Zurich University of Applied Sciences
ZHAW

School of Management and Law
Department International Business

Master of Science in International Business

Cohort 2018 - 2019

Master Thesis

Sustainability Innovation in the Food Industry

Blockchain Technology's Potential Role in Addressing Social Sustainability Challenges in Cocoa Bean Production

submitted by:

Forichi, Maphrida T.
Student-Number: 18-877-662

Supervisors:

Main Supervisor:
Dr. Fridolin Brand

Co-Supervisor:
Dr. Jörg Schmidt

Winterthur, 10 September 2019

Address:

ZHAW School of Management and Law

St.-Georgen-Platz 2

8400 Winterthur

Table of Contents

List of Tables ..... **III**

List of Figures ..... **IV**

1 INTRODUCTION **1**

1.1 Practical Relevance **2**

1.2 Research Gap **2**

1.3 Research Questions **3**

1.4 Overview of Thesis **4**

2 METHODOLOGY **5**

2.1 Main Terms **5**

2.1.1 Blockchain Technology 5

2.1.2 Social Sustainability According to SAFA 13

2.1.3 Cocoa Bean Production 20

2.2 Structuring Heuristics **27**

2.2.1 Sustainability Management 27

2.2.2 Sustainable Supply Chain Management 28

2.2.3 Value-drivers for Corporate Social Responsibility (CSR) 30

2.3 Procedure and Methods **34**

2.3.1 Research Design and Approach 34

2.3.2 Data Collection 35

2.3.3 Data Analysis 40

2.3.4 Research Collaboration 41

2.4 Case Description **41**

3 RESULTS **44**

3.1 Literature Review **44**

3.1.1 How Blockchain Can Address Challenges 44

3.1.2 Blockchain's Position Amidst Current Sustainability Management Tools 50

3.1.3 Current Considerations for Blockchain Adoption 53

3.1.4 Value-drivers of Adopting Blockchain 55

3.2 Expert Interviews 58

3.2.1 How Blockchain Can Address Challenges 58

3.2.2 Blockchain's Position Amidst Current Sustainability Management Tools 63

3.2.3 Current Considerations for Blockchain Adoption 65

3.2.4 Value-drivers of Adopting Blockchain 67

4 DISCUSSION 71

4.1 Summary of Findings 71

4.2 General Observations 74

4.2.1 Fair Trading Practices Most Addressed 74

4.2.2 Cocoa Production's Unique Challenges Limiting Blockchain's Adoption 75

4.2.3 Blockchain Adoption of Small vs Large Industry Players 75

4.2.4 Varying Incentives of Small vs Large Industry Players 76

4.3 Potential Hurdles for Adoption 76

4.3.1 Unrealistic Expectations 77

4.3.2 Acceptance Among Actors 77

4.3.3 Establishing Standards 78

4.3.4 Interoperability with Existing Systems 79

4.3.5 Reliability of Data Input 79

4.3.6 Technical Feasibility 80

5 CONCLUSION 82

5.1 Main Results 83

5.2 Recommendations for Chocolate Manufacturing Companies 84

5.3 Limitations of Research 86

5.4 Options for Further Research 87

5.5 Research Outlook 88

LIST OF REFERENCES 89

APPENDIX I – Interview Transcriptions 105

List of Tables

Table 1: Sustainability Assessment for Food and Agriculture (SAFA) social well-being framework (Adapted from: Scialabba, 2014, pp. 176-208)..... 15

Table 2: Value-drivers for CSR (Adapted from: Eckelmann, 2006)..... 33

Table 3: List of expert interviewees (own illustration) 37

Table 4: List of expert interview questions (own illustration) 39

Table 5: Largest chocolate manufacturing companies 2018 (Source: International Cocoa Organization, 2019)..... 42

Table 6: Results of triangulated data (own illustration) 71

List of Figures

Figure 1: How blockchain works (Source: World Economic Forum, 2018) 7

Figure 2: Blockchain decision-making process (Source: Wüst & Gervais, 2018, p. 47)..... 9

Figure 3: Types of networks (Source: GSMA Digital Identity, 2017, p. 5)..... 10

Figure 4: Traditional supply chain management vs Blockchain powered supply chain management (Source: Wüst & Gervais, 2018, p. 48)..... 12

Figure 5: Cocoa sustainability challenges (Source: Wettstein, 2015, p. 26)..... 24

Figure 6: United Nations Global Compact outline for operationalizing a sustainable supply chain (Source: International Business Standards Organization, 2017) 30

Figure 7: Certified cocoa vs used cocoa 2017 for chocolate manufacturers (Source: Fountain & Huetz-Adamns, 2018, p. 41) 52

Figure 8: Perspectives from 193 organizations, initiatives, and projects on whether blockchain enables solutions not previously possible (Source: Galen et. al., 2018, p. 3) 54

1 INTRODUCTION

That innovation is key for business has become a widely accepted notion. However, what is now considered the key driver for innovation is sustainability (Nidumolu, Prahalad, & Rangaswami, 2009, p. 3). Sustainability challenges are offering plenty of potential for innovation and business opportunities. Multinational companies are increasingly being held accountable for upstream supply chains, leading them to seek new ways to manage them and reduce liabilities (Tachizawa & Wong, 2014, p. 643). New social and environmental regulation and laws are increasing the pressure for innovativeness, and business opportunities are presenting themselves through the visions and ideas presented by sustainability (Hansen, Grosse-Dunker, & Reichwald, 2009, p. 684). Moreover, various empirical studies have identified sustainability's positive correlation with business success (Wagner & Schaltegger, 2003).

A rising demand for transparency and increasing consumer awareness of the conditions under which products are produced and raw materials are obtained has been observed since the early 2000s (Carter & Rogers, 2008, p. 366). While companies are looking to technological advances to do social good (Suyash, 2012, p. 122), there is increasing attention to the prospect of blockchain addressing sustainability in supply chains (Kamble, Gunasekaran, & Gawankar, 2019, p. 180). Blockchain is increasingly being hailed as a breakthrough technology that will improve transparency, transferability and accountability in value chains, which for companies in food value chains could imply improving sustainability standards (Pearson et al., 2019; Yiannas, 2018). Walmart and other big food companies are harnessing blockchain's potential in their supply chains.

In the meantime, sustainability in cocoa has been receiving a lot of attention (Ton, Hagelaars, Laven, & Vellema, 2008, p. 1). Consumers, governments, non-governmental organizations (NGOs) and business towards the end of supply chains have been calling for proof of regulatory compliance and voluntary social and environmental standards of food products (Provenance, 2016). There is an urgent need for ways to trace cocoa. Despite their efforts to address the issues, "chocolate companies still cannot identify the farms where all their cocoa comes from, let alone whether child labor was used in producing it" (Whoriskey & Siegel, 2019, p. n.p.). Ensuring that production in agri-food supply chains is sustainable has thus become critical (Gayi & Tsowou, 2016, p. 2), reinforced by the signing of a commitment to "make all necessary efforts to accomplish a sustainable cocoa economy" (United Nations Conference on Trade and

Development, 2010, p. 25) by members of the United Nations Conference on Trade and Development (UNCTAD), including the major cocoa producing countries, in 2010.

The world may not revolve around chocolate, but cocoa is at the epicenter of the lives of those living in cocoa producing countries, whose incomes and livelihoods depend on it. This research aims to investigate what value blockchain holds in ensuring that cocoa is produced under socially sustainable conditions for the sake of cocoa bean producers, but also at the benefit of chocolate manufacturing companies, and supposedly the industry as a whole.

1.1 Practical Relevance

The greatest sustainability challenges in the cocoa supply chain can be found at the root of the supply chain, and "[a] supply chain is only as secure as its weakest link" (Yiannas, 2018, p. 50). Since social-related topics pose some of the biggest concerns about the cocoa bean production, the idea of exploring the potential of blockchain in addressing sustainability challenges arose. Developed by stakeholders from various sectors of the cocoa-chocolate industry, the International Organization for Standardization (ISO) published the first set of industry standards for sustainable and traceable cocoa in 2018. These standards are indication of the industry's growing commitment towards improving sustainability in cocoa production. Furthermore, in the agriculture and food sector, the sustainability of an enterprise and that of [small-scale] farming families are entwined (Scialabba, 2014). Thus, investigating how sustainability can be addressed, and how companies can utilize new technologies to do so, is in their best interest. Current systems for traceability are unable to link food chains records, are inaccurate, and experience delays in obtaining essential data (Badia-Melis, Mishra, & Ruiz-García, 2015, p. 393), deeming blockchain an interesting solution to explore.

1.2 Research Gap

To the best of the author's knowledge, this is an original topic that has not yet been academically pursued and documented. Blockchain's potential in addressing sustainability is an emerging topic, and this research will add to the nascent literature. Companies considering implementing blockchain have conducted research in-house, but it is seldom publicized. Not only do social sustainability topics have less treatment compared to environmental and economic topics, they have also emerged as some of the most critical to the case of cocoa bean production. In terms of sustainability management tools, the main focus has been on

environmental management systems, and socially-oriented approaches have not received a lot of attention (Seuring & Müller, 2008, p. 1704), which could be attributed to the fact that environmental performance can be measured and tracked more tangibly.

This research thus aims to:

- Contribute to a better understanding of blockchain technology's role within the social context of cocoa bean production,
- Add to the nascent literature on blockchain technology's impact on sustainability, namely social sustainability,
- As an increasingly interesting technology for agri-food supply chains, discover blockchain technology's potential in addressing social sustainability challenges in cocoa bean production,
- Provide actionable insights for the industry, but mainly chocolate manufacturing companies, to aid decision-making for blockchain's adoption, and
- Determine what the value-drivers for implementing blockchain are for chocolate manufacturing companies.

1.3 Research Questions

This research aims to answer the following research question: *What potential role can blockchain play in addressing social sustainability challenges in cocoa bean production, and what are the value-drivers of implementing the technology for chocolate manufacturing companies?*

The following sub-questions will help to guide and answer the main research question:

1. What social sustainability challenges in cocoa bean production might blockchain address and how?
2. How does blockchain compare to upstream supply chain and sustainability management systems and tools currently used to address social sustainability?
3. What are the current industry considerations for harnessing blockchain's capabilities in cocoa bean production to address social sustainability?
4. What are the value-drivers for chocolate manufacturing companies for implementing blockchain technology?

1.4 Overview of Thesis

Henceforth, **Chapter 2** begins by describing the three foundational terms, namely blockchain technology, social sustainability, and cocoa bean production. To understand sustainability within an organizational context, and particularly, within a supply chain, the concepts of sustainability management, sustainable supply chain, and value-drivers for corporate social responsibility (CSR) are then presented. Upon providing sufficient background, the procedure and methods undertaken for this research are justified, as well as the case description is provided. In **Chapter 3**, the results of the findings from an integrative literature review and expert interviews conducted by the researcher are presented. Thereafter, a summary of the findings is given and the potential hurdles of blockchain technology within cocoa production are explored within **Chapter 4**. Finally, a conclusion is drawn in **Chapter 5** with the main results emphasized once more, recommendations for chocolate manufacturing companies offered, limitations of research and options for further research suggested, and ultimately and outlook for the research reflected.

2 METHODOLOGY

The following chapter elaborates the methodology of this research. First, the three overarching themes for this research are described, then the concepts of sustainability management, sustainable supply chain, and value-drivers for corporate social CSR presented. Thereafter, the research design and methodology are justified, and case description for this research provided.

2.1 Main Terms

Foundational to this research, this sub-chapter will describe blockchain technology, social sustainability cocoa bean production.

2.1.1 Blockchain Technology

According to Botsman (2017), digitalization has redefined how trust is built and managed, by creating a shift of trust through technology. One such technology is blockchain, to which trust has recently been delegated. Blockchain forms the foundation of this research, hence a good understanding of it is crucial for the research.

2.1.1.1 What is Blockchain

Blockchain is essentially a type of distributed ledger technology (DLT) or shared databases. In technical terms, it is a chain of immutable blocks, or data structures, which store a list of transactions that are "created and exchanged by peers of the blockchain network and [that] modify the state of the blockchain" (Wüst & Gervais, 2018, p. 45). In simpler terms, it is a platform where everyone can know what is true (GSMA Digital Identity, 2017).

Blockchain was created with the aim of preventing the issues of double spending of money from a digital account that came about as the result of the digitalization of financial transactions. Double spending can occur on single, central digital ledgers if there are no control mechanisms to avoid account holders creating money from nothing. This was hardly an issue when banks were the trusted intermediaries that registered transactions and changes of ownership in the traditional setting (Wehner, 2018, p. 22). Blockchain helped create the cryptocurrency Bitcoin which was released in January 2009. An alternative to real currencies,

Bitcoin was to eliminate the middle man or trusted third party, while virtual currency was transferred in a fully distributed manner between participants anonymously (Nakamoto, 2008).

After the Bitcoin came other blockchain-based platforms, such as Ethereum, which was created in 2015 and introduced smart contracts (World Economic Forum, 2018). Smart contracts are a type of blockchain contract enforced by a consensus protocol, where transactions are executed when they pass predefined processes and smart conditions without the involvement of a third party or intermediary (Locher, Obermeier, & Pignolet, 2018; World Economic Forum, 2018). When a party attempts to enter a new record, the blockchain runs a code to check whether all the elements of the contract add up (i.e. contract terms, open purchase orders, and existing invoices and payments) and an accredited third-party audit is done. If the elements do not add up and one party breaches, the block is not verified, and it cannot be written. A trail of the transactions is maintained over the lifetime of a relationship between the parties in a supply chain.

2.1.1.2 How Does Blockchain Work

DLT allows participants in a peer-to-peer network maintain a local copy of a ledger to which transactions can be added by participants, depending on the permissions of the network. These participants can be referred to as nodes. When a node enters a new transaction, the entire network of nodes is alerted in real-time, and they can then view and verify the new transaction. This, coupled with the appropriate consensus mechanisms (i.e. proof of work and proof of stake) and encryption technology in place, allows transactions among anonymous participants to occur without the need of a third party. As a result, malicious actors are blocked from tampering with transaction history, which makes DLT tolerant to faults (Locher et al., 2018). **Figure 1** below demonstrates how blockchain works.

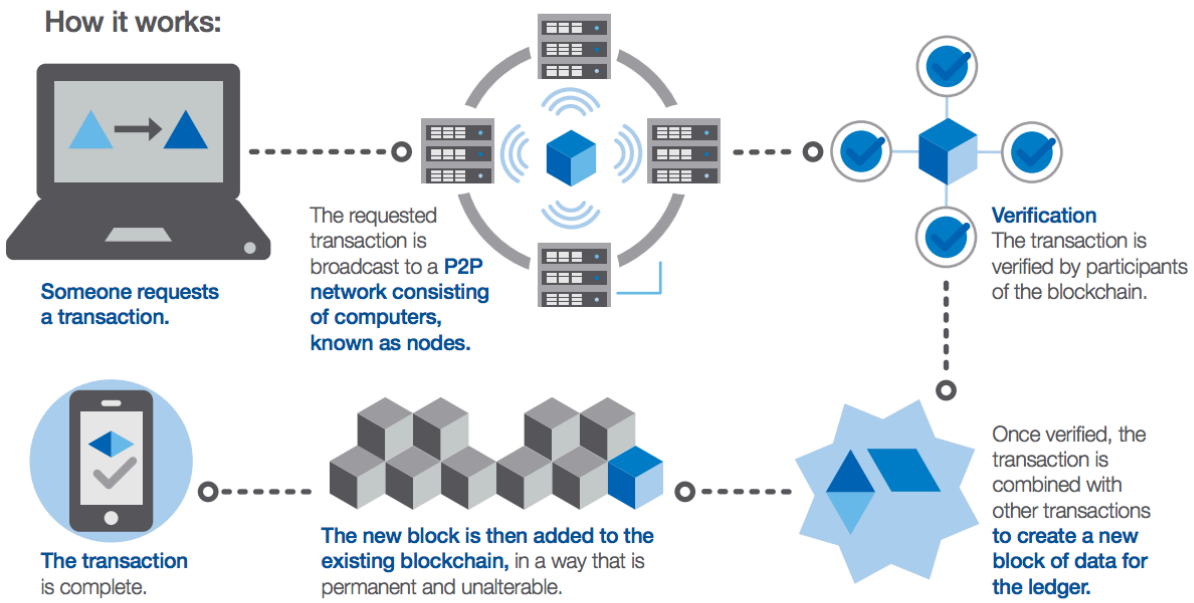

Figure 1: How blockchain works (Source: World Economic Forum, 2018)

There are three layers to a blockchain, namely the protocol, network and application layers (Cavaliere, 2018, p. 13). The protocol layer is where the code and basic functionalities of the technology are developed i.e. data structures and consensus mechanisms. It is where the computing power resides and the foundation of the next two layers. The network layer is where replications of the ledger are contained. The application layer is where the applications are built, and a digital profile of a product configured. Therefore, the only people who can own blockchain are those on the network layer, not the application users. According to Platt, application users in the future will not even notice when an application is built on a blockchain (Platt, 2017) Customers can interact with products they are associated with on a customized version of the user interface (Abeyratne & Monfared, 2016, p. 5).

2.1.1.3 Where is Blockchain Applicable

Blockchain essentially allows mutually mistrusting entities to exchange value. Its participants are called writers or readers. A writer writes state to the database and is involved in the consensus protocol of the blockchain (Wüst & Gervais, 2018, p. 45). The writer can essentially add blocks to a blockchain. Meanwhile, a reader does not extend a blockchain, but rather participates in the transaction creation process by reading and analyzing, or auditing the blockchain (ibid, p. 45). Wüst & Gervais (2018) defined a methodology to evaluate blockchain's appropriateness as a technical solution for a particular scenario within supply

chain management. However, it is first necessary to differentiate between permissionless and permissioned blockchain.

Permissionless blockchains are open and decentralized, meaning anyone in the world can gain access, view transactions, submit their own records, and participate in consensus process. For instance, the cryptocurrency Bitcoin and a platform for building decentralized applications through smart contracts, Ethereum, are two instances of permissionless blockchain, meaning any peer can have access as a writer and reader at any time. In a permissionless blockchain, there exists no central entity which manages membership or could legitimize participants. On the other hand, permissioned blockchain only allows an authorized set of entities to write and read the respective blockchain, where a central entity determines the rights of peers to participate. In that sense, a permissioned blockchain closely resembles a centralized database which raises the question of how suitable blockchain is compared to other centralized databases. Hyperledger Fabric and R3 Corda are two of the most widely known permissioned blockchains. Between permissioned and permissionless blockchains, there are also hybrid systems which combine characteristics of both private and public ledgers.

In general, a permissionless or permissioned blockchain makes sense "when multiple mutually mistrusting entities want to interact and change the state of a system, and are not willing to agree on an online trusted third party" (Wüst & Gervais, 2018, p. 46). Firstly, if there is no data to be stored, blockchain is unnecessary. In addition to having no data, if only one writer exists, blockchain is not needed as it does not provide additional guarantee in this case. If what has been mentioned is true, and an online trusted third party (TTP) – which functions as a verifier for state transitions if always online – can be used, blockchain, again, is not unnecessary. Further to being able to use an online TTP, if all the writers are known and all are trusted (i.e. they do not assume malicious behavior from other participants), then blockchain is not needed. However, if data does need to be stored and an online TTP cannot be used, and there exist multiple, unknown writers, permissionless blockchain is the solution. On the other hand, if the writers are known, but are not trusted and therefore public verifiability is required, then public permissioned blockchain is an appropriate solution. If the previously mentioned is true, but public verifiability is not required however, then a private permissioned blockchain is appropriate. This decision-making process of determining where blockchain makes sense in a particular scenario is outlined in a flow chart in **Figure 2** below.

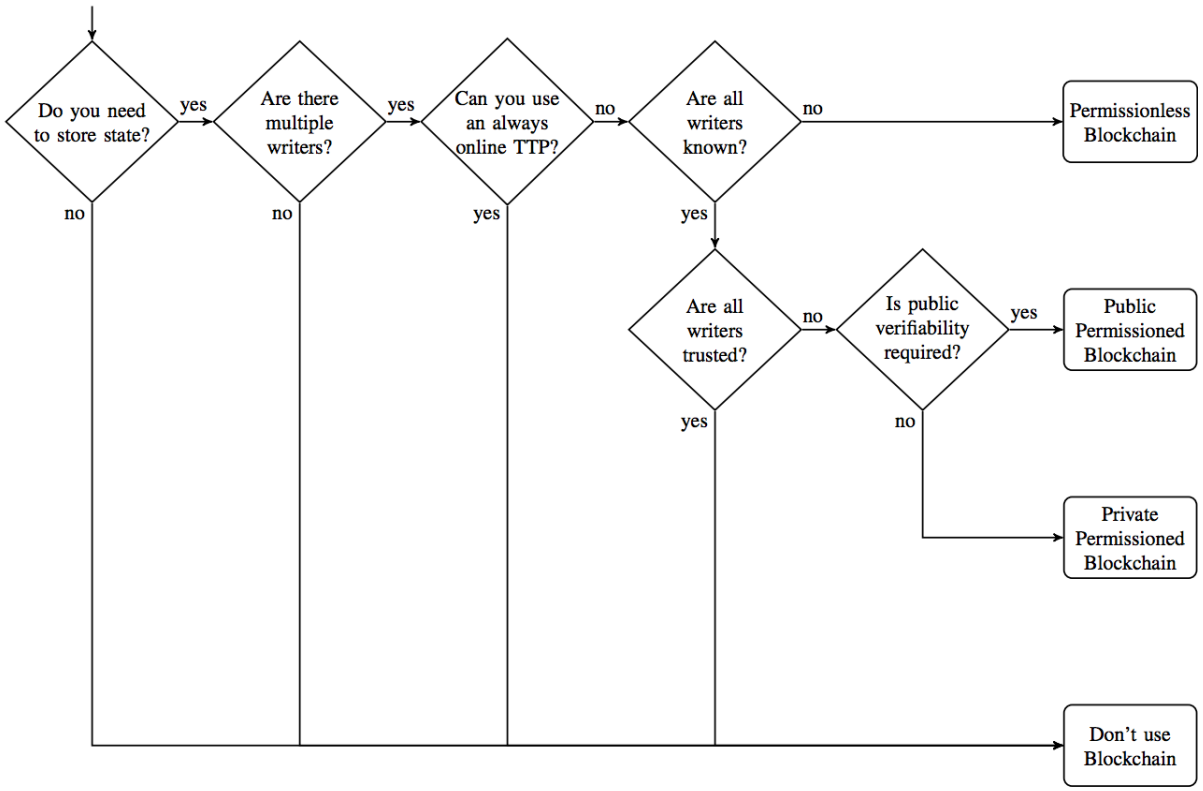

Figure 2: Blockchain decision-making process (Source: Wüst & Gervais, 2018, p. 47)

From a less technical perspective, the World Economic Forum (2018) proposes three broad principles – to address the temptation of trying to use blockchain as a solution for everything – that should be the starting point of assessing whether blockchain should be deployed. The three principles are firstly, whether blockchain would solve the envisaged issue; secondly, whether the downside risks or unintended consequences can be acceptably managed; and lastly, whether the right ecosystem of stakeholders is built (ibid, p. 6). Notheisen et. al. (2017, pp. 437–438) mention the following to be preconditions for applying blockchain to obtain added value compared to centralized data systems: 1) if actors have conflicting motivations and interests, 2) if information asymmetry exists, and 3) if several conflicting parties have writing access and there is a need for a consensus protocol.

2.1.1.4 Features of Blockchain

Distributed

All transactions on a blockchain are bundled together as a chain of blocks and listed on a distributed database by cryptography (Cavaliere, 2018, p. 15). Each participant has [not necessarily identical] access to the distributed database.

Decentralized

Compared to a centralized database, a blockchain operates on a decentralized network (See **Figure 3**), meaning it is not controlled or governed by one single entity (Abeyratne & Monfared, 2016, p. 2). This eliminates the need for mediation from a third party and increases trust. The distribution of failure risk in a decentralized network makes blockchain durable and reduces its vulnerability to malicious attacks (ibid, p.2).

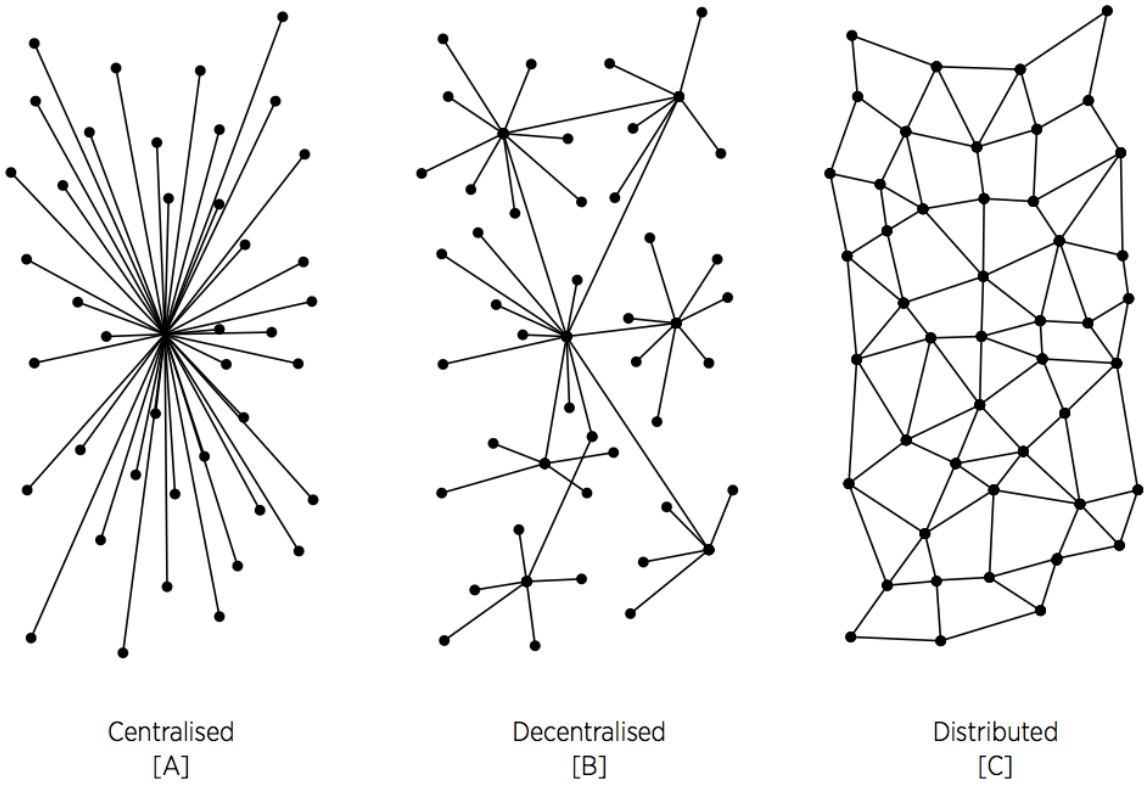

Figure 3: Types of networks (Source: GSMA Digital Identity, 2017, p. 5)

A number of nodes host information added to the blockchain. However, the extent to which private blockchain is considered a true 'peer-to-peer' system is debatable since there still exist centralized intermediaries (Mainelli & Smith, 2015, p. 14).

Consensus-based

As soon as a transaction on the blockchain is verified it is assigned with a unique hash and updated across each node in the network in real time. The network has to agree unanimously on the new state of the ledge, and are informed when there is a discrepancy (Verhoelen, 2017). However, as the system grows, the consensus-mechanism could introduce inefficiencies and decrease performance, introducing scalability issues (Cavaliere, 2018, p. 16)

Cryptographic

Blockchain privacy and security is enhanced by cryptography, which is the source of authority supporting all transactions on the network (Cavaliere, 2018, p. 16). Cryptography enables encryption of data which allows participants to communicate directly and openly, while guaranteeing authenticity. Encryption enables immutability of data, which means once an entry has been made, it is given a time-stamp and unique hash that identifies it and automatically ties it to the entry that came before it (Wehner, 2018, p. 26). This feature makes it impossible for any participant to duplicate, amend or delete an entry without alerting other users on the blockchain, and resultantly helps maintain the integrity of data stored on the blockchain.

2.1.1.5 Blockchain in Supply Chain Management

Blockchain technology has evolved beyond its initial purpose of financial transactions to bring disruptive innovation to other sectors that have traditionally relied on trusted third parties. It has gained much attention in cloud storage, healthcare, ownership of royalty distribution, smart property, Internet of Things, and supply chain provenance, to name a few. The financial industry can get similar benefits from blockchain as from a regular database, but supply chain has more to gain from blockchain than from other data system (Kshetri, 2018, p. 87).

Supply chain management is often discussed as a use case for the employment of blockchain. Supply chains are characterized by a range of intermediaries that control a functioning system. However, they can be complex, and it can be difficult to maintain an overview of the actors involved and their activities. As a platform for supply chain, blockchain holds great promise and offers a transparent and integrity-protected data storage (Wüst & Gervais, 2018). In supply chain management, it is assumed that suppliers use the ledger for tracking material and verifying certain attributes during each step of production and transportation (Locher et al., 2018, p. 8), and the new distribution of data in a blockchain-powered supply chain is characterized by **Figure 4** below.

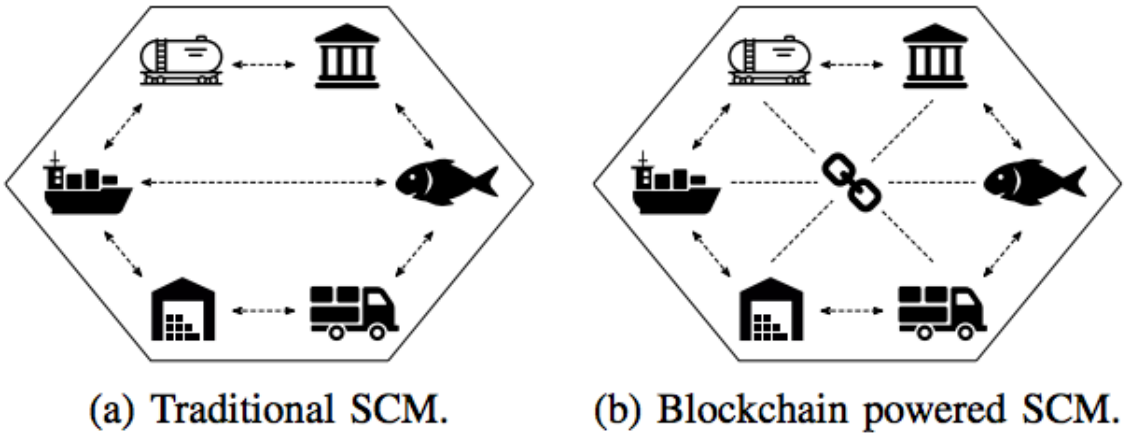

Figure 4: Traditional supply chain management vs Blockchain powered supply chain management (Source: Wüst & Gervais, 2018, p. 48)

If the process for adding goods into the ledger is consensus-based, certain object creation criteria must be met. However, defining the internal predicate criteria can be the most problematic step. Firstly, the good is attached with some form of information tag which represents a "unique digital cryptographic identifier" (Abeyratne & Monfared, 2016, p. 5) linking the physical product with its virtual counterpart on the network. Then, the supplier must state certain properties of the object which correspond to predicate properties in the ledger. The type of data that can be collected about a certain product on a blockchain are ownership data, time stamping, location data, product-specific data, as well as environmental impact data, and certification and standards programs can also be implemented into the blockchain (ibid, p. 6). Here, an entity must physically verify the reliability of the information. Therefore, there are four major entities in a blockchain-based supply chain, namely registrars who give actors on the network their identities, standards organizations who define standards schemes (e.g. sustainability), certifiers who certify actors in the network, and actors which include suppliers, manufacturers, retailers and customers (Steiner & Baker, 2015).

Since there are various intermediate cycles and a multiplicity of supply chain actors which are usually known in a supply chain, if some actors are not necessarily trusted, public permissioned blockchains or private permissioned blockchains are a suitable technical solution, according to the logic described in **sub-Chapter 2.1.1.2**. Public permissioned blockchains allow for anyone to read the state, while private permissioned blockchains restrict the readers. Permissionless blockchains allow anyone to participate as readers or as writers. Within a food supply chain, blockchain offers a traceable, transparent and interoperable system to generate fair products

(Potma, 2018). It allows for the synchronization of resource flow through the supply chain of both materials and cash (Hunink, 2018). Furthermore, its architecture can be harnessed for peer-to-peer payments, managing records, tracking physical objects, and transferring value via smart contracts (World Economic Forum, 2018, p. 8).

2.1.2 Social Sustainability According to SAFA

The most frequently quoted definition of sustainability, is that which was established by the Brundtland Commission, which defines sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p. 37). Sustainability has also been defined by the triple bottom line concept which proposes a balance between environmental and social dimensions (Seuring & Müller, 2008, p. 1700). Because the economic, environmental and social challenges of cocoa production can be intertwined, as will be observed in **sub-Chapter 2.1.3.3**, it was necessary to select a framework for social sustainability that would define the boundaries for the challenges which will be considered. This research resorts to a definition of social sustainability encompassed by the Sustainability Assessment for Food and Agriculture (SAFA) framework.

Defining sustainability as "ensuring human well-being (and achieving global food security) without depleting or diminishing the capacity of the earth's ecosystems to support life or at the expense of others' well-being" (Scialabba, 2014, p. 20), the Sustainability Assessment of Food and Agriculture system (SAFA) is a holistic international reference tool that defines elements of sustainability and is a framework for assessing tradeoffs and synergies among the economic, environmental, social and governance dimensions of sustainability. Based on sustainability frameworks developed over the last few decades as well as international reference documents and conventions (i.e. International Labor Organization, etc), and core methodological principles, SAFA was developed by the UN Food and Agriculture Organization (FAO) to provide a common language for assessing the sustainability performance of enterprises from production to retail. It can be applied by food and agriculture enterprises to evaluate sustainability in operations and identify opportunities for performance improvement and manage or benchmark suppliers to improve procurement sustainability (ibid.). The framework focuses not on products, but on supply chains and the evaluation of enterprises in those supply

chains, making it relevant for this particular purpose. It is also suitable because it is the most comprehensive framework for sustainability in food and agriculture to date.

In the SAFA framework, good governance, environmental integrity, economic resilience and social well-being are translated into universally agreed definitions of sustainability and are divided into 21 universal sustainability goals (themes) which are detailed into 58 sustainability objectives specific to supply chains (subthemes). The subthemes can be measured and verified through a set of indicators applicable to agricultural and food supply chains. It is sufficient for, this research, to remain on the sub-theme level as those dictate how a certain theme can be addressed, which will be relevant were investigating the potential of blockchain in addressing social sustainability challenges in cocoa bean production. This research focuses on social sustainability and will therefore adopt the social well-being dimension of SAFA in order to define the challenges encountered in cocoa production.

The SAFA Guideline quotes the following World Commission on Environment and Development (1987) definition of social sustainability: “meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life” (ibid, p.37). The dimension of social well-being encompasses the themes presented in **Table 1** below, which contain the respective sub-themes. More detailed information can be found in the SAFA Guidelines Version 3.0 document:

Table 1: Sustainability Assessment for Food and Agriculture (SAFA) social well-being framework (Adapted from: Scialabba, 2014, pp. 176-208)

Theme	**Theme Goal**	**Sub-theme & Sub-theme Objective**	**Examples of how the objective can be fulfilled**
Decent livelihood The capabilities, material assets and social resources, as well as the activities required to obtain a means of living that ensures the basic needs to maintain a decent living standard within the community and ability to save for the future are met.	The responsibility of the enterprise is to provide activities, capabilities, and assets that increase the livelihood security of farmers and the community in which it operates.	*Right to quality of life:* "All producers and employees in enterprises of all scales enjoy a livelihood that provides a culturally appropriate and nutritionally adequate diet and allows for family, rest and culture" (Scialabba, 2014, p. 179).	e.g. Stakeholders of the enterprise report that they do not live in oppression, but in peace, security and health, with enough time for family and personal needs e.g. 100% of employees are paid a living wage
		Capacity development: "Through training and education, all primary producers and personnel have opportunities to acquire the skills and knowledge necessary to undertake current and future tasks required by the enterprise, as well as the resources to provide for further training and education for themselves and members of their families" (Scialabba, 2014, p. 180).	e.g. Enterprises provide opportunities for producers and workers to learn how to improve techniques and management through trainings, conferences and other networking events e.g. Together with local community and other farmers, small-scale producers identify best practices, seek and attend trainings on better practices e.g. Primary producers recruit and train next generation to ensure continuity of farming practices
		Right of fair access to land and means of production: "Primary producers have access to the means of production, including equipment, capital and knowledge" (Scialabba, 2014, p. 182).	e.g. Regular and relevant access to agricultural extension services e.g. Access to facilities and equipment e.g. Availing opportunities for producers to gain skills and learn best practices to make operations more efficient and sustainable

Fair trading practices The legal and human rights that allow farmers to have access to markets with fair, stable and negotiable prices based on true costs, and where agreements are long-term, and contracts include a mutually agreeable, dispute-free settling process.	The responsibility of the enterprise is to ensure fair trading prices based on the true costs of the process to sustain a regenerative ecological system, and to support the livelihoods of producers as well as their families and employees.	*Responsible buyers:* "The enterprise ensures that a fair price is established through negotiations with suppliers that allow them to earn and pay their own employees a living wage, and cover their costs of production, as well as maintain a high level of sustainability in their practices. Negotiations and contracts (verbal or written) are transparent, based on equal power, terminated only just for cause, and terms are mutually agreed upon" (Scialabba, 2014, p. 185).	e.g. Trade deals with suppliers are 100% based on contracts with buyers that include conflict resolution processes and guarantee that trade relations are only terminated for a just cause
		Rights of suppliers: "The enterprises negotiating a fair price explicitly recognize and support in good faith suppliers' rights to freedom of association and collective bargaining for all contracts and agreements" (Scialabba, 2014, p. 186).	e.g. 100% of buyer relationships with suppliers are based on trust and suppliers' rights to freedom of association and collective bargaining
Labor rights The group of legal and claimed human rights, usually obtained under labor or employment law, that have to do with labor relations between workers and their employees.	The responsibility of the enterprise is to provide employment that fully complies with national law and international agreements on labor, social security, and contractual agreements.	*Employment relations:* "Enterprises maintain legally-binding transparent contracts with all employees that are accessible and cover the terms of work and employment is compliant with national laws on labor and social security" (Scialabba, 2014, p. 189).	e.g. Written policies of enterprises provide contracts for all employees that are legally binding and meet labor laws and treaties
		Forced labor: "The enterprise accepts no forced, bonded or involuntary labor, neither	e.g. The enterprise ensures that forced labor is not a part of its supply chain through written policies and in practice

		in its own operations nor those of business partners" (Scialabba, 2014, p. 190).	
		Child labor: "The enterprise accepts no child labor that has a potential to harm the physical or mental health or hinder the education of minors, neither in its own operations nor those of business partners" (Scialabba, 2014, p. 191).	e.g. No employees under the age of 16 are employed by the enterprise in a way that interferes with their rights
		Employees' freedom of association and right to bargaining: "All persons in the enterprise can freely execute the rights to: negotiate the terms of their employment individually or as a group; form or adhere to an association defending workers' rights; and collectively bargain, without retribution" (Scialabba, 2014, p. 193).	e.g. The establishments of all workers' rights are facilitated by the enterprise e.g. The enterprise provides and facilitates legal rights training for all employees
Equity The degree of gender, ethnic and inter-generational inclusiveness and fairness that resources are distributed with, opportunities are allowed, and decisions are made, as well as the provision of comparable employment opportunities and social services.	The responsibility of the enterprise is to proactively support vulnerable groups by pursuing a strict policy on equity and non-discrimination.	*Non-discrimination:* "A strict equity and non-discrimination policy is pursued towards all stakeholders; non-discrimination and equal opportunities are explicitly mentioned in enterprise hiring policies, employees or personnel policies (whether written or verbal or code of conduct) and adequate means for implementation and evaluation are in place" (Scialabba, 2014, p. 195).	e.g. The enterprise has clear non-discrimination policies and consistently applies those policies to all employees and in dealings with all suppliers

		Gender equality: "There is no gender disparity concerning hiring, remuneration, access to resources, education and career opportunities" (Scialabba, 2014, p. 196).	e.g. The enterprise does not discriminate against women in hiring or firing, renumeration, training or advancement to resources
		Support to vulnerable people: "Vulnerable groups, such as young or elderly employees, women, the disables, minorities and socially disadvantaged are proactively supported" (Scialabba, 2014, p. 197).	e.g. The enterprise has policies and practices that effectively accommodate different levels of ability and disability, and ages of workers e.g. The enterprise supports vulnerable people by providing resources to the local community like social and health services, development training, and even cultural events
Human health and safety The maintenance and promotion of the highest degree of mental, physical, and social well-being of all workers, including the organization of workplace culture and personal health resources at work.	The responsibility of the enterprise is to provide a safe, hygienic and healthy work environment with clean water, food, accommodation and sanitary installations to cater to the satisfaction of human needs.	*Workplace safety and health provisions for employees:* "The enterprise ensures that the workplace is safe, has met all appropriate regulations, and caters to the satisfaction of human needs in the provision of sanitary facilities, safe and ergonomic work environment, clean water, heathy food, and clean accommodation (if offered)" (Scialabba, 2014, p. 200).	e.g. The enterprise provides health and safety as well as specialized equipment training to 100% of its employees e.g. The enterprise ensures a workplace for its employees that is safe, clean and healthy, by determining whether its facilities, equipment, practices, and amenities offered are safe and meet the needs for a healthy lifestyle for employees e.g. The enterprise covers and ensures employees' health and emergency access to medical care
		Public health: "The enterprise ensures that operations and business activities do not limit the healthy and safe lifestyles of the local community and contributes to community health resources and services" (Scialabba, 2014, p. 202).	e.g. The enterprise avoids polluting or contaminating the local community, but rather contributes to its health

Cultural diversity The numerous forms of cultural identity (including but not limited to age, ethnicity, language, religion, sexual orientation, political affiliation and economic status) taken through acculturation.	The responsibility of the enterprise is to respect the rights of stakeholders in choosing their lifestyle and patterns of production and consumption, as well as indigenous communities' knowledge and intellectual property rights.	*Indigenous knowledge:* "Intellectual property rights related to traditional and cultural knowledge are protected and recognized" (Scialabba, 2014, p. 205).	e.g. The enterprise protects the knowledge of indigenous communities and recognized and respects their universal rights e.g. Based on mutually agreed upon terms, the enterprise remunerates indigenous communities in a fair and equitable manner e.g. The enterprise meets all national and international laws and treaties about indigenous knowledge in written policies and in practice
		Food sovereignty: "The enterprise contributes to, and benefits from, exercising the right to choice and ownership of their production means, specifically in the preservation and use of traditional, heirloom and locally adapted varieties or breeds" (Scialabba, 2014, p. 202).	e.g. The enterprise sources seed varieties or traditional or heirloom breeds locally for at least the majority of its production e.g. The enterprise maximizes purchases from local producers instead of importing heirloom or varieties for at least the majority of its raw material needs

As can be observed, SAFA strongly attributes responsibility of obtaining the goals of the above-mentioned themes to the enterprise. Hence this framework complements the target audience and perspective of this research, which are chocolate manufacturing companies.

All themes and subthemes of social well-being appear to be relevant for cocoa bean production and pertain to the social sustainability challenges experienced at that stage of the supply chain, the most prominent of which will be discussed in **sub-Chapter 2.1.3.3**.

2.1.3 Cocoa Bean Production

Assessing the potential of blockchain beyond the cocoa production stage of the supply chain was beyond the scope of this study. This research this focuses on the beginning of the cocoa-chocolate supply chain, namely cocoa bean production, and the discrete steps and stakeholders relevant to this stage. Intermediate stages such as logistics and transportation are not relevant for this study and therefore not considered.

2.1.3.1 Cocoa Bean Production in the Cocoa Supply Chain

The United Nations Conference on Trade and Development (UNCTAD) simplifies the cocoa-chocolate supply chain in five major segments: cocoa beans production, sourcing and marketing, processing of powder and butter, manufacturing and distribution of industrial chocolate, and retailing to final consumers (Gayi & Tsowou, 2016). Other sources i.e. Cocoa Barometer, are more or less in accordance with this.

According to the International Cocoa Organization (2018), cocoa is cultivated in tropical regions, with about 10% being produced in Asia and Oceania (mainly in Indonesia and Papua New Guinea), 17% in Latin America (mainly in Ecuador, Brazil and Colombia), and 73% in Africa (mainly in Ivory Coast, Ghana, Cameroon and Nigeria). The highest producing country of cocoa is Ivory Coast, followed by Ghana then Indonesia. Most of the cocoa exported from Africa is destined for European Union, while South-east Asia is dependent on the American market, and Latin America has no clear market orientation, but includes United States, European Union, and Mexico (Fold & Pritchard, 2005, p. 225; Vega & Beillard, 2015, p. 2)

Cocoa production involved growing trees, harvesting cocoa pods, fermenting then drying the beans. Cocoa is typically produced by small-holder farmers who account for up to 90% of the

world's production, and for whom cocoa plays a vital economic role. In Africa and some parts of Asia, farmers generally cultivate cocoa on 2 to 4 hectares of land. Cocoa trees are most productive for up to 30 years, and they thrive in tropical areas under the protective shadow of palm, banana and plantain trees. They begin to bear pods in the fifth year of their life, while new species can bear fruit in their third year. When the pods ripen, the cocoa beans – which are the seeds of the cocoa fruit – are harvested. Thereafter, they are fermented and dried, normally on the farm or in the villages of the producers.

Traditionally, cocoa bean processing was done closer to retail production in Europe and North America. Now, a significant proportion of the first stages of cocoa bean processing are undertaken in producing companies, owing to investments by national and transnational companies, as well as government incentives (Gayi & Tsowou, 2016).

2.1.3.2 Organization of Cocoa Sector in Major Cocoa Producing Countries

The cocoa supply chain is inherently complex. From a chocolate manufacturing company's perspective, cocoa production is an activity that involves a complex network of supply chain actors, sometimes around the globe. The product passes through a number of intermediaries before it reaches the final customer (Kaplinsky, 2004, p. 2). Moreover, due to increasing vertical and horizontal integration in the industry, the boundaries between trading and processing companies are also blurred (Gayi & Tsowou, 2016, p. 15; Ton et al., 2008, p. 2). There is also an increasing trend for chocolate manufacturing companies to adopt a 'bean to bar' supply chain. Cocoa supply chains vary in different countries, and it is important to understand the dynamics to identify the key players related to cocoa production.

Farm sizes in West Africa are about 3 ha large, and 90% of cocoa is produced by smallholder farmers (The International Cocoa Organization, 2009, p. 3). Ghana is the second largest producer of cocoa in the world, and the commodity plays a central role in the country's economy (Vigneri & Kolavalli, 2018, p. vii). In Ghana, the production stage consists of the cocoa farmers, input suppliers, and The Ghana Cocoa Board Head Office (COCOBOD) (World Bank, 2013). COCOBOD oversees the marketing activities of Ghana's cocoa supply chain which has a unique marketing arrangement, combining elements of privatization with strong governmental presence that regulate the activities of stakeholders in the industry. The marketing process of cocoa is overseen COCOBOD, beginning with farmers and ending with government export. Ghana is the only major cocoa producing country with a marketing system

that is not fully liberalized (ibid.). Farmers sell their cocoa to privately owned and operated licensed buying companies at farmgate at a guaranteed floor price, who then sell it to COCOBOD at a fixed price. The revenue these licensed buying companies receive depends on volumes marketed. Because they face a floor price for farmers and a fixed sale price from COCOBOD, they seek to maximize volumes and minimize 'turnaround' times between purchasing the beams to selling them in order to maximize profits. Domestic cocoa processors are supplied with cocoa by the COCOBOD. Just next door in Ivory Coast, which is the largest producer of cocoa in the world, approximately 80% of cocoa procurement occurs through the unorganized sector involving several intermediaries, namely farmers, farm-gate buyers, wholesalers, and exporters (Fair Labor Association, 2012, p. 2; Ton et al., 2008, p. 17). Cooperatives make up a small proportion of the market for cocoa, and supply chains are rather unstable since participants buy from and sell to anyone (Fair Labor Association, 2012, p. 2). The Conseil du Café-Cacao (CCC) is the Ivory Coasts's COCOBOD equivalent, and it facilitates the marketing of cocoa in Ivory coast (Fountain & Huetz-Adams, 2018, p. 7)

Indonesia is the most significant cocoa bean supplier in East Asia. Smallholder farmers, who constitute more than 90% of cocoa cultivated area in Indonesia, have land sizes of about 0.5 to 4 ha (The International Cocoa Organization, 2009, p. 3). Farmers sell their cocoa to local collectors (i.e. cocoa farmers themselves or rural entrepreneurs with transportation means) at farm-gate price or, to a lesser extent, directly to local traders (Panlibuton & Lusby, 2006, p. 3). The traders sell the cocoa beans to local exporters or local processors. The market is unregulated with limited government policy intervention, so most farmers prefer to deal with private collectors and traders independently as there are few farmer cooperatives (Collinson & Leon, 2000, p. 8). In Malaysia, the cocoa board, a governmental organization, is not involved in marketing but only conducts scientific research on cocoa (International Trade Centre, 2001, p. 15). Farmers are free to sell to whoever and wherever they please, but the export business is rather small due to high local processing.

Latin America is more efficient in producing cocoa than West African countries "who are 'blighted' by cumbersome land ownership issues and an ageing farmer population" (Myers, 2018, p. n.p.). Latin America may not be leading in terms of cocoa yields globally, but the sector is driven by a relatively young workforce and its production methods are rather technologically advanced (ibid, n.p.). Cocoa farms in Latin America are small to medium-sized, except Brazil where farms range between 10 to 100 ha, while Ecuadorian units range from 3 to 4 ha per family (The International Cocoa Organization, 2009, p. 3). In Ecuador, the

government plays a facilitating role in setting up policies to within the liberalized system (Fountain & Huetz-Adams, 2018, p. 31; Ton et al., 2008, p. 24). Farmers are paid high prices due to the efficient marketing system, national policies and the high quality of cocoa beans Ecuador produces (Gayi & Tsowou, 2016, p. 23)

2.1.3.3 Social Sustainability Challenges in Cocoa Bean Production

While cocoa farmers are the backbone of their countries' cocoa supply chains, they are also the most disadvantaged actor within the supply chain. According to the ISO 34101-3 standards, sustainably produced cocoa is "cocoa beans that are produced in an economically viable, environmentally sound and socially responsible manner, within an organization" (International Organization for Standardization, 2019b, p. 4). It defines an organization as a "person or group of people that has its own functions with responsibilities, authorities and relationships to achieve its objectives" (ibid, p. 3), which refers to sole-traders, cooperatives, companies, corporations and associations, among other entities. A sustainable cocoa economy is thus "an integrated value chain in which all stakeholders develop and promote appropriate policies to achieve levels of production, processing and consumption that are economically viable, environmentally sound and socially responsible for the benefit of present and future generations, with the aim of improving productivity and profitability in the cocoa value chain for all stakeholders concerned, in particular for the smallholder producers" (United Nations Conference on Trade and Development, 2010, p. 9).

Although supply chain structures differ across cocoa producing regions, there is a consensus on the general sustainability challenges in cocoa production. The four majority priority areas that companies across the cocoa industry have chosen to focus on for a positive impact in their supply chains include 1) achieving sustainably livelihoods for cocoa producers, including incomes, 2) eradicating child labor and promoting children's rights, 3) advancing economic opportunities for unemployed youth and women, and 4) stopping deforestation (Hershey Co, 2019, p. 23). This research takes on a global perspective in order to make it more relevant for chocolate manufacturing companies, which normally have global supply chains (i.e. multiple regional sources for their cocoa and a mass balance aggregation). Moreover, 80-90% of worldwide cocoa comes from small, family-run farms (Beg, Ahmad, Jan, & Bashir, 2017, p. 109), which are prone to sustainability challenges. Wettstein (2015) presents an overview of the economic, environmental and social challenges seen in **Figure 5** below, highlighting the

key ones as being low income, poor infrastructure, climate change effects, and lack of education.

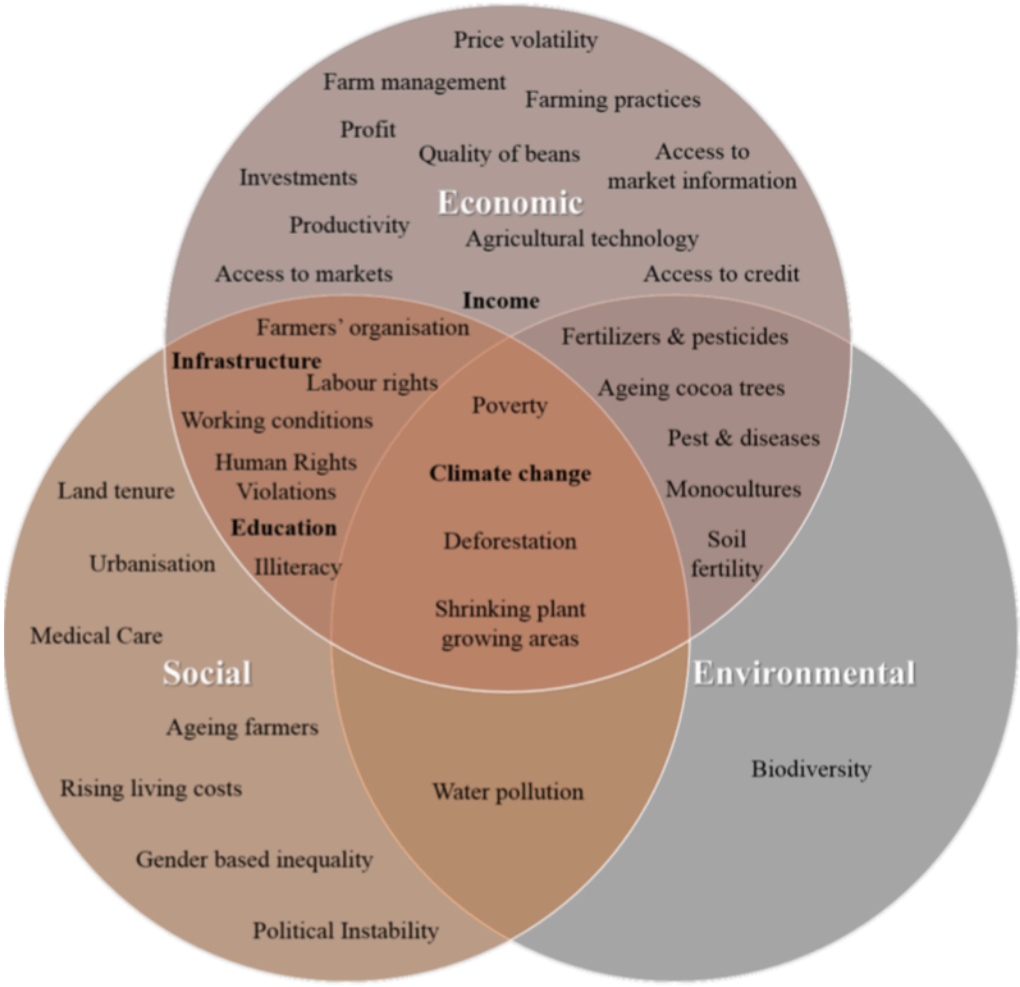

Figure 5: Cocoa sustainability challenges (Source: Wettstein, 2015, p. 26)

Taking into consideration the industry priorities stated above, some social sustainability challenges identified through literature which are in line with the SAFA classification and are believed to be addressable by blockchain, have been summarized below:

Low Income

Low farmer income is widely considered to be the principal challenge of and the root of other problems in cocoa production (Fountain & Huetz-Adams, 2018, p. 3; Wettstein, 2015, p. 27; Whoriskey & Siegel, 2019). In West Africa, a living income is calculated to be USD 2.51, but farmers currently receive USD 0.78 (Fountain & Huetz-Adams, 2018, p. 6). This is almost 200% below the absolute poverty line of USD 1.25 (Wettstein, 2015, p. 27). The main cause of this is that farmgate prices (the price farmers receive for their cocoa) are considered to be

too low, and in Ghana and the Ivory Coast, do not adjust according to fluctuations in the world market price of cocoa. Meanwhile, farming inputs and living costs are high relative to what the farmers earn. Low net incomes create a vicious cycle of sustainability challenges which result in issues like poverty in farming communities, unfavorable working conditions, and forced labor, as well as low productivity levels due to lack of resources which feed into the low income received by farmers. Because farmers has a weak bargaining positions, some companies deal with this by paying premiums to farmers to bridge the gap between what they receive for the cocoa at farmgate and what they need to live (Fountain & Huetz-Adams, 2018, p. 38).

Respective SAFA theme: Fair trading practices

Forced labor

The enforcement of international labor standards represents a challenge for the agriculture and food sector, particularly in rural areas where work is informal and is seldom covered by national labor legislation (Scialabba, 2014). In some of these countries, human rights violations are a stark reality. Moreover, laborers work under abusive conditions. Cocoa bean production is labor intensive and is vastly a family enterprise (Schrage & Ewing, 2005, p. 101)

Respective SAFA theme: Labor rights

Child labor

Child labor is widespread in cocoa producing countries. It is “work that deprives children of their childhood, their potential and their dignity, and that is harmful to physical and mental development” (Fair Labor Association, 2012, p. 66). Child labor was initially denied by the industry, then later acknowledged, and there have been public commitments to addressing it ever since (Schrage & Ewing, 2005, p. 99). In West Africa, there are even allegations that children are trafficked to work on cocoa farms. There are an estimated 2.2 million children in cocoa in Ghana and Ivory Coast alone (Fountain & Huetz-Adams, 2018, p. 6). The legal minimum working age is 12 years according to the International Labor Organization (Schrage & Ewing, 2005, p. 102). In Ivory Coast, children over the age of 14 are allowed to work given that the work is not dangerous, does not interfere with compulsory education, and their parents consent to it.

Respective SAFA theme: Labor rights

Poor workplace safety

Cocoa farming is no more dangerous than the farming of other crops (Muilerman, 2013, p. 2). It is majorly carried out in rural environments by smallholder farmers where living and working environments are interwoven (Mull & Kirkhorn, 2005, p. 650). Nevertheless, health and safety deserve attention if sustainability in cocoa bean production is to be addressed. While research on operational health and safety in cocoa farming is limited, the main focus has been on exposure to physical (i.e. farming tools, carrying and lifting loads) and chemical hazards (i.e. misuse of agrochemicals), especially without proper training or protective equipment (Muilerman, 2013, pp. 11–13). Some people working on cocoa farms, for instance pregnant women, young girs and children, are more vulnerable to health and safety hazards.

Respective SAFA theme: Human health and safety

Poor education and training

Illiteracy among cocoa farmers is common. In the rural areas of Ivory Coast, the illiteracy rate is less than 50% (Whoriskey & Siegel, 2019). Illiteracy makes transferring knowledge in written form (i.e. instructions, market information, keeping records) difficult (Wettstein, 2015, p. 28). This contributes to a lack of modernization resulting in cocoa farmers using outdated farming methods. This can have adverse effects on farmers' yields as well as the environment (e.g. misapplication of agro-chemicals). Illiteracy also contributes to a lack professionalization of cocoa farming which results in farmers potentially being ripped off at the market.

Respective SAFA theme: Decent livelihood

Gender inequality

In the agriculture and food sector, the employment of non-salaried family members and workers who have not received professional training, mostly women and foreigners, is particularly prevalent (Scialabba, 2014). In West Africa for instance, women run about a quarter of cocoa plantations (Fountain & Huetz-Adams, 2018, p. 12). Yet, female farmers in Ghana earn 25-30% and in Ivory coast up to 70% less than their male counterparts (Mondēlez International, n.d.-a). However, they often have limited access to extension services, land rights, credits and certification than men, and are also underrepresented in farmer organizations (Fountain & Huetz-Adams, 2018, p. 12). In many cases, these issues are also culturally or traditionally embedded and would require a change of mindset of men in these communities.

Respective SAFA theme: Equity

2.2 Structuring Heuristics

The following section will introduce structuring heuristics to assist with structuring the findings. The research approach and design of this research, which will be elaborated on in **sub-Chapter 2.3.1**, does not require that a theory be specified. Rather it "retains theoretical flexibility" (Eisenhardt, 1989, p. 533). Sustainability innovation, sustainable supply chain management, as well as value drivers for CSR were found to be relevant structuring heuristics for the research that follows.

2.2.1 Sustainability Management

Sustainability management is the internal development of social and environmental measures and the external contribution to sustainable society and economy (Johnson & Schaltegger, 2016, p. 483). In addition to enabling business managers to "operationalize sustainability-oriented strategies and to coordinate the activities through an enterprise" (ibid, 483) sustainability management tools aid in reducing negative social and environmental impacts while exploiting and managing positive impacts, as well as allowing companies to stay competitive and economically successful (Johnson, 2015, p. 272). After all, the quest for sustainability is transforming the competitive landscape (Nidumolu et al., 2009, p. 4). They are needed by companies pursuing corporate sustainability to aid the selection and design of sustainable programs, processes and products (Gladwin, Kennelly, & Krause, 1995).

According to Kuhndt (2004), these tools can be grouped into three categories, namely tools for analysis and evaluation (e.g. life-cycle assessment), tools for action (e.g. environmental management system), and tools for communication (e.g. sustainability report). Tools for analysis and evaluation support companies in evaluating their CS performance and are oriented towards the assessment of product or service supply or value chains. Tools for action support the company in linking corporate strategy and core business activities on an operational level. They do this by integrating CS into the management control system, which represents "the physical and social dynamics […] aimed at reducing the impact caused by a company's business operations" (Witjes, Cramer, & Vermeulen, 2015, p. 4). Action tools, however, are not expected to support CS integration fully as they lack an obligation for setting absolute targets for sustainability measures (ibid, p. 4). Finally, tools for communication help companies communicate their CS performance. They support companies' strategy development since an essential focus of these tools is understanding how CS related to the company's future vision.

There are various tools to support companies in integrating CS into their organization. The most relevant tools to this research are supply chain management and sustainability reporting, which are explored by Johnson & Schaltegger (2016) in their assessment of two decades of sustainability management tools. The first is a tool for action while the latter is a tool for communication, according to the above categorizations. It must be noted that blockchain is not a CSR technology in itself, but it is rather a tool that can be utilized to realized sustainability goals, thus deeming it a sustainability management tool within the context of this research. Blockchain would constitute itself as a system that aids action within supply chain management, and a system that aids communication within sustainability reporting.

The ISO34101-1 requirements for sustainability management systems in cocoa postulate that the objective of a cocoa sustainability management system is "primarily to ensure there are clear roles and responsibilities to promote internal planning, implementation, monitoring evaluation and learning, and to ensure ongoing progress towards sustainability goals (International Organization for Standardization, 2019a, p. vii). ISO attributes a few benefits of a cocoa sustainability management system, including the ability to address risks and opportunities association with the objectives of the organization and context in which it operates, as well as to consistent provide cocoa that is sustainably produced and that meets specified requirements (ibid, p. viii). A cocoa sustainability management system helps establish management practices which can be assessed through operational performance indicators.

ISO also considers initiatives to support rural livelihoods as other activities or programs that are integral to sustainability (International Organization for Standardization, 2019a, p. viii). In response to the various challenges, cocoa processors, trading companies and chocolate manufacturers have increased their sustainability initiatives. Initiatives take the form of company-specific projects, joint actions with other companies, or cooperation with governmental institutions, NGOs, multi-stakeholder initiatives and certifying organizations (Wettstein, 2015, p. 30). Companies consider beans that have been sourced through their sustainability programs to be sustainable cocoa (ibid, p. 31)

2.2.2 Sustainable Supply Chain Management

The UN FAO defines a supply chain as "the entire network of entities, directly or indirectly interlinked and interdependent in serving the same consumer or customer" (Scialabba, 2014, p. 233). It consists of activities that transform natural resources, raw materials and components

into finished products or services that are delivered to the end customer. Throughout every stage of the supply chain are social and environmental impacts (United Nations Global Compact, 2015, p. 7). A sustainable supply chain is thus "the management of environmental, social and economic impacts, and the encouragement of good governance practices throughout the lifecycle of goods and services" (ibid, p.7). Among other things, its aim is to create, protect and grow social value for stakeholders involved in bringing products to the market. Suppliers are crucial stakeholders and can play a major role in improving sustainability within the supply chain. Tachizawa & Wong (2014, pp. 651–656) propose four approaches for companies to manager multi-tier supply chains, including the direct (direct contact), indirect (contact through tier-1 suppliers), 'work with third parties' (delegate to NGOs, governments or certification bodies), and 'don't bother' (focus only on tier-1 suppliers and do not influence sub-suppliers) (ibid, p. 656). The first three are the ones adopted variably by chocolate manufacturing companies in the upstream cocoa supply chain, and crucial here is information symmetry.

The corporate sector's interest in sustainable is evidenced by the more than 7,700 companies in 130 countries that had signed the United Nations Global Compact (UNGC) in 2012 (Lozano, 2012, p. 15). The UNGC encompasses six guiding principles related to social sustainability, which prescribe companies the responsibility to respect human and labor rights, including protecting human rights, abolishing forced and child labor, and eliminating discrimination. To operationalize the principles of sustainable supply chain, the UNGC proposes an outline of practical steps a company can take shown in **Figure 6** (United Nations Global Compact, 2015).

Figure 6: United Nations Global Compact outline for operationalizing a sustainable supply chain (Source: International Business Standards Organization, 2017)

The cycle starts with committing. The company first needs to develop a business case by understanding the value-drivers and landscape. It needs to establish a vision and objectives, as well as expectations for the sustainable supply chain. Having a strong business case for supply chain sustainability can help with internal buy-in (United Nations Global Compact, 2015, p. 15). Next, is assessing. The company needs to determine where the greatest risk of adverse impacts are and define a scope that focuses on those areas. After that, the company can define and implement. This entails communicating expectations and engaging with suppliers, entering collaboration and partnerships, and ensuring internal alignment. The last step is to measure and communicate. In this step, the company tracks performance of the sustainable supply chain against its goals, and reports on progress transparently.

2.2.3 Value-drivers for Corporate Social Responsibility (CSR)

Corporate sustainability – a business approach to addressing sustainable development which contextually integrates economic, environmental and social aspects in business activities – has

gained much interest in the past three decades (Johnson & Schaltegger, 2016). As a result, a heated debate on the definition of more humane, ethical and transparent ways of doing business has been taking place, resulting in the creation of concepts such as sustainable development, corporate citizenship, Triple Bottom Line, business ethics, and corporate social responsibility, among others (van Marrewijk, 2003, pp. 95–96). The latter term – corporate social responsibility (CSR) – has caused businesses to take up responsibility towards society and its stakeholders, but has also left executives with more questions than answers.

2.2.3.1 Approaches to CSR

Corporate social responsibility (CSR) has been defined in different ways by various authors. This research will accept the supply chain view of CSR investigated by Forsmann-Hug et. al. (2013) within the context of food chains which defines CSR as a "concept of collectively standardized business activities of a company to pressures from stakeholders" (ibid, p. 31) and links the goals of a company and society's expectations. The answer of whom an organization has a responsibility towards finds itself in three approaches, namely the shareholder approach, the stakeholder approach, and the societal approach (van Marrewijk, 2003, p. 96).

In 1970, Milton Friedman postulated about the shareholder approach that "the social responsibility of a business is to increase its profits" (Friedman, 2007, p. 173). A classical view on CSR, this idea is based on the belief that social responsibilities are the task of governments and do not belong in the domain of organizations. It can be interpreted as businesses engaging in CSR to further the aims of the business and create long-term value for the company (van Marrewijk, 2003, p. 96). The stakeholder approach asserts that an organization's responsibility is towards a multiplicity of stakeholders' interests that influence and can be affected by the achievement of organization's objectives (ibid, p. 96). Stakeholders have traditionally been ignored and their relationships to companies characterized as constraints (Freeman & Mcvea, 2001, p. 9). Moreover, it has often been hypothesized that companies will be penalized by investors who are interested in financial returns if they invest in stakeholder management to improve their social performance (Freeman, 2004, p. 236). The final approach, namely the societal approach, attributes a company's responsibility to society as a whole, of which it is an integral part (van Marrewijk, 2003, p. 97). In this view, a company serves the needs of society constructively and operates by public consent, giving it the 'license to operate' (ibid, p. 97).

According to the Schüz (2012, p. 10) Triple Corporate Responsibility law, a business has an equally significant duty towards society and the planet as to its own prosperity.

2.2.3.2 Value-drivers for CSR for Companies

Companies worldwide have adopted concepts such as CSR, the triple bottom line, creating shared value, and responsible supply chain management to define better management practices and improve social and environmental impacts of human activities. This approach has introduced companies to new challenges and has required them to reevaluate their position in complex societal contexts. Accepting this new position within society, "companies develop new values, new strategies and policies and new institutional arrangements that support their functioning in areas that were once left to others, redefining their roles and relationships with others" (van Marrewijk, 2003, pp. 100–101).

The roots of CSR often find themselves in charity and stewardship (van Marrewijk, 2003, p. 98). However, this is not necessarily what drives companies to engage in initiatives that address social and societal challenges. Research has identified a clear correlation between economic performance and CSR (Carter & Rogers, 2008; Wagner & Schaltegger, 2003) with 'win-win' or 'triple win' potentials (Schaltegger, Lüdeke-Freund, & Hansen, 2012, p. 99). Weber (2008, p. 249) identifies five main areas of CSR business benefits from a large body of research on the topic, namely the positive effects on company image and reputation; the positive effects on employee motivation, retention, and recruitment; cost-savings; revenue increases from higher sales and market share; and CSR-related risk reduction or management. Later on, Schltegger et. al. (2012, p. 100) find reduction of costs; reduction of technical, political, societal and market risks; sales and profit margins; and reputations and brand value, to be the bigget drivers.

In his thesis about strategic sustainability management in the pharmaceutical industry, Eckelmann (2006) presents a more detailed set of value drivers for CRS for a company based on 4 perspectives: 1) market-product-customer, 2) process-production-resources, 3) reputation-regulation-public, and 4) finance-risk. **Table 2** below describes the constituents of these perspectives.

Table 2: Value-drivers for CSR (Adapted from: Eckelmann, 2006)

Market-product-customer Perspective	Product and technology innovation	A new product opens new opportunities for the customer and therefore new return
	Product properties	Product properties influence the price the customer is willing to pay
	Value proposition to customers	The customer receives more value and is willing to buy or pay more
	Market growth	The company sells more and receives a higher return
	New markets	Raises potential to sell more with higher return, but requires investment
Process-production-resources Perspective	Value proposition to employees	Employees motivation to work efficiently correlated with what is in it for them
	Process development	Structures that influence operational processes positively or negatively
	Operational efficiency	Operational quality influences production costs
	Supplier management	Management of suppliers influences production cost
Reputation-regulation-public Perspective	Value proposition to the public	The value for the public influences license to operate
	Value proposition to the government	The value for the government influences license to operate
	Legal compliance	The need to be compliant with laws to maximize value
	'License to operate'	The license to operate influences reputation and risk
	Company reputation	Reputation influences company value, access to top employees and access to money
Finance-risk Perspective	Risk position	How risky the company or its products are influences the price of loans
	Access to capital	Access to money (from investors or banks) and the financial mix a company can achieve in its books

Eckelmann's (2006) value-drivers for CSR will be adopted for framing the value-drivers for chocolate manufacturing companies for implementing blockchain in order to address social sustainability challenges in the cocoa supply chain.

2.3 Procedure and Methods

The following section will present the procedure and methods followed by this research by describing the research design, explaining the data collection method, and elaborating on how the data was analyzed.

2.3.1 Research Design and Approach

This qualitative research is an exploratory case study with an inductive approach. The inductive approach is appropriate for new topic areas such as the one address by this research (Eisenhardt, 1989, p. 532). As a case study of the upstream cocoa supply chain, with particular focus on chocolate manufacturing companies and their relation to cocoa farmers, this research attempts to grasp a phenomenon in a holistic way within its real context, as inductive research tends to do (Saunders, Lewis, & Thornhill, 2009, p. 126). In this case, the research is not concerned with generalizing, but rather giving indicative evidence of the phenomena. It specifically explores the potential role of blockchain technology in addressing social sustainability issues in cocoa bean production. By focusing on understanding those dynamics within a single setting, the researcher gathers a descriptive insight, thus gaining an understanding behind complex phenomena (Eisenhardt, 1989, p. 534). This is also the reason why the research does not refer to any theories, but rather structuring heuristics to aid with the research structure (Abualsamh, Carlin, & McDaniel, 1990, p. 160).

The paradigm this research adopts is pragmatism, which argues that “the most important determinant of the epistemology, ontology and axiology you adopt is the research question” (Saunders et al., 2009, p. 109). A pragmatic research, “focus[es] on practical applied research, integrating different perspectives to help interpret the data” (ibid, p. 119). This paradigm also accommodates a multiple method design, which is what this research intends. It first gathers findings through literature review and analysis then triangulates these findings with expert interviews. Triangulation investigates a certain phenomenon through the designed use of multiple methods in order to reinforce the validity of research results (Greene, Caracelli, & Graham, 1989, p. 256; Saunders et al., 2009, p. 146).

2.3.2 Data Collection

There are three principal methods for conducting exploratory research (Saunders et al., 2009, p. 140). Two of those three, namely literature review and analysis and expert interviews, were used for this research. This was also appropriate, as this research uses the multi-method qualitative data collection technique (Saunders et al., 2009, p. 152).

Literature Review

An inductive approach was adopted in reviewing the literature, in that it did not start with any predetermined theories or conceptual frameworks, but rather with questions (Saunders et al., 2009, p. 61). This was suitable for the exploratory nature of the research. Furthermore, the review procedure outlined by Luederitz et. al. (2016) was followed in executing the literature review.

The review of literature provided the foundation of the research as well as the questions developed for the expert interviews. Guided by the sub-questions posed by this thesis, the literature review attempted an integrative review of the existing literature on the themes of blockchain, social sustainability, and cocoa bean production. Integrative reviews "present the state of the science, contribute to theory development, and have direct applicability to practice and policy" (Whittemore, Aprn, & Knafl, 2005, p. 546). They are also suitable for new sustainability topics (Wehner, 2018, p. 9). Because the topic of blockchain in supply chain management and sustainability applications, and particularly in agri-food applications, is a rather nascent one within the agri-food sector, the review of literature was a synthesis of the aforementioned themes, and the outcome a summary to provide a comprehensive understanding of the topic at hand.

The review and, later, analysis of literature was performed through primary or grey (i.e. reports, theses, company reports) and secondary (i.e. journals, books, news articles, academic literature) literature and resources (Saunders et al., 2009, p. 69). A great part of the research was also based on documented use cases of blockchain in other fields. A search on the following databases, using relevant topic key words combined with link terms such as "sustainability and supply chain," "blockchain and sustainability," "blockchain and agri-food," "blockchain and supply chain," "blockchain and chocolate," "blockchain and cocoa," and "cocoa and sustainability," helped to identify the relevant academic literature: Web of Science, Google Scholar, and NEBIS. Other sources, such as company reports, were found on company

websites. To give indication to the scarcity of research on the topic for instance, a search for "blockchain and cocoa" generated 0 results on Web of Science while "blockchain and chocolate" generated 1. News articles were found online. The researcher attempted to use the most recent literary sources, which was ultimately inevitable given the nascence of the research topic.

Expert Interviews

Expert interviews were conducted in order to triangulate the research conducted through the literature review and analysis, with an aim of verifying and elaborating on those findings. The sample was determined through non-probability sampling. Specifically, a purposive sampling approach was utilized in selecting the interviewees that would help meet the objectives of the research (Saunders et al., 2009, p. 237). The author relied on judgmental criteria while critically identifying them as the most suitable individuals. Three relevant groups were thus identified for the interviews, each pertaining to the three main topics of the research question. These are: 1) sustainability and/or supply chain management professionals from chocolate processing or manufacturing, or cocoa trading companies, 2) industry experts on applied blockchain in supply chain (with knowledge of cocoa industry), and 3) experts on cocoa bean production and/or sustainability from NGOs or research organizations. These individuals were deemed experts on the topic based on their seniority which was purposefully observed. The chocolate companies were the main focus and audience of this research, therefore the applied blockchain experts and NGO and research organizations commented on blockchain and sustainability within the context of chocolate companies. CSR strategy development is a managerial exercise ultimately up to top management, employees, experts and consultants (Kiesnere & Baumgartner, 2019, p. 7), so it was crucial to obtain interviews from management-level individuals. A cross-sectional perspective fit the purpose of this research in addition to the inherent research time constraint, so only one single interview was conducted per interviewee. Therefore, the perspectives of the experts were captured under a cross-sectional horizon of time.

A list of the interviewees can be found in **Table 3** below. These persons were identified by the author as having the expert knowledge required for this research and were also responsive to the author's requests for interviews.

Table 3: List of expert interviewees (own illustration)

Background	Interviewee	Date of Interview
Sustainability and/or Supply Chain Management Professional from Chocolate Processing or Manufacturing, or Cocoa Trading Company	**Interviewee 1** (Manager Raw Materials & Sustainability, *Top 10 largest global chocolate manufacturing company*)	26.06.2019
	Interviewee 2 (Cocoa Sustainability Manager, *Top 10 largest global chocolate manufacturing company*)	28.06.2019
	Interviewee 3 (CEO Goodio Chocolate, *Helsinki Heaven*)	05.07.2019
	Interviewee 4 (Global Cocoa Sustainability Program Manager, *Top 10 largest global chocolate manufacturing company*)	09.07.2019
	Interviewee 5 (CEO and Founder, *SCHÖKI AG*)	23.07.2019
	Interviewee 6 (Manager Cocoa Supply & Partnerships, *Läderach AG*)	25.07.2019
	Interviewee 7 (Chief Sustainability Officer, *Cocoasource*)	09.07.2019
Industry Expert on Applied Blockchain in Supply Chain	**Interviewee 8** (Senior Consultant Blockchain, *IBM Food Trust*)	26.06.2019
	Interviewee 9 (Project Manager Blockchain, *Bühler Group*)	28.06.2019
	Interviewee 10 (Researcher Blockchain, *FiBL*)	12.07.2019
	Interviewee 11 (Blockchain Developer for Tony's Chocolonely, *Accenture*)	26.07.2019
	Interviewee 12 (Founder, *SeeHow*)	29.07.2019
Expert on Cocoa Bean Production and/or Sustainability from NGO or Research Organization	**Interviewee 13** (Head Sustainability Assessment, *FiBL*)	05.07.2019
	Interviewee 14 (Director Social Development, *World Cocoa Foundation*) **Interviewee 15** (Technologist and External Digital Advisor, *World Cocoa Foundation*)	12.07.2019

	Interviewee 16 (Chair on sustainable and traceable cocoa of CEN/ISO Committees, *Equipose*)	13.08.2019

It was important that the interviewees not be subject to unethical behavior on the researcher's part. Hence the identities of the interviewees were anonymized. Interviewees 1 and 4, from two of the world's largest chocolate manufacturing companies, preferred the company name to be anonymized altogether. A non-disclosure agreement (NDA) was signed on three occasions. The research also attempted to present the results of the interviews as objectively as possible and not impose bias against any individual or group. Access to the interviewees was obtained ethically (i.e. no coercion or bribery). Moreover, they were performed with informed consent. Some interviewees existed within the author's networks, while others were contacted through cold emails or social media (i.e. a professional network called LinkedIn) messages. Interviewees 14 and 15 were interviewed simultaneously because while 14 is an expert on cocoa production, 15 is an expert on digital technologies such as blockchain currently advocating a blockchain program for large chocolate companies.

Conducted either in person or over Skype, the interviews were semi-structured, each lasting between 40 minutes and one hour, and were recorded by a recording device and transcribed manually by the researcher. A semi- structured interviewing technique makes for a standard questioning format while allowing for flexibility for interviewer and interviewees to elaborate on certain responses or ideas. Moreover, semi-structured, in-depth interviews are suitable for an exploratory study (Saunders et al., 2009, p. 323). The interview questions were formulated based on the sub-questions and informed by the literature review. Different sets of open-ended questions pertaining to the background and expertise of the different groups of interviewees on the topic were developed. The interviewees were provided with the interview questions beforehand which included a glossary of terms so that they were aware of the frameworks and concepts to ensure their responses were relevant.

The questions are listed in **Table 4** below and numbered for reference in the explanation that will follow indicating the questions that contributed to answering the respective sub-questions. A marking in column 'C' indicates that the question was posed to companies as the researcher found appropriate, 'B' to applied blockchain experts, and 'N' to NGOs and research organizations.

Table 4: List of expert interview questions (own illustration)

	Interview Questions	**C**	**B**	**N**
1	What are the common social sustainability challenges the chocolate industry faces in cocoa bean production?	X		X
2	Which upstream supply chain or sustainability management systems or tools does the industry currently use to ensure sustainable practices in cocoa bean production regarding the social sustainability challenges you mentioned?	X		X
3	Describe blockchain. What are its main characteristics and what advantages does it offer for supply chains?		X	
4	What potential role do you think blockchain has in addressing social sustainability challenges encountered in cocoa bean production? If so, which ones and how? If not, why not?	X	X	X
5	What additional benefits can blockchain offer in ensuring socially sustainable practices in cocoa bean production compared to other upstream supply chain management systems or tools currently deployed by the industry?	X	X	X
6	Does your company find blockchain an interesting solution for ensuring socially sustainable practices in cocoa bean production and is blockchain something you are considering adopting? Why or why not?	X		
7	Which actors would be involved in the adoption of blockchain technology at the cocoa bean production stage if your company were to implement it, and how receptive do you think they would be of the technology?	X		
8	What would the value-drivers or incentives of adopting blockchain in cocoa bean production to address social sustainability be for a confectionary company?	X	X	X
9	What would some challenges or hurdles associated with implementing blockchain at the production stage of an upstream agri-food supply chain be?		X	X
10	And finally, do you see blockchain as being an ultimate solution for addressing social sustainability challenges in cocoa bean production?	X	X	X
11	Would you like to share any other thoughts?	X	X	X

The intention of questions 1 and 3 were to stimulate the discussion and set the context for the interview to follow. They also contributed towards answering the first sub-question, along with questions 4 and 5. The second sub-question was answered by questions 3 and 5, with some contributions from question 4. To answer the third sub-question, perspectives were borrowed from all questions, with the main contribution coming from questions 6, 7, 10 and 11. Question

11 was purposefully open to give interviewees an opportunity to express thoughts that might have occurred to them during the interview or was not addressed by any of the questions. Finally, the fourth sub-question was answered by question 8, and unexpectedly question 9 as well. Question 9 was meant to make the interview wholistic by addressing the challenges associated with blockchain's adoption. The responses to this question also informed **sub-Chapter 4.3** on potential hurdles companies should observe.

2.3.3 Data Analysis

Qualitative data analysis is based on the meanings expressed through words which require classification into categories, and is conducted through conceptualization (Saunders et al., 2009, p. 482). An inductive analysis of the data was performed on both the literature and the expert interviews.

Literature Analysis

In the integrative review method that this research assumes, analysis is performed by extracting data from sources and drawing categories that include aspects of the research in question (Whittemore et al., 2005, p. 549). With the goal of developing a unified and integrated conclusion to the research question, blockchain's potential role in addressing social sustainability challenges in cocoa production is drawn from the interrelations between the topics of blockchain, social sustainability and cocoa bean production. The method entails reducing data, displaying data, comparing data, drawing conclusions, then verifying, and its suitable for a multi-methods research approach (Miles & Huberman, 1994). The data of this research has thus been ordered, coded, categorized and summarized. The codes obtained in the literature review informed the codes that would be developed for the expert interviews.

Expert Interviews

The transcribed expert interviews were analyzed through first cycle and second cycle qualitative coding in order to develop codes. According to Saldaña (2009), "a code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data" (ibid, p. 3)

The methods for the first cycle included: attribute coding, which logs essential information about the data and demographics of the participants for future management and reference (i.e.

taking into consideration the backgrounds of the interviewees which might inform the researchers about their responses to the questions); descriptive coding, which summarizes the basic topic of an excerpt of qualitative data (i.e. extracting the key messages of the interview); and in vivo coding, which draws from the participants own language for codes (i.e. trying to decipher codes which are specific to cocoa production, sustainability, and blockchain) (Saldaña, 2009, pp. 55–77). The second cycle made use of: pattern coding, where explanatory or inferential codes are used to identify an emergent theme, configuration, or explanation; and focused coding, which identifies the most prevalent or frequently occurring initial codes (Saldaña, 2009, pp. 152–158). No tools were used for this analysis. The researcher developed common codes from the literature and utilized them in analyzing the interviews to create links between data points and ensure comparability of results across interviews. The codes formed the basis of the themes and ideas expressed in the outcome of the research.

2.3.4 Research Collaboration

The researcher was also engaged in a research collaboration with a fellow MSc International Business student from the Zürcher Hochschule für Angewandte Wissenschaften (ZHAW) School of Management and Law, as well as a BSc Environmental Science student from the Eidgenössische Technische Hochschule (ETH) Zürich, who were also pursuing their research on blockchain in the cocoa-chocolate supply chain. Initiated by their supervisors Drs Fridolin Brand, Jörg Schmidt, and Grégoire Meylan, respectively, the collaboration entailed meeting to share and exchange information, ideas, as well as resources. The researchers conducted several shared interviews with industry experts over Skype, having developed a common list of interview questions from which they could all benefit and obtain the data they needed. This collaboration was fruitful and provided substantial support for the research that follows.

2.4 Case Description

The focus of this research is on the upstream supply chain of chocolate manufacturing, namely, that which has to do with cocoa bean production. While certification entities provide the standards, and NGOs monitor and audit their fulfilment, chocolate manufacturing companies would be blockchain's primary funders and implementers. The 'iron law of responsibility' assigns corporations the responsibility of engaging in global sustainability challenges given their capability to do so due to their amount of resources and global reach (Davis, 1973, p.

314). For instance, in October 2008, Walmart – today, the world's largest company – gave more than 1,000 of its Chinese suppliers a directive to reduce waste and emissions and increase energy efficiency of products they supplies to Walmart by 25% (Nidumolu et al., 2009, p. 5). According to the ISO 34101 standards for sustainable cocoa, an organization must "identify any vulnerabilities that may threaten its capacity to assist registered farmers to improve their livelihoods […]" (International Organization for Standardization, 2019a, p. 11). Moreover, as of 2019, the first buyer of the cocoa should cover the costs of the investments so that the farmer organization meets the requirements (ibid.). This notion ultimately leads to chocolate manufacturing companies being the ones to make the investments required to implement blockchain technology. Chocolate manufacturing companies therefore play a major role in the potential adoption of blockchain technology in the upstream cocoa supply chain. They are the ones to capture majority of the value created and would carry the greatest burden if there would be a threat (Schrage & Ewing, 2005, p. 110). The world's largest chocolate manufacturers are listed in **Table 5** below.

Table 5: Largest chocolate manufacturing companies 2018 (Source: International Cocoa Organization, 2019)

Company	**Net Sales 2018 (US$ millions)**
Mars Wrigley Confectionary (USA)	18,000
Ferrero Group (Italy)	12,390
Mondelēz International (USA)	11,792
Meiji Co Ltd (Japan)	9,662
Hershey Co (USA)	7,779
Nestlé SA (Switzerland)	6,135
Chocoladenfabriken Lindt & Sprüngli AG (Switzerland)	4,374
Ezaki Glico Co Ltd (Japan)	3,327
Pladis (UK)	2,816
Kellogg Co (USA)	1,890

There has also been a recent proliferation of smaller companies with strong commitments to sustainability. They cater more to consumers, who according to studies, are increasingly demanding more transparency. It should be disclaimed that the author does not prescribe any responsibility to companies towards addressing sustainability challenges in cocoa bean

production, but rather derives this responsibility from the general business environment and pressures, as well as the companies' communication materials themselves. The sole aim of the research is to investigate how companies can use blockchain technology in their pursuit of achieving social sustainability in cocoa bean production.

3 RESULTS

According to Saberi et. al. (2019), "inefficient transactions, fraud, pilferage, and poorly performing supply chains, lead to greater trust shortage, and therefore, a need for better information sharing, and verifiability" (ibid, p. 1) To resolve the mistrust that exists between farmers and their intermediaries in the cocoa supply chain (The International Cocoa Organization, 2009, p. 10), blockchain is increasingly becoming regarded as a potential solution. Tackling this trust alone can unlock sustainability potential in the cocoa supply chain. The following chapter will provide the results from the literature review as well as the expert interviews regarding the potential role of blockchain in addressing social sustainability challenges, how blockchain compares to existing systems, what the current considerations are for harnessing its potential, and what the value-drivers for chocolate manufacturing companies are.

3.1 Literature Review

3.1.1 How Blockchain Can Address Challenges

As previously mentioned, the social sustainability challenges that emerged from literature were low income, child labor, forced labor, poor workplace safety, poor education and training and gender inequality. These challenges pertain to the SAFA social well-being themes of fair trading practices (i.e. low income), labor rights (i.e. child labor and forced labor), human safety & health (i.e. poor workplace safety), decent livelihood (i.e. poor education and training), and equity (i.e. gender inequality). This will be used to indicate which social sustainability challenged blockchain can address. Accordingly, section addresses the sub-question: What social sustainability challenges in cocoa bean production might blockchain address and how?

Firstly, the World Economic Forum (2018) reports that the potential of blockchain is in "its architectural ability to shift, and potentially upend, traditional economic systems – potentially transferring value from shareholders to stakeholders as distributed solutions increasingly take hold" (ibid, p. 4) The technology's mere existence has also inspired new attitudes towards supply chain visibility and transparency that the industry can exploit to drive awareness and direct better focus towards action. Therefore, blockchain plays a role in fostering transformational change in various industries, including that of cocoa-chocolate.

Secondly, from available literature and documented use-cases on the impact of blockchain on sustainability in other contexts, it was evident that blockchain's potential role in addressing sustainability challenges is mostly indirect. Subsequently, it also works in combination with other efforts to address sustainability, so it can be said that blockchain's role in addressing social sustainability challenges in cocoa bean production is complementary. This will be elaborated further in **sub-Chapter 3.1.2**.

Lastly, blockchain is described as a facilitator or enabler of supply chain transparency and traceability (Provenance, 2016) which seem to be fundamental requirements for sustainable cocoa (Saberi et al., 2019, p. 1; Wettstein, 2015, p. 47). Additionally, blockchain seems to be able to enable trust across the supply chain, as is the promise of the technology. However, blockchain "cannot solve the issue of trust alone, [but] it can help create trust in agri-food supply chains" (da Costa Guimarães, van Andel, Gocsik, & Brouwers, 2019, p. 22). So again, its role is indirect and complementary. Finally, blockchain is especially equipped to facilitate financial transactions. These 4Ts enabled by blockchain will be explained further below.

Traceability

Traceability is considered the precondition for improving sustainability in the supply chain. There are three levels of traceability in the cocoa upstream supply chain, namely – in descending order of traceability – identity preserved, segregated and mass balance which are all sustainability 'conforming,' and ultimately 'nonconforming' cocoa. The ISO 34101-3 standards for sustainable and traceable cocoa describe them in more detail (International Organization for Standardization, 2019b, pp. 8–11). The highest level of traceability is identity preserved, where one should be able to follow cocoa throughout the supply chain till the point of knowing exactly which farm the beans in a particular chocolate bar come from. In this case, if cocoa is processed with a manufacturer that processes other cocoa, all other cocoa should be out of the system to maintain this high level of traceability. The middle level is full segregation, where sustainable cocoa is separated from unsustainable cocoa. If all cocoa sourced is sustainable, it is possible to mix cocoa regardless of its origin. Thus, in a chocolate bar stemming from a fully segregated supply chain, it is not possible to name the exact origin of the cocoa. The lowest level of traceability is mass balance, which is referred to as administrative traceability. For the volume of sustainable cocoa that a company declares, it has supported sustainably produced cocoa at some point, somewhere in the world, but it would not necessarily the same cocoa that would end up in a particular chocolate bar.

Traceability determines the cocoa's origin, movement in the supply chain, and its history. In mass balance supply chain, which is the most common among chocolate manufacturing companies, conforming and nonconforming cocoa is mixed from the first buyer of cocoa. Besides this, local traders are known to manipulate deliveries by mixing beans of different origins (smuggled from neighboring countries for example), so a company cannot be sure that the beans going into its manufacturing line are sustainable (Wettstein, 2015, p. 48). Furthermore, there is no consistency in local trade, nor documentation and record keeping (ibid, p. 48). A common internal control and reporting system that is centrally documented is required to monitor the mass balance cocoa (International Organization for Standardization, 2019b, p. 11). Blockchain can be applied in this case to provide data on the origins of the cocoa to improve companies' efforts towards more sustainable production, by enhancing their administration and control activities at identified nonconforming sites. The technology gives better assurance of fair and safe work practices, as well as human rights (Saberi et al., 2019, pp. 6–7). In this vein, blockchain fulfils the role of a traceability system, which is by definition "a technical tool [or system] to assist an organization operating within a cocoa supply chain to achieve defined sustainable cocoa objectives" (International Organization for Standardization, 2019b, p. vi). Tracking potential social conditions that might cause concern is an important application of blockchain (Adams, Kewell, & Parry, 2017, p. 129)

Currently, traceability in agri-food chains addresses at least one step forward and one step backward for each supply chain actor (International Organization for Standardization, 2019b, p. 5; Yiannas, 2018, p. 47). Reliance on this pragmatic arrangement still leaves the supply chain vulnerable, and makes it difficult to verify the provenance of specific products (Pearson et al., 2019, p. 146). Therefore, companies can be far removed from the realities of cocoa production. Blockchain's ability to link and connect actors can give relevant actors better visibility of the supply chain, and because the technology is consensus-based and information put onto it has to be validated by other actors in the chain, blockchain can aid significantly with verification. Furthermore, the unique immutability of blockchain has been considered to be the panacea for food traceability (Pearson et al., 2019, p. 147).

By enhancing traceability in the cocoa upstream supply chain, the origin of cocoa can be determined and, as a result, the conditions with which it was produced can be known. Thus, blockchain can indirectly help address essentially all social sustainability challenges within the SAFA social well-being themes of fair trading practices, labor rights, human safety & health, decent livelihood, and equity.

Transparency

Companies are facing increasing reputational, regulatory, investor and consumer pressure to address risks such as human rights violations, modern slavery, and gender-based violence in the supply chain (World Economic Forum, 2018, p. 14). Because it offers better visibility, blockchain can help companies showcase their commitments and achievements better. It can make sustainability indicators more meaningful and quantifiable. By doing so, "blockchain has the potential to end unethical and illegal practices" (Kshetri, 2018, p. 87) and expose any unethical trading or activities, as well as improve monitoring, verification and reporting (World Economic Forum, 2018, p. 14). Blockchain helps capture whether something was sustainably produced because it can provide visibility right from the farm (Yiannas, 2018, p. 48). For instance, the chocolate manufacturing companies can ensure that labor in cocoa production is voluntary, because it can be reported from the farmers themselves.

However, it must be noted that while transparency and accountability are essential towards implementing sustainability and safeguarding human rights, they are not end goals themselves (Fountain & Huetz-Adams, 2018, p. 56). They help better manage and accelerate progress, identify gaps in current approaches, prevent transgressions from happening, facilitate the mitigation of transgression effects on farmers, and enhance available stakeholder synergies (ibid, p. 56). By increasing the transparency in supply chains, blockchain can ultimately raise awareness about the living and working conditions of agricultural workers (da Costa Guimarães et al., 2019, p. 24), helping farmers find grievance mechanisms for potential violations. The high level of supply chain visibility blockchain introduces makes the information readily available for developing sustainable supply chain strategies that offer social benefits to deprived communities (Kamble et al., 2019, p. 188).

Therefore, by enabling an unprecedented level of transparency in the upstream supply chain, blockchain indirectly addresses social sustainability. Based on the mentioned impacts transparency can have, it can be concluded that blockchain transparency can increase visibility on unfair trade practices, child and forced labor, poor working conditions, and gender biases, therefore helping to address the SAFA sustainability themes of fair trading practices, labor rights, human safety & health, and equity, towards ensuring social sustainability.

Trust

Blockchain makes information stable and immutable, and this is considered one way of building a socially sustainable supply chain (Saberi et al., 2019, p. 6). For instance, with the

certification products claim to have, blockchain provides the opportunity for those claims to be verified directly from the source (da Costa Guimarães et al., 2019, p. 17; Kshetri, 2018, p. 83). Through a blockchain-run application, the farmers could directly verify the conditions under which the cocoa was produced. In the downstream, this could justify companies charging premium prices of products that have been produced sustainably, the value of which could be trickled down to the farmers as income to alleviate them from their financial situation (Galen et al., 2018, p. 15).

According to the World Trade Organization (WTO), micro, small and medium-sized enterprises as well as farmers from low and middle income countries struggle to obtain trade financing due to poor credit histories or lack of sufficient collateral (da Costa Guimarães et al., 2019, p. 18). Additionally, funding organizations do not possess their own 'record of reality,' but instead rely on information provided to them by interested parties (GSMA Digital Identity, 2017, p. 23). With its immutable and complete record of historical data, blockchain can provide credible evidence of activities within a supply chain. In some use cases within environmental sustainability, blockchain-enabled finance platforms have the potential to revolutionize access to capital by unlocking investor potential and crowdfunding for projects that address environmental challenges (World Economic Forum, 2018, p. 17). Blockchain provides independent and accurate information to support investor decisions (ibid, p. 20). The same opportunity avails itself for cocoa farmers as well as sustainable chocolate manufacturers. Südwind conceptualized a cocoa sustainability fund to provide necessary support for cocoa farmers who "wish to work profitably and sustainably in line with good agricultural practices" (Huetz-Adams, 2016, p. 5). This funding body too could use blockchain to directly support farmers with financial support.

By enabling more trust within the supply chain, blockchain can indirectly help address the social sustainability challenges within the SAFA social well-being theme fair trading practices.

Transactions

"Identity is central to everything" (Thomason et al., 2018, p. 138) and is a fundamental right as well as a prerequisite for financial inclusion. In cocoa producing communities especially in West Africa, people lack identification documents (Whoriskey & Siegel, 2019). One use case of blockchain is that of using a digital approach to giving farmers an identity to help them "authenticate and take ownership of a wide range of personal data, such as their income, transactional histories, credit worthiness, rights to/ownership of land, geolocation, farm size,

and other vital credentials" (GSMA Digital Identity, 2017, p. 17). A blockchain solution called BanQu that does exactly this is being run in Asia. According to the initiative, "a centralized approach to managing user identities would be too cumbersome, too insecure, and too heavy [but] a permissioned, distributed ledger on the other hand is powerful, light and easy to configure" (ibid, p. 18). Blockchain creates the opportunity to generate a permanent, immutable identity record where identity does not exist. A portable, digital economic identity would allow farmers to connect with their peers, aid organizations, banks, and payment companies, helping alleviate them from poverty. Furthermore, women, who are normally underrepresented in cocoa producing societies and have no financial sovereignty, can benefit from a digital identity on blockchain. By having a digital identity, companies can also ensure that their impacts are reaching women and measure the extent of their reach.

Indeed, one of blockchain's key functions is the movement of value. The technology is most often used to facilitate payments (Galen et al., 2018, p. 4). It can automate transactions against currency fluctuations through the use of smart contracts, reducing human error (da Costa Guimarães et al., 2019, p. 20). In cocoa producing countries which do not have a free trading market for cocoa, the commodity is pre-purchased by intermediaries from farmers at a fixed price for the season (based on the international market price for cocoa), at a price as low as possible for the organizations to cover costs and yield a profit (International Trade Centre, 2001, p. 26). In liberalized markets, there is a lack of market knowledge which generates problems for farmers (Huetz-Adams, 2016, p. 5), and makes it easier for them to be ripped off. It has been found that blockchain can reduce fraud and corruption in trading (Saberi et al., 2019, p. 6; World Economic Forum, 2018, p. 12).

Advancing large sums of money to an institution can pose a financial risk, especially in markets that are fragile and most likely to commit fraud (GSMA Digital Identity, 2017, p. 23). Leveraging mobile money services, blockchain can help facilitate financial transactions to farmers directly (depending on the trade structure in a particular country) without intermediaries because it makes verified transactions among trading parties possible. Smart contracts minimize the need for trusted intermediaries between parties, by triggering transactions once certain criteria are met. They reduce the occurrence of malicious activities (Zhao et al., 2019, p. 88) and enable international payments (Wognum, Bremmers, Trienekens, Van der Vorst, & Bloemhof-Ruwaard, 2011, p. 400), allowing companies to even send money directly to farmers without the large transactions fees. One such application is in climate finance, where blockchain enables the secure and timely flow of donor and government funds,

where conventional transfers usually take weeks to arrive and get lost 5-10% of the time (Thomason et al., 2018, p. 140). With blockchain, cocoa farmers can receive financial transactions quicker and ensure that they receive a fairer share of the payments they are entitled to. Companies usually pay premiums above the international market price for certified cocoa (Huetz-Adams, 2016, p. 10). Even a slight income increase through premiums can make a difference for farmers.

In summary, blockchain can indirectly addresses the social sustainability challenges of the SAFA social well-being themes of fair trading practices and even equality, by improving financial transactability and transparency, and ensuring that cocoa farmers receive a fairer share of the cocoa value.

3.1.2 Blockchain's Position Amidst Current Sustainability Management Tools

The globalization of supply chains makes managing and controlling them difficult (Saberi et al., 2019, p. 1). A limitation of existing sustainability management tools in general is their widespread applicability given the varying contexts, sectors, and types of companies in which they are applied (Witjes et al., 2015). Moreover, different tools are often required to address environmental, social and economic issues because a one-size-fits all solution does not exist (Azapagic, 2015). According to Kuhndt's (2004) classification of sustainability management tools discussed in described in **Chapter 2.2.1**, the tool under question here is the supply chain management action tool. To support the supply chain management tool, supply chains currently rely on centralized and sometimes stand-alone information management systems within organizations, such as enterprise resource planning (ERP) systems (Saberi et al., 2019, p. 1), which are farm management software that permit the industry to "coordinate the whole set of enterprise activities […] such as production, supply, marketing, human resource management, etc. […] with an integrated information system" (Vincent Abt, Emeline Perrier, & Frédéric Vigier, 2006, p. 469). ERP solutions are promoted by IT providers such as SAP, PeopleSoft, Oracle or Microsoft (ibid, p. 469). At the moment, environmental ERPs to support environmental sustainability strategies exist, but not social ones. Other support systems utilized by the cocoa industry include Sedex, a platform for sharing responsible sourcing data on supply chains, and Ecovadis, which helps companies monitor CSR in sustainable procurement for global supply chains. To address social issues, like child labor, the cocoa industry currently uses a community-based instrument to identify and remediate child labor called the Child Labor

Monitoring and Remediation System (CLMRS). A local liaison visits families to spot child labor, which is then flagged in a central database (Fountain & Huetz-Adams, 2018, p. 16).

Within this context, blockchain constitutes itself as a system for action for supply chain management and a platform that helps companies integrate and realize sustainability in terms of transparency, trust, and transactions in their supply chains, to facilitate social sustainability within cocoa bean production. Ideally, blockchain should be linked to standard ERP systems (Pearson et al., 2019, p. 149). These conventional systems are often fragmented, an issue which the likes of Sedex try to solve. According to Yiannas (2018), "[t]here is no widely adopted industry standard for how each segment of the food system (farmer, processors, distributor, retailer, etc.) tracks and records data for food traceability purposes" (ibid, p. 56). Blockchain can break up data silos that characterize the current ERP systems by creating a more distributed network. While such centralized systems are prone to single point failure which leave the whole system vulnerable to malicious attacks, blockchain offers high security and its distributed. Moreover, companies will normally like to streamline their activities and use as few processes and tools as possible. Blockchain offers that flexibility to be applied for environmental, social and economic sustainability.

A common way for chocolate manufacturing companies to support sustainability in their supply chains is through the adoption of three major industry certification standards, which are Fairtrade, Rain Forest Alliance, and UTZ. Fairtrade sets a minimum price and fixed premium for cocoa and its farmers, while Rainforest Alliance and UTZ address deforestation, climate change, systemic poverty and social inequality. Usually, it is the farms themselves which are certified. Blockchain can help auditors validate that, by obtaining verification directly from the farmers about the companies' claims with its consensus feature.

However, Fountain and Huetz-Adams (2018, p. 37) believe that the term 'certified cocoa' is mistakenly used interchangeably with 'sustainable cocoa' especially in sustainability commitments. They believe that although certification is important for improving companies' supply chains, becoming sustainable requires a lot more, as exhibited by See **Figure 7** below. Lozano (2012, p. 14) finds that relying on one initiative to address sustainability result in a limited and narrows contribution. That's why in addition to certification, most companies have rolled out their own sustainability programs and commitments to tackle critical topics (Boles, 2017, p. 12), in which they incorporate aspects of the certifications standards or even those set by CEN/ISO. An example of one of these programs is Cocoa Life by Mondēlez. Through cocoa

life, Mondēlez aims to verify the flow of cocoa produced through its sustainability program, as well as the benefits cocoa farmers receive (e.g. premium payments and clear trade terms) (Mondēlez International, n.d.-b). Meanwhile, progress regarding these points is measured on the ground. The company outsources these services to two independent their parties. Another example is Mars' Cococa for Generations, in which it has invested more than USD 1 billion in an aim to make its cocoa supply chain sustainable (Mars Incorporated, n.d.). The first pillar of the program, Responsible Cocoa Today, aims to protect children and improve farmer income. Lindt & Sprüngli also has a commitment to ensure that its chocolate is sustainable sources, produced, and consumed (Chocoladefabriken Lindt & Sprüngli AG, n.d.-b). Through the Lindt & Sprüngli Farming Program, consisting of traceability and farmer organization, training and knowledge transfer, farmer investments and community development, and verification and continuous progress, the company sources its beans from bean to bar, allowing it to foster sustainable behavior along the supply chain (Chocoladefabriken Lindt & Sprüngli AG, n.d.-a).

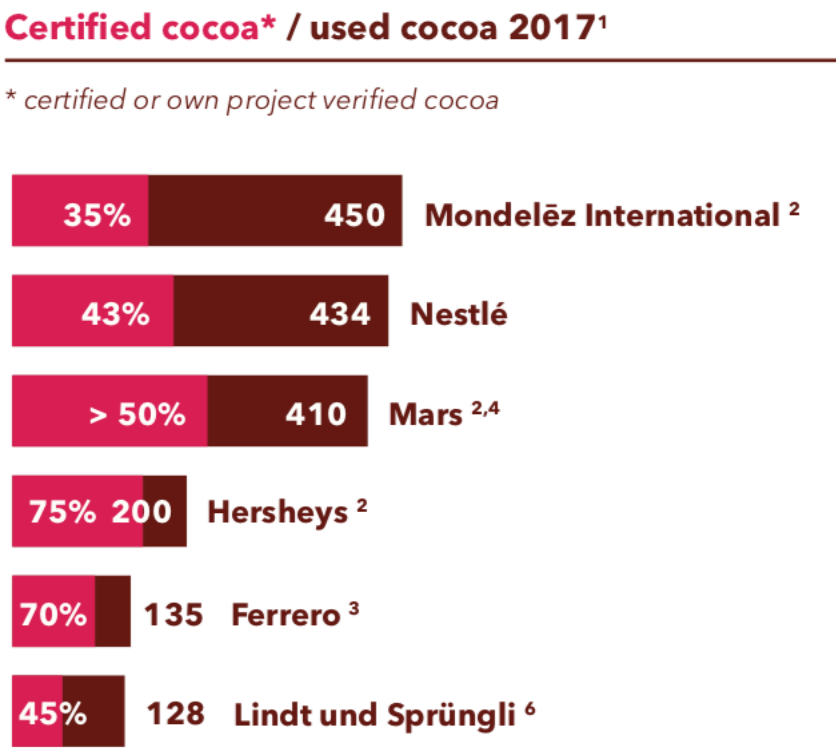

Figure 7: Certified cocoa vs used cocoa 2017 for chocolate manufacturers (Source: Fountain & Huetz-Adamns, 2018, p. 41)

Although companies have taken ownership of cocoa sustainability rather than outsourcing to standard bodies, "there are also concerns […] specifically about transparency and reliability of reporting, making farmers – who are already struggling with a severe power asymmetry in

relationship to their purchasers – even more dependent on the large cocoa companies" (Fountain & Huetz-Adams, 2018, p. 39) Blockchain can potentially aggregate all of the systems addressing individual issues onto one platform that can be traced throughout different actors in the upstream supply chain. It provides a single, tamper-resistant ledger on which actors with appropriate permissions can view and exchange information, reducing frictions and vulnerabilities that exist in the supply chain's network (Pisa, 2018).

Finally, to make sure blockchain delivers on its promised trust, additional technologies such sensors and other smart applications may be required (da Costa Guimarães et al., 2019, p. 27). Provenance, a blockchain solution provider, uses blockchain technology along with smart tags to track physical products (Provenance, 2016). Another example of a complementary technology is one that helps ensure the reliability of data put into the blockchain for auditors. GPS satellite images are used in the case of environmental sustainability for instance to link the production of cocoa beans with a certain farm, confirming that the cocoa is not produced in a critical area (i.e. deforestation). Similarly, for social sustainability, different technologies can reinforce the value of blockchain in bringing to like social issues.

3.1.3 Current Considerations for Blockchain Adoption

Apparently, an estimated 45% of agri-food practitioners have been experimenting with blockchain technology with 11% preparing to deploy it in their businessesu. 66% of 193 organizations, initiatives, and projects implementing blockchain consider the technology to be an improvement for solving their issues, over other methods (Galen et al., 2018, p. 3). Walmart is one of those companies that is substituting its current traceability systems with blockchain for a few of its supply chains (e.g. mangoes and pork). Yiannas (2018, p. 48), who is Walmart's Vice President of Food Safety, went from being a blockchain skeptic to a blockchain believer after the food chain successfully piloted the technology. He praises blockchain's unique features such as immutability and consensus to enhance food traceability and therefore, sustainability.

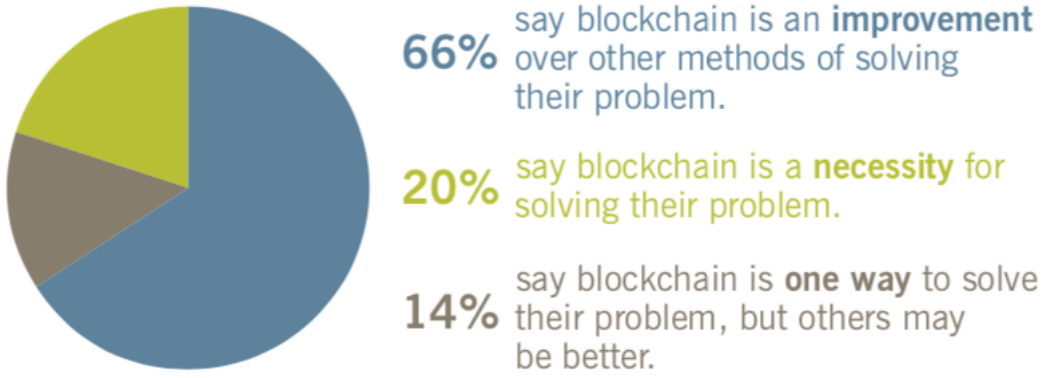

Figure 8: Perspectives from 193 organizations, initiatives, and projects on whether blockchain enables solutions not previously possible (Source: Galen et. al., 2018, p. 3)

Tony's Chocolonely, a Netherlands based chocolate company whose mission is to make 100% slave free chocolate, ran a six-week blockchain pilot in February 2018 in collaboration with consulting company Accenture. Theirs is the most frequently referenced implementation of blockchain in the cocoa-chocolate supply chain. The company successfully tested blockchain for traceability, but was of course met with the challenge of putting data into the blockchain accurately (Tony's Chocolonely, 2018, p. 28). Despite running a successful pilot, Tony's Chocolonely decided to stick with its own Beantracker application, which was not developed to be compatible with blockchain, and also keep an eye open for blockchain's development. Experimentation of blockchain from other chocolate manufacturers, if occurring at all, has not been publicized. However, Nestlé, one of the world's largest chocolate manufacturers, is experimenting with blockchain for other products (Morrison, 2019).

Tony's Chocolonely's dilemma – blockchain's compatibility with existing systems invested in and deployed – is one faced by many companies who express interest in the technology. Despite much interest in the technology, companies experience uncertainty when passing from discussion and consideration to actually implementing the technology (Cavaliere, 2018). While considering, companies seem to forget that the rewards reaped from sustainability are long-term (Harrington, 2016, p. 17). It is especially larger companies that appear to be doing small-scale sample or pilot projects with blockchain, whereas smaller companies are more proactive and engaging in proper implementations. Everyone seems to be waiting for the technology to develop further. However, it is not only the technology that makes them hesitant, but also factors pertaining to the cocoa supply chain that make it intrinsically complex for a technology to fix.

3.1.4 Value-drivers of Adopting Blockchain

Literature on value created by blockchain services is limited (Cavaliere, 2018, p. 7). Therefore, Eckelmann's (2006) proposed value-drivers for CSR framework (See **sub-Chapter 2.2.3.3**), was used to arrange value-drivers associated with the adoption of blockchain drawn in from literature to construct the top five most prominent value-drivers. These were:

Legal compliance

According to Nidumolu et. al. (2009), compliance is usually the first motivation for companies towards sustainability. If products fulfil a certain set of requirements, for instance social standards of production, they are given certification. For companies, determining provenance of their products and ensuring they meet a multitude of laws and standards to obtain these certifications can be costly (Nikolakis, John, & Krishnan, 2018, p. 2). For regulators, the paper-based documentation used in global value chains and diverse information sources makes verification challenging (ibid, p. 2). And finally, customers and retailers have reliable information about which products are in fact produced sustainably and can take legal action towards the accountable party in case of any misrepresentations (ibid, p. 2). Blockchain provides tamper-proof data which allows for verifiability of information to aid with legal compliance.

Value proposition to customers

A study by Kiesnere & Baumgartner (2019, p. 20) found that the second biggest factor promoting sustainability implementation for SMEs in Austria was customer demand. Confirming this are other studies showing that consumer confidence has been broken after food risk incidents (Wognum et al., 2011, p. 65; Zhao et al., 2019, p. 83). By fostering more transparency in the agri-food industry, customers' confidence towards agri-food products would be re-established (Faye, 2017, p. 40; Kamble et al., 2019, p. 189). Customers ask for transparency within supply chains (Saberi et al., 2019, p. 6). Fulfilling this can result in an increase in customers' trust, which can benefit the firm financially. Blockchain could allow better visibility into the cocoa supply chain, to which consumers can have access to confirm the standards with which the cocoa was produced.

Operational efficiency

To achieve transparency in a supply chain, data "must be relevant, accurate, factual, reliable, timely, and available in an appropriate quantity" (Wognum et al., 2011, p. 65). According to

ISO (2019b, p. 6), a traceability system requires for the documented information to be distributable, accessible, retrievable and usable, as well as to be well-preserved. Furthermore, documented information should be retained for at least five years (ibid, p. 6). With blockchain's immutability, it can be guaranteed that information cannot be tampered with, and that it will stay forever. Moreover, because the relevant actors will be active nodes on the network, they receive information simultaneously in real time and has access to its entire history (Cavaliere, 2018, p. 18). Thus, blockchain helps ease shareability of information across different actors. Increased efficiency is seen as one of the top two primary benefits of blockchain (Galen et al., 2018, p. 4).

Furthermore, the food industry still relies heavily on paper records which limits the capturing of data in a computerized and searchable format (Pearson et al., 2019, p. 146; Yiannas, 2018, p. 46). Blockchain can help with logging the product characteristics of the cocoa as well as connect the various actors on one single platform, easing the transferability of data and information and reducing costs of data transfer.

Supplier management

Issues like unpredictable delivery times, supply chain disruptions, and social and environmental issues have given importance to supply chain management in recent years (Brammer, Hoejmose, & Millington, 2011, p. 4). Moreover, sustainability has been a key motivation behind companies engaging with multi-tier supply changes to reduce supply chain liabilities (Tachizawa & Wong, 2014, p. 643). According to Wettstein (2015, p. 6), sub-suppliers located upstream generate the most serious sustainability issues. Thus, if blockchain is a way to improve transparency and traceability, it can assist a company manage its suppliers.

Furthermore, coordination of supply chain actors is lacking in the cocoa supply chain (Huetz-Adams, 2016, p. 16), an issue which blockchain could potentially fix. Moreover, traceability in the supply chain is currently limited to one step forward and one step backward from an entity's position in the supply chain (International Organization for Standardization, 2019b, p. 5; Yiannas, 2018, p. 47). Blockchain can cause disintermediation in the supply chain, thus realizing transaction costs and time reductions, and reducing business waste (Saberi et al., 2019, p. 6). With the augmented traceability companies can achieve through blockchain, they will necessarily need to have an overview of a greater number of their upstream suppliers. Blockchain will connect more actors than current systems.

Company reputation

Companies are struggling to find reliable data when they implement their sustainability programs (Fountain & Huetz-Adams, 2018, p. 57). According to Huetz-Adams (2016), "[t]here is no reliable data available on how many farmers have been reached by [company sustainability projects] so far" (ibid, p. 16). Blockchain can assist companies to gather data across the supply chain to improve their reporting efforts, thereby aiding their reputations. The transparency achieved by blockchain and augmentation of social sustainability efforts can also contribute towards a better company reputation. Fountain and Huetz-Adams (2018, p. 58) request that data be made comparable through, for instance, coordination of reporting periods and collaboration on indicators. As a system that can link various actors in the supply chain, blockchain can inspire this standardization. However, these standards would need to be established beforehand.

Others

License to operate was another value-driver that occurred and is worth mentioning. Research has identified that environmental and social performance are considered as prerequisites to allow suppliers to provide materials (Seuring & Müller, 2008, p. 1704). Chocolate manufacturing companies as the focal company can gain confidence from their customers, the public, and governments of the cocoa producing countries from which they source. Moreover, having better proof of their supply chain activities helps them gain trust.

Taking from a number of empirical studies, Hansen et. al. (2009, pp. 684–685) distinguish six market potentials for sustainability innovation, namely: 1) cost reduction through increased efficiency, 2) risk reduction, 3) planning reliability, 4) legitimacy assurance, 5) new customer segments attraction, and 6) new product and business segment development. These are more or less in line with those that have just been mentioned above.

3.2 Expert Interviews

The findings from the expert interviews reiterate and elaborate on the findings of the literature review.

3.2.1 How Blockchain Can Address Challenges

What was analyzed from the interviews were the social sustainability challenges that recurred from interviewees as motifs. It became evident that these were the industry priorities in terms of which are the most prominent challenges, and which are the most urgent to address. Similar to the literature review, the social sustainability challenges mentioned by interviewees were low income, child labor, forced labor, poor workplace safety, poor education and training and gender inequality. Again, these challenges pertain to the SAFA social well-being themes of fair trading practices (i.e. low income), labor rights (i.e. child labor and forced labor), human safety & health (i.e. poor workplace safety), decent livelihood (i.e. poor education and training), and equity (i.e. gender inequality). Different to the literature review was food sovereignty, which emerged twice in the expert interviews but was not included. This section addresses the sub-question: What social sustainability challenges in cocoa bean production might blockchain address and how? When asked whether blockchain had potential at all in addressing social sustainability challenges, four interviewees expressed that they were not sure about technology's potential, while the other 12 seemed to believe in it. During the interviews, the interviewees elaborated on their views.

Firstly, the codes that emerged from the interviews showed blockchain technology being described as having an "indirect" role in addressing social sustainability in cocoa production in general. Interviewee 4 initially failed to see the link between blockchain and social sustainability in cocoa production and saw traceability and transparency as the intermediary step. In the end his conclusion was the same as all other interviewees, that blockchain plays an indirect role in addressing the social sustainability challenges. As Interviewee 10 put it: "Blockchain does not target social sustainability directly" (Interviewee 10, Personal Communication, July 10, 2019). Exactly how it addresses social sustainability then will be elaborated on further.

Secondly, blockchain seems to have a "complementary" role. Most interviewees see it as enhancing the existing systems and tools for addressing [social] sustainability in cocoa production. Interviewee 3 stated: "Companies do a lot for sustainability, and blockchain can

support those efforts" (Interviewee 3, Personal Communication, July 5, 2019). He went on to say that blockchain could not begin to address social sustainability challenges on its own, but that: "[It] has to be combined with other technologies" (Interviewee 3, Personal Communication, July 5, 2019). More details on blockchain's complementary role can be found in **sub-Chapter 3.2.2**.

Lastly, interviewees said and implied that blockchain is an "enabler" and in addressing social sustainability challenges in cocoa bean production. Interviewee 2 believes that technology is generally viewed as an enabler, but says: "I usually tend to worry when some technology comes around and says it can fix everything" (Interviewee 2, Personal Communication, June 28, 2019). In that regard, Interviewee 4's perspective is taken into consideration, which is that besides being a data system, blockchain has some "fringe benefits" (Interviewee 4, Personal Communication, July 9, 2019). It may not fix everything or directly target the problem, but blockchain technology can enable transparency, traceability, trust, and make financial transactions more secure. These 4Ts can be considered the fringe benefits of blockchain:

Traceability

Blockchain could enable more precision in the traceability of cocoa bean origins. Interviewee 16 describes the three levels of traceability that were also described in **sub-Chapter 3.1.1**. He adds that most cocoa today is sourced through mass balance (Interviewee 16, Personal Communication, August 13, 2019). With this explanation, it is thus clear that traceability is essential for ensuring that cocoa is sustainably produced. Interviewee 5 says: "Traceability is the key […] to achieving sustainability" (Interviewee 5, Personal Communication, July 23, 2019). Interviewee 1 believes that traceability is the baseline for tackling sustainability. Blockchain does not necessarily make cocoa production sustainable, but it enables companies to trace cocoas origins and support them in their efforts to source sustainable cocoa. Interviewee 4 believes that blockchain can help with preserving the identity of the farmers down the line.

Traceability comes with information about where cocoa comes from and how it was produced at its origin. This could give some indication as to whether farmers on that farm misuse agricultural inputs like chemicals, hence whether farmers are trained or not. It could also give indication as to whether a farm is certified, and what that certification entails i.e. whether production free of child labor or forced labor and labor rights are respected, whether farmers receive vocational education as well as farming training depending on the sustainability

program potentially applied to that farm, or even whether farmers receive a fair wage. Paired with smart solutions, blockchain could even help alert companies when beans have potentially been smuggled from unsustainable or low earning farms, which is a frequent occurrence according to Interviewee 7.

Moreover, when commenting on blockchain's potential role in addressing social sustainability as well as compared to existing systems, four of out of the 16 interviewees, suggested that blockchain is the system that spans all suppliers, which Interviewee 4 mentioned as being something that was missing in the industry. Other interviewees implied the same by lauding the interoperability of blockchain technology, that it eases exchange of information among actors.

The expert interviews revealed that by enabling more precision in tracing the origins of cocoa, blockchain can indirectly help address essentially all social sustainability challenges within the SAFA social well-being themes of fair trading practices, labor rights, human safety & health, decent livelihood, and equity. This was also found to be the case in the literature review.

Transparency

Blockchain could enable better transparency of activities surrounding cocoa production. According to Interviewee 16: "The part of the chain that is weakest and also most important to address is the first, rusty shackle" (Personal Communication, August 13, 2019). What he meant here is what Interviewee 15 eluded to in his interview, which is that the part where the cocoa leaves the farmer and first enters the blockchain unlocks the further supply chain, as he emphasized on the importance of transparency.

Interesting to note is Interviewee 16's comment about blockchain introducing new norms of sustainability. Interviewee 8 states that: "Blockchain is about a change of mindset" (Interviewee 8, Personal Communication, June 26, 2019). Interviewee 2 confirms this in his statement: "Blockchain transparency does change behaviors" (Interviewee 2, Personal Communication, June 28, 2019). In a way, with its unprecedented level of transparency, blockchain inspires new ways of addressing sustainability issues.

One important feature of blockchain is its immutability. This means that once data is logged onto the blockchain, it cannot be altered. Furthermore, if a party requests to add a block to the chain (i.e. make a transaction, add information or change something), it must be validated and approved by peers in the network. It is due to these characteristics that Interviewee 10 believes

blockchain could bring transparency to the activity occurring at the production stage of cocoa, which could also potentially reduce corruption levels, as according to Interviewees 7 and 11, this helps prevent malicious data. In general, blockchain can provide better quality of information. Of course, it is dependent upon the reliability of the data put onto the blockchain in the first place.

Interviewees 10 and 12 agree that making issues more transparent can help alleviate the issues and improve social sustainability. By enabling better transparency of activities surrounding cocoa bean production, blockchain can indirectly help address the social sustainability challenges of fair trading practices (i.e. poverty), labor rights (i.e. child labor and forced labor), human safety & health (i.e. poor workplace safety) and, equity (i.e. gender inequality), according to the SAFA social well-being themes. Again, no major differences between the expert interviews were identified in the results, besides the fact that immutability was mentioned in this section as being important to transparency.

Trust

Blockchain could enable more trust within the entire supply chain. After all, it is the underlying promise of blockchain technology. Eight interviewees see blockchain as increasing security and trust in the supply chain. Interviewee 4 explicitly stated: “What blockchain does is increase security and trust between the actors” (Interviewee 4, Personal Communication, July 9, 2019). This increased security and trust can apply to both the upstream and downstream of a supply chain. Trust between the chocolate manufacturing companies and their suppliers can be increased, as well as that between the companies and their customers later on.

Through improved trust and supply chain visibility, the technology can also improve companies’ access to capital. Interviewee 5 stated: “Blockchain will not solve sustainability but will lead to a more transparent system where actors can check whether companies’ claims are true” (Interviewee 5, Personal Communication, July 23, 2019). Being the founder of a small and sustainable chocolate manufacturing company, Interviewee 5 sees that blockchain can verify what a company is doing and help them communicate it better, therefore establishing trust. For his and other small companies, sustainability funds are something they have better access to if they can back their actions up with proof. Interviewee 3, CEO of a small chocolate company, also mentioned there are sustainability trust funds, can help [small] companies to gain access to capital.

By enabling companies to provide proof of their socially sustainable activities in cocoa bean production, blockchain can indirectly help address the social sustainability challenges within the SAFA social well-being theme fair trading practices, through empowering companies with a strong sustainability agenda to push their work forward to provide better standards for cocoa bean farmers. Similar results were generated through the literature review, although the literature review put more emphasis on the benefits for cocoa bean producers generated through increased trust downstream the supply chain.

Transactions

Blockchain could enable cocoa farmers to obtain a living income. In majority of the interviews, it was implied that solving the issue of poverty and ensuring that farmers receive a living income can help solve many of the other social sustainability issues faced by cocoa producers, based on the belief that child labor, forced labor, and poor quality of life for instance are functions of poverty. According to Interviewee 7: "Quality of life, gender equality, and other challenges can be improved through faster financial transactions and ensuring that premiums are paid" (Interviewee 7, Personal Communication, July 9, 2019). In addition to this, Interviewee 6 stated: "If you tackle poverty, you tackle many problems" (Interviewee 6, Personal Communication, July 25, 2019).

To ensure a living income for farmers, Interviewee 5's company for instance, based on its standards, asks its suppliers what they paid for the cocoa and confirm by asking the farmers what they received. They then pay the balance, or premium, between that amount and what constitutes true price of cocoa is (i.e. what farmers need to have a living income and to guarantee sustainable production). The transactions between buyers and farmer could be facilitated through blockchain smart contracts. Interviewee 8 explicitly prescribes smart contracts for financial transactions. He exclaimed: "[Blockchain] not only moves information but is also moves money or things with value" (Interviewee 8, Personal Communication, June 26, 2019). Chocolate manufacturing companies can know what farmers are paid through the data available on the blockchain, and then use the technology to pay farmers their premiums directly as well. He believes: "Blockchain can verify what the buyer paid and what the farmer received" (Interviewee 5, Personal Communication, July 23, 2019), while Interviewee 6 suggested that a company could even send the premiums directly to farmers.

Interviewee 10 expressed concern about how the new value realized within supply chains would be shared between different parts of the supply chain, and whether that value would

trickle down to farmers and what share of it they would actually get. Farmers are currently price takers. He suggests that this is where blockchain could help, by again, writing codes into a smart contract and ensuring the farmers receive a fair share of the value. This would, however, require the negotiations that determine the value distribution to occur before anything goes onto the blockchain

In another proposed application of blockchain for transactions, Interviewee 14, who is Director Social Development at the World Cocoa Foundation and is therefore very close to the challenges faced by cocoa farmers, explained the gender imbalances existing in cocoa production. He stated: "Women [are] totally invisible even though they contribute majorly to cocoa cultivation. They are kept out of the transactional part of the work and have no assets" (Interviewee 14, Personal Communication, July 12, 2019). Blockchain can help empower women to also be included within the transactional process by ensuring that they receive an income directly. A limitation of this however would be overcoming the cultural institutions that exclude women in the first place, which blockchain has nothing to do with.

Overall, the interviewees who believe in blockchain's ability to aid with transactions suppose that it can ensure that contracts are well-enforced and are automatically triggered when conditions are met. By enabling quick and transparent transaction of monetary value, blockchain can indirectly help addresses the social sustainability challenges of fair trading practices and equity, according to the SAFA social well-being themes. This was also found to be the case in the literature review. The enablement of transactions is perhaps one of the most important fringe benefits of blockchain because it helps to tackle the most fundamental challenge in cocoa production, which is low farmer income which drives poverty, and thus a vicious cycle of other challenges.

3.2.2 Blockchain's Position Amidst Current Sustainability Management Tools

It seems there is no single industry approach on upstream supply chain management systems or tools for ensuring sustainable farming practices, nor does a standard reporting system exist. This fact also contributes to companies engaging in sustainable activities, while still maintaining their competitive edge. Rather, what emerged from the interviews was mainly two ways in which [social] sustainability is ensured, namely companies' own sustainability programs and certification schemes. Interviewees mentioned that to support with traceability

as part of the sustainability programs, companies also utilize ERP systems, as similarly observed in the literature review.

What emerged from the interview responses was that blockchain is not necessarily better than these current systems. If anything, seven interviewees out of 16 suggested that blockchain has a complementary role, as discussed in **sub-Chapter 3.2.1.** Interviewee 8 confirmed: "It's important to note that blockchain is not replacing any ERP or supply chain management systems, it's rather like an additional layer on top of the different ERP systems in the supply chain" (Interviewee 8, Personal Communication, June 26, 2019). Interviewee three believes it supports companies' efforts in addressing [social] sustainability.

Then there is the question of whether blockchain can add any more value than a regular centralized database. Interviewees who are convinced there are alternative ways to achieve what blockchain promises, believe that customers do not really care which technology companies use to get information, they just want the information at the end. For instance, Interviewee 2 wonders whether mobile money or transfer options that are increasingly prominent in the rural area are not sufficient for financial transfers. On this matter, Interviewee 15 stated: "Companies will develop different solutions for the same problem" (Interviewee 12, Personal Communication, July 12, 2019) Interviewee 6 declared: "It's not necessarily about blockchain, but that you develop a tool that addresses these things" (Interviewee 6, Personal Communication, July 25, 2019). Interviewee 16 believes that companies have things under control with certification and their sustainability programs. He does not believe that blockchain has many additional benefits compared to these, but that it could be important for certification.

Furthermore, if they are to adopt blockchain at all, companies in the cocoa-chocolate supply chain are most likely to adopt hybrid or, probably, private blockchains. Interviewee 4 then questions whether anything that is not a public distributed ledger can be considered as blockchain and suggests that companies would not like to open up their supply chain anyway. While there are different types of blockchain, as exhibited in **sub-Chapter 2.1.1.3**, this interviewee sees the true distinction of blockchain compared to other systems in how open it is.

It is true that some applications of blockchain are not unique to blockchain alone. Rather, blockchain introduces them on an unprecedented level. In the instance of the mobile money example provided above, blockchain offers smart contracts and can alert other participants in real-time when there is a discrepancy. Moreover, its main properties of being decentralized and

trustless alone are special to blockchain technology. It is also immutable, a unique advantage observed by half of the interviewees. If anything, blockchain can optimize the current way of doing things. Most importantly, as previously mentioned, Interviewee 4 believes that the industry has been missing a system that spans all suppliers, all the origins of a product, as well as the issues. In this regard, he believed that blockchain could be this system. This was confirmed by Interviewee 8, an applied blockchain expert, who suggested that blockchain's main benefit in this regard is the ability to trace a product throughout these multiple ERP systems (Interviewee 8, Personal Communication, June 26, 2019). This corroborates what was mentioned in **sub-Chapter 3.1.2** about blockchain being a single ledger on which actors can view and exchange information. When asked what additional benefits blockchain offers compared to existing systems, Interviewee 12 summarized the following as the benefits of blockchain: 1) it is a base layer to enable smart solutions like sensors for tracking, 2) all stakeholders along the supply chain have one system, and 3) data cannot be changed in hindsight (Interviewee 12, Personal Communication, July 29, 2019). These three points encompass precisely what has been mentioned above

On the point of enabling smart solutions, Interviewee 12 believes blockchain is enhanced by, and in itself, can enhance smart solutions to ensure uncorrupted data. She sees this at her company which offers a communication platform enabled by blockchain and GPS satellite imagery. Practically speaking, she suggests a traceability solution she has seen emerging on the market, where cocoa beans are somehow embedded with an edible DNA barcode. Blockchain in itself cannot do anything, but its true value is realized in pairing it with other systems and tools. Interviewee 16 believes: "Blockchain will improve the effectiveness of other solutions" (Interviewee 16, Personal Communication, August 13, 2019).

3.2.3 Current Considerations for Blockchain Adoption

When asked whether blockchain was an ultimate solution to addressing social sustainability, all interviewees responded that it was not, with majority suggesting that it could be part of the solution. They consider it a great technology, but Interviewee 11 would not call it the "holy grail" (Interviewee 11, Personal Communication, July 26, 2019), nor would Interviewee 12 call it the "silver bullet" (Interviewee 12, Personal Communication, July 29, 2019) to solving all the issues. When asked whether they found blockchain an interesting solution for social sustainability, one chocolate manufacturing company seemed to be considering blockchain

passively, while the other five are actively considering it to various degrees. The one cocoa sourcing company has been actively considering blockchain as well. The ones that are actively considering blockchain are engaged or have been engaged with one or more projects. It seemed however that the larger companies are more hesitant about the adoption of blockchain, while the small companies are more proactive. This is also reflected by the level of knowledge about and attitude towards the technology embodied by the different groups.

One thing hindering the larger companies is the complexity of their upstream supply chains. It became clear during the interviews that if a company is closer to the source, or rather, the farmer, there are less nodes in the blockchain network which makes the implementation less complication. Adopting blockchain is apparently easier for smaller chocolate manufactures since they can more easily segregate their supply chain, whose supply chains are rather fully segregated, or identity preserved as explained in **sub-Chapter 3.2.1**. Interviewee 2, from one of the largest chocolate manufacturers in the world believes that it depends on how far a company is from the cocoa's origin both in a physical sense and supply chain distance sense. Interviewee 4, who also works at one of the world's largest chocolate manufacturers stated: "The bigger and more complex, and the more countries of supply a company has, the more difficult it is to segregate the supply chain. You lose efficiencies" (Interviewee 4, Personal Communication, July 9, 2019). Having an overview of the entire cocoa-chocolate industry however, Interviewee 16 suggests that blockchain can actually make administrative control of mass balance easier. It should be recalled here that the general consensus among interviewees is that traceability is the basis of sustainability, as discussed in **sub-Chapter 3.2.1** in the traceability section.

While the motive behind blockchain's adoption is not solely for addressing social sustainability, sustainability was one of the reasons behind the interest (e.g. Interviewee 1 mentioned deforestation as being a hot topic). Companies find blockchain interesting for traceability, transparency, trust, and transactions, which in turn address social sustainability. However, Interviewee 12 believes that adoption of blockchain is low because she has so far not identified any good short-term benefits for the investments (i.e. setting up software, rolling out the technology, education and training stakeholders) required (Interviewee 12, Personal Communication, July 29, 2019). Some interviewees are of the opinion that blockchain is just not a priority for adoption and implementation at the moment. Interviewee 4, who believes that blockchain will not be a high priority as long as blockchain is not mature, cheaper, or easier to implement. He also said: "Without addressing the current main challenges, [blockchain's] not

pressing to apply" (Interviewee 4, Personal Communication, July 9, 2019). Meanwhile, Interviewee 11 sees blockchains adoption starting to pick up within the next 2 to 5 years, as it is increasingly being seen as "a valuable technology rather than a hype" (Interviewee 11, Personal Communication, July 26, 2019).

3.2.4 Value-drivers of Adopting Blockchain

Besides potentially having a positive impact on social sustainability, sustainable supply chain management needs to be linked to value drivers in order to be implanted in companies (Brand, 2019). The top 5 most frequently occurring value-drivers for interviewees for adopting and implementing blockchain for cocoa production, according to Eckelmann's (2006) value-drivers for CSR framework (See **sub-Chapter 2.2.3.3**), were mentioned as being the following by interviewees:

Value proposition to customers

12 interviewees proposed that an implementation of blockchain could be used as a value proposition to customers. Interviewee 15 states: "Technology is shifting power to consumers" (Interviewee 15, Personal Communication, July 12, 2019), and that consumers use that power to inform brand decisions which therefore influence a company's supply chain. On one hand, customers are increasingly demanding sustainably produced goods. On the other hand, companies can create a unique selling point out of the augmented transparency and traceability they can achieve from implementing blockchain. Customers can come to know where exactly their cocoa comes from and how it has been produced, and they could potentially have direct access to and interact with the data that showcases these facts. Interviewee 9 suggests that this could even foster a closer relationship between customers and chocolate brands. Some interviewees suggested that the fact of the implementation itself helps win over customer confidence and trust, but the data generated from its implementation can be used for marketing purposes and to differentiate a brand from its competitors. As Interviewee 3 put it: "The consumer in the future will really appreciate transparency" (Interviewee 3, Personal Communication, July 5, 2019).

Additionally, as mentioned in **sub-Chapter 2.2.3.2**., there is a direct correlation between economic performance and CSR. Interviewees 10, 11 and 13 suggest that companies can sell their chocolate at a higher price and earn higher returns, with the belief that consumers are

willing to pay more for [social] sustainably. Ideally, these returns would also trickle down to the farmers, truly impacting the social sustainability of cocoa bean production.

Company reputation

The implications of implementing blockchain can have positive effects on a company's reputation. Not only would taking measures to address social sustainability in cocoa production reflect a company's core values, but it also helps it credibly live up to them. Interviewees 6 and 12 specifically suggested that implementing blockchain would prove that a company adheres to certain sustainability goals and invests into them. Interviewee 12 confirms that: "Confectionary companies are the ones that need to implement blockchain and invest in it" (Interviewee 12, Personal Communication, July 29, 2019). See adds that they can monetize blockchain through brand value. Since companies normally have to report on their non-financial performance, some interviewees also suggested that the data generated by blockchain could also augment their sustainability reporting.

Operational efficiency

Most interviewees that suggested operational efficiency as a value-driver for adopting blockchain made note of the efficiency gains to be obtained. Blockchain could improve operational efficiency through the possibility of reducing paperwork by automizing the process of documenting and sharing data, as well as easing the control of data input. As Manager Raw Materials & Sustainability at one of the world's largest chocolate manufacturing companies, it is Interviewee 1's job to cross-check the supplier list she receives from a shipment of cocoa beans with a spreadsheet of suppliers that are part of their program. With blockchain, this can be checked automatically and digitally within logistics. She believes that blockchain could potentially reduce the paperwork between the steps prior to the product reaching the company, which in one of their cases for instance is farmer to cooperative, cooperative to suppliers, and suppliers to them. Interviewee 8 suggests that the digitalization introduced by blockchain for cocoa production makes transaction processes leaner and more standardized (Interviewee 8, Personal Communication, June 26, 2019). These digital copies of information can also be useful when proving what a company has done in its supply chain. Moreover, for auditing purposes, information can be coupled with a digital trace of the product.

Furthermore, interviewees noted that companies can also realize cost- and time-savings. According to Interviewee 11, conventional data sharing between entities in the cocoa supply chain is costly, requiring validation, migration, and back-up solutions (Interviewee 11, Personal

Communication, July 26, 2019). With blockchain, validation occurs instantaneously, the data is available in real-time for all with access to it, and the blockchain in itself is a back-up solution. Moreover, by reducing risks of fraud in the supply chain, companies may have less cases of bad cocoa that needs to be dealt, which saves time and money. This all confirms Eckelmann's framework regarding operational efficiency, that it reduces production costs, but in this case also administration costs.

Legal compliance

Legal compliance emerged as a value-driver for adopting and implementing blockchain. Companies do not have a legal obligation to source cocoa sustainably per say , but they do so voluntarily. Hence what the interviewees refer to as legal compliance is compliance with sustainability standards. By implementing blockchain, chocolate manufacturing companies can show that their chocolate really is fair trade. The data on the blockchain can make certification more efficient. Interviewee 8 mentions that blockchain can not only make sure there is good news, but also that there isn't bad news, which is true in the case of legal compliance. According to Interviewee 7, the transparency introduced by blockchain can help reduce risks related to labor rights. This has a long-term positive impact on social sustainability and can help with risk management according to Interviewee 16.

Supplier Management

According to Interviewee 2, there is currently a lot of fragmentation of the upstream supply chain. Eight interviewees mentioned supplier management as a value-driver for the adoption and implementation of blockchain due to the interoperability that the technology can introduce. Interviewee 4 mentioned that the industry was missing a system that spans all suppliers and all origins. On a separate occasion, Interviewees 8, 9, 11 and 12 suggested that blockchain was perhaps the system that would connect the various actors, making it seamless to share and manage data. Interviewees also believed that the implementation of blockchain around the production stage of the cocoa bean could improve engagement and trust among actors. For the chocolate manufacturing company, it could assist with decision-making regarding which from which suppliers and where to source their cocoa.

Others

In terms of frequent occurrence, access to capital and risk position are two value-drivers that followed closely behind the above-mentioned and were deemed important to note by the

researcher. For small chocolate companies, access to capital seems to be a major value-driver as there are sustainability funds available to help with their cause. Risk position was interesting as it was mentioned by interviewees to be a driver for securing the supply of cocoa by professionalizing cocoa farming and making it more sustainable, as well as reinforcing relationships with farmers and suppliers. Interview 16 states that: “Everyone knows that cocoa will run out if it does not become sustainable” (Interviewee 16, Personal Communication, August 13, 2019), and it is thus important to manage the risk of this potentially occurring. Interviewee 4 believes: “Anything that increases the level of professionalization of farmers, that they are more enabled and better empowered, is beneficial for the company” (Interviewee 4, Personal Communication, July 9, 2019).

Overall, these findings from the expert interviews reflect those found within the literature review, thus elaborating on and validating them.

4 DISCUSSION

In the following chapter, the results of the research will be discussed by first providing a summary and comparison of the literature review and expert interview findings, then discussion some general observations in light of existing literature.

4.1 Summary of Findings

Ultimately, there was great value in triangulating the results due to the fact that literature can help establish conceptual comprehension, while expert interviews can reflect an empirical reality. The results between the two data collection sources were quite consistent. It is speculated that the reason behind this is the repetitive nature of the conversation around and little literature available on blockchain for sustainability, from which the interviewees most likely based their knowledge. The technology is still in its early stage and is yet to mature, and in the meantime more applications may be developed. Moreover, the codes generated from the literature review and analysis were sought out during the analysis of the expert interviews, but also occurred themselves, to enable comparability of results. Hence why similarities were observed. The triangulation of results can thus be considered successful. **Table 6** below summarizes the findings from the two data collection methods and juxtaposes them against each other.

Table 6: Results of triangulated data (own illustration)

Sub-question	**Literature Review**	**Expert Interviews**
What social sustainability challenges in cocoa bean production might blockchain address and how?	- Indirect role - Complementary role - Foster transformational change - Enabler of **traceability** (addresses fair trading practices, labor rights, human safety & health, decent livelihood, equity), **transparency** (fair trading practices, labor rights, human safety & health, equity), **trust** (fair trading practices) and **transactions** (fair trading practices, equity)	→ Indirect role → Complementary role → Foster transformational change (“change of mindset”) → Enabler of **traceability** (fair trading practices, labor rights, human safety & health, decent livelihood, equity), **transparency** (fair trading practices, labor rights, human safety & health, equity), **trust** (fair trading practices) and **transactions** (fair trading practices, equity)

How does blockchain compare to upstream supply chain and sustainability management systems and tools currently used to address social sustainability?	- Complements existing systems (ERP, CLMRS, etc) and tools (certification schemes and company own sustainability programs for supply chain management), and does not replace them - Main added benefits compared to existing systems: 1) defragmenting supply chain actors, 2) high security and distributed, 3) flexible for other sustainability issues like environment and economic, 4) better verifiability due to tamper-resistance	→ Complements existing systems (ERP) and tools (certification schemes and company own sustainability programs for supply chain management), and does not replace them → Main added benefits compared to existing systems: 1) enhances smart solutions, 2) spans all suppliers, origins and issues, 3) immutable
What are the current industry considerations for harnessing blockchain's capabilities in cocoa bean production to address social sustainability?	- Blockchain part of the solution - Majority of those who have adopted blockchain are pleased - Active consideration from sustainable (smaller) chocolate manufacturing companies - Nothing found on large companies - All-around hesitation due to current systems already functioning and complexity of cocoa supply chains	→ Not seen as an ultimate solution for addressing social sustainability in cocoa production, but part of it → Mixture of passive and active considerations from chocolate manufacturing companies accompanied by pilot projects → Smaller companies more proactive, larger companies more hesitant due to supply chain complexities → Curiosity and interest are there but its adoption not a high priority for the industry overall
What are the value-drivers for chocolate manufacturing companies for implementing blockchain technology?	Top five value-drivers according to Eckelmann framework: - Legal compliance - Value proposition to customers - Operational efficiency - Supplier management - Company reputation Also worth mentioning - License to operate	Top five value-drivers according to Eckelmann framework: → Value proposition to customers → Company reputation → Operational efficiency → Legal compliance → Suppler management Also worth mentioning: → Access to capital → Risk position

How Blockchain can Address Challenges

The conclusions drawn about blockchain's potential in addressing social sustainability challenges and the challenges it does address were surprisingly, but not so coincidentally, identical. Blockchain was found to play an indirect role in addressing the challenges, be complementary to other solutions, foster transformational change and enable traceability, transparency, trust and transactions. Fair trading practices was the theme which blockchain could most address, which will be elaborated on more in **sub-Chapter 4.2.1**.

Blockchain's Position Amidst Current Sustainability Management Tools

Blockchain was found to be a system that complements and supports sustainable management tools and systems. It works work best in combination with existing systems such as ERP and CLMRS but does not replace them. In both the literature and expert interviews, certification and company self-declared sustainability projects emerged as being the two tools to support sustainability supply chain management to address social sustainability in cocoa bean production.

The added benefits of blockchain were phrased differently between the literature review and expert interviews but essentially covered the same things. Immutability in the expert interviews pertains to better verifiability and tamper resistance in the literature review, and spanning all suppliers to defragmentation and distribution, respectively. Distribution and therefore no single point of failure was emphasized in the literature review, whereas it was not in the expert interviews.

Current Considerations for Blockchain Adoption

The expert interviews represented a small sample of the population probably reflected in the literature review. However, the expert interviews shed more light on the intentions of larger chocolate manufacturing companies which was not available through the literature review. In this case, triangulation through expert reviews provided elaboration on the literature review findings. It was found that larger companies are more passive in the consideration for adopting and implementing blockchain, whereas the smaller companies are more proactive. The expert interviews revealed that the larger companies are also experimenting with blockchain, something the literature review did not reveal.

Furthermore, the discovery that blockchain's adoption in the industry is currently not a high priority can be justified by the finding in the literature review that chocolate manufacturing

companies are hesitant because they have systems that already work for them and that they have invested heavily in. An interviewee (Interviewee 16) also mentioned this. Iansiti & Lakhani (2017, p. 7) believe that if blockchain presents a high degree of novelty and high amount of complexity and coordination for a particular application, the more effort is required to make users understand what problem it solves and get people on board. In the end, in both data collection instances, blockchain was found to be part of the solution to address social sustainability challenges.

Value-drivers of Adopting Blockchain

Although in a different order, the value drivers identified in the literature review mirrored those in the expert interviews, which were ordered in terms of most frequently mentioned. Access to capital also emerged in the expert interviews due to the more granular opportunity to investigate the value drivers from the chocolate companies themselves, which included smaller and more sustainable companies, as opposed to the generalizations of the literature reviewed. Although interviewees were provided with the Eckelmann framework prior to the interviews, with "risk position," the few interviewees that mentioned it implied the possibility to secure the supply of cocoa for the future by producing sustainably. Nevertheless, Hileman & Rauchs (2017, p. 4) admit much still needs to be done to build confidence about how blockchain can deliver business value.

4.2 General Observations

Below are some key general observations what were extrapolated during data collection that are worth discussing.

4.2.1 Fair Trading Practices Most Addressed

The fair trading practices theme of the SAFA social-wellbeing framework appeared to be the most addressed social sustainability aspect of cocoa production. All four fringe benefits that are enabled by blockchain (i.e. traceability, transparency, trust and transactions) helped alleviate income related challenges for farmers. After all, studies found that traceability and transparency are fundamental for sustainability (Saberi et al., 2019, p. 1; Wettstein, 2015, p. 47), trust generated from independent and accurate information support investor decisions (World Economic Forum, 2018, p. 20), and that financial transactions are the most frequently applied function of blockchain for sustainability (Galen et al., 2018, p. 4). Since poverty is the

source of many of farmer's problems, and if blockchain promises to address these issues, it can be concluded that implementing the technology is worthwhile.

4.2.2 Cocoa Production's Unique Challenges Limiting Blockchain's Adoption

Interestingly, conversations about blockchain's potential during expert interviews would often stray away from the technology itself, but rather towards the intrinsic complexities of the cocoa supply chain and physical challenges of the product itself. It seems there is a myriad of issues within the cocoa bean production where blockchain can only be a small part of the solution. The instability in cocoa supply chains is often what makes efforts for transparency, monitoring and remediation challenging (Fair Labor Association, 2012, p. 2). The root of the social challenges of cocoa production are bigger than blockchain (e.g. child labor and gender discrimination being partly cultural, partly educational, and partly poverty), and there are things that need to be addressed on a ground and humanistic level before a technology can be introduced. As Interviewee 6 put it: "If you had a logistical problem running on a purely logical grid then it could help. But when It comes to human behavior, that's not mathematically solvable" (Interviewee 6, Personal Communication, July 25, 2019)

In general, technology also tends to put pressure on industries whose core business may not be technology. Interviewee 2 even stated: "A lot of times, technology comes not out of a business need, but from, 'Oh this is cool. How can we do it?' versus 'What is out business need that we want to address and what technology maps onto it?'" (Interviewee 2, Personal Communication, June 28, 2019).

4.2.3 Blockchain Adoption of Small vs Large Industry Players

From the data collection, it was observed that larger companies are a lot more hesitant and skeptical about blockchain technology. It seems that they are so overwhelmed by their complex supply chains to even fathom how blockchain can be applied and implemented. Smaller chocolate manufacturing companies on the other hand have more vicinity to farmers within the supply chain. They have thus proactively explored ways of applying blockchain to their supply chains and have more in-depth knowledge about the technology than larger companies. In relative terms, they do spend more on sustainability programs than larger companies (Wettstein, 2015, p. 31). Moreover, literature has shown that they normally possess favorable organizational capabilities such as shared vision, simplified decision making process, and

greater innovation propensity, that enable them to be more proactive in addressing sustainability issues (Hörisch, Johnson, & Schaltegger, 2015, p. 769)

As stated by Interviewee 3, CEO of a small and sustainable Finnish chocolate manufacturing company: “The supply chain is very difficult to manager for bigger companies because they don’t buy beans directly from farmers or cooperatives, but rather chocolate base [from processors]” (Interviewee 3, Personal Communication, July 5, 2019).

4.2.4 Varying Incentives of Small vs Large Industry Players

It was observed, that the drive to potentially adopt blockchain in smaller chocolate manufacturing companies came more from end consumers, whereas in larger companies it was more from whether it made sense for the business. Having a strong business case for sustainability can help an entity identify opportunity (United Nations Global Compact, 2015, p. 15). Interviewee 4 from one of the world’s largest chocolate manufacturers stated that human rights for instance are important in their own right, but: “It has to add value to the business” (Interviewee 4, Personal Communication, July 9, 2019), and where there is a need to achieve traceability, transparency, trust, or make transactions, companies will ultimately opt for a solution that best helps them achieve what they need to achieve. As ideal as it would be to address farmers’ needs purely for the sake of their well-being, the reality is that the industry is driven by business incentives. If another solution helps a company achieve that in a more efficient and/or cost-effective way, it will most likely be considered.

4.3 Potential Hurdles for Adoption

Very often, the technology is portrayed as “the panacea to all information problems” (Zhao et al., 2019, p. 92), and a major focus put on its potential and promise. Although blockchain use cases have increased, there are a number of behavioral, organizational, technological or policy-oriented obstacles to its adoption and implementation (Saberi et al., 2019, p. 2). This section presents a number of relevant hurdles to the adoption of blockchain in cocoa bean production that emerged throughout the research and offers suggestions to resolve them.

4.3.1 Unrealistic Expectations

Blockchain critics are skeptical about the "trustless collaboration" that the technology promises to allow among people and organizations, and believe this notion is misguided. According to Pisa (2018), the double spending problem that blockchain solves with Bitcoin removes reliance on trusted intermediaries that oversee the transaction of *digital assets*, but "when the problems we want to solve involve changes in the real 'off-chain' world, the need for human agency, and therefore trust, remains" (ibid, n.p.). This echoes the sentiments of majority of the experts interviewed for this thesis, who always reverted back to the fundamental issues faced by the cocoa industry during discussions. Blockchain does nothing to solve the core challenges of the intrinsically complex cocoa upstream supply chain. It must be noted however, that this is not a problem of blockchain alone, it is an issue faced by any database, and should be corrected off-chain.

4.3.2 Acceptance Among Actors

Blockchain is based upon a network of actors. To link different parts of a supply chain, a number of actors need to be involved and silos overcome (Galen et al., 2018, p. 11). Key stakeholders or actors may include farmers, traders, production standard organizations, data/information organizations, supervisory authorities, financial service providers (Ge et al., 2017, p. 23), as well as cooperatives, processors, and chocolate manufacturing companies. In order for this to happen, each group needs incentives (Hirbli, 2018, p. 14). Farmers need to know that their lives will improve; trading companies need assurance that it will make them more attractive to their customers; auditors and certification organizations want to know blockchain will make their jobs easier; chocolate processing and manufacturing companies need to see the business-added value. Farmers are already overwhelmed with each manufacturer and brand's requirements for information. Convincing these groups of the incentives is one thing, the cost to benefit ratio of adopting and implementing blockchain for each group is another. Seuring & Müller (2008, p. 1704) found that coordination effort and complexity is one of three barriers for implementing sustainable supply chains. Industry wide collaboration. However, is considered necessary to drive sustainability in the cocoa-chocolate supply chain forward (Huetz-Adams, 2016, p. 7)

Limited technical knowledge and expertise of how to use blockchain may be another limiting factor to blockchain's adoption. Blockchain may change organization culture and structures

which may face resistance and hesitation (Saberi et al., 2019, p. 9). Furthermore, some organizations are unwilling to share commercially sensitive data with each other (Pisa, 2018; Saberi et al., 2019, p. 9). This hesitation may hinder successful adoption and implementation of blockchain.

4.3.3 Establishing Standards

The very first step of using blockchain as a supply chain platform, which is to assign an identity to a product (i.e. serialization), requires a certain degree of coordination governed by a set of standards to make sure that all actors along the upstream supply chain can make use of the data (Pisa, 2018). Blockchain's role is to ensure the documentation of trusted data, but there must be rules and regulations in place. As Interviewee 8 put it: "Blockchain cannot help where there is no regulation at all" (Interviewee 8, Personal Communication, June 26, 2019). The regulatory compliance of blockchain needs to be established.

In order for blockchain to indeed be the system that spans all actors and origins to improve traceability, establishing the common set of rules and will require the different actors in the supply chain to collaborate and work together. Interviewee 9 believes: "The potential comes when people get together around the technology itself any agree upon who owns what data, which processes are being digitized and what data is shared" (Interviewee 9, Personal Communication, June 28, 2019). A platform for industry-wide collaboration could be the Global Cocoa Agenda (GCA), which is "a roadmap towards a more sustainable cocoa sector, outlining roles, responsibilities and actions for all major stakeholder groups involved in a sustainable cocoa sector; from producing governments and consuming governments to industry actors, civil society, and farmers" (Fountain & Huetz-Adams, 2018, p. 27). Experts believe that establishing serialization that is recognized across an industry would take years. However, the ISO Blockchain (TC 307) initiative is currently developing global blockchain standards (Pearson et al., 2019, p. 147). These are currently not industry specific, but a good start to getting the job going. On the other hand, Interviewee 14 does not believe that the industry is ready for blockchain, as it still struggles to adopt common standards in areas of its own work (Interviewee 14, Personal Communication, July 12, 2019).

4.3.4 Interoperability with Existing Systems

The interoperability of blockchain-generated data along the supply chain poses a technical challenge. Companies' existing systems are normally not designed to interact with blockchain solutions (KPMG, 2018, p. 10), nor has blockchain been designed taking into account the current systems. Therefore, there needs to be a comprehensive examination of blockchain integration into the company sustainability and supply management systems and a strategy for change management. However, food processing technological provider Bühler Group is pioneering the development of blockchain-ready food technology solutions (Bühler Group, 2019). Being the biggest provider of processing solutions for the chocolate industry (70% of the world's chocolate), the conversation around blockchain for the cocoa supply chain could drive the company's implementation in its chocolate processing technology. If the rest of the industry takes suit and makes systems and technology compatible with blockchain, there could be a greater level of its adoption. While the idea of blockchain being the 'backbone' of other systems is considered an optimistic one by some (Ge et al., 2017, p. 22), it is possible if the industry agrees to work together.

4.3.5 Reliability of Data Input

This thesis has assumed that the information that would be added to the blockchain database is true and valid. However, blockchain can ensure trust insofar as the technology goes, but like any other database, it cannot prevent fraudulent human behavior. While the blockchain is incorruptible and immutable, the trustworthiness of the data that is put onto the blockchain in the first place should be established separately. According to Interviewee 16: "For blockchain to deliver on its promises, most of the attention should be towards data input" (Interviewee 16, Personal Communication, August 13, 2019).

Regular announced and unannounced audits by independent, accredited third-parties such as Fair Labor Organization or Better Work to ensure data reliability are recommended. Some may find it ironic that the very central, third party authority that blockchain eradicates in its functionality is required to verify the data that is put onto a blockchain platform. This only goes to show that technology on its own cannot completely absolve trust issues, but it can mitigate them. But just as sensors are used in transporting goods to monitor and verify data on the blockchain, GPS and satellites are one way to verify aspects of sustainability. For instance, SeeHow uses satellite images and compares the data they receive with that it sees on satellite

images (SeeHow, n.d.), but this works better for environmental challenges because on satellite gender equality cannot be observed for instance, although perhaps kids working on a farm can. Measures necessary to avoid what Interviewees 8 and 11 similarly quoted: "[…] garbage in, garbage out" (Interviewee 8, Personal Communication, June 26, 2019; Interviewee 11, Personal Communication, July 26, 2019).

4.3.6 Technical Feasibility

Mobile devices and connectivity will be important for blockchain development projects since an interface needs to be maintained between users and blockchain applications (GSMA Digital Identity, 2017). Cocoa is produced in the rural areas of developing countries which often lack technological infrastructure, experience network difficulties, and have electricity shortage. As a result, the mobile penetration is relatively low. This might hinder the development of cocoa. However, a study on development in rural India found that blockchain can potentially overcome issues of geographical access, high costs associated with financial transactions, and inappropriate banking products, to improve rural peoples' [financial] inclusion into global supply chains (Schuetz & Venkatesh, 2019, p. 2). Literacy is one factor that should be closely monitored, and appropriate measures taken to train users.

A short-term way to address this will be for farmer cooperatives or NGOs to have phones that farmers can use – although this will be inefficient – rather than expecting each farmer to own a mobile phone. However, seeing as cocoa constitutes a major part of the economy in cocoa producing countries, perhaps the rising demand for data and the general proliferation of mobile connectivity will drive infrastructural development. The mobile industry has apparently begun to support the UN's Sustainable Development Goals (SDGs) by finding new ways to deliver impact in digital identity in partnership with governments and other key stakeholders (GSMA Digital Identity, 2017). This could present an opportunity for blockchain adoption. Moreover, global coalitions such as Alliance for Affordable Internet can aid with network accessibility (Galen et al., 2018, p. 13).

Energy consumption also appears to recur as a concern for implementing blockchain, however it depends on the process used to verify a transaction to establish consensus. Here it is important to distinguish between proof of work (PoW) and proof of stake (PoS). PoW is the process of "mining" used in older blockchains (i.e. Bitcoin) that is required before information is stored where users verify unique hashes attached to each block by an algorithm in order to update the

current status of the blockchain. PoW requires many random guesses which makes the process costly and energy-intensive, and ultimately constrains speed as the network grows, making it inefficient (World Economic Forum, 2018, pp. 10–11). PoS on the other hand is used by newer blockchain (i.e. Ethereum) and is a process required before information is stored whereby users validate and make changes on the blockchain based on their stake in the asset. PoS is less complex than mining due to its decentralized verification process which delivers savings on energy and operating costs (World Economic Forum, 2018, p. 11). Other emerging verification methods include proof of authority (PoA)[1], proof of important (PoI)[2] and proof of history (PoH)[3]. The type of consensus mechanism that would be utilized in a supply chain would be based on PoS, which are a less cost- and energy-intensive than PoW. Moreover, computing power would not be required in the rural area on the farms because farmers would only be concerned with the user interface of the blockchain, not the system network itself.

[1] A consensus and verification algorithm which relies on identity as a form of stake

[2] A consensus and verification mechanism known as "harvesting" used to determine the nodes eligible to be added to the blockchain

[3] A consensus and verification algorithm which creates a record, proving the occurrence of events at a specific moment in time

5 CONCLUSION

Blockchain may have become a buzzword to its own detriment, to the extent that people have lost sight of its true value and are quick to dismiss it as a fleeting hype. Blockchain is not a holy grail, nor is it a silver bullet for fixing sustainability challenges. But it is a technology that can help improve supply chains, especially those with high requirements for traceability, transparency and trust. As far as its current development, blockchain can be considered just one part of the solution for addressing social sustainability challenges in cocoa bean production, especially with its capability to transfer value quicker and cheaper than other means. Most importantly, in order to truly make an impact on social sustainability, blockchain will need to be accessible to the farmers who should have the authority to verify information. After all, the sustainability efforts are aimed for them and ensuring that cocoa will be produced sustainably to secure its supply. But sustainability in cocoa will require more than just technology, but even structural and institutional reform in some cases (such as the variables determining farmer income and price competition in the industry). Blockchain only covers perhaps 5% of the problem, leaving issues related to how the supply chain is organized to still be tackled (Potma, 2018). But like the internet at its conception, blockchain is foreseen to become a foundational technology.

Overall, it could be concluded that whatever the potential role blockchain could play in addressing social sustainability in cocoa, it will certainly have a transformational impact by challenging the cocoa supply chain, whether the industry chooses to adopt it, or merely continue talking about it. Every company interviewed admitted to having experimented with or considered blockchain for establishing transparency in their supply chains, but even those with skepticism are now aware of the potential that can be reached in creating trustful and fair chains. If applied, it helps achieve what sustainability management tools are working towards achieving, but with more rigor. As it becomes more mainstream, blockchain “will likely push companies to be aware of their actions, and enable them to clearly demonstrate responsible and ethical operations in a cost- and time-efficient way” (World Economic Forum, 2018, p. 14).

5.1 Main Results

This research pursued the following research question: *What potential role can blockchain play in addressing social sustainability challenges in cocoa bean production, and what are the value-drivers of implementing the technology for chocolate manufacturing companies?* Four sub-questions guided the research. For the first part of the question, the following was found to be the potential role of blockchain in addressing social sustainability challenges in cocoa bean production:

- Blockchain technology can play an *indirect* role in addressing social sustainability in cocoa production in general, and will probably not itself eradicate or solve the issues
- Blockchain technology can also play a *complementary* role in addressing social sustainability challenges in cocoa production, in that it would work in combination with existing measures the industry currently takes in ensuring socially sustainable practices, as well as with other smart solutions to aid its utility
- Blockchain technology can be an *enabler* in helping chocolate producing companies, who are ultimately held accountable for sustainability in the industry, to achieve *transparency, traceability, trust,* and make financial *transactions* more secure (the 4Ts)
- Blockchain technology has *transformational potential* in challenging the status quo of sustainability in cocoa by introducing unprecedented norms for traceability, transparency and trust, and ways of exchanging value

For the second part of the research question, the following (in alphabetical order) were found to be the major value-drivers for chocolate manufacturing companies for implementing blockchain in both data collection methods:

1) Company reputation
2) Legal compliance
3) Operational efficiency
4) Supplier Management
5) Value proposition to customers

From these findings, it can be concluded that the main research question was adequately answered. The significance of the overall findings for companies will be outlined below through a recommendation for the chocolate industry.

5.2 Recommendations for Chocolate Manufacturing Companies

The adoption of blockchain in cocoa is foreseen to occur in a few years once expertise about decentralized models has been developed, and greater confidence in the technology built. In the meantime, the cocoa industry may explore less complex options. Nevertheless, this research provides recommendation to companies that would consider adopting or implementing blockchain. Brand (2019) recommends applying a management cycle to set up a sustainable supply chain in a company. The UNGC outline for operationalizing sustainability in a supply chain introduced in **sub-Chapter 2.2.2** will be applied to structure the recommendation for any chocolate manufacturing company that considers blockchain for addressing social sustainability.

1) Commit

First and foremost, sustainability should be embedded within the company's values. A chocolate manufacturing company can use the value-drivers identified in **sub-Chapter 3.1.4** and **3.2.4** to build a business case to adopt blockchain to address social sustainability challenges in cocoa bean production. Then, in order to set the expectations of what blockchain should accomplish, the company could refer to the findings in **sub-Chapters 3.1.1** and **3.2.1** on how blockchain can address certain social sustainability challenges. By linking the blockchain application to its existing upstream sustainable supply chain management systems, it will already have an idea of how blockchain compliments

2) Assess

The company should then map its upstream supply chain to identify the most critical parts for action, but in the case of cocoa, it is already evident that the smallholder farmers are the greatest priority as they are exposed to the most social sustainability challenges, as seen in **sub-Chapter 2.1.3**. It would then define cocoa bean production as its scope.

3) Define and Implement

Once the scope of the implementation has been defined, the company would then need to engage the respective upstream actors (i.e. cocoa processors, national commodity boards, trading/commodity companies, cooperatives, farmers, NGOs, etc) and incentivize them as to

how a blockchain implementation would benefit them, since adopting blockchain would require renovating their current processes. Before blockchain can even be implemented, the cocoa supply chain will need to be digitized. As mentioned in **sub-Chapter 4.3.5**, audits of the farms would need to be arranged to ensure reliability of data input. Before everything starts rolling and during its operation, education and training of compliance and the blockchain application should also be organized.

Then the question of who owns the blockchain (on the network layer), whether it is the companies themselves, their suppliers, or even NGOs (as suggested by Interviewee 5), is often a difficult one. Arriving at a solution would require the industry to collaborate on coming to a conclusion together. A suggestion could be for certification companies to take ownership of the blockchain, but not to exert control over the information, but rather to define what information is required and shared, basing this on the standards the industry already follows. Perhaps some industry standards should be established.

For individual companies, some interviewees expressed the need for blockchain to be adapted to their existing supply chain and systems. Tailored solutions would be preferred and a one-size-fits all solution would not be optimal. However, an industrial transformation is recommended. For this, standards for the blockchain need to be established to ensure interoperability along the supply chain and different actors. This might require industry-wide uprooting and reevaluation of current processes which will require a lot of temporal and financial investment. Blockchain cannot function effectively within the context of the current status quo. In a call to leaders of some the of world's most influential companies, including competitors, Walmart proposes creating a collaborative solution that would work for all and is scalable (Yiannas, 2018, p. 53). Once supply chain actors are ready, a private blockchain is recommended, rather than public blockchain. A private blockchain also allows companies to adapt to their own needs, remain competitive since they would be able to find unique use and applications for their data, and maintain certain data that necessarily needs to be, confidential. There are many emerging blockchain solution providers as well as foundations the industry can consult.

4) Measure and Communicate

Finally, the company needs to monitor blockchain's performance in effectively meeting its goals and how it can be enhanced. This is also where the company should be evaluating how it uses the data it obtains from the blockchain. Ultimately, social sustainability on cocoa farms

should improve as a result of this implementation. The company would also use that data to communicate its sustainability efforts for various purposes (i.e. sustainability reporting, certification, etc).

5.3 Limitations of Research

Every research has its limitations, and these must be acknowledged for the sake of transparency and in case of further study. There were a few areas in which the research could improve. Firstly, as is the case in a pragmatic research, the researcher's interpretations of data may have been subjective at times. It is not guaranteed that a replication of the study would yield the same results, but it might draw similar conclusions. Although this is inherent to the philosophy of the research, it should still be noted.

Secondly, this research tried to aggregate a global perspective, which was its aim. However, this was at the risk of being too general or superficial about the challenges faced in cocoa production all over the world. This potentially has as impact one the relevance of the research for one group versus another. In the future, it might be beneficial to focus on one region. Another limitation is that the, although it was not within the scope of the, it would have been enriching to get the perspective of smallholder cocoa farmers as these initiatives are really intended for them. It would also give this research a more wholistic perspective instead of considering one side. However, experts from NGOs and research organizations, in a way, represented the farmers. The researcher also failed to reach commodity traders who would be a major part of blockchain's implementation and could provide further insights about its adoption.

Furthermore, because the challenges in cocoa production are interrelated (e.g. environmental issues affecting poverty), an isolation of the social sustainability challenges from the others could be considered negligent. The result of this isolation could be a simplistic or limited view of blockchain's potential. Environmental challenges particularly recurred during interviews – sometimes as being the determinants of poverty – and companies usually approach sustainability in cocoa production holistically, showing that it may have been negligent to separate them. It was the researcher's initial intention to explore all aspects of sustainability, but there was a time limitation that hindered that from happening.

Another potential limitation could be the limited knowledge some interviewees had in one or more of the overarching themes of cocoa bean production, social sustainability, and blockchain.

Although the interviewees were provided sufficient background information on the three, not all would have read the guideline by the time of the interview. This may have affected the quality of the interview responses as interviewees spoke within the boundaries of their existing knowledge. However, the nature of the research was integrative, and the aim was to synthesize different topics towards a holistic perspective, so bringing in experts from different fields could not have been avoided. Even with literature, the integrative review method is known to be potentially fraught with error (Whittemore et al., 2005, p. 550).

A final, but minor, limitation is perhaps that the description word "trust" is not the best representative of the dimension of blockchain that enables cocoa bean producers and chocolate manufacturing companies to access funds. "Access to funds" may have been clearer, but in an attempt to make the results catchy (i.e. the 4Ts), "trust" was maintained.

5.4 Options for Further Research

As a very first step, it might be valuable to open the research up to more players both upstream and downstream in the cocoa-chocolate supply chain rather than limiting it to the players at the beginning of the chain. For instance, retailers and consumers also emerged during this research as being important to the cause of driving demand for sustainably produced products. This research presumed the decision of companies to potentially implement blockchain, therefore the stage for considering stakeholder opinion would have been skipped. However, if the scope of the research would be broadened to include other stakeholders concerned with social sustainability along the cocoa supply chain (e.g. customers, regulators, investors, and even governments), it may be worthy to explore stakeholder theory to create a more holistic perspective on who is driving demand for sustainability in chocolate what the implications of that are.

Moreover, if this topic is to be researched further, it is recommended that all four dimensions of sustainability according to the SAFA framework are investigated. This is due to the fact that a clear separation of the challenges proved to be impossible, with environmental, economic and governs issues emerging as causes and results of the social challenges in literature review and expert interviews all the same.

Furthermore, this research investigated the theoretical role of blockchain, rather than practical applicability the technology. The next step for further research would therefore be to investigate *how* the technology can be implemented within the cocoa supply chain. For

instance, how it can be connected to the different ERP systems, how the transactions would actually work, what it will cost to implement, whether the different players in the supply chain will be receptive, or what implications it would have for the future of cocoa production. Additional research in developing business models where blockchain can be integrated is also encouraged (Kamble et al., 2019, p. 188). Doing this would enhance the recommendations that can be given to companies. For interviewees: "The big question is how you are going to do it" (Interviewee 5, Personal Communication, July 23, 2019).

5.5 Research Outlook

Qualitative research is a good start to uncover insights about a new topic. But it also raises many questions. This research is just the tip of the iceberg for exploring what blockchain technology can do for social sustainability. Soon enough, blockchain may become a reality the industry cannot ignore and it is better to be ready than caught off guard. As Nidumolu et. al. (2009) put it: “Don’t start from the present. […] start from the future” (ibid, p. 8). Be it with blockchain, or any other equally capable technology, the industry’s goal should be a sweeter outcome for farmers immediately if it wants to ensure that the world can still enjoy chocolate.

LIST OF REFERENCES

Abeyratne, S., & Monfared, R. (2016). Blockchain Ready Manufacturing Supply Chain Using Distributed Ledger. *International Journal of Research in Engineering and Technology*, *05*.

Abualsamh, R. A., Carlin, B., & McDaniel, R. R. (1990). Problem structuring heuristics in strategic decision making. *Organizational Behavior and Human Decision Processes*, *45*(2), 159–174. https://doi.org/10.1016/0749-5978(90)90009-X

Adams, R., Kewell, B., & Parry, G. (2017). *Blockchain for Good? Digital Ledger Technology and Sustainable Development Goals*. https://doi.org/10.1007/978-3-319-67122-2_7

Azapagic, A. (2015). Sustainable Production and Consumption: A Decision-Support Framework Integrating Environmental, Economic and Social Sustainability. *Computer Aided Chemical Engineering*, *37*, 131–136. https://doi.org/10.1016/B978-0-444-63578-5.50017-7

Badia-Melis, R., Mishra, P., & Ruiz-García, L. (2015). Food traceability: New trends and recent advances. A review. *Food Control*, *57*, 393–401. https://doi.org/10.1016/j.foodcont.2015.05.005

Beg, M. S., Ahmad, S., Jan, K., & Bashir, K. (2017). Status, supply chain and processing of Cocoa—A review. *Trends in Food Science & Technology*, *66*. https://doi.org/10.1016/j.tifs.2017.06.007

Boles, H. (2017). *A Matter of Taste*. Retrieved from STOP THE TRAFFIK Australian Coalition website: https://cocoainitiative.org/wp-content/uploads/2017/09/A-Matter-of-Taste.pdf

Botsman, R. (2017). *We've stopped trusting institutions and started trusting strangers*. Retrieved from

https://www.ted.com/talks/rachel_botsman_we_ve_stopped_trusting_institutions_and_started_trusting_strangers

Brammer, S., Hoejmose, S. U., & Millington, A. K. (2011). *Managing Sustainable Global Supply Chain: Framework and Best Practices*.

Brand, F. (2019, March). *CR in Procurement and Supply Chain Management*. Presented at the MSc International Business Lecture, Winterthur, Switzerland.

Bühler Group. (2019, April 1). Bühler introduces blockchain-ready solutions at Hannover Messe to cut food poisoning rates and increase production efficiency. Retrieved 25 June 2019, from https://www.buhlergroup.com/global/en/about-buehler/media/media-releases/details.htm

Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: Moving toward new theory. *International Journal of Physical Distribution & Logistics Management*. https://doi.org/10.1108/09600030810882816

Cavaliere, C. (2018). *A case study on the exploration of Blockchain potential: An exploratory research on the impact of the technology on business process and value configuration of a mid-European company* (TU Delft). Retrieved from https://repository.tudelft.nl/islandora/object/uuid%3Aae77f34e-9c2f-459d-9172-48c2cd302d29

Chocoladefabriken Lindt & Sprüngli AG. (n.d.-a). Lindt & Sprüngli Farming Program. Retrieved 8 September 2019, from https://www.farming-program.com/en#the-lindt--spr%C3%BCngli--promise

Chocoladefabriken Lindt & Sprüngli AG. (n.d.-b). Sustainability | Lindt & Sprüngli. Retrieved 8 September 2019, from https://www.lindt-spruengli.com/sustainability/

Collinson, C., & Leon, M. (2000). *Economic Viability of Ethical Cocoa Trading in Ecuador* (p. 38). Retrieved from University of Greenwich website: https://core.ac.uk/download/pdf/42390190.pdf

da Costa Guimarães, R., van Andel, M., Gocsik, E., & Brouwers, J. (2019). *A chain of possibilities: Scoping the potential of blockchain technology for agri-food production chains in low- and middle- income countries*. Retrieved from Fair food, Wageningen University website: https://fairfood.nl/wp-content/uploads/2019/05/A-Chain-of-Possibilities.pdf

Davis, K. (1973). The Case for and Against Business Assumption of Social Responsibilities. *Academy of Management Journal*, *16*(2), 312–323.

Eckelmann, O. (2006). *Strategisches Nachhaltigkeitsmanagement in der pharmazeutischen Industrie*. Berlin University, Wiesbaden, Germany.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, *14*(4), 532–550. https://doi.org/10.2307/258557

Fair Labor Association. (2012). *Sustainable Management of Nestlé's Cocoa Supply Chain in the Ivory Coast—Focus on Labor Standards*. Retrieved from https://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?referer=https://scholar.google.com/&httpsredir=1&article=2740&context=globaldocs

Faye, P. S. (2017, June). *Use of Blockchain Technology in Agribusiness: Transparency and Monitoring in Agricultural Trade*. Presented at the 2017 International Conference on Management Science and Management Innovation (MSMI 2017). https://doi.org/10.2991/msmi-17.2017.9

Fold, N., & Pritchard, B. (2005). *Cross-Continental Agro-Food Chains: Structures, Actors and Dynamics in the Global Food System*. Routledge.

Forsman-Hugg, S., Katajajuuri, J.-M., Riipi, I., Mäkelä, J., Järvelä, K., & Timonen, P. (2013). Key CSR dimensions for the food chain. *British Food Journal*, 30–47. https://doi.org/10.1108/00070701311289867

Fountain, A., & Huetz-Adams, F. (2018). *Cocoa Barometer 2018*. Retrieved from VOICE Network website: https://www.voicenetwork.eu/wp-content/uploads/2019/07/2018-Cocoa-Barometer.pdf

Freeman, R. E. (2004). The Stakeholder Approach Revisited. *Zeitschrift Für Wirtschafts- Und Unternehmensethik*, *5*(3), 228–241. https://doi.org/10.5771/1439-880X-2004-3-228

Freeman, R. E., & Mcvea, J. (2001). A Stakeholder Approach to Strategic Management. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.263511

Friedman, M. (2007). The Social Responsibility of Business Is to Increase Its Profits. In W. C. Zimmerli, M. Holzinger, & K. Richter (Eds.), *Corporate Ethics and Corporate Governance* (pp. 173–178). https://doi.org/10.1007/978-3-540-70818-6_14

Galen, D., Brand, N., Boucherle, L., Davis, R., Do, N., El-Baz, B., … Lee, J. (2018). *Blockchain for Social Impact*. Retrieved from Stanford Graduate School of Business website: https://www.gsb.stanford.edu/faculty-research/publications/blockchain-social-impact

Gayi, S. K., & Tsowou, K. (2016). *Cocoa Industry: Integrating Small Farmers into the Global Value Chain*. https://doi.org/10.18356/cfb75b0e-en

Ge, L., Brewster, C., Spek, J., Smeenk, A., Top, J., Diepen, F. van, … Wildt, M. de R. de. (2017). *Blockchain for agriculture and food: Findings from the pilot study*. https://doi.org/10.18174/426747

Gladwin, T. N., Kennelly, J. J., & Krause, T.-S. (1995). Shifting Paradigms for Sustainable Development: Implications for Management Theory and Research. *The Academy of Management Review*, *20*(4), 874–907. https://doi.org/10.2307/258959

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a Conceptual Framework for Mixed-Method Evaluation Designs. *Educational Evaluation and Policy Analysis*, *11*(3), 255–274. https://doi.org/10.3102/01623737011003255

GSMA Digital Identity. (2017). *GSMA Blockchain for Development: Emerging Opportunities for Mobile, Identity and Aid* (pp. 1–28). Retrieved from GSMA website: https://www.gsma.com/mobilefordevelopment/programme/digital-identity/blockchain-development-emerging-opportunities-mobile-identity-aid-2/

Hansen, E. G., Grosse-Dunker, F., & Reichwald, R. (2009). Sustainability innovation cube—A framework to evaluate sustainability-oriented innovations. *International Journal of Innovation Management*, *13*(04), 683–713. https://doi.org/10.1142/S1363919609002479

Harrington, L. (2016). Sustainability Theory and Conceptual Considerations: A Review of Key Ideas for Sustainability, and the Rural Context. *Papers in Applied Geography*. https://doi.org/10.1080/23754931.2016.1239222

Hershey Co. (2019). *Cocoa Interrupted: The role of social enterprise in cocoa sustainability*. Retrieved from Acumen website: https://acumen.org/wp-content/uploads/Acumen-Cocoa-Interrupted-Report.pdf

Hileman, G., & Rauchs, M. (2017). *2017 Global Blockchain Benchmarking Study* (SSRN Scholarly Paper No. ID 3040224). Retrieved from Social Science Research Network website: https://papers.ssrn.com/abstract=3040224

Hirbli, T. (2018). *Palm Oil traceability: Blockchain meets supply chain* (Massachusetts Institute of Technology). Retrieved from

https://dspace.mit.edu/bitstream/handle/1721.1/117800/1051223547-MIT.pdf?sequence=1

Hörisch, J., Johnson, M. P., & Schaltegger, S. (2015). Implementation of Sustainability Management and Company Size: A Knowledge-Based View. *Business Strategy and the Environment*, *24*(8), 765–779. https://doi.org/10.1002/bse.1844

Huetz-Adams, F. (2016). *STUDY ON THE ESTABLISHMENT OF A COCOA SUSTAINABILITY FUND* (pp. 1–73). Retrieved from SÜDWIND e.V. - Institut für Ökonomie und Ökumene website: file:///Users/maphridaforichi/Downloads/Sudwind%20study%20Cocoa%20Sustainability%20Fund.pdf

Hunink, Y. (2018). Hype or Ripe? Retrieved 13 July 2019, from Blockchain for Change website: http://blockchainforchange.thespindle.org/nl_NL/6090/90687/hype_or_ripe%3f.html

Iansiti, M., & Lakhani, K. R. (2017). The Truth About Blockchain. *Harvard Business Review*, 11.

International Cocoa Organization. (2018). *ICCO Quarterly Bulletin of Cocoa Statistics, Vol. XLIV* (No. 4). Retrieved from https://www.icco.org/about-us/international-cocoa-agreements/cat_view/30-related-documents/46-statistics-production.html

International Organization for Standardization. (2019a, May). *ISO 34101-1: SUSTAINABLE AND TRACEABLE COCOA -- PART 1: REQUIREMENTS FOR COCOA SUSTAINABILITY MANAGEMENT SYSTEMS*. Retrieved from http://www.iso.org/cms/render/live/en/sites/isoorg/contents/data/standard/06/47/64765.html

International Organization for Standardization. (2019b, May). *ISO 34101-3: SUSTAINABLE AND TRACEABLE COCOA -- PART 3: REQUIREMENTS FOR TRACEABILITY*.

Retrieved from http://www.iso.org/cms/render/live/en/sites/isoorg/contents/data/standard/06/47/64767.html

International Trade Centre (Ed.). (2001). *Cocoa: A guide to trade practices*. Retrieved from http://www.intracen.org/uploadedFiles/intracenorg/Content/Publications/Cocoa%20-%20A%20Guide%20to%20Trade%20Practices%20English.pdf

Johnson, M. P. (2015). Sustainability Management and Small and Medium-Sized Enterprises: Managers' Awareness and Implementation of Innovative Tools. *Corporate Social Responsibility and Environmental Management*, *22*(5), 271–285. https://doi.org/10.1002/csr.1343

Johnson, M. P., & Schaltegger, S. (2016). Two Decades of Sustainability Management Tools for SMEs: How Far Have We Come? *Journal of Small Business Management*, *54*(2), 481–505. https://doi.org/10.1111/jsbm.12154

Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2019). Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications. *International Journal of Production Economics*, *219*, 179–194. https://doi.org/10.1016/j.ijpe.2019.05.022

Kaplinsky, R. (2004, May). *COMPETITIONS POLICY AND THE GLOBAL COFFEE AND COCOA VALUE CHAINS*. Retrieved from https://www.ids.ac.uk/files/RKaplinskycocoacoffee05.pdf

Kiesnere, A., & Baumgartner, R. (2019). Sustainability Management in Practice: Organizational Change for Sustainability in Smaller Large-Sized Companies in Austria. *Sustainability*, *11*, 572. https://doi.org/10.3390/su11030572

KPMG. (2018). *Realizing blockchain's potential* (p. 16). Retrieved from KPMG International website: https://home.kpmg/content/dam/kpmg/co/pdf/2018/09/kpmg-realizing-blockchains-potential.pdf

Kshetri, N. (2018). 1 Blockchain's roles in meeting key supply chain management objectives. *International Journal of Information Management*, *39*, 80–89. https://doi.org/10.1016/j.ijinfomgt.2017.12.005

Kuhndt, M. (2004). Sustainable Business Development. In *Eco-efficiency and Beyond: Towards the Sustainable Enterprise* (pp. 64–72). Greenleaf Publishing Limited.

Locher, T., Obermeier, S., & Pignolet, Y. A. (2018). When Can a Distributed Ledger Replace a Trusted Third Party? *ArXiv:1806.10929 [Cs]*. Retrieved from http://arxiv.org/abs/1806.10929

Lozano, R. (2012). Towards better embedding sustainability into companies' systems: An analysis of voluntary corporate initiatives. *Journal of Cleaner Production*, *25*, 14–26. https://doi.org/10.1016/j.jclepro.2011.11.060

Luederitz, C., Meyer, M., Abson, D., Gralla, F., Lang, D., Rau, A.-L., & von Wehrden, H. (2016). Systematic student-driven literature reviews in sustainability science—An effective way to merge research and teaching. *Journal of Cleaner Production*, *119*, 229–239. https://doi.org/10.1016/j.jclepro.2016.02.005

Mainelli, M., & Smith, M. (2015). *Sharing Ledgers for Sharing Economies: An Exploration of Mutual Distributed Ledgers (Aka Blockchain Technology)* (SSRN Scholarly Paper No. ID 3083963). Retrieved from Social Science Research Network website: https://papers.ssrn.com/abstract=3083963

Mars Incorporated. (n.d.). Saving Tomorrow's Cocoa, Today | Mars, Incorporated. Retrieved 8 September 2019, from https://www.mars.com/news-and-stories/articles/cocoa-farming-sustainability

Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook* (2nd ed.). Retrieved from https://vivauniversity.files.wordpress.com/2013/11/milesandhuberman1994.pdf

Mondēlez International. (n.d.-a). Cocoa Life—Cocoa Life is Empowering Women. Retrieved 14 August 2019, from Cocoa Life website: http://www.cocoalife.org/the-program/womens-empowerment

Mondēlez International. (n.d.-b). Cocoa Life—Cocoa Life is Making an Impact. Retrieved 6 September 2019, from Cocoa Life website: http://www.cocoalife.org/impact

Morrison, O. (2019, April 16). Nestlé unveils blockchain initiative with Carrefour to improve transparency. Retrieved 28 August 2019, from Foodnavigator.com website: https://www.foodnavigator.com/Article/2019/04/16/Nestle-Carrefour-unveil-blockchain-initiative-to-improve-transparency

Muilerman, S. (2013). *OCCUPATIONAL SAFETY AND HEALTH ON GHANAIAN COCOA FARMS* [Baseline report]. Retrieved from International Institute of Tropical Agriculture (IITA) website: https://cocoainitiative.org/wp-content/uploads/2017/10/Occupational-safety-and-health-on-Ghanaian-cocoa-farms.pdf

Mull, L. D., & Kirkhorn, S. R. (2005). Child Labor in Ghana Cocoa Production: Focus upon Agricultural Tasks, Ergonomic Exposures, and Associated Injuries and Illnesses. *Public Health Reports*, *120*(6), 649–655. https://doi.org/10.1177/003335490512000613

Myers, A. (2018, October 23). Spotlight on South America from the World Cocoa Foundation Conference. Retrieved 3 August 2019, from Confectionerynews.com website: https://www.confectionerynews.com/Article/2018/10/23/Spotlight-on-cocoa-production-in-Latin-America

Nakamoto, S. (2008). *Bitcoin: A Peer-to-Peer Electronic Cash System*. 9.

Nidumolu, R., Prahalad, C. K., & Rangaswami, M. R. (2009). Why Sustainability Is Now the Key Driver of Innovation. *Harvard Business Review*, (September 2009). Retrieved from https://hbr.org/2009/09/why-sustainability-is-now-the-key-driver-of-innovation

Nikolakis, W., John, L., & Krishnan, H. (2018). How Blockchain Can Shape Sustainable Global Value Chains: An Evidence, Verifiability, and Enforceability (EVE) Framework. *Sustainability*, *10*, 1–16. https://doi.org/10.3390/su10113926

Notheisen, B., Cholewa, J. B., & Shanmugam, A. P. (2017). Trading Real-World Assets on Blockchain. *Business & Information Systems Engineering*, *59*(6), 425–440.

Panlibuton, H., & Lusby, F. (2006). *Indonesia Cocoa Bean Value Chain Case Study*. Retrieved from United States Agency for International Development website: http://www.value-chains.org/dyn/bds/docs/541/USAID%20AMAP%20Indonesia%20Cocoa%20VC%20Case%202006.pdf

Pearson, S., May, D., Leontidis, G., Swainson, M., Brewer, S., Bidaut, L., … Zisman, A. (2019). Are Distributed Ledger Technologies the panacea for food traceability? *Global Food Security*, *20*, 145–149. https://doi.org/10.1016/j.gfs.2019.02.002

Pisa, M. (2018, May). Reassessing Expectations for Blockchain and Development. Retrieved 15 August 2019, from Center For Global Development website: https://www.cgdev.org/publication/reassessing-expectations-blockchain-and-development-cost-complexity

Platt, C. (2017, January 16). Of permissions and blockchains… A view for financial markets. Retrieved 4 September 2019, from Medium website: https://medium.com/@colin_/of-permissions-and-blockchains-a-view-for-financial-markets-bf6f2be0a62

Potma, M. (2018, November 25). Blockchain to restore trust in food supply chains? — A case study in the cacao sector of Costa Rica. Retrieved 11 July 2019, from Medium website: https://medium.com/dsi4eu/blockchain-to-restore-trust-in-food-supply-chains-a-case-study-in-the-cacao-sector-of-costa-rica-207dab35b0b2

Provenance. (2016, July 15). From shore to plate: Tracking tuna on the blockchain. Retrieved 7 September 2019, from Provenance website: https://www.provenance.org/tracking-tuna-on-the-blockchain

Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research*, *57*(7), 1–19. https://doi.org/10.1080/00207543.2018.1533261

Saldaña, J. (2009). *The coding manual for qualitative researchers*. Retrieved from https://epdf.pub/the-coding-manual-for-qualitative-researchers.html

Saunders, M. N. K., Lewis, P., & Thornhill, A. (2009). *Research methods for business students* (5th ed). New York: Prentice Hall.

Schaltegger, S., Lüdeke-Freund, F., & Hansen, E. (2012). Business Cases for Sustainability: The Role of Business Model Innovation for Corporate Sustainability. *International Journal of Innovation and Sustainable Development*, *6*, 95–119. https://doi.org/10.1504/IJISD.2012.046944

Schrage, E. J., & Ewing, A. (2005). The Cocoa Industry and Child Labour. *Journal of Corporate Citizenship*, *2005*. https://doi.org/10.9774/GLEAF.4700.2005.su.00013

Schuetz, S., & Venkatesh, V. (2019). Blockchain, adoption, and financial inclusion in India: Research opportunities. *International Journal of Information Management*. https://doi.org/10.1016/j.ijinfomgt.2019.04.009

Schüz, M. (2012). Sustainable Corporate Responsibility—The Foundation of Successful Business in the New Millennium. *Central European Busines Review*, *1*, 7–18. https://doi.org/10.18267/j.cebr.12

Scialabba, N. (2014). *SAFA guidelines: Sustainability assessment of food and agriculture systems* (Version 3.0; Food and Agriculture Organization of the United Nations, Ed.). Retrieved from http://www.fao.org/3/a-i3957e.pdf

SeeHow. (n.d.). SeeHow | Supply chain transparency wins trust. Retrieved 8 September 2019, from SeeHow website: https://www.seehowconnection.com

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, *16*(15), 1699–1710. https://doi.org/10.1016/j.jclepro.2008.04.020

Steiner, J., & Baker, J. (2015, November 21). Blockchain: The solution for supply chain transparency. Retrieved 25 August 2019, from Provenance website: https://www.provenance.org/whitepaper

Suyash, K. C. (2012, October 1). *Leveraging Technological Advances in Corporate Social Responsibility (CSR): A Systems Thinking Approach*. 122–127. https://doi.org/10.1109/GHTC.2012.27

Tachizawa, E. M., & Wong, C. Y. (2014). Towards a theory of multi-tier sustainable supply chains: A systematic literature review. *Supply Chain Management: An International Journal*. https://doi.org/10.1108/SCM-02-2014-0070

The International Cocoa Organization. (2009). *Roundtable for a Sustainable Cocoa Economy*. Retrieved from https://www.icco.org/sites/www.roundtablecocoa.org/documents/RSCE2-6_EN%20Social%20Issues.pdf

Thomason, J., Ahmad, M., Bronder, P., Hoyt, E., Pocock, S., Bouteloupe, J., … Shrier, D. (2018). Blockchain—Powering and Empowering the Poor in Developing Countries. In *Transforming Climate Finance and Green Investment with Blockchains* (pp. 137–152). https://doi.org/10.1016/B978-0-12-814447-3.00010-0

Ton, G., Hagelaars, G., Laven, A., & Vellema, S. (2008). Chain Governance, Sector Policies and Economic Sustainability in Cocoa: A Comparative Analysis of Ghana, Côte D'Ivoire, and Ecuador. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1609686

Tony's Chocolonely. (2018). *Tony's Chocolonely Annual Fair Report 2017/2018*. Retrieved from Tony's Chocolonely website: https://tonyschocolonely.com/storage/configurations/tonyschocolonelycom.us/files/jaarfairslag/2017-2018/tonyjfs_201718_complete_eng.pdf

United Nations Conference on Trade and Development. (2010). *International Cocoa Agreement*. Retrieved from https://unctad.org/en/Docs/tdcocoa10d5_en.pdf

United Nations Global Compact. (2015). *Supply Chain Sustainability: A Practical Guide for Continuous Improvement, Second Edition* (pp. 1–74). Retrieved from https://www.unglobalcompact.org/docs/issues_doc/supply_chain/SupplyChainRep_spread.pdf

van Marrewijk, M. (2003). Concepts and Definitions of CSR and Corporate Sustainability: Between Agency and Communion. *Journal of Business Ethics*, *44*(2), 95–105. https://doi.org/10.1023/A:1023331212247

Vega, H., & Beillard, M. J. (2015). *Ecuador Cocoa Update and Outlook*. Retrieved from USDA Foreign Agricultural Service website: https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Ecuador%20Cocoa%20Update%20and%20Outlook_Quito_Ecuador_2-18-2015.pdf

Verhoelen, J. (2017, October 17). Consensus mechanisms of the blockchain. Retrieved 19 August 2019, from Codecentric AG Blog website: https://blog.codecentric.de/en/2017/10/consensus-mechanisms-blockchain/

Vigneri, M., & Kolavalli, S. (2018). *Growth through pricing policy: The case of cocoa in Ghana*. Retrieved from http://www.fao.org/3/I8329EN/i8329en.pdf

Vincent Abt, Emeline Perrier, & Frédéric Vigier. (2006). Towards an Integration of Farm Enterprise Information Systems: A first Analysis of the Contribution of ERP Systems to Software Function Requirements. *Computers in Agriculture and Natural Resources, 23-25 July 2006, Orlando Florida*, 469–474. https://doi.org/10.13031/2013.21919

Wagner, M., & Schaltegger, S. (2003). How Does Sustainability Performance Relate to Business Competitiveness? *Greener Management International*, *2003*. https://doi.org/10.9774/GLEAF.3062.2003.wi.00003

Weber, M. (2008). The business case for corporate social responsibility: A company-level measurement approach for CSR. *European Management Journal*, *26*, 247–261. https://doi.org/10.1016/j.emj.2008.01.006

Wehner, N. (2018). *Sustainability Certification Goes Blockchain*. Retrieved from http://lup.lub.lu.se/student-papers/record/8962967

Wettstein, M. (2015). *Cocoa Sourcing: Sustainability Challenges and Emerging Corporate Response*. University of St. Gallen, St. Gallen, Switzerland.

Whittemore, R., Aprn, P., & Knafl, K. (2005). The integrative review: Updated methodology. *Journal of Advanced Nursing*, *52*(5), 546–553.

Whoriskey, P., & Siegel, R. (2019, June 5). Hershey, Nestle and Mars won't promise their chocolate is free of child labor. Retrieved 6 September 2019, from Washington Post

website: https://www.washingtonpost.com/graphics/2019/business/hershey-nestle-mars-chocolate-child-labor-west-africa/

Witjes, S., Cramer, J. M., & Vermeulen, W. J. V. (2015). *On corporate sustainability integration and the support of tools*. 27. https://doi.org/10.1504/wremsd.2018.10014674

Wognum, N., Bremmers, H., Trienekens, J., Van der Vorst, J., & Bloemhof-Ruwaard, J. (2011). Systems for sustainability and transparency of food supply chains—Current status and challenges. *Advanced Engineering Informatics*, *25*, 65–76. https://doi.org/10.1016/j.aei.2010.06.001

World Bank. (2013). *Ghana: Cocoa Supply Chain Risk Assessment*. Retrieved from World Bank website: https://openknowledge.worldbank.org/bitstream/handle/10986/16516/775890WP0Ghana0Box0342041B00PUBLIC0.pdf?sequence=1&isAllowed=y

World Commission on Environment and Development. (1987). *Report of the World Commission on Environment and Development: Our Common Future*. Retrieved from United Nations website: https://www.are.admin.ch/are/en/home/nachhaltige-entwicklung/internationale-zusammenarbeit/agenda-2030-fuer-nachhaltige-entwicklung/uno-_-meilensteine-zur-nachhaltigen-entwicklung/1987--brundtland-bericht.html

World Economic Forum. (2018). *Building Block(chain)s for a Better Planet*. Retrieved from https://www.weforum.org/reports/building-block-chain-for-a-better-planet/

Wüst, K., & Gervais, A. (2018). Do you Need a Blockchain? *2018 Crypto Valley Conference on Blockchain Technology (CVCBT)*, 45–54. https://doi.org/10.1109/CVCBT.2018.00011

Yiannas, F. (2018). A New Era of Food Transparency Powered by Blockchain. *Innovations: Technology, Governance, Globalization*, *12*(1–2), 46–56. https://doi.org/10.1162/inov_a_00266

Zhao, G., Liu, S., Lopez, C., Lu, H., Elgueta, S., Mileva-Boshkoska, B., & Chen, H. (2019). Blockchain technology in agri-food value chain management: A synthesis of applications, challenges and future research directions. *Computers in Industry*, *109*, 83–99. https://doi.org/10.1016/j.compind.2019.04.002

	C	B	N	Questions		Response	Codes		Response	Codes	
						Interviewee 1 *(Manager Raw Materials & Sustainability, Top 10 largest global chocolate manufacturing company)*			**Interviewee 2** *(Cocoa Sustainability Manager, Top 10 largest global chocolate manufacturing company)*		
				About the company/interviewee					Sustainability has become how this company does business; Partner with local and international NGOs or help develop capacity of suppliers to develop programs; Mapped supply chains first to figure out where stuff is coming from then mapped them across 5 impact areas and cocoa emerged in this prorgam as one of the priority raw materials;		
1	X		X	**What are the common social sustainability challenges the chocolate industry faces in cocoa bean production?**	1	Main challenge is low farmer income due to small farm size, low productivity, weak agricultural practices, high input and transportation costs; Child labour; Health and safety	Living income Low productivity (linked to farm & environment) Child labor Health and safety	1	Challenges are common across every company in a region but differ depending on geography; Low productivity, smallholders not able to get high production and yield because of the whole ecosystem, productivity a function of soil, knowledge, access to capital, and human behavior and behavior change; Cocoa production is labor intensive as a consequence, poverty; Low farmer income, resilience to economic shocks, productivity and yields, child labor partly cultural partly educational partly poverty – interviewee says should do less policing and more remediation; More professional cocoa farming in Latin America and Asia because more access to capital and youth being engaged	Low productivity Living income Child labor Unprofessional cocoa farming Need for remediation	1
2	X		X	**Which upstream supply chain or sustainability management systems or tools does the industry currently use to ensure sustainable practices in cocoa bean production regarding the social sustainability challenges you mentioned?**	2	Company own sustainability programs executed by the suppliers with full traceability e.g. this company's farming program; Certification i.e. UTZ and Fair Trade, sourcing either directly from farmers through these programs or mass balance through cooperatives	Company sustainability programs Certification (UTZ, Fair Trade, Rain Forest Alliance)	2	No standard system that everyone uses and no standard reporting system on impact, no industry approach; On social challenges historically there's been a shift from doing some community-oriented programs in places and buying from other places, towards a convergence of sustainability in the areas suppliers are sourcing from; No common systems out there, althougth certification has been a way to organize supply chain and put in some of the base sustainability challenges; "Now our needs for change and impact are far greater than what certification can provide" so you see companies coming up with own standards of management systems or buying into supplier standards and management systems or improving certification systems to align with higher impact; Certification is quite widely used and helps with accountability	No industry standard Certification (UTZ, Fair Trade, Rain Forest Alliance) Company sustainability programs	2
3		X		**Describe blockchain. What are its main characteristics and what advantages does it offer for supply chains?**	3			3			3
4	X	X	X	**What potential role do you think blockchain has in addressing social sustainability challenges encountered in cocoa bean production? If so, which ones and how? If not, why not?**	4	Blockchain can't address the challenges but can tackle the transparency and traceability, which then depends on how public the blockchain is; If not public, it helps company have more efficient process for traceability; Potentially reduces paperwork between all the steps which is usually farmer to cooperative, cooperative to suppliers, suppliers to chocolate company; However digitization and automization of paperwork possible even without blockchain	Believes in potential Indirect role Transparency Traceability Increased efficiency (less paper work) Automization	4	Two things 1. have to look at the chat around blockchain and how that has changed over the last few years, the promise and the perils and 2. have to look at where it can be applied; On the potential of blockchain there has been a proliferation of blockchain providers; There are some concerns about what's realistic and what's technology fluff; In cocoa blockchain can add value to a number of things but doesn't solve fundamental issues like mapping supply chain, and once you map your supply chain you have to collect quality information that flows through that blockchain; Also a question of what business need you are trying to solve	Not sure about potential Indirect role The closer to farmers you are, the better Establish relevance of implementation Relevance of blockchain application	4
5	X	X	X	**What additional benefits can blockchain offer in ensuring socially sustainable practices in cocoa bean production compared to other upstream supply chain management systems or tools currently deployed by the industry?**	5	Blockhain offers benefit for automatic traceability visible for more people i.e. customers; More transparent; Blockchain won't be solution to solve sustainability problems; Baseline for tackling sustainability should be traceability, but even then you need to engage with farmers etc; Assume it means less paper work e.g. this company has to cross-check supplier list they receive from a shipment with list of suppliers that are part of their program to ensure sustainability; Company should have stable base of suppliers in order to engage with farmers but cocoa is a commodity traded at the stock exchange so the farmers cooperatives source from can change, but a company can keep it's cooperative consistent	Better and automatic traceability Augmented transparency (depending on how public blockchain is) Increased efficiency (less paper work)	5	If there are issues with either food safety or financial transparency because cocoa is aggregated at different points and money is exchanged and there are concerns that farmers are not receiving the premiums they are meant to, then blockchain can be useful, but then you've got mobile money/transfer options that are more interoperable	Augmented transparency Financial transactions (farmer premiums)	5

6	X		**Does your company find blockchain an interesting solution for ensuring socially sustainable practices in cocoa bean production and is blockchain something you are considering adopting? Why or why not?**	6	Don't find it interesting as a solution to ensure socially sustainable practices but to have the traceability and transparency which helps ensure sustainable practices, but still need monitoring and assessments on the ground; This company not actively considering it but following its development; Wants to see more adoption and use cases	Passively considering Following its development Hesitant Want more successful adoption cases	6	This company has tested different blockchains to see where it makes the most sense to apply it i.e. high costs associated with seggregating cocoa, keeping an eye open for the future, but is also looking for solution that is simpler, faster, cheaper than blockchain; Tested it for the following: can you use blockchain to improve financial transparency along the supply chain, to give farmers more of an economic identity so they get access to credits and inputs in the future, can you connect it with your purchases to give more evidence to what you do; Issues encountered were the mobile penetration in these countries, interoperability in terms of blockchain provider not working with company sustainability management system provider because they see each other as future competitors; There are points in the supply chain which require human intervention i.e. mapping	Actively considering (tested) Following its development Hesitant/skeptical Open to alternatives Limited by complexity of supply chain (big company)	6
7	X		**Which actors would be involved in the adoption of blockchain technology at the cocoa bean production stage if your company were to implement it, and how receptive do you think they would be of the technology?**	7	Has to be driven from commodity companies e.g OLAM as they are the link to the farmers and have the supply chain under their control; But has to start with the intermediaries between OLAM and the farmer; If this company would start it would make an alliance with cocoa bean suppliers	Farmers Intermediaries Trading/commodity companies	7	In an ideal case it would be a farmer linked to a collective/farmer organization or cooperative then a trader/large supplier then processor that might be a supplier itself then the cocoa manufacturing company; This company's supply chain is segregated until the farmer cooperative (where the farmer is, how much of the farmer's production went to the cooperative, and how much goes to this company) to make sure they're buying sustainably produced cocoa, and then after that it's mixed with other products; There are some clear applications of blockchain when it comes to an overlap between the people you are working with and the kind of work you're doing i.e. supply chain structure, if you're closer to the farmers and there are less nodes in the network, it's more relevant and easier to implement; Chocolate manufacturers fund/pay cooperatives a lot to achieve a certain level of transparency	Farmers Cooperatives Trading/commodity companies Processors Segregation of supply chain required	7
8	X	X	X	**What would the value-drivers or incentives of adopting blockchain in cocoa bean production to address social sustainability be for a confectionary company?**	8	Less paper work and manual work and automized checks – efficiency; Could market traceability more than they already do; Company reputation; Value proposition to public; Legal compliance does not go in there yet because the laws are not yet so strict; Operational efficiency	Operational efficiency (less paperwork, automized) Value proposition to customers Company reputation Value proposition to public	8	Consumer perspective is not the main driver, and differs between different markets i.e. US vs EU for instance; Supplier management but would require all suppliers being part of the blockchain but tricky because lots of fragmentation; Operational efficiency but depends on how far you are from origin i.e. supplier making sure that money reaches farmer; Value proposition to public	Supplier management Operational efficiency Value proposition to public	8
9		X	X	**What would some challenges or hurdles associated with implementing blockchain at the production stage of an upstream agri-food supply chain be?**	9			9			9
10	X	X	X	**And finally, do you see blockchain as being an ultimate solution for addressing social sustainability challenges in cocoa bean production?**	10	No; Helps traceability and transparency so you know which farmers are behind the program but it's not automatically addressing sustainability	No But somehow addresses issues No immediate effect on sustainability	10	No, it's one solution that can work for certain types of supply chain structures which intersect with certain types of challenges, very context specific; Technology is viewed as an enabler in general, but usually tend to worry when some technology comes around and says it can fix everything; It's incentives and peoples' behavior change that matters in the long term; But blockchain transparency does change behavior; Interoperability and question of who owns blockchain; At the end of the day, what do farmers get out of it?	No But somehow addresses issues Technology is an enabler Blockchain changes behavior Business incentives Ownership of blockchain	10
11	X	X	X	**Would you like to share any other thoughts?**	11	Having traceability with cocoa bean is challenging because many bags of cocoa beans go into the silo and one bar of chocolate is produced by mixing beans with different origins, mass balance, that's a challenge for cocoa blockchain – different to fish for example; Blockchain not only interesting for social sustainability but deforestation is a hot topic		11	From across companies and departments realised that "A lot of times technology comes not from a business need, but it comes from, oh this looks cool, how can we do it, vs what's our business need that we want to address and what technology maps onto it"; With regards to transparency, "In the end its not about how you do it, but that you it" so it doesn't necesarily have to be with blockchain		11

	Response	Codes
	Interviewee 3 *(CEO Goodio Chocolate, Helsinki Heaven)*	
1	Child labor, Living income, poverty; Envrionmental issues will also be a huge social problem because farmers have to increase production; Inability to trace cocoa, supply chain is very difficult to manage for bigger companies because they don't buy beans directly from farmers or cooperatives but rather chocolate base; Price of cocoa is low	Child labor Living income Low productivity (linked to farm & environment) Inability to trace cocoa Low price of cocoa
2	Certification schemes and own company programs; This company promises to get rid of child labor in the industry; The chocolate chain in the country of origin is normally managed by the government and you can't just change the government; There has to be gradual change but more drastic measures should be taken to accelerate change; Companies have their own programs to improve the supply chain; The issue is how to ensure that these programs are working, of course there are price premiums to make sure that things get better	Certification (UTZ, Fair Trade, Rain Forest Alliance) Company sustainability programs Cocoa chain managed by government in origin countries
3	Blockchain is good in transparency and you are sure that the information is not tampered in any way; The consumer in the future will really appreciate transparency; Blockchain could add trust to a complex supply chain	Believes in potential Enabler Transparency Immutability Increased security and trust (downstream)
4	Blockchain is a good technology to use as a part of the existing systems, because companies do a lot for sustainability and blockchain can support their efforts; But blockchain has to be combined with other technologies; The immutability; With blockchain you can create a two way street e.g. an application that if a consumer wants to donate money to a project, they can donate and be sure that the farmers get 100% of the value	Complementary role Immutability Increased security and trust (downstream)

	Response	Codes
	Interviewee 4 *(Global Cocoa Sustainability Program Manager, Top 10 largest global chocolate manufacturing company)*	
1	Three main ones: labour laws, child protection, earning a living income; But then also environmental because boundaries are fluid, you always touch on social things like income	Child labor Living income Labor laws
2	Mix of a lot of different things because many people involved with their own systems i.e. farmers, cooperatives and processors; In-house systems e.g. keeping a list of farmers who are members, that are transferred throughout the supply chain; This company has own data it collects and manages which it gets from its suppliers e.g. where farms are collected & data collected by third parties that visit farmers to confirm data and evaluate farms & other data for R&D; What is incredibly challenging or missing is one system that spans all suppliers, origins and issues because exchange of data among actors quite cumbersome, blockchain could help standardize	No industry standard Company sustainability programs Missing a system that spans all suppliers and origins
3	Blockchain does have the potential; Pushes further the ease of interoperating data and resources i.e. who is maintaining and who has ownership rights, but it hasn't been the biggest challenge before, blockchain is not offering a brand new solution; Blockchain is a buzzword for systems somewhat similar or have components of blockchain, everything else is a more private form of blockchain; Organizations that approach blockchain haven't gone full out; What blockchain does is increase security and trust between the actors, but again this wasn't the main challenge; The main challenge is the complexity of topics in cocoa supply chain and how to make them simplers in their nature which blockchain cannot really address; Other challenge is getting reliable information to begin with and the exact identity of the farmers, and how to preserve the identity down the line which blockchain can help (to some extent, not considering the bulk nature of cocoa); Blockchain can help down the line, but without addressing the current main challenges it's not pressing to apply	Believes in potential Indirect role Interoperatability Increased security and trust (upstream)
4	Blockchain could help down the line to have integrated system across a lot of actors actors with reliable information; Increases security and trust between actors; Can more closely monitor exact origin of production which could help with deforestation for example	Complementary role Improved interoperability Increased security and trust (upstream) Better traceability

	Response	Codes
	Interviewee 5 *(CEO and Founder, SCHÖKI AG)*	
	Founded 2 years ago; Currently applying for funds from Secco; Founder worked in sustainability field of Barry Callebaut and was inspired to take sustainability to a new level through Schöki which he considers a use case to prove what should be done by other companies; What are the flaws with Fair Trade and other labels/certifications; Fairstanability = fair + sustainability; Want to ensure a living income to farmers by paying direct income to them for the ecosystem service (e.g. plant trees) that they provide through their forest, this is how this company takes responsiblity; Want to program open access software that can be used for free but need to adapt fairstainability standards; This company guarantees that for the chocolate it produces, it pays a fair price to its farmers by paying a premium to cover the difference between the farm-gate price and a fair price i.e. what farmers need to have a living income and to guarantee sustainable production	
1	The word sustainability is used differently; Poverty, influenced by environmental limitations; If you can achieve a living income, most problems will solve themselves e.g. child labor happens because of poverty	Living income
2	Certification schemes	Certification (UTZ, Fair Trade, Rain Forest Alliance)
3	Communication is key, blockchain can help with communication and proving what the company does; Blockchain will not solve sustainability, but will lead to a more transparent system where other actors can check whether companies' claims are true, can prove what you do; Blockchain is one option to achieve traceability, to verify what you're doing, it will help you trace data through the supply chain; Blockchain can verify what the buyer paid and what the farmer received	Believes in potential Indirect role Enabler Traceability Increased security and trust (suppliers, funders) Financial transactions (farmer premiums)
4	Today you have a lot of paperwork to prove what you've done in your supply chain; "Transparency allows you to communicate openly" and has the potential to show every transaction a company has made; The data you put on blockchain needs to be verified from the beginning, "blockchain does not guarantee that the data in it is true, but it does guarantee that the data you put in it cannot be changed"	Increased efficiency (less paper work) Increased security and trust (downstream, funders) Augmented transparency Immutability

This company has a project going on where the idea is to put stuff in the blockchain in different parts of the process; This company is working with start-up on an app that the farmers can put earphones on and are asked "are your kids at school" and then they press a green or red button; Want to get information straight from farmers; Need a database to manage the information, blockchain doesn't manage information; Built on trust, want to gain the consumers' trust; There are a lot of similar projects at the moment e.g. IBM has projects with bigger companies; Consumers are forerunners in generating demand for blockchain benefits i.e. trust, but need to make the information interesting for consumers; Adoption is dependent on companies being willing to show their supply chain	Actively considering (project) Optimistic Increased security and trust (downstream, funders) Willingness to be transparent	6	Easier for smaller chocolate manufacturers like Tony's Chocolonely as they can segregate their supply chain and for e.g. say this line of chocolate production only accepts certain batches of beans and only the outcome of that is used in their products; The bigger, more complex and more countries of supply a company has, the more difficult it is to segregate supply chain and you lose efficiencies i.e. more complicated transport routes, wastage, etc; This company discusses and thinks about blockchain all the time, emerges in meetings every other week, but lots of reconsideration when thinking how it would look like or mean when actually implemented, as touching the fundament of how produce is sourced and traded; Usually not thought about for addressing social sustainability; Used for traceability, and then how does that create an impact on social sustainability; This company's priority is not the social sustainability however, its about keeping trace of how volumes are moved globally; This company partnered with an NGO on a credit score project with cocoa farmers in Indonesia for them to get bank loans – interviewee called this a "fringe application" of blockchain and "farmer centric"	Actively considering (small project) Limited by complexity of supply chain (big company) Hesitant/skeptical Social sustainability not a priority	6	Today if you scan QR code on chocolate you get to landing page with story, but later you will have a source map with all the dots the cocoa went through and the ability for customers to interact with farmers; A big company told this company that it's good if the small companies take the lead in trying blockchain and then the big companies try it later, but interviewee mentions that the big companies are the ones with the funds	Actively considering (project) Trailblazer (small company) Optimistic
Farmers; The interface has to be built in such a way that farmers, without understanding or even access to network can operate (like app mentioned above)	Farmers Straight from source User friendly interface required	7	Has to be facilitated by intermediaries and NGOs who are proficient and can maintain it, run it, administer it, and encourage the farmers to join; The infrastructure is not yet fully on the ground to the extent that it can bring value to farmers or be easily integrated into a farmers reality	Intermediaries Trading/commodity companies NGOs Infrastructure not currently compatible	7	Partners with the farmers, Buyers, Auditors; "The big question is how you're going to do it"; If this company programs a blockchain softward, everyone in the chain needs to adapt to the existing program or system; If we don't want blockchain to be owned by corporate we need to invest public funds i.e. state could invest, remove the capitalistic drive	Farmers Trading/commodity companies NGOs Adaptability of blockchain to existing supply chain
Value is in the trust that blockchain is perceived as a trust mechanism, otherwise you can use other technologies but with blockchain information cannot be changed; Value proposition to customers, use for marketing and communication; Legal compliance, can show that your stuff is really fair trade, at the moment it's not really illegal to buy a certain way; Company reputation; Access to capital, there are sustainability trust funds, can help [small] companies to gain access to this capital	Supplier management Value proposition to customers Legal compliance Company reputation Access to capital (funds)	8	What would create value for the company if blockchain would be used in cocoa production?; Anything that increases the level of professionalization of farmers, that they are more enabled and better empowered, is beneficial for the company; Security of cocoa supply; "It has to add value to the busines"s e.g. human rights is important in its own right but there has to be value for the business; Company reputation, supplier management, legal compliance providing data resource showing due dilligence, operational efficiency; Blockchain is not a CSR technology	Risk position (increased professionalization, secure cocoa supply) Company reputation Supplier management Legal compliance Operational efficiency	8	Marketing, traceability is a unique selling point (but is it unique if other people are doing it?); Fulfiling the demands of end-consumers; Company should take responsibility to produce sustainable products and retail companies should demand sustainable products from chocolate manufacturers Innovation, prove that chocolate can be fair and sustainable; Almost all of Eckelmann's value drivers	Value proposition to customers Product properties Value proposition to public All
farmers; The interface has to be built in such a way that farmers, without understanding or even access to network can operate (like app mentioned above)	No Could be part of the solution There are alternatives Bigger problems in cocoa (government)	10	Blockchain delivers one part of the solution but it's not make it or break it; Blockchain is at the peak of its hype cycle or even on the downslope, but that's not to say it's bad; It can deliver a lot but will not solve all the problems; As long as it's not mature, cheaper, and easier to implement, it won't be a high priority; There was a lot of misleading information where everything was labelled as blockchain	Maybe Could be part of the solution Needs to mature	10	It's not clear that blockchain will be the technology, nowadays it requires a lot of energy; At the moment it's the best known technology; Not sure it's necessarily blockchain, but "traceability is the key to achieve sustainability"	Maybe Could be part of the solution Best known technology
The technology is the easy part, but the really difficult part is the creation of a sustainable supply chain; Many companies don't want to show consumers what their products have been made of; In the future when people start to understand blockchain, it will be a big thing		11	The only true implementation of blockchain is cryptocurrency but most applications get rid of the distributed open ledger part, in supply chain noone wants to have distributed open ledger because of a lot of sensitive data, e.g. mobile transfer already exists = transactional capabilities of blockchain, centralized database = private blockchain; If you look at a vilage in Ivory Coast, this company is not the world... there is the village system, leaders, infrastructure, laws, rule of law, other economic branches – he seems to distance companies from that responsibility, this company does not use "CSR"		11	There's fronted/user interface, backend/storage and data processors, blockchain/database; In the end this blockchain technology should not be owned by a private company, rather a purpose company or foundation for instance to maintain the integrity instead of being driven by money	

	Response	Codes	Response	Codes	Response
	Interviewee 6 *(Manager Cocoa Supply & Partnerships, Läderach AG)*		**Interviewee 7** *(Chief Sustainability Officer, Cocoasource)*		**Interviewee 8** *(Senior Consultant Blockchain, IBM Food Trust)*
	Responsible for assessing partners as fit for the company; Looking for partners who the company can see at eye height and has mutual understanding, who has sound values; That they can have someone to talk directly to and no intermediaries in the supply chain; Company is very close to cocoa sourcing, to ensure their standard of sustainability		Trading company whose main commodity is cocoa beans and moving towards more sustainability		
1	For this company, fair trading practices are important and there its about close relationships, traceability, transparency and fair pricing structures; Decent livelihood, Ghana and Ivory Coast produce majority of world's cocoa and the livelihood there is most critical, facing a lot of child labor which is a direct by product of poverty; If you tackle poverty, you tackle many problems; Labor rights is difficult to control/influence because often farmers are independent and entrepreneurs so to say, so they are not contracted or employed by the company so they are responsible for the labor rights, companies are responsible for sensitizing and giving guidelines or assistance; Human health, is usually an issue in agriculture e.g. machetes in cocoa harvesting, misuse of agricultural inputs; Access to information including cellphones; Governance of country especially in Africa, and companies would be intervening with sovereignty if they would have a say; Environmental issues	Living income Traceability Transparency Child labor Forced labor Human health and safety Access to information Environmental	1	Main ones are related to quality of life so like housing, access to energy, clean drinking water etc; Forced labor; Child labor, political unrest and instability especially in Ivory Coast that forces people to migrate and this leads to child labor and forced labor; Gender inequality of women; Human health and safety like working with machetes and chemicals; Access to education for children and literacy for adults	Quality of life Forced labor Child labor Gender inequality Human health and safety Education and literacy	1	
2	Mostly certification like UTZ, Rain Forest Alliance, Fair Trade; Counteract issues with trainings	Certification (UTZ, Fair Trade, Rain Forest Alliance) Company sustainability programs	2	For example Tony's Chocolonely uses Beantracker and have also tried blockchain; Certification scheme which the interviewee doesn't really see as supply chain management systems but a method to ensure sustainability	Certification (UTZ, Fair Trade, Rain Forest Alliance) Company sustainability programs	2	
3			3			3	You often read is that it's immutable, it's peer-to-peer, distributed, decentralized; Explains blockchain to customers using three words: 1) trade, 2) trust and 3) ownership, this better describes blockchain especially the advantages and characteristics; This is more like the next generation of the internet; 1) Not only moves information but is also moves money or things with value, when you move value you leave a trace; 2) When you do trading you have to address the trustless system because this ensures you cannot copy and paste value, this is the basis for for traceability and transparency, this is how you trust data; 3) Ownership underpins that element of transferring a value or referring an owner of a value or asset, would describe it as accountability, its clear who's doing what and what is owned by who; Blockchain removes intermediaries; Advantages: trusted data, transparency, lowering risk, save time and money when you become more efficient
4	Blockchain is a buzzword; So its not necessarily about blockchain but that you develop a tool that addresses these things, so could be another encryption tool that runs from farmers phone straight to company for intsance; On blockchain cannot tamper with information, but doesn't directly solve the social sustainability; Transparency; Send premiums directly to farmers	Not sure about potential Indirect role Enabler Immutability Traceability Transparency Financial transactions (farmer premiums)	4	More indirect potential and mid to long term because effects because lack of transparency is good for people who want to maintain bad practices so it forces people to act right; Bringing in transparency; Quality of life, gender equality, and other challenges mentioned before can be improved through faster transactions, ensuring premiums are paid; You can have better quality of information that is not corrupted; Forces people to be more fair	Believes in potential Indirect role Enabler Transparency Financial Transactions (farmer premiums) Increased security and trust (upstream)	4	Blockchain as part of the solution to make the data recorded and trusted and traceable; There must be regulations and rules in place and blockchain only makes sure data you enter can't be altered, "blockchain cannot help where there is no regulation at all"; Information has to be reliable, "in general if you have garbage in, garbage out" that's not good; Makes the job of a certification agency easier and also more trusted, because usually the documents they send around with email are not coupled with a product; Help with sustainability reporting, can be more precise to trace where the beans came from; Blockchain smart contracts for financial transactions, this is nothing fancy really but it's an automated protocol
5	When comparing blockchain solutions provided by other companies e.g. SAP, it's about how the tool is designed on the ground that makes the difference, not the way the information is sent to different stakeholders along the supply chain because that's just blockchain; On blockchain cannot tamper with information; Some applications of blockchain are not unique to blockchain e.g. transactions, sharing information, consensus	Immutability	5	Improving speed of transactions; Better solution for premiums; Better way of tracing the beans to avoid smuggling of beans; Better traceability and product origination; Transparency; Goes in the direction of establishing long-term relationships you can prove that cocoa has been produced sustainably e.g. avoid buying smuggled cocoa	Financial transactions (farmer premiums) Increased security and trust (upstream) Augmented transparency	5	It's important to note that blockchain is not replacing any ERP or supply chain management systems, it's rather like an additional layer on top of the different ERP systems in the supply chain so connecting to those or other systems if you don't have ERP systems; The main benefit using blockchain is that you have the ability to trace a product throughout these multiple ERP systems, blockchain will support and build the traceability and improve the connection between them rather than replacing them

6	Although interviewee doesn't really know what exactly blockchain is, the company considers adopting blockchain and finds it an interesting solution to address social sustainability challenges; Considering a pilot project at the moment, concept and research and pilot stage; For one project had opportunity to share information via blockchain but opted away from that because company didn't see the necessity to do that, information about the farmers e.g. transactions, conditions of production, whether children are in school, could reliably be transfered end-to-end	Actively considering (projects) Testing Open to alternatives	6	In collaboration with Tony's Chocolonely have the chance to explore blockchain; This company can use it as a value proposition to its customers like Tony's and can guarantee; The trend is there from its customers; This company is still small so has more flexibility to experiment; Current problem is technical feasibility like access to mobile network, not sure what implementing blockchain implies	Actively considering (projects) Optimistic Partnered with trailblazer Technical feasibility is problem	6		
7	If it should tackle social sustainability problems, then farmers because then you have real feedback from the ones that are most vulnerable, but they are the most difficult group to add to due to mobile phones and data and infrastructure and literacy	Farmers Infrastructure not currently compatible	7	Farmers and again depends on reality i.e. illiteracy, in different countries; Cooperatives; Intermediaries/traders	Farmers Cooperatives Intermediaries	7		
8	If it could provide real solution to the challenging situation of the farmers; If it credibly lives up to the core values of the company; But it's not about the value proposition of the company internally e.g. if it could enable a farmer to have access to finance; This company follows its own principles or guidelines does not publish everything they're doing so in this case does not contribute to sustainability reporting, but it could, value proposition to customers	Value proposition to employees Company reputation Access to capital (farmers)--> Risk position Value proposition to customers	8	Previous sustainability efforts haven't had impact expected so transparency of blockchain would help; Better traceability; Reduced product (cocoa bean) alteration; Blockchain can improve the access to finance for the farmers and that they get a better share of their premiums; Would have an overall positive impact on the cocoa value chain; Legal compliance by helping reduce the risks related to labor rights, also that the product is legally compliant in the way it is produced; Company reputation; Operational efficiency linked to quality of product; Proposition to customers	Risk position Access to capital (farmers)--> Risk position Legal compliance Company reputation Operational efficiency Value proposition to customers	8	On one hand marketing to end consumers, differentiation from other brands; Brand image, not only make sure there's positive news but also that there isn't bad news; Key for chocolate companies to ensure social sustainability for ensuring cocoa supply i.e. building communities and long-term relationships; Operational effciency, digitalizing the supply chain, make the process leaner and more standardized e.g. while the farmers now get physical receipt, they will now get digital receipts; Market growth, new markets, because of building good credibility; Legal compliance, certiifcation process; These countries work a lot with prefinance, so building trust for farmers to have access to funding	
9			9			9	The level of digitization required is a hurdle, if everything is done manually so far then have to find way to create digital data points, so need smartphones; In this interviewees view the technology is the lowest hurdle, but what's harder to implement are the standards, interoperability of data, also about getting the whole ecosystem involved; If people don't see business value then they won't go for it	
10	No, it could contribute but nothing will be an ultimate solution especially for social sustainability; If you had a logistical problem running on a purely logical grid then it could help, but when it comes to human behavior, that's not mathematically solvable; It's a bit simplified to say it can solve the challenges	No Could be part of the solution Cocoa problems are humanistic	10	It is one solution, but not the ultimate solution; There are many other things that need to be fixed for instance corruption; Not sure it can really have direct impact on corruption; You need education in order to implement blockchain; "There is no such thing as one solution to all these problems", so its a combination of all the efforts i.e. certification, company's programs, government initiatives etc	No Could be part of the solution Cocoa problems are humanistic	10	Definitely not the ultimate solition, but certainly part of the solution; If you just implement blockchain it doesn't solve anything	
11	This interviewees skepticism is not about the technology itself, but rather how it will be applied		11	All of this has been under the assumption that the information put on the blockchain is reliable		11	"Blockchain is about a change of mindset"	

Codes		Response	Codes	Response	Codes	
		Interviewee 9 *(Project Manager Blockchain, Bühler Group)*		**Interviewee 10** *(Researcher Blockchain, FiBL)*		
	1	Company develops blockchain-ready solutions for food processing; Developed two use-cases for wheat value chain		Has been 5 years in social economic department of FiBL and researching the socio-economic impacts of technology and blockchain is one of the; Trying to understand blockchain at FiBL, its barriers and enablers to adoption and impacts for farmers, supply chain labels, fraud reductions etc		1
	2					2
Characteristics three words: Blockchain is Trade (moving value), Trust (traceability and transparency), Ownership (accountability) Advantages: trusted data, transparency, lowered risk, time savings, money savings	3	Blockchain is made up of several levels, there is a network level where computing power resides and several servers have a ledger replicated, the second level is where you build the applications – the only people that can say they own the blockchain are the network-level people, not the application users	Characteristics: Made up of two levels = network level & application level		Characteristics: Ledger system to track actions and movement of assets, decentralized, peer-to-peer Advantages: immutable, uncorrupted data	3
Believes in potential Indirect role Enabler Increased security and trust (upstream, audits, funders) Increased efficiency (less paperwork) Augmented sustainability reporting Financial transactions (farmer premiums) Rules and regulations for blockchain required	4	Depends on how you're defining blockchain, the technology itself cannot solve all the challenges in the world, so prefer to call the technology an enabler; The potential comes when people get together around the technology itself and agree upon who owns what data and which processes are being digitized and what data is shared	Believes in potential Indirect role Enabler Interoperatbility Rules and regulations for blockchain required	Blockchain does not target social sustainability directly; Blockchain is used to increase traceability and transparency in agricultural supply chain; Agrees that making issues transparent can help alleviate the issues and improve social sustainability; Can also be used for insurance to establish contracts between parties where all the terms of the contracts are in the blockchain and can ensure that the contract is well-enforced, automatized smart contracts where transactions are automatically triggered when conditions are met; If data can be stored safely then and that you reduce the fraud in the supply chains, then you reduce costs e.g. don't have to call back different loads if there is a problem; Increased efficiency through automization and not having to write everything on paper because everything is computerized; Incomes of smallholder farmers are an issue and blockchain could increase incomes of farmers by helping reduce costs in the supply chain and having consumers pay more for products; Can improve trust and relationships between different stakeholders i.e. consumers, chocolate manufacturers and cocoa producers	Believes in potential Indirect Enabler Traceability Transparency Smart contracts Cost savings Increased efficiency (less paper work) Improve farmer income Increased security and trust (upstream, downstream)	4
Complementary role System that spans all actors and origins (see Interviewee 4)	5	There are not so many supply chain management systems that tackle the entire value chain; When asked why blockchain, this interviewee asks people who is going to own and take responsibility of that database, with blockchain with the potential of being co-owned by multiple people along the supply chain – but make distinction over who has access to data and can upload it, and who is co-owning the data; Need to have real-life contracts	Complementary role Interoperability (spans all actors)	The added advantage of blockchain is that data is secured and immutable, and also that it is decentralized so data is validated by the network; With blockchain you are sure that data matches i.e. smart contracts	Increased security and trust (upstream) Immutability Decentralized and consensus driven Smart contracts	5

	6			6	6
	7			7	7
Value proposition to customers Product and technology innovation Company reputation Risk position Operational efficiency Market growth Legal compliance Access to capital	8	Closer relationships among three major actors in the supply chain, linking the sourcing of the chocolate with processing and selling, farmer can have access to funds; Value proposition to employees; Company reputation; Product and technology innovation	Supplier management Value proposition to customers Value proposition to employees Company reputation Product and technology innovation	If consumers are willing to pay more for the social sustainability as a result of blockchain that's a value driver; Efficiency gains and money savings; Reputation by showing that it improves the situation of smallholder farmers then it can also increase their clients and income, new markets; Operational efficiency; Supplier management; Value proposition to the public; Legal compliance; Risk position, that you do not receive or sell an altered product to the consumer	Value proposition to customers Operational efficiency Company reputation New markets Supplier management Value proposition to the public Legal compliance Risk position	8
Digitization of physical assets Technical infrastructure (mobile phones) Establishing common standards Involvement of actors (incentives)	9	Infrastructure, having stable network and mobile phones; Everyone is concerned about blockchain because of the bitcoin example, but it's a problem when mining; Reliability of data input, could put sensors or DNA tracker in the beans, this helps with tracing the farm where the beans come from, a company standardizes this by itself; Need to trust someone at some point, so could use auditors	Technical infrastructure (mobile phones, network) Reliability of data input	Difficult to involve all actors from the value chain, if you source from relatively far (geographically) or if you have a complex supply chain then it might be difficult to involve them all, if you don't involve everyone it will not work; You need drivers and incentives for actors to participate; Technical infrastructure in developing countries might now have all IT infrastructure, blockchain can be used with the phones so at least on application level the actors need a phone to validate transactions	Involving and incentivizing actors Technical infrastructure (mobile phones, network)	9
No Could be part of the solution	10	Better to call blockchain an enabler; It has some potential to make people reason about these things more and more and ask for transparency regarding sustainability issues	No Could be part of the solution Challenging industry	It can contribute but it is not the solution, and also not sure to what extent; There are many other tools; Don't know so much about the consequences e.g. computer energy, which decreases the sustainability	No Could be part of the solution There are alternatives	10
	11	Consumers don't really care which technology you are using to get this information, they just want the information at the end; But auditors would be interested in blockchain		Yes there is potential to increase the added value in supply chains, but a little concerned about how this value will be shared between different parts of the value chains, risk that big retailers will take all of the value e.g. consumers pay a little bit more from retailers, and in the end farmers might get a small share of that; You could write some codes in the blockchain but the negotiations need to happen before putting this onto blockchain		11

	Response	Codes
	Interviewee 11 *(Blockchain Developer for Tony's Chocolonely, Accenture)*	
	This interviewee was the sole developer of the Tony's Chocolonely project which was an innovation project around September 2017; Use blockchain as an extra layer or service on top of their database solutions	
1		
2		
3	From a basic perspective blockchain is a form of a distributed database with a lot of different extras attached to it for example everyone has the same copy of the same state of the blockchain and when someone wants to add or change something on that state, they have to verify it with the other participants, consensus – "consensus mechanisms are usually automated" and are more based on preventing malicious data e.g. discrepancy in values; After consensus a new state of the blockchain is created and a timestamp made; Also depends on what kind of blockchain you're using e.g. in this company they focus on private blockchain so participants have ownership and admin structure where they can grant permissions for reading or writing, private blockchains easier to market and develop e.g. in public blockchain like Bitcoin everyone can connect; Advantages: have all the actors and all their actions recorded on blockchain, real time data	Characteristics: Distributed database, peer-to-peer, consensus-driven, automized Advantages: spans all actors, transparency, real-time
4	There are some benefits in blockchain; Private blockchain is better for supply chain but depends on scope and purpose of blockchain, open blockchains are permissionless so anyone can open but with private you can control who can do what; Introduces efficiency in auditing processes; Saving costs and time of data maintenance and sharing because conventionally sharing data between entities is expensive i.e. validating data, migrating data, back-up solution etc, but with blockchain everyone has copy of data & and time consuming i.e. blockchain has real-time data; Can back sustainability efforts up with proof	Believes in potential Indirect Enabler Interoperability (spans all actors) Increased efficiency (time) Cost savings Increased security and trust (downsteam, upstream)
5	Compared to regular databases blockchain has a shared database among the nodes; Current solutions are based on trust and relying parties that claim they have sustainable products and get certified etc, compared to blockchain it would be the same case but you would still need to involve those authorization parties in the blockchain, but the blockchain helps to automize and digitalize instead of making it a physical activity	Interoperability (spans all actors) Automization

	Response	Codes
	Interviewee 12 *(Founder, SeeHow)*	
	SeeHow helps producers or manufacturers of any consumer goods communicate what happens along supply chain; Implementing pictures and videos from the field which are cured and encrypted on the public Ethereum blockchain; Why they use blockchain because the company in hindsight can say the picture has been taken at that time and that location and hasn't been tampered with	
1		
2		
3	Blockchain is a base layer for smart solutions; It is a tool to enhance transferring data or transparency in data or live updates in the supply chain; Blockchain can store data immutably and it will be there forever	Characteristics: Base layer for smart solutions, tool to enhance transferring data or transparency Advantages: transparency, real-time, immutable
4	Blockchain enables smart solutions to ensure uncorrupted data e.g. spraying liquid onto beans which is edible and readable to track the beans; Blockchain can bring transparency into the money distribution along the supply chain; Also transparency in social sustainability issues like slavery or child labor by introducing new level of transparency	Believes in potential Indirect Enabler Transparency Financial transactions (farmer premiums)
5	Three benefits 1) base layer to enable other smart solutions like sensors for tracking 2) all stakeholders along the supply chain have one tool 3) cannot change data in hindsight, immutability	Complementary role Interoperability (spans all actors) Immutability

	Response	Codes
	Interviewee 13 *(Head Sustainability Assessment, FiBL)*	
1	Basically related to working conditions, labor conditions and especially child labor but also forced labor in some countries; Decent livelihood	Labor conditions Child labor Forced labor Decent livelihood
2	Two ways to source cocoa for companies 1) spot market and you and then you don't know much about where the cocoa comes from, but you know if the production was labeled or certified, you know your trader 2) direct with companies increasingly try to get into companies with their primary producers so they train them and run programs	Certification (UTZ, Fair Trade, Rain Forest Alliance) Company sustainability programs
3		
4	Blockchain is an interesting technology which is in its infancy, but there is quite a lot of potential and supply chain management is one of them; But it is somehow not targeted towards the problems that there are in supply chain management; It can give more security about the certification of cocoa, but in the end the main problem/challenge with this is basically that if the data is entered wrongly in the first place, blockchain will not happen	Not sure about potential Indirect role
5	The only additional benefit is that entries cannot be changed without alerting other participants; Blockchain complements certification and sustainability programs but maybe there is a more efficient way that can be achieved other than blockchain, "It's a very time, energy and cost consuming approach for ensuring only a small part of the supply chain"	Complementary role Immutability

6				6			
7				7			
8	Open up new markets by being able to prove sustainability efforts (but value-driver for cooperatives or suppliers) to stakeholders; Value proposition to customers, and can charge a higher price; Operational efficiency; Supplier management; Value proposition to the public; Legal compliance; Licence to operate, if you involve third party for the certificates; Company reputation	Value proposition to customers Operational efficiency Supplier management Value proposition to the public Legal compliance Licence to operate Company reputation	Most interesting question because "it's all about the incentives"; Tech is not going to solve it all, at the end of it's always people that interact with it and you have to incentivize those people, there has to be a value in it for them to them to actually enter the data as they should and to treat data as it should and also to act according to what they entered; So not only about the confectionary companies, all stakeholders in the supply chain; Can help with company's long term sustainability goals i.e. guarantee farmer gets fair share of money, so ensure you have enough farmer and so continuous production of cocoa; Can help prove that company adheres to certain goals, goes into reputation or brand management	Risk position (secure cocoa supply) Supplier management Company reputation	8	Monetary rewards, costs should be lower than benefits, they want to be able to claim a certain price for their chocolate; Benefits related to reputation and regulation	Value proposition to customers Company reputation Legal compliance
9	Disconnect between digital and real-world, would need IoT devices or sensors to support; Literacy of how to use the application, so need to keep it as simple as possible and user friendly; "If you put garbage data in, you get garbage data out", but also just human error in terms of information input e.g. shipping data; The challenges with Tony's pilot was not the technology/blockchain itself, but rather the human errors in the front end and back end, so had to work in many exceptions e.g. front end or back end not being able to process discrepancy correctly so they could crash (front end > back end > blockchain); Another challenge for adoptation is that companies are stuck in old way of thinking of keeping and protecting their information, and opening up ther data to the public is difficult or out of the question	Digitization of physical assets Training and education (literacy) Reliability of data input Involving and incentivizing actors Supply chain secrecy	What's often ignored is the huge challenge of data documentation or data creation, so most of the times that data, which is the critical part is gonna be recorded in areas where there is no internet connection in stressful and corrup situations and incentives are not aligned; This company's tool can record the data and syncronize it once the phone is connected back to the network; Whether the data input is true or not has nothing to do with blockchain; Incentivizing cooperatives to input valid data which will let the farmers get more money and the middle men less, basically how do you align humans with the tech? the difficult part is getting people to use it correctly; Educating on how to use it and its adoption; Internet connection	Involving and incentivizing actors Technical infrastructure (internet) Reliability of data input Training and education (literacy)	9	It can give more security about the certification of cocoa, but in the end the main problem/challenge with this is basically that if the data is entered wrongly in the first place, blockchain will not happen e.g. farmers are trained to say no when asked if there is child labor on their farm; Internet availability on the farms; Training and education, literacy of farmers	Increased security and trust (upstream) Reliability of data input Training and education (literacy)
10	"Blockchain is a great technology, but it is not the holy grail" There's always a lot of hype but we have recently gained more information about it; "Blockchain [is] a step in the right direction, but it depends on the human who has to input or interact with the data on the blockchain", it's still vulnerable to corruption like plenty of security holes that allow cheating of identity	No Could be part of the solution Step in the right direction	No, blockchain plays a part but it's not the silver bullet what will solve it all, if there is a silver bullet at all it would be incentives	No Could be part of the solution Not a silver bullet	10	For really verifying social standards blockchain can only deliver a very small part actually; In some countries child labor is not legal but somehow it's still done, and this has nothing to do with blockchain	No Could be part of the solution Cocoa problems are humanistic
11	In the next 2 or 5 years we will start to see more blockchain applications, it's finally starting to be seen as a valuable technology rather than a hype; When the blockchain platforms themselves mature, the solutions will also mature		Interviewee believes adoption is low because hasn't come across any good short term benefits for the high front-up investments (i.e. setting up software, rolling out the technology, education and training stakeholders), in the long-term the benefits are high; Confectionary companies are the ones that need to implement blockchain and invest in it		11	Interviewee did disclaim his limited supply chain management and blockchain expertise	

	Response	Codes	Response	Codes	Response	Codes
	Interviewee 14 *(Director Social Development, World Cocoa Foundation)*		**Interviewee 15** *(Technologist and External Digital Advisor, World Cocoa Foundation)*		**Interviewee 16** *(Chair on sustainable and traceable cocoa of CEN/ISO Committees, Equipose)*	
					Chairman of the ISO comittee that published the standards on sustainable cocoa; ISO standards consist of 4 different parts, Pt 1. is about the management of sustainable cocoa production Pt 1. requirements in social, environmental and economic context Pt 3. is about traceability, and Pt 4. is about the requirements for the organizations that operate the scheme and auditing claims on sustainability; Standards have two purposes 1) to become a benchmark for sustainability certification and 2) it can be used as a standard that can be audited directly; You see ISO requirements being part of the Fair Trade and Rain Forest alliance and private sustainability prorgrams	
1	Inbalances in the cocoa value chain, cocoa farmers are weakest in the supply chain in terms of capturing a significant share of value in the sector and in the sense of not being able to secure a stable revenue, just price takers, then trying to cope with this using diversification; Gender imbalances which makes women totally invisible even though they contribute majorly to cocoa cultivation, they are kept out of the transactional part of the work and have no assets; Since cocoa is smallholder based crop, it's based in the remote area where access to basic needs (e.g. drinking water, health services, school) is problematic	Living income Gender inequality Decent livelihood			Usually when people talk about sustainable cocoa, they talk about sustainably produced cocoa; Major challenge is poverty in cocoa production and all other problems derive from that, because of poverty child labor, food sovereignty problems, health issues, deforestation etc; To address these issues need to improve farmer resilience to cocoa price fluctuation, also need to deal with child labor because it reproduces poverty; The first buyer of the cocoa should cover the costs of the investments so that the farmer organization meets the requirements, operating costs should be covered by farmer organization out of revenues of the cocoa	Living income Child labor Food sovereignty Human health and safety
2	Certification schemes; Own company programs	Certification (UTZ, Fair Trade, Rain Forest Alliance) Company sustainability programs			There are 2 approaches 1) companies have their own definition of sustainability and therefore their own intensive cooperation with farmer organizations and are moving towards souring all their cocoa from the cooperatives they cooperate with e.g. Cocoa Life in the case of Mondelez 2) certification programs like fair trade, rain forest alliance, UTZ	Company sustainability programs Certification (UTZ, Fair Trade, Rain Forest Alliance)
3						
4	Blockchain will be helpeful in accelerating the effectiveness of cocoa extension services to facilitate access to technological information	Not sure about potential Enabler Access to information	There is a certain prioritization of solving these issues by applying blockchain e.g. transaction verification; "First transaction transparency," when it leaves the farmer and first enters the blockchain, transparency on that transaction unlocks the whole thing for the further supply chain; "Technology is shifting power to consumers" i.e. shopping choices, buying choices, delivery etc and consumers use that power to inform brand decision and therefore supply chain decisions, customer would say *my buying choice is for sustainable cocoa* ; The primary digital transformation opportunity when applied to a supply chain, is in managing the transactions between the links in the supply chain; Consumers will have simple questions and will expect simple answers, industries that cannot respond will lose trust, a loss of trust is a loss of value; If you don't have common standards and understanding on what things mean, blockchain would never execute	Believes in potential Indirect Enabler Transparency Financial transactions	Blockchain is an instrument that can be used but it really depends on the reliability of the input, for blockchain to deliver on its promises most of the attention should be towards data input; Blockchain helps introduce new norms for sustainability; First shackle (See Interview 15 First transaction transparency) is the weakest point of the chain that is rusty and also most important part to address; Blockchain is the traceability system that makes sure that the sustainable cocoa remains identifiable so it would help support the three levels of sustainability, but you can have unsustainable cocoa inside a blockchain, however it makes traceability more precise to help reduce fraud, misspending of money available in the supply chain, and improve the sustainability efforts	Believes in potential Challenges industry Traceability Financial transactions (farmer premiums)
5			It takes 6 months to get a paper receipt out of the jungle in Ivory Coast, blockchain information is real-time	Cost savings Increased efficiency (less paper work, time)	The same thing as mentioned above applies to existing traceability systems, that attention should be towards data input, no system or technology is immune to corrupted data; But once it's on the system, the blockchain can be a very good system; Compared to companies' sustainability programs, blockchain doesn't have very many added benefits because they have it under control, it will be more important for certification, but it will contribute to transparency and more precise operations; Blockchain can reduce costs though	Complementary role Immutability Augmented transparency Cost savings

6						6	
7						7	
8			Getting premiums for chocolate knowing that it has been produced sustainably; Brand reputation	Value proposition to customers Company reputation		Everyone understands that cocoa will run out if not sustainable; Value proposition to customers because improves reliability of the system; Operational efficiency because administrative contol of mass balance would be much easier and input control would be much easier; Supplier management; Legal compliance and risk position, the better the traceability the better their posibility of risk management	Risk position (secure cocoa supply) Value proposition to customers Operational efficiency Supplier Management Legal compliance
9	Will have to work on agreeing on common standards, and whether this is done on private level or governmental/public level are two different things, but common standards have to be agreed upon – In Ghana for example, government would be a major player because it's a strongly state regulated sector i.e. COCOBOD; Having strong incentives can help with overcoming hurdles; Cocoa is a competitive sector, one of the major challenges is also competition management, what is competitive, need to agree to lower competition barrier, how can having blockchain still be considered a competitive advantage and differentiation?	Establishing common standards Involving and incentivizing actors	Blockchain is a protocol for trust nobody needs to know about distributed ledgers or encryption, it is a protocol for trust and competitors don't trust one another so they are incentivized to mask the critical data necessary to determine whether cocoa is sustainable	Supply chain secrecy		All of the challenges in cocoa supply chain are at the root of the supply chain, once those are solved then everything functions better; The cocoa supply chains originate in countries that are far from IT surrounding there is quite some corruption and untransparent activity in these countries, so reliability of input can be a challenge; Educating and training people, literacy of using tools	Technical infrastructure (network) Reliability of data input Training and education (literacy)
10	Blockchain cannot resolve everything; The cocoa industry is not yet blockchain-ready because it still struggles to adopt common standards in areas of its work	No Cocoa industry not ready	Blockchain is forcing an industry that has usually had resistant operational standards to change, "to have simple answers to complex questions"	No Could be part of the solution Challenging industry		Nope, don't think there's one single solution; It is part of the solution, an important part, but it's not the ultimate; It will improve the effectiveness of other solutions, if you look at the investment in farmer programs there is a lot being spent, blockchain will make sure that those actions are rewarded; The introduction of blockchain will be gradual because the existing systems are functioning too; it's not that the cocoa industry is not agile, just that technology is not the cocoa industry's core business	No Could be part of the solution Technology not core business of cocoa
11			(In response to interviewee 14) The industry can mantain its competitive advantage because not everybody will adopt blockchain to achieve transparency or traceability, companies will develop different solutions for the same problem, and also how they use that data will be different; Farmers are overwhelmed with each manufacturer and brands information requirements			There are three levels of traceability 1) highest level of traceability which is identity preserved, should be able to follow cocoa throughout supply chain, you would know that the actual beans in your chocolate bar come from a certain operator or farmer e.g. organic cocoa, bean to bar – if cocoa is processed with manufacturer that processes other cocoa, all other cocoa should be out of the system, if you have a large factory have to flush out other cocoa 2) full segregation, separate sustainable cocoa from unsustainable cocoa, but you could mix the origins of the sustainable cocoa, so you cannot say the exact origin of the cocoa because you mix all the sustainable cocoa 3) mass balance, for the volume of sustainable cocoa that you declare you have supported sustainably produced cocoa at some point in the world but it's not necessarily the same cocoa that's in your chocolate bar, most cocoa that you find today are mass balance; Sustainability should be a voluntary thing and not a legislative thing because "You stick to the law but you don't go beyond", if its voluntary companies go all the way they can, "Legislation kills innovation"	