TECHNOLOGIES OF TRANSPARENCY: THE ROLE OF INFORMATION AND COMMUNICATIONS TECHNOLOGIES IN PROMOTING LABOUR RIGHTS IN DISTANT WATER FISHERIES

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Abstract

Ethical production networks and supply chains have garnered significant attention in both academia and industry. The ethical supply chain has become a topic of significant debate in the global fishing industry in particular, and especially in distant water fishing (DWF). Monitoring labour rights/abuses presents a challenge in this field, as workers are employed on fishing vessels operating in isolated and remote waters, often outside any effective oversight or regulation. This study aims to investigate the potential of various information and communication technologies (ICTs) in tracking, monitoring, and promoting labour rights in DWF. In pursuing this question, I use the intersection of global production networks (GPN) and labour regimes as a theoretical framework. While GPN theory addresses the institutions, actors and power relations in global production processes, labour regime theory provides a conceptual understanding of how workers are both disciplined and exert agency within global production systems. The study is based on qualitative interviews with stakeholders who are active in both developing and deploying various technologies in relation to migrant labour rights in fisheries, complemented by an extensive review of secondary documentation. The findings indicate that, within this framework, ICTs can be primarily classified into two distinct categories based on their approach to monitoring and observing labour conditions: a) remote monitoring and b) on-board/community-based monitoring and reporting systems. I will argue that the use of such technologies holds significant potential for advancing transparency and accountability in terms of the labour rights and working conditions of fishing crews. In this way, new possibilities for labour agency and the re-regulation of labour regimes in global production are being opened up, while, at the same time, limitations on the application of ICTs still remain.

Dedication

I am dedicating this thesis to my mother, father, and wife, who supported me during this journey

And,

I would like to dedicate my Master's thesis to individuals deeply interested in this field, to those whose lives may be significantly influenced by this research, and to anyone who reads this thesis.

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In conclusion, this thesis is not just a culmination of my academic endeavor but a testament to the collective effort and support of those mentioned and many others who have contributed in various ways.

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List of Acronyms

Abbreviation	Explanation	Abbreviation	Explanation
AI	Artificial Intelligence	MCS	Monitoring Control Surveillance
AIS	Automatic Identification System	ML	Machine Learning
CNRS	French National Centre for Scientific Research	MSC	Marine Stewardship Council
CSO	Civil Society Organization	MPA	Marine Protected Area
DFO	Fisheries and Ocean Canada	NCCU	National Chung Cheng University
DWF	Distant Water Fishing	NGO	Non-Governmental Organization
EEZ	Exclusive Economic Zone	NOAA	National Oceanic Atmospheric Administration
EM	Electronic Monitoring	PCT	Presbyterian Church in Taiwan
ER	Electronic Reporting	PNAS	Proceedings of the National Academy of Sciences
FOSPI	Indonesian Seafarers Gathering Forum	ROSEAP	Regional office Southeast Asia and the Pacific
GLJ	Global Labor Justice	SAR	Synthetic Aperture Radar
GLJ-ILRF	Global Labour Justice-International Labour Rights Forum	TAHR	Taiwan Association for Human Rights
GPN	Global Production Network	TTA	Taiwan Tuna Association
GPS	Global Positioning System	UN	United Nations
HRC	Humanity Research Consultancy	UNCLOS	United Nations Convention on Law of the Sea
ICES	International Conference on Environmental System	UNODC	The United Nations Office on Drugs and Crime
ICTs	Information and Communication Technologies	UNU-CS	United Nations University Institute on Computing and Society
IHRB	Institute For Human Rights and Business	VBD	VIIRS Boat Detection
ILO	International Labour Organization	VIIRS	Visible Infrared Imaging Radiometer Suite
IMO	International Maritime Organization	VMS	Vessel Monitoring System
IOT	Internet of things	AWS	Amazon Web Service
IUU	illegal, unreported, and unregulated	FCV	Foreign Charter Vessels
MAST	The Multi-stakeholders Initiative for Accountable Supply Chain of Thai Fisheries	CoC	Chain of Custody

Chapter One - Introduction

1.1 Thesis Overview

Ethical production networks and supply chains have garnered significant attention in academia, industry, and politics. For instance, the Canadian government recently passed legislation known as Bill S-211, aimed at addressing the issue of forced labour inside the Canadian supply chain. The present legislation, known as the Fighting Against Forced Labour and Child Labour in Supply Chains Act, establishes a requirement for specific governmental institutions and private-sector entities to disclose the actions they have undertaken to prevent and mitigate the potential utilization of forced labour or child labour within their operations or supply chains. The legislation establishes a system of inspection that applies to many entities and grants the minister the authority to compel an entity to furnish specific information. The legislation additionally modifies the customs tariff to incorporate a provision that permits the prohibition of importing goods that have been manufactured or produced, either wholly or partially, through the utilization of forced labour or child labour, as per the definitions outlined in the Act (Public Safety Canada, 2023).

The ethical supply chain has become a topic of significant debate in the global fishing industry in particular, and especially in distant water fishing (DWF). According to the FAO reports, fishing and aquaculture play a direct role in providing livelihoods for over 820 million individuals globally (FAO, 2020). Monitoring labour rights/abuses presents a challenge in this field, as workers are employed on fishing vessels operating in isolated and remote waters, often outside any effective oversight or regulation. This study investigates the potential of various information and communication technologies (ICTs) in tracking, monitoring, and promoting labour rights in DWF. The implementation and utilization of these technologies have the potential to significantly improve the working conditions of DWF labour worldwide by increasing public awareness, detecting violations and informing mechanisms of regulation and enforcement.

In pursuing this question, I use the intersection of global production networks (GPN) and labour regimes as a theoretical framework. While GPN theory addresses the institutions, actors and power relations in global production processes, labour regime theory conceptualizes how workers are

disciplined and exert agency within global production systems. The study is based on qualitative interviews with stakeholders who are active in both developing and deploying various technologies in relation to migrant labour rights in fisheries, complemented by an extensive review of secondary documentation. The findings indicate that, within this framework, ICTs can be primarily classified into two distinct categories based on their approach to monitoring and observing labour conditions: a) remote monitoring of vessel activities, and b) on-board/community-based monitoring and reporting systems. I will argue that the use of such technologies holds significant potential for advancing transparency and accountability in terms of the labour rights and working conditions of fishing crews. In this way, new possibilities for labour agency and the re-regulation of labour regimes in global production are being opened, while, at the same time, limitations on the application of ICTs still remain.

1.2 Research Significance and Motivation

The DWF industry is significant in global food supply, but is characterized by complex and non-transparent operations. Within this context, a considerable barrier exists in raising awareness about working conditions. The geographical features of the ocean present challenges in terms of accessibility for monitoring capacities and contribute to the hidden nature of labour conditions in distant water fisheries. Therefore, it is important to investigate the impact of ICTs on improving the visibility and monitoring of labour conditions and increasing awareness among key stakeholders. ICTs possess significant potential in terms of data collection and the establishment of a mechanism for tracking and monitoring the behaviour of vessels. Therefore, we can say ICTs can lead to increased transparency regarding the activities of fishing vessels in remote ocean areas. Consequently, this heightened awareness can facilitate the implementation of measures aimed at safeguarding and advancing labour rights and working conditions within the DWF industry.

This research is motivated by an opportunity to examine the interplay between technology and human well-being. Rapid advancements in the development of technology and the deployment of ICTs present possibilities to drive improvements and take crucial steps toward establishing an ethical global economy. “Ethical” refers to the adherence to fair labour practices and human rights

standards throughout the production chain based on ILO labour rights indicators. Therefore, this thesis aims to examine the interconnection between ICTs and labour rights. The objective is to understand how ICTs may be utilized to safeguard and enhance labour conditions, as well as establish a more ethical global fishing supply chain that prioritizes the protection of individuals and their livelihoods.

1.3 Research Questions

This inquiry employs a conceptual and contextual framework that draws upon literature pertaining to labour regimes in GPNs , as well as exploring the potential of technology as a crucial tool for facilitating improvements.

The following questions have shaped the foundation of this thesis:

a) What information and communication technologies (ICTs) are currently accessible for tracking, monitoring, detecting, and establishing transparency regarding the labour conditions on fishing vessels operating in distant waters? What future directions are being taken in adopting technology concerning labour rights?

b) Who are the key stakeholders and entities involved in applying and utilizing ICTs in detecting and addressing labour rights abuses? Who is involved in generating data in specific ICTs? Who is funding various initiatives, and with what goals? What is the nature of stakeholder collaboration?

c) How is data from ICTs collected, analyzed and used to address the issue of poor labour conditions and forced labour in DWF?

d) What potential challenges may arise when integrating ICTs into the governance of labour conditions in DWFs – for example, in terms of coverage, evasion, implementation, conflicted interests, or resulting action?

By addressing these questions, the potential applications of various ICTs within the governance of the DWF production network can be addressed. This knowledge can facilitate the implementation of measures to increase awareness about labour conditions in the DWF. The heightened awareness resulting from these efforts can prove advantageous in formulating decisions and undertaking actions that promote a production network characterized by social responsibility and respect for labour rights.

1.4 Methods

1.4.1 Introduction

The primary aim of this thesis is to examine the utilization of various ICTs for monitoring and tracking labour conditions aboard vessels within the context of DWF. This research has been undertaken globally, gathering data from significant stakeholders worldwide. Qualitative data is the primary research methodology employed in investigating the efficacy of various technologies as tools for advancing labour rights and working conditions. The research design employed in this thesis comprised of two phases: a) a review secondary documents; and b) semi-structured interviews with key stakeholders.

1.4.2 Review of Secondary Documentation

During this phase, an extensive study was conducted on existing ICTs utilized in the fishing industry, with a specific focus on using ICTs in the DWF sector. The primary objective of this evaluation was to assess the effectiveness of these technologies in tracking and monitoring labour conditions, as well as their ability to detect potential instances of illicit activities, poor labour conditions, and possible forced labour. I have thoroughly examined various secondary sources, including academic articles, news articles, governmental documents, and websites of different

NGOs, companies, and start-ups. This extensive review aimed to gain a comprehensive understanding of the technologies being utilized, their potential applications, the entities employing them in the field, and the responsible parties governing the collected data within these technologies. Upon completion of data collection, the ICTs have been classified into two primary categories: a) remote monitoring technologies, encompassing positioning systems and satellite imaging, and b) on-board and community-based monitoring and reporting. In addition to categorizing and intensively studying various ICTs, I collected data on the principal stakeholders within this domain. Subsequently, upon identifying a key informant in several organizations, I proceeded with the interview-based component of my research design.

1.4.3 Semi-Structured Interview

Semi-structured interviewing was a key method of primary data collection for this research, as it elicits hands-on experiences and perspectives that cannot be found on websites, documents, or reports. The interviews were semi-structured in the sense that the encounter begins with pre-determined questions and a specific plan, but there is flexibility to adapt and react to the participant's response (Dunn, 2005). Appendix B: Interview Sample Questions (MAST Human) provides sample questions for the interviews.

Many parties and stakeholders are involved in ocean governance and are working on applying ICTs in DWF. Based on their relevance to the issue at hand, I selected ten candidates for the interviews and collected primary data regarding the development, application, and effectiveness of the ICTs. The selection of these ten respondents was based on their development or use of ICTs with a specific focus on labour conditions in the DWF. Of the ten selected respondents, I was able to conduct interviews with seven of them, as noted in Appendix A: List of Seven Interviews Conducted for Research on the Application of ICTs in Monitoring of Labour Rights in DWF. On the other hand, due to non-responses to my inquiries, I was unable to conduct interviews with key stakeholders in the DWF sector, including major fishery and vessel owner companies. I hope to interview these critical stakeholders in future research efforts.

1.4.5 Conducting Interviews

This study encompasses a global scale, with participants located in various regions worldwide. The interviews were conducted with individuals residing in the United States, United Kingdom, Australia, Thailand, and Taiwan; hence, the interviews were conducted via Zoom. To facilitate the execution of these interviews, I emailed each participant to extend an invitation to partake in the interview. Prior to the scheduled interview, individuals who expressed their willingness to participate and confirmed their attendance were sent an email containing the York University ethics consent form. This form was provided to ensure that participants were informed about the terms and conditions pertaining to data recording protocols and the utilization of interview materials. Participants were requested to carefully review the document and affix their signature if they agreed with the specified conditions. As per the research ethics protocol of York University, participants who express privacy concerns and discomfort with computer-mediated communication interviews can choose alternative data collection modes, such as written or telephone interviews. The informed consent form, which provides detailed information on this matter, can be found in Appendix C: Informed Consent Form.

1.4.6 Recording, Keeping, and Analyzing the Data

Once I obtained the necessary consent from the participant, I conducted the interview and transcribed the recorded conversation into written text. In this study, all participants provided their consent to have the interviews recorded for the purpose of transcribing. Amazon Web Services (AWS) was utilized for the transcribing process. After transcribing the data, I carefully reviewed and analyzed the content. I then chose and highlighted the relevant sections that would contribute to the thesis. Additionally, I ensured proper citation of the selected material for incorporation into the study.

1.5 Format of the Thesis

Chapter 2 presents an overview of the theoretical notions that serve as a foundation for understanding the concept of labour within the global economy, with a particular focus on global production networks. I employ GPN and labour regime theory as the major theoretical frameworks

for the research. While GPN theory addresses the institutions, actors and power relations in global production processes, labour regime theory provides a conceptual understanding of how workers are both disciplined and exert agency within global production systems. Acquiring knowledge of these concepts provides a framework for understanding labour governance, discipline and agency inside GPNs, and the ways in which technology can interact with labour conditions.

Chapter 3 presents an overview of the governance structure of DWF and examines the various issues encountered by the labour force within this domain. The chapter commences by examining the geographical characteristics of DWF, followed by an exploration of its geopolitical dimensions and an overview of the DWF domain. Subsequently, I analyze the governance framework for DWF and the pertinent issues surrounding labour rights. The chapter notes the prevailing unfavourable working conditions within the DWF sector, as well as the underlying reasons and mechanisms that render labourers in this industry vulnerable to exploitation and harm, including instances of forced labour. This contextualization provides a broader understanding of the issue at hand, enabling us to identify the necessary actions required for its improvement.

Chapter 4 provides an examination of remote monitoring and tracking systems employed to investigate the behaviour of vessels at sea. The primary objective is to identify suspected fishing fleets engaged in unlawful activities, including potential instances of forced labour. The technologies under consideration encompass positioning systems and satellite imagery, which hold the potential for enhancing labour rights and combating forced labour in DWF.

Chapter 5 focuses on the utilization of on-board and community-based monitoring and reporting tools. On-board electronic monitoring is specifically focused on CCTV and community-based electronic reporting. The latter involves workers and others actively participating in reporting their situations through the use of smartphones, various applications, and software. This chapter examines the potential of such electronic monitoring and reporting systems to enhance labour rights and mitigate instances of abuse within the DWF.

Chapter 6 provides a final discussion and conclusion by reviewing the results and establishing connections between these findings and the theoretical and contextual frameworks presented earlier. Additionally, it presents recommendations and questions for future study.

Chapter Two - Theorizing Labour in Global Production Network

2.1 Introduction

Many products that we consume in our daily lives traverse a complex network of production, transformation and distribution, known as a global production network.Within this interconnected system, a network links labour and production processes, facilitating the transformation of raw materials into the final commodities that individuals consume. Together this global production network manifests the interconnectedness of global geography, whereby a significant proportion of the commodities utilized by individuals are derived through global interconnections.

The treatment of labour within the global production system is a significant concern. This chapter aims to provide an overview and elucidation of the intersection of global production networks (GPN) and labour regimes as a theoretical framework. While GPN theory addresses the institutions, actors and power relations in global production processes, labour regime theory conceptualizes how workers are disciplined and exert agency within global production systems. Technology plays a significant role in GPNs and labour regimes, and it is therefore also important ask how it might influence labour rights in GPNs.

This chapter will be organized in the following manner. Firstly, this discussion will focus on GPN theory, and related frameworks such as the global value chain (GVC). Subsequently, a more detailed analysis of the idea of labour embeddedness in GPNs will be presented, explicitly addressing the labour regime concept. After discussing the regulations and norms outlined in the labour regime and GPN, we can explore the concept of labour governance and the power relations within the intersection of GPN and the labour regime. Lastly, I will explore the role of technology in labour advocacy and agency through the monitoring and reporting of labour abuses.

2.2 Global Production Networks

Geographers have proposed GPN theory as a means to comprehend the intricate spatial dynamics of power relationships among various factors that influence the global system of production and

exchange (Henderson et al., 2002; Dicken, 2005; Cumbers et al., 2008). The global production system is a crucial component of the global economy, and comprehending its intricacies is of great importance. The GPN framework has been described as a heuristic framework for analyzing the global economy (Dicken, 2004). GPN theory's central path is to analyze the complex network of interconnected actors, processes, and resources involved in the production and distribution of goods and services systems across global, regional, and local scales. It aims to understand the roles, relationships, and power relations among various actors - such as firms, states, and civil society - and examine how value is created, transformed, and distributed within these networks (Henderson et al., 2002; Hess & Yeung, 2006, Coe et al., 2008, Coe, 2011, Dicken, 2015, Coe & Yeung, 2019). The primary objective of this section is to examine the GPN theory, including its characteristics, structure, and approach to the global production system and supply chains.

The GPN comprises various stakeholders, including governmental entities, corporations, non-governmental organizations (NGOs), civil society organizations, labour unions, and other groups. The GPN structure possesses the capacity to support a network architecture that is both multilateral and multiscale. The concept of multilateralism, as discussed by Lanza et al. (2019), is a significant aspect of GPN. It pertains to the active participation of numerous players and stakeholders inside the network. This emphasis on multilateralism underscores the crucial role of collaboration among these actors in the functioning of the network. As previously stated, several players have a role in defining the production network. These actors may be categorized as institutions operating at multiple sizes, including international and local levels, as well as engaging both governments and non-state entities. Coe et al. (2008) describe this system as "multi-scalar." Two examples illustrate this point. In Gereffi's (2014) analysis of Brazil's soybean exports to China, and Macdonald's (2007) examination of fair-trade coffee in a Starbucks case study, the interplays between private sector entities (firms), states, and civil society organizations are explored. These studies shed light on the collaborative efforts at both local and international levels to influence the structure of value chains, consequently impacting production and supply chain networks. By examining examples such as Brazil's soybean exports and Starbucks' coffee supply chain, it becomes evident that there exists a complex and interconnected production network operating on various scales and involving multiple actors.

The fact that production networks are inherently dynamic is one of the most important contributors to the complexity of these systems. In particular, the unpredictability and contingency of the temporal and spatial aspects of production networks are significant contributors to the complexity of these networks (Coe et al., 2008). GPN theory is widely recognized as a valuable tool for understanding such intricate dynamics of production, distribution, and consumption.

GPNs themselves have emerged as significant forms of transnational economic organization in the global economy. GPNs represent the convergence of two crucial processes: economic globalization, which involves the dispersal of production activities across various international locations, and production fragmentation, which entails the organizational division of different production functions among independent firms. These processes are primarily driven by subcontracting and specialization (Coe, 2021).

The GPN framework is distinguished by a network of interrelated variables encompassing value generation, value enhancement, and value capture (Coe & Yeung, 2015). Value creation is the act of producing surplus value throughout the production process, wherein labour is transformed into goods and services that can be sold for a value greater than the labour value inherent in them. Value improvement is achieved by means of information transfer, technology exchange, and industrial upgrading, which allow companies to enhance their competitive position within the network. Value capture involves the examination of the organizations and geographical areas within the GPN that effectively acquire the generated value. Power dynamics and the systems of governance drive this process. The assessment of these components provides insight into the uneven allocation of advantages and opportunities within the worldwide economy, as well as the variables that influence the competitive advantages of enterprises in the production network (Coe et al., 2008; Coe, 2011; Coe & Yeung, 2015; Coe & Yeung, 2019).

Additionally, the GPN paradigm considers the allocation and functioning of power within the production network, as well as the incorporation of the GPN into societal, network, and geographical contexts (Coe, 2011). In this context, power might be conceptualized as the capacity

of persons or entities to exercise dominion or sway over others. The phenomenon under examination exhibits a dynamic and complex nature, significantly influenced by the specific setting in which it occurs. It is imperative to refrain from oversimplifying this phenomenon by reducing it to a simplistic notion of supremacy (Coe & Yeung, 2015). Therefore, the concept of embeddedness explored more in the next section, examines organizations' strategies to establish a foothold in diverse geographical settings while also considering the impact of cultural, institutional, and historical elements and their integration into network frameworks (Coe, 2011).

The GPN method is a comprehensive relational framework that seeks to surpass the global commodity chain (GCC) and global value chain (GVC) formulations, which, although highly valuable, are more limited in practical application. While the fundamental essence of all three conceptualizations is comparable, involving the interconnected network of functions, operations, and transactions that facilitate the production, distribution, and consumption of a particular product or service, two significant distinctions exist in the practical application of GCC/GVC and GPN. GCC/GVC can be characterized as linear architectures, whereas GPN aims to surpass this linearity by encompassing many network configurations. Furthermore, GCC and GVC specifically emphasize the administration of inter-firm transactions, whereas GPN strives to contain all pertinent actors and interactions (Coe et al., 2008). In more detail, as Coe (2021) explained, GPN analysis has differentiated itself from GCC and GVC techniques from the start. First, explicit consideration of extra-firm networks brings into view the wide range of non-firm institutions, such as supra-national organizations, government agencies, trade unions, employer associations, NGOs, and consumer groups, that have the potential to shape firm activities in locations connected by global production networks. Thus, it tries to expand GCC/GVC accounts beyond inter-firm networks and include non-firm actors. Second, GPN analysis is multi-scalar and incorporates all local and global geographical scales. Third, it is a network technique that goes beyond chain analysis. To avoid deterministic linear interpretations of production systems and value generation and distribution, they are regarded as complex meshes of intra- and inter-industry links. For instance, we could refer to Krauss and Barrientos's (2021) paper regarding fair trade cocoa. This research clearly shows how non-linear and horizontal relationships and multi-dimensionality are incorporated, as Coe et al. (2008) emphasized. The GPN approach demonstrates how horizontal

relationships and non-linear dynamics can reshape cocoa sustainability in the context of fluctuating credibility sources and standards (Coe et al., 2008; Krauss & Barrientos, 2021).

In sum, GPN theory focuses on examining the interconnectedness of socio-political and spatial temporality inside the production network, as discussed by Coe et al. (2008). The theory incorporates power, embeddedness, and value as crucial elements (Coe & Yeung, 2015). A GPN is an interconnected comprehensive network. The concept entails the presence of different stakeholders within a network who assume specific roles, and the purpose of GPN analysis is to examine the interconnections among these informants within the broader framework of the global production system.

2.3 Labour Embeddedness in Global Production Network

It is essential to integrate questions of labour dynamics within GPN analysis. In this way, we can delve into how agency is politicized and institutionalized, as emphasized by Coe and Jordhus-Lier (2010). Moreover, it is imperative to examine labour embeddedness throughout a GPN to have a comprehensive understanding of the diverse roles and positions that labour holds throughout a production network.

As previously stated, the GPN framework has been employed to comprehend the complex spatial power relation among various actors that influence global systems of production and trade (Henderson et al., 2002; Coe et al., 2004; Dicken, 2005). Labour plays a role as a societal (Todd et al., 2017) actor within the GPN framework, as highlighted by Coe and Yeung (2019). It adds a socio-political dimension to the global production system, primarily by incorporating social ties into the networks. The current study centres on investigating social connections inherent in the production process and the processes by which value is transmitted across different geographical locations as it moves across space. Hence, including the value chain within the GPN becomes significant in comprehending labour from a more structural perspective (Rainnie et al., 2011). The GVC framework also aids in understanding the organizational structure and dynamics of global economies by examining the different entities involved in a particular industry. The labour force

assumes a crucial role as a fundamental actor within the value chain of a production network. The inclusion of labour as an actor has played a significant role in integrating social aspects into the GPN and GVC frameworks (Gereffi & Fernandez-Stark, 2011; Gereffi, 2018; Stringer et al., 2013).

It is essential to engage in a discussion of the concept of embeddedness as it relates to power relations within a production network. When we get involved in the idea of labour embeddedness in a GPN, Giddens' structuration theory helps us better understand the epistemology of labour agency and its positionality in the GPN. Coe and Jordhus-Lier (2010) discussed the structuration theory introduced by Giddens (1984) as a background concept to understand social life as an ongoing and iterative phenomenon, wherein it is perpetually generated and sustained through the mechanism of structuration. From this particular standpoint, it can be observed that both structure and agency played a significant role in every instance of social contact. The theory garnered interest among geographers due to its ability to acknowledge and account for the temporal and spatial settings within which these interactions occur. Therefore, it is crucial to establish a sense of labour embeddedness in GPNs (Coe & Jordhus-Lier, 2010). In the context of this thesis, an examination of the literature reveals that the incorporation of labour into the GPN framework can be analyzed via the lenses of behavioural and spatial/temporal embeddedness.

The concept of social embeddedness in GPN implies and illustrates the presence of economic activities within production networks, extending beyond the realm of economics alone. Furthermore, cultural, social, political, and institutional circumstances significantly affect this matter. Labour serves as an active entity engaged in diverse social endeavours, which are significantly shaped by a range of power dynamics. As Todd et al. (2017) argue, organizations are intricately intertwined within institutional and cultural-political structures. Labour's social and political integration within a GPN is crucial in sustaining social reproduction and supporting labour welfare. Hence, Carswell and De Neve (2013) discussed the interrelated nature of workers within social networks and their involvement in activities related to sustaining their livelihoods.

Furthermore, Carswell and De Neve (2013) recognize that broader considerations concerning reproduction, livelihoods, and social relations significantly influence individuals' decision-making processes and capacity to exercise agency. Labour agency is situated in both the internal and external realms of production, encompassing both the material and socio-political dimensions. Workers' agency plays a significant role in the realm of production and have a profound impact on labour markets and labour processes. Additionally, it facilitates substantial non-material changes in broader social interactions within which workers are situated. A comprehensive understanding of agency, which is deeply rooted in reproductive and social connections, provides a valuable framework for examining how labour agency influences the dynamics, procedures, and social disparities within the realm of work.

Moreover, this framework allows for analyzing a GPN's broader effects on livelihoods, social reproduction, and the dynamics of inequality and dependence. From a conceptual standpoint, the incorporation or exclusion of labour within a GPN is contingent upon many embedded institutions extending beyond the boundaries of enterprises and firm networks. These institutions encompass the labour market, the state, and civil society. Furthermore, labour has an active role in shaping the dynamics of inclusion and exclusion within a GPN, as well as influencing the overall composition of these networks through daily practices and conflicts related to value (Alford et al., 2019).

The concept of embeddedness from economic sociology is critically evaluated within the GPN context. It employs various aspects of global chain frameworks to underscore the intricate interconnections of labour and economic activities across distinct geographical regions. This examination aims to elucidate the complex dynamics that underpin the integration of labour as a societal actor into the broader global production landscape, highlighting the significant role of geographical diversity in shaping global economic processes. By exploring these relationships, the analysis contributes to a more nuanced understanding of the social and economic, as well as local and global, nexus within GPNs, revealing the multifaceted interactions between labour, economic

activities, and geographical locations in the global economy (Bair, 2008). The GPN methodology centers on the manner in which various social entities engage with one another in the course of generating and acquiring value and the subsequent impact this has on geographical results (Cumbers et al., 2008). It is essential to discuss the influence of labour's actions in relation to their position within the geographies of capitalism, their capacity to engage in organizing efforts across different locations, and their approaches to aligning with the (potential) mobility of capital and power (Castree et al., 2004; Coe & Jordhus-Lier, 2010). According to Coe and Jordhus-Lier (2010), workers strategically utilize their structural power in specific locations and time periods, resulting in a geographically and temporally diverse manifestation of labour agency (Coe & Jordhus-Lier, 2010, p. 218).

According to Cumbers et al. (2008), the concept offers a framework for understanding the intricate spatial dynamics of power interactions among many players that influence global systems of production and exchange. The temporal embeddedness of labour within the GPN, in addition to spatiality, serves as a means to comprehend the dynamic nature of labour within the GPN framework. The agency of labour is not characterized by static attributes but rather by its mobility and temporal dependence. The concept of labour agency temporality pertains to the recognition of the GPN as an intrinsically temporal phenomenon and the acknowledgement of the significance of time in forming a labour agency within the dynamics of the GPN. According to Coe and Jordhus-Lier (2010), there is a need for a more comprehensive understanding and exploration of the concept of agency, particularly in relation to its various geographical and temporal dimensions. The potential for worker action should always be considered in the context of the interplay between capital formations, the state, the community, and the labour market, to which workers are inevitably connected to varying degrees.

The concept of labour embeddedness and labour rights through a GPN requires further development and elaboration in terms of its social, geographical and temporal dimensions. According to Bair (2008) and Barrientos (2013), it is crucial to consider the concept of labour

embeddedness within the context of GPN/GVC. In this regard, the issue of labour rights and fair trade intersects significantly with the concept of labour embeddedness and needs further attention. Additionally, it is essential to consider the potential for worker action in relation to the interplay between capital formations, the state, the community, and the labour market. These factors collectively shape the context in which workers are inevitably but differently embedded (Coe & Jordhus-Lier, 2010). The case study of labour agency in the football manufacturing industry of Sialkot, Pakistan, by Lund-Thomsen (2013) is an excellent example of how looking at the labour embeddedness through the GPN and exploring its relation to vertical forces can clarify the labour power relation through the network.

In conclusion, labour has many political interactions in GPN. The idea of labour embeddedness is crucial for comprehending the power dynamics within GPN and facilitating our knowledge of labour regimes and governance in connection to power dynamics and the integration of responsible labour governance (Hughes et al., 2008; Selwyn, 2013).

2.4 Labour Regime and Governance in Global Production Network

The 1990s and 2000s witnessed a significant increase in economic globalization, resulting in the emergence of fragmented GPNs across various sectors, such as natural resources, manufacturing, and services. Scholars such as Coe and Yeung (2015), Dicken (2015), and Baglioni et al. (2022) have extensively studied this phenomenon. Consequently, a necessity arose to investigate the causal impact of labour in shaping the structure of these global production systems. This collection of literature highlights the significance of international dynamics in affecting national, regional/local, and workplace labour systems, frequently extending beyond geographical boundaries. To take one example, studies of dormitory regimes in China during the mid-2000s represented a significant advancement in understanding the impact of labour demands in export-oriented industries within a country characterized by extensive internal migration. This research shed light on the development of a distinct workplace system that effectively eroded the traditional

boundaries between production and reproduction spheres (Baglioni Campling, Coe, et al., 2022; Goodburn & Mishra, 2023, Peck, 2022, Yang, 2012).

The presence of labour as an actor inside a GPN contributes to its societal and political integration within the global production system. The study of labour regime and governance is crucial for gaining a deeper understanding of the intricate and multifaceted nature of labour within the context of a GPN, taking into account societal and political power dynamics. The literature on labour regimes and governance focuses on examining labour as a dynamic agency and the intersection with GPN. Within the context of the labour regime and governance framework, it is vital to emphasize and explore the equitable treatment of workers and the protection of labour rights, which are considered to be essential issues and objectives.

The term "labour regime" refers to a system of regulations and the establishment of necessary infrastructure. However, the primary focus of labour governance lies in ensuring compliance, regulating labour practices, and enforcing these regulations. The labour regime can be understood as the set of local social interactions and labour governance primarily shaped by power asymmetry and interconnections at multiple scales (Baglioni , Campling, Coe, et al., 2022; Gereffi et al., 2005). In this section, the focus will be on a review of the labour regime, followed by an exploration of labour governance within GPNs. This analysis aims to enhance comprehension of labour dynamics within the GPN, specifically as a non-firm societal and political entity, and its positioning within power dynamics vis-à-vis firms within the global production system.

The theoretical framework of a labour regime in addition to labour governance involves an examination of the socio-political dynamics between labour and institutions within a multifaceted economic system. In essence, the labour regime pertains to the analysis of power dynamics between the labour force and the owners of capital. Baglioni, Campling, Coe, et al. (2022) assert that the labour regime serves as the fundamental element inside networked and scalar economic

integration and production systems. The essence of a labour regime entails the amalgamation of social interactions and establishments that provide a contentious yet relatively stable connection between capital and labour within specific temporal and spatial contexts. The process of recentring which means reorienting attention to give priority to labour in global economic evaluations, recognizing labour significance in different parts of GPN, holds significance from both an analytical and political standpoint. In other words, this process ensures that no specific location within the GPN is excessively prioritized; it directly aligns with the broader examination of labour regimes and their pivotal role in the socio-economic landscape. It recognizes the labour regime as the sociocultural structure that enables capitalist accumulation on a global scale. From a political standpoint, it places labour as a central component in discussions regarding the comprehension and approach towards the global economy. Scholarship has frequently been overlooked to thoroughly examine the connections between workplace dynamics and broader societal institutions and processes. There is a significant deficiency in the complete implementation of labour regime analysis to thoroughly explore these links. An intensive diagnostic analysis of this topic area has the potential to make a distinctive contribution. Its objective is to precisely define the complex connections between regional labour systems and the overarching global production networks. This approach has been supported by scholars such as Baglioni, Campling, Coe, and others in 2022, as well as Peck in 2022 and Baglioni in 2017, who argue that grasping these interconnections is essential for understanding the structure and functioning of the global economy.

When analyzing labour within the GPN framework, we refer to the labour regime and governance at various scales (Campling et al., 2019). In the context of globalization and establishing multilateral structures, transnational private regulation has emerged as a significant force in shaping the global labour regime. As multinational organizations expand, they establish cross-border regulations among affiliated firms, positioning themselves as substantial participants in the GPN (Bartley & Coe, 2022). Furthermore, within the framework of this power dynamics equation, civil society organizations and unions assume various responsibilities through the labour regime of this GPN. For example, civil society groups and unions serve as impartial overseers that monitor the relationship between corporations and the labour force while also campaigning for the protection of labour rights. Non-profit organizations are tasked with the responsibility of

conducting inspections and monitoring the actions of corporations in relation to labour agencies based on global labour standards in order to address and combat inequality through GVC and GPN. According to Wickramasingha (2022), their advocacy involves facilitating communication and negotiation between global operations and regional labour conditions. Therefore, it may be argued that in addition to state regulations and intergovernmental institutions, rules and regulations imposed by transnational private corporations and non-profit organizations' involvement also contribute to the formation of the global labour regime and labour governance. This is evident in the case of South Korea's Automotive Labour Regime, Hyundai Motors and free trade agreements with Europe (Campling et al., 2019). Campling et al. investigate the interconnectedness between GPN and free trade agreements within the context of the South Korean automotive industry and its employment dynamics. This study centres on the production network of the Hyundai Motor Group that examines the Free Trade Agreement established between the European Union (EU) and South Korea. This article examines the significance of such agreements in relation to labour standards, as well as the interactions between states, firms, and social organizations such as unions in establishing the labour regime within the GPN. In another example, Stringer et al. (2013) address labour issues within the fishing industry, specifically focusing on South Korean vessels facing allegations of labour abuse and forced labour in New Zealand waters. This case exemplifies labour challenges in the DWF's GPN, highlighting the interactions among vessel owner companies, the Korean Government, and the New Zealand Government concerning this complex, multilateral issue.

While examining the labour dynamics inside GPN and the labour regime in global economies, it is crucial to understand the power dynamics that exist within the network between employers and employees. Labour governance within the context of GPN pertains to the establishment of mechanisms for regulating, formulating policies, ensuring compliance, enforcing regulations, and determining jurisdiction in relation to labour conditions within the production network. The governance of labour in GPN is a multifaceted concept encompassing a combination of national labour policies, international standards, and transnational corporate policies (Raj-Reichert, 2013; Gereffi, 2018).

Labour governance aims to ensure the protection of labour rights and serve as a proactive framework to combat exploitation. It also involves monitoring practices to promote sustainable and ethical production within a globalized production system. Riisgaard and Hammer (2011) say GVC/GPN governance is crucial to labour's strategic options. It shapes how labour movements and institutions like private social norms and international framework agreements regulate value chains. GVC/GPN concepts emphasize how power in the job relationship transcends organizational borders and how industrial power is transferred from production to consumption. An examination of GPN using the labour process theory, influenced by Braverman (Spencer, 2000), uncovers the intricate power dynamics among corporations, employees, and the capital-labour connection. Braverman offered a critical analysis of the capitalist inclination to reduce the skills of workers in order to increase profits and advocated for a reassessment of these methods (Spencer, 2000). He began a significant discussion on labour processes, emphasizing the difficulties of tackling worker detachment and exploitation. The theory provides a valuable understanding of the intricate dynamics inside GPNs, emphasizing the need to comprehend both local and global economic linkages. Nevertheless, Braverman warned against a limited concentration that may disregard wider aspects of labour organization and social consequences, thereby strengthening the existing state of affairs (Spencer, 2000). By combining Braverman's criticism with GPN labour governance research, a holistic perspective on global economic operations is achieved. This approach highlights the crucial influence of labour in influencing economic trends and advocates for systemic transformation to promote an equitable future. The labour process idea offers a significant perspective for comprehending the dynamics of labour and power relationships within the GPN (Selwyn, 2007; Rainnie et al., 2010; Baglioni, 2017). Vandergeest and Marschke (2019) discussed about exploring the contemporary anti-slavery campaign by analyzing the slavery crisis that occurred in Thailand's fishing industry. The introduction of the concept of slavery prompted governments, companies, and NGOs to take action, resulting in enhancements in working conditions. The use of the slavery framing successfully garnered attention and resources for solidarity groups. However, it falls short as a practical guide for action due to its oversimplification of the intricate and physical dynamics of freedom and unfreedom. This oversimplification can be exploited to justify capitalism as a domain of freedom, rather than recognizing it as a catalyst for coerced labour or slavery (Vandergeest & Marschke, 2019).

Various methodologies can be employed to investigate the intricacies of labour governance structures in a GPN. Here I will focus on examining the labour governance structure within two distinct analysis methods: the vertical/horizontal power relation and the multiscale labour governance.

As previously stated, the labour governance of GPN is a multifaceted notion. This implies that several entities are involved in the equation that contribute to the formation of power dynamics. One of the analytical approaches employed in the study of GPN is the examination of vertical and horizontal power relations. According to Lund-Thomsen (2013), the stakeholder can be understood in terms of horizontal and vertical forces. The concepts of vertical and horizontal, within the framework of power dynamics and labour governance, provide a means to enhance the understanding of the decision-making process, the allocation of power, and the interactions between various players within the production system. The concept of vertical power relations mainly pertains to hierarchical relationships characterized by a top-down organizational structure where gives us the clue of asking and thinking structurally about whether one player possesses a significant degree of influence and power over other actors (Torfing et al.,2012; Thomas & Turnbull, 2017).

The relationship between states, multinational corporations, and intergovernmental actors is complex and complicated, and which characterized as vertical, wherein for instance, theoretically intergovernmental entities establish norms and standards that governments and transnational corporations are required to adhere to. In the context of vertical power relations and structures, decision-making is predominantly centralized, namely at the level of lead firms and multinational organizations. The adoption of a centralized strategy by enterprises resulted in their ability to exert control over various aspects of the network, such as establishing standards, determining pay, and regulating working conditions (Fichter et al., 2011; Lund-Thomsen, 2013; Barnes et al., 2015; Malesky & Mosley, 2018). Furthermore, the labour governance system inside the GPN also encompasses horizontal power relations. Horizontal power relations mainly involve collaborative

partnerships between entities, such as engaging in trade agreements or establishing labour standards (Torfing et al., 2012; Lund-Thomsen, 2013). Collaboration serves as a prominent means of establishing horizontal power dynamics. This is particularly evident when examining the interactions between civil society organizations, unions, and other stakeholders within the GPN. These actors adopt a collaborative approach to enhance monitoring, transparency, and adherence to labour rights and standards within the network (Barrientos, 2013; Todd et al., 2017). According to Lund-Thomsen (2013), horizontal power relations strongly emphasize the socio-economic dimension of labour and power relations in a GPN, with a primary focus on labour rights and standards.

Furthermore, an illustrative instance of the horizontal and vertical power dynamics in labour governance can be found in the research conducted by Boudreau et al. (2023). Their study examines the global value chain of coffee, focusing on the case study of South Sudan and Nespresso. This study examines the interplay between horizontal and vertical labour governance. The labour regime and governance in the GPN are influenced by various factors, including the regulatory policies of the South Sudan government, the presence of Nespresso as an international firm, and the involvement of civil organizations in social movements.

Moreover, labour governance under the GPN structure exhibits traits that span several scales. The concept of scale is an inherent aspect of labour governance, serving as a centralized foundation for establishing global order. When considering the ontological and epistemic aspects of scale in GPN labour governance, we can infer that the scale concept refers to a hierarchical system encompassing global, regional, national, and local levels where labour regulations and operations occur. It serves to understand the functioning of labour governance mechanisms at different levels and how labour rights and conditions are situated within this power dynamic, as explored through the GPN framework (Cumbers et al., 2010; Herod, 2010). In other terms, the notion of scale serves as an effective means of assessing the degree of alignment between global labour legislation and norms and the actual implementation of local labour practices. Thus, understanding the

fragmentations and gaps across various scales might enhance the effectiveness of labour governance within GPN, leading to improved labour rights and working conditions.

According to Cumbers et al. (2008), the GPN framework's emergence in economic geography has provided significant contributions to comprehending the social and political dynamics among regional, state, and corporate entities. This approach sheds light on the intricate processes involved in creating value within the production of commodities. The process of integrating into a GPN presents notable problems and simultaneously creates prospects for labour governance. The influence exerted by lead firms on governance has implications for working conditions and may contribute to the prevalence of precarious employment. This dynamic interaction can also impose limitations on the effectiveness of national labour legislation in safeguarding labour rights. The utilization of the GPN framework enables the analysis of their interplay with labour markets that are integrated within institutions and society and the identification of possible areas of influence for labour disputes that extend beyond local, national, and global boundaries. This statement highlights the significance of analyzing commercial and societal articulations as disputed processes that create opportunities for worker action at several scales across the GPN (Alford et al., 2017). The impact of global-scale industrial organization evolution extends beyond the financial performance of enterprises and the configuration of industries. It also influences the progress or lack thereof of countries in the global economy and the underlying factors contributing to such outcomes.

In general, labour regimes and governance essentially need attention and a mutually reinforcing approach in comprehending, tackling, and responding to potential obstacles and concerns pertaining to labour rights and working conditions. The labour regime is responsible for addressing the prevailing patterns of labour rights and working conditions. In contrast, labour governance needs to delve further into examining structural frameworks, regulations, standards, and enforcement mechanisms. The present inquiry revolves around the efficacy of various perspectives

and methodologies in the existing literature to comprehensively understand labour conditions in the GPN.

2.5 How ICTs Influence Labour Rights in GPNs

In contemporary times, the increasing prevalence of technological advancements has led to the widespread adoption of information and communication technologies (ICTs) within the global production system. ICTs possess the capacity to bring about transformative effects in the operations of GPNs, thereby generating prospects for enhancing efficiency, connectivity, and transparency. Hence, it can be argued that the integration of ICTs within GPNs has the potential to significantly transform the global labour regime and governance structures. This transformation involves leveraging the network to implement measures aimed at enhancing labour conditions.

ICTs are significant in the governance of GPNs when it comes to enhancing the labour situation within the network. This is achieved through the enhancement of data-sharing methods and the management of supply chains (Chen, 2002; Murphy & Carmody, 2015; Foster & Graham, 2016). When examining the role of ICTs in GPN and their impact on the improvement of labour rights within the system, the concepts of connectivity and access become significant. When examining labour within the GPN, we are referring to its societal and political embeddedness, as well as its value chain and power dynamics. Consequently, the notions of connectivity and access gain greater importance in relation to enhancing transparency within the network (Foster & Graham, 2016).

With a specific emphasis on labour rights, ICTs possess the capacity to enhance monitoring, tracking, and transparency within GPN. According to Marschke et al. (2020), the utilization of ICTs has witnessed significant developments. These advancements have the potential to enhance workplace visibility, thereby facilitating improved communication and information accessibility for workers.

There are two primary methods by which the potentialities and functionality of (ICTs) can be categorized in relation to connectivity and access, with the aim of fostering transparency in GPN.

These two are: A) ICTs offer the potential for various stakeholders, such as corporations, governments, and non-profit organizations, to effectively monitor and assess labour conditions through diverse means. B) Conversely, ICTs have the potential to provide workers with an avenue to report their circumstances and raise awareness about their condition, thereby facilitating empowerment. Foster and Graham (2016) conducted an empirical study on the role of ICTs in global production networks (GPNs). Their research focused specifically on the tea production industry in Rwanda, using a case study approach to examine the interaction between technology and GPNs. The study emphasized the identification of the efficacy and advantages of internet connectivity. According to Foster and Graham (2016), ICTs play a crucial role in GPN labour governance by providing assistance in monitoring and patrimonialism. A more comprehensive analysis of how ICTs can enhance monitoring and reporting mechanisms will be elaborated upon in the following chapters.

Therefore, according to Foster and Graham (2016), the incorporation of ICTs into GPN has necessitated the establishment of a sociotechnical regime. The impact of ICTs on labour conditions within GPN can be examined through three critical conceptual categories: embeddedness, value, and power (Foster & Graham, 2016). The concept of embeddedness examines the enduring norms within territories and networks that influence production relationships. In this context, the technology realm is often regarded as a supporting element that facilitates long-lasting interactions. The association between value and the distribution of rents or surpluses within a network has been established. This line emphasizes the acknowledged connection between the creation of value and the distribution of economic rewards among actors, particularly labour, in the production network. With advancement of technology, examination of the explicit mechanisms employed to facilitate exchange has been conducted. As a result, The ICTs and GPN can be closely integrated (Chen, 2002; Murphy & Carmody, 2015; Foster and Graham, 2016); the sociotechnical regime (Murphy & Carmody, 2015) has the capability to enhance access to information, thereby increasing awareness and subsequently leading to improvements in labour conditions. This, in turn, brings about changes in the governance of labour within the GPN.

Overall, the incorporation of ICTs into GPN has the potential to establish a more effective labour regime and governance that aligns with ethical principles. Nevertheless, this potential for

advantage is accompanied by a series of challenges. ICTs can also be employed to oversee and regulate workers in manners that compromise privacy and autonomy. In order to achieve a harmonious integration of ICTs for enhanced efficiency while upholding labour rights, it is imperative to establish regulatory frameworks that safeguard worker privacy, foster transparency, and guarantee ethical and social labour practices.

2.6 Conclusion

In this chapter, the focus has been on the development of the theoretical framework for this thesis. The primary theoretical framework under consideration in this chapter was the convergence of GPN and labour regimes. On the other hand, GPN theory examines the various institutions, actors, and power dynamics involved in global production processes. Labour regime theory offers a conceptual framework for comprehending how workers are subjected to discipline while also exerting their agency within global production systems. This pertains to the labour process and the protection of labour rights within GPNs, as well as the influence of technology on labour advocacy and agency through the monitoring and reporting of labour abuses.

The chapter has discussed and reviewed the literature and has arranged it in the following manner. The primary focus of this debate pertained to the GPN theory and the GVC, with an examination of their evolution and the significance of labour within this network. Following this, a comprehensive examination of the concept of labour embeddedness in GPN was subsequently provided, explicitly focusing on the labour regime within the GPN framework. Upon engaging in a comprehensive analysis of the regulations and standards delineated within the labour regime and GPN, it becomes pertinent to delve into the notion of labour governance and the intricate power dynamics that arise at the intersection of GPN and the labour regime. Finally, this chapter has made clear that technology in the realm of labour advocacy and agency can be a means of monitoring and documenting violations of labour rights.

At the same time, this literature review reveals that the existing scholarship does not pay enough attention to labour rights and the role of technology in labour advocacy and agency through

monitoring and reporting. Several researchers contend that labour remains underrepresented in ongoing discussions, and it is essential to pay more attention to labour (Alford et al., 2019; Bair & Werner, 2015; Coe & Yeung, 2015; Stringer et al., 2013). Attention to labour in the GPN framework is a vital issue and needs to be considered and resolved, as this marginalization can cause more inequality in global supply chains (Cumbers et al., 2008; McGrath, 2013).

ICTs play a significant role within GPNs by influencing the global labour regime and governance. This can potentially bring about changes in worker rights and working conditions in the future. Consequently, the existing literature and scholarly discourse need to respond and adapt to these developments. The current global production landscape reveals new prospects for labour agency and the re-regulation of labour regimes. Nevertheless, it is crucial to acknowledge that despite these technological improvements, there continue to be limitations and restrictions on using ICTs.

Chapter Three - Contextualizing Labour Rights in Distant Water Fishing

3.1 Introduction

Seafood plays a substantial role in providing global food resources, exhibiting considerable economic significance. According to Rashid Somalia, the director of the Fisheries Economics Research Unit at the UBC Institute for the Oceans and Fisheries, the global fisheries industry has been estimated to have a value of 246 billion USD (CBC News, 2010). In addition to its substantial economic magnitude, the industry plays a crucial role in generating employment opportunities and supporting livelihoods. Based on the research conducted on the global employment implications of marine fisheries, Teh and Sumaila (2013) found that approximately 260 million jobs are generated by the fishery sector.

The multinational and geographical attributes of distant water fishing (DWF) demonstrate complexity in the supply chain and production network. Thus, it is imperative to take into account the contextualization of the DWF and its supply chain system as a pivotal factor in order to acquire a comprehensive understanding of the challenges that emerge within this particular field.

Labour rights and environmental impacts are primary concerns in the DWF supply chain. The issue of labour rights is a significant focal point within the context of high-seas fisheries, with migrant workers, particularly those working in remote oceanic locations, encountering various challenges. Regrettably, forced labour has emerged as a distressing occurrence within this sector (Kalia et al., 2022). The challenges faced by workers aboard vessels in distant waters include substandard working conditions, as well as instances of physical and mental abuse (EJF, 2019).

The objective of this chapter is to provide a contextual understanding of distant water fisheries, with a specific emphasis on the prevailing labour conditions within their production networks. The chapter will commence by examining the geographies of DWF, accompanied by a contextual overview. Next, I will address the topic of DWF governance and discuss the key actors involved,

both governmental and non-governmental, and their collaborative efforts in terms of governance and legislation pertaining to global fisheries governance. Furthermore, I will delve into an in-depth review of the labour conditions and the formidable challenges faced by workers operating in the DWF. In the following section, I will explore several factors contributing to the existence of precarious labour conditions. Finally, the phenomenon of forced labour in the context of DWF will be elucidated.

3.2 The Geography of Distant Water Fishing

3.2.1 Geographical Complications

Various scales exist in the fisheries domain, encompassing local, national, regional and international dimensions. Fisheries are conducted within the regional waters or Exclusive Economic Zones (EEZs) that fall under the sovereignty of each respective country, as well as on the high seas. The present study centres on global DWF, which pertains to fishing fleets operating within the 200-mile EEZ of foreign nations, or in the high seas located further offshore (Pauly, 2013).

Access to fishing areas and resources is geopolitically significant. Moreover, it is also complex in terms of jurisdiction – territorial control depends on the distance from a country's coastline, and distant water fleets will often operate in marine areas that are outside of territorial waters; in simple terms, transboundary and mobile nature creates this complexity in DWF and ocean governance (Havice, 2021). It means there are no solid boundaries in maritime space, and the definition of access and bordering is different than on land; also, the resources (fish) are mobile.

3.2.2 DWF Fleets

Based on studies conducted, it has been determined that seven flag states account for 75 percent of the entire fleet of distant water vessels. Kelly et al. (2023) estimated the number of active boats in DWF by calculating data from Millage et al.(2021). The calculation demonstrates that the Chinese fleet, which operates in the exclusive economic zones (EEZs) of other countries as well

as the high seas, consists of about 5,560 vessels. The next most substantial fleet is that of Taiwan, comprising a total of approximately 1,400 vessels; the remaining seven leading fleets with estimates of numbers of vessels consist of the Japanese fleet with a total of 692 vessels, followed by the American fleet with 475 vessels, the South Korean fleet with 463 vessels, the Spanish fleet with 438 vessels, and the Russian fleet with 414 vessels (Kelly et al., 2023; Millage et al., 2021). Orlowski (2019) asserts that distant-water fishing fleets prioritize the capture of high-value fish in areas with limited regulatory measures and law enforcement, specifically targeting the Pacific, East Africa, and West Africa. These fleets focus on regions with abundant fish stocks, easy market access, and weak governance capacities. Orlowski's analysis highlights the central challenge and intricate nature of DWF operations.

Kelly et al. (2023) identified four primary fishing gears or techniques employed by distant water fleets, which correspond to distinct capture technologies utilized for specific marine species. The fishing vessels that fall into this category include longliners, squid jiggers, trawlers, and purse seiners. Each gear type is specialized for capturing certain marine species, indicating that distant water fleets deploy a range of fishing strategies tailored to the specific ecological niches and behaviours of their target species.

3.2.3 Migrant Workers in DWF

The majority of crew members working on DWF vessels are migrant labourers. According to the findings of Hung et al. (2022), Taiwan is recognized as one of the prominent DWF nations on a global scale; also, the nation heavily depends on migrant labour to maintain cost efficiency. According to the Taiwan Fisheries Agency's estimation, approximately 22,710 migrant fishers have been recruited from foreign countries to engage in employment on Taiwanese fishing vessels, mainly from Indonesia and the Philippines (Greenpeace, 2019). Additionally, China, which is one of the most populous nations that participate in DWF, employs migrant labour to operate vessels that operate in international waters. An example of a news report on BBC World News, dated January 4th, 2023, highlights the presence of Chinese vessels in Africa and the employment of Ghanaian workers. Wright and Naadi (2023) discussed that employing migrant workers from low-income countries is one of the reasons that labourers are vulnerable and at risk of forced labour.

The report documents the unfortunate incidents that occurred on the vessels. In an interview with the BBC, one of the workers shared their experience, "one of his colleagues fell sick with cholera on board a Chinese vessel, but the crew refused to bring him back to shore for treatment. He did not make it back alive" (Wright & Naadi, 2023). Migrant workers play a significant role within the fishing industry's geographies. They are recruited primarily from low-income countries ,and they encounter various challenges during their employment and engagement in fishing fleets besides human trafficking. According to Kelly et al. (2023), the expansion of distant water fleets has led to an escalation in competition for economic viability. In addition to the unfavourable nature of employment on said vessels (which will be elaborated upon below), DWF fleets have increasingly employed migrant workers as crew members, reflecting a trend towards the globalization of maritime labour. These individuals may possess limited alternative means of subsistence within their respective localities.

Migrant crew vulnerability in DWF geographies is exacerbated by their citizenship status and circumstances; for instance, as Hyun-Ju (2016) discussed, when illicit activities such as the abuse of labourers on Korean fishing vessels take place, legal measures can be employed to safeguard the rights of these workers. However, a pertinent issue arises in that the existing legislation primarily focuses on protecting Korean workers rather than extending the same level of protection to migrant workers. The current limitations on governance and jurisdiction within the DWF framework make workers, particularly those who are migrants, vulnerable to modern slavery as a result of instances of forced labour and human trafficking (Kojima, 2021). This has been acknowledged as a key concern in DWF operations (EJF, 2018). In the subsequent sections of this chapter, a more comprehensive analysis will be provided regarding the factors contributing to workers' vulnerability in DWF.

3.3 Distant Water Fishing Governance and Questions of Labour Rights

3.3.1 DWF Governance Key Stakeholders

In order to enhance comprehension of labour as a non-firm actor in the DWF Global Production Network and to obtain awareness and understanding of the labour rights situation on the high seas, it is imperative to conduct further investigation into the operational mechanisms of governance in DWF. This section will begin by examining ocean governance, focusing on the ocean as a geographical domain encompassing deep-sea fisheries. Afterwards, I will proceed to explore the entities involved in the governance of DWF, explicitly focusing on both state and non-state actors. In this section, I will examine the two prominent international conventions pertaining to the governance and jurisdiction of maritime activities. Additionally, I will explore how these conventions can safeguard the labour rights of individuals working in fisheries fleets during their operations in distant water.

In the initial segment of this section, I will address the concept of ocean governance concerning the geographic expanse of the DWF. I will now proceed to conceptualize the principal actors involved in ocean governance and the DWF. These actors can be categorized into governmental and non-governmental entities within the context of international conventions and agreements established by intergovernmental organizations such as the United Nations (UN) and its affiliated bodies, including the International Labour Organization (ILO), International Maritime Organization (IMO), and the Food and Agriculture Organization (FAO), among others.

The ocean is a space with unique characteristics, resulting in a governance structure that differs from terrestrial environments. As previously noted, the ocean presents a unique challenge due to its transboundary and mobile resources and invisibility, which makes it complicated to have access to distant water (Havice, 2021; Havice & Zalik, 2018). Within the context of ocean governance, multilateral responses exist, as defined by the European Commission in 2023, wherein various actors participate in the governance of maritime areas. Hass et al. (2021) explained that the governance of distant waters is a complex phenomenon influenced by multiple drivers and actors with diverse perspectives and objectives. According to Perez-Esteve (2010) and Marschke et al.

(2020), the entities involved in governance can be broadly categorized into two groups: state actors, which include governments and governmental institutions; and non-state actors, such as corporations, civil society organizations, non-profits, and non-governmental organizations (NGO). Thus, the management of the oceans and DWF exhibits multinational and multilateral features. Ocean governance pertains to the all-encompassing administration of policies, measures, and matters concerning the global oceans. Its fundamental aims are to ensure the protection of the oceanic environment, encourage the sustainable utilization of coastal and marine space, and conserve its biodiversity (Pratikto, 2016). The involvement of various stakeholders, such as governmental institutions, the private sector, non-governmental organizations, academics, and scientists, is crucial for effective collaboration and coordination across all levels of governance within an integrated system (Pratikto, 2016).

When considering the involvement of governmental actors in the ocean and DWF (DWF) governance, it is essential to examine the contextualization of these actors and their respective roles. This necessitates identifying the high seas fishery industry participants and discerning their specific functions. Government actors can be categorized into two primary groups: national actors, which refer to states, and international actors, which pertain to intergovernmental entities. On an international level, intergovernmental organizations exist within the United Nations system, such as the ILO, IMO), and FAO. These organizations establish international norms and regulations that are universally accepted by governments, who commit to implementing the conventions and agreements established by these bodies.

Regarding the concept of territorial sovereignty and the establishment of national roles, countries with EEZs encompassing coastal regions and countries engaged in importing goods and services exist. The countries and governments involved in the DWF industry and its governance can be categorized into non-flag states (Kojima, 2021), flag states (KaranC, 2022), and port states (Ryngaert & Ringbom, 2016). The next part of this chapter will provide a more detailed discussion of these categories.

3.3.2 Flag and Non-Flag States

Flag states and non-flag states are two major actors in DWF governance. A flag state refers to the nation in which a company officially registers its commercial and merchant vessels. The phrase "flag state" refers to the practice of ships registering under the jurisdiction of a certain nation and displaying the flag of that nation to indicate their registration. As an example, any ships that are officially registered with the United States will display the flag of the United States (Laura, 2023). Furthermore, the term 'non-flag states' refers to countries that lack jurisdiction over a specific vessel because it is not registered under their flag. However, non-flag nations generally have limited jurisdiction over these boats unless particular international agreements, such as port state control, provide them the ability to examine foreign-flagged ships in their ports to guarantee adherence to specified international standards (Rayfuse, 2004). Due to the geographic characteristics of distant waters, the United Nations has convened the United Nations Convention on the Law of the Sea (UNCLOS). This convention delineates the maritime boundaries adjacent to a nation's coastal region, as well as the corresponding legal entitlements and obligations of the nation adjacent to these zones; the UNCLOS affirms the recognition of coastal nations' exclusive rights to investigate and use the resources of the seabed and subsoil within their EEZ, which extends up to 200 nautical miles beyond a nation's coastline. The implementation of this convention was formally established in 1994 (DFO, 2019, UN, n.d.). With the emergence of UNCLOS, the maritime territorialization for each state became clearer. In general, UNCLOS establishes the legal framework governing the rights and obligations of states in relation to their utilization of the world's oceans (Hoagland et al., 2001). Consequently, determining jurisdiction in EEZ fisheries becomes evident within the context of national fisheries. For instance, if a nation determines that domestic fleets fully utilize its fishing resources, it has the authority to prohibit the entry of foreign vessels. A nation has the option to permit foreign vessels to engage in fishing activities within its EEZ and may issue fishing licenses to them for this purpose (GFW, 2021). Nevertheless, flag states maintain authoritative control and legal oversight concerning issues related to labour rights and working conditions, exercising their sovereignty to enforce and regulate standards aboard vessels registered under their flags (Guilfoyle, 2011& Haas et al., 2023).

Now, the question is, does the UNCLOS cover the vessels' labour rights and conditions? In the realm of international law, particularly within the framework of the UNCLOS, it is conceivable that insufficient emphasis may be placed on the labour conditions prevalent aboard vessels. Nonetheless, it is crucial to acknowledge that there are established agreements that provide port states with power to conduct inspections. However, the flag state retains control. According to Kojima's explanation, the practices of contemporary slavery that occur across maritime boundaries, including human trafficking and coerced labour within the maritime and fishing sectors, frequently operate without regulation or oversight due to legal ambiguities and a shortage of political determination. One of the purposes of UNCLOS is to grant non-flag states a supplementary role in regulating and overseeing modern cases of human trafficking and forced labour in maritime settings, incorporating provisions that address criminal activities more broadly (Lampo, 2022; Mbiah, 2020). New Zealand is a compelling illustration of how EEZ states can establish regulations to safeguard and promote labour rights effectively. According to the findings of Stringer et al. (2011), one of the objectives of the UNCLOS is to provide non-flag states the authority to serve in a supporting role in regulating and overseeing modern cases of human trafficking and forced labour in maritime areas. This also includes rules pertaining to wider criminal activities. Consequently, New Zealand has enacted the Foreign Charter Vessels (FCV) laws, demonstrating its commitment to addressing coerced labour and overseeing working conditions on non-domestic ships operating in its territorial seas and EEZ. An essential element of these regulations is that reflagging to New Zealand is required in order to access its EEZ fisheries. The reflagging procedure essentially shifts the authority over work relations to New Zealand, enabling improved supervision and implementation of labour regulations on these vessels (Stringer et al., 2011).

UNCLOS addresses flag states as well, giving them jurisdiction over what is happening on board a vessel.The flag state refers to the nation where a vessel is formally registered; this implies that the state possesses sole legislative and enforcement jurisdiction over the ship while it navigates international waters (The Pew Charities Trust, 2019). According to Nguyen's (2023) explanation, the rights and duties of flag states are interconnected within the legal framework of the UNCLOS. The authority to confer nationality upon a vessel and exercise sole jurisdiction over it is vested in the state. Simultaneously, it is incumbent upon a flag state to duly exert its jurisdiction and

oversight over a vessel operating under its flag. The provisions pertaining to the rights and obligations of flag states are located in Part VII of the UNCLOS, titled "High Seas." These provisions are applicable regardless of the ship's location (Nguyen , 2023). Flag states must establish and effectively implement regulations that serve as a deterrent against the occurrence of illegal, unreported, and unregulated (IUU) fishing and related criminal activities on vessels under their jurisdiction (The Pew Charities Trust, 2019).

3.3.3 Port States

Port states are another state actor in DWF governance and jurisdiction. Besides UNCLOS, there are several international conventions to increase stewardship regarding the labour rights of vessels in distant waters. ILO, FAO, and IMO have introduced conventions and agreements to increase the port state's power to inspect and monitor DWF activities. Port states are required to implement adequate port measures to identify illegally caught fish and prevent vessels transporting such fish from entering or departing from the port (The Pew Charities Trust, 2019).

ILO, FAO, and IMO introduced the C-188 convention in 2007, the agreement on Port State Measures (PSMA) in 2009, and the Cape Town agreement in 2012, respectively (The Pew Charitable Trusts, 2018). I will address each of these frameworks in turn.

The primary aim of the ILO's C-188 Convention is to guarantee that individuals engaged in fishing activities are provided with satisfactory working conditions while aboard fishing vessels. This encompasses establishing minimum standards for onboard work, regulating conditions of service, ensuring adequate accommodation and food provisions, safeguarding occupational safety and health, facilitating access to medical care, and providing social security benefits. This regulation pertains to all individuals involved in the act of fishing, as well as the vessels used for commercial fishing activities. This measure aims to promote and uphold satisfactory working conditions aboard fishing vessels while also facilitating the enforcement of minimum requirements through labour inspections conducted in foreign ports. The convention establishes a mechanism to guarantee adherence to and implementation of its provisions for member states that have ratified

it. This mechanism entails conducting labour inspections at foreign ports for large fishing vessels and fishing vessels engaged in extended international voyages (Seafish, n.d.). The procedure involves conducting inspections when a fishing vessel enters a port state of a C-188 ratifying country to verify compliance with the convention. This is particularly important for distant water fishing vessels that depend on international ports. The convention aims to address the issue of forced labour by establishing standards that are defined in the forced labour index (ILO, n.d.; Kelly et al., 2023; Vandergeest & Marschke, 2019). The effectiveness of the inspection rights under the International Labour Organization's Convention No. 188 (C-188) on Work in Fishing is currently constrained due to its limited ratification status, with only 21 states having ratified the convention as of now. Notably, several key port states, crucial for the enforcement of the convention's provisions through labour inspections, have not ratified C-188. The countries that have ratified the convention include Angola, Antigua and Barbuda, Argentina, Bosnia and Herzegovina, Congo, Denmark, Estonia, France, Kenya, Lithuania, Morocco, Namibia, Netherlands, Norway, Poland, Portugal, Senegal, South Africa, Thailand, and the United Kingdom of Great Britain and Northern Ireland. Spain has also signed the convention, with its ratification set to come into force on February 29, 2024 (Ratifications of ILO Conventions: Ratifications by Convention, n.d.). The list reflects a diverse group of countries committed to improving labour conditions within the fishing sector. However, the absence of ratification by many other key port states limits the global reach and potential impact of the convention's provisions designed to safeguard the rights and working conditions of those in the fishing industry.

The Agreement on Port State Measures (PSMA) (FAO, n.d.) represents a significant milestone as the inaugural legally binding global agreement that specifically addresses the issue of illegal, unreported, and unregulated (IUU) fishing. The primary aim of this initiative is to effectively combat, discourage, and eradicate IUU fishing activities by implementing measures that restrict the access of vessels involved in such activities to ports and prohibit the offloading of their catches. The implementation of the PSMA serves to diminish the motivation for these vessels to persist in their operations, simultaneously impeding the entry of fishery products obtained through IUU fishing into both domestic and global markets. The successful execution of the PSMA ultimately contributes to the enduring preservation and responsible utilization of living marine resources and marine ecosystems. The regulations outlined in the Port State Measures Agreement (PSMA) are

applicable to fishing vessels that are requesting access to a specific port within a State that is not their own flag State (FAO, n.d.). The PSMA has witnessed a significant rise in commitment from the U.N. FAO, with 100 states now pledging to combat the issue of IUU fishing. Notably, 60 percent of port states have already expressed their ratification to the PSMA, and the recent additions of Angola, Eritrea, Morocco, and Nigeria further exemplify this trend (Desrochers, 2022). PSMA's primary objective is to prevent the practice of illicit IUU fishing by enabling inspections conducted by port authorities. Although the main objective is not specifically focused on labour rights, these inspections provide a unique chance to detect instances of labour exploitation on fishing vessels. Inspectors have the ability to discover proof of exploitation or poor working conditions, so indirectly dealing with labour concerns within a system that was originally created to govern fishing activity. The PSMA inadvertently serves as an efficient mechanism for exposing labour rights infringements in the fishing sector, connecting endeavours towards environmental sustainability with the promotion of human rights in maritime settings.

The Cape Town Agreement is a legally binding document that establishes a set of minimum standards for the design, construction, equipment, and inspection of fishing vessels that are 24 meters in length or larger or have an equivalent gross tonnage. The agreement encompasses obligatory global standards pertaining to stability and associated seaworthiness, machinery and electrical installations, life-saving appliances, communications equipment, fire protection, and fishing vessel construction (Hwang, 2022; IMO, n.d.). The Cape Town Agreement, established by the International Maritime Organization, encompasses regulations pertaining to the welfare and safety of maritime crew (Kelly et al., 2023). Nevertheless, it does not directly address the issue of labour rights, potential poor working conditions, and forced labour.

The central point I would like to highlight regarding these three conventions and agreements is increasing the power of port states in ocean governance. As Ryngaert and Ringbom (2016) have discussed, flag states have shortcomings in effectively regulating their vessels and enforcing relevant laws, and port states may undertake a supplementary role in regulation and enforcement. By exercising port state jurisdiction over foreign-flagged vessels, port states can enforce

universally applicable international rules and standards or, alternatively, enforce their own domestic laws.

3.3.4 Importing States

"Market States" (The Pew Charities Trust, 2019) or importing countries can play a role in DWF governance. It is imperative for these nations to ensure that the seafood entering their supply chains and subsequently reaching consumers has been obtained through legal means and adheres to ethical standards. This implies that regulatory measures can be implemented to prohibit the importation of seafood products associated with forced labour within their production processes. For example, on May 28, 2021, the United States implemented a ban on imports from a number of fishing companies and fishing fleets from China due to allegations of forced labour, which encompassed various instances of abuse of Indonesian workers (Lawder, 2021).

The EU yellow card system is a highly beneficial system in this particular context. The EU regulation aimed to address the issue of IUU fishing mandates that non-EU countries exporting fish to the EU or allowing their vessels to import fish into the EU must adhere to rigorous fisheries management standards. In the event that these criteria are not fulfilled, nations may be subjected to the process of being 'carded,' which entails the potential consequence of their fish being excluded from the European Union market. Countries that are found to have insufficient mechanisms in place to ensure the legality of their catch may be subjected to the issuance of a formal warning, commonly referred to as a "yellow card." The European Union subsequently initiates formal dialogues with these nations to address their deficiencies. Failure to comply with these regulations may result in the designation of the entity as "non-cooperating," potentially leading to a prohibition on exporting their seafood to the EU market, commonly referred to as a "red card." (EU IUU Fishing Coalition 2022 Kelly et al., 2023). For instance, in Thailand's case, the European Commission decided to remove Thailand from the category of "warned countries" due to its notable advancements in addressing the issue of illegal, unreported, and unregulated fishing. Presently, the Commission recognizes that Thailand has effectively remedied the deficiencies within its fishery's legal and administrative frameworks. Due to this rationale, the EU has decided to revoke the "yellow card" measure, which had been in effect since April 2015. This

measure served as a cautionary warning to the country, indicating its inadequate efforts in addressing issues related to IUU fishing practices at that time. The decision made today by the EU marks a reversal of the initial stage in a procedural sequence that had the potential to culminate in a comprehensive prohibition on the importation of marine fisheries products into the European Union (European Commission, 2019). The EU's decision marks a shift from the first stage of a procedural sequence that may have resulted in a complete prohibition on importing marine fishing products into the European Union, as stated by the European Commission in 2019. Like the Port State Measures Agreement on illicit fishing, the EU's program does not directly tackle labour problems. Nevertheless, in some cases, such as the one involving Thailand, labour concerns might be informally included in the discussions (Kadfak & Linke, 2021).

3.3.5 Labour Origin State

As previously indicated, crew members from Indonesia and other countries encounter challenges while working aboard Chinese fishing vessels (Lawder, 2021). The final state actor, then, is the government of a migrant's country of origin. The term "country of origin" refers to the nation where fishery workers hold citizenship. By this designation, that country is responsible for adhering to and overseeing labour conditions and taking appropriate measures to address any instances of illicit practices, such as forced labour. Bilateral and multilateral agreements, along with cooperation with flag states and other stakeholders, represent a crucial approach that labour origin states can take to address labour working conditions on fishing vessels in Distant Water Fishing (DWF). This strategy ensures collaborative efforts to improve labour standards and enforce compliance. Migrant labourers or individuals employed on foreign vessels often encounter challenges pertaining to their working conditions and the provision of essential coastal services (Vandergeest et al., 2021). A clear example in this context is the case of the Indonesian government. The Indonesian government is forging bilateral agreements to protect the rights of its citizens working on fishing boats under other countries' flags to tackle labour abuses and modern slavery. The Indonesian foreign ministry is now pursuing such agreements with Taiwan and China since the latter's fishing fleet contributes to virtually the same level of activity in remote seas as the combined efforts of the top four nations (Gokkon, 2022).

3.3.6 Non-State Actors

The governance of DWF is characterized by its multilateral and multinational nature, as previously indicated. The actors involved in this context can be classified into three primary categories: state; industry (seafood and fishing corporations); and non-governmental. I have previously engaged in a discussion regarding states and governmental actors, and I will now proceed to examine non-state and non-governmental actors. Firstly, it is crucial to understand the definition of non-state actors within this particular context, followed by an exploration of their role and approaches in the governance of DWF. Hence, it is evident that a significant degree of multilateralism and participation from non-state actors, in addition to governmental agencies, exists. The non-state actors engaged in this matter include NGOs, business associations, multinational corporations, private research-based organizations, and consultancies (Peterson, 2019).

As we have learned, most states/governmental agencies are responsible for policy setting, enforcement, and jurisdiction in the DWF governance. In contrast, the non-state (non-governmental) actors, such as advocacy organizations, play a role in increasing awareness and assisting governance in tracking, monitoring, and surveillance of fishing vessels' activities in distant waters. As Guggisberg discussed, non-governmental entities assume various significant functions in advancing adherence to international fisheries regulations. The roles encompass the monitoring, investigating, and reporting of instances of illegal, unreported, and unregulated fishing. These activities, specifically the collection and dissemination of data, align directly with the established framework of the law of the sea (2019). Transparency is an essential principle within the realm of DWF governance. The establishment and maintenance of transparency are essential factors for fostering an ethical and sustainable DWF industry. The fishery industry has undergone significant growth and expansion on a global scale. Although the industry is significant in international trade, it continues to exhibit a deficiency in transparency (Yozell & Shaver, 2019). The initial stage of significance involves identifying instances of labour discrimination occurring onboard vessels. Monitoring and tracking vessel activities is crucial in identifying illicit practices, such as forced labour, as noted by Makoni (2020). In addition, establishing transparency is essential in addressing issues related to illegal fishing and coerced labour in offshore areas. The term "transparency" holds various connotations for those involved in the global ocean sector,

spanning from the act of divulging all information to the notion that greater visibility of data fosters heightened accountability. Transparency is increasingly being acknowledged as a forward-thinking strategy to advance improved ocean governance worldwide (Poortvliet, 2023). According to Peterson (2019 & 2022), a growing body of literature emphasizes the significance of transparency in enhancing the efficacy of international organizations in dealing with complex issues of global fishery governance. This viewpoint is widely accepted within academic circles. Civil society actors, such as NGOs, private research-based organizations, and consultancies that advocate for non-profit public interests, are widely acknowledged as important agents and drivers in promoting transparency. Various non-profit organizations are actively engaged in ocean governance and play a significant role in promoting transparency, advocating for ethical supply chains, and prioritizing labour rights. The European Fisheries Fund, Greenpeace, Stella Maris, and the International Transport Workers Federation are non-profit organizations that are dedicated to monitoring and advocating for appropriate and standardized working conditions for labourers in the deep-water fishing industry. Global Fishing Watch is an exemplary illustration that plays a crucial role in promoting transparency in DWF governance through the utilization and advancement of various ICTs in this context. Additionally, business associations and corporations play vital roles in developing and providing services and infrastructures that can support various stakeholders in effectively tracking, monitoring, detecting, and ultimately creating transparency. One of the suitable examples of cooperation and involvement of the business sector in global fishing governance is the Seafood Ethics Action Alliance. It can be cited as an example of an international collaboration promoting ethical practices within the global seafood supply chain. The Seafood Ethics Action Alliance is a collaborative initiative between seafood enterprises and vendors aimed at augmenting the execution of human rights due diligence across the global seafood supply chain and advocating for the observance of human rights (Seafish, n.d.).

3.3.7 Conclusion

The concept of ocean governance exhibits both multilateral and multiscalar attributes. Both governmental and non-governmental actors have a role in global fishing governance (Yea et al., 2022). Governments and intergovernmental organizations are responsible for setting policy, regulation, enforcement and jurisdiction; conversely, non-state [and non-corporate] actors assist

in increasing transparency and efficient surveillance. Cooperation between stakeholders is a fundamental key to efficient DWF governance. Guggisberg (2019) notes that non-governmental entities assume various significant functions in facilitating adherence to international fisheries regulations. The aforementioned roles encompass two primary functions. Firstly, they involve the surveillance, examination, and documentation of instances of illicit, unreported, and unregulated fishing. Secondly, they entail engaging in proactive measures within the exclusive economic zones of coastal nations and in international waters (2019).

Overall, the capital structure and power dynamics of the DWF sector are shaped by national legislation, multinational enterprises, and international conventions and agreements. Major stakeholders in the corporate sector often include prominent fishing conglomerates, seafood corporations, seafood suppliers, and merchants. Key corporate players often include large fishing conglomerates and seafood companies based in countries with significant maritime capabilities, such as China, the United States, Taiwan, Japan, South Korea, and Spain. Corporations, together with nations and intergovernmental organizations, play a crucial role in determining how resources are obtained, transformed, and allocated on a global scale.

For instance, China, as previously said, has one of the greatest remote water fleets in the world. Chinese enterprises, sometimes controlled or linked with the state, have significant influence over the industry. These entities get financial assistance from the government and diplomatic backing, which enables them to function in other regions and secure permission to fish in faraway waters (Shi, 2023; The Outlaw Ocean Project, 2023).

In chapter 2 and in this section of chapter 3, specifically in the DWF governance section, I have shown that the capital and governance structure becomes more complex due to the involvement of joint ventures and partnerships between enterprises from other nations. These collaborations are generally motivated by the need to gain access to technology, ships, and finance. These ties may alter power dynamics, as local enterprises may acquire technology and expertise from international partners while foreign partners gain entry to fishing areas and local markets.

In the DWF sector, power dynamics and governance are dispersed across an intricate network that includes corporations, governments, non-governmental organizations, and intergovernmental entities. This network has an impact on the organization and functioning of capital within DWF production networks.

3.4 Poor Labour Working Conditions in Distant Water Fishing

Questions of environmental sustainability in fisheries have been at the forefront of public concern for several decades. However, in recent years, the rights and working conditions of migrant crew members have also become a prominent issue. One of the turning points regarding public attention to labour rights in the fishery industry arose because of media exposure of forced labour in offshore fisheries beginning in 2014 (Marschke & Vandergeest, 2016). In particular, the mainstream media drew attention to the dark side of offshore fisheries in Thailand and Taiwan, focusing more on labour rights in DWF. Additionally, there is evidence of poor working conditions in remote water fisheries in other regions, including Northwest Africa (Wright & Naadi, 2023; Urbina, 2019).

One way to describe the "situation" of a migrant fisher is as a "risk environment" (Yea & Stringer, 2021). Various forms of abuse, encompassing both physical and mental mistreatment, are inflicted upon labourers in the context of dangerous and difficult working conditions, thereby infringing upon their fundamental human rights. These abuses serve to illustrate the labourers' involvement in a contemporary manifestation of slavery (Yea & Stringer, 2023). The issue of working conditions in the global fishery industry, particularly aboard vessels located in the high seas, is a significant concern. Ensuring adequate provisions of food, water, and medication constitutes a fundamental aspect of human rights, hence necessitating universal access to these resources in all settings, including the workplace. By exploring labour working conditions in DWF vessels, we can see that many workers do not have access to proper food, water, and medication. There are multiple reports published by the Environmental Justice Foundation (EJF) that provide evidence of widespread human rights violations within the fishing industry (2018, 2019, 2020,2022). The

report in 2019 explicitly highlights instances of what is called modern slavery[1] as well as inadequate provisions of food and water, as documented; likewise, it is crucial to acknowledge and tackle the substantial challenge posed by the restricted accessibility of healthcare services (Vandergeest & Marschke, 2021). Physical assault and poor living conditions are also labour challenges for distant water fishing fleets (EJF, 2019). Physical violence and poor living conditions within maritime operations have been reported, wherein ship captains have been observed engaging in acts such as striking and kicking crew members. In particularly severe cases, it has been documented that crew members have been subjected to confinement within a freezer and to electrocution (EJF, 2020). More everyday problems include substandard food and water quality, sleeping quarters with limited space, and pungent odours of gasoline and septic waste permeating living and sleeping areas (Vandergeest & Marschke, 2021).

Alongside the conditions already described, there are also documented cases of long working hours, debt bondage, and withholding wages (EJF, 2020). There is a project called Outlaw Ocean that reports about Chinese squid fishery which shows us examples of tough and poor labour conditions in DWF industry. The "Outlaw Ocean" report exposes illegal practices and labour abuses in the Chinese squid fishing industry, highlighting overfishing, exploitation, and regulatory evasion. It underscores the challenges in enforcing maritime laws and labour standards, focusing on the environmental and human rights issues prevalent in international waters, particularly within China's extensive squid fisheries. The investigation uncovered a broad pattern of misconduct: Nearly half of the studied Chinese squid fleet, with 357 out of 751 vessels, was associated with human-rights or environmental infringements. The probe pinpointed at least 119 vessels with documented potential human-rights abuses since 2013. These violations encompassed debt bondage, withholding of wages, excessive work hours, crew abandonment at ports, forced and captive labour, physical assault on deckhands, seizure of passports, denial of prompt medical attention, and fatalities due to neglect or aggression (Urbina, 2019). The report by Greenpeace

[1] These reports predominantly use ILO indicators of forced labour to define slavery, diverging from the definition outlined in the 1926 Slavery Convention.

Southeast Asia specifically examines the conditions of Filipino and Indonesian workers on Taiwanese DWF vessels. It provides a contextual understanding of the situation, highlighting the labour conditions on these DWF fleets. These assertions demonstrate that employees are subject to a significant amount of physical strain, that they cannot obtain sufficient rest, and that their physical and mental health is at risk. At the same time, salary is an issue that, besides long working hours, makes the situation challenging for the workers. One of the most frequently reported human rights issues was the withholding of wages. The act of intentionally and consistently withholding wages to compel a worker to stay with an employer and preventing them from seeking alternative employment is indicative of modern slavery, which leads to forced labour (Greenpeace, 2019).

Regarding the salary and payment condition of the labourers on the fishing fleets, debt bondage is another concern. The individuals engaged in forced labour frequently work with the intention of repaying a debt that has been acquired and, in some cases, inherited. Debt may be incurred due to wage advances or loans obtained to address recruitment or transportation expenses and meet daily living or emergency needs, such as medical expenditures (Greenpeace, 2019).

Having examined the issue of poor labour conditions aboard vessels in the DWF industry, it is now important to explore the potential factors contributing to the vulnerability of labourers and the prevalence of such circumstances. There are many possible reasons that make workers in DWF more vulnerable and put them at risk of abuse and forced labour. According to the ILO, these include: "Lack of training, inadequate language skills, and lack of enforcement of safety and labour standards" (2022). Other factors include the geographic characteristics of their operation, which are distant, invisible and inaccessible (Havice, 2021), the citizenship status of crew members, who are primarily migrant workers (McVeigh, 2022), and weak governance (Orlowski, 2019).

The issue of accessibility poses significant challenges when examining the study of labour rights and the working conditions experienced by crew members on fishing fleets. The significance lies in considering how labourers can attain access to the external world, given their geographical isolation. Additionally, it is crucial to explore avenues through which third parties and stakeholders

can gain entry to the labourers in order to assess their circumstances and to hear from them directly. The complexity of tracking and monitoring labour conditions on vessels in distant water may be attributed to factors such as invisibility and distance from terrestrial space.

Similarly, Havice and Zalik expounded that Vandergeest highlights the labour conditions present on fishing vessels as a dimension of oceanic activity that is predominantly concealed and challenging to govern effectively (2018). Additionally, because of this geographic isolation and complex accessibility, it puts labour in a situation of long operation time, which means labour needs to work for extended periods far from their family and lack access to land-based facilities; Workers might be isolated at sea for periods from months to one or two years (EJF, 2022). The crew cannot contact their family most of the time because of a lack of access to the internet or Wi-Fi while on board (Godfrey, 2022). According to Global Labor Justice, the availability of Wi-Fi is of utmost importance for protecting workers' rights as outlined in international labour standards, specifically their right to freedom of association. The provision of Wi-Fi access is crucial for the well-being of employees and their families, as stated in a recent study (Chiang & Chen, 2022).

The issue of citizenship status poses an additional challenge and raises concerns for workers employed on maritime fishing vessels. A significant proportion of the workforce in the DWF industry comprises migrant workers who engage in emigration from their home countries and subsequently work on vessels operating under the flag of a different nation (Urbina, 2019; Asis, 2019). Migrant workers face a high vulnerability to instances of slavery, exploitation, and maltreatment due to their societal and citizenship status. The investigation by Hyun-Ju (2016). also uncovered that migrant fishing crews are exposed to inadequate living conditions, prolonged working hours, discriminatory compensation, deprivation of their official documents, physical aggression, and verbal abuse, among other issues. The vulnerability of migrant workers to various forms of exploitation, including human trafficking, is attributed to their lack of legal protection and social status within the jurisdiction of the flag state.

Consequently, they are exposed to additional abuses, alongside enduring low wages and excessive working hours (EJF 2018, 2019, 2020; Murphy, 2017). The factors mentioned above pertaining to migrant workers and their rights aboard DWF vessels bring us to the final aspect of vulnerability that I wish to address: inadequate governance concerning labour affairs within the state of origin. Inadequate governance can contribute to the vulnerability of labourers in precarious situations. The Wright and Naadi (2023) reports exemplify the precarious position of migrant labour due to the absence of robust policy and governance in their home countries, as evidenced by the labour abuse prevalent in Chinese fleets. In recent years, there has been a noticeable trend wherein the governments of origin countries, such as Indonesia and the Philippines, have established various conditions and agreements with major destination countries for migrant workers, such as China and Taiwan. These measures aim to safeguard the welfare and rights of their respective citizens employed on vessels in these destination countries (Gokkon, 2022; Asis, 2019).

3.5 Modern Slavery: Forced Labour a Major Concern in Distant Water Fishing

The concept of modern slavery, as mentioned in the preceding chapter, primarily pertains to the illicit practices of human trafficking and forced labour within the global fishing industry (Kojima, 2021; Makoni, 2020). According to Yea and Stringer (2021), the term "forced labour" generally denotes work performed involuntarily under the threat of punishment. It encompasses situations in which individuals are coerced into labour through violence, intimidation, or more covert methods such as debt manipulation, identity theft, or the threat of deportation (ILO, n.d.). The ILO has introduced indicators as part of a particular action programme to combat forced labour. The indicators are as follows: abuse of vulnerability, deception, restriction of the movement, isolation, physical and sexual violence, intimidation and threats, retention of identity documents, withholding of wages, debt bondage, abusive working and living conditions, and excessive overtime (ILO, n.d.).

Verite has researched the "Indicators of Forced Labour ” in the Supply Chain of Fish in Indonesia" (Verité, n.d.) The objective is to define the indicators and occurrences within the Indonesian fishery sector utilizing the ILO's indicators. Moreover, indicators produced by the ILO were adopted by stakeholders in the DWF sector. Verite is an esteemed non-profit civil society

organization (CSO) that provides its clientele , such as the seafood corporations in this case, with essential knowledge and resources to eliminate undesirable practices, including child labour, forced labour, human trafficking, and gender-based discrimination, from their supply chains. The organization develops and introduces targeted indicators for the global fishery industry, which serve as a basis for measuring labour rights and raising awareness about forced labour within the supply chain. These indicators are forced and excessive overtime, forced to work on call, limited freedom of movement and communication, constant supervision, isolation, degrading living conditions, hazardous work, physical and verbal abuse and harassment, withholding of wages, coercive pay structure, and exploitation of workers with mental disabilities (Verité, n.d.). DWF has some characteristics that make DWF workers more vulnerable to forced labour, including illegal and destructive fishing practices, lack of supply chain transparency and oversight, complex monitoring and enforcement, and limited data availability (RISE, 2021).

There are many occurrences of forced labour within the worldwide fishery sectors, with various stakeholders actively engaging in efforts to combat this issue. Two prominent illustrations exist that I would like to examine in order to demonstrate the presence of forced labour and the corresponding measures that have been devised to combat it. Firstly, I would like to address the issue of forced labour within the Taiwan DWF sector. Specifically, there have been instances of forced labour occurring on Taiwanese vessels, as exemplified by the experiences of Indonesian migrant workers (Soulina & Yovani, 2020; Greenpeace, 2019). By examining these cases, we can gain insight into the measures that have been implemented thus far and identify further actions that need to be taken to combat this unfortunate situation. Furthermore, the presence of South Korean vessels within the EEZ of New Zealand also serves as a notable illustration of the prevalence of forced labour in the DWF industry, as well as the potential actions that coastal states can undertake to address this issue (Stringer et al., 2013; Stringer et al., 2015).

Taiwan is recognized as a prominent participant in the DWF industry on a global scale. It encounters the issue of forced labour as a significant obstacle within this sector. In contemporary

times, significant investigations have revealed troubling occurrences of human rights infringements within the fisheries sector. The violations include forced labour cases and the illegal trafficking of individuals, with Taiwanese vessels and companies being recognized as particularly severe transgressors (Greenpeace, 2020). Indonesian migrant workers encounter various forms of mistreatment aboard Taiwanese vessels. Therefore, the agreements established between the Indonesian and Taiwanese governments are designed to safeguard the rights of migrant workers, focusing on enhancing their protection and ensuring their fair treatment and safety while working in Taiwan and Taiwanese fishing vessels in DWF (Gokkon, 2022; Asis, 2019). New Zealand has coastal water and is involved in DWF, and it also hosts foreign vessels like South Korean fishing fleets in its territorial waters. Stringer et al. (2015) reframe the historical perspective on substandard labour practices observed on foreign charter vessels operating in New Zealand's waters to highlight their potentially malicious nature. Stringer et al. (2015) assess the classification of migrant fishing crew aboard South Korean vessels as victims of forced labour by utilizing the operational indicators of human trafficking for forced labour provided by the ILO and European Commission (EC). They discovered that individuals are indeed subjected to involuntary labour, thereby necessitating the expansion of the ILO's operational indicators and encompassing exit strategies.

Greenpeace (2021) has suggested the actions that need to be taken against forced labour. These are (as a direct quote):

- "Governments in the fisheries supply chain should ratify and implement ILO C-188[3] and ILO fundamental conventions[4].
- Governments should ratify and implement the FAO Port State Measures Agreement[5];
- Governments should ratify and implement the IMO Cape Town Agreement[6];
- Governments of origin of the migrant fishers should establish and implement policies that protect labour rights, including but not limited to:
    - Recruitment of workers through formalized channels; and
    - Zero recruitment fees;

- Fishing companies that recruit migrant fishers should ensure that all fishers receive no less than 10 hours of rest in any 24-hour period;

- Fishing companies, traders, processors, and brands should ensure that workers have access to secure, anonymous, confidential, and independent complaint mechanisms with strong protections against retaliation;

- Fishing companies, traders, processors, brands, end-buyers, and investors should uphold the corporate responsibility to respect human rights as defined by the UN Guiding Principles on Business and Human Rights (UNGPs)[7]; Buyers should only source from vessels that spend a maximum of three months at sea before going to a port and allow crew unfettered access to port services for a minimum of 10 days.

- Buyers should prioritize sourcing from vessels subject to port state labour inspections and shown to be compliant with C-188[8] and the ILO fundamental conventions[9]; and

- Fishing companies, traders, processors, brands, end-buyers, and investors should publicly disclose information on the entire supply chain, including vessel owner, vessel name, fishing gear, and species caught."

3.6 Conclusion

All in all, the production network of DWF exhibits complexity due to its geographic characteristics, situated within the confines of the oceanic domain, which is characterized by its remote and secluded nature, and operating as a globally interconnected and cooperative network involving multiple nations and organizations. The concept of labour rights is a significant concern within the global fishery production network due to the characteristics of DWF. The presence of forced labour is a regrettable aspect observed within the fishery supply chain. This chapter has analyzed the geographies associated with DWF and its governance. Subsequently, I transitioned to an examination of the labour conditions prevalent within this particular industry, as well as an exploration of the factors contributing to the susceptibility of labour within the broader global fishery value chain. In the final section of the chapter, I have presented a conceptualization of forced labour within the context of DWF. In summary, the absence of transparency is a significant

concept that must be considered a major obstacle to DWF governance and the protection of labour rights. Yozell and Shaver (2019) argue that enhancing transparency and shedding light on the dark, opaque aspects of the DWF production network is crucial for fostering an ethical and sustainable global fishery industry. This chapter contextualizes DWF, focusing on its challenges and concerns within the labour rights framework. In the following chapter, I will examine the role of ICTs in enhancing transparency and subsequently promoting labour rights in the context of DWF.

Chapter Four - The Role of Positioning Systems and Remote Monitoring of Vessels

4.1 Introduction

Various types of information and communication technologies (ICTs) are utilized to monitor, detect, and track the behaviour of fishing vessels in remote waters, effectively serving as a proxy to estimate the extent of illegal, unreported, and unregulated (IUU) fishing activities. Implementing tracking of a vessel's position and movement can also, to some extent, address concerns regarding labour conditions on board and the possibility of forced labour because IUU fishing serves as a significant indicator regarding the presence of forced labour (Kadfak & Linke, 2021). In addition, some of these monitoring technologies and practices can also be used to directly or indirectly observe some aspects of working conditions.

This chapter aims to examine the potential impact of positioning and remote monitoring systems on enhancing labour rights and improving working conditions within the context of DWF. The term "positioning and remote monitoring systems" in this study pertains to technological tools primarily used to analyze vessel movements. These systems are employed to identify any unusual actions exhibited by vessels, enabling the assessment and classification of such vessels as potentially engaged in suspicious activities. It is essential to acknowledge, as Emma Seal (Ocean Mind, 2023) highlighted in our interview that these technologies do not provide a direct representation of labour conditions. Instead, they are a proxy to allow estimations about the likely situation on board a vessel, and in this way, they can function as complementary tools for training algorithms to identify suspicious behaviour.

In this chapter, the discussion will commence with an examination of how vessels' positions and behaviours are detected through the utilization of ICTs. Subsequently, the focus will shift toward an exploration of how the acquired data is managed and its potential to aid the detection of vessels' behaviour. To enhance the clarity of this chapter, the techniques of collecting data have been categorized into two distinct sections, namely positioning systems data and satellite imagery data. Finally, I have developed an additional segment entitled "Machine Learning: Training,

Monitoring, and Detection Algorithms." In this section, I will address the processing and utilization of collected data in training algorithms to enhance the efficacy of vessel identification and augment our understanding of distant water vessel activity and estimation of labour conditions.

4.2 Positioning Systems Data

4.2.1 Introduction

This section will discuss positioning system technologies and examine their potential to gather data relating to labour rights and working conditions in DWF. Positioning systems have the capability to monitor and track objects in remote and inaccessible regions, such as the oceans, where direct human observation is very limited. Analyzing the behaviour of distant water fishing fleets offers crucial insights for predicting labour conditions during operations. This relationship is viable as operational patterns, including routes and practices, often indicate compliance with or breaches of labour and environmental regulations. Fleets operating in poorly regulated areas or exhibiting secretive behaviour are likely candidates for exploitative practices. Factors such as time at sea, port call frequency, and engagement with monitoring and positioning systems shed light on crew conditions, rest periods, and the risk of abuses like forced labour. These observations enable targeted interventions, enhanced regulatory enforcement, and improved worker protection strategies. By closely monitoring these fleets, authorities and organizations can better safeguard workers' rights and promote sustainable practices within the global fishing industry, ensuring a more ethical and responsible seafood supply chain. This study explores three positioning systems utilized as essential tools in fishing fleets. The three positioning systems are Global Positioning Systems (GPS), Automatic Identification Systems (AIS), and Vessel Monitoring Systems (VMS).

This section comprises three distinct parts clarifying the nature of the positioning technologies, their potential advantages for managing fishing fleets and tracking vessels, and ultimately, the efficacy of GPS, AIS, and VMS in monitoring and detecting abusive working conditions in distant water fisheries.

4.2.2 Global Positioning Systems

A GPS is a technology that facilitates the identification and locational tracking of objects in various domains, including but not limited to personal, industrial, scientific, security, and military applications. Garmin is a leading technology enterprise that offers GPS solutions and merchandise. According to Garmin's official website, a GPS is a navigation system that operates through satellites and comprises a minimum of 24 such satellites. These GPS satellites follow a precise orbit and complete two revolutions around the Earth daily. GPS devices are able to determine the exact location of a satellite by decoding the unique signal and orbital parameters transmitted by each satellite. The GPS receivers utilize the available data and a trilateration technique to determine the precise geographical coordinates of a user's location (Garmin.com, 2022).

GPS technology is widely used in maritime transportation and the fishing industry as a means of locating commercial vessels at sea. The utilization of GPS technology facilitates the prevention of collisions between vessels and the surveillance of their conduct when fishing vessels enter and leave territorial waters and protected areas, thereby mitigating unlawful actions. The utilization of GPS technology has the potential to identify instances of IUU fishing through diverse means. For instance, a novel GPS-based method for detecting IUU fishing involves the utilization of avian species as surveillance agents to locate fishing vessels. The French National Centre for Scientific Research (CNRS) conducted a study in which 169 albatrosses were equipped with loggers containing radar detectors, a GPS antenna, a processor, and memory. An Argos antenna was also included to enable instantaneous data transmission (Carreon, 2020). This research showcases the possible capabilities of GPS technology in identifying instances of illicit fishing, with an avian species serving as a valuable intermediary. In this context, the term "third party" refers to avian entities that are neither affiliated with the control centre nor aligned with any involved parties. Their role is limited to facilitating the transportation of detectors in close proximity to the vessels, thereby enabling data collection by experts. Beurteaux (2018) reported in Hakai Magazine that avian species have a natural tendency to aggregate in close proximity to fishing fleets. As mentioned earlier, according to the ILO forced labour index, IUU can be one of the most clear signs of poor labour conditions and possible forced labour.

Another example is provided by Google's sustainability webpage, which focuses on utilizing GPS technology to monitor and identify instances of unauthorized fishing activity spanning a vast marine area of 1.4 billion square miles (Google, n.d.)." Google claims that its sustainability program represents Google's dedication to providing individuals, organizations, and governments with the necessary data and tools to facilitate constructive action toward adopting more sustainable practices". The Google Sustainability website, as referenced above, has conducted research on the topic of IUU fishing. The findings suggest that the utilization of GPS technology has the potential to be highly effective in monitoring and detecting instances of illegal fishing. Identifying unregulated fishing practices in aquatic environments is essential due to the significant implications of illicit activities, including forced labour and substandard vessel working conditions.

The utilization of positioning systems such as GPS, AIS, and VMS has gained significant traction and interest in recent years. Collaboration between non-state actors like technology companies and non-governmental organizations with states and intergovernmental actors is underway to incorporate positioning technologies in ocean governance, explicitly focusing on the distant water fishing sector. For instance, Global Fishing Watch (GFW) is an illustrative example of a network that aims to enhance transparency in commercial fishing practices in the ocean, focusing on addressing the issue of forced labour. Oceana is an international advocacy organization that operates as a non-profit primarily focused on ocean conservation efforts (Oceana, n.d.). SkyTruth is a non-profit technological provider that offers satellite imagery for sustainability monitoring across various industries (SkyTruth, n.d.). Additionally, these entities (Google Sustainability, Oceana, and SkyTruth) have collaborations to establish the most prominent platform to combat illegal fishing (Oceana, 2022) and forced labour in distant water fisheries, which is called GFW. (Poortvliet, 2023). GFW is a non-profit organization dedicated to advancing the cause of ocean sustainability through the systematic monitoring and dissemination of data pertaining to commercial fishing practices on a global scale. Technology is employed to address the issue of illegal fishing and promote marine conservation by enhancing transparency, facilitating informed policymaking, and improving resource management. GFW primarily utilizes satellite technologies and positioning systems such as GPS, AIS, and VMS to collect data. This data is then used to

generate datasets and models that aid in the identification and detection of suspected illegal fishing vessel activities (GFW, n.d.).

Another illustration that demonstrates the potential of GPS data in enhancing the knowledge and awareness of labour conditions on fishing vessels in international waters is the MAST Human Intelligence App. During my interview with Dornnapha Sukkree (2023), it was revealed that the MAST application possesses the capability to transmit location data. This feature will be further examined and elaborated upon in chapter 5. The system entails equipping each worker with a mobile application that transmits their location data to a central server. Even in cases where the connection is lost, once the vessels are 5km away from shore the application is designed to send the last recorded location along with the timestamp. By leveraging this temporal and spatial information, experts in time and location analysis can make estimations about the vessel's behaviour. Consequently, this enables the identification of potential illegal activities, which may indicate poor labour conditions or instances of forced labour.

Furthermore, Kang reported another example of the Thai Navy employing GPS technology in this context. The article discusses the tool's efficacy in combating abuses within the fishing industry. According to Kang (2016), the Navy has been conducting tests on novel equipment, comprising a GPS tracking system to monitor fishing vessels, a central database, and a scanner that enables officials to verify documents. As mentioned earlier, the statement denotes the utilization of GPS data collection and analysis technologies. It can be inferred that GPS technology has the potential to assist initiatives and critical stakeholders in gathering data pertaining to the geographical coordinates of vessels. By collecting such data, it becomes possible to develop a model that can estimate the presence of vessels operating in prohibited areas or fleets that may be engaged in illicit activities. Consequently, this approach facilitates the estimation of instances of substandard working conditions and illegal practices, such as potential cases of forced labour occurring on fishing vessels operating in international waters.

4.2.3 Automatic Identification Systems

The AIS is a positioning technology that is primarily utilized for vessel management purposes. Its main objective is for navigation—to help vessels avoid colliding with each other. Over time it has also become used to track and monitor vessel activities, serving as a tool for identifying vessel locations and monitoring their behaviour. The AIS has been implemented in a terrestrial manner, as Bhattacharjee (2022) noted, whereby communication signals are transmitted between vessels and from ships to shore. According to the Oceana AIS fact sheet, the AIS device comprises a VHF radio that is utilized to transmit the location and identity of the vessel, along with a GPS receiver employed to detect incoming signals. These signals can be detected by nearby vessels, receivers located on land, and satellites (Oceana, n.d.). As per the International Maritime Organization (IMO), the AIS transponders are engineered to automatically provide information regarding the ship's position, identification, and other relevant details to coastal authorities and other ships (IMO, 2022). The current state of affairs indicates that AIS has a functional data pipeline and a comprehensive database that has amassed identifying information pertaining to each vessel. This database is utilized to monitor and estimate the behaviour of the vessels.

Consequently, every commercial vessel over a certain size in operation must furnish the ship's identification, type, position, course, speed, navigational status, and other details to facilitate the creation of the vessel identity database (IMO, 2022). The utilization of transponders is crucial for various types of watercraft, specifically commercial and large fishing vessels operating in deep waters, as it enables the communication of pertinent vessel information. This exchange of information serves as a means to enhance the safety and sustainability of the ocean. Marine Insight claims that "The IMO Convention for the Safety of Life at Sea (SOLAS) Regulation V/19.2.4 requires all vessels of 300 GT and above engaged on international voyages and all passenger ships, irrespective of size, to carry AIS onboard" (Bhattacharjee, para 6, 2022). Concerning the IMO ship identification number, IHS Maritime, by S&P Global, as an example, serves as the scheme's manager and is responsible for the identification and allocation of IMO numbers (IMO identification number schemes). In order to uphold extensive and precise datasets throughout its development, S&P Global has established several significant strategic relationships with governmental and inter-governmental organizations that include allocating the IMO Ship Number,

IMO Company Number, and IMO Registered Owner Number (S&P Global, n.d.). The vessel identification number facilitates the tracking and monitoring of vessel activity. Such monitoring provides valuable insights into potential illegal activities and the likelihood of forced labour. The AIS is designed to enhance situational awareness by detecting and displaying nearby vessels. This system utilizes a broadcast transponder that operates on the VHF mobile maritime band. According to Bhattacharjee (2022), the presence of an AIS system on a ship enables it to be detected on the displays of neighbouring vessels.

The utilization of AIS technology can significantly streamline the process of monitoring and tracking fishing vessel operations, thereby enhancing traceability and transparency in DWF operations, the use of tracking and monitoring technologies like the AIS is pivotal in detecting IUU fishing activities. This capability not only sheds light on IUU fleets but also enables a more accurate evaluation of labour conditions, identifying potential instances of poor treatment and forced labour onboard. Through such technological interventions, stakeholders can better understand and address exploitative practices, highlighting the critical role of AIS in improving oversight and safeguarding against labour abuses in the global fishing industry (Swartz, Cisneros-Montemayor, et al., 2021). Fishing vessels equipped with AIS account for more than 50% of the fishing activity beyond 100 nautical miles from the coastline and up to 80% of the fishing operations conducted in the open ocean. The annual growth rate of fishing vessels equipped with AIS is estimated to range from 10 to 30 percent, indicating a steady increase in the utilization and potential of this technology over time (Global Fishing Watch, 2023). As mentioned earlier, the statement highlights AIS's growing significance and relevance within the fishing industry, particularly regarding advancing labour rights and establishing a more ethical global fishery.

The issue of IUU fishing, as well as labour rights, is a significant concern within the realm of distant water fisheries. AIS is an effective tool that sheds a light on the above-mentioned concerns. As Gee says, "AIS has recently taken on a new role of transparency by allowing the public to monitor and track these ships, from where they fish to which ports they visit to which other ships they may meet up with" (Para 2, 2021). The issue of IUU fishing is a significant concern, particularly concerning labour conditions. Research indicates that in many instances of IUU

fishing, labourers are subjected to substandard working conditions and, in certain cases, may even be considered to be working under conditions of forced labour. (ILO, 2022). AIS provides valuable assistance in the collection of diverse data and the creation of datasets pertaining to fishing vessel activities. These systems also aid in the classification of fishing fleets, enabling the identification of high-risk vessels engaged in hazardous or illicit activities. Consequently, further investigations can be conducted on these high-risk vessels to detect potential forced labour on board (Swartz et al., 2021).

The collaborative efforts of GFW and Spire Global involve utilizing AIS technology for data collection, tracking, and analysis within the fishing industry. GFW monitors the data acquired by Spire Global's nanosatellites. According to Bladen (2021), Spire Global is a space enterprise that centres its operations on satellite constellations. According to Taconet et al. (2019), using AIS technology enables the acquisition of data about fishing vessel activities and behaviour, including but not limited to fishing presence and intensity. This data is then utilized to establish a comprehensive database on fishing fleet operations. The statement suggests that the system acquires information regarding the duration of fishing, the geographical location of the vessel's expedition, and potential transshipment, as evidenced by Miller et al. (2018). Subsequently, the fishing algorithm (more detail will be provided in section 4.4) was developed based on the model, leading to improved visibility in the estimation of fishing operations and activities, as posited by Taconet et al. (2019). By utilizing the AIS mechanism for tracking, monitoring, and detection, it becomes possible to analyze the behaviour of each vessel over time.

By applying the algorithm to this behaviour, it becomes easier to identify vessels that are engaging in IUU Employing AIS to study vessel behaviour greatly helps in identifying those involved in IUU fishing during DWF operations. By analyzing certain patterns identified by AIS, such as irregular movements or activities in prohibited zones, suspicions of IUU activity arise. These behavioural indications, when examined, may indicate inadequate work conditions or even forced labour on board, since vessels involved in IUU fishing are often associated with labour rights abuses. Utilizing AIS data allows for the identification and examination of boats for indications of labour exploitation in addition to IUU fishing operations. This method highlights the significance

of AIS in monitoring both unlawful fishing activities and work conditions, assisting in the enforcement of labour rights within the DWF fleets. Various patterns of problematic behaviour demonstrated by fishing vessels can be noticed within the context of international waters. To improve accuracy, it is crucial to examine two often observed types of suspected IUU fishing practices. These include covert fishing operations conducted by disabling AIS and the transfer of captured fish between vessels while at sea, known as transshipment. Concealed fishing can be regarded as a prominent manifestation of unlawful behaviour, wherein vessels deliberately disable their GPS systems (Coleman, 2022). Welch et al. (2022) provided a comprehensive analysis of the analytical methodologies and model construction employed in predicting the individuals, rationales, and locations linked to the deactivation of positioning devices. Boosted regression tree models were utilized to assess the significance of eight potential drivers of suspected disabling. Four behavioural drivers were identified, including distance to shore serving as a proxy for distance to exclusive economic zone (EEZ), loitering by transshipment vessels (serving as a proxy for potential transshipment events), distance to reported antishipping activities (referred to as piracy, which mainly includes reported pirate attacks), and distance to MPAs. According to Welch et al. (2022), behavioural drivers serve as crucial indicators for comprehending various types of behaviours and facilitating the analysis of vessel motion, thereby enhancing the ability to estimate the activities of DWF vessels. These analyses are advantageous in the context of identifying instances of poor labour working conditions and possible forced labour in offshore fishing operations.

Transshipment serves as an additional factor and component that raises concerns about the problem of IUU. Transshipment, as defined by Miller et al. (2018), pertains to the act of transferring cargo, supplies, or personnel between two vessels. Diverse methodologies exist through which AIS technology can effectively detect them. The article titled "Identifying Global Pattern of Transhipment Behaviour" by Miller et al. (2018) categorizes potential transshipment activities into two distinct types: "two-vessel encounter" and "single-vessel loitering." According to Miller et al. (2018), a two-vessel encounter can be detected through AIS data when a fishing vessel and a transshipment vessel remain in close proximity, travelling at a speed of less than 2 knots for a distance of 500m over 2 hours, within a 10 km range from coastal anchorage. Similarly, a single

vessel loitering event can be identified when a transshipment vessel travels at a speed of less than 2 knots for a distance of 20 nautical miles away from the shore for a duration of 8 hours.

Implementing AIS technology has demonstrated significant effectiveness in tracking, monitoring, and detecting fishing vessel operations, as well as identifying instances of IUU fishing. One notable concern with fisheries in distant waters revolves around the labour conditions that exist aboard fishing vessels. Through the collection of data on vessel behaviours and activities, AIS has the capacity to identify vessels that are suspected of having experienced inappropriate working conditions and are in violation of labour rights. As mentioned earlier, AIS facilitates the acquisition of diverse data and the generation of data models pertaining to fishing vessel activities. These models enable the classification of fishing fleets, specifically identifying vessels that engage in hazardous or illegal practices. Consequently, further investigations can be conducted on high-risk vessels to detect potential instances of forced labour occurring on board (Swartz et al., 2021). Macdonald et al. (2021).

Swartz et al. (2021) noted there are limitations to utilizing AIS for detecting forced labour on fishing vessels. Specifically, they challenge the research conducted by McDonald et al. (2021) on the potential of satellite and AIS technologies to identify forced labour in remote water fisheries, characterizing it as "unsubstantiated." Swartz highlights the significance of three key elements, namely limited dataset, assumptions, and model validation, in the context of evaluating the efficacy of AIS as a tool to combat forced labour on fishing vessels (Swartz, 2021, p. 1). Swartz et al. (2021) emphasize the importance of academics and practitioners demonstrating patience and mindfulness regarding the possibility of research to lead policymakers astray in the context of human horrors and forced labour within the global fishing industry.

Based on the applied approach for data collection and analysis, it has been determined that the use of AIS holds promise in mitigating unethical behaviours within maritime fisheries despite its inherent limitations. Numerous ongoing research investigations are focused on augmenting the utilization of ICTs in the efforts to prevent illegal fishing. Based on the operations and research

conducted by GFW, it has been evidenced that AIS holds promise in offering an accurate assessment of IUU fishing and, as a consequence, in estimating the possible poor labour conditions and labour rights on the fishing vessels.

4.2.4 Vessel Monitoring System

The VMS is an additional tool for tracking and monitoring vessel location and behaviour in global waters. Every positioning system, as well as ICTs in general, possesses specific capabilities. The VMS is a positioning system that has been developed to aid commercial fishing activities. The VMS is used by coastal states to track fishing vessels in their EEZ's—thus, government authorities often do not make this public. In some cases, we can see the implementation of VMS in DWF, such as in Taiwan (Chang et al., 2010). Chang et al. (2010) discussed supervising vessel activities continues to be a significant management concern. VMS, offering crucial monitoring capabilities for national and multinational organizations to ensure resource management, was identified as a key solution to this problem. Initially, the fishers found the system undesirable, but the government has used external pressures from international agreements and management regulations to encourage the implementation of VMS on Taiwanese fishing vessels. Consequently, it is a commendable tool for enhancing transparency within the fisheries industry. According to the National Oceanic and Atmospheric Administration (NOAA), VMS can be classified as a satellite-based monitoring system that is predominantly employed for the purpose of tracking the geographical position and mobility of commercial fishing vessels. Typically, coastal governments or authorities receive and retain the data captured by VMS. However, in recent years, there has been a trend toward the online publication of VMS data, thereby rendering it accessible to the general public. The VMS is a tracking mechanism that operates in a manner akin to the AIS. However, it has conventionally been limited to utilization by governmental regulatory bodies or other entities responsible for overseeing fisheries in their EEZ. The utilization of VMS has become a crucial tool in contemporary fisheries management. Through effective implementation and data dissemination, VMS has the potential to identify, deter, and eradicate unauthorized fishing activities (The Pew Charitable Trusts, 2016).

This assists authorities in the identification of anomalous fleet trends and contributes to the optimization of monitoring, control, and surveillance endeavours (The Pew Charitable Trusts, 2016).

The utilization of VMS data represents a promising strategy for enhancing transparency and ameliorating labour conditions. Nevertheless, it is essential to acknowledge that the availability of such data is limited to a particular audience and not readily available to the general public. The recent increase in the presence of additional stakeholders, such as Non-Governmental Organizations (NGOs), in monitoring and overseeing fishing activities in remote aquatic environments has led to a significant rise in the accessibility of VMS data very limited—just seven countries to date as far as I know, make the data available to global fishing watch, for example. As a result, there is a collective endeavour to enhance the visibility and openness of fishing activities and supply chains at the governmental level. Emmert (2018) noted that several nations, including Indonesia and Peru, have shared their national EEZ statistics and VMS data with the GFW platform.

Conversely, a difficulty arises in utilizing VMS for the purpose of monitoring and tracking fishing vessels operating in national and EEZ mostly and in some cases such as Taiwan implementing slightly in DWF. According to a report by the FAO on the challenges of VMS operation, industrial IUU operators are utilizing advanced communication technologies to target fish and evade detection. According to Davis (2000), individuals involved in IUU fishing are employing advanced deceptive tactics, including the use of complex holding company structures, frequent reflagging, and regular changes to vessel names and call signs to hide their activities. Additionally, there are indications that major IUU operators are collaborating to exchange intelligence and conduct counter-surveillance activities. Hence, in such circumstances, utilizing alternative ICTs may prove efficacious in mitigating the shortcomings of individual systems. The issue of integration between detection technologies remains, though, with some advancements being made. As stated by Marschke et al. (2020), Indonesia is currently integrating VIIRS (satellite imagery) boat detection data, AIS, and VMS track data to understand nocturnal fishing practices better.

4.2.5 Conclusion

In this section, I have explored vessel tracking technologies and positioning systems, which are technological tools utilized to collect data with the aim of improving and advocating for labour rights and working conditions within the context of deep-sea fishing. Positioning systems have the capability to monitor and observe locations and behaviour of fishing vessels that are inaccessible.. In order to evaluate the labour conditions aboard these vessels, it is imperative to ascertain and monitor the geographical coordinates and trajectories of the fishing fleet. The data collected on the geographical positioning and behavioural patterns of fishing vessels operating on high seas contributes to the assessment of risks and facilitates the identification of suspect vessels that may be associated with substandard labour conditions. The present section primarily centres on three commonly employed positioning systems that are utilized by fishing vessels: GPS, VMS, and AIS.

The utilization of AIS and VMS has demonstrated notable efficacy in the areas of vessel tracking, monitoring, and detection, as well as in the acquisition of knowledge pertaining to IUU fishing activities. One of the primary concerns associated with fishing in international waters pertains to the labour conditions prevalent on fishing vessels. According to Macdonald et al. (2021), positioning systems have the capability to detect vessels that exhibit unfavourable working conditions and contravene labour regulations through the collection of data on their operational and behavioural patterns. According to secondary documentation and interviews, it can be argued that the utilization of positioning systems in combination with other ICTs is a practical approach to overseeing and regulating fishing vessel activities in global waters. This approach also promotes transparency, especially concerning the working conditions of labourers on board. AIS and VMS possess distinct technological architectures and operational methodologies; these two positioning systems serve as complementary instruments for the purpose of tracking and monitoring fishing vessels in the maritime domain. Gee (2021) asserts that the utilization of AIS and VMS in conjunction with one another is optimal due to their ability to compensate for each other's respective strengths and deficiencies. AIS has the capability to enhance the comprehensiveness of sparsely available VMS messages, whereas VMS can effectively address the limitations caused by inadequate satellite coverage in certain regions.

4.3 How Satellite Imagery and Data Can Promote Labour Rights in Distant Water Fisheries

4.3.1 Introduction

Remote sensing refers to the scientific method of observing and analyzing the physical characteristics of a given geographical area without direct physical contact. This is achieved by utilizing instruments that measure the radiation emitted or reflected by the area under investigation, often employing satellite or aircraft platforms (USGS, n.d.). Satellite imagery is crucial in offering essential contextual information and visual representation, enabling organizations to make timely and significant decisions (Maxar, n.d.). Satellite data finds its most common application in Earth Observation, wherein satellites provide valuable insights into surface and weather dynamics on our planet (ICEYE, n.d.). The primary purpose of using satellite data is to conduct studies related to the natural environment.

Nevertheless, it is evident that the integration of satellite imagery can be enhanced within the realm of social studies. The utilization of remote sensing to shed light on social and human rights issues is a growing practice, as exemplified by the contributions of the National Academy of Sciences (PNAS) (Wongsamuth,2020). For example, the utilization of satellite imagery and machine learning for poverty prediction (Jean et al., 2016) and the identification of slavery within economic and production units through satellite data (Boyd et al., 2018) represent notable applications within the field of human geography research. In the context of this thesis, the focus will be on examining the application and capabilities of satellite imagery and data in tracking and monitoring fishing vessel activities in remote oceanic regions. The objective is to detect and estimate labour conditions, including potential instances of forced labour, occurring on board these vessels. In this discourse, I will initially expound upon the potential benefits of utilizing satellite imagery to combat forced labour and promote improved working conditions within the DWF. In this discussion, I will address three primary categories of satellite images that stakeholders have employed to assess the labour conditions aboard vessels.

4.3.2 Satellite Imagery Data and Labour Rights in Distant Water Fishery

Boyd et al. (2018) emphasize that using high-resolution satellite remote sensing, in conjunction with on-the-ground observation, holds substantial potential for conducting assessments of human rights violations. In their research, Boyd et al. illustrate how satellite imagery and data can serve as valuable instruments for monitoring labour conditions in land-based manufacturing facilities. It is important to note, however, that conditions in the DWF industry differ significantly from those found in land-based industries, so distinct and potentially more intricate approaches to utilizing remote sensing data and techniques are needed in fisheries compared to other production networks.

This section primarily focuses on the significance of satellite data and its efficacy in detecting illegal activities in DWF, focusing on detecting and tracking the labour conditions on vessels at sea. It explores how satellite data can aid in assessing and estimating labour conditions on fishing vessels in distant waters. Additionally, an examination of satellite imagery's operational mechanisms and functionality within this particular context is warranted.

High seas possess distinct characteristics and conditions. The most contentious aspect pertaining to the DWF concerns the vessels and fishing operations occurring in remote oceanic regions where monitoring the entirety of activities and events proves challenging. When examining the comparison between brick kilns, as discussed by Boyd et al. (2018), and the fishery industry, it becomes evident that the former, being a land-based industry, offers more significant opportunities for accessibility and monitoring the situation in comparison to DWF. Therefore, within the fishery industry, it is evident that satellite data plays a crucial role in the surveillance of labour conditions (McDonald et al., 2021). Accessibility poses a significant challenge in the realm of oceanic space. Consequently, implementing remote observation techniques can enhance awareness and facilitate access to information regarding the conditions and activities of labourers on fishing fleets operating in remote areas of the ocean. The accessibility of the DWF for tracking, monitoring, and transparency of its supply chain has been enhanced through the application of satellite data, machine learning techniques, and the valuable insights contributed by human rights practitioners. As an example, scholars have employed satellite imagery technology to uncover the prevalence of forced labour in the global fishing industry. Their findings indicate that a considerable portion,

approximately 26%, of the approximately 16,000 industrial fishing vessels examined displayed a substantial probability of involvement in the deplorable act of forced labour (Wongsamuth, 2020). We can say that an advantageous aspect of satellite imagery is its remote format, which is managed and operated by third parties. Manipulating this form of monitoring is more complex compared to other ICTs (Andrews, 2022).

When examining the impact of satellite imagery on labour rights in DWF, the focus lies on the potential utilization of this technology to enhance the clarity of observations pertaining to fishing vessel activities occurring in the vast expanse of international waters. Satellite imagery, in addition to the indicators established by stakeholders and the ILO-defined indicators discussed in chapter three, has the capability to identify vessel behaviour by studying the satellite imagery and classifying the fishing vessels' activities to track and monitor the vessel activities and as a result of that estimation the labour conditions. In more accessible terms, various stakeholders utilize the ILO's indicators for forced labour to establish indices that gauge the behaviour of vessels, provide a risk assessment estimation of the labour conditions present on those vessels and identify the suspect vessels. Therefore, regarding these indices, expertise can classify a vessel as engaging in legal or illegal activities. In their study, McDonald et al. (2020) examined the utilization of satellites as a valuable tool for detecting and monitoring potential labour abuse in marine environments. This study examines the categorization of data based on ILO indicators in order to identify non-compliant vessels. The three ILO indicators that are frequently observed pertain to servitude labour. The three main factors that contribute to the negative experiences of individuals are 1) the presence of abusive working and living conditions, 2) the imposition of restrictions on their freedom of movement, and 3) the experience of isolation (McDonald et al., 2020).

The study by Gavin McDonald et al. (2020) examined the utilization of satellite data and machine learning techniques to identify instances of forced labour on fishing vessels in distant waters. By analyzing the behaviour of these vessels using satellite data obtained from the GFW, the research findings indicate that specific distinctive patterns of vessel behaviour can indicate the presence of forced labour. The behaviours in question are characterized by increased time spent on the high seas, greater distances travelled from ports compared to other vessels, and more fishing hours per

day relative to other fleets. For instance, on certain occasions, these vessels of questionable nature would remain at sea for extended durations, spanning several months (McDonald, 2020). Hence, the combined utilization of vessel behaviour indicators, ILO forced labour indices, and satellite data enables the monitoring and tracking of labour conditions in DWF. For instance, one of the phenomena that can be detected through satellite imagery, which proves to be instrumental in identifying illicit fishing activities, is known as transshipment (Selig et al., 2022).

Satellite imagery also has the capability to identify instances of transshipments by utilizing satellite data. This occurs when a trawler transfers its illicitly obtained catch to a refrigerated cargo vessel, commonly referred to as a reefer. This practice involves commingling legal and illegal catches, thereby obfuscating the traceability of the fish on board and impeding the ability of governmental authorities to monitor and regulate fishing activities effectively. These difficult-to-monitor trawlers can subsequently recommence fishing in open waters without being inspected by port authorities (World Economic Forum, 2020).

The GFW project described earlier is a prominent network that utilizes satellite technologies and positioning systems to monitor DWF. The GFW has developed through a partnership between Google, Oceana, and SkyTruth. It aims to provide an unprecedented global view of commercial fishing activities. The GFW has implemented a project aimed at combating forced labour. This initiative utilizes satellite imagery, AIS, and VMS data to gather information and visually represent the conditions in DWF. By analyzing historical data and training algorithms, the project seeks to enhance understanding of fishing vessel behaviour and effectively identify instances of forced labour (World Economic Forum, 2020; Poortvliet, 2023).

4.3.3 Three Major Types of Satellite Imagery and Data

Multiple categories of satellite imagery exist, each serving diverse purposes. However, a shared characteristic among these categories is their application in identifying illicit activities, particularly in DWF. They can aid experts in raising awareness regarding the fishing vessels' activities and behaviour on high seas, increase the ability of risk assessment labour rights, and identify instances

of forced labour occurring on vessels engaged in DWF operations. Based on a comprehensive review of the existing literature in this domain, I have observed that the tracking and monitoring of vessels in oceanic environments primarily rely on three distinct categories of satellite imagery. These three categories include the Visible Infrared Imaging Radiometer Suite (VIIRS), Synthetic-aperture Radar (SAR), and Optical imagery (Bladen, 2022; Marschke et al., 2020).

The VIIRS is an infrared imaging system that is capable of collecting data during both daytime and nighttime periods. The VIIRS instrument is utilized for the collection of visible and infrared images, as well as global observations about the land, atmosphere, cryosphere, and oceans. The maritime forecasting products derived from VIIRS, such as sea ice and ocean nutrients, have proven beneficial for the maritime and commercial fishing industries. These products contribute to the enhancement of vessel routing and the optimization of fishery management processes (NESDIS, n.d.). The VIIRS demonstrates high sensitivity in detecting emitted light during diurnal and nocturnal periods (GFW, 2022). The algorithm developed by the Earth Observation Group (EOG) at Colorado School of Mines (Sparks, 2022) enables the identification of vessels using data from the VIIRS. The EOG also manages the VIIRS Boat Detection (VBD) database, which stores the detected vessel information. Although VBD is not exclusively applicable to fishing vessels, it is capable of detecting the presence of fishing vessels that utilize luminous techniques to attract catch. This includes industrial squid vessels and specific categories of purse seines (GFW, 2022). In recent years, scholars have employed such imagery to identify vessels in motion, enabling the monitoring and analysis of their behaviour. The utilization of this form of imagery presents both advantages and disadvantages. One advantage of employing such forms of imagery is their ability to collect data during both daytime and nighttime conditions (Marschke et al., 2020). However, a limitation of this technology is its inability to capture images of fleets without sufficient lighting, such as squid jiggers, during nighttime (Marschke et al., 2020). Therefore, it can be asserted that this approach holds significant advantages in effectively capturing nocturnal squid jigging vessels. According to my interview with Emma Seal from Ocean Mind, the utilization of VIIRS has proven to be a highly efficient method for detecting nighttime light emissions. However, there are specific errors that require further investigation. One of the issues affecting the accuracy of VIIR is the presence of false light reflection, including elements such as moonlight reflection—the degree of luminosity and the level of certainty regarding its nature as a light source. False detections can also

occur due to factors such as the glare from the moon. However, there is an optimistic outlook that in the future, there will be the capability to enhance further and streamline the process. However, the current information merely indicates the presence of a suspected vessel in that location (Ocean Mind, Interview, 2023).

Moreover, SAR is a form of satellite imagery utilized for the purpose of monitoring and analyzing the activities of vessels within the ocean. SAR is a data collection technique characterized by the sensor's ability to independently generate energy and subsequently quantify the amount of energy reflected upon encountering the Earth's surface (Earth et al., 2020). SAR is an integral element within a repertoire of surveillance methodologies employed by environmental monitoring entities such as Skytruth and law enforcement agencies to detect the existence of "dark ships." These entities possess the capability to instruct SAR satellites to acquire imagery of designated areas where illegal fishing activities are suspected (Palminteri, 2019). SAR satellite imagery possesses the unique ability to penetrate cloud cover and capture high-resolution images irrespective of lighting conditions. Consequently, it plays a crucial role in maritime surveillance. For example, SAR has the capability to identify vessels that are involved in unauthorized fishing activities within protected areas. Additionally, SAR can detect dark ships, which are vessels that do not transmit their position through AIS. These dark ships may intentionally conceal their whereabouts in order to engage in illicit activities. SAR imagery has the capability to unveil discernible patterns pertaining to the movement and behaviour of fishing vessels that are suspected to be involved in cases of forced labour within the domain of the DWF industry. The presence of vessels that remain at sea for extended durations without docking may suggest instances of crew members being excessively burdened with work and potentially exposed to labour exploitation. The utilization of satellite imagery could also potentially capture instances of transshipment, which involves the transfer of catch from one vessel to another, enabling the fishing vessel to sustain prolonged periods at sea. This particular situation is frequently associated with the presence of forced labour practices. SAR, when combined with the integration of various satellite imagery and ICTs, has the potential to offer a comprehensive overview of fishing activities. This integrated approach can effectively identify areas where enforcement and intervention measures may be required (Joo et al., 2023; Ocean Mind Interview, 2023; Andrews, 2022; Bladen, 2022; McDonald et al., 2021;

Palminteri, 2019). Nevertheless, the SAR has been criticized for its limited coverage and high cost (Marschke et al., 2020).

Finally, optical imagery is a technique utilized for the monitoring and data collection of fishing vessels in remote marine regions. Optical imagery refers to the utilization of visible light, which is detectable by the human eye, for the purpose of capturing images. Similar to aerial photography, imagery that closely resembles visual images can be acquired. When considering the data collected by a sensor, it is important to note that this data can be observed across various frequency bands, extending beyond the visible light spectrum (JAXA, n.d.). Bladen provides an explanation of optical imaging, which pertains to the utilization of satellite imagery that captures visible colours and, on occasion, infrared wavelengths, similar to the images available on the Google Earth platform. According to a study conducted in 2012, optical satellite photography can be utilized on cloudless days to observe ships at sea, offering the most definitive proof regarding the type of ship and its activities. In their publication titled "Ship Detection and Classification from Optical Remote Sensing Images: A Survey" (2021), Li et al. examine the efficacy of optical imagery in detecting and monitoring commercial vessels, specifically fishery vessels, in oceanic environments. By means of these visual representations, analysts possess the capability to discern maritime vessels by virtue of their dimensions, configuration, and even their shadows, contingent upon the resolution and perspective of the image. Through the analysis of various patterns, such as the frequency and spatial distribution of DWF vessels, it becomes feasible to identify and raise concerns regarding potentially unauthorized or illicit fishing operations (Joo et al., 2023; Ocean Mind Interview, 2023; McDonald et al., 2021; Rowlands et al., 2019). In my interview with her, Emma Seal noted that optical imagery is a common approach utilized by stakeholders to examine the behaviour of vessels within the framework of labour rights. When considering the detection of labour rights, however, optical imaging is limited in its ability to directly detect the employment conditions on board due to its resolution limitations. However, it serves as a tool that facilitates the study of vessel conduct and provides an opportunity to make estimations regarding suspected fishing fleets that may be in violation of labour rights aboard (Ocean Mind, Interview, 2023).

4.3.4 Conclusion

In summary, satellite imagery is a technique that enables observers to characterize a vessel's behaviour inside maritime space. The utilization of satellite imaging and vessel monitoring is commonly acknowledged as a very efficacious and valuable instrument in augmenting the traceability and transparency of the fishing production network. Satellite imaging has the capability to offer valuable insights into the activities of vessels operating in remote ocean areas. The application of remote sensing technology facilitates the monitoring of maritime phenomena and compensates for limited accessibility. Based on the interview conducted with Emma Seal from Ocean Mind, it has been observed that there are instances where vessels disable their positioning systems, rendering them unable to receive radio frequency signals for location and behavioural analysis. However, the utilization of satellite imagery as a third-party monitoring technology can prove advantageous in enhancing awareness pertaining to vessel behaviour (Interview, 2023). The utilization of satellite imaging technology can facilitate a more thorough comprehension of the labour dynamics present aboard offshore fisheries vessels. This involves conducting studies and creating models to analyze the behaviour of these vessels, ultimately providing an evaluation of the labour conditions experienced by the onboard workforce. The primary pragmatic benefit of utilizing satellite imagery is its capacity to monitor the activities of fishing vessels in distant water. Incorporating these images in conjunction with established indicators such as vessel behaviour and forced labour indices, created by reputable organizations like the International Labour Organization (ILO), enhances our understanding of labour circumstances and improves the accuracy of our estimations. As a result, they contribute to facilitating actions designed to enhance labour rights in DWF.

4.4 Machine Learning: Training, Monitoring and Detection Algorithms

4.4.1 Introduction

The contemporary period has observed a pervasive implementation and utilization of machine learning (ML) technology across various sectors, attributed to the swift proliferation of technology, specifically artificial intelligence (AI). This section aims to present an in-depth introduction to ML and its ability to utilize temporal and historical data for training algorithms to identify patterns and facilitate data analysis, ultimately leading to the achievement of a desired outcome, which is

monitoring the fishing vessels in distant waters and raise the awareness regarding labour conditions. ML allows us to train algorithms using historical and temporal datasets. This can enhance the accuracy of detection and monitoring systems, thereby assisting experts and stakeholders in taking necessary actions to combat potential instances of forced labour on the DWF.

In this section, the primary goal is to learn how ML can play a role in promoting labour rights in DWF through training algorithms to analyze data collected from GPS, AIS, VMS, and satellite imagery. The aim is to enhance the efficiency and effectiveness of monitoring, detecting, and tracking vessel behaviour in distant waters. Employing ML techniques makes it possible to patternize the data and obtain more accurate estimations regarding labour conditions.

4.4.2 Machine Learning as an Assistive Tool

ML is a subfield of computer science and artificial intelligence that centres on the utilization of algorithms and data to simulate human learning, intending to enhance its precision over time (IBM, n.d.). ML is commonly utilized for the purposes of classification and prediction, as well as aiding in the analysis of extensive datasets (IBM, n.d.). ML is a computational approach to creating data patterns and assisting in data analysis that involves automating the building of analytical models (SAS, n.d.). The process of collecting, analyzing, storing and representing data is commonly referred to as a data pipeline. The data pipeline process involves ingesting unprocessed data from multiple sources, which is subsequently transferred to a data store such as a data lake or data warehouse for analysis (IBM, n.d.).

The utilization of ICTs in distant water fisheries, specifically concerning labour rights, involves integrating ML as one of the fundamental components of the data pipeline. ML facilitates the creation of models from collected data by training its algorithm. It also aids in categorizing data, resulting in more accurate and efficient data analysis. The main aim of incorporating ML into the DWF's data pipeline for labour conditions is to efficiently arrange, establish patterns, and model the collected data, thereby enhancing the analysis process (Bora, 2019).

In recent times, the utilization of ML for data analysis and management has become increasingly prevalent across various industries within their respective data pipelines. For instance, Jean et al. (2016) conducted research on the topic of forecasting poverty by employing satellite imagery for data collection and ML for the modelling and analysis of the data. This led to the creation of an outcome that allowed for a better comprehension of the situation as well as the ability to anticipate poverty. In their work, Jean et al. (2016) incorporated nocturnal maps with high-resolution daylight satellite imagery. The integration of photographs has the potential to facilitate the estimation of household consumption and assets in underdeveloped nations, which can be challenging to evaluate. This can be achieved through the implementation of ML techniques. In this particular instance, satellite imaging is used to collect data concerning nighttime lighting, and ML is utilized as a method to classify and pattern the data and then integrate the data in order to produce an estimation (Jean et al., 2016). As Bora (2019) says, the utilization of ML algorithms in conjunction with other approaches has the potential to expedite the efforts aimed at eliminating modern slavery.

4.4.3 Machine Learning in the Fishery Industry: Monitoring Labour Rights and Discover Forced Labour in Distant Water Fisheries

The global fishery industry is one of the industries that is using ML for different purposes. The utilization of data mining and ML frameworks provides sophisticated decision-making solutions for the intricate information present in the domains of aquaculture and fisheries (Gladju et al., 2022). One of the primary objectives of utilizing ML in the fishery sector is to act against IUU fishing activities and modern slavery, particularly forced labour. A growing number of organizations are investigating the use of ML and how it is advantageous for data analytics as a means of addressing the issue of IUU fishing (Bajpai, 2017).

The utilization of satellite imagery and vessel monitoring via AIS/VMS as means of data collection, coupled with ML as a classification and pattern tool and model builder, creates an opportunity to have a more accurate estimation of occurrences of forced labour within fishing fleets worldwide by learning the pattern of the vessel's behaviour (Emma Seal, Interview, Ocean Mind, 2023).

Estimating the global occurrence of forced labour and enhancing the effectiveness of port inspections are important measures, but they are not enough to eradicate the issue. Machine learning models, backed by a substantial dataset verified as consistent with the ILO C188 standard, may be an efficient approach to creating data models that enhance understanding of the issue. The challenges in clearly distinguishing positive (violations) and negative (compliant) cases are underscored by the inherent constraints of data certification and the potential for undetected abuses. Despite obstacles, machine learning, using satellite images, AIS and VMS data, together with global reporting, has the potential to revolutionize the identification of labour rights breaches in DWF. This technology provides a viable solution to reduce labour violations in the industry by enabling more focused inspections and enhancing regulatory enforcement (Joo et al., 2023; McDonald et al., 2020).

GFW is a significant contributor to the use of ICT in the fight against IUU fishing and forced labour in DWF. The organization has elaborated on the application of ML in identifying instances of forced labour in distant waters. Poortvliet (2023) provided an explanation about how GFW employs ML to train algorithms; the objective is to assess the actual magnitude of forced labour within the worldwide fishing industry. The research team employs ML algorithms that are trained to utilize historical data on fishing vessels' behaviour across the globe; the objective is to assist in learning to predict the likelihood of forced labour on these vessels based on the collected positional and behavioural data (Poortvliet, 2023).

In addition, Ocean Mind is another stakeholder that engages in the training of ML algorithms. This training aims to enhance the understanding of suspected vessels and improve the accuracy of labour condition estimations on board. Based on the interview conducted with Emma Seal (2023), Ocean Mind utilizes satellite imagery and positioning systems data, such as AIS, to train algorithms based on ILO indicators in order to gain insights into vessel behaviour that may not adhere to regulations. As an example, Ocean Mind utilizes two criteria in training its algorithms: operating hours, which refer to the working hours of vessels, and transshipment, which serves as an indicator of potential unlawful activities. However, as Emma Seal pointed out, these algorithms are still being refined for accuracy. Additionally, efforts are being made to incorporate other forms

of behaviour into the algorithms to enhance their reliability. Nevertheless, despite their limitations, these algorithms can provide a valuable evaluation of potential suspects. By analyzing these patterns and learning about the behaviours, it is possible to obtain more precise estimations of fleets suspected of poor labour conditions.

4.4.4 Conclusion

All in all, the utilization of ICT for detecting and monitoring DWF aims to enhance awareness of labour rights in distant waters. To achieve this, a data pipeline has been established to facilitate a systematic approach to the collected data. Various types of ICT are utilized to capture data through diverse methodologies. In the next step, classifying, patterning, and modelling the data for analysis, prediction, estimation, and management is crucial. ML is a tool that can be utilized to perform various tasks and aid stakeholders in achieving more precise outcomes and comprehension of the situation. ML aids in the training of algorithms using temporal and historical data to identify patterns and develop models for monitoring, detecting, and tracking vessel activities. The utilization of modelling and algorithm training aids in achieving more precise estimations of vessel behaviour, particularly in cases where there are suspicions of forced labour involvement. As a result, it enhances the efficiency and accuracy of the analytical and decision-making process.

4.5 Conclusion

This chapter has provided an overview of the methods employed for monitoring vessel activities and behaviour in distant water, explicitly focusing on the utilization of positioning and remote monitoring systems. ICTs, such as GPS, AIS, VMS, and satellite imaging, can be used to collect data to monitor and study the behaviour of fishing vessels in remote waters. We have acquired knowledge of the methods employed in data collection. In the subsequent phase, ML was introduced as a sophisticated technological approach to leverage the gathered data for the purpose of training algorithms. These algorithms attempt to provide a more precise model and pattern of fishing vessels' behaviour, particularly those suspected to exhibit inadequate labour conditions during operations in remote aquatic regions.

These positioning and remote monitoring systems do not provide direct information regarding the labour conditions of fishing fleets. Nevertheless, they offer an approximation of the probability of labour circumstances. As previously noted, these technologies have the capability to create datasets and data modelling to provide estimations of what is happening on board the vessels. Therefore, the accuracy of risk assessment pertaining to work conditions is a significant concern when utilizing such technologies. Stakeholders need to prioritize the advancement of data collection accuracy and detection algorithms to make the transparency process more efficient. Positioning and remote monitoring systems are complementary technologies with onboard and communication-based monitoring and reporting systems, which I will discuss in more detail in the next chapter.

Chapter Five - On-board and Community-based Monitoring/ Reporting with Access and Data Validation Concerns

5.1 Introduction

In the previous chapter, I described the utilization of diverse positioning systems data and satellite imagery data to facilitate the training of algorithms. This training enables algorithms to develop an understanding of the behavioural patterns exhibited by fishing vessels in the vast expanse of the ocean. Furthermore, it allows for estimating the labour conditions prevailing on board these vessels. In this chapter, the focus will shift to technologies that have the capability to enhance accuracy and cost-effectiveness in monitoring and reporting labour conditions and employment relations on board fishing vessels. On-board and community-based technologies, such as on-board cameras and smartphone apps/online platforms, effectively enhance awareness of labour conditions. These technologies are advantageous since they are situated on board or directly reported by workers or auditors, providing more accurate data.

This chapter will focus first on video-based electronic monitoring systems installed aboard fishing vessels. Specifically, attention will be given to closed-circuit television (CCTV) systems that capture and document on-board events. These systems have proven to be practical tools for monitoring and recording working conditions. Next, I will address the topic of electronic reporting (ER) tools as an additional advantageous approach for raising awareness about labour rights in DWF. I categorize ER into two distinct types: reporting conducted directly by labourers themselves; and reporting facilitated via platforms utilized by various stakeholders such as auditors, firms, and civil society organizations. Thirdly, I will now address the matter pertaining to the issue of Wi-Fi access. The absence of Wi-Fi connectivity is a significant barrier in monitoring and reporting activities on-board vessels operating in remote waters. This issue makes crew members vulnerable to poor working conditions. Finally, I will be addressing the topic of blockchain as a technological innovation that facilitates the storage and representation of data while ensuring its integrity and resistance to tampering.

5.2 Video-Based Electronic Monitoring (EM)

5.2.1 Introduction

The utilization of video-based electronic monitoring (EM) systems is a practical application of ICTs (in this section, EM stands for a video-based electronic monitoring system, which often refers to CCTV). This technology is crucial in enhancing transparency within the DWF industry and promoting greater awareness of working conditions in offshore environments. According to Godfrey (2021), when comparing remote ICTs with EM, it is evident that EM offers more cost-effectiveness and applicability relative to satellite technology and remote monitoring of fishing vessels, particularly regarding working conditions and the detection of potential instances of forced labour. This section will cover the video-based EM technology that may be used to monitor and track fishing fleets, as well as the potential benefits that this technology may have in enhancing labour rights in DWF. This part will begin by introducing EM and expanding on the data it collects. After that, I will explore the benefits and obstacles involved in using it to monitor, detect, and generate transparency regarding probable forced labour on fishing vessels in the middle of the ocean. In addition to this, in the last part, I will discuss four case studies of the implementation of video-based EM by various stakeholders. These stakeholders will include non-governmental organizations, corporations, governments, and other institutions.

5.2.2 CCTV as an Advantageous On-Board Monitoring System

Various methodologies exist for monitoring activities on fishing vessels. Historically, and presently in rare instances comprising a minority of less than 1 percent, human observers are deployed for the purpose of monitoring (Institute for Human Rights and Business, 2020). As a substitute, video-based monitoring involves the installation of cameras on board to capture crew members' fishing and catch retrieval activities (Bryce, 2022).

Moreover, recently, there has been an increased focus on labour rights in distant water fisheries and the working conditions of labourers during operations. In this context, it is noteworthy that video-based EM has played a significant role in raising awareness about these issues. Despite limited usage in addressing labour issues, the tool is well-suited for this purpose. Some vertically

integrated companies have utilized their internal camera systems to assess labour practices, as noted by Michelin et al. (2018). Video-based EM technology is capable of collecting various types of data that can provide transparency regarding labour conditions during missions, both directly and indirectly. In addition to providing direct visual documentation of labour conditions on board, the recording of fishing activities, such as the species caught (including whether the catch is legal or illegal), the duration of time spent in a particular geographic location, the incidence of bycatch, and the occurrence of transshipment (i.e., the transfer of catch to another vessel during the operation), can provide valuable data that indirectly contribute to our estimation of labour conditions on board (NOAA Fisheries, n.d.; Bryce, 2022).

Implementing video-based EM in remote marine fisheries offers many benefits in advancing transparency in environmental and labour rights domains. According to a report by The Nature Conservancy (TNC) in 2020, vessels involved in fishing activities in international waters are being observed through onboard cameras to encourage sustainability and ethical practices in the fishing sector. The following section is focused on investigating the potential of video-based EM technology to enhance labour conditions in the DWF sector. Hence, the present discussion aims to elaborate on the two main benefits of video-based EM and its effective and practical utilization in augmenting transparency in the respective field. However, it is essential to commence a discourse concerning the plausible peril or obstacle linked with adopting electronic surveillance technology.

There are three main advantages associated with the application of video-based EM: scalability, data quality (Michelin et al., 2018) and cost-effectiveness (Van Helmomd et al., 2019). To begin with, the factor of scalability has been identified as significant in the context of EM. Historically, human observers faced limitations in achieving comprehensive coverage and collecting extensive amounts of data during operations. "The single largest problem with human observer systems is that there simply is not and will never be enough" (Michelin et al., p. 26, 2018). Accordingly, in the context of data quality, the utilization of EM technology can significantly facilitate extensive data acquisition and the establishment of a more comprehensive database. Consequently, it can foster greater awareness regarding the prevailing circumstances.

Moreover, the collection of EM data exhibits a notable strength in terms of data quality. EM technology is a precise approach for gathering data to uncover the activities taking place on fishing vessels. EM data have been compared with data from self-reported logbooks and data from at-sea observers in a large number of investigations. In a broader sense, EM can successfully monitor for discard events, and it has demonstrated that it is at least as accurate as other methods (Michelin et al., 2018).

In terms of cost-effectiveness, according to Van Helmomd et al. (2019), EM is a monitoring method that offers a more cost-effective alternative to onboard observer programs in the mid-to-long term. This is attributed to the reduced operational expenses associated with EM, which allows for a broader sampling coverage within a given monitoring budget. Therefore, in the context of time, coverage, and pace, the EM, especially video-based EM, is more cost-effective, in contrast with traditional onboard observants.

On the other hand, the utilization of the EM system presents its own set of difficulties requiring careful consideration and resolution. One of the primary obstacles relates to the issue of hacking and data manipulation in the context of this technology; it is imperative to address supplementary concerns such as hacking and data misuse prior to achieving widespread deployment. This necessitates engaging in conversations pertaining to data ownership, data storage facilities, and access (Van Helmond et al., 2019). The rapid growth of video-based EM applications and technological progress mandates the implementation of secure data protocols and storage mechanisms as a critical factor. The utilization of blockchain technology is a strategy employed by several stakeholders to address the problem of keeping data validated (Godfrey, 2021). Further elaboration on this topic will be provided in the following sections.

5.2.3 Four Examples of Video-based Electronic Monitoring Systems

The achievement of openness in global fisheries governance necessitates the active involvement of a wide range of stakeholders. Commonly mentioned examples encompass non-governmental organizations (NGOs), governmental agencies, and companies. This section presents four distinct

instances that demonstrate the manner in which various stakeholders engage with video-based EM technology.

A) The Marine Stewardship Council

The Marine Stewardship Council (MSC) is a non-profit organization based in London, United Kingdom, founded by the World Wilde Fund for Nature and committed to developing and implementing standards for promoting sustainable fishing methods. The MSC in DWF governance functions as a non-profit third-party organization that collaborates with both state and non-state actors, such as the Indonesian government, The International Pole and Line Foundation, and Asosiasi Perikanan Pole and Line dan Handline Indonesia (Kearns, 2021; White, 2022). Its primary roles are to work with fisheries management organizations (state or private) to produce sustainable management plans, to monitor compliance through inspections, audits, monitoring, and tracking of fishing activities, and finally, to create traceability for seafood produced by fisheries certified by MSC along with a brand, so that sea buyers and consumers know what products have been certified as sustainable. MSC has added some provisions for reporting on labour conditions within the certified seafood supply chains, but it has been much criticized for its inadequacy (Outlaw Ocean Project). As per the information provided on their website, the organization is currently carrying out a program that is referred to as "At-sea monitoring and surveillance."

In order to monitor fishing operations in remote waters effectively, the presence of both observers and inspectors is necessary to gain insight into the activities taking place on board the vessels. The installation of the camera represents a contemporary approach to enhancing transparency in DWF facilitated by technological progress. According to The Marine Stewardship Council (n.d.), at-sea monitoring programs encompass various strategies such as the deployment of video cameras on vessels, utilization of GPS technology to monitor fishing activity locations, and the inclusion of human observers during fishing expeditions.

The utilization of techniques known as EM can be effectively combined with conventional monitoring approaches, such as fishers' logbooks, at-sea inspections, surveillance patrols, and

dockside monitoring of landings, in order to acquire valuable information (The Marine Stewardship Council, n.d.). The Marine Stewardship Council (MSC) holds considerable importance within the domain of sustainable seafood certification. The topic of interest pertains to the monitoring and surveillance activities conducted in marine environments. For instance, according to Kearns (2021), accreditation from the Marine Stewardship Council (MSC) has been granted to eight Indonesian tuna fisheries operating on a modest scale. All the fisheries that have obtained MSC certification use selective and small-scale methods for the extraction of tuna.

MSC's committed objective is to take action against the use of forced and child labour within the seafood sector.This commitment is driven by the organization's dual emphasis on promoting environmental sustainability and ensuring the integrity of supply chains. Since 2014, MSC has established labour regulations that render organizations with infractions ineligible for certification. The MSC claims that "MSC Labour Eligibility Requirements," issued in 2022, serve as a comprehensive compilation of labour rules. Fisheries and supply chain enterprises that have obtained MSC certification are required to publicly declare their practices aimed at mitigating instances of severe labour violations. In order to comply with regulations, certified supply chain enterprises are required to complete either third-party labour audits or self-assessment reports. In the year 2022, researchers affiliated with MSC conducted a comprehensive analysis of data obtained from all fisheries that have been certified by the MSC. The MSC labour evaluation system is essential for improving worker conditions inside the Chain of Custody (CoC) of fisheries. Companies in the seafood industry that hold certificates must complete a Labour Self-Assessment Form, which evaluates labour conditions including forced and child labour, engagement with worker rights organizations, and transparency in addressing labour risks. Employment contracts must also specify the conditions of labour. However, there are some critics to the MSC certification system regarding to the labour condition monitoring; one of the critics is the application of Chain of Custody certification extends beyond the point of fish landing, hence excluding fishing vessels from the scope of this certification (The Outlaw Ocean, 2023). Unclarity is another critic about the MSC labour certification is about transparency; the MSC lacks transparency regarding the extent and authority of its voluntary standard, particularly its focus on ecological sustainability without adequately addressing human rights protections for those working at sea (Human Rights at Sea, n.d.). For instance, these systems have recently shown to

be a failure in detecting forced labour in seafood supply chains passing through China (Human Rights at Sea; The Outlaw Ocean, 2023).

Despite the much-criticized shortcomings of the MSC requirements concerning labour, more broadly EM systems, such as CCTV, play a crucial role in directly watching work conditions on DWF vessels to ensure compliance with labour requirements. By integrating blockchain technology, these efforts provide a strong structure to enhance transparency and accountability in labour practices in the seafood supply chain. This strategic approach aims to effectively address and reduce forced labour and inadequate working conditions, therefore promoting ethical and sustainable use of marine resources (BRCGS, 2021). The primary objective of this assessment was to evaluate the effectiveness of procedures used by these certified fisheries in combating instances of forced labour and child labour.

B) National Oceanic and Atmospheric Administration Fisheries

The National Oceanic and Atmospheric Administration (NOAA) Fisheries is a federal agency in the United States that primarily engages in the monitoring of oceanic fisheries. The organization delineated the mission of NOAA Fisheries as follows: “Productive and sustainable fisheries, Safe sources of seafood, Recover and conservation of protected resources, and Healthy ecosystem” (NOAA Fisheries, n.d.). In order to fulfill its mission, NOAA Fisheries employs various methodologies for acquiring and compiling data. EM is a prominent technique employed in this domain. As the NOAA Fisheries website describes, the EM is “Electronic monitoring equipment such as video cameras that capture information on fishing location and catch” (NOAA Fisheries, n.d.). The adoption of EM is proving to be a proficient mechanism for generating awareness and promoting transparency with regard to fishing operations. Over time, there has been a growing trend in applying and adopting EM technology within the fishing industry. This is exemplified by the findings reported by the NOAA fisheries; for instance, according to the NOAA fisheries, “onboard cameras were added to boats in the Atlantic pelagic longline fishery to track the bycatch of bluefin tuna” (NOAA Fisheries, n.d.). The National Oceanic and Atmospheric Administration (NOAA) Fisheries is a US federal government agency mandated to oversee and regulate oceanic matters, responsible for overseeing oceanic matters, particularly in the realm of fisheries. As such,

the agency is actively involved in facilitating the adoption and integration of ICTs within the industry. “NOAA Fisheries provides financial support to develop and implement electronic technologies. This includes supporting more than 30 pilot projects to experiment with various technologies” (NOAA Fisheries, n.d.). NOAA Fisheries is allocating resources towards the advancement of technological tools used for the purpose of tracking fishing activities. The emerging technologies have the potential to enhance the timeliness, accuracy, and cost-effectiveness of data collecting. The camera installed on the fishing trawler is capturing footage of the events taking place on board (NOAA Fisheries, n.d.).

A story that NOAA Fisheries published on its website called “Forced Labour and The Seafood Supply Chain” discussed how vulnerable labour is in deep-ocean fisheries. It described the condition as follows, “Fishing activity is often isolated, with vessels sometimes spending months to years at sea, impeding the escape from, or the reporting of, labour abuse” (NOAA Fisheries, n.d.). NOAA actively involved in terms of acting against forced labour in seafood supply chain; for instance, NOAA is actively involved in efforts to address forced labour in the fishing industry by contributing its data and expertise to the "Congress on Human Trafficking in the Seafood Supply Chain," highlighting its commitment to combating human trafficking and enhancing transparency within global seafood supply chains. (NOAA Fisheries, 2020).

The critical point is to understand the manner in which the NOAA, a governmental agency, makes use of EM systems to oversee and identify instances of labour exploitation in the course of fishery operations. In order to maintain the long-term viability of The United States fisheries, which are responsible for supporting many employment opportunities and generating substantial economic revenue, it is essential to possess a comprehension of the temporal, spatial, and methodological aspects of fishing activities, as well as to closely monitor their capture, retention, and discarding practices. Electronic monitoring is a technological instrument used for the purpose of gathering fishing data, which serves to enhance and bolster stock assessments, as well as to guarantee the long-term fishing sustainability. NOAA Fisheries is making investments in technological advancements used by fishermen for the purpose of tracking fishing activities. The emerging

technologies have potential in enhancing the timeliness, accuracy, and cost-effectiveness of data collecting (NOAA-Fisheries, 2021).

C) Fisheries and Ocean Canada (DFO)

The management of fisheries and maritime affairs is essential to the Canadian government. Fisheries and Oceans Canada, sometimes known as DFO, is a Canadian government department responsible for fisheries management and oceanic policy. The Department of Fisheries and Oceans (DFO) is charged with several vital obligations, including ensuring that offshore fisheries' operations are lawful and sustainable.

In 2019, the DFO conducted a study titled "Review of catch monitoring tools used in Canadian fisheries" (Beauchamp et al., 2019). The objective of this study is to examine the diverse monitoring tools employed in the marine fishery sector with the aim of improving sustainability. The research conducted by Beauchamp et al. (2019) explored the objectives and benefits associated with video-based electronic monitoring. During this research data collection process pertaining to the utilization of EM within the DWF sector of Canada, an initiative named "At-Sea Observers and Electronic Monitoring" was encountered. The DFO introduced this program in April 2013. According to the Government of Canada (2017), the At-Sea Observer Program in Canada involves the deployment of certified private-sector observers on fishing vessels. The primary objectives of this program are to oversee fishing activities, gather scientific data, and ensure compliance with fishing regulations and license conditions within the industry. The primary objective of this program was to explore the use of EM technology on vessels targeting groundfish, to oversee groundfish populations in the Pacific region.

The Groundfish Electronic Monitoring Program in the Pacific Region utilizes a variety of cameras and sensory devices that are installed on fishing vessels. This program serves as the purpose of monitoring fishing activities, gathering scientific data, and ensuring that the fishing industry complies with fishing regulations and licensing requirements (Government of Canada, 2017). This

case study illustrates how a government, in its capacity as a stakeholder, utilizes EM to supervise and monitor the operations conducted on fishing vessels operating within a designated maritime jurisdiction. As mentioned earlier, observer companies fulfill the role of supplying fishers and fishery organizations with observer and EM tools and technology. The primary responsibility for governing these activities in the "At-Sea Observers and Electronic Monitoring" program is assumed by the Department of Fisheries and Oceans (DFO) (Government of Canada, 2017)—the process of accrediting and licensing service providers. EM is used on board to collect sensor data and video recordings. An essential component of the recorded video material captured by the onboard cameras pertains to the visual representation of the act of releasing the catch back into the aquatic environment. In order to ensure accuracy in size determination and species identification prior to release, it is necessary to hold each fish in front of a measuring board that is clearly visible to the camera. This enables the assignment of mortality to any catch that is released at a lawful size. The EM system is a cost-effective approach that may be used by hook and line fisheries. The data derived from the system is used to conduct audits on logbooks that have been completed by harvesters, to ensure the proper representation of the catch (Government of Canada, 2017). The primary reason for studying this case is that it highlights the potential of EM in contexts beyond simple observation, such as monitoring labour and ethical supply chains in DWF at a governmental level. This demonstrates the significant role EM can play in enhancing transparency and accountability within the industry.

This research provides an appropriate example that examines one of the issues faced by governments as key players in the control of sustainable fisheries within the framework of maritime affairs. Fisheries and Ocean Canada is a dedicated governmental entity that the Canadian government has formed with the purpose of addressing various difficulties pertaining to fisheries and the ocean. The topic of sustainability is a matter of great importance within the domain of DWF. Governments, including the Canadian government, have created a range of initiatives and offered assistance to improve the business's environmental sustainability and well-being. One of the subjects addressed in this part is the implementation of programs using "At-Sea Observers and Electronic Monitoring." The present study investigates EM technology's effectiveness in tracking and monitoring deep-sea fishing operations. The current research has included a comprehensive analysis of the programs and techniques used for data gathering in this context, with a primary

focus on the ecological aspect. Nevertheless, it is worth mentioning that there is a clear need for a precise and unequivocal discussion about the implementation of EM systems by the Department of Fisheries and Oceans (DFO) in order to monitor employment conditions and protect labour rights in the context of ocean fisheries activities. These programs became more important and paid more attention to the labour working conditions when the Canadian government passed Bill S-211 to act against forced labour in Canadian supply chains (Public Safety Canada, 2023).

D) The Taiwan Tuna Association (TTA) and National Chung Cheng University

As previously stated, the adoption of video-based EM technology during this study has been identified as an effective means of raising awareness about fishing activities in international waters. The primary application of video-based electronic monitoring pertains to remote water fishery's ecological and environmental dimensions. Nevertheless, the issue of labour rights, in addition to ecological considerations, poses a significant challenge in this domain (Marschke & Vandergeest, 2016). Taiwan is a prominent DWF jurisdiction, and its fishing industry is confronted with challenges related to labour rights, as per Godfrey's recent research (2021). According to Godfrey (2021), a partnership has been established between the TTA and the NCCU to conduct a trial of a video surveillance system on fishing vessels operated by the former. The aim of this initiative is to address the issue of labour exploitation in the fishing industry (Godfrey, 2021). This project represents a noteworthy example of the utilization of video-based electronic monitoring (EM) for the purpose of gaining insight into the working conditions experienced by employees while on board. The TTA has announced the utilization of a government grant to implement surveillance systems on its distant-water fishing vessels. This initiative aims to enable onshore monitoring and employ blockchain technology to ensure the integrity and authenticity of the collected data (Godfrey, 2021). The collaboration among a university, government, TTA association, and fisheries companies (supplier) serves as an example of how multifarious stakeholders in ocean and fishery governance collaborate to establish a more ethical and sustainable fishery industry. The case of TTA for the implementation of CCTV cameras on vessels involves the funding of the project by the Taiwanese government, specifically the Ministry of Science and Technology. The NCCU is responsible for the development of the technology, while

the tuna suppliers, namely Chun-I Fishery, Jinn Chun Fishery, and Hong Yuan Fishery, are collaborating for the operation and installation of the cameras (Godfrey, 2021). The question at hand pertains to the evaluation of the efficacy of video-based electronic monitoring (EM) in the advancement of labour rights within the remote water fishing industry and how relevant stakeholders and experts can conduct this assessment.

In order to obtain additional empirical data connected to this research, an interview was conducted with Hao Mai as external consultant of FCF [2]to gather further insights and details. Hao Mai asserts that the Taiwanese government intends to provide subsidies for DWF vessels in order to facilitate the installation of CCTV systems. This initiative aims to enhance monitoring capabilities and promote transparency in addressing instances of labour abuse and forced labour. The collaboration between TFA and NCCU focuses on the establishment and implementation of a data capture and analysis system. This project falls within the broader scope of outfitting Taiwanese fishing vessels with camera surveillance technology. The case study conducted by the Taiwan Tuna Association (TTA) and National Chung Cheng University serves as a pertinent illustration for understanding the implementation of video-based EM in DWF governance. Additionally, it sheds light on the significant role played by non-state actors alongside state actors in terms of monitoring, tracking, and acting against forced labour in the DWF sector.

5.2.4 Conclusion

This study focuses on the examination of the impact of ICTs on the advancement of labour rights in the international water sector. Specifically, this section has introduced the implementation of video-based EM and the possible potential it has for the future as a viable tool to enhance the working conditions of fishery employees working on vessels located in the middle of the ocean. The present study refers to the utilization of video-based EM in the DWF industry. While these

[2] FCF is one of the leading worldwide suppliers of comprehensive supply chain services for maritime items. With 50 years of experience in tuna trading and marketing, FCF utilizes its vast worldwide marketing and logistical network to fulfill its customers' service needs.

mechanisms are not primarily utilized for labour rights enforcement, their potential application within the context of an ethical supply chain has seen a notable increase. Furthermore, an elucidation was provided regarding the advantages and difficulties inherent in executing it. Finally, I have presented four distinct examples of stakeholders and their respective approaches toward this technology. One of the significant findings from my data collection pertains to the installation of onboard cameras, which are primarily utilized for monitoring the environmental and ecological aspects of fishing. However, recent research has demonstrated that video-based EM could be an efficacious tool for combating forced labour and promoting labour rights in DWF (Godfrey, 2021). The employing of video-based EM is an essential technique for collecting data to promote awareness and transparency regarding the activities taking place on fishing vessels.

There are notable factors related to our comprehension of the application of video-based EM technology that require investigation by industry stakeholders. The examination of access holds significant importance when it comes to the recorded data obtained from onboard cameras, particularly with regard to the personnel who possess the authorization to get such data. There are several important considerations regarding the access and management of data by government agencies and third-party entities, including commercial inspection firms. These considerations include the ability of these institutions and civil organizations to access accumulated data, the provision of data access to the general public, and data storage and representation. The location of data storage and its representation method are two key aspects to consider. Lastly, the matter of data security emerges as a challenge. In particular, this inquiry pertains to the measures employed to ensure the protection of gathered data against potential breaches such as hacking and manipulation.

5.3 Electronic Reporting

5.3.1 Introduction

Electronic reporting (ER) is a community-based participatory method that can be employed to facilitate the tracking, monitoring, reporting, and promotion of transparency. In this part, I will explore two distinct approaches to ER: a) worker-based and b) inspector/auditor-based reporting

systems. This suggests that individuals may provide varying accounts of the events transpiring at the location, according to their respective objectives. The utilization of information and communications technologies (ICTs) has seen a rise in many industries, including public health, namely for the goal of tracing and monitoring infected patients during epidemiological research. According to the study conducted by Friedfeld et al. (2010), in recent years, the adoption of ER has witnessed a notable increase in the domain of DWF, hence carrying considerable implications for the sustainable and ethical aspects of the supply chain. In the next section, I will focus on elucidating the potential utility of ER as an instrument for advancing improved working conditions and labour rights within the context of DWF operations situated at considerable distances from the shoreline. Understanding the potential advantages arising from community-based engagement in labour reporting, facilitated by smartphone technology, is crucial for fostering ethical practices within the fishing sector. The significance of social compliance in ensuring ethical production is evident in the context of ER in DWF. Smartphones and applications/online platforms serve as crucial hardware and software tools in facilitating social compliance in this domain.

The use of ER, supported by applications and platforms on electronic devices like computers, tablets, or smartphones, enables workers and auditors to input and share data with various stakeholders, thereby enhancing visibility regarding labour rights and conditions. Crucially, ER serves as a community-based participatory tool, engaging labour and third-party auditors as active agents in creating transparency within the global production network. The increasing prevalence of ER in DWF underscores its efficacy in addressing labour exploitation and inequity and in fostering ethical practices within the fishing sector, manifesting its vital role in ensuring sustainable and ethical aspects of the supply chain (TNC,2020).

In this section, I will examine multiple aspects of ER in the DWF context and explore its potential to contribute significantly to the enhancement of awareness and transparency regarding working conditions aboard the vessel. I will be discussing smartphones as hardware tools that contribute to the establishment of reporting infrastructure. In this discussion, I will address the topic of applications/platforms serving as software portals that facilitate the transfer of data to external parties, hence enhancing awareness and openness regarding labour conditions in the domain of

DWF. This paper aims to examine five operational applications/platforms that are utilized for the purpose of ER and monitoring the social compliance of DWF production networks. Applications and platforms, as mentioned earlier, can be utilized in two distinct manners: labour-based applications that cater to the needs of workers; and third-party platforms that auditors employ for reporting purposes. The applications include MAST Human, E-Voices, Golden Dreams, DiginexApprise, and Cumulus. In this discussion, I will examine the functioning of several applications/platforms and their potential as practical tools for enhancing transparency and promoting labour rights and conditions in the context of DWF.

5.3.2 Smartphones

Smartphones are one of the most influential and applicable hardware tools for community-based participation. It means smartphones can play a significant role in ER. "Smartphone technology is playing a role in catalyzing public and community involvement" (Andrachuk et al., 2019, p.431). Smartphones, because of their hardware and software abilities and features, are considered one of the significant tools for ER in DWF (Calderwood, 2022). As Jeffers notes, fishers and fisheries inspectors alike are increasingly turning to their mobile devices in order to report instances of forced labour and IUU fishing (2019). In today's world, smartphones have become the tools that make it simple to record, monitor, track, and maintain transparency. The speed, ease, and online nature of smartphones facilitate communications. It is clear that in recent times, the use of smartphones has become increasingly common in the context of increasing traceability in the fishery supply chain.

Furthermore, I can anticipate that the use of smartphones in the fight against forced labour will become more widespread in deep-sea fisheries (United Nations: UNODC Regional Office for Southeast Asia and the Pacific, n.d.). Smartphones themselves come equipped with cameras, recording tools, and the necessary data to connect them to general social media so workers can use them to report what is happening to them. Mapping the Patterns of Mobile Phone Usage Among Fisherman in Malaysia studied the benefits of smartphones as well as how practical and popular the usage of smartphones among fishermen while operating; the benefits for fishermen were

identified as providing updates on weather forecasts, strengthened marketing aspects, giving tips on where to get the best catch, and keeping in touch (Shafrill et al., 2015).

During the study of the usage of smartphones among Malaysian fishermen, the researchers found that smartphones, besides their benefits, are not very popular among fishermen to get into the work yet. The results of the study validate the notion that a significant proportion of individuals engaged in fishing activities allocate limited resources, both in terms of time and financial expenditure, towards the act of using smartphones; however, despite the limited investment of time and financial resources by most fishermen in telecommunications, still mobile phones remain indispensable tools, primarily for the purposes of safety enhancement and communications (Shafrill et al., 2015). Nowadays, cell phones have become essential instruments for workers to report and record their activities while they are engaged in their duties. This serves to enhance awareness and transparency about their working conditions. The issue of enhancing the accessibility of smartphones, both in terms of affordability and infrastructure, is a subject of debate. Shafrill et al., 2015 highlight that access to smartphones for fishermen is not readily available, complicating the ER process and potentially exacerbating the vulnerability of workers, especially in the context of DWF. This lack of access poses significant challenges to implementing technological solutions aimed at improving labour conditions and ethical practices within the industry.

5.3.3 Applications

Within the fishing industry, various applications have been employed to promote social compliance and ethical supply chains concerning labour rights. Calderwood (2022) conducted a study titled "Smartphone application use in commercial wild capture fisheries," which examined 84 applications within this domain. The research findings shed light on the methods employed for data capture, categorization, and reporting in this field. The apps were categorized into five primary groups, namely: (1) Science, Knowledge, and Data Collection; (2) Provision of Information to Fishers; (3) Value Chains and Post-Harvest; (4) Employment, Legislation, and Safety; and (5) Multi-Purpose App Suites. Hence, it is possible to acquire comprehension regarding the transmission of information and data facilitated by smartphone applications, as well

as the significance of these applications for DWF. The study's results suggest that smartphone applications can be utilized in commercial fisheries involved in wild-capture fishing for multiple objectives, such as data collection, improved safety measures for fishermen at sea, and participation in supply chains and marketing endeavours (Calderwood, 2022).

My own research has focused on five distinct applications/platforms, all centred on safeguarding labour rights throughout the production process. These programs and platforms can be classified as either labour or worker-based reporting systems, with some being based on auditors' and stakeholders' reporting.

MAST Human Intelligence App

The initial application under consideration is referred to as the MAST Human Intelligence App. The Multi-stakeholders Initiative for Accountable Supply Chain of Thai Fisheries (MAST) is a non-profit organization based in Thailand. It collaborated with the United Nations Office on Drugs and Crime's Regional Office for Southeast Asia and the Pacific (ROSEAP). It received additional support from the Japanese government to develop the MAST application (United Nations: UNODC Regional Office for Southeast Asia and the Pacific, n.d.). The coalition known as MAST was established in March 2016 with the objective of addressing the underlying factors contributing to human trafficking and IUU fishing in the fishing sector of Southeast Asia. MAST adopts a collaborative and constructive approach in its efforts (MAST Human, n.d.).

The MAST Human Intelligent App was publicly launched on August 1st, 2023. The application's main aim is to augment the level of security in the working circumstances of migrant labour in DWF. Based on an interview with Dornnapha Sukkree at MAST Human in 2023, it was found that the mobile application provided by MAST functions as a platform that utilizes crowdsourcing methods in order to combat the issues of human trafficking and forced labour in the fishing industry. The MAST Human is an application that gathers many types of data, which will be further elaborated upon in this section. The data is disseminated to key stakeholders, including governmental bodies and non-state actors such as proactive NGOs, with the aim of facilitating crime prevention and enhancing law enforcement efforts (Sukkree, D., Interview, 2023). This

program has the capability to provide access to many types of data. As elucidated in the interview conducted with Dornnapha Sukkree, it is worth noting that certain individuals within the workforce may experience a loss of communication and subsequently remain unaccounted for over an extended duration. Consequently, in situations where law enforcement entities become involved in such cases, they may request MAST Human to furnish the accumulated data for the purpose of tracing and comprehending the circumstances surrounding the individuals who have gone missing (Sukkree, D., Interview, 2023).

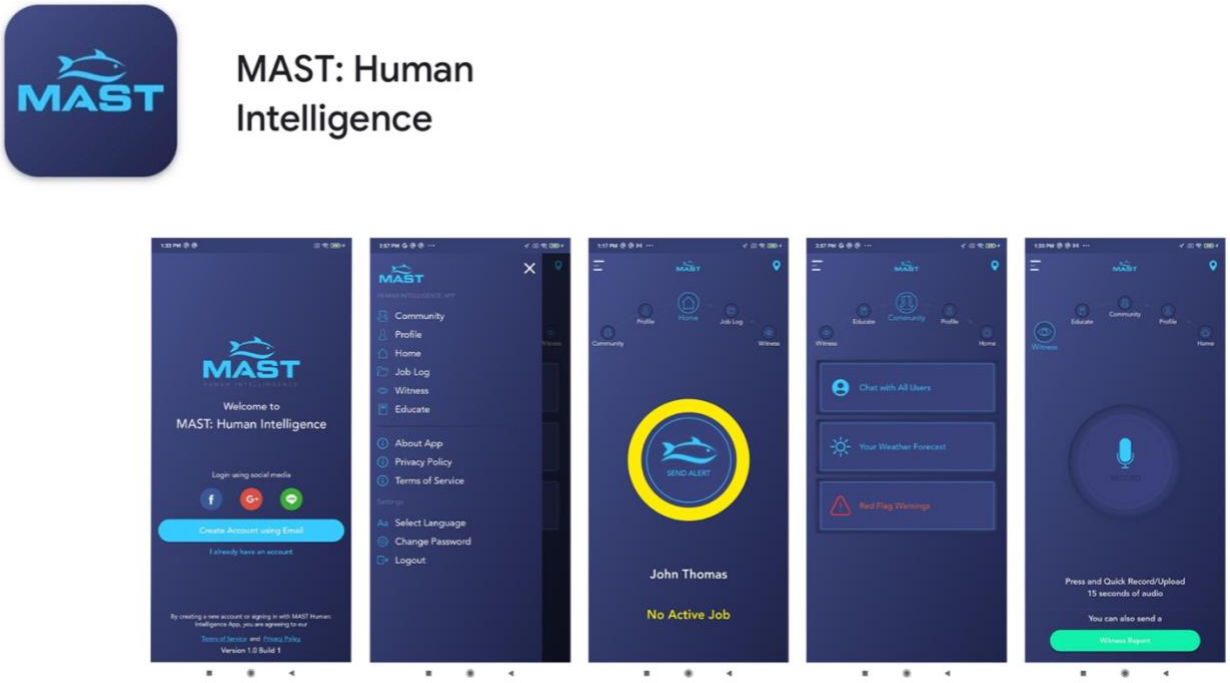

Figure 1. User Interface of MAST Human Intelligence Application

MAST Human employs an infrastructure to efficiently collect, store, and represent many types of data and information. To begin with, this platform offers users watch lists of vessels that are deemed risky, serving as a red flag for potential abuse. The proposed system aimed to establish a comprehensive review platform for vessel workers, enabling them to access valuable insights and ratings from their peers regarding the vessels they are scheduled to embark on. The platform serves as a communication area for individuals engaged in fishing and related occupations. The system notifies designated emergency contacts in the event that a user's safety is deemed to be at risk. The system also features an integrated automated warning/alert mechanism, which operates on the basis of job-specific information, to notify designated emergency contacts in the event that a

worker fails to complete the "check-in" process upon concluding a job. One of the major features of this application is a peer-to-peer communication method in which different labourers or witnesses can communicate and share their experiences. Thus, the app facilitates multidirectional communication between users, MAST, and fishing vessels staff in proximity. This technology facilitates the efficient generation and submission of eye-witness reports pertaining to illicit activities, and collects evidence pertaining to criminal activities. The MAST platform also serves as a medium for the distribution of educational resources pertaining to workers' rights. For example, the implementation of online training programs may effectively equip workers with vital knowledge and information. Additionally, the provision of gateways to third-party services can be used to facilitate many aspects of the labour market. Also, promoting ethical practices and openness in recruiting processes can contribute to the integrity of the supply chain. These measures are just a few examples of the potential strategies that can be implemented to enhance labour-related operations. Lastly, the platform enables users to upload contracts for further evaluation by legal professionals affiliated with MAST (Sukkree, D., Interview, 2023).

Having already addressed the objectives and aims of the MAST Human Intelligence app, I will now delve into a more comprehensive examination of its primary features and tools. One notable feature of the application is its capability to send emergency alerts to the designated emergency contact that the user has selected during the registration process. The emergency alert is a functionality that is activated when there is a threat to labour or when there is a potential risk, such as the loss of internet connectivity. The emergency alert is a warning message that is received by a person's designated emergency contacts. This message contains crucial information and provides directions for the emergency contacts to take appropriate action. These notifications are transmitted using email, SMS, or WhatsApp. The Job Log/Automatic Warning System is another feature that warrants further examination. The application asks workers before they embark to document the terms and conditions of their employment. The Disembark Date should be set in order to enable the "Automatic Warning" feature. This feature will automatically generate an alert if a worker fails to arrive at the given time or if the signal is lost within 24 hours after the scheduled arrival time.

Moreover, the MAST Human Intelligence app incorporates crime reporting as an additional functionality, aiming to foster transparency and enhance knowledge regarding work conditions on board. A recommended method for documenting and reporting criminal activities occurring on fishing vessels is through the utilization of a comprehensive checklist comprising photographs and videos. Nevertheless, as stated by Dornnapha Sukkree, the photographs, audio recordings, and videos are not saved within the worker's mobile device; they are saved on the app, which reduces the risk of reporting for the crew member. Also, the Community Chat function facilitates peer-to-peer discussions, ratings, and reviews of vessel working conditions, thereby establishing a social media platform for workers to engage in communication (Sukkree, D., Interview, 2023).

According to Dornnapha Sukkree, the initial phase's objective is to raise awareness and educate people about the importance, benefits, and features of this app. Additionally, the goal is to enhance cooperation with more governments, businesses, and NGOs on the frontlines, aiming to reach 100,000 users. This effort is directed towards making impactful changes in combating human trafficking and forced labour in the fishery industry (Interview, 2023 ; Johjit, 2024 & Shah, 2024).

e-Voices

E-Audit is a corporate consulting organization based in Hong Kong and Shanghai that specializes in auditing and providing consultation services to promote social and ethical practices within supply chains. E-Audit provides a range of integrated services aimed at facilitating the implementation and administration of comprehensive data-driven environmental and social supplier audit/inspection programs. These programs encompass not only first-tier suppliers but also extend to lower-tier suppliers and producers. Additionally, e-Audit offers practical solutions to manage social risk effectively, such as confidential and anonymous grievance mechanisms that enable workers to voice their concerns (e-Audit, n.d.). E-Voices is a platform developed by e-Audit with the purpose of addressing issues related to forced labour and social compliance within the context of the DWF industry, with a particular emphasis on the tuna sector. I undertook an interview with Hubert de Bonafos, the managing director of e-Audit, in order to acquire a comprehensive understanding of the e-Voice platform.

The e-voice platform operates on a victim-centered approach. Based on the discussion I had with Hubert de Bonafos, this platform serves as a means for workers to directly input their data and documents regarding their working conditions aboard vessels during their operations. In order to utilize this platform, it is necessary for the labourer to scan the QR code that is presented on the fishing vessels. According to my interview with Hubert de Bonafos, these QR codes function in a specific manner. Before operations commence, fishing vessels are equipped with sticker labels that have QR codes. Labourers on board can scan these codes to access a platform where they can answer questions and report any abuse or illegal activities. Workers have two main options for submitting their reports via the platform: they can register (sign up), which shares their information with a third party that can then communicate and follow up with them, or they can choose not to register, keeping their identity unknown (de Bonafas, Interview, 2023). As per my acquired knowledge in the conversation I had with Hubert de Bonafos, there are two major ways that e-Audit makes sure that the vessels are equipped with QR code labels. Firstly, several retailers and suppliers, mostly for their brand image concerning ethical supply chains, are encouraging and sometimes prefer to work with vessels that use the technology of transparency.

E-Audit has established significant collaborations with key stakeholders, including trading companies and retailers, in this matter. Consequently, this partnership offers a valuable chance to streamline the reporting process for numerous fishing vessels through the utilization of a QR code that labourers can scan. These entities exert pressure on vessel owners and impose a requirement for the implementation of QR codes (de Bonafas, Interview, 2023). For a better understanding, I asked Hubert de Bonafos to provide an example that shows how trading companies and retailers put pressure on the vessel owners. As explained earlier, in the intricate global fishing supply chain, the role of trading companies is pivotal, particularly in the context of major retailers like Costco and Walmart. These retailers typically do not engage directly with fishing vessel owners; instead, their procurement involves intermediary traders. These traders play a crucial role by purchasing large quantities of fish, which are then processed for further distribution. The fishing vessel owners, who manage fleets ranging from a single vessel to as many as 15 in the case of larger companies, require substantial investment for each boat, costing anywhere between 2 to 20 million

dollars. To facilitate these operations, trading companies provide essential financial support covering the costs of fuel, food, and other logistical necessities. Post-harvest, these traders buy the fish from vessel owners, oversee its processing, and then export it to markets in the United States. Here, retailers like Costco and Walmart become the end buyers. In this supply chain, trading companies are not just financial enablers but also key players in ensuring the ethical sourcing of fish. There is growing market pressure, especially concerning imports from regions like China, to ensure compliance with human rights standards. Retailers are increasingly demanding evidence of ethical practices from these trading companies, underlining their significant influence in shaping labour conditions and sustainability practices within the global fishing industry (de Bonafas, Interview, 2023).

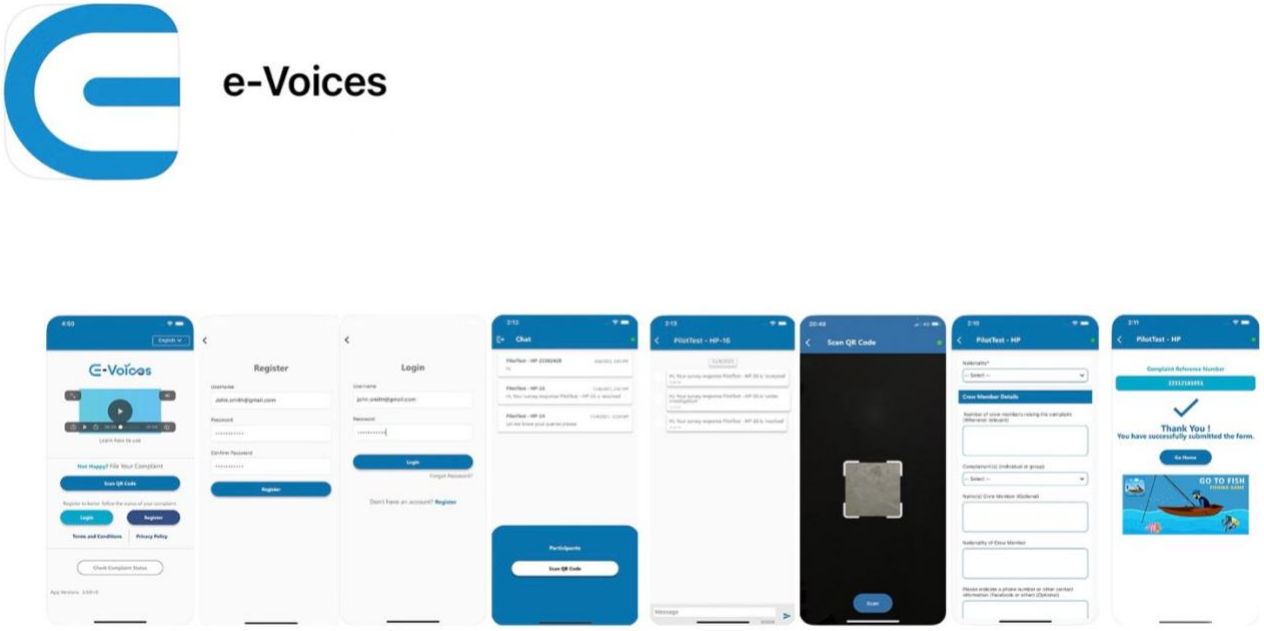

Figure 2. User Interface of e-Voices Application.

The QR codes encompass comprehensive data pertaining to the fishing vessels. Upon scanning the code, personnel may easily identify and report on the specific vessels that they are working on. Regarding the flow of data, when the crew members report through the utilization of a QR code, the data by e-Voice is transmitted to a third-party entity such as the Presbyterian Church in Taiwan (PCT) is one example of an entity that has a responsibility to monitor the labour condition. The complaints are received and subsequently analyzed to identify instances of illegal acts. In certain

cases, the identified illegal activities are reported to the appropriate government authorities. The managing director of e-Audits provided a comprehensive explanation of the primary data flow and process during the meeting in 2023. As explained, labourers can enter their information on the issue on the vessels and can also upload pictures to show and report what is happening on the vessels (Huber de Bonafos, Interview, 2023).

Furthermore, during the interview, I acquired knowledge about several characteristics pertaining to this platform. The concept of confidentiality is of utmost importance in various professional fields and industries; it refers to anonymous complaints that can be submitted with the added feature of being able to track the status and resolution of the issue. Secondly, the involvement of an impartial third party facilitates the ability to resolve conflicts and pursue subsequent actions independently. Therefore, the act of monitoring refers to the systematic observation and tracking of a particular subject or situation. A comprehensive dashboard has been developed to facilitate the monitoring of complaint status and ensure suitable follow-up measures are taken. Thirdly, multiple language options are provided for accessing information and submitting complaints. Fourthly, online and offline modes of operation. The application functions in both online and offline modes, allowing users to file complaints promptly once a connection is established. During to the interview Hubert de Bonafos noted that "having access to Wi-Fi is not necessary is nobody immediately cannot do something and needs to arrive at the port to report or follow-up as made an example of in addressing crew welfare, providing Wi-Fi access raises expectations that might not always be met. For instance, immediate assistance for accidents at sea is impractical, as injured crew members must wait for the vessel's return to port for medical attention. This highlights the challenges in balancing technological benefits with realistic operational limitations in maritime labour conditions" (de Bonafos, Interview, 2023). Lastly, the chat function is a feature that allows users to engage in real-time communication using text-based messages. The chat feature is provided to allow for potential follow-up with the complainant if they desire to do so (de Bonafos, Interview, 2023).

Golden Dreams

Issara Institute (Issara), a non-profit organization operating in the United States and Thailand, aims to address migrant labour abuse. The Issara Institute is responsible for developing Golden Dreams, an additional category of ER application. While this application does not specifically target or directly cater to DWF, it is a pertinent illustration of how an application can significantly combat exploitative labour within a production network. Golden Dreams specifically aims to empower workers and job seekers from Burma, Cambodia, and Nepal. This application is regularly updated to include new countries and languages (Issara Institute, 2017). The primary objective of the Golden Dreams application is to utilize technology and innovation to empower workers and bring about a transformation in labour recruitment corridors that are characterized by exploitative practices (Issara Institute, 2017). This project aims to address the problem of migrant labour abuse with a two-part approach. Firstly, it introduces 'The Golden Dream' app to assess the causal relationship between inefficiencies in labour recruitment processes and the subsequent occurrences of labour abuse. The app analysis will provide policy recommendations based on empirical data. Secondly, the approach proposes an algorithm that integrates matching and learning techniques for the recruitment platform developed by Issara, known as 'Golden Dreams.' The primary objective of this algorithm is to facilitate the identification of suitable matches between workers and recruiters while using the data generated from this process to estimate the extent to which employers adhere to fair labour practices. The goal is to offer employer ratings that provide accurate insights, enabling workers to make better-informed decisions. Additionally, these ratings aim to help businesses meet their labour needs more efficiently and reduce labour-related risks by closely monitoring their frontline labour practices (Boyu, 2022).

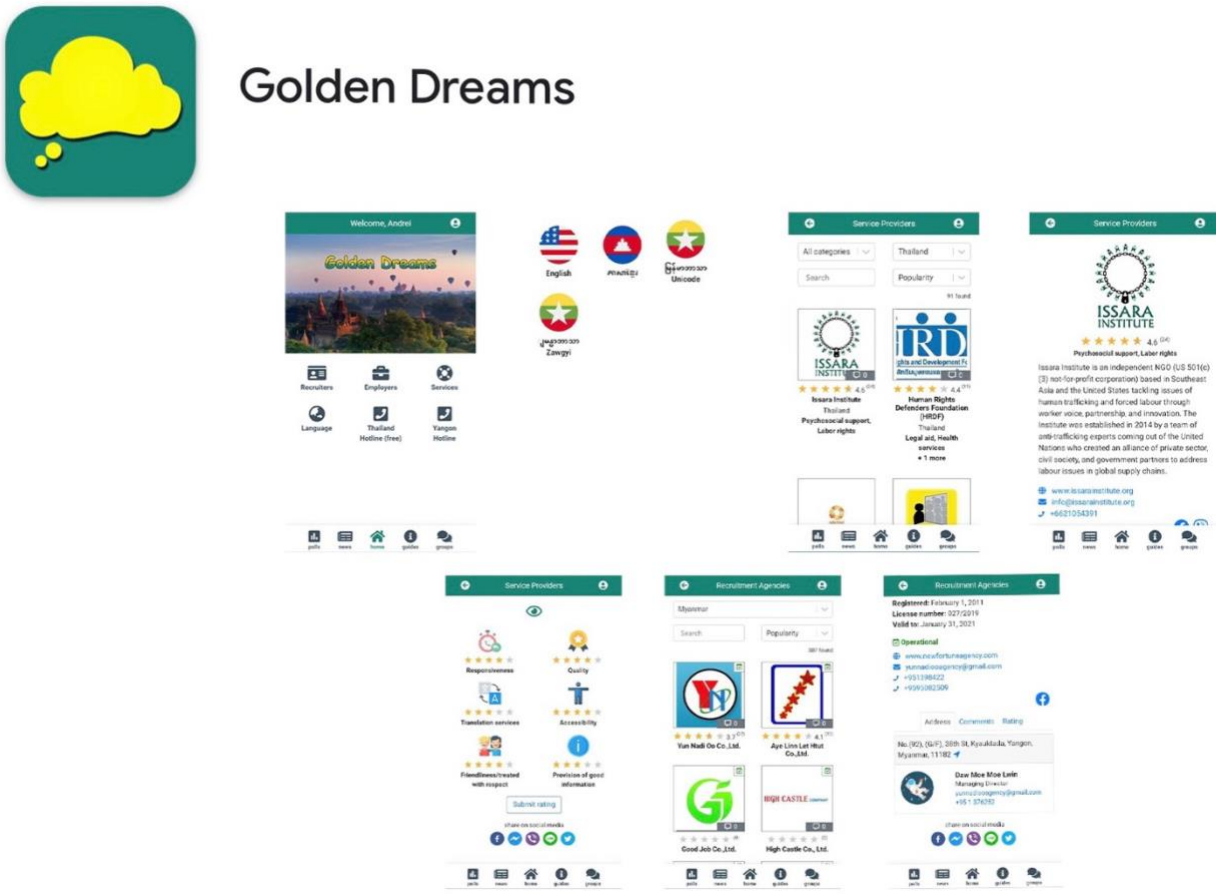

Figure 3. User Interface of Golden Dreams Application.

The Golden Dreams application functions as a peer-to-peer platform that facilitates communication and enables workers to assess and evaluate their respective working conditions. According to the Issara Institute, Golden Dreams can be characterized as a mobile application similar to Yelp. This application is crucial in facilitating education and empowerment, ensuring safe migration, promoting ethical recruitment practices, and providing access to necessary support when needed (Issara Institute, n.d.). Individuals possess the capability to peruse evaluations and appraisals sourced from a collective group of users about corporations, recruiters, and providers of services. Moreover, individuals have the opportunity to access current and relevant data about the expenses and procedures associated with migration, alongside comprehensive details concerning labour rights in host nations (Issara Institute, no date). The Golden Dreams application possesses the capacity to address the issue of forced labour across multiple sectors through a

diverse range of mechanisms. Among these sectors, distant water fishing emerges as a particularly pertinent industry that would greatly benefit from implementing such an application, thereby fostering enhanced ethical practices. The Golden Dreams application enhances transparency by offering a platform for workers to engage in discussions regarding their working conditions, as well as to evaluate their employers and colleagues. As a result of this increased transparency, various stakeholders within the supply chain, such as recruitment agencies, brands, suppliers, and retailers, exhibit greater caution and responsibility.

Diginex Apprise

The application named DiginexApprise was started in 2017, jointly developed by Diginex, the Mekong Club, and the United Nations University Institute on Computing and Society (UNU-CS). The primary objective of this initiative is to facilitate the evaluation of labour conditions in the supply chains of various organizations, with a particular focus on finding occurrences of forced labour and substandard working conditions (Mekong Club and United Nations University Institute on Computing and Society, 2019). According to Sassetti and Thinyane (2021), the mobile application called DiginexApprise enables the proactive and comprehensive screening of vulnerable populations to detect indications of labour exploitation and forced labour. DiginexApprise is a platform that enables the promotion of transparency and the detection of cases of forced labour and gender imbalance. This is achieved by the implementation of a structured questionnaire and the conduct of interviews with the relevant individuals. Diginex (n.d.) states that the DiginexApprise application provides a wide range of question sets covering multiple subjects, including gender equality, responsible recruitment, and forced labour. The provided question sets have been purposefully designed to be easily incorporated into various industries, thereby facilitating their successful implementation. Organizations have the opportunity to create customized inquiries to gather data from their employees on a particular subject matter. As stated by Diginex (n.d.), the employees partake in a procedure wherein they are presented with a series of inquiries in their preferred language and subsequently furnish responses through the utilization of a headset. The comments provided by the workers are afterwards communicated to an analytics dashboard, facilitating the immediate and effective detection of any possible concerns or areas in need of enhancement. The case study of DiginexApprise provides a compelling illustration of the

implementation of ethical and sustainable production practices achieved via the use of ER systems and community engagement. The Apprise application exhibits the potential to make a substantial contribution towards the progress of labour rights within the offshore fishing sector. Apprise offers a platform for those who have experienced forced work and inequality to record and reveal the mistreatment they have been subjected to (Seafish, n.d.).

Figure 4. User Interface of Diginex Apprise Application.

To obtain a more comprehensive understanding of the application, an interview was conducted with Hanna Thinyane, the Director of Supply Chain Technology Research and Development at Diginex. According to the interview, a major feature of DiginexApprise is its ability to overcome language barriers in the Emergency Response (ER) process. It achieves this by offering a range of languages within the application, ensuring that anyone involved in reporting does not face communication issues (Hanna Thinyane, Interview, 2023). As I observed, that one of the key communication challenges is the difficulty workers face in verbally articulating their conditions.

To address this, DiginexApprise includes a questionnaire format where workers can respond with 'yes/no' or multiple-choice answers. Moreover, enhancing privacy is another goal of the application (Hanna Thinyane, Interview, 2023). Since a third party conducts the interviews with workers, they are carried out individually, and workers are provided with headphones to listen to the questions and respond. Based on the interview conducted in 2023 with Hanna Thinyane, it has been ascertained that the DiginexApprise application is primarily utilized by inspectors, police officers, and inspection NGOs. In other words, this application is predominantly employed by entities that are responsible for auditing. The auditing entities visit the labourers and provide them with headphones to facilitate their listening and response to the questions. However, employees can independently utilize the program by scanning the QR code mandated by the supplier for vessel owners. Based on the interview, it was indicated that the application mostly caters to auditors and labourers who can utilize the QR code scanning feature for conducting interviews. Moreover, a noteworthy aspect of DiginexApprise pertains to its communication methods employed for conducting interviews.

Overall, the highlight of DiginexApprise is its interview questions in many languages, which crew members can access. The questions are presented in a yes or no format that allows for affirmative or negative responses. This method ensures the secrecy of the responses by preventing anyone, such as the vessel captain or other crew members, from accessing participants' answers, thus maintaining anonymity. DiginexApprise is a platform that facilitates the participation of both labourers and auditors to report labour working conditions. This application serves as an effective portal for enhancing stakeholders' understanding of labour conditions in DWF.

CUMULUS Forced Labor Screen™

Verité is a an independent, non-profit, non-governmental organization focused on labour rights, aiming to ensure the provision of safe, equitable, and lawful working conditions for individuals globally, with particular emphasis on East Asia. Verité offers enterprises a range of solutions aimed at mitigating labour abuses. The objective is to enhance the capacity of workers to promote and defend their rights actively. The objective is to generate resources that are openly accessible to the public, which serve to inform and motivate individuals to take action. In order to make a

meaningful contribution to formulating government labour and human rights *policy* (Verité, 2022).

Figure 5. User Interface of Cumulus Forced Labour Screen Application

The CUMULUS Forced Labour Screen™, developed by Verité, serves as a risk assessment platform, requiring stakeholders engaged in the supply chain to provide relevant information and documentation for the purpose of conducting risk assessments. The presence of forced labour concerns in supply chains related to recruitment is deeply ingrained and pernicious. The CUMULUS Forced Labour Screen™ developed by Verité employs proprietary technology to systematically trace and analyze transnational labour supply chains, aiming to collect comprehensive information about labour forces, recruitment agents, and unscrupulous behaviours related to recruitment and employment. The platform, which operates on a membership model, takes proactive measures to assess priority activities, supply chains, and investment portfolios for the detection of forced labour indicators as defined by the ILO. CUMULUS is utilized by companies, suppliers, and investors for the purpose of doing forced labour due diligence, with the aim of adhering to established best practice guidelines, such as the Organisation for Economic Co-

operation and Development (OECD) Due Diligence Guidance for Responsible Business Conduct. CUMULUS can be implemented across various sectors, geographies, and supply chain tiers, as it is based on widely acknowledged standards and practices (Verité, 2023).

In order to obtain additional practical insights, an interview was conducted with Declan Croucher, Senior Director, Advisory, and Chief Commercial Officer of Verite, regarding the CUMULUS Forced Labour Screen™. Based on the interview's contents, the platform in question is characterized as a transparency tool that conducts risk assessments to evaluate the potential occurrence of labour abuse inside the supply chain. CUMULUS facilitates the execution of due diligence at the organizational level and traces labour supply chains and recruitment agents back to the nation of origin. The goal is to determine the presence of indications of forced labour as specified by the ILO, and to assess the impacts of implementing corrective and preventative actions. Efficiently provide information to appropriate stakeholders on the enforcement of forced labour due diligence procedures (Verité, 2023). According to Declan Croucher (2023), the platform includes a questionnaire that covers various aspects such as the company profile, workforce characteristics, foreign worker recruitment agency, certificates, and screening questions related to recruitment cost, contracts and termination, identity documents, payroll, wages and deductions, and housing. Upon submission, the report's outcome entails an elucidation of the risks and assessment information. According to the interview, a key focus of Cumulus is debt-bonded labour, a pervasive form of forced labour in supply chains. The platform tracks recruitment costs, identifying if these are borne by the employer or unfairly passed on to the workers, leading to debt bondage. Cumulus assesses risks by analyzing various elements like contracts, proof of payments, and agency agreements, often revealing inflated recruitment fees paid by workers. The platform scrutinizes employers' recruitment practices, particularly whether they bear recruitment costs or unfairly pass them onto workers. This is crucial because when workers shoulder these costs, they often fall into debt bondage, a form of forced labour where they are trapped in a cycle of debt and exploitation. By identifying such practices, Cumulus helps mitigate the risk of debt bondage, ensuring that labour recruitment is ethical, fair, and free from coercive financial burdens (Decan Croucher, Interview, 2023).

On the other hand, one of the primary challenges faced by Cumulus is engaging employers to participate actively and provide detailed, sensitive data. The platform demands employers' transparency regarding their recruitment practices, especially the financial aspects of hiring foreign migrant workers. This level of transparency can be daunting for many employers, requiring them to disclose potentially compromising information about their labour practices and relationships with recruitment agencies. In summary, while Cumulus presents a robust tool for combating forced labour, its widespread adoption is hindered by challenges related to employer engagement, data sensitivity concerns, industry-specific barriers, and the need for greater awareness and recognition of its value in various sectors (Declan Croucher, Interview, 2023).

The Cumulus platform is designed to perform a comprehensive, risk-based mapping of labour supply chains, a crucial step in identifying vulnerabilities and areas requiring immediate attention. It plays a pivotal role in identifying the presence of ILO forced labour indicators, which are essential for understanding the extent of labour rights violations within these chains. A significant aspect of Cumulus's functionality is prioritizing employers and labour recruiters for enhanced due diligence, ensuring that those with higher risk profiles are subject to more rigorous scrutiny. One of the critical measures it verifies is whether employers are responsibly covering recruitment fees and related costs, a practice integral to preventing debt bondage and other forms of labour exploitation. Additionally, the platform monitors the impact of remediation and prevention efforts, providing valuable insights into effective strategies to combat labour abuses. Lastly, it serves as a tool for transparent communication with stakeholders, enabling organizations to demonstrate their commitment and efforts towards forced labour due diligence. This holistic approach not only aids in mitigating risks but also fosters a more ethical and sustainable labour supply chain. Based on insights gained from my interview with Decan Croucher, I argue that Cumulus, as an enterprise risk tool, can be considered a proactive strategy aimed at promoting awareness and openness within the DWF production network, particularly concerning labour rights conditions, although the platform's use is not yet widespread in the fishing sector (Decan Croucher, Interview, 2023).

5.3.4 Conclusion

Overall, ER is one of the most advantageous ICTs that can significantly promote transparency and raise awareness about labour rights and conditions in DWF. ER is a type of ICT that mostly NGOs and corporations create and is utilized to document and disclose working conditions aboard vessels situated in remote oceanic locations. The ER methodology is conducted by two distinct groups inside the network: the workers themselves and third-party auditors. After doing an examination of ER, it is apparent that ER technology may be categorized into two primary components: hardware, specifically smartphones, and software, encompassing applications and online platforms. Smartphones are a tangible infrastructure enabling labourers and auditors to record and gather data. Additionally, software apps and online platforms function as gateways to connect this data with third parties, enhancing transparency and promoting awareness through representation. Hence, the data flow facilitated by smartphones, applications, and platforms such as ER can play a crucial role in fostering transparency and advancing labour rights in the context of DWF. This section has examined five distinct applications and platforms to assess their functionality and potential contributions in this context. It is evident that every application possesses advantages and weaknesses, yet it is crucial to acquire knowledge about these flaws and contemplate potential resolutions.

5.4 On-Board Access Issue: Wi-Fi Connectivity Challenge

5.4.1 Introduction

The DWF industry possesses particular characteristics when compared to other industries. Geographical inaccessibility is identified as an essential factor in the DWF industry, with a notable impact on working conditions (Marschke et al., 2020). DWF operations take place in remote areas of the ocean, posing challenges for effective surveillance and monitoring of fishing vessels. The utilization of various ICTs has the potential to mitigate the lack of visibility and enhance transparency capabilities. One of the primary approaches for gaining further insight into labour conditions on fishing vessels is through the utilization of ER mechanisms, whereby workers can report their conditions. Additionally, EM via CCTV systems are employed to enable various stakeholders to monitor onboard activities. However, the absence of Wi-Fi connectivity complicates matters and places labourers in a more precarious position. Access to Wi-Fi is

essential for facilitating connectivity among labourers and various external entities, such as their families and stakeholders like non-governmental organizations (NGOs) and civil society groups. This connectivity enables labourers to inform these parties about their current condition and well-being. The absence of internet connectivity increased their vulnerability to poor labour conditions and labour rights concerns. This section will focus on the civic movement and measures undertaken by stakeholders in response to the Wi-Fi issue. Hence, the possibilities and solutions for enhancing internet connectivity for crew members in remote oceanic locations will be examined.

5.4.2 Wi-Fi Connection Demand

The issue of internet access is a subject of considerable debate in DWF. The provision of Wi-Fi connectivity is of utmost importance for upholding workers' rights as defined by international labour standards, particularly their right to freedom of association. The provision of Wi-Fi connectivity is crucial not just for the well-being of employees but also for their own mental health and their families (Chiang & Chen, 2022; Global Labor Justice, 2023). One of the primary challenges in providing internet connectivity to fishing vessels is the significant cost involved. According to a labour rights campaign group, it is suggested that seafood companies and merchants should jointly bear the expenses associated with the installation of Wi-Fi internet connections aboard fishing vessels. This recommendation comes in light of the group's efforts to exert pressure on the authorities to ensure that fishing fleets are equipped with online connectivity. According to Kimberly Rogovin, the senior seafood campaign coordinator at Global Labor Justice-International Labour Rights Forum (GLJ-ILRF), certain apprehensions exist regarding the rising expenses associated with installing Wi-Fi on vessels (Human Rights at Sea, 2023).

Nevertheless, advancements in satellite internet technology, coupled with forthcoming government subsidies, should render these costs entirely manageable for the industry. The latest meeting between GLJ-ILRF and the Taiwan Fisheries Agency mostly discussed improving the working conditions of fishermen. GLJ-ILRF received favourable comments from the agency, emphasizing their financial commitment to enhancing Wi-Fi services aboard fishing boats over the next four years. Furthermore, it was revealed that a list of vessels equipped with internet access

will be released, showing progress in enhancing communication for sailors at sea. (Chiang & Chen, 2022; Godfrey, 2022).

Furthermore, during the Seafood Expo North America held in Boston, Massachusetts, United States, on 12 March 2023, a group of migrant fishers, predominantly from Indonesia, expressed their dissatisfaction with the absence of mandatory Wi-Fi access on the distant-water fishing vessels where they are employed (White, 2023). The protest was organized by Global Labor Justice – International Labour Rights Forum (GLJ-ILRF). This non-governmental organization operates on a transnational level to promote policies and legislation that safeguard workers' rights. The Boston demonstrators group comprised Tunigo and Edi Kasdiwan, Indonesian fishermen employed by fishing vessels located in Taiwan throughout the 1990s. Both individuals are affiliated with the Indonesian Seafarers Gathering Forum (FOSPI) (White, 2023). The "Wi-Fi Now for Fishers' Rights at Sea" campaign was initiated by several human rights NGOs, such as the Indonesian Seafarer's Gathering Forum (FOSPI), Taiwan Association for Human Rights (TAHR), Stella Maris Kaohsiung, FOSPI Donggang Pingtung, Global Labor Justice - International Labour Rights Forum (GLJ-ILRF), and Humanity Research Consultancy (HRC). This campaign aims to address the lack of Wi-Fi access for fishermen working at sea, who often endure months without connectivity. Through the establishment of a global advocacy platform, these organizations seek to promote and protect the rights of Taiwanese and overseas migrant workers in the fishing industry (Cheung, 2023). Consequently, these social movements can create opportunities for increased pressure and significantly influence governmental entities and corporate actors, such as seafood producers, trading businesses, and merchants, who wield considerable power. This pressure is aimed at compelling these stakeholders to address issues related to labour exploitation and establish internet connectivity as a means of intervention.

5.4.3 Satellite Communication Service as an Alternative

In recent years, the accessibility of establishing an internet network on DWF vessels in offshore operations has increased due to the advancements in satellite communication technologies. The Korea Times (2016) reported that the government's latest satellite communication project aims to provide continuous access to email and social networking services for fishermen who spend

extended periods of time away from home on deep-sea vessels. This initiative is expected to enhance communication capabilities for these individuals, as stated by a relevant ministry. At present, the utilization of satellite communication services by South Korean deep-sea fishing vessels is primarily restricted to instances of emergency or the transfer of time-sensitive data, thereby addressing the issue of communication limitations.

Moreover, as I had a comprehensive meeting with Emma Seal at Ocean Mind (2023), I discussed the Wi-Fi issue and the alternatives and solutions that Ocean Mind is working on. According to Emma Seal's explanation to me via meeting and email, four types of connectivity options can resolve the issue of network access by labour on DWF vessels. These four options are:

A) near-shore airtime, B) connectivity box, C) metered technology, and D) LEO satellite.

A) Near-shore airtime, often referred to as low/no "airtime" GSM extenders and LoRa, are suitable for the transmission of tiny payload data at a proximity of up to 30 km. One approach involves the installation of an onboard module that enhances the offshore range by providing connectivity to existing terrestrial cellular networks. The second technique discussed is known as Low Power, Long Range Wide Area Network (LoRa), which is a relatively new wireless technology operating in the license-free sub-gigahertz spectrum designated for Industrial, Scientific, and Medical (ISM) purposes. LoRa technology offers fundamental digital connection across a range of 10-30 km in a direct line of sight, rendering it applicable to domestic fishing vessels operating in close proximity to the coast. It should be noted that the range has the potential to be expanded up to 100 kilometres by utilizing the 400 MHz sub-band. However, it is important to acknowledge that the establishment and operation of such a network would typically require substantial investment and effort from a local network operator.

B) The connectivity box, measuring approximately 56 x 45 x 25 cm, can be likened to a compact, self-contained unit similar to a router. In order to guarantee worker

accessibility, it is recommended that the installation be carried out within the crew quarters. The expandability of the Box allows for the integration of various plug-in modules, such as GSM, LoRa, and VHF & L-Band Short Burst Data (SBD), and potentially enables the future incorporation of Low Earth Orbit (LEO) satellite systems. The boat box possesses the capability to be conveniently transported onto the vessel and promptly operate upon its arrival at the port, following a plug and play approach. The unit is compatible with consumer devices that possess either a Wi-Fi or cellular data connection. Configurations can be established to cater to the specific requirements of a given vessel and afterwards undergo onshore testing and setup prior to manual transportation. This feature facilitates the convenient removal or redeployment of the solution, especially in cases where vessels have limited time available for port calls.

C) The technologies known as "metered" technologies, specifically Swarm-like and L-Band SBD, are the focus of this discussion. The previously mentioned modules are compact in size, measuring 11 x 11 x 3 cm. They function alone or can be easily connected to other devices. These modules serve the purpose of establishing a Wi-Fi interface for crew members and bridge staff. Additionally, they are capable of connecting to low Earth orbit (LEO) satellite networks, enabling the storage and forwarding of communications services. Although the transmission of videos and high-resolution images may not be feasible, this alternative presents a durable and economically viable solution (with costs as low as US $3 per month) to maintain contact among workers at sea.

D) The ongoing proliferation of low Earth orbit (LEO) constellations of internet satellites, such as SpaceX's Starlink, Amazon's Kuiper, and OneWeb, is poised to facilitate affordable and accessible internet connectivity. Given the appropriate cost, the integration of increased data transfer capacity, reduced time delay, and enhanced responsiveness compared to current geosynchronous satellites, along with the ability to allocate bandwidth dynamically, renders low Earth orbit (LEO) an attractive option for establishing connectivity for offshore fishing vessels.

5.4.4 Conclusion

In general, individuals employed aboard maritime fleets encounter difficulties when attempting to establish communication with external entities, including the reporting of their status to authorities or non-governmental groups. Advocacy groups have played a significant role in spearheading a campaign to secure internet connectivity for workers in the middle of the ocean aboard fishing vessels. The provision of internet connectivity on DWF vessels is an essential amenity that is necessary for labourers and stakeholders to effectively report and monitor the working conditions of workers while they are situated in the middle of the ocean. The increasing prevalence of satellite communication systems has made them a popular choice for providing internet connectivity to personnel situated in remote oceanic locations. However, one of the primary challenges this research identified is the costs associated with equipping fishing vessels with internet connectivity. In addition to technological advancements aimed at establishing onboard internet connections, it is crucial for stakeholders to explore strategies for incentivizing vessel owners to facilitate internet usage among crew members.

5.5 Data Validation Challenge: Blockchain as Possible Solution

5.5.1 Introduction

This chapter has provided an overview of the techniques used to collect data through both onboard and remote methods for monitoring and tracking vessel behaviour. Additionally, it has explored the utilization of these techniques to gain insight into labour conditions during operations in distant water fisheries. It has been observed that machine learning technology has the capability to analyze vast quantities of data obtained through onboard and remote technologies. This section will cover the storage, representation, and security of data. Blockchain is a technological innovation that facilitates the secure storage and representation of data and information that has been captured and analyzed. This refers to the transfer of stakeholder gains and comprehension into blockchain formats, thereby enhancing transparency and traceability. This section will provide an overview of how blockchain technology can be a possible solution for data validation and discuss its

applicability in maintaining labour condition data and information on fishing vessels located in remote oceanic areas.

This part will focus on the topic of blockchain as a technology that promotes transparency of labour conditions on DWF vessels. In particular, I will examine the key features of the blockchain that enable it to help protect data against manipulation and contribute to the ethical and responsible global supply chain, with a particular emphasis on its application in the seafood industry and labour rights. The primary objective of this segment of my study is to address the potential impact of blockchain technology in enhancing labour rights within the DWF industry. The manner in which the collected data is incorporated into the blockchain ledger, the stakeholders responsible for data input, and those who have data access are all critical factors to be taken into account.

5.5.2 Data Validation with Blockchain

Blockchain technology has gained significant attention in the realm of cryptocurrencies, such as Bitcoin. The salient feature commonly associated with blockchain technology is its decentralized nature. This means that no one can manipulate the system or its data. According to IBM, "Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network" (IBM, n.d.). In addition, "Virtually anything of value can be tracked and traded on a blockchain network, reducing risk and cutting costs for all involved" (IBM, n.d.). The decentralization of blockchain is a prominent feature that supplies it with the attribute of technological transparency. Blockchain technology is distinguished by the lack of a centralized storage system for its information. According to Hayes (2023), the blockchain is not stored centrally but is instead replicated and disseminated among a distributed network of computing devices. Following the inclusion of a novel block in the blockchain, every computer in the network undergoes a synchronization process to ensure that its blockchain is updated to precisely reflect the alteration. According to Hayes (2023), blockchain technology's resistance to tampering is enhanced by transmitting information across the network rather than storing it in a single centralized database.

Blockchain technology is utilized in various industries and enterprises to promote sustainability by facilitating traceability and transparency, as per its conceptualization and characteristics. The growing utilization of blockchain technology in sustainable development is apparent. The renewable energy industry is an example of an industry that could potentially integrate blockchain technology. The utilization of blockchain technology has been observed in the context of peer-to-peer microgrids and the distribution of renewable energy across utility grids, as noted by Ahl et al. (2019). Furthermore, it is evident that blockchain technology has been employed in the fight against climate change. The utilization of blockchain technology has enabled the effective administration of carbon emissions for both individual and institutional entities. However, the precise costs and benefits associated with this approach to society and the environment remain uncertain, as noted by Howson (2019).

The food industry is a significant sector that has integrated blockchain technology into its operations (Fortuna & Risso, 2019). The food industry has incorporated blockchain technology in the area of food supply chain management to enhance transparency and traceability. In contemporary times, with growing public apprehensions regarding the food supply chain, the blockchain has emerged as a favoured mechanism for monitoring food production, thereby making the production network more lucid. "Blockchains are, potentially, a disruptive technology for the design, organization, operations, and general management of supply chains" (Saberi et al., p. 2120, 2019). As previously stated, the adoption of blockchain technology in the food supply chain has gained significant traction due to its ability to facilitate transparency and traceability. According to Saberi et al. (2019), the implementation of blockchain technology aims to optimize the effectiveness of material and information exchange in the supply chain by offering heightened reliability and visibility.

More sustainability and ethical production networks are among the main objectives of using blockchain in the food industry. Traceability and transparency are the main issues with regard to sustainability in the food supply chain, particularly in the fishing sector and seafood production network. The three main considerations for a sustainable supply chain are the health of the product, environmental impact, and labour rights. One of the primary goals of this study is to understand

how blockchain, as a technology of transparency, contributes to the advancement of workers' rights aboard vessels that are engaged in deep-water fisheries and act against "modern slavery" (Boersma & Nolan, 2020).

The matter of labour rights and working conditions represents a significant concern within the realm of distant water fisheries. The utilization of blockchain technology has the potential to enhance transparency in production systems, thereby promoting sustainability and ethical practices within the fishery industry. As the general public becomes increasingly aware of the intricacies of product supply chains, it is imperative that major stakeholders exercise greater caution with respect to sustainability and ethical considerations within this network. The implementation of blockchain technology would allow consumers to scan a code associated with a desired item, providing them with access to extensive details about its entire journey from creation to the point of purchase (Visser & Hanich, 2018), as viewed from the consumer's standpoint. Research on the efficacy of blockchain technology in facilitating the development of sustainable and ethical seafood supply chains has experienced a notable increase in recent years. The utilization of blockchain technology within the Thai fishing sector to achieve the United Nations Sustainable Development Goals serves as a noteworthy illustration of the potential significance of blockchain in the seafood industry, as posited by Tsolakis et al. (2021). The study conducted by Tolentino-Zondervan et al. (2022) explores the potential role of blockchain technology in promoting transparency in distant water fishery and advancing labour rights. Specifically, the authors investigate the impact of blockchain on the global fishery value chain and its potential to bring about changes in the industry's production network. According to Tolentino-Zonderva et al. (2023), blockchain is an innovative technology that has been employed in recent times for the purpose of coordinating actors within a value chain. In summary, civil society organizations are employing blockchain technology to achieve comprehensive transparency in supply chains, leading to the achievement of end-to-end traceability.

Our study has elucidated the benefits of deploying blockchain technology in the advancement of labour rights within remote marine fisheries. The subsequent aspect of significance pertains to the functionality of the digital ledger, specifically with regard to the methods employed by stakeholders for data entry, as well as the accessibility of said data and information to the public

and other stakeholders. As previously noted, blockchain serves as a secure ledger for data storage, safeguarding against tampering. It is crucial to understand the process by which data is entered into the ledger and transformed into the blockchain, as well as the level of accessibility afforded to users. The Internet of Things (IoT) is a mechanism for transmitting data, as noted by Feng et al. (2020). IoT refers to a category of communication technologies that facilitates the exchange of data via tangible objects. "The Internet of Things (IoT) describes the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet" (ORACLE, n.d.). IoT is one of the major methods for launching data in the blockchain ledger. According to IBM, "IoT enables devices across the Internet to send data to private blockchain networks to create tamper-resistant records of shared transactions" (IBM, n.d.). In the seafood industry, two key technologies, namely radio frequency identification (RFID) and quick response (QR), have been used for the purpose of entering data into the blockchain. Additionally, the Internet of Things (IoT) technology is employed for data transfer. For instance, the collection of data regarding the movement of tuna across various stages of the supply chain is facilitated through the use of radio-frequency identification (RFID) tags, quick response (QR) code tags, and scanning devices. While the practice of employing technology for supply-chain tracking is not novel, the distinctive feature of this process is the integration of blockchain technology for recording the acquired data (Visser & Hanich, 2018). In the realm of labour rights and working conditions aboard vessels, it is imperative to comprehend the types of information and data that must be gathered to raise awareness about the conditions of workers. This understanding is contingent upon the methods employed to transfer said data.

In other words, blockchain technology functions as a secure and tamper-proof ledger for storing data. Blockchain technology is a potent tool for improving transparency in the DWF industry's labour circumstances. The decentralized ledger system enables the secure and unchangeable recording and immediate validation of labour-related information, such as employment agreements and hours worked. This guarantees that any departures from ethical labour norms may be readily recognized and tracked. Blockchain makes information easily available and verifiable, which deters tampering with records and encourages responsibility among vessel operators. It enables stakeholders to uphold legislation and advocate for strong labour standards, representing

a major advancement in eradicating forced labour and exploitation in the DWF industry. This characteristic is a significant advantage that positions blockchain as a potential catalyst for improving labour conditions in the DWF. As previously said, several methodologies exist for data collecting. However, the preservation and safeguarding of this accumulated data constitute another crucial process whereby blockchain technology might serve as a suitable solution. Therefore, we can call blockchain a technology of transparency in this context.

5.5.3 Blockchain Development and Application

Various stakeholders within the fishery industry, including retailers and non-governmental/non-profit organizations, have used or devised diverse examples of blockchain technology to establish traceability and enhance transparency throughout the fishery production network. The purpose of this section is to examine three instances wherein blockchain technology has been implemented.

WWF:

The World Wildlife Fund (WWF) Australia is widely regarded as Australia's foremost conservation organization, enjoying a high level of trust among the public. The WWF has initiated a project called OpenSC, which aims to address the issues of illegal fishing and slavery within the tuna industry. This project focuses on enhancing transparency in the seafood supply chain through the utilization of blockchain technology and smartphones. The WWF and its collaborative partners have implemented blockchain technology within the tuna industry of the Pacific Islands. This pioneering initiative marks the first of its kind in the region, aiming to combat illicit fishing practices and violations of human rights. The project is being delivered through a collaboration between WWF-Australia, WWF-Fiji, WWF-New Zealand, ConsenSys, TraSeable, and Sea Quest Fiji Ltd., with the aim of implementing an innovative initiative in the field of technology and conservation. The retailer's value proposition lies in the ability of their customers to utilize their smartphones to scan a QR code, thereby enabling them to track tuna products from the initial stage of baiting to the final stage of consumption. This tracking process is facilitated by blockchain technology, which ensures the creation of a singular and authoritative record of information. Major corporations are increasingly embracing blockchain technology as they strive to create applications

that leverage its distinct characteristics in terms of security and accessibility (Campbell, 2021; Whiting (2020). The aim of WWF research was to explore the impact of information and communication technologies, particularly blockchain and smartphones, on enhancing traceability and transparency in the fishery supply chain. They report that smartphones can effectively augment the visibility of labour practices, thereby facilitating a more ethical and transparent supply chain in the fisheries sector. This study demonstrates the effectiveness of these technologies in mitigating risks associated with labour abuses, offering promising avenues for future interventions in the industry.

Provenance:

Provenance is a non-profit organization that primarily focuses on the traceability of products in the supply chain through the utilization of blockchain technology. Provenance has initiated a pilot project in Indonesia aimed at tracking tuna through the use of blockchain technology. Notably, the pilot project specifically emphasizes monitoring instances of labour exploitation within the remote water fishing industry (Provenance, 2016). "Provenance is an early adopter of blockchain technology in seafood supply chains" (Capri, 2018). Capri expounded upon the process whereby indigenous fishers capture a fish and attach an RFID tag to it during the initial stage of the process, commonly known as the "first mile." Following this, handheld devices are utilized to scan and transmit digital data to the cloud. This data is then stored in the blockchain ledger of Provenance, creating a lasting record of the fish's journey throughout the supply chain, including traders, suppliers, processors, canners, and, ultimately, the end consumer (2018). In other words, this project is about the traceability and transparency of tuna by employing blockchain. From this project, we can learn about how blockchain as technology can play an essential role in the transparency of the seafood supply chain. The utilization of blockchain technology in the pilot project initiated by Provenance serves as a noteworthy illustration of how transparency regarding labour conditions can be achieved through blockchain. Provenance use blockchain technology to trace the source of tuna, starting with its capture and concluding with its delivery to the customer. This process involves meticulous documentation of all transactions and data pertaining to labour conditions and environmental standards. By digitizing and delivering it via a user-friendly smartphone interface, consumers may access reliable information on the social and environmental

conditions of the tuna's capture. This concerns the fishermen's compliance with equitable working conditions, ethical standards, and certification by respectable non-governmental organizations (NGOs). This method offers clarity and protection, allowing consumers to make educated choices and choose seafood that adheres to ethical and environmental standards (Provenance , 2016), specifically, this technology can be employed to ensure that data pertaining to labour conditions is made transparent in the fishery supply chain, thereby exposing instances of forced labour.

PROVENANCE

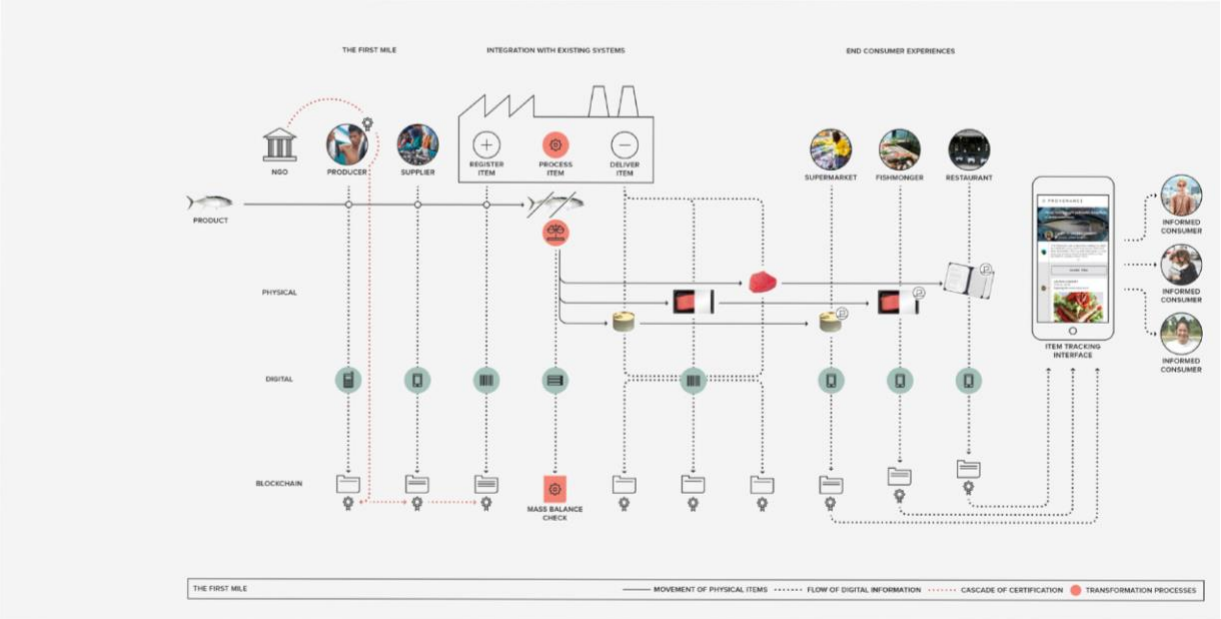

Figure 6. Provenance Blockchain System Map

Taiwan Tuna Association (TFA) and National Chung Cheng University (NCCU)

As previously stated under the CCTV EM section, TFA has collaborated with National Chung Cheng University to install camera surveillance systems on Taiwanese vessels in order to combat instances of labour abuse and forced labour (Godfrey, 2021). An issue that arises pertains to the

methods employed for capturing data through closed-circuit television (CCTV), their subsequent transfer to third-party entities, and the prevention of tampering. In the report authored by Godfrey (2021), it is observed that blockchain technology is utilized within this project as a means to ensure the authentication of the stored data. In order to gain a deeper comprehension of the practical implementation of blockchain technology, an interview was conducted with Hao Mai, a seafood sustainability expert and external consultant of FCF.The discussion focused on exploring the project's utilization of blockchain and the measures taken to ensure data security and integrity. According to Hao Mai (Interview, 2023), the data is predominantly maintained on the onboard hard disk . To ensure its integrity, blockchain methods are employed to save the data on the hard disk of the fishing vessels. Blockchain technology is used in the DWF Industry to securely record data on work conditions in order to address poor labour working conditions and abuse. This includes information on employment agreements, hours of work, salary disbursements, and any infringements of labour rights as outlined by ILO indicators and the C188 convention. Blockchain technology guarantees the authentication and integrity of records, such as onboard CCTV video, by making them tamper-proof. This method improves openness and accountability by allowing immediate verification and auditing of work practices. Blockchain technology is essential for enhancing supervision and ensuring compliance with labour standards in the DWF industry by protecting the accuracy of work condition data. These methods contribute to enhancing the transparency of the DWF.

5.5.4 Blockchain Challenges and Criticism

In my previous discussion, I explored the concept of blockchain and its potential application in enhancing transparency within the DWF production network by facilitating the representation and storage of data. However, it is important to acknowledge certain problems and drawbacks associated with the implementation of blockchain technology. The utilization of blockchain technology for enhancing traceability and transparency in the food industry, specifically DWF, is a new phenomenon. Consequently, there exist certain aspects that remain ambiguous and require further clarification. After conducting a review of both secondary and primary sources in this particular domain, it has come to my attention that several concerns and challenges accompany the use of blockchain technology in the DWF production network. The process of guaranteeing data

quality prior to its insertion into the blockchain ledger, the techniques and capacities for storing data such as videos and images, providing appropriate data access to authorized individuals, and cost-effectiveness are the primary focal points within the debate around employing blockchain as the technology of traceability and transparency (Mutter, 2017; Turpitka, 2020; Wamba & Queiroz, 2020). Based on the interview conducted with Emma Seal (Ocean Mind, 2023), The cost of blockchain is a significant concern that merits attention. In many cases, funders are willing to cover the initial expenses associated with implementing blockchain technology, although they may be less inclined to provide continuous financial support due to the comparatively elevated costs involved in its maintenance and operation when compared to alternative system setups. The emergence of blockchain technology is relatively recent, and it is expected to provide challenging difficulties that require resolution as it undergoes refinement. Current blockchain systems lack effective solutions for data storage. The resolution of worker grievances within the blockchain systems sometimes entails a significant time frame, necessitating the preservation of data, particularly larger multimedia files like images or videos. There was a suggestion that a relational database could potentially offer advantages, although a detailed discussion on this matter was not pursued due to contextual factors such as the implementation location of the grievance system and the technological capabilities of mediator organizations. The implementation of this intricate system necessitates a comprehensive comprehension in order to achieve optimal outcomes, guarantee security measures, minimize computational demands and resource consumption, and facilitate scalability (Interview, Emma Seal, Ocean Mind, 2023; Hao Mai, 2023)

5.5.5 Conclusion

The blockchain is a technological innovation that facilitates the secure storage and representation of data and information that has undergone collection and analysis. Blockchain has emerged as a solution that certain stakeholders have recently used to ensure data validation and prevent manipulation. The incorporation of stakeholder advantages and comprehension into blockchain frameworks, leading to enhanced transparency and traceability, is a significant topic of discourse on the challenges and efficacy of blockchain technology. This section provides a thorough examination of blockchain technology and its possible application in the preservation of labour condition data and information pertaining to fishing vessels located in distant water. In this section,

I have examined the potential of blockchain technology and engaged in a discussion regarding the obstacles and criticisms surrounding its implementation in the realm of transparency. Understanding the advantages and disadvantages of blockchain technology is crucial in the context of maintaining data validation inside a decentralized workflow production network while ensuring its integrity and transparency for all stakeholders, including the public. However, further research is required to delve into the intricacies of blockchain technology and examine other methods in order to identify an efficient approach for storing, maintaining, and representing data while ensuring its validation. This approach needs to be both feasible and useful in real-world scenarios.

5.6 Conclusion

In this chapter, an in-depth study has been conducted on the subject of on-board community-based monitoring and reporting ICTs. These technologies are compared to positioning systems and satellite imagery due to their ability to directly interact with labour conditions on board, providing a more immediate representation of the conditions. In this research, two distinct categories of community-based ICT have been examined. The first category is video-based EM, commonly referred to as CCTV. The second category is community-based ER facilitated through the use of cell phones, applications, or online platforms. The video-based monitoring system is a method employed by DWF vessels, wherein CCTV cameras are installed to monitor the working conditions and on-board activities. Conversely, ER is a technological approach wherein workers report their conditions using digital means. In the context of this thesis, the ER has been classified into two distinct groups: self-reporting by the labourers themselves; reporting assisted by platforms that involve many stakeholders, including auditors, firms, and civil organizations.

After conducting an extensive literature review on the DWF production network and its application in the context of ICTs and conducting interviews with a number of expertise in the field, it has become evident that there are obstacles associated with the implementation of ICTs, particularly in the realm of community-based monitoring and reporting technologies. This study addresses two primary obstacles, namely access and data validation. Regarding the topic of access, it is worth noting that the DWF takes place at a location situated in the middle of the ocean. This geographical setting presents some obstacles in terms of accessibility, particularly in the context of ICTs. One

notable challenge pertains to the availability of internet network access, commonly referred to as the Wi-Fi issue. The crew members and labourers working on fishing vessels often endure extended periods of time at sea, during which they frequently lack access to internet connectivity. This circumstance places them in a vulnerable position. However, there are several initiatives and technical advancements that can potentially address this issue, hence encouraging stakeholders to act. Ultimately, the field also presents the difficulty of data validation. Blockchain technology is now regarded as a dependable option for securely storing data in an immutable ledger, hence preventing any form of manipulation. However, there are ongoing discussions regarding the capabilities of blockchain and its appropriate utilization as a transparent technology in supply chain management. Community-based monitoring and reporting is recognized as an effective approach to combat forced labour in DWF. Nevertheless, it is imperative to maintain a sense of optimism while acknowledging the need to address the significant obstacles that arise in this context.

Chapter Six - Discussion and Conclusions

6.1 Summary and Main Findings

The global fishing industry, particularly distant water fishing (DWF), has a complex production network where environmental integrity and ethical supply chains are significant concerns. This thesis focuses on concerns about labour rights within DWF. Monitoring labour rights abuses presents challenges in this field since workers are employed on fishing vessels operating in isolated and remote waters, often beyond effective oversight or regulation. This study investigates the potential of various information and communication technologies (ICTs) to track, monitor, and promote labour rights in DWF.

To comprehensively understand how ICTs can play a role and be efficient in promoting labour rights and creating a more ethical DWF production network, it is necessary to explore the different kinds of ICTs currently available for tracking, monitoring, detecting, and establishing transparency regarding labour conditions on fishing vessels operating in distant waters. It is also essential to consider the future directions being taken in adopting technology concerning labour rights.

To understand how ICTs can advance labour rights in DWF, it is significant to explore the major initiatives, entities, and stakeholders involved in applying and utilizing ICTs to detect and address labour rights abuses. Additionally, it is crucial to examine how data collected by these stakeholders addresses labour rights and forced labour concerns in DWF. This discussion should include the complexities and challenges of ocean governance that may arise when integrating ICTs into the governance of labour conditions in DWF.

By addressing these inquiries, we can gain insights into the potential applications of various ICTs within the governance of the DWF production network. This knowledge can facilitate the implementation of measures to enhance awareness of labour conditions in DWF. Such heightened awareness can be beneficial in making informed decisions and taking actions that promote a production network characterized by social responsibility and respect for labour rights.

To achieve this research's fundamental objectives and answer this thesis's primary question, I have first studied the position of labour in the production network conceptually, employing the Global Production Network (GPN) theory as the main theoretical framework. In the conceptual study of this thesis, I use the intersection of GPN and labour regime theories to understand the theoretical standing of labour and labour rights within the global production system. While GPN theory addresses the institutions, actors, and power relations in global production processes, labour regime theory provides a conceptual understanding of how workers are disciplined and exert agency within these systems. Therefore, this theoretical understanding clarifies the impact of ICTs as an external factor on labour's position in the production network.

Understanding the context of DWF is a crucial part of learning about the key stakeholders and entities in this industry. In the contextual chapter, I first discussed the geography of DWF, which reveals the complexities of global fishing through the division of both physical characteristics (such as accessibility, transboundary issues, and the mobile nature of fishing grounds) and human geographical characteristics (migrant workers). Furthermore, one of the objectives of this thesis was to understand the governance of DWF and identify the major stakeholders. DWF is governed by a multinational and multi-lateral system where stakeholders are divided into state actors like the governments of various countries, intergovernmental actors such as the UN, ILO, IMO, and FAO, and non-state actors, including for-profit corporations and non-profit organizations. Each of these actors has responsibilities, and together, they shape the governance of the oceans and DWF.

Learning the conceptual and contextual background creates an opportunity to better understand the potential for improving rights and working conditions within DWF. The empirical data collection sections began by examining different kinds of ICTs and how they integrate into DWF governance to enhance labour conditions and counter possible forced labour. The empirical component of this research is divided into two phases. The first phase involved reviewing secondary documentation, including academic articles, news reports, governmental documents, and websites from various NGOs, companies, and start-ups. The second phase of the data collection process entailed conducting qualitative interviews with stakeholders who are actively

involved in developing and deploying technologies related to migrant labour rights in fisheries, accompanied by an extensive review of secondary documentation. Due to certain limitations and conditions, I was unable to conduct interviews with a number of key stakeholders in the DWF industry, including major fishery and vessel owner companies. However, I hope to engage with these crucial stakeholders in future research to gain deeper insights into the sector.

The findings indicate that, within this framework, ICTs can be primarily classified into two distinct categories based on their approach to monitoring and observing labour conditions: a) remote monitoring and b) onboard/community-based monitoring and reporting systems.

In the remote monitoring category, I have discussed two major types of technologies: vessel tracking systems (GPS, AIS, VMS) and satellite imagery (VIIRS, SAR, Optical Imagery). On the other hand, for the onboard/community-based monitoring systems category, I have discussed Electronic Monitoring (EM) technologies like onboard CCTV cameras and Electronic Reporting (ER) technologies such as mobile apps and computer-based platforms that allow labour conditions to be reported by the workers themselves or by a third party.

Furthermore, the technologies I have mentioned are kinds of ICTs that assist us in collecting data related to labour conditions on board fishing vessels in DWF. However, I have discussed two other types of technologies: machine learning, which aids in creating datasets and developing algorithms to enhance our analytical capabilities for a better understanding of the situation; and blockchain, another technology that helps in securely storing, tracing, and representing data in a safe ledger to reduce the risk of data manipulation.

All in all, I have gathered both secondary and primary data to discuss how these technologies can enhance the transparency of activities on fishing vessels in DWF. I have explored how they can assist in tracking, monitoring, and detecting potential forced labour on these vessels. Additionally, I have identified the key stakeholders involved in integrating each of these technologies into the

sector. Moreover, I have examined how ICTs can contribute to advancing labour rights and conditions in DWF governance and combat the issue of forced labour.

6.2 Limitations and Discussions

Despite the numerous advantages that ICTs offer in advancing labour rights in DWF and combating potential forced labour, there are notable limitations in their application and efficiency in this context. As previously mentioned, DWF vessels operate in geographically complex areas, making it challenging to track and monitor labour conditions in distant waters. The limitations of integrating ICTs in DWF can be categorized into three main areas: accuracy, accessibility, and effective governance.

Significant limitations impede the application of vessel tracking and monitoring systems in the DWF industry, particularly in terms of ground truthing. Ground truthing refers to the process of validating model predictions by comparing them with actual events that occur. The primary obstacle is in the inadequacy and inferior quality of the available data for training these prediction systems. The available data about vessels engaged in forced work or other labour conditions mostly comes from a limited number of port inspections, hence offering a constrained perspective on a broader global concern. The significance of this inadequacy lies in the fact that the efficacy of machine learning models is strongly contingent upon the diversity and quality of the training dataset. There is a notable decline in the predictive accuracy of models when they are trained on datasets that include a limited number of confirmed instances of poor work conditions, including both positive and negative cases. As a result, these models exhibit reduced efficacy in identifying analogous issues in vessels that have not undergone prior investigation (Swartz et al., 2021).

These data collection methodological concerns are further intensified by the complex nature of DWF labour conditions and the varied operational profiles of fishing vessels. Utilizing data from vessel tracking and monitoring systems without establishing direct relationships to onboard labour conditions poses significant challenges in the construction and validation of data models. Without extensive ground truthing that incorporates a broader spectrum of authenticated cases of labour

conditions, there's a heightened risk of inaccuracies and the perpetuation of biases or oversimplifications in the detection of labour conditions in DWF. This situation highlights an urgent necessity to augment both the quality and volume of data concerning labour conditions in the DWF sector, aiming to enhance the dependability and ethical usage of technology designed to combat such issues.

The incorporation of ICTs in monitoring labour conditions in DWF faces significant accuracy challenges. Ensuring the reliability and accuracy of data is paramount for effective monitoring and enforcement of labour standards. Fishing vessels operate in isolated geographies, often beyond effective oversight or regulation, with the unpredictability of conditions in distant waters. Coupled with the varying quality and robustness of the technologies used, this often results in inconsistent data collection. Additionally, accuracy challenges can arise from extreme weather or sea conditions, limitations of some technologies in capturing data, and the lack of cooperation from vessel owners in equipping and transmitting essential data. For instance, as mentioned in Chapter 4, vessels intent on illegal catch or transshipment may turn off their positioning systems like AIS, making it difficult to track these vessels and highlighting the challenge of data collection accuracy.

Accessibility issues are another primary limitation in DWF. The limitation in accessibility to required infrastructure, such as internet connectivity onboard in remote waters, complicates both accessibility and data collection accuracy. As discussed earlier in Chapter 5, labour operations in distant waters for extended periods and lack of access to Wi-Fi disconnect them from the outside world, putting them in vulnerable situations. The absence of reliable Wi-Fi or other internet connectivity significantly limits real-time data transmission and analysis. This lack of connectivity impacts the effectiveness of monitoring labour conditions and restricts timely communication necessary for ensuring compliance with international labour standards. However, installing internet connectivity infrastructure and equipment is costly, making the solution for encouraging vessel owners to equip their vessels with internet connections a subject of debate.

Effective governance is another challenge in the integration of ICTs in DWF. Data manipulation risks, privacy concerns, and determining who is responsible for employing ICTs and their regulation are complex issues. The multi-lateral and multi-scalar characteristics of DWF, involving diverse jurisdictions and multiple stakeholders, provide opportunities for data manipulation. For instance, operators might transmit false information, undermining the trustworthiness of monitoring efforts. Furthermore, the use of surveillance technologies raises significant privacy concerns for crew members, necessitating a careful balance between effective monitoring and respecting individual privacy.

The involvement of ICTs in DWF governance is unavoidable, and it's a reality that, as in other fields, technological tools play a vital role. The protection and promotion of labour rights and conditions in DWF are significant concerns to which ICTs can significantly contribute, making the DWF supply chain more ethical. However, there are limitations and concerns that major stakeholders need to acknowledge. By addressing these challenges collaboratively, there is an opportunity to enhance the efficiency of ICTs in detecting illegal activities and forced labour in DWF, thereby fostering a socially responsible global fishing industry.

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Appendices

Appendix A: List of Seven Interviews Conducted for Research on the Application of ICTs in Monitoring of Labour Rights in DWF

As part of the research for this thesis, interviews were conducted with key individuals from seven organizations, including NGOs and technology companies, working on the application of ICTs in the DWF sector to monitor labour rights and combat forced labour. These interviews sought to uncover the roles and effectiveness of various ICT solutions in addressing labour rights issues within distant water fishing. The dialogue with participants from a blend of advocacy groups and technological innovators provided valuable insights into the challenges and emerging strategies for enhancing labour conditions at sea. The collected data has been crucial in understanding the potential of ICTs to transform monitoring practices and enforce labour rights in the DWF industry.

1. **MAST Human**

- Interviewee Name: Dornnapha Sukkree

- Role: Executive Director

- Major Activities of the Organization: The MAST Human Intelligence App is an innovative smartphone application designed to prevent human trafficking and protect vulnerable workers in the fishing industry

- Date of Interview: August 11, 2023

2. **Verité**

- Interviewee Name: Declan Croucher

- Role: Senior Director, Advisory & Chief Commercial Officer

- Major Activities of the Organization: Verité offers the expertise and resources necessary to eradicate child labour, forced labour, human trafficking, and gender discrimination from supply chains.

- Date of Interview: August 10, 2023

3. **Diginex**

- Interviewee Name: Hannah Thinyane

- Role: DiginexAPPRISE creator

- Major Activities of the Organization: Diginex is an intuitive and exceptional software tool to work with your clients on their environmental, social and governance (ESG) requirements

- Date of Interview: August 16, 2023

4. **OceanMind**

- Interviewee Name: Emma Seal

- Role: Expert Intelligence Analyst

- Major Activities of the Organization: OceanMind provides fisheries information and analysis to authorities to support intelligence-led, risk-based enforcement.

- Date of Interview: 16 August, 2023

5. **FCF Co Ltd**

- Interviewee Name: Hao Mai

- Role: External Consultant

- Major Activities of the Organization: FCF stands as one of the largest global providers of integrated supply chain services for marine products. Boasting 50 years of expertise in the trading and marketing of tuna, FCF leverages its extensive global marketing and logistics network to meet the service requirements of its clients.

- Date of Interview: August 24, 2023

6. **e-Audit**

- Interviewee Name: Hubert de Bonafos

- Role: Managing Director

- Major Activities of the Organization: Development of innovative technologies for sustainable fishing, research on alternative fishing methods, and collabour ation with startups on sustainability projects.

- Date of Interview: 29 August, 2023

7. **Greenpeace**

- Interviewee Name: Do not want to mention

- Role: Former Greenpeace Activist

- Major Activities of the Organization: Support for coastal communities in adopting sustainable fishing practices, facilitation of dialogue between stakeholders, and provision of resources for sustainable livelihoods.

- Date of Interview: August 29, 2023

Appendix B: Interview Sample Questions (MAST Human)

1. How was MAST Human initially developed, who initiated it, and for what purpose?

2. Can you provide statistics on the user base or download rate, and how many reports have been filed? What demographics characterize the users in terms of sectors, geographies, and their positions within production networks?
3. What types of data are most commonly reported through the app?
4. Among the app's features (location tracking, emergency alerts, criminal reporting, worker education, and crowdsourced communication), which are most frequently used? Are certain features more popular than others?
5. Have government inspection or enforcement agencies shown any interest in the system?
6. Who encourages workers to use this application, and how are labour ers informed about its existence and functionality?
7. Is the MAST HUMAN Intelligence app compatible with all types of cell phones, considering many workers may not own brand-name devices? Are there specific system requirements?
8. What measures are in place to validate data before it is uploaded to the platform?
9. Who has access to the data reported through the app, and who is responsible for analyzing it?
10. In the event of an emergency alert, automatic warning, or crime report, who receives the alert and who takes action? Is it only the designated emergency contact?
11. Is it feasible to submit reports electronically while aboard a vessel? If Wi-Fi is unavailable, when can crew members submit their reports?
12. What future enhancements are planned for the MAST Human tool? Are there any reports or evaluations of the system available for review?
13. What do you perceive as the system's limitations, such as coverage gaps, misinformation, or inaccessible areas within supply chain networks?
14. What other key ICT tools are utilized to combat labour abuses in the fisheries sector?

Appendix C: Informed Consent Form

Date:

Study Name: Technologies of Transparency: The Role of Information and Communications Technologies in Promoting Labour Rights in Distant Water Fisheries

Researcher name: Amir-Ali Ebrahimirad, Geography, Master of Arts, York University, Toronto, Canada. Email: amirer38@yorku.ca

Purpose of the Research:

The purpose of this research is to study the role of information and communication technologies (ICT) in promoting labour rights on distant water fishing vessels.

What You Will Be Asked to Do in the Research:

I will be asking you to participate in an individual interview to answer questions related to the role of your organization in the development or use of ICTs in monitoring labour issues in distant water fishing. The time commitment for this interview will be approximately 30 minutes.

Risks and Discomforts:
I do not foresee any risks or discomfort from your participation in the research.

Benefits of the Research and Benefits to You: The results of this research may be helpful to your organization in considering possible uses of ICTs to promote better labour conditions in distant water fishing.

Voluntary Participation and Withdrawal: Your participation in the study is completely voluntary and you may choose to stop participating at any time. Your decision not to volunteer, to stop participating, or to refuse to answer particular questions will not influence the nature of your relationship with York University either now, or in the future. In the event you withdraw from the study, all associated data collected will be immediately destroyed wherever possible.

Confidentiality:

- I will be recording our conversation, or taking notes, according to your preference.
- Data (recordings and transcriptions) will be stored electronically in secure folders and will only be accessible to myself and my supervisor.
- All information you supply during the research will be held in confidence and unless you specifically indicate your consent, your name or other identifying information will not appear in any publication or report of the research.
- The data will be stored until the research is completed and will be deleted by December 30th 2023.

This study will use Zoom or Skype to collect data, which is an externally hosted cloud-based service. When information is transmitted over the internet privacy cannot be guaranteed. There is always a risk your responses may be intercepted by a third party (e.g., government agencies, hackers). Further, while York University researchers will not collect or use IP address or other information which could link your participant to your computer or electronic devices without informing you, there is a small risk with any platform such as this of data that is collected on external servers falling outside the control of the research team. If you are concerned about this, I would be happy to make alternative arrangements (where possible) for you to participate, perhaps via telephone. Please contact me for further information.

Questions About the Research? If you have questions about the research in general or about your role in the study, please feel free to contact me at amirer38@yorku.ca or my supervisor, Dr. Philip Kelly, at pfkelly@yorku.ca and/or +1 416 736 2100 X 66199 You may also contact the Graduate Program in Geography Depa at gradgeog@yorku.ca and/or +1 416 736 5106.

This research has received ethics review and approval by the Human Participants Review Sub-Committee, York University's Ethics Review Board and conforms to the standards of the Canadian Tri-Council Research Ethics guidelines. If you have any questions about this process, or about

your rights as a participant in the study, please contact the Director, Research Ethics in the Office of Research Ethics, 3rd Floor, Kaneff Tower, York University (e-mail ore@yorku.ca).

Legal Rights and Signatures:

I ----------, consent to participate in conducted research, Technologies of Transparency: The Role of Information and Communications Technologies in Promoting Labour Rights in Distant Water Fisheries by Amir-Ali Ebrahimirad I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by signing this form. My signature below indicates my consent.

Signature _____ **Date** _____

Participant

Signature _____ **Date** _____

Principal Investigator

Additional consent (where applicable)

1. **Audio recording**

☐ I consent to the audio-recording of my interview(s).

2. Consent to waive anonymity

I, ----------, consent to the use of my name in the publications arising from this research.

I, ----------, consent to my de-identified data being placed into a research data repository with restricted access.

Signature _____ **Date** _____

Participant Name: