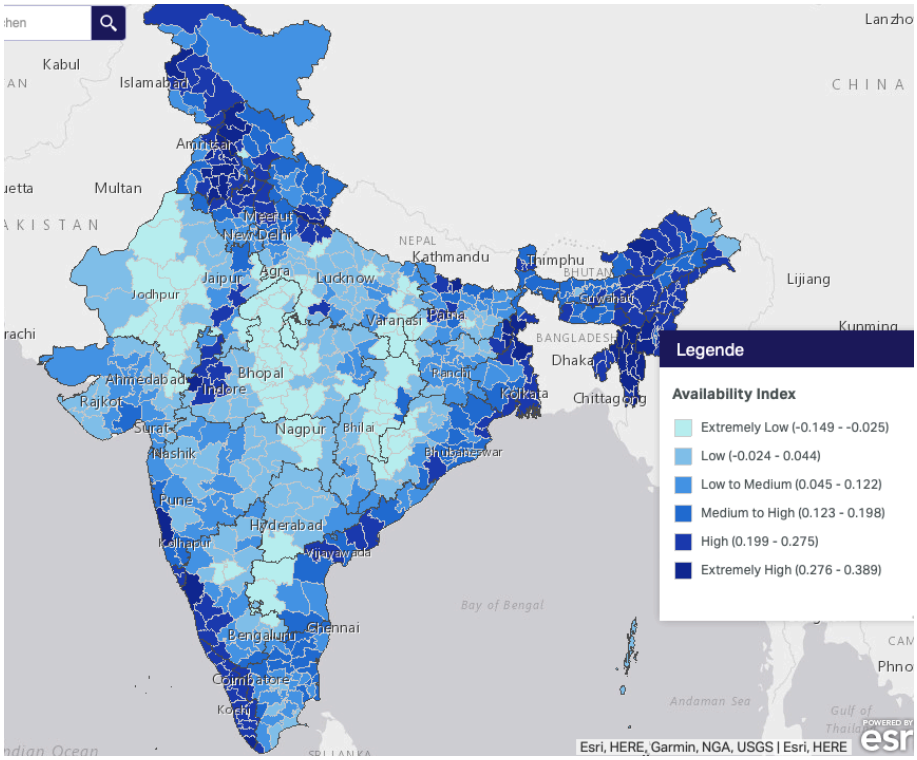

Figure 7 Water Availability in India (Indiawatertool, 2019)

DE2 and RI2 explain that the entire dairy industry is dependent on the monsoon, which in past years has changed pattern to shorter cycles, commonly attributed to global warming. This is also confirmed by research which finds changing climate patterns to reduce rainfall, majorly harming food production (Khanal & Mishra, 2017). The lack of water together with the growing dairy demand poses serious constraints on cattle farming (DE2; RI2; RI3). According to RI3, only few act upon water scarcity and there is not a big will to change. Many people, according to him, still overuse water - hoping that by the time groundwater levels are so scarce that solutions such as desalination plants become more affordable. While RI3 recognises its potential, he also believes that it is quite difficult to apply for agriculture purposes and that it needs to be pushed by the government. SE1 even points out that forests are sacrificed to increase industrial production as forests consume a lot of water. Such action by the government clearly demonstrates that economic growth and providing for families is of higher priority.

However, some initiatives are already taken nowadays. SE3 talks about zero discharge legislative requirements, which mandate private companies to recycle their used water. Groundwater extraction by the private sector for industrial purposes is even prohibited (SE3). Another major issue is water pollution (SE1). Most utilised water or spoiled milk is not recycled or appropriately treated. Instead, it is poured back into the soil contaminating the clean groundwater (SE2; SE1). SE1 addresses that despite policies being in place for water contamination, many people still die from drinking such water. Thus, one can identify a significant gap between policy making and its implementation. Considering that water scarcity is stressed by various actors one could expect either the private sector to take action or the GOI to strengthen its regulations or the enforcement thereof. Besides their lack of responsibility, it is surprising that only few sustainability innovations have emerged on farm level as the water issue has long been prevalent and well-understood among academics. A possible explanation however may be that despite niches developing sustainability solutions, these may not receive sufficient attention or too few funds are made available to help them scale up.

Concluding, despite the severely pressing issue of water scarcity which should be of high priority to the government, only few regulations and sustainability innovations have evolved and been supported by the current regime. Furthermore, none of the available initiatives have gained large acceptance among the industry, mainly due to significant capital requirements.

4.2.7 Energy

"Officially, every village is already connected to the grids" (RI3), however, energy availability and access on farm level turns out to still be a substantial problem (C3; Stk1). To reduce milk spoilage, farmers need to be able to cool milk accordingly, which is very energy intensive (SE3). Moreover, the grids in rural villages are not very reliable and often powered on environmental unfriendly diesel motors (RI1). However, renewable energies in the form of bio- and solar energy are gaining recognition. Nevertheless, the benefit of these solutions has not yet been sufficiently emphasised, leaving the majority unaware of their options (C3; Stk1).

Renewable Energies

While small in number, few farms have started to extract bio energy from cow dung. Especially for farmers with large herd sizes and subsequently large amounts of animal excreta, biogas plants can be particularly impactful to convert cow dung into energy and consequently to mitigate GHG emissions (C3; PS1; Pathak, Jain, Bhatia, Mohanty, & Gupta, 2008). Another source of renewable energy is solar panels. These not just improve villages' access to energy and hence decrease milk spoilage and waste but also reduce the environmental footprint. Moreover, DE2 emphasised:

"India has the luxury of getting direct sun for almost 300 days a year, bright sunlight. That we want to convert".

To foster the implementation thereof, the GOI provides subsidies for solar panels. However, these are often insufficient in comparison to the setup costs (PS1; C3). Moreover, these solutions and subsidies are more applicable for larger farms having approximately 300 cows instead of for the small and marginal farmers, which are still the majority in India (PS1). Overall, as solar energy is still at a nascent stage, only few solar systems have been implemented for milk collection centres and bulk milk coolers (BMC) at farm- and transportation level of the DVC (C2; C3). Yet, considering the size of the country and its number of collection centres and BMC, solar energy has significant environmental potential. Nevertheless, the high capital requirements to set up solar panels drastically slow the adaptation rate (C3; P1).

The potential of these solutions to reduce global warming, as pointed out by Pathak et al. (2008), should encourage the GOI to provide further incentives and support for the implementation. Notions regarding the implementation of renewable energy solutions noticeably differ among interviewees. Such differing opinions may be explained by the different interviewees'

occupation. Research participants working in offices, who deal with these topics from distance, were more affirmative of progressed implementation. Contrary, interviewees regularly being on-site express these solutions to be in a more immature stage thus far. This in turn may potentially imply that much of these initiatives are conceptualised on theoretical terms rather than on practical grounds. One major impediment for both solutions, biogas plants and solar panels, is that 70% of farmers are smallholders owning two to three cows. Thus, it is difficult to imagine that they have the necessarily capital nor would such an investment pay off quickly enough. Nevertheless, despite the organised sector making up only 20% of the market thus far, taking into account the size of India, there is still significant potential for change and impact. Considering the GOI's ambition to further increase the ratio of the organised sector (Government of India, 2018b), these solutions' potential should further increase and motivate the regime's support.

4.3 Transportation

Transportation in India, especially in rural areas, is still a major issue (DE4). As farmers are very scattered throughout the country, infrastructure within outskirts is often undeveloped. At present, most villages have a milk collection centre encompassing between 50 and 80 litres from where it is further transported to the nearest facility to be chilled. Milk should be chilled four hours from collection, otherwise milk gets spoiled (PS1). As this cannot always be guaranteed, 10-15% of the transported milk is wasted (RI2). In warmer seasons, up to 30% of farmer's milk is lost due to spoilage (Jamal, 2014). More advanced and larger villages already have BMC where milk is immediately chilled. Solar-powered milk coolers were also mentioned to reduce energy consumption (C2). Notions regarding the degree of implementation vary across interviewees. Some advocate already strong implementation of solar whereas others are of the opinion that it is at a nascent stage, implying that much is empty talk. C3 highlights the effect of GHG emissions through small milk vehicles, which are currently run on diesel, whereas in city areas more sustainable gas can be used. Smaller vehicles, which cannot cool the milk also increase milk spoilage due to exposure to heat and insufficient infrastructure (DE4; DE1).

Summarising, milk spoilage is a major concern in transportation. To mitigate waste and CO2 emissions, infrastructure should be more emphasised by the GOI. Apparently, in 2017, the GOI has announced a budget supporting the "creation of milk processing infrastructure" (Dairy

Processing and Infrastructure Development Fund, 2019). However, despite the publication of such scheme, the degree of implementation is uncertain. Nonetheless, the private sector, which includes MNE has the potential here to create shared value as conceptualised by Porter and Kramer (2011). They can do so by providing better infrastructure for the country (social impact), which consequently results in less milk spoilage (environmental impact), they can simultaneously increase their own profits (economic impact)

4.4 Processing

Out of the 176.3 million tons of milk produced in India in 2018 (National Dairy Development Board, 2018b), only one third has been processed (C2). The processing stage of the DVC is highly dependent on many natural resources. Thus, the most pressing issues of water, energy and waste are separately elaborated in the following. Thereafter, initiatives taken more generally and applicable across all issues at processing level are further addressed. Finally, this section discusses empirical data on how globalisation and the organised sector influence the DVC. As these findings seemed most influential for the processing stage, it is addressed within this section.

4.4.1 Water

The issue of water is, to a large extent, present in the dairy processing (SE3). Especially, for cleaning of milk collection centres and tanks water consumption is very high (SE2). DE1 addressed cleaning in processing (CIP), a system commonly used to clean tanks and other equipment. “Conventional CIP systems have four reservoirs: with cold water, an acid, a base and the so-called steamy water, and there are systems with another added hot water” (Memisi, Moracanin, Milijasevic, Babic, & Djukic, 2015, p.185). Thus, considering India's size and number of processing plants one can only imagine its water consumption. Hence, not surprisingly many interviewees emphasised the huge potential of water recycling technologies to reduce the environmental footprint of the DVC. C2 points out that approximately 40% of water will be recycled and reused. In this regard, PS1 also highlights the concept of zero disposal plant. Meaning, whatever water is used during the processing needs to be reused instead of flushing it to nearby villages or rivers. Thus, the interviewee also elaborates that cooperatives like Amul use the clean water for milk processing while water containing chemicals is rather used for washing and steaming. DE1 states that more advanced dairies already have installed parameters for water consumption per litre of milk. The awareness among

processors about water scarcity was identified to be highest amongst DVC stakeholders. Most interviewees agreed that processors would be most likely to initiate change and implement environmental solutions. This could be explained either by their current and future dependence on natural resources or by their higher education standards as well as superior financial means. Nevertheless, there seems to be differences in financial support among states and size of processing plants. In general, water initiatives and subsidies therefor seem not yet prevalent, despite water being essential to guarantee long-term sustenance of business operations. Based on the ST theory, one could expect more sustainability innovations to emerge within the near future as well as that the GOI exerts more responsibility. Thus, power should be used by the regime to create awareness for the scarcity of water and the need for solutions. Water is a precious resource and the amount of water that could be saved at processing level is significantly higher than the water consumption at farm level (C1).

4.4.2 Energy

Dairy processing is highly power- and fuel intensive, hence focus towards reducing the environmental impact and costs by replacing conventional power sources with solar power has increased (DE2). RI1 further emphasises "solutions are out there, definitely there is potential [at processing level]". Cold chains, specifically, are very energy and maintenance demanding and thus expensive. Recently, concentrated solar thermal technologies and absorption systems have been introduced (DE1; C2). These reduce the power requirement by using solar panels for heating and cooling processes (Velraj, 2016). Eco-friendly motors have also been addressed which reduce energy requirements (C2). Generally, new energy technologies as well as automation processes are more and more emerging to reduce the environmental footprint (C2). Again, these technologies require high capital investments and thus implementation of such is still not very diffused. Processing plants, despite their growing awareness and increasing efforts of applying environmental friendly solutions, still seem to be economically motivated instead of being environmentally driven. Based on the technology s-curve model (Schilling, 2017) it can be assumed that the more these technologies diffuse, the better their performance becomes while decreasing in cost. Hence, such development may exponentially accelerate the adoption of such solutions throughout the processing level.

4.4.3 Waste

Waste, next to water and energy, is another big issue within the DVC (SE3). Sufficient waste disposal and waste segregation are not yet fully integrated (DE4). Neither waste collection

methods nor sorting methods are currently in place (RI2; PS1). Thus, despite general increased awareness for specifically plastic waste, it seems that the usage of recyclable material is not yet serving its purpose as waste infrastructure is missing. Policies and incentives only partially exist while lobbying is also said to play a major role (SE1). Lacking waste regulations can be analysed as barriers towards a ST. Furthermore, as long as lobbying remains prevalent it can be assumed that stakeholders instead of collaborating towards a common sustainability purpose rather take advantage to yield higher economic returns.

However, contrary to other initiatives, the GOI seems more engaged to push zero waste cycle. Thus, waste is supposed to be reused for various applications (C2). The "GOI has promulgated a notification about the use of plastic in food" (DE2). DE4 also points out that investments for waste management have increased and that government incentives are ensured. People also start realising that waste can be converted into electricity, thus, generating profits (DE4). In some urban areas, waste segregation is already compulsory and is becoming more and more the norm (DE4; SE2; PS1). Largely, interviewees emphasised that packaging has changed to reduce and recycle plastic, especially as DE1 emphasises:

"landfills are all going sky high".

4.4.4 Resource Management at Processing Level

Resource management in processing is specifically handled by the central pollution control board, controlled by the GOI (PS1). The interviewee argues that processors are obliged to submit details about production levels and generated waste to obtain licenses. PS1 and Ranade both elaborate that the government regularly visits these processors to assess submitted data and to approve or disapprove plant operations. Yet, according to P1, the government has not paid a single visit to his large-sized plant within the last nine years to control for water usage, for instance. Additionally, DE1 points out that there is rather little innovation in the processing sector. Besides, introducing more sustainable processes leads to more expensive consumer products, for which the vast majority of consumers as of now is not willing to pay extra. Thus processing plants are in a vicious cycle when it comes to incorporating sustainability procedures and materials (RI2). Though, "every company knows or has now started realising that the next five or ten years down the line, we have to be very careful about environmental impact" (DE2). Furthermore, one reason for processors in the private sector to refrain from environmental solutions could possibly be the necessity to act in the stakeholders' interest. This could be

especially the case for cooperatives where the majority of shareholders are farmers. These, in turn, have been identified as short-term oriented and price sensitive which could impede the costly, long-term investments in environmental friendly machineries. This is also argued by literature which finds farmers to be often financially insufficiently equipped and hence short-term motivated, which hampers the adoption of natural resource management interventions (Shiferaw, Okello & Reddy, 2009). Interviewees also revealed that initiatives are often taken predominantly by MNEs. These can be seen as a promoter of globalisation, which further accelerates the advancement of technologies, capital and services across borders (Little & Green, 2009).

4.4.5 Globalisation's Impact on the Organised Sector

Interviewees' opinions differ regarding the influence of globalisation. On the one hand, RI1 and Stk2 indicate that globalisation does not influence India to a large extent as they are, based on the industry's size, relatively independent of external actors. DE2 also highlights that innovations largely originate in India as many global innovations cannot be directly adopted. Throughout the interviews it has become evident that consumers have very concrete expectations of dairy products in terms of taste as well as production. Therefore, product innovations within this field occur rather locally (DE2). Packaging solutions, however, seem to be easier adoptable, often from countries like Europe or the U.S. (DE2; C1). Contrary, C1 explains that globalisation has helped to spread knowledge about sustainability and for people to understand the importance of living more sustainably. RI2 further argues, "what America does, India does". In addition, C2 mentions India's dependence on Europe regarding machinery while also highlighting existing collaborations. Differing opinions may be explained by the contrasting views of globalisation. Scholars still debate on whether globalisation is "good or bad", which is heavily influenced by the fact that globalisation does not equally effect nations (Little & Green, 2009). Little and Green (2009) argue that opponents of globalisation often advocate the process to have further enriched the wealthy states at the cost of developing countries. Especially in India, they add, many attribute globalisation to the extreme inequality gap. Therefore, the perception thereof is said to be influencing the engagement in globalisation.

Overall, empirical findings suggest that the private sector still demonstrates little effort to contribute specifically towards a more environmentally friendly consumption and production system. It is still challenging for MNEs to enter the Indian market and to appeal to consumers as these are very sensitive to non-local brands (Stk1; P1). MNE like Danone or Kellogg's have

both failed after entering India as they did not seem to have fully understood the market (DE3; Stk1). Therefore, it is recommended for MNEs to partner up with local companies for a successful and long-term market entry (C2; RI3). Nevertheless, their entrance can be expected to provide a benchmark for local companies (C4). As these are exposed to pressure from the media, they are often urged to act more sustainably. Moreover, societies often view companies as powerful and important source to find solutions for societal problems. Thus, business decisions are more and more taking sustainability issues into consideration (GRI, 2015). Hence, the entrance of MNE can proliferate enhanced sustainable performance.

4.5 Distribution

Physical distribution systems in the DVC are as efficient as they can be, according to DE1. Many interviewees agreed upon the rise of e-commerce, larger supermarkets and online orders via the use of applications. For instance, milk basket, a milk delivery application, delivers milk according to requested amount and time scheduled. These types of innovations are rapidly increasing, especially due to increasing phone availability and affordability (RI2). Stk1 also indicates an increase of enterprises adopting a farm-to-home model, which directly delivers milk to consumers' home. These orders, however, are still handled through the marketplace as distributors do not yet have their own collection centres yet (DE4). Considering the increase of online applications or larger supermarkets, a change in the distribution can be anticipated. Middlemen may become redundant as many consumers are moving up in Maslow's hierarchy of needs (1943) due to higher income levels and are able to seek more convenience when shopping. Nevertheless, as Indians are strongly path-dependent, a radical change or disruption of distribution is not expected within the near future. It seems that conventional distribution methods, especially in more rural areas, will remain. Such changes and their impact on the environment is an interesting topic but goes beyond the scope of this dissertation. Therefore, it can be concluded that this study's findings did not reveal major ES trends within this stage of the DVC.

4.6 Retailing

Retailing in India is the step in the DVC with the largest share of milk wastage (RI1; SE1). Based on researchers' observation, this can be assumed to predominantly occur in smaller retail shops as cooling and proper storage might be challenging based on non-reliable electricity grids. While large supermarkets are emerging, retailing is still predominantly operated through small

shops. C2 also believes them to remain long-term. This could be either explained by India's path-dependency and their resistance to change traditional habits and behaviours or by the high fragmentation of India's population. Despite several inquiries made addressing ES in retailing, interviewees did not seem very knowledgeable which may be due to their occupational focus on the front-end of the DVC.

4.7 Consumption

The following describes and analyses the final step of the DVC, consumption. Dairy products in the DVC flow downstream, meaning from farmer to consumer. Information, on the contrary, simultaneously flows upstream. Such upstream-flowing information and signals from consumers are usually necessary for front-end stakeholders to initiate change (Janssen & Swinnen, 2019). Therefore, the Indian consumers are likely to have substantial power to influence the ST of the DVC and hence to affect its environmental impact.

4.7.1 Consumption Patterns

Consumers' awareness about sustainability, a balanced diet and food waste is very important (C2). Overall, consciousness about product quality and environmental impact is increasing, however, as previously mentioned, the gap between urban and rural is still prevalent (Stk2; SE3; Stk1). The rise in consumer ES awareness can be attributed to the fact that environmental challenges slowly become more prevalent in people's life, indirectly or directly (SE3). The usage of plastics, for instance, is already decreasing. Yet, SE1 emphasised "there is a severe behavioural change among the public, but this is not as developed or as advanced and mature like Japan or even countries like yours". Despite the younger generation being much more aware of environmental challenges, at least on an intellectual level, ES is still not a driver to change consumption patterns (RI1). This was further confirmed on-site when researchers have talked to younger locals. Furthermore, only a small population fragment is currently willing to pay extra money for more sustainable products such as more environmental friendly packaging (Stk1; RI2). India is a very price sensitive country and unless environmental friendly solutions are not economically beneficial, most consumers are not willing to shift their consumption pattern (RI2; DE1; DE2). This demonstrates a major ST barrier considering that firms are little incentivised then to incorporate sustainability solutions as these would ultimately increase the product's price. "Every innovation in ES calls for capital investments" (C3) and as long as the consumer remains unwilling to pay extra, their profit margin cannot be remained and little

change can be anticipated. Many advocate that unless the government initiatives a sustainability movement supporting ES solutions, one cannot expect the Indian consumer to entirely and voluntarily change. The increased media accessibility and its global coverage of sustainability, however, may in turn influence consumers behaviour and increases their awareness as well as willingness to take action. This may be further influenced by the younger generation, which increasingly travels across borders. Therefore, DE2 and PS1 firmly believe more international products to enter the market along with new concepts and innovations. Ultimately, presuming a shift in consumer behaviour and a growing dairy demand, this landscape shift could lead to more investments in new technologies and environmental solutions.

4.7.2 Indian Culture and Path-dependency

The "cow is holy" and thus "dairy [in India] is holy" (RI2). A cow "will be forever useful and is always giving" (DE1). Milk has been consumed for more than 5000 years and many value-added products and Indian sweets are made from milk (DE1; P1).

"Milk is the ideal food! Milk is life" (C2).

Besides, India is a "very fresh, fresh, fresh country" (DE1). Despite the increasing recognition about the importance of pasteurisation due to health and safety concerns, many still prefer "fresh milk being brought to the cities […] from rural areas" (DE4). Fresh milk can refer to milk with a shelf life of approximately ten days or to milk directly sold from farmers to consumers without pasteurisation (C1; DE1). DE1 emphasises the difficulty of changing the Indian dairy consumption as it is deeply embedded in their culture. Indians are extremely taste sensitive (C3; DE1; RI2) and it was highlighted that it is even more difficult than "changing the French cuisine" (DE1). Throughout the data collection it became evident that changing towards a more environmentally friendly DVC deems challenging due to Indian's change resistance and path-dependency embedded in the Indian culture.

"It is in the culture to start the day with a glass of milk and some people also end it with a glass of milk. It is a very big part of the Indian household" (Stk1).

In India, people commonly still boil their milk despite it being pasteurised (Stk1). Since they have always done it this way, "it is hard to really get them to do something new, it works as it is in their mind" (RI1). Changing traditional methods will take time until 2030 or 2050, according to PS1.

4.7.3 Dairy Alternatives

Dairy alternatives such as plant-based dairy products or cellular milk protein developments have increasingly gained global attention (GVR, 2019). As these possibly have a disruption effect on the dairy market and hence, would drastically change the Indian DVC's environmental impact, this study explored such developments in India.

All interviewees agreed on plant-based alternatives being a very small segment in India, not having any disruption potential on the DVC. DE2 argues that no plant-based alternative can replace natural cow milk. C2 highlights "soy or almond or any other milk is not real. Only mothers milk is the milk" and C3 adds, "milk is milk. […] Milk is something that cannot be replaced". Milk is considered to be very nutritious and rich in protein, which is less available in any alternatives (RI3). Whereas for other countries it may be easier to obtain protein and important nutrition from other food sources, India is limited on the diversity of food availability. This is further stressed by the large vegetarian population as well as by insufficient financial means. Furthermore, people do not yet understand the urge to switch to dairy alternatives as these are still more expensive and taste is perceived as inferior to "fresh" cattle milk (RI2). This shift is likely further undermined by the already identified lacking motivation to mitigate environmental footprint.

Cellular milk protein containing genetic manipulation is another dairy alternative globally gaining attention (FT1). Whereas consumers are more hesitant to try lab-grown meat, they seem more willing to test lab-grown milk proteins (Devenyns, 2018). According to all interviewees, however, this trend seems to be difficult to adopt in India as it is still too expensive and since dairy is deeply ingrained in the Indian culture. Meaning, milk is demanded to be pure and people are expected to demonstrate gratitude towards the cow as it has always provided a nutritious food-intake. Therefore, milk alteration or genetic manipulations are neither now - nor in the future expected to gain acceptance in India. (Stk2; Stk1; C1; PS1). C2 further expresses his confusion by saying:

"Nonsense. Nothing can be grown in the lab. Why they want to do all these rubbish things?".

These findings clearly confirm that local adaptation is necessary for a successful ST as advocated by Wieczorek (2018). In India, special attention should be directed towards culture. However, globalisation may impact such cultural constraint as some literature points out the shift of societies towards a global landscape (Metcalfe & Ramlogan, 2008). Especially the

younger generation can be expected to become increasingly liberal-minded. Meaning, culture as well as historic dependency may become less prominent - leading towards more open-mindedness of novelties and food-tech innovations. Nonetheless, it can be assumed to take several years for such change to become prevalent. Overall, interviewees agreed that plant-based dairy alternatives occupy merely a small niche in the Indian market with little growth potential. Contrary, milk protein is not yet present in India and is not expected to enter the Indian dairy market within the near future.

4.8 Further ES implementation challenges

"Name an issue and we have it" (SE1). As often addressed by interviewees, India is still a very corrupt country where lobbying still takes place to large extent. This poses an issue for ST as literature in this field finds collaboration and the participation of various stakeholders to be important (Markard, Raven & Truffer, 2012). However, in India it seems that only the affluent population, which by far is the smallest segment, controls the regime and is economically rather than environmentally oriented. Hence, corruption and lobbying should be mitigated, powered through the government, to achieve a ST. Yet, as the GOI seems to be involved in such matters themselves, this issue is unlikely to resolve in the near future. Another issue for the ST is the size of the country and its federal government. The government constitutes of 29 states having their own policies (DE4). Consequently, it is difficult to implement environmental regulations amongst all these states as well as to convince them of its environmental benefits. This poses an issue especially since these still seem to be poorly understood. Through primary and secondary research, it became apparent that the GOI itself has not yet fully assimilated the concept of ES. Hence, resources, specifically financial ones, are not appropriately allocated, which hampers the persuasion for stakeholders to move towards a more sustainable system. As C3 mentions, "the government […] is useless" in moving towards more environmental friendly solutions (DE2). Despite the existence of policies and schemes, they are neither properly executed nor properly enforced and monitored (C3; Stk1; SE2). According to DE1, only few incentives are provided, for example for infrastructure at farm level as well as for cooling and refrigeration systems. Yet, the biggest issue in India, namely "water scarcity, is as of now officially ignored by the government" (RI3). Although the GOI has published the NDDP, which focuses on socio-economic issues impacting India, the issue of water scarcity was only briefly covered. Additionally, official documents published by the GOI address many initiatives to be taken, however, only partially elaborating on how these can be implemented. Few reports are

published showing the progress of initiatives said to be implemented while it seems that many of these initiatives only target facilities the government has a stake in (Government of India, 2019b). At the bottom line, this demonstrates the government's awareness but also shows their lack of responsibility and the lack of resources allocated towards such issues. This is coherent with many interviewees who could address the issue and some vague initiatives taken without being able to provide specific information for implementation.

Concluding, changes towards a more sustainable system are happening but in a more indirect manner and is progressing very slowly as there are many other challenges yet to overcome. Furthermore, changes are primarily occurring in urban areas as rural areas have still far different priorities and needs (Shukla et al. 2007). It seems that there is an overall laid back attitude regarding environmental challenges, as SE3 explains, and an overall resistance to take responsibility. Instead, environmental challenges are seen as somebody else's problem (SE3).

4.9 Revised Conceptual Framework

The empirical data collection has revealed that the utilised theory and framework is largely applicable and useful for the context under study. Most casualties suggested by the model could be confirmed by this study. Nevertheless, findings suggest minor disparities which requires small-scale yet relevant alterations to more suitably display the interrelationships between the three elements, namely, landscape, regimes and niches, as highlighted in Figure 8.

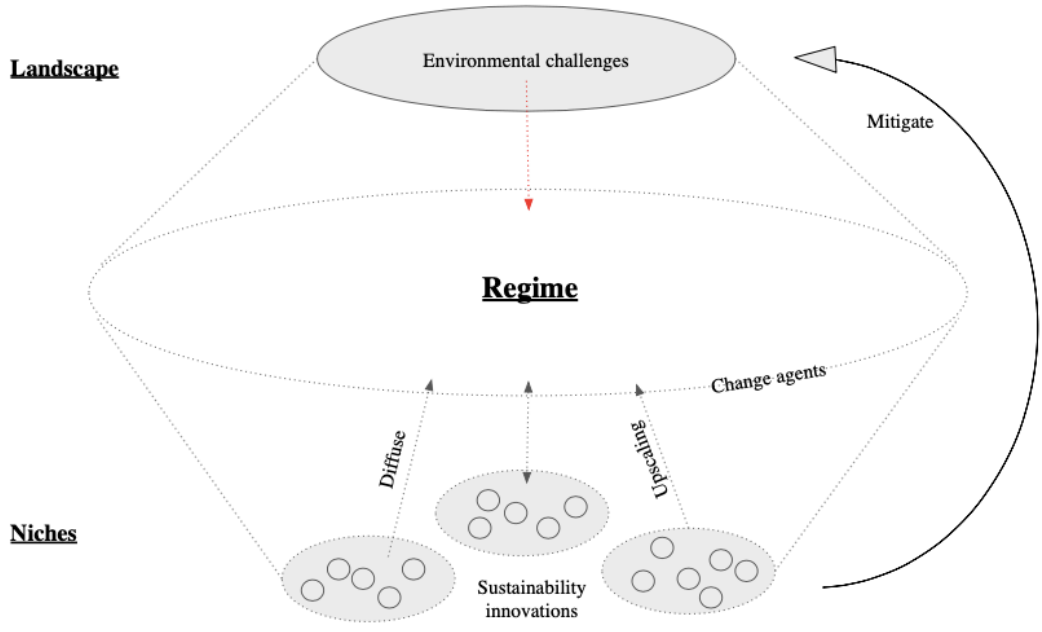

Figure 8 Revised ST Framework applicable for the Indian Market (adapted from Geels, 2002)

The following provides the researchers motivation for the adjustments undertaken:

Cause-and-effect relationship between environmental challenges and the regimes: Prior to the research, it was expected that pressing environmental issues would stimulate the regime and thus critical actors such as the GOI to take action and foster the development and implementation of sustainability innovations. However, empirical findings of this research could not verify such notion. While the regime was found to be aware of such issues and also of its severity, few actions are taken. Despite policies and schemes being in place to support the notion of ES, seemingly moving towards a more sustainable system, realisation of such initiatives are lacking to a high degree.

Environmental challenges stimulating sustainability innovations: Based on literature, it was anticipated that prevalent environmental challenges, especially most pressing ones such as water scarcity and CO2 emissions, would stimulate the emergence of sustainability solutions. The framework suggests that when the landscape changes and imposes problems, in this case the scarcity of resources, small niches start experimenting to identify solutions. These can be philanthropically motivated or by profits, but regardless, they would find solutions to mitigate the problem. However, these causal relationships are not as strong as theory predicts since only very few sustainability innovations seem to be present despite the acknowledged problem among the regime stakeholders. Large-scale experiments within external niches also do not seem to have emerged, despite the large potential. The innovations that are somewhat present in the market, such as solar energy or biogas plants, for instance, were not innovated in India but adopted from abroad. Therefore, this study does not find environmental challenges to noticeably stimulate sustainability innovations to diminish and solve these problems for the future.

5 Discussion and Conclusion

5.1 Major Findings

The study revealed that water scarcity constitutes the most pressing environmental issue for the Indian DVC. India as a water-scarce country still consumes water with no metering or limitation in many states. This causes groundwater levels to drastically decrease while the intensity and frequency of monsoons diminishes. Considering that dairying requires large quantities of water, such scarcity thereof can pose a major impediment to sustain dairy operations, and hence to meet the identified growing dairy demand. The dairy industry, however, also substantially stresses the environment in three major ways. Firstly, it produces large amounts of plastic waste, which cannot be sufficiently recycled. Secondly, cattle in India are emitting significant amounts of methane, consequently leading to air pollution. Methane emissions are primarily caused by India's immense herd size partially due to extremely low animal productivity and by insufficient nutritious forage. As India's biogas plant infrastructure is not yet far developed, methane is largely entering the atmosphere, contributing to global warming. Thirdly, findings revealed that the dairy industry is extremely energy intensive while implementation of renewable energies is scarce thus far. Therefore, the DVC contributes further to global warming as the production of energy is associated with large amounts of CO2 emissions. Global warming, for example, is said to abate the water yield of monsoons, to impair forage growth, and to increase heat stress of animals, leading to a decrease in animal's productivity. This creates a cyclical pattern as it negatively impacts the economic situation of the DVC stakeholders.

Furthermore, the growing population leads to a growing dairy demand. Interviewees as well as official documents stated that increasing animals' productivity would only solve this challenge. Findings, however, have manifested that productivity improved only marginally in recent years and thus, India may not be able to satisfy future demand. In order to meet future needs, interviewees pointed out that herd size may increase, which again accelerates global warming due to higher emissions. Overall, the Indian DVC seems to be caught in a vicious cycle as dairying negatively impacts the environment, which adversely affects the dairy industry through global warming.

Despite the pressing environmental issues, ES awareness still does not seem to be present throughout the entire DVC. India's population was identified to have strong economic focus with high price sensitivity. While the younger and urban population has become more aware, especially through media and travelling across borders, the older and rural population is still lagging far behind. Nevertheless, despite some increased awareness, ES still does not seem to become a change driver nor does it encourage the willingness to pay extra for environmental friendly products. The strong unawareness among the majority of DVC stakeholders can be explained through strong path-dependency and missing education. Especially, path-dependency has proven to significantly influence farmers' working routines as well as consumer behaviours and thus further hampers a change towards ST. The GOI seems to abdicate from their responsibility for the transition to a more sustainable system. While policies and schemes are officially in place to cater stability, implementation and enforcement seem to be a major issue, hampering change towards more ES. Lobbying and corruption are additional impediments bringing a ST to a halt. Hence, resources are often allocated among wealthy people, who are not acting socially responsible but instead are heavily profit-oriented. Despite having substantial power, it was found that the GOI is not particularly responding to the ST. Actions are only taken in an indirect manner, aiming primarily to increase animal productivity which is more economically motivated. As India is a federal government consisting of 29 states, all states operate under different policies. These, however, seem to not equally understand the severity of ES which hampers the successful implementation of a ST since close collaboration among critical actors is crucial. For ST to be successful, the GOI needs to introduce regulations for all 29 states with regular and effective enforcement to ensure a long-term transition.

Some sustainability innovations seem to already be somewhat integrated within the DVC, specifically at farm and processing level. These include renewable energy solutions such as solar panels and biogas plants as well as water recycling and waste segregation techniques. Yet, due to high capital requirements and little to no available governmental subsidies, the implementation rate of these solutions is still negligible. This research has also found globalisation to positively impact Indians to move towards sustainable development. Besides making ES solutions more available, it also increases people's awareness mainly influenced through media and increased global travelling. This is important as India does not yet seem to have fully assimilated environmental issues and hence has not developed suitable solutions. Therefore, India likely depends on environmentally advanced countries offering innovations that can be adopted in India, presupposed local adaptation.

Moreover, dairy alternatives were investigated to evaluate whether the industry is potentially subject to disruption, which would result in a different environmental footprint, whether this may be better or worse. Prior to the study, the researchers believed these alternatives to have relatively high disruption potential. While these alternatives have gained in acceptance globally, growth does not seem to pick up in India nor is it anticipated in the near future. The study revealed several reasons explaining such low adoption rate, where a strong historic culture poses the most significant one. Taste and price sensitivity as well as the large vegetarian population with the need of dairy as a source of protein constitute further barriers. Ultimately, Table 3 demonstrates the main challenges as well as opportunities in achieving ST. Such challenges and opportunities not just merely address ST but also refer to MNE within or eager to enter the Indian market.

Table 3 Main Challenges and Opportunities to achieve a sustainability transition

DVC Stakeholder	Challenges	Opportunities
Farming	• Lack of education • High unawareness of ES • Change resistance • Path-dependency • Lacking availability of electricity	• Breeding Management • Renewable energy • Water recycling → Solutions need to be affordable and applicable to marginal farmers
Transportation	• Lacking infrastructure	
Processing	• Few subsidies available • Customers' unwillingness to pay extra for more environmental friendly solutions	• Water recycling techniques • Waste recycling & segregation • Recyclable material • Renewable energy
Consuming	• No willingness to pay extra → price sensitive • Change resistant • Path-dependency	• Globalisation through media increases ES awareness
GOI	• Lobbying and corruption • Lack of responsibility • Federal government in India → difficult to enforce rules & regulations in every state	

While this study has targeted all six steps of the DVC, only little information was revealed regarding distribution and retailing. One possible explanation may be that little ES trends are prevalent within these steps or that research participants were not as experienced within retailing and distribution, as these steps are more decentralised.

5.2 Aim and Objective

The aim of this research was to explore and comprehend the Indian DVC to identify opportunities for the reduction of the environmental footprint to sustain future operations. This is to further enhance the economic situation for stakeholders and to meet the growing dairy demand. To approach this topic, 19 semi-structured interviews were conducted as well as field notes in India were taken. Furthermore, an adapted ST framework majorly based on Geels (2002; 2011) was utilised to facilitate addressing the following research question:

"How does the Indian dairy industry respond to the environmental sustainability transitions?"

The findings of this study revealed India to respond very little to ST in spite of its huge potential for the mitigation of environmental impact. A change towards a more sustainable system, however, is essential to preserve natural resources, which enable sustainable long-term business operations. The response of the Indian DVC regarding ST seems at a very nascent stage. Some changes are visible but are mainly economically motivated. Willingness to change only partially exists, but is also restricted as suitable and affordable sustainability innovations are not yet available. Hence, there is a huge opportunity for MNEs as well as other investors to develop sustainability innovations that also yield an economic benefit. An overall change towards a more sustainable system needs to be implemented top-down, meaning it should be initiated by the GOI or a corporation with necessary power and resources. Based on the identified impact of globalisation, the GOI should be encouraged to facilitate the market entry for MNEs, considering that these would bring along R&D efforts for ES innovations. With diminishing entry barriers, the Indian dairy market offers great opportunities for FDI and MNEs. This is based on high growth potential and India's lack of necessary solutions. Furthermore, MNEs can create shared value in several ways. From one perspective, shared value can be created by MNEs providing education to farmers on sustainable practices. While this enables farmers a more profitable operation, it also ensures MNEs with high quality and steady milk supply. Besides, considering the strong path-dependency embedded in the Indian culture, innovations first need to be adapted accordingly before being implemented. Moreover, the entrance of

MNEs in the Indian dairy market is also considered to strengthen the currently smaller organised sector. This would result in more industry efficiency due to economies of scale. The number of farmers may also decrease while their herd size is expected to increase due to rising urbanisation and income-levels.

Sustainability perceptions differ throughout India and its regimes causing disagreements about the severity of environmental challenges and thus hampering the development of sustainable solutions. Overall, findings showed that India, thus far, only responds very little to ST.

5.3 Practical and Theoretical Implications

This study is of significance to all DVC stakeholders, but specifically for processors and farmers, to proactively move towards more sustainable operations and hence to ensure long-term sustenance. Considering the regime's significant influence on such ST, the study also sheds light on current issues. This should desirably raise awareness to accelerate a successful ST process. Although this study targets India as a focal country, which is unique in context, it can be argued to have global significance considering the economic potential of the Indian DVC for international actors. These can learn from this study to identify economic opportunities and to become aware of challenges to facilitate strategic decisions. For MNEs to invest in these ST opportunities does not only yield economic profits but also reduces the global environmental footprint and improves the economic wellbeing of farmers. It can further help to meet future dairy demand while simultaneously yielding profits for its investors. Hence, the GOI should stimulate FDI activities and encourage the entrance of MNEs to create economic, social and environmental value. Furthermore, whereas resource depletion is more of a local issue, emissions from the Indian dairy industry leading to global warming are of global concern. Hence, this study should obtain global attention for both practitioners as well as scholars.

From a theoretical point of view, this study seeks to enrich current literature on ST, more specifically on multiple-level perspective within the Indian context. ST literature has significantly increased in recent years, especially for developing countries such as China and India. Most of these studies have focused on strategic niche management (Wieczorek, 2018). Industries predominantly addressed are energy, agriculture and mobility (Wieczorek, 2018). Nevertheless, most of the existing literature has a pure theoretical foundation as not many empirical examples have yet fully emerged or have been published (Loorbach & Rotmans,

2010). However, it was found that in spite of the immense growth potential of the DVC and its strong dependence on natural resources, literature does not sufficiently outline challenges and opportunities to derive at a more sustainable system, which was the aim of this research. Thus far, no study has been conducted within the dairy industry in terms of ST. Therefore, this study contributes to the existing stem of research as it was able to further refine a ST model that is suitable for investigations in the Indian market. It has utilised the ST concept to understand and outline the factors that hamper or stimulate the pathway towards a more sustainable dairy industry in India. While this research aims for a holistic analysis of current transformation change in India, it builds a context-rich fundament for future research as elaborated in the next section. This study chose India as emerging market, which is complex and unique in setting. Nevertheless, one can presumably also apply this framework to other Indian industries. Due to its high level of abstraction it may possibly even be applicable across borders, in markets that exhibit a fair degree of similarities.

5.4 Limitations and further Research

Findings have to be seen in light of a few limitations that however offer opportunities for future research. Findings revealed the cultural imprint influencing Indian's consumption patterns, working habits and way of living. As also language has proven to be a significant barrier in communication, a cross-cultural study is believed to add further value and more depth to this field of research. For this study, researchers were unable to gain access to information from the GOI, which is a key component in attempts for successful ST. Moreover, the GOI has proven to be influenced by lobbying, thus an interesting question to study is how lobbying could be mitigated in developing countries and to what extent it influences the adoption of ST as such. Additionally, the disruption potential of dairy alternatives on the Indian DVC was attempted to be identified throughout this dissertation. Although this trend does not seem to be of significance in India, future research could investigate whether or not dairy alternatives are environmentally friendlier than conventional dairy products. It was further revealed that path-dependency is highly embedded in the Indian culture impeding the adoption of sustainability initiatives. Thus, an interesting investigation could address the question of how path-dependency can be overcome to provide impetus for sustainability innovations and ST. This research has primarily investigated two Indian states, namely Delhi and Maharashtra, with only few exceptions. Since both states were found to be relatively similar in terms of economic and sustainability advancement, an interesting avenue of research can be a multiple case comparison

study between states with more dissimilarities. Especially interesting would be to compare states that are differently impacted by environmental challenges. This study was also unable to obtain rich data on retail and distribution in the DVC. Therefore, future researchers may study current and anticipated trends and to what extent these will impact the environment. Ultimately, literature availability on TM seems scarce, which are studies that provide a more detailed navigation roadmap to achieve a ST (Wieczorek, 2018), this gap offers an opportunity for further research.

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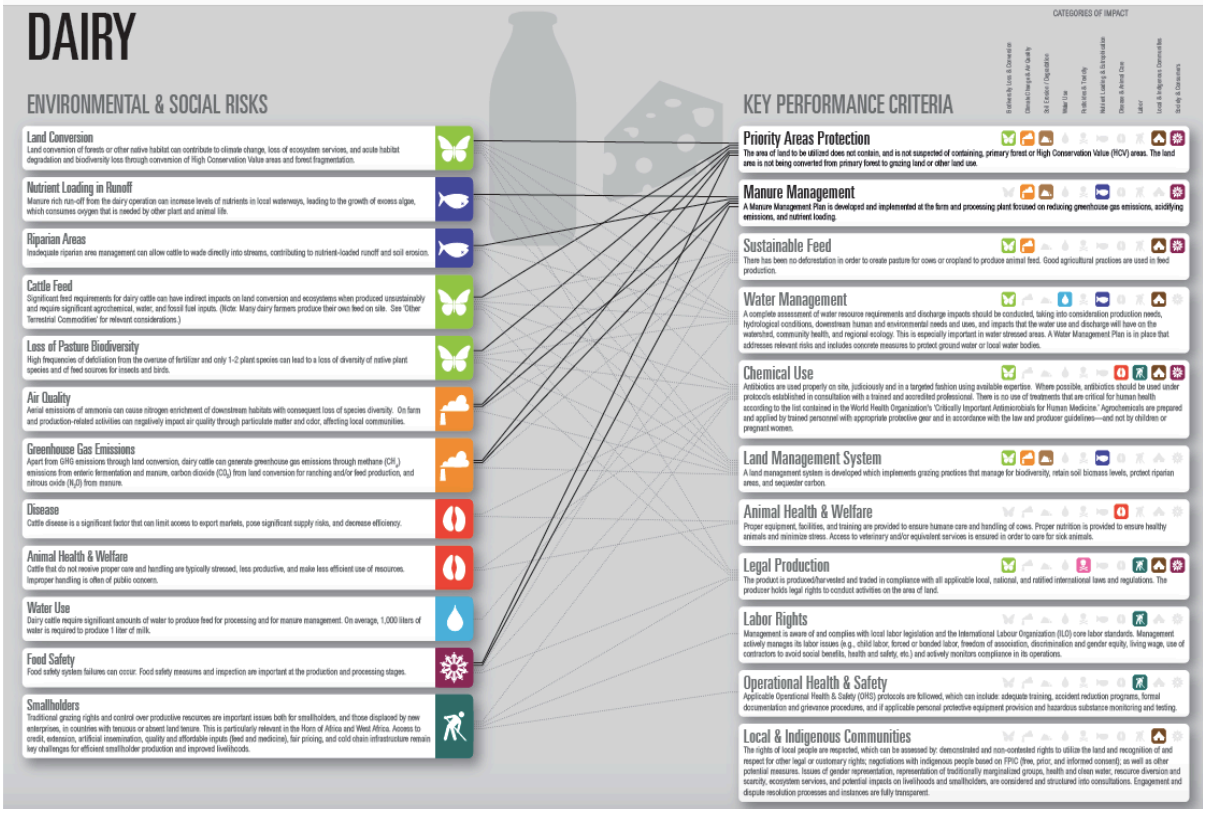
Appendix A

Dairying Impacts on the Environment



Appendix B

Interview Guide – Environmental Sustainability in India's DVC

1. What are **current environmental sustainability trends within the dairy value chain** (*Farming, Transporting, Processing, Distributing, Retailing, Consuming*)? Environmental sustainability referring to issues such as water scarcity, air pollution, waste or energy inefficiency, for example

    a. To what extent are **environmental sustainability initiatives** already integrated throughout the value chain?
    b. How will the **perception of environmental sustainability** change within India and the dairy industry by 2030+? How will consumer acceptance change?
    c. Who are and will be **main stakeholders in terms of environmental sustainability** within the dairy value chain?

2. What are the consequences of a) **climate change**, b) **food technology developments**, c) **e-commerce** for the traditional dairy value chain players with a 2030+ time horizon? How will each of the trends impact the dairy industry? Do they have disruption potential?

3. What are the **biggest sustainability issues** India is facing and which geographic areas are likely to be hit the hardest?

4. What are **future trends in terms of food-tech** (food alternatives that substitute dairy products)?
    a. What is the **tech status and long-term potential** related to climate change challenges, food technology developments and e-commerce opportunities?

5. In how far does **collaboration** take place within the value chain to communicate, exchange and share knowledge?

6. What **investment patterns** are observable within the dairy industry and what are investment patterns specifically for environmental sustainability or dairy alternatives?
    a. What are **investment needs**? Where will the money come from?

7. How is India's dairy industry **influenced by globalisation**?
    a. Will environmental sustainability innovations likely come from India or abroad?
    b. How does **globalisation influence the absorptive capacity** of stakeholders?

8. Your overall assessment: **How will the dairy industry look like in 2030+**? Who are the supply chain losers and winners?

9. Are there **adjacent industries** to keep an eye on and to learn from?

Appendix C

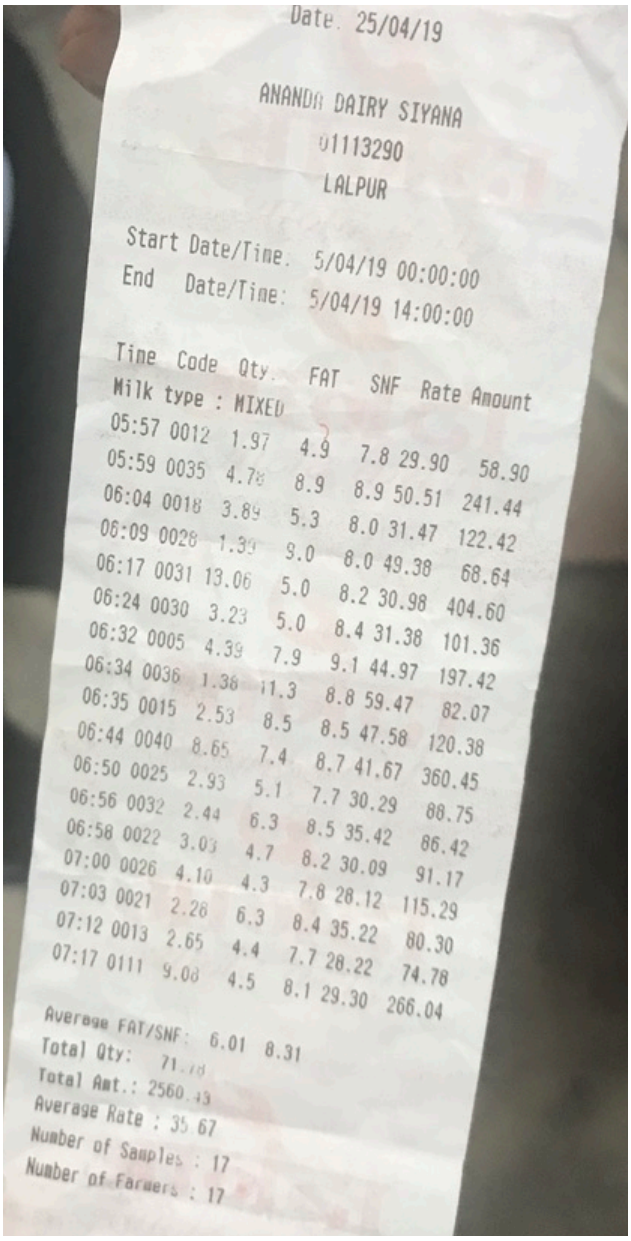
Field Observations

Milk Collection Centre in Lal Pur

Storage of Cow Dung

Herd size of a marginal farmer in Lal Pur

Milk Payment Overview



Date. 25/04/19

ANANDA DAIRY SIYANA
01113290
LALPUR

Start Date/Time. 5/04/19 00:00:00
End Date/Time: 5/04/19 14:00:00

Time	Code	Qty.	FAT	SNF	Rate	Amount
Milk type : MIXED						
05:57	0012	1.97	4.9	7.8	29.90	58.90
05:59	0035	4.78	8.9	8.9	50.51	241.44
06:04	0018	3.89	5.3	8.0	31.47	122.42
06:09	0028	1.39	9.0	8.0	49.38	68.64
06:17	0031	13.06	5.0	8.2	30.98	404.60
06:24	0030	3.23	5.0	8.4	31.38	101.36
06:32	0005	4.39	7.9	9.1	44.97	197.42
06:34	0036	1.38	11.3	8.8	59.47	82.07
06:35	0015	2.53	8.5	8.5	47.58	120.38
06:44	0040	8.65	7.4	8.7	41.67	360.45
06:50	0025	2.93	5.1	7.7	30.29	88.75
06:56	0032	2.44	6.3	8.5	35.42	86.42
06:58	0022	3.03	4.7	8.2	30.09	91.17
07:00	0026	4.10	4.3	7.8	28.12	115.29
07:03	0021	2.28	6.3	8.4	35.22	80.30
07:12	0013	2.65	4.4	7.7	28.22	74.78
07:17	0111	9.08	4.5	8.1	29.30	266.04

Average FAT/SNF: 6.01 8.31
Total Qty: 71.78
Total Amt.: 2560.43
Average Rate : 35.67
Number of Samples : 17
Number of Farmers : 17

Village Visit in Lal Pur

Milk Transportation Vehicle of Indicow

Appendix D

Code Group	Colour	Code Name	Frequency
Implementation issues		Administrative barrier	1
		Corruption	6
		Cultural Constraint	**22**
		Impediment for organised sector	1
		Implementation issues	**28**
		Lacking Responsibility	**22**
		Static scattered pattern	2
		Taste	4
		VC Coordination	6
Industry information		Industry information	**38**
		Necessary Industry collaboration	5
		Population growth	1
		Potentially impacting industries	4
Farming		Animal Health	4
		Clean milk	9
		Farm Management	5
		Farmer suicide	5
		Farming	5
		Feed and fodder	**15**
		Genetic upgradation	1
		Land availability	7
		Livelihood	3
		Methane	11
		Milk quatlity	13
		Mixed farming	1
		Nutrition	3
		Priorities	6
		Productivity	12
		Social impact investment	2
		Unawareness	11
		Water Farming	1
		Zero Budget Natural Farming	1
Processing		Consumer	12
		Fresh Food	7
		Hierarchy of Needs	13
		Importance of milk	8
		Nutritous Food	2
		Path Dependency	10
		Processing	11
		Trust in processing	1

Breed Management		Breed	7
		Crossbreeding	4
		Indigenous Breed	1
		Perception	**16**
		Sex Semen	3
Motivation Reasons		Awareness	**33**
		Cost efficiency	5
		Economic focus	**18**
		Motivation reasons	3
		Productivity Motivation	1
Globalisation		Changing Industry pattern	5
		Globalisation	**14**
		Imports	4
		Local Adaptation	4
		Multinationals	**12**
		Social Media	1
		Unorganised vs. organised sector	5
Transportation		Milk cooling	1
		Transportation	7
Government initiatives		Compliance	1
		Government initiatives	**33**
		Government structure	3
		Impeding government regulation	3
		National Dairy Plan	1
		NDDB	1
		Plastic iniatives	7
		Subsidies	**10**
Impact of Dairy		Impact of Dairy	7

Initiatives taken		Automation	5
		Biogas	10
		Concentrated Solar Technology	1
		Data Availability	1
		Education	**26**
		Energy	10
		Fodder	1
		Initiatives taken	7
		Orgainc Milk	1
		Plastic	5
		Renewable Energy	3
		Resource recycling	9
		Solar energy	**23**
		Solar energy potential	5
		Success Factors	1
		Technology Solutions	1
		Waste water	4
		Water Recycling	12
Investments		Indirect Initiatives	1
		Investments	**16**
Dairy alternatives		BDP	1
		Growth Potential	2
		Lactose Intolerance	1
		Milk Protein & Genetic Manipulation	**15**
		Plant-based Alternatives	**29**
		Price Sensitivity	7
		Stakeholders potential impact	8
		Value Added Products	5
Breed Management		Breed	7
		Crossbreeding	4
		Indigenous Breed	1
		Perception	**16**
		Sex Semen	3

Sustainability issues		Air quality	7
		CO2 emissions	8
		Communication	7
		Draught	2
		Energy intensive	1
		Global warming	4
		Greenhouse Emissions	1
		Groundwater contamination	3
		Groundwater levels	5
		Herd size	2
		High Capital Requirements	9
		Interconnectivity of environmental issu	2
		Milk adulteration	2
		Plastic waste	8
		Spoilage	**13**
		Sustainability definition	4
		Sustainability Implementation Speed	13
		Sustainability issues	**15**
		Uncertainty	1
		Unethical water availability	1
		Waste	2
		Waste segregation	9
		Water management	3
		Water scarcity	**34**
		Water scarcity in processing	2
		Distribution efficiency	1
		Retail	8
		E-Commerce	7
		Efficient resource utilization	1
		Efficient system	2
		Innovation	4
		Urban vs. Rural	6

Appendix E

An Exhibit from Atlas.ti