

# **Tuning in on the Global Tuna Value Chain. A Political Ecology Perspective on Food Loss and Waste**



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Front page, Image of Canned Tuna Box from Ghana

## **Preface**

What a time to be writing a master's thesis on food. To appreciate the urgent need for a food system transformation is quite simple, when looking at the status of food distribution, production and utilisation today. However, the transformation process is a process so intricate and complex that even Isaac Newton would be overwhelmed. We could have hoped that he would have spent more of his great brain capacity on thinking about what should happen to the apple after it fell on his head, and not only about why the apple fell in the first place. But then there is more for me to research. The ubiquitous and all-encompassing nature of food is exactly what makes it so interesting to dive into.

The tuna box on the front page of my master thesis was kindly gifted to me by Ragnhild Overå. I am immensely grateful for having her as my supervisor this year. Thank you for being patient and kindly guiding me through the very chaos of this process, pandemic and year. The tuna box she provided to me was the closest I got to the Ghanaian tuna value chain.

Thanks to my family for coping with me on home-office for months and months. And for being ever so supporting throughout this process. Thanks to the great Ghana gang for keeping my spirits up even when we could not go on a field trip. Thanks to all the great people I met in Bergen – I am truly grateful that this master experience resulted in so many great friendships. And lastly thanks to Henrik. You make anything possible.

Lise Saga, 29.07.2021

## **Abstract**

This master thesis explores the food loss and waste of tuna resources in the global tuna value chains. The aim is to understand how the global system of governance affects the access to and utilisation of tuna resources and by-products. By exploring the processing stage of the industrial value chains of tuna, the food loss and waste in this section is scrutinised. A desk-based approach was necessitated by the covid-19 pandemic, and secondary sources were employed to acquire quantitative and qualitative data. The methodological approach was based on case studies for the global tuna value chain with document analysis and systematic literature reviews. An illustrative case study of the tuna processing industry was used to contextualise the global relations of the tuna value chain in a Global South context.

The major findings show that the tuna by-products are to a great degree utilised for fish feed. The Western trade regime governs the global value chains of tuna through standards and regulations on products exported to the EU and US, which restricts the use of by-products for human consumption. The globalised nature of the value chain limits the access to and utilisation of tuna resources for food insecure populations. An international network of actors control the tuna resources through different power mechanisms. The discourses that shape and are being shaped by the global tuna value chains are based on Western narratives, which do not apply well to Global South contexts.



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## List of Abbreviations

DWF	Distant Water Fleet
DWFN	Distant Water Fleet Nation
EEZ	Exclusive Economic Zone
FAD	Fish Aggregating Devices
FAO	Food and Agriculture Organisation of the United Nations
FLW	Food Loss and Waste
HACCP	Hazard Analysis Critical Control Point
IUU	Illegal Unreported and Unregulated
MNC	Multinational Corporations
MSC	Marine Stewardship Council
MSY	Maximum Sustainable Yield
PNA	Parties of the Nauru Agreement
FFA	Fisheries Forum Agency
RFMO	Regional Fisheries Management Organisations
SIDS	Small Island Developing States
WCPO	Western and Central Pacific Ocean
WIO	Western Indian Ocean

# 1.0 INTRODUCTION

The global tuna industry is one of the largest marine value chains globally, with highly globalised fisheries, processing, trade and consumption. The volume of tuna catches from this industry has risen more than ten-fold since the 1950s. Tuna catches were approximately 500 000 tonnes in 2018 (FAO, 2021). The industry processes tuna products in cans and in fresh and frozen state. All of these products are based on the tuna loins, which amount to about 30-50% of the tuna fish (Herpandi et al., 2011). The rest of the fish is considered by-products and is in most cases used for fish feed (Gamarro et al., 2013).

The numerous and entangled sustainability issues of the global tuna industry might imply that we should not eat tuna at all. Tuna fish are at the top of the trophic pyramid. Many of the tuna species are endangered, and the industry has vast consequences for other marine species, marine plastic pollution and other types of environmental pollution. Tuna fishery fleets are large-scale industrial trawlers with huge ecological impacts on marine species caught as by-catch. Additionally, 43% of tuna stocks are fished at unsustainable levels (FAO, 2020).

However, if we are to continue to eat tuna, we should utilise the resources that the tuna fish provide as efficiently as possible, both in an environmental, social and economic sense. The tuna by-products that do not go to human consumption today are energy and nutrient dense. They could provide food-insecure populations with dietary additives that could alleviate malnourishment (Hicks et al., 2019).

The question is then how we utilise these by-products. The question of food security and its determinants in availability, accessibility and utilisation is conducive to challenges in the food system (Ericksen, 2008). The commodification of food incentivises productivity and revenue growth as food is juxtaposed with any other commodity in the financialised system (Zerbe, 2018). The social and environmental value of food is, however, neglected in this system. Food as a resource is wasted at reprehensible levels and is not distributed as the vital necessity of life that it is. All people need food, but the contemporary food system is not providing food to all people.

Access and utilisation of the tuna resources could benefit populations of low-income countries and also provide nutrition and energy to people experiencing food insecurity. Nevertheless,

tuna as a commodity is controlled by a globalised system of large-scale actors, which does not benefit these populations. The ability to derive benefits from the tuna resource is in many cases restricted due to the monetary value of the resource. By giving more power to the small-scale fisheries and local processors, to increase food sovereignty, tuna resources could benefit the populations of those with the *rights* to the fish.

The foundation for this research is the exploration of food loss and waste (FLW) generation within the global tuna value chain. FLW is one of the great challenges to the global food system. FAO estimates that about one third of all food goes to waste (Gustavsson et al., 2011). FLW is a great challenge both socially, environmentally, and ethically (Stuart, 2009). The environmental and ecosystem pressure of FLW is acute (Stuart, 2009). Stuart (2009) emphasises that the link between the food decadence in rich countries and food poverty among the food insecure is not simple nor direct but does however exist. According to the recently published report on the state of the world's food security and nutrition, there were 811 million people experiencing hunger in 2020, which was an increase of 161 million people from the year before (SOFI, 2021). With hunger on the rise, allowing such vast amounts of food to go to waste is a moral issue.

FAO define FLW as “*the masses of food lost or wasted in the part of food chains leading to edible products going to human consumption*” (Gustavsson et al., 2011, p.). Some definitions differentiate between food loss and food waste, but there are a wide variety of understandings, which makes the measuring and conceptualisation of FLW highly uncertain (Chauhan et al., 2021). The decision was therefore made, to use *food loss and waste* as one concept, corresponding to much of the literature used in this research on FLW issues.

Food systems encompass interactions between the environment and human society, activities from field to table and the outcomes of these activities for food security, environment and welfare, including other determinants for food security (Ericksen, 2008). These other determinants do not necessarily involve the activities in a value chain. From a food system perspective, food security is based on three parameters: availability, access and utilisation (Ericksen, 2008). The definition of food security has evolved over time, and the most updated definition was developed at the World Food Summit in 2009:

*“Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. (CFS, 2012)*

Food insecurity was in the 20<sup>th</sup> century believed to be a problem of availability of food (Lang and Barling, 2012). However, the understanding of food insecurity today is based more on social dimensions of access and utilisation. Access as affordability, and allocation are important market determinants, which control where and by whom food can be accessed. The utilisation of food is also determinant for the beneficiaries of the nutritional and social value of food. Questions of access and utilisation are important in the link with FLW challenges, to understand why and how food is lost and wasted, even in locations where these resources would be vital for food insecure populations.

The tuna industry is an industry with a low utilisation of resources for human food consumption. The value chains are largely industrialised. To understand how the industry developed to its current state, one must look at the historical relations and the paradigms of technology, governance and discourses which have shaped the industry (Taylor, 2016). Bolwig et al. (2010) define the flows of material resources, knowledge, finance, and information as the main determinants for the activities in a value chain. The material resources in the tuna value chain are obviously defined by the tuna itself, but also the technologies used in the production which therefore become relevant in a spatio-temporal and historical context. The flow of knowledge and capital is recognised as an imperative part of the global system of governance which controls the value chain. The flow of information is closely linked to the discourses of the value chain. The history of the global tuna value chain is recognised as a process of globalisation and internationalisation of all the stages from production through to consumption (Adolf, 2019).

## **1.1 History of the global tuna value chain**

The tuna industry is a value chain that has followed and shaped many of the global ocean governance discourses throughout history. One can see truly how well the discourse of economic growth has been embraced in a value chain which has expanded steadily and rapidly since the 1950s, with a clear goal of efficiency and productivity at its core.

Tuna have been caught and traded for centuries. There are records of trade tracing back to 1525 from the tuna dynasty of the Medina Sidonia family in Spain (Adolf, 2019). Martín Sarmiento, a biologist and monk from a monastery in Madrid, warned about the decline in tuna stocks due to human fishing activities already in 1757 – and thus began what would become a quest for sustainability in the tuna value chain (Adolf, 2019). Traditional tuna fisheries exist worldwide and have been essential for food provision in many coastal nations (Parris, 2010; Zelasney et al., 2020).

The industrialisation of the tuna fisheries began in Spain in the 1860s when albacore tuna was introduced as a substitute when sardines were running low in the canning industry (Miyake et al., 2010). The US followed Europe in canning albacore in 1906. To begin with, they canned tuna in vegetable oil, but tuna in brine was introduced in 1936 (Miyake et al., 2010).

The US, Spain and Japan developed to become the most significant tuna industrial countries in the pre-WWII era. They had large fisheries providing fish to their local markets, with substantial demand for tuna. The US established a great tuna canning industry, whilst the tuna in Japan went to sushi and sashimi consumption (Adolf, 2019). Spain had a large production of cured and dried tuna products which were based on regional preservation knowledge which were deeply embedded in Spanish food culture (Esteves and Aníbal, 2019). The development of these three national industries would shape the patterns of the new global tuna industry.

### **1.1.1 Shifting technological tides**

The Second World War (WWII) marked a distinct change in the tuna industrial era. Before WWII, an increasing number of countries were establishing tuna fisheries. In this period, the development pattern was often characterised by the introduction of tuna fisheries in domestic waters, which led to the development of onshore tuna industries, through the use of refrigerator technology and canneries (Parris, 2010; Chen, 2014). Taiwan is an example of this, where migrating Japanese fishermen came to Taiwan and introduced longline fishing techniques so that the Taiwanese fishermen began to catch tuna in 1912 (Chen, 2014). After only six years of providing tuna for the local market, the Taiwanese fisheries began a tuna trade with Japan. As a result, the Japanese invested in port facilities in Taiwan, and the onshore tuna industry was initiated in the country.

A significant expansion of the tuna industry did not take off until the 1950s when bait boat fleets were developed and expanded into new territories. Earlier, simple boats with sails and canoes had been used for tuna fishing, but now motorised boats with larger capacity were developed. The tuna catches increased along with technological development. The bait boats were labour intensive and used pole and line with baits to attract tuna (Adolf, 2019). Sardines and anchovies were used as live bait, and the tuna industry relied heavily on the availability of small fish to the point where stocks in, for example, Ghana collapsed temporarily in the 1970s (Nunoo et al., 2014).

Tuna was for a long time caught with bait boats, pole and line and long-liners. These fishing techniques are labour intensive. In the 1960s, purse seiners were introduced to the industry, enabling a great increase in catches in enormous nets, which trapped whole schools of tuna that could be hauled onto the deck (Robbins et al., 2014). A consequence of catching whole schools of tuna is that juvenile fish is caught along which decreases the reproductive ability of the tuna species (Barclay, 2014). The purse seine boats required less labour and were more efficient, making pole and line and bait-boat fleets less commercially viable (O'Neill et al., 2018; Robbins et al., 2014). In the 1960s and 70s, the development of purse seiners in tuna fisheries increased catches drastically.

The 1970s' cold chain technology was essential for developing the value chain of fresh and frozen tuna. With further developments of a super-cold freezer chain, which could keep the tuna at  $-70^{\circ}\text{C}$  on board the fishing vessels, tuna could now be kept almost indefinitely, travelling around the world to faraway ports (Adolf, 2019). The ability to freeze tuna to lower than  $-60^{\circ}\text{C}$  was important for increasing the quality of the fish meat. Upgrading of the cold chain storage at sea transformed the industrial tuna fisheries and the geographical distribution of landing points because the tuna vessels could now spend a much longer time at sea and move the tuna catches to ports for lower-cost processing (Miyake et al., 2010).

In the 1990s, the use of Fish Aggregating Devices (FADs) began in the tuna industry. FADs are based on a simple principle: fish tend to gather underneath floating objects in the ocean. Tuna tend to swarm and search for smaller fish to prey on (Adolf, 2019). When fishers understood this, they began using bamboo logs and platforms to attract fish. As the fisheries have become more industrialised, the FADs are being made in plastic and are issued with technological devices such as GPS trackers and sensors for detecting fish species. The use of

FADs has changed the nature of tuna fisheries in such a tangible way that one can say that they have gone from catching fish to harvesting fish in a farm-like manner (Adolf, 2019). FADs make the process easier and more predictable. Some would go so far as to say that it becomes too easy and that the FADs are manipulating the ecological system.

The increased use of FADs was detrimental for several tuna species and schools. In the 1990s, the use of FADs increased the efficiency of tuna fisheries that had already experienced a stark increase after the purse seine development (Miyake et al., 2010). The use of FADs gives a higher catch-rate of juvenile fish and by-catch than free-school fishing without FADs (Priddle et al., 2020). The problem with FADs is not limited to their incredible ability to attract fish, but also that they have become so widespread in fisheries around the world. According to Phillips et al. (2015), about 30.000-65.000 FADs were circulating in the waters of Western Central Pacific Ocean (WCPO). As they are now made in plastic, they are also adding to the global marine plastic pollution problems. The FADs have received attention from environmental activists and organisations and have become a symbol of unsustainable tuna fisheries practices. The Marine Stewardship Council (MSC) has strict policies on the use of FADs for certified fisheries (Priddle et al., 2020).

### **1.1.2 Shifting organisational tides**

The three big processors in the US were already established brands after the war. StarKist, Bumblebee and Chicken of the Sea had been vertically integrated companies in the US, operating the entire value chain from tuna vessels, landings, processing and to the branding (Adolf, 2019). The international expansion of these processors came from the need to access more productive fish stocks and the search for cheaper labour. As a result, the US invested in tuna processing facilities in Thailand, the Philippines, Indonesia, Papua New Guinea, and Ecuador (Miyake et al., 2011).

In the post-WWII era, the development trajectory for tuna fisheries and industries gradually changed. A shift from tuna fisheries that initiated industry development to large tuna canneries that would outsource the processing and expand production into foreign waters (Havice and Campling, 2017) was in line with an outsourcing trend in the general economy (Dicken, 2015). From the 1970s and onwards, outsourcing developed from the fisheries into the processing. Fisheries had been established in all the world's oceans, but now the branded canneries began to outsource processing to new geographical locations (Havice and

Campling, 2017). A dichotomy between branded and non-branded canneries emerged and would affect the tuna value chain for decades to come. This dichotomy will be addressed and explored later. As already stated, rapid technological developments in the following decades would have a significant impact on the size of catches.

From the 1970s onwards, the development of a *Law of the Sea (UNCLOS)* was initiated, which would define the rights to the marine resources in a clear sense by creating marine borders for coastal states. They could now claim the rights to the areas which were 200 nautical miles from their coastline. The establishment of Exclusive Economic Zones (EEZs) was important for the economic independence and development of many coastal states in the Global South. The EEZs were formalised in 1982 under the *Law of the Sea Convention*. The coastal states were given responsibilities and rights to the resources in their coastal territories (Parris, 2010). Parris (2010) points to how the establishment of EEZs led to an increased frustration over Distant Water Fleets (DWFs) and ‘resource nationalism’ in many coastal states.

The management and conservation of tuna stocks are founded on rights-based management principles (Allen, 2010). When the EEZs first were established, they gave coastal countries legal justification to control their marine jurisdiction. Fishery licenses could be controlled by the countries themselves, and the financial potential of the licenses was the first step to full utilisation of marine resources (McCluney et al., 2019).

In the 1980s, the American tuna industry was essentially restructured, and the vertical integration which had been characteristic of the tuna industry in the country was dwindling. The tuna processing facilities in the US were less and less commercially viable, and the processing was reduced to canning of imported loins, which were already processed elsewhere. The same tendencies were seen in Europe. The processing facilities elsewhere were either developed through private partnerships with the companies that were still dominant in the Western tuna industry or by public state investments into the industry (Parris, 2010). The importance of processing for gaining revenue from the tuna resources came into the consciousness of tuna fishing countries, slowly and steadily as tuna fisheries were developed.



The 1980s also brought with it a public awakening in the US to the consequences of tuna fishing techniques and methods which were targeting dolphin flocks to reach the trailing tuna stocks underneath (Robbins et al., 2014). The awareness of dolphin killings in the tuna fisheries had already been in the media in 1967, but a movie made by Sam LaBudde in 1988 created an uprising. In the 1990s the success of the movement resulted in the three largest tuna canning brands in the US; StarKist, Bumble Bee and Chicken of the Sea, deciding to only buy and market ‘dolphin-safe’ tuna. An era of environmental certification was initiated in the tuna industry. The consequences of the social movement was that the fishing grounds for american canned tuna was moved from the Eastern Pacific Ocean to the Western and Central Pacific Ocean, with detrimental effects for the tuna stocks there.

## **1.3 The waves of discourses in the tuna value chain**

Both the technological and organisational developments of the global tuna industry and value chains have shaped and been shaped by the hegemonic discourses of the different historical periods. Svarstad et al. (2018) define discourse as “a socially shared perspective on a topic” (p. 356). Narratives are stories that are told, to justify and support a certain discourse (Roe, 1991). A theoretical review of the concept of discourses will be given in the next chapter. The hegemonic discourses, which are the discourses that have steering power, have different ways of integrating food security into the food systems.

### **1.3.1 Discourses of marine governance**

Historical waves of global economic and environmental discourses have shaped the tuna industry. The industrialisation of the global tuna value chains was based on a Western push, which originated from a discourse of modernisation. From the 1950s to the 1970s the development in African fisheries was focused on technological development and industrialisation motivated by economic growth (Overå, 2011). Modernisation theories were based on the need for a strong state at the forefront of economic development (Adger et al., 2001). The narrative of the strong state is a sustained view in the governance of tuna value chains today. The narrative suggests a need for institutional transformation to enable economic growth in less developed countries (Bailey et al., 2016; Zelasney et al., 2020). The modernisation discourse was connected to food security issues, through the narrative that

increased productivity would increase the availability of food and therefore decrease food insecurity (Lang and Barling, 2012).

From the 1980s onwards, a neoliberal discourse replaced the modernisation narrative with a focus on export-oriented industrialisation (Havice and Campling, 2017). The neoliberal discourse emphasised the role of free markets and as little involvement of the state as possible (Springer, 2010). The firm-level was promoted, through processes of outsourcing and upgrading to maximise profit from extraction of resources by expanding and moving outwards. For the tuna industry, the neoliberal discourse was both absorbed and resisted. Because of the establishment of the EEZ, countries that had been deprived of their access to the tuna resources in their own waters, were given the right to exploit these resources, which created a discourse of tuna nationalism and sovereignty (Parris, 2010). However, this discourse was not strong enough to restrict the drive of outwards expansion of Western and Japanese fleets and tuna processing- and trading firms (Havice and Campling, 2010).

The neoliberal discourse of growth and expansion was challenged by sustainability issues and overexploitation of tuna stocks. Building on sustainable development and green growth discourses, the Rio +20 Conference in 2012 established the concept of blue economy and blue growth (Silver et al., 2015). The blue economy discourse resembles the neoliberal discourse, with the continued narrative of growth as the aim of development, but with a renewed focus on sustainability and environment. The reliance of the blue economy discourse on narratives of growth and conservation of the environment can be seen as contradictory (Andriamahefazafy et al., 2020). The neoliberal and blue economy discourses have forwarded a novel understanding of food security, which emphasises the narrative of *security* (Childs and Hicks, 2019). Narratives of security and securitisation have been established, justified by a perceived need for measures against a potential threat of conflicts created by environmental degradation (Peluso and Watts, 2001). Securitisation of food promotes concepts of protection of the consumers, through notions of food safety (Freidberg, 2007) and the producers, with a focus on rights to tuna resources (Parris, 2010).

With the establishment of global frameworks such as the Sustainable Development Goals in 2015, a discourse on the potential role of fish for food and nutrition has developed in the global policy and development community (Bennett et al., 2021). This discourse underlines the importance of utilising resources for the purpose of nutrients. This links closely with the

political ecological narratives of FLW that have been brought forward recently. Gascón (2018) emphasises the need to consider the nutrients and energy that is lost when food is wasted, challenging the sole focus of the monetary value of food. The fish as food discourse promotes a focus on health and the issue of malnutrition rather than conservation and economic growth, bringing in social dimensions to ocean governance and the politics of food security (Cohen et al., 2019). With an emphasis on the role of fish as food, fish can be linked to issues of nutrition and social equity within the industry (Bennett et al., 2020).

Conservation and economic growth are discourses which have dominated ocean- and marine governance. Andriamahefazafy et al. (2020) refer to the blue economy discourse as a paradox based on its promotion of both sustainable use of resources and economic growth. The contradictions in these two discourses do often reside in international governance. The discourse of environmental sustainability has been present in the tuna industry for as long as tuna has been traded, so the link between fisheries productivity and conservation is tightly intertwined. The novel focus on nutrition in fisheries governance has been instrumental in lifting the importance of fish as food.

### 1.3 Research Questions

The main research question of this project aims to explore the governance of the global tuna value chain and how the tuna resource is treated as a food product. Contributing to increased food security, through a focus on FLW is the foundation for the analysis. The utilisation of the tuna resources and generation of FLW in the processing node of the value chain is mapped and linked to the activities, organisation and governance mechanisms of the different stages and scales of the global tuna value chain. My research question is therefore the following;

**How can governance of the global tuna value chains contribute to food security through a greater focus on reduction of food loss and waste?**

To address the main research question, these sub-questions have been formulated:

1. *How do the actors in the tuna value chain negotiate access to and utilisation of the tuna resources?*
2. *How, by whom, and where are tuna by-products utilised?*

3. *How does the global system of governance of the tuna value chain affect access to tuna as a food resource in tuna-producing countries in the Global South?*

The research questions will be explored with a theoretical framework which combines the Global Value Chain literature with political ecology and political ecological concepts of discourses and power. To understand the network in which the tuna industry is embedded and that has evolved along with the tuna value chain, an overall understanding of the historical developments within the industry is needed.

## **2.0 THEORY**

The main research question explores how the global value chain of tuna is governed with regards to reduction of FLW as a food security measure. Food security is a product of the availability, accessibility and utilisation of food resources in the food system (Ericksen, 2008). The focus of this research is the access to and utilisation of tuna resources, as a product of the global system of governance and its discourses and power relations shaping the globalised tuna value chain. The theoretical framework for the exploration of the research questions is based on global value chain (GVC) analysis through a political ecology lense.

The discourse perspective is useful to situate the governance of the value chain in a context. The first section of this theory review will therefore focus on theories of discourse and how discourse perspectives are applied in research. The value chain framework is central to this research, and its theoretical background, history and relevant frameworks are therefore explored in the second section. The third section looks at the application of political ecology perspectives to case studies on FLW issues and resource utilisation.

### **2.1 Steering discourses**

The discourses in the global tuna industry were introduced in section 1. Certain discourses have hegemonic status, and can shape the way the global system of governance is steered, through a socially shared perspective on a topic (Svarstad et al., 2018). Svarstad et al. (2018) use the definition of discourses to describe discursive power as a process where an actor creates a discourse which is replicated by other actors. When some discourses are hegemonic, other discourses are excluded. The objective for exploring the hegemonic discourses in the tuna value chain is to recognise how they integrate the topic of FLW.

Discourses of the environment are made up of narratives, concepts, ideologies and signifying practices (Barnes and Duncan, 1992). The concepts that are central to discourses are single ideas, often represented as words or phrases. The narratives are communicated through the

use of signifying practices. Robbins et al. (2014) describe them as modes and methods of representation.

Narratives are defined by Roe (1991) as storylines that attempt to describe specific happenings as a part of a broader discourse. The understanding of narratives is based on the notion that people are storytellers, and that stories are told with certain elements included. These elements include a protagonist, antagonist, conflict, character development and resolutions (Cope and Kurtz, 2016). The narratives can therefore be said to be foundational for the contextual knowledge that a discourse is built on.

Ideologies as a central part of a discourse, which Barnes and Duncan (1992) point to, are based on ontologies which shape the way one depicts truth. Robbins et al. (2014) define ideologies as worldviews of how the world is and how it should be. Goodman (2001) stresses the link between political ideology and ontology, in agro-food research. The lack of inclusion of nature in research on agro-food systems is due to an ontological understanding of nature as being an integrated part of labour processes, grounded in the ontology of nature as capital (Silver et al., 2015). When the ontological formation of an ideology is based on the assumption that nature is relevant only when part of a labour process, it has consequences for the discourse and ultimately to how nature is utilised and managed.

When a discourse is replicated or reproduced by a large number of actors, it can be said to be hegemonic, meaning that the knowledge that the discourse is based on, is practically seen as the truth (Dittmer, 2010). Gramsci (1992, in Dittmer, 2010) was the first to use the concept of hegemony, in his accounts of the capitalist class having power of definition over the cultural realm. Peet (2002) made the connection between hegemony and discourse, in describing global hegemonic discourses. The integral role of economy in global hegemonic discourses was central to the formation of the concept of hegemony, and continues to be central in hegemonic discourses, as seen in the tuna industry with the discourses of neoliberalism and blue economy. Foucault (1981) emphasises how the relationship between power and knowledge is constitutive of society and space, through the power of discourses. The discourses leverage into actions and practices (Couper, 2015). This shows the significance which is put into the language used about an activity in for example a value chain. In section 1 the discourse perspectives that were hegemonic in the tuna value chain were historically

contextualised, to show how hegemonic discourses are interchangeable; shifting over time and sometimes in parallel.

Ponte et al. (2019) explore different modes of governance and discursive power in analysis of GVCs. Coordination within a value chain happens by normalising standards, expectations, and norms (Ponte et al., 2019). This can be seen as a form of discursive power because the ability to normalise will require a certain control over the activities in the value chain. Ponte et al. (2019) points to how discursive governance dynamics can be analysed to understand (1) what impact the normalised standards, expectations and norms have on the products, business practices and technologies, and (2) how these standards, expectations and norms travel along the value chain. The standards and regulations in the global tuna value chain can therefore be analysed with regards to their effect on the processing procedures and generation of FLW and how they affect producers all along the globalised tuna value chains.

Discourse analysis is used by political ecologists to explore the relationship between local and global phenomena (Adger et al., 2001). The narratives of global discourses can be problematic to apply to local contexts, if they are not based on local narratives. The narrative of global environmental management is based on the thought that resources are best managed on a global scale, often with highly managerial and technocratic practices (Adger et al., 2001). Ponté et al. (2019) emphasise the role that development theories have played in the progression of theoretical value chain approaches. The narratives of modernisation, neoliberalism and blue economy are all based on the belief in large-scale structures such as nation-states and free markets managing the resources. For political ecological research frameworks, local knowledge is vital to broaden and challenge global discourses.

The second narrative that Adger et al. (2001) discuss is what they have named the populist discourse, which is often portrayed by non-governmental organisations (NGOs). This narrative sees local actors as victims of international transgression. Bené et al. (2010) present a similar narrative in the fish trade discourse, where fish trade and exports are portrayed as negative for food security, the local populations and the GDP of the country. The opposing narrative is based on the ideology that fish trade has a pro-poor effect, improving the livelihoods for people involved in production and processing for a globalised value chain. These competing narratives exist within the fish trade discourse.

The discourse perspective is used as a backdrop to understand the relations within the global tuna value chains. The discourses and narratives are used to contextualise the actors in the value chain. Svarstad et al. (2018) identify the epistemological practices of political ecology to analyse discourses through a critical realist framework. The discourses are compiled with empirical data to evaluate the claims of the discourse. Placing the actors of a value chain in a context is central to understanding their inter-relations.

## **2.2 Global Value Chain Analysis and Global Production**

### **Networks**

Global value chain (GVC) analysis is used in this research to map the global value chains of tuna. Bolwig et al. (2010) have developed a useful framework for placing activities and actors of the value chain in a type of matrix of a networked chain. Ponte et al. (2019) has pushed this theoretical framework further by bringing in notions of power. These two theoretical approaches are central to the mapping of the tuna value chain for this research. The development of the GVC analysis is reviewed to understand the contemporary position of this theoretical approach.

The history of the tuna industry depicts a development towards a truly globalised value chain. Globalisation has been constitutive of and shaped by the neoliberal discourse and ideology (Springer, 2010). The need to move production elsewhere has been triggered by the depletion of local resources, and the internationalisation of production created a globalised economy (Dicken, 2015). The same was seen in the tuna industry, where depletion of tuna stocks in certain areas led to an outwards expansion of tuna fleets to undiscovered waters (Chen, 2014; Mullon et al., 2016; Havice and Campling, 2017). This internationalisation of tuna fisheries created a global distribution of production. Economic globalisation and international trade have since the 1990s been analysed with the use of GVC analysis (Bolwig et al., 2010).

Today, there is a multitude of understanding of the system which a product, such as canned or fresh tuna, goes through from producer to consumer. Ponte et al. (2019) define global value chains as the *“full range of activities that firms, farmers and workers carry out to bring a product or service from its conception to its end use, recycling or reuse”* (p.1). For the tuna value chain in the marine sector, the fisheries and the fishers become the starting point for the value chain. Bolwig et al. (2010) describe the different activities of the value chain as ‘nodes’



(see figure 1). As the first activity in the value chain, the fisheries constitute the production node. In their framework, Bolwig et al. (2010) have named the second node the primary processing/trading node. This node will be the focus of the research. The full range of nodes involve a great array of actors and long distances in which the tuna is transported. By exploring the chain which a product goes through, one can look at the actors involved on the one hand, and the materials involved on the other hand.

The conceptualisation of chains, from production through to consumption, began as descriptions of economic activities configured in linear processes. The linear notion of chains is criticized for being overly simplistic and lacking consideration for complexities of production and agents involved (Henderson et al, 2002). However, this linear mapping of the value chain can create a useful foundation for understanding the wider implications of the network that surround and constitute the chains of production.

Shifts in understanding of production chains in the literature of economic geography not only reflect academic debates but have also mirrored the overall developments in the global economy. The global economy has gone from being linear and geographically concentrated, to becoming increasingly internationalised and interlinked through production of complex products, with more geographically dispersed production processes, liberal market strategies and increased communications (Fagan, 1997; Gibbon and Ponte, 2005). Harvey (1989) described these processes of globalisation as space-time compressions since increased efficiency in these realms has transformed the interactions in the global economy. The value chain research and literature has evolved along with developments in the configuration of the global economy and have come to include concepts such as governance and power relations.

An important aspect of GVC analysis is therefore to explore the realms of globalisation. Research on GVC has shown patterns of spatially dispersed production and distribution networks which are centrally coordinated (Ponte et al., 2019). Wallerstein (1979) was the first to use the concept of commodity chains to describe negative consequences of globalisation through the role of lead firms creating power asymmetries in the global economy. This point of analysis is still highly relevant for a value chain such as the tuna industry, where lead firms continue to play an increasingly significant role in the governance.

In the 1990s the value chain literature shifted towards an appreciation for participation in value chains, and how this could reduce global inequalities (Gibbon and Ponte, 2005; Werner,

2016). By increasing revenues for participants in the value chains through value-added activities and upgrading strategies, value chains could benefit developing countries. This has been important in the tuna value chain, where countries which have been introduced to the tuna industry through outsourcing, have taken ownership of the resource extraction, and have made strategies for economic development, based on the tuna resources. Tuna-led development has become an economic strategy, where developing countries aim to use the tuna resources to benefit populations that are experiencing poverty and lack of prosperity (Parris, 2010; Andriamahefazafy et al., 2020).

In the last decades, the value chain literature has shifted from a structural to a relational ontology (Boggs and Rantisi, 2003). The ‘relational turn’ in economic geography and political economy increased inclusion of actors into the value chain analysis, with a novel focus on the individual as having agency (Dicken et al., 2001). By employing the concept of networks, the relational approach gave room for challenging relationships within the global economy. The nation state was abandoned as the main character in the global economy, and the new focal point became the networks and the flows (Sonnenfeld and Mol, 2002).

Dicken (2015) defines global production networks (GPN) as “*extremely complex organizational and geographical networks of production, distribution and consumption*” (p.429). The core of a GPN is that processes of production happen in a circuit of interconnected functions, operations, and transactions in the production chain (Dicken, 2015). The concept of networks is useful to grasp the complexity of the value chains and reflect the messiness of relations between actors.

Werner (2016) emphasises the role of GPN research in embracing uneven development as a central topic for understanding inclusion in a network. She describes the potential of GPN research to explore the downsides of becoming integrated into a network, whilst also exploring the processes of uneven development that expanding networks create for populations and places excluded from them. The GPN literature has transformed the focus within GVC analysis.

However, the GVC analysis perspective is still widely used today, and is therefore the chosen framework to ensure that this research can connect to different aspects of the political economy literature. The GVC literature provides a broad base for understanding the political, social and economic context of a chain of production. The historical developments of the

GVC literature provides a useful framework for an analysis of the historical context of a value chain, because of the parallel developments in the literature and the economy.

The understanding of the network as central to value chain analysis is clearly integrated in the GVC literature. Bolwig et al. (2010) and Havice and Campling (2017) use vertical and horizontal linkages to describe the complexity of actor relations in the value chain. The linear value chain, which was the baseline for the political economy of commodities, is integrated into their framework as the vertical linkages between the different nodes in the value chain.

Bolwig et al. (2010) has used the increased focus on agency to establish a framework to explore processes of inclusion and exclusion in the value chains. They use the notion of flows in the chain to analyse the upstream and downstream activities to understand the local context and its position in the political economy. This is done by combining understandings of vertical and horizontal aspects of the value chain (figure 1) (Bolwig et al.,2010). The vertical aspects can be understood as the linkages between the activities from production to consumption. The horizontal elements are the impacts on participation in the value chain. Specific activities within the value chain are defined as nodes and can be analysed in certain segments of a value chain or in larger parts of the value chain, which they refer to as strands.

Havice and Campling (2017) used a similar analogy of horizontal and vertical value chain linkages in the tuna industry. They describe the horizontal linkages as environmental regulations and the vertical linkages as chain governance to analyse the consequences of environmental upgrading in the tuna industry.

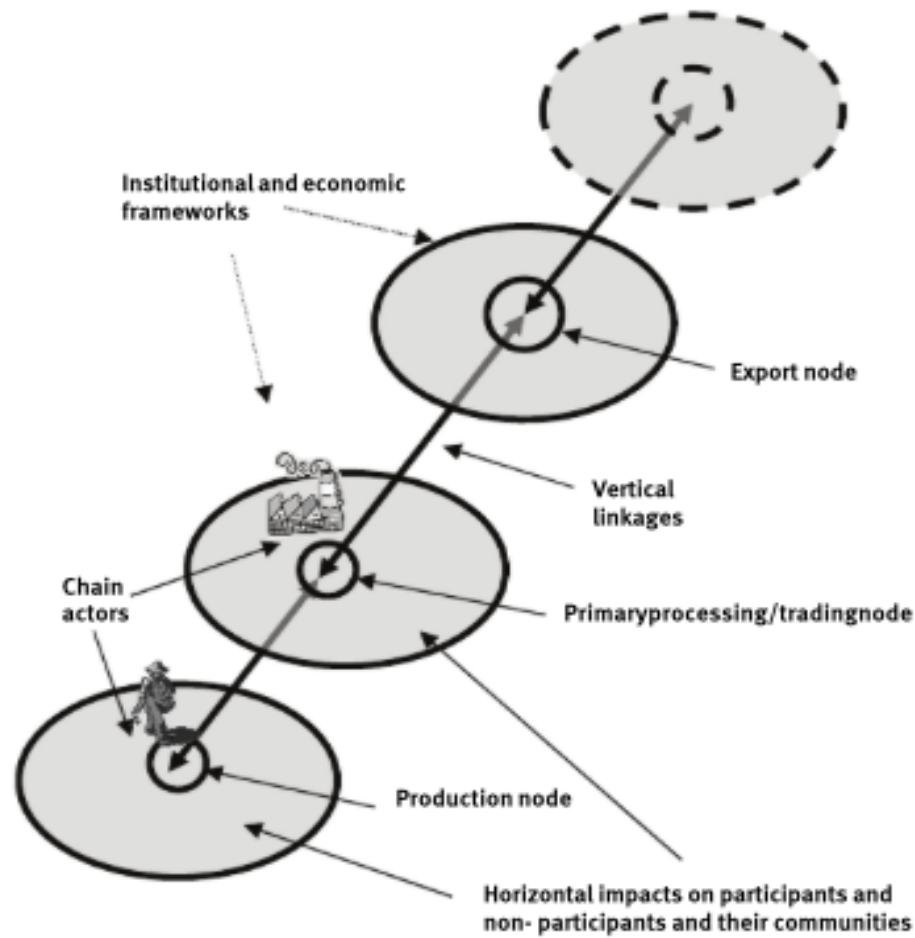


Figure 1. Value chain highlighting horizontal and vertical elements. (Source: Bolwig et al., 2010).

Bolwig et al. (2010) use the concept of flows of material resources, knowledge, finance and information to describe the activities along the value chains. To describe the flows that move towards consumption, they use the term downstream, whilst flows towards production are upstream. The notions of upstream and downstream activities are typically used in the GVC literature. Fredrick (2019) points to how the value chain stage of analysis will define upstream and downstream activities. Since the processing is the point of analysis for this research, the downstream activities are trade, retailing and consumption. The upstream activities are the tuna fisheries.

The relational turn has also imposed an inclusion of concepts of governance and power into GVC analysis. Ponte et al. (2019) explore the modes of power that are present in GVCs. They recognise two dimensions of power; the transmission mechanisms and the arena of actors. The transmission mechanisms of power are recognised as the direct or diffuse exertion of influence over other actors. The arena of actors are the groups and people involved in the

indirect or direct governance of the GVC. They define two sets of arenas of actors; dyads and collectives. The dyadic linkages are the links between firms in the GVCs, while the collectives are a multitude of actors working simultaneously towards the same goal. Ponte et al. (2019) use these dimensions as a matrix to explore four types of power; the bargaining power, the demonstrative power, the institutional power and the constitutive power (table 1). One can see Ponte et al’s (2019) inclusion of power into GVC analysis as a theoretical development of the developmental approach of Bolwig et al’s (2010) framework which includes concepts of governance and social justice.

Table 1. Typology of power in global value chain (GVCs) (Adapted from: Ponte et al., 2019, p.128).

Transmission Mechanisms			
		Direct	Diffuse
Arena of Actors	Dyadic	<b>Bargaining Power</b> <ul style="list-style-type: none"> <li>• firm to firm relation</li> <li>• powerful firms interacting with government agencies</li> </ul>	<b>Demonstrative Power</b> <ul style="list-style-type: none"> <li>• informal ‘transmission’ mechanisms between buyers and suppliers</li> <li>• shaped by quality conventions accepted by parties to a dyadic transaction</li> </ul>
	Collective	<b>Institutional Power</b> <ul style="list-style-type: none"> <li>• government regulation, multi-stakeholder initiatives</li> <li>• can be leveraged through industrial standards and codified - ‘best practice’</li> <li>• ‘agenda setting’, removing issues from bargaining table</li> </ul>	<b>Constitutive Power</b> <ul style="list-style-type: none"> <li>• Broadly accepted norms, expectations and best practices</li> <li>• can arise through decentralized collaboration</li> </ul>

Bolwig et al. (2010) established a useful matrix for a systematic approach to the networked understanding of value chains. The concepts of vertical and horizontal linkages will be instrumental for the analysis of the empirical findings of the global tuna value chains. The power typology of Ponte et al. (2019) is used to amplify the relational approach of the GVC analysis. The relation between value chain analysis and FLW strategies is relevant for the research, and will be explored in the following section.

## **2.3 Food Loss and Waste in the Value Chain**

The most common and wide-spread understanding of the FLW issue can be linked to Global Value Chain Analysis. FLW is often depicted as being due to inadequate logistics, lack of technology, or because of consumer behaviour (Chauhan et al., 2021). These reasons are often linked to a geographical dispersion. Poor logistics and technology are attributed to the production of food in the Global South, whilst poor management is attributed to the consumers in the Global North (Gustavsson et al., 2011).

Reasons for FLW at the stage of processing can be linked to both organisational and structural mechanisms (Chauhan et al., 2021). The High-Level Panel of Experts (HLPE) on Food Security and Nutrition (2014) categorised FLW reasons on a scale-based level. HLPE (2014) recognises reasons for FLW on a micro-, meso- and macro-scale. The micro-scale reasons are organisational in nature, such as packaging and transportation. The meso- and macro-scale reasons can be understood as systemic or relational factors that lead to practices of waste generation.

Food loss and food waste are two phenomena which are highly contested with a wide variety of understandings and definitions (Gascón, 2018; Chauhan et al., 2021; Delgado et al., 2021). Since there is such a wide variety of understandings of these phenomena, the existing literature on this topic is also highly diverse. Delgado et al. (2021) emphasise how a lack of consistent measurements for FLW has led to an underreporting of the food wasted. The weak data foundation on FLW issues is reflected in the literature on the global tuna value chains as well.

FLW issues are seen as a challenge to be overcome to obtain sustainable food systems. The link between issues of FLW and notions of upgrading is useful for a value chain approach to

the topic. Upgrading is a central concept in GVC analysis, and is about “acquiring capabilities and accessing new market segments through participation in particular chains” (Bolwig et al., 2010, p. 176). Bolwig et al. (2010) point to how upgrading is often issued as a managerial and competence solution, in the same way that solutions to FLW often are described. The idea of upgrading the value chain to decrease FLW is established in the discourse of the blue economy (FAO, 2018). To move the discussion of knowledge creation in the value chain past a debate about upgrading, the theoretical framework of political ecology will be included in the research. Political ecology theories provide a foundation for addressing knowledge production and inclusion of voices from the Global South.

## **2.4 Political Ecology of Food Loss and Waste**

The framework of GVC analysis is useful to study the FLW generation in the global tuna value chains. The inclusion of concepts such as agency and power has made the framework even more useful to an analysis of food security issues. However, to ensure that the traditional micro-level perspectives of FLW are challenged, the use of a political ecology framework is included in this research. Political ecology challenges ideas of apolitical development, to ensure that resource utilisation is understood as intrinsically political.

Gascón (2018) has linked the FLW debates to the theoretical framework of political ecology. By emphasising the political dimension of material resource utilisation, FLW can be theorised in a manner which challenges the micro-level, value chain approaches. They challenge contemporary FLW definitions and measurements, with the main criticism focusing on the definition of FAO: “food losses or waste are the masses of food lost or wasted in the part of food chains leading to edible products going to human consumption” (Gustavsson et al., 2011, p. ). The definition defines FLW as food mass that does not become food for humans. Gascón (2018) challenges the reductionist assumptions of the contemporary definition. They point to how the simplistic notion of food mass is degrading the value of the food and overlooking the nutritional benefits of different types of food.

When FLW is measured based on the mass that is lost, the product is understood as a single mass entity with a single monetary and nutritional value. A more nuanced perspective on food resources, will consider the by-products which are lost and the nutritional value of these components. The consequence of defining food waste based on the mass lost is that the

monetary value of the food that is lost becomes the focal point. The use of the by-products from tuna for fish feed can in a monetary sense be considered efficient, because the by-products provide some financial feedback. However, the nutritional value of this utilisation cannot be seen as efficient.

Gascón (2018) uplift an old definition by Kling (1943, cited in Gascón, 2018) where food waste is defined as nutrients that return relatively little human food value. The role of energy and nutrients is prioritised, which moves the discourse of food away from the commodification and monetary narrative, and towards a narrative of social value of food. Kruijssen et al. (2020) emphasise how methods for food loss measurement in fisheries are highly uneven, and often based on measurements of physical loss rather than quality loss. Research on nutritional loss is often based on experimental methods rather than field-based methods.

The notion of scale is important to political ecology perspectives. These perspectives attempt to lift the debate from a micro-level perspective to a wider focus on concerns of the agribusiness model. They point to how challenges of FLW are a product of the way the food system is structured, rather than shortcomings of individuals within the system. Distribution and inequity in the food system is a concern for the food insecurity of economically less-developed populations. The way the food system is organised is highly unequal and based on the needs of large retailers. The retail and trading node has great power over the consumer, to shape practices through product development, shelf placement and marketing (Freidberg, 2007; Everts and Jackson, 2009). The traders and retailers rely on consumer-trust, by ensuring food safety and quality, and put the consequences of these challenges on the producers by applying extremely strict standards. For the global tuna value chains, the retailers have tuna brands that source tuna on a global level, and create competition within the processing node with the power to upgrade and downgrade processors (Campling, 2012).

The understanding of responsibility in generation of FLW in the value chain often creates a dichotomy between developing and developed countries. By looking at the power relationships in the tuna value chain, responsibility for FLW can be reconceptualised. Gascón (2018) positions food waste as a phenomenon in theories of political ecology, through the concept of food sovereignty.



With a top-down approach to solving FLW problems in the value chain, one could apply solutions to the problematic stages, but without understanding the local context and local knowledge. By applying principles of social justice to a scaled analysis, FLW as an inequality issue is highlighted. In this research, FLW is explored as a local context issue of social justice, with a discussion of resource utilisation and food accessibility as opposed to food availability, as an issue.

To summarise the FLW discourses have been centered around the micro-level which have focused on upgrading strategies of technological solutions, efficiency measures and behavioural change for the consumers. The definition of FLW is also highly contested and inaccurate.

## **2.5 Political Ecology of Resource Utilisation**

Political ecology is concerned with the how access to and control over resources is established in the political economy (Peluso and Watts, 2001). Escobar (2011) emphasises how political ecology attempts to fill a void in the political economy, where there is a lack of appreciation for the ecological and environmental. Additionally, he points to how political ecology is a reaction to the lack of politics in the cultural ecology. Robbins et al. (2014) show how political ecology and political economy can create a fruitful analysis of a material reality within the tuna industry. This combination of frameworks shows how a political ecological approach to the realms of political economy creates a deeper understanding of the issues at play.

Political ecology is a framework for analysing the relationship between political decision-making and environmental change. Robbins (2012) defines the objective of political ecology frameworks as; *“address[ing] the condition and change of social/environmental systems, with explicit consideration of relations of power”* (p. 20). The framework relies on broad understandings of concepts such as power, agency, knowledge production and social justice (Sundberg and Dempsey, 2014).

Political ecology understands environmental change and ecological conditions as products of political processes (Robbins, 2012). The framework developed from ideas of human-environment relations as a reaction to Malthusian eco- scarcity frameworks, which portray

local populations in the global South as poor managers of resources or environments (Blaike and Brookfield, 1989). An important aspect of political ecology research is the scaled understanding of environmental issues, and how there are multi-level relations between local and global processes (Adger et al., 2001). The relations between global systems of governance and local processing nodes in the tuna industry is explored in this research.

Novel understandings of these processes have been termed the urban political ecology, where urbanisation is associated with scaled and multi-level relations (Swyngedouw, 2009).

Swyngedouw emphasises how urbanisation is the link between the human and the non-human, where development of human-environmental relations has become all-encompassing in nature. Urban political ecology is therefore also relevant to the value chain of tuna, to understand how comprehensive the anthropogenic effect is on the tuna ecology. The tuna resources are utilised in such a scale that certain tuna species are in danger of extinction.

Ribot and Peluso (2003) formed the theory of access, where they coined the definition of access as “the ability to derive benefits from things” (p. 153). The theory of access differentiates between access as property and access as ability. The literature on access was limited to discussions of property and rights. By understanding access as ability, one was able to include a wider perspective of power into discussions of access. The ability to derive benefits from things is not limited to the legal jurisdiction of a resource but is also controlled and configured by the power relations of the actors involved and interested in the resource. The access to the tuna resource in the processing nodes of global tuna value chains are scrutinised, with a lense which aims to go deeper than the legal rights-based approach.

This theory chapter has laid out the structure and framework for the theoretical approach and construction that is used to analyse and discuss the findings of the governance and food accessibility and utilisation in the global tuna value chains. By applying a discourse perspective, the narratives and ideologies of the different actors in the value chain is recognised. The GVC analysis approach of Bolwig et al. (2010) is central to the value chain mapping and analysis. Their understanding of horizontal and vertical linkages in the value chain is combined with the power typology of Ponte et al. (2019) to add a dimension of power to the analysis. Political ecology narratives strengthen the consideration for governance and power with perspectives on food sovereignty, access theory and resource utilisation.



## 3.0 METHODS

### 3.1 Research Design

The aim of the research is to understand how the network of actors in the global tuna value chain interact, and how this affects the utilisation of tuna resources and by-products. The choice of methods is based on the objective of mapping the value chain, mapping various ways of utilising tuna by-products, and to understand how the mapped interactions affect the identified utilisation of tuna resources and by-products of tuna. The research design should be developed as a close interaction between the methodological choices and the ontological positioning of the research project (Cresswell and Cresswell, 2018). This research design is therefore a product of the desk-based approach of the research project and the poststructural ontological foundation.

#### 3.1.1 Ontological and epistemological foundation

The act of theory development is based on different understandings of the objectives of a research project. Scientific research traditions are based on natural sciences, with an understanding of knowledge and theory as having to correspond with an objective world (Aase and Fossaaskaret, 2014). Founded on this perspective, the approaches of deduction and induction were developed. Popper proposed the deductive approach as an alternative to the positivist approach of induction, where theory was derived from empirical findings to organise knowledge of the existing objective world. The deductive approach was based on the establishment of the concept of hypothesis, where a theory is induced and then tested to assess if it persists falsification (Holden, 2012).

Post-structuralism challenges the ideas of society established by these understandings of *science*, by stating that one cannot understand the world independently of the concepts we use to understand it, and our concepts cannot be objective because they are based on our perceptions (Aase and Fossaaskaret, 2014). Goodman (2001) points to how deduction leads to political agendas shaping the ontological basis for research on agro-food systems. The ontological tradition has not been able to capture the role of nature in food system research. The challenge of deduction in social science is that theories are not challenged, but rather just

applied to a widening amount of contexts, with the risk of over-analysing and shaping the data to fit with the theory (Silverman, 2003; Kennedy and Thornberg, 2014).

Abductive approaches have been suggested as a third mode of inference for post-structural research. Abduction is based on an inaugural process of examining data, which then leads to a preeminent explanation from the interpretation (Thomas, 2010; Gray, 2014). The process concludes with an hypothesis which is assumed to be the strongest explanation of what is observed (Charmaz, 2014). Kennedy and Thornberg (2014) describe abduction as “*selecting or inventing a provisional hypothesis to explain a particular case or data set better than any other candidate hypothesis, and pursuing this hypothesis through further investigation*” (p. 49). The abductive approach can to some degree ensure that presumptions do not guide the research. Silverman (2003) criticises deductive approaches in social sciences of being susceptible to idealising data. This is a challenge when bringing in political ecological perspectives, which are based on strong narratives of social justice. To limit the chance of idealising data the exploration of data should rather shape the theory development, in a way which ensures that the most appropriate theory is applied to the empirical findings.

This research project began with the hypothesis that standards and regulations had an effect on the FLW generation in the global tuna value chains. Data was then gathered and the most correct hypothesis was derived from these findings. This research became iterative in nature, due to the many restructurings of the project which had to be done. Taylor (2016) emphasises the potential of iteration to balance the breadth and the depth of a case study research. The iterative process of going back and forth with theory, methodology can be used as a strength for the project.

The ontological foundation for political ecology is based on a post-structuralist understanding of what is real. Based on the theory of correspondence the realist perspective sees what is real as completely disjointed from human thoughts and perceptions (Aase and Fossåskaret, 2014). The opposite view is the constructivist understanding, which is based on the view that reality is only a conception of the human thought, and reality only exists within the consciousness of individuals (Benjaminsen and Svarstad, 2017). The post-structuralist understanding of reality is based somewhere in between the realist and constructivist understanding and is often referred to as critical realism. Critical realists believe that there is a reality outside our

consciousness, but we can only experience it through our own perceptions, so our own thoughts will shape the way we understand reality (Benjaminsen and Svarstad, 2017).

Political ecologists use the ontological framework in a fruitful way to understand discourses as knowledge-production, which is foundational for the understanding of truth; the notion that language is constitutive of and a configuration of the experienced world. Foucault (cited in Couper, 2015) emphasised the role of the relationship between truth, knowledge and power. Political ecology can therefore be described as the attempt to understand the balance between shaping and being shaped by.

### **3.1.2 The research project**

This research project has been through various stages of restructuring due to the unforeseen event of a global pandemic, which changed the research design and methodological choices several times. The research project was initiated with an aim to do an intensive exploration of the processing node of the industrial tuna value chain in Tema in Ghana, to detect practices that lead to food loss in the processing, packaging and distribution. I wanted to explore how power and governance structures of the value chain were organised, and how this was affecting food loss and waste and initially food security in Ghana.

My plan was to base the research on a case study of the Ghanaian tuna industry, and the research would be conducted by doing a field trip to Accra and Tema last summer. I would gather information from the tuna processing plants on the functioning of the tuna value chain in Ghana, by doing interviews with different actors in the industry and in the governance structure. Travel-restriction due to the pandemic of Covid-19 made this impossible during the course of this research project. Because of time limits and difficulties in conducting online-interviews, which was attempted, the choice of methods was therefore restricted to secondary sources. Since I was not able to go to Ghana, I changed the research design slightly to broaden the scope. However, the chance of travelling was still held open for the duration of the year, hoping for it to be possible to conduct a field trip to Ghana after Christmas of 2020.

The restructuring of the research design involved the introduction of a second case study. From focusing only on the value chain of tuna in Ghana, the scope was widened to a global perspective. The first case study would explore the global system of governance of the global tuna value chains. By initiating the research at the international level, an understanding of the

hegemonic discourse for the industry could be explored and could then be applied to understand its materialisation and manifestation in the second case, to the material flow of resources in the Ghanaian value chain. The availability of sources for secondary data was subsequently widened, which would secure the ability to pursue the research project based solely on secondary data, if that would be necessary.

Qualitative research is often intensive in nature, in attempting to delve deep into the material. By switching to a global perspective, the research consequently became more extensive in nature, by including sources of qualitative data and looking for patterns and regularities in the global system of governance and in country-case research. However, one should still say that the research is intensive in that its aim is to get deep into the power relations and knowledge foundation of the value chain, and not to find quantitative regularities. White (2010) points to how data can provide an *extensive* basis for an *intensive* exploration of a field of research. The aim is to go deep into the value chain to add to the research on the tuna industry, rather than to create generalisable knowledge on FLW in value chains.

The foundation for the mixed method approach is built on the belief that the quantitative and qualitative methodologies enrich each other's traditions for the better (Aase and Fossåskaret, 2014). The pragmatism of bringing two diverging traditions together is useful for building a solid empirical foundation for the research. The mixed method approach is valuable to grasp complex phenomena, because of the ability to bring together complex data sets to provide several perspectives. Quantitative data was gathered and used to build a problem description of the contemporary situation of the global tuna value chains. This was necessary to understand if the issue of FLW was relevant to the tuna industry and to what extent the industry contributes to overall generation of FLW. Qualitative methodologies and data would then build on the problem description to look at reasons and solutions for the FLW challenges in the industry.

The mixing of methods can happen at different stages of the research design (Gray, 2014). For this research, quantitative data gathering is an initial process for mapping the problem description and is not embedded into the entire research process. This eases the ontological and epistemological considerations for the mixed method approach.

## **3.2 Research Setting: two case studies**

### **3.2.1 The global tuna value chain**

The case study of the global tuna value chain with a focus on the processing node was chosen based on a couple of factors. The tuna industry is interesting because the tuna is a pelagic and migrating fish species, which travels through the world's oceans. The globalised nature of the tuna species makes it an interesting resource to follow at an international level. El Bilali (2018) has pointed to the need for food security research focusing on the wider implications on a global level. There are also many Global South countries heavily involved in the tuna industry within all the nodes of the value chain. Since the research would focus on FLW as a food security issue, the Global South context would need to be a factor.

The choice of researching a global value chain makes the scope of the research extremely wide. This requires a strong focus on setting limits through the sampling process. Since this research is based solely on secondary sources, the sampling of data was limited to the existing research on the tuna value chains. However, the tuna industry and value chains have been researched widely. Gobo (2004) emphasises how sampling is an unavoidable consideration that needs to be approached properly. The sample frame was limited by doing a wide literature review to recognise main producers and end-markets in the industry, which then would be explored more deeply. In social sciences the social significance of the sample becomes the central trait, for ensuring representativeness (Gobo, 2004). The European market stood out in the literature as one of the most important end-markets and also the one with the most prevalent standards and regulations for governing the value chains (Miyake et al., 2010; Campling, 2012b; Campling, 2015). For the producers, the Western Indian Ocean (WIO) and the Western and Central Pacific Ocean (WCPO) stood out as the most important producers (Havice and Campling, 2010; Parris, 2010; Havice, 2013; Barclay, 2014; Andriamahefazafy et al., 2019). These conclusions were based both on quantitative and qualitative data.

The wide research scope is chosen to gain an insight into the overall tendencies in the industry and will therefore focus on a context of extensive relations. The research is extensive in its approach to geographical space and place as well as scale. However, the intensity of the research is kept with the aim to go deep into the regulatory relationality of the value chain, which ensures that the research does not attempt to create generalisable knowledge based on a



wide data set, but rather to describe a small number of cases with a great amount of detail (Clifford, et al., 2010).

### **3.2.2 The Ghanaian tuna processing node**

The country-specific case study of Ghana is used as an illustrative case study to explore the effects of the global and globalised governance of the tuna value chain on a country involved in tuna processing in Africa. Bassey (1999, cited in Taylor, 2016) describes how case studies can be used for story-telling, where the case is used to illuminate the theory that is developed. The case study of the tuna industry in Ghana is used to uplift and explore the experiences of participating in the global tuna value chain from a Global South perspective. The case study of Ghana is interesting because the value chain has quite a limited existing research foundation and is not that often included in the literature on the global tuna industry. The Small Island Development States (SIDS) in the Western Indian Ocean and the Western and Central Pacific Ocean are heavily researched, but the mainland countries involved in the tuna industry in the Global South have not been subject for research to the same extent.

Ghana's relevance in the global tuna industry makes the country-specific case study appropriate since the research then can integrate a consideration for scale, by connecting the global relations with a local context. Ghana is a good case study for the tuna industry, because it is the most important tuna producing country in Africa (Asiedu et al., 2015). On the other hand, tuna is the most important non-traditional export product for Ghana (O'Neill et al., 2018), which has been an objective for the national economy to decrease reliance on traditional products such as cocoa, timber and minerals (Addo and Marshall, 2000). The question of scale is essential to geographic research on food systems and value chain governance. Delaney et al. (2018) emphasise the need for future research to focus on scale in exploring components of a food system. This understanding of food systems can be linked to the value chain framework with a scaled integration of the effects of governance on the processing node.

## 3.3 Methodological choices

### 3.3.1 Data collection methods

Secondary data became the foundation for this research project. The gathering of quantitative and qualitative data was based on secondary sources from global actors actively involved in the tuna value chain, as well as a great reliance on existing academic literature on the topic.

Descriptive statistics were gathered to describe the phenomenon of food loss and waste in the global tuna value chains. White (2016) points to the benefits of using secondary data, including descriptive statistics, to demonstrate that the research topic is somehow worthwhile researching. Positive aspects of using secondary sources is the availability and effectiveness of accessing data (Smith, 2008).

The outset for the research is a description of the global tuna value chain, following Fredrick's (2019) method for qualitative GVC mapping (p.33) Value chain mapping seeks to describe an industry in a way that is analytically useful. The descriptive and qualitative way of describing the value chain is valuable. Frederick (2019) focuses on how the GVC framework can be used as a methodological and analytical tool. Since the focus of this research is on the processing of tuna, the upstream activities will be the activities in the tuna fisheries. The downstream activities are trade and consumption. The tuna value chain is analysed following the following template for GVC mapping (see figure )

- 1. Compile a list of keywords for the industry:**

The keywords resonate with a mapping of the global discourses guiding the value chain. Keywords were used for different systematic literature reviews.

- 2. Create a supply chain and relevant product groupings. Determine which of the four stages you are focusing on:**

The processing node of the value chain became the point of analysis.

- 3. Determine the reach of the GVC. Establish a threshold:**

The global tuna value chains became the focus with the aim to point to relevant and good cases for the points of analysis.

- 4. Determine the types of buyers of the final products. Which value adding activities beyond manufacturing are the most important for the GVC?**

Canned tuna for the European and American market was the most prominent final product and buyers.

**5. How do firms interact in the chain? What are the typical distribution channels at each stage?**

The central role of branded tuna firms and trading companies is explored.

**6. Identify the top countries and regions of the world for each stage.**

Quantitative data on producing and consuming countries was gathered.

**7. Identify the leading firms for each product and market.**

Qualitative research on the dynamics of the tuna industry revealed data on leading firms in the global tuna value chains.

**8. Identify important institutions such as tariffs and standards and supporting stakeholders, including industry associations and government agencies:**

The main component of the mapping of power relations in the value chain was based on the empirical findings of these matters.

**9. Use the global template that is created, to benchmark a country's position:**

The foundation that was made from secondary sources on the case of Ghanaian tuna industry, was used as an illustrative case study on a contextualisation of a country in the Global South.

The initial stage for this template is to recognise keywords in the value chain, which is done for the tuna value chain by mapping the dictating discourses. This initial mapping guides the findings for the first research question to understand how the global tuna value chain is governed. Listing keywords is also very useful for creating a framework for further systematic literature review.

Quantitative data was gathered from multiple sources for the initial mapping process of the global tuna value chains. The aim of determining the reach of the GVC in Fredrick's (2019) model, was operationalised with quantitative data on tuna producers and consumers. Information on tuna catches was obtained from FAO's databases of fisheries. Multiple graphs were made from extracted data sets from secondary sources of academic articles and other data sources, such as ATuna, which is an established website for tuna industry news (Atuna, 2021).

The value of understanding the discursive context of a case or phenomenon is recognised in this research (Adger et al., 2001). Dittmer (2010) recognises analysis of discourse as contextualising discourses and recognising their role as spatial images of the political. However, taking on the task to do a complete discourse analysis was unachievable. Based on the secondary source approach of this research, the option of gathering recognised data on the leading discourses of the value chain was therefore opted as a valuable alternative to do a discourse analysis. The literature review on existing and recognised discourses in the value chain could then be applied as a discourse perspective to the empirical data.

The research project relied on several rounds of systematic literature reviews. Healey and Healey (2010) point to how a systematic literature review should be initiated by a framework to ensure an efficient and effective review process. However, they emphasise how iterative research progresses as a messy and chaotic process. This was necessary to provide a wider field of research on certain topics, and to re-visit and explore relevant and interesting literature. Gray (2014) provides several applications for systematic literature reviews in a research project. Literature reviews can be used for theoretical, methodological and empirical mapping. Following the principles of abductive processes, the empirical literature was reviewed as the primary. After the empirical foundation was established, the theoretical literature went through review, to apply theories to the findings. Havice and Campling have done substantial research on the tuna industry, applying value chain and political ecology frameworks. Their approaches formed a basis for the theoretical development of this research (Campling, 2012a; Havice and Campling, 2013; Havice and Campling, 2017).

The first part focuses on the case study of the global system of governance, by scrutinising documents and reports for standards and regulations of the tuna value chain. The historical developments in global tuna value chains was deemed important for the understanding of the contemporary power relations and knowledge foundation. For the case study on the Ghanaian value chain documents, reports, academic literature and news stories were collected.

The topics that were used for empirical literature reviews were:

- the Ghanaian tuna value chain;
- the Global tuna value chain;
- FLW in the tuna value chain;
- By-product utilisation in the tuna industry.

### **3.3.2 Data analysis methods**

The data that was gathered and obtained from secondary sources was analysed using the theoretical frameworks of GVC analysis and discourse perspectives. The secondary sources provided a rich foundation of empirical findings on the architecture and activities in the global tuna value chains.

The institutional and organisational documents were analysed using an open coding to recognise common themes and recurring patterns (Taylor, 2016). For the coding process the program NVivo was used. This worked well for systematic document analysis. Gibbs (2012) points to the possibility of coding definitinal drift, where the consistency of coding is lost as the research progresses. Consistency in coding categories was attempted, to avoid a great disparity in the empirical findings and the early mapping of keywords was useful in this regard.

The academic texts were coded in a similar way, after having been through a systematic literature review (Healey and Healey, 2010), reviewing to extract keywords, messages and findings. Lists of keywords were essential for the first process of mapping, but also for analysis, where searchable words could categorise the texts and be used to extract relevant data at a later point in the analysis process.

The empirical findings on the Ghanaian tuna value chain was obtained and analysed to make a map of the material flows between the nodes of the tuna that is processed in Ghanaian tuna processing facilities. The process of visualising the data was highly valuable for the contextualisation of the value chain.

## **3.5 Ethical considerations and data quality**

An important way of incorporating ethical considerations into research designs is through the act of reflexivity (Carling et al., 2014). One way of being reflexive, is to think through potential ethical dilemmas at the planning stage and build these considerations into the research design (Hay, 2016). However, Gray (2014) emphasises how qualitative research processes are contextual and emergent, and ethical considerations need to be a continuing

process through the period of research. This research has been iterative and constrained by time- and travelling-limits, and has therefore required rethinking of the ethical dimensions at multiple stages.

Research validity is a concept which comes from qualitative research, and does not have a proper definition when applied to qualitative research (Gray, 2014). However, a consideration for the internal and external validity is useful to reflect on to ensure rigour and reflexivity throughout the research process.

### **3.5.1 Internal validity: Reflexivity and positionality**

From a critical realist standpoint, knowledge is produced based on the experiences of reality that the researcher holds (Holt-Jensen, 2018). The knowledge that is produced about the tuna value chain in this research project is based on the political ecological standpoint of me as a researcher and the narratives which that brings with it. The research has value because of its position and the positionality of the researcher, rather than losing value because of its lack of neutrality. With this understanding of validity, the more clear the positionality of the researcher is, the higher is the validity and reliability of the research (Rose, 1997).

My positionality as a researcher is coloured by my experiences, political standpoint and motivations. As an activist engaged in the climate and environment politics through a youth NGO, my motivations are affected by the work that I do there. The organisation which I am a part of has a strong focus on climate and environmental justice, bringing the voices of people in the Global South forward in global and national governance. This has linked well with the theoretical framework of political ecology, which is focused on knowledge generations through language, discourses and representation at its core. However, Benjaminsen and Svarstad (2017) emphasises how political ecology is not more political than other theoretical frameworks. The politics of avoiding value-laden observations of apolitical ecology is equally political.

Political ecology attempts to display an anti-Eurocentric conception of the world (Loftus, 2017). Loftus (2017) however, challenges the ongoing production of Eurocentric and colonial political ecology research. My positionality as a white European researcher writing about the experiences of tuna producers in the Global South requires reflections of my personal

positionality. That is done best by being reflexive in all the processes of the research, and also by ensuring that data collected is reflective of the multiple viewpoints in the context researched (Mullings, 1999).

### **3.5.2 External validity: Generalisation, transferability and reliability**

The external validity of a research project is based on the extent to which one can generalise from the findings to another research context (Gray, 2014). The generalisability of qualitative studies is complicated in itself. Gray (2014) problematizes attempts to generalise from very specific qualitative findings. This is relevant to both internal and external validity of the research. Since the sampling frame for the research is based on the global tuna value chain, chosen case studies to illustrate the relations should not be used to generalise the whole value chain. The context is important.

The methodological frameworks that are used for the data gathering and analysis increases the replicability and transferability of the research, which again increases the external validity (Gray, 2014). Fredrick's (2019) mapping exercise that is used for the initial mapping of the tuna value chain is a framework which can be utilised for any value chain analysis. The framework was chosen based on its usefulness and based on the aim to increase the transferability of the research.

Triangulation is put forward as a viable way of ensuring validity in social science research. Data triangulation is built into the research with the mixed method approach, providing both quantitative and qualitative data (Jick, 1979). The sources of secondary data were sampled to ensure a wide variety of viewpoints among the actors within and outside the value chain, to obtain a nuanced understanding.

Additionally, the triangulation of theories is used in this research. The triangulation of GVC analysis and political ecology is first of all based on the theoretical perspective aimed for this research and the technical instrument which GVC analysis could provide. Gray (2014) emphasises the need for 'theoretical sensitivitiy' in approaching qualitative research. By triangulating the theories, the awareness and reflexivity of what these theories contain and provide becomes more persistent throughout the research process. Also, one can use the

divergence between the theories to criticise their contributions to the topic, as an act of reflexivity to increase the reliability of the findings.

The methods and methodology of the research has been presented in this chapter. The case study approach on this desk-based research used secondary sources for data. The ontological and epistemological foundation for the research has been presented and explored with an understanding of how the abductive approach has affected the data gathering and theory formation. Methodological frameworks for data gathering and analysis have been presented and the ethical considerations have been explored, looking at the internal and external validity of the research. The following chapter will set the context based on the empirical findings on the tuna ecology and the stakeholder analysis on actors in the tuna value chain.



## 4.0 Tuna Ecology and Political Actors

### 4.1 Tuna Ecology

Tuna (genus *Thunnus*) are fish in the Scombridae family, related to mackerels (Robbins et al., 2014). There are several tuna species, which vary in size and colour, but in general they are large fish which range between 40 and 200 cm in length (table 2) (FAO, 1989). The Atlantic Bluefin Tuna is the largest of the tuna species, and one of the largest individuals caught was around 400 kg and more than 3 meters in length (Brogle, 2021). Tuna is a highly important commercial fish in the global market. The most commercially viable species of tuna are Bigeye tuna, Yellowfin tuna, Albacore tuna, and three species of bluefin tuna; Northern/Atlantic, Southern and Pacific Bluefin tuna (Mullon et al., 2016). The Skipjack is not a part of the tuna genus but is however considered a tuna fish and is also the most popular one (figure 2) based on global production rates (FAO, 2021). The tuna species are found in tropical, temperate and even cooler waters; in the Atlantic, Indian and Pacific Ocean, but do also move in between them (Granata et al., 2012).

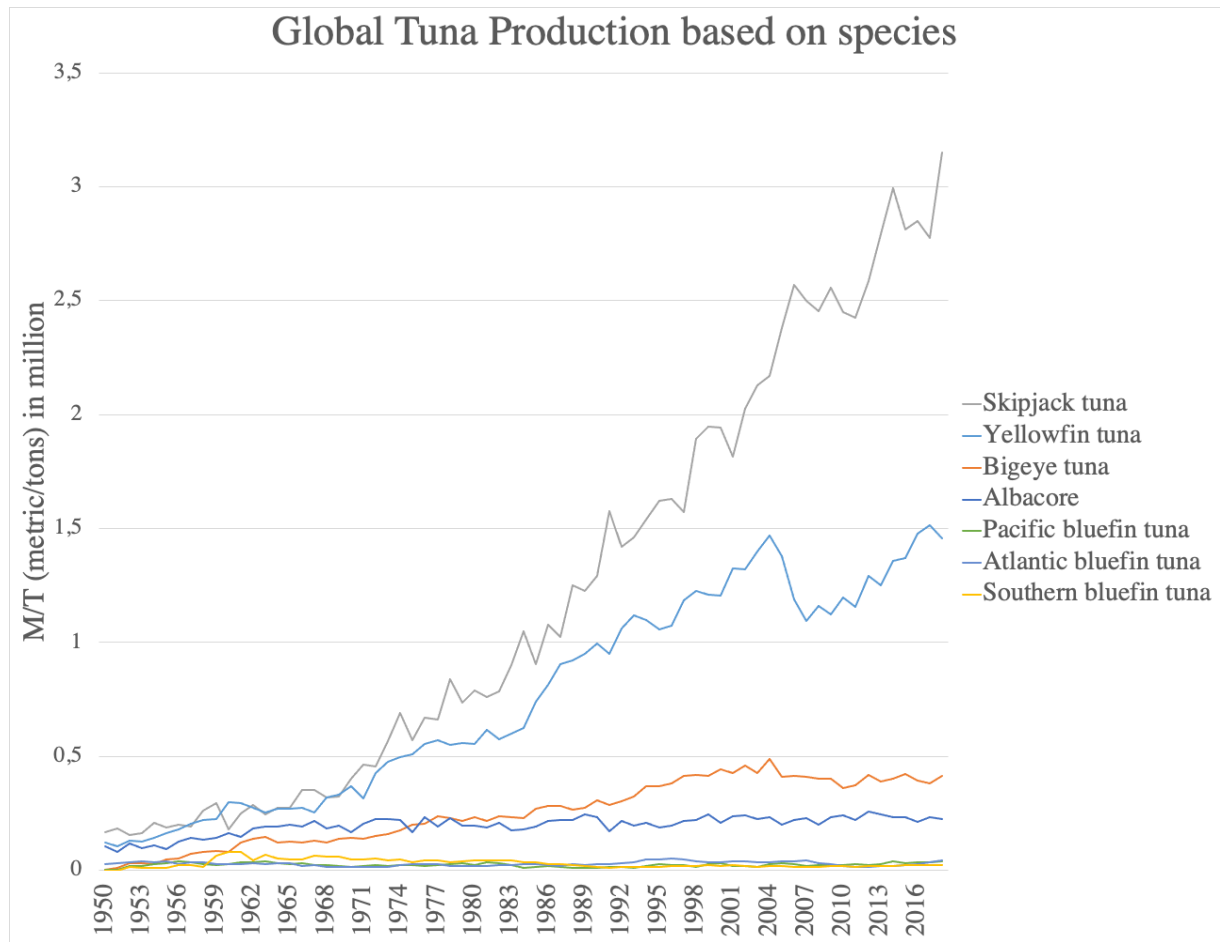


Figure 2. Global Tuna Production based on species from 1950 - 2016. (Graph produced based on data extracted from database of FAO, 2021)

Tuna fish are warm blooded, which makes them tremendously strong, in addition to having a strong stamina (Robbins et al., 2014). Warm blooded fish have a high transport of oxygen to the blood, which makes them powerful. The largest species of tuna can reach a speed of 70 miles per hour (Robbins et al., 2014). The warm bloodedness is a result of high amounts of red muscles that the tuna fish have. Tunas have a greater proportion of red muscles compared to other fish, and a lower proportion of white muscles (Dickson, 1995).

Table 2. Size and yield of different tuna species. (Based on FAO, 1989).

Tuna Species	Scientific Name	Average size (cm)
Skipjack	Katsuwonus pelamis	40 – 80
Yellowfin tuna	Thunnus albacores	60 – 150
Bigeye tuna	Thunnus obesus	70 – 180
Albacore tuna	Thunnus alalunga	40 – 100
Atlantic bluefin tuna	Thunnus thynnus	80 – 200
Pacific bluefin tuna	Thunnus orientalis	200
Southern bluefin tuna	Thunnus maccoyii	160 – 200

In a food product perspective, the white muscles are meat which is most consumed by humans (Herpandi et al., 2011). Since they have a lower proportion of white muscles, tuna fish will give a lower yield compared to other species. Graham et al. (1983) discovered that the ratio between red and white muscles did not seem to follow the size of the tuna, so that smaller tuna fish have a higher proportion of red muscles than larger fish (table 2). This results in smaller tuna fish having a lower percentage of what would be considered edible mass than larger tuna fish, and a greater amount of by-product. For canned tuna, this differentiation in colour between red and white muscles is often referred to as light/white and dark/black meat (Herpandi et al., 2011). The white meat is highly popular for human consumption, whilst the black meat is considered low quality and sometimes inedible (Gamarro et al., 2013).

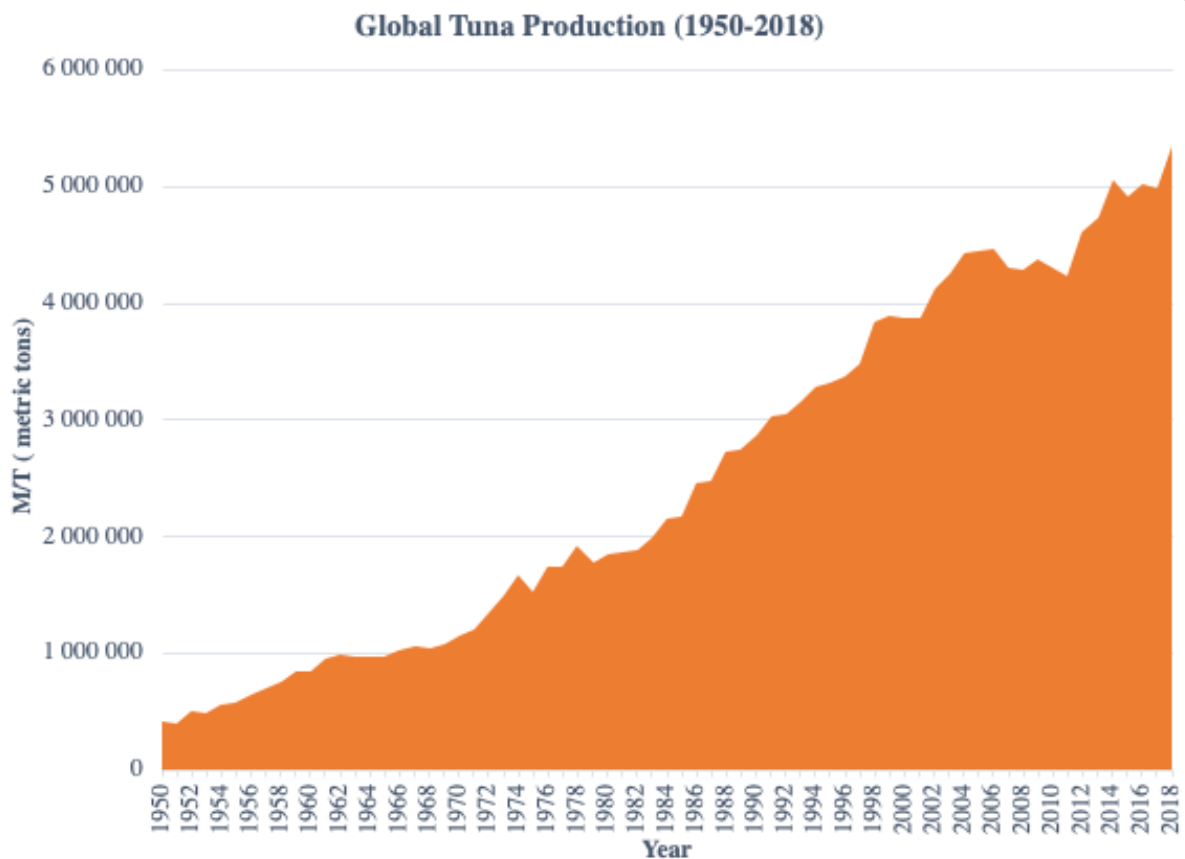


Figure 3. Global Tuna Production 1950 - 2018 (Graph made from data extracted from report by FAO, 2020)

In 2018 the total global landing of tuna was 5.3 million metric tons, and this number has increased steadily (figure 3) since the 1950s and annual catches have increased by more than a ten-fold (FAO, 2020). In most parts of the industry, it is only the white meat which is consumed, which is about 30-50% of the tuna fish. According to Sutanbawa and Aksnes (2006) discards from tuna processing equaled 450.000 million tons per year and about 10 per cent of the total catch. Others estimate a FLW rate of 50-70 per cent of total global landings of tuna, which does not go directly to human consumption (Herpandi et al., 2011; Saidi et al., 2018). This enormous amount of biomass has potential to be used in more or less efficient ways. The by-products of the tuna are nutrient dense. An incentive to utilise more of the by-products from tuna production is often that the by-products can present potential for increased profits and add value to the production (Saidi et al., 2018).

Tuna fisheries face challenges of ensuring sustainable catch rates. According to FAO (2019), 43% of tuna stocks worldwide are fished at unsustainable levels. The International Union for Conservation of Nature and Natural Resources (IUCN) assessed the tuna and billfish species

for the Red List of Threatened Species in 2011. The most vulnerable tuna species that were defined as critically endangered and endangered, were the Southern Bluefin Tuna and Atlantic Bluefin Tuna (figure 4). The Bigeye Tuna was categorized as vulnerable, whilst the Yellowfin Tuna and Albacore Tuna was put in the category of near-threatened species (Collette et al., 2011).

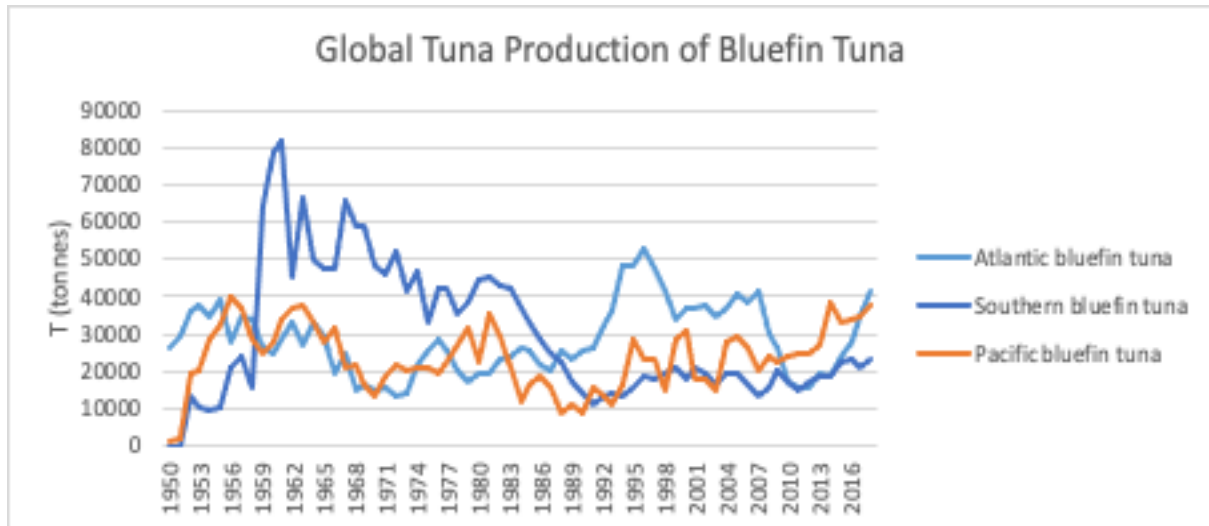


Figure 4. Global Production of Bluefin Tuna from 1950 - 2016 (Based on FAO, 2020)

The Bluefin Tunas are the largest and fastest tuna species. The Southern Bluefin tuna reside in the Southern Hemisphere, and move between the Atlantic, Pacific and Indian Ocean (Herpandi et al., 2011). The Atlantic or Northern Bluefin Tuna belong in the Atlantic Ocean and move between the Eastern Mediterranean and Western parts of the Gulf of Mexico, from Lofoten, Norway in the North to the Canary Islands in the South (Herpandi et al., 2011). The Pacific Bluefin Tuna is found across the Pacific Ocean.

Measuring the sustainability of tuna stocks and catches is intricate. To map the exploitation and sustainability of catch rates, one developed the Maximum Sustainable Yield (MSY). The MSY is a measurement for the greatest amount of fish that can be caught to uphold a reproductive yield among fish stocks (Tsikliras and Froese, 2019). FAO (2001) defined MSY as the highest theoretical equilibrium yield that can be continuously taken from a stock under existing (average) ecological conditions. The management of tuna stocks is based on MSY in the EU, through the Common Fishery Policy (Leroy et al., 2016). Subsequently, the data foundation for tuna catches is highly uncertain, due to Illegal, Unreported and Unregulated (IUU) fishing activities and poor monitoring capacity among many stakeholders in the tuna industry (Adolf, 2019).

## **4.2 Actors in the tuna value chain**

### **4.2.1 Tuna Nations**

Tuna fisheries are active and present on a global level, with about 70 countries involved in fishing activities (WWF, 2021). An increasing number of countries are involved in tuna fishing and processing, and for many of them the tuna production is an essential industry in the country and one of the most important export products for the national economy (Havice and Campling, 2007; Havice and Reed, 2012; Asiedu et al., 2015; Prieto Carolino et al., 2021). Since tuna has become such an important trade product for many countries, tuna-led development has become an established strategy (Parris, 2009; Zelasney et al., 2020). The exploitation of tuna resources to create economic development has shown to have very different results in different countries. Attempts to increase revenue from tuna resources affect the way the biomass is utilised and leads to more or less efficient utilisation in different contexts.

The nation states are important actors in the global tuna value chain and are involved in both market-based and public management, regulation, and development of the industrial tuna processing (Campling, 2012). In discussions and debates of management and rights-based claims within the global tuna value chain, one can often find a division between Distant Water Fleet Nations (DWFNs), which are foreign fleets operating within the jurisdiction of other countries, and the coastal nations that have the jurisdiction over these areas (Parris, 2010; Campling, 2016). Coastal Nations which have received attention in the tuna governance literature, are the Small Island Developing States (SIDS) in the WIO (Andriamahefazafy et al., 2019) and the WCPO (Havice and Campling, 2010; Parris, 2010; Havice, 2013; Barclay, 2014) which attempt to use the availability of tuna resources as a pathway for domestic economic development.

The EU and US use their role as main markets for processed tuna, to control and regulate the industry through preference programs for tariffs, and by applying strict regulations for industry compliance (Havice and Campling, 2007; Campling, 2012). They also play important roles in the regional and global institutions for tuna management. The EU is the most important canned and processed tuna market (table 3) but is also important in terms of production. Spain has always been the leading tuna nation in Europe and continues to be the

fourth leading tuna exporter in the world today (Table 3) (FAO, 2021). The country has upheld a national production through tuna industrial clusters in the North of Spain (Adolf, 2019). Within the EU, there are active canneries in Spain, Italy, Portugal and France today (Miyake et al., 2011). They have large national brands and provide tuna for their domestic markets. The EU as a regional actor along with European countries have been an important actor in the development of a truly international tuna value chain through a variety of mechanisms.

The US began with tuna canning in 1906. From the 1950s until the 1980s the American tuna industry was recognised as a vertically integrated value chain which was controlled by the state (Robbins et al., 2014). After years of competition from cheap Asian labour markets and more efficient fisheries the American tuna industry moved from a Fordist to a post-Fordist state, where outsourcing of fisheries and processing and importing of biomass became the norm (Robbins et al., 2014). Today there are no canneries left on the US mainland, but there are some processors based on the US territories of American Samoa.

Table 3. Global top importers of canned/processed tuna from January-September 2018-2020. (FAO, 2021).

	2018	2019	2020	Per change 2020/19
European Union	560,4	578,6	629,8	8,80
USA	149,9	153,1	194,2	26,5
Japan	48,9	48,2	50,9	5,6
Saudi Arabia	30	36,9	44,4	20,3
Colombia	25,3	23,7	36,3	53,3
Egypt	32,6	37,6	35,2	-6,4

The main tuna catching nations are Asian countries (Herpandi et al., 2011). In East Asia, we find both the largest processors, Thailand, Philippines, China and Indonesia, the greatest fisheries fleets from Indonesia, Taiwan, Korea and China and the largest trading companies from Japan, Korea and Taiwan. Thailand is the greatest canned tuna producer in the world, followed by Ecuador. Thailand has developed a large processing industry but does not have a great provision of tuna from its own waters. The thai industry is therefore reliant on imports

of tuna from other countries and is highly dependent on the Western Pacific Ocean fisheries. Indonesia has the largest tuna fisheries globally. China is gaining strength in the global tuna market, without having a long history of involvement in fisheries fleets or processing. The country was not even on the list of top 10 canned tuna processing countries in 2008 (Hamilton et al., 2011), but is now the third greatest processor of tuna (Table 4).

*Table 4. World top exporters of canned/processed tuna from January-September 2018-2020, FAO (2021)*

	2018	2019	2020	% change 2020/2019
Thailand	373,2	393,2	450	14,4
Ecuador	169,5	181,4	189,7	4,5
China	76,3	91	95,8	5,2
Spain	82,7	81,1	86	5,8
Philippines	61,6	54,9	68,7	25,1
Indonesia	59,5	70,4	64	-9

**4.2.2 Tuna Regional Fisheries Management Organisations (RFMOs)**

The migratory patterns of tuna fish make global governance of tuna value chains complex and multifaceted, but highly necessary. The most important institutions for global tuna governance are the Regional Fisheries Management Organisations (RFMOs). There are five organisations which each represent a region (McClunley et al., 2019). The establishment has been gradual between 1949 and 2004.

The RFMOs are constellations of nation-states, and often the most active coastal nations in each region (McClunley et al., 2019). The RFMOs are consensus-based, so conflicting actors have to come to agreement for anything to be decided upon within the organization. This has proven to make the RFMOs relatively inefficient in implementing new management strategies.



The five RFMOs and their year of establishment are:

- the Inter-American Tropical Tuna Commission (IATTC), 1949
- the International Commission for the Conservation of Atlantic Tunas (ICCAT), 1966
- the Indian Ocean Tuna Commission (IOTC), 1993
- the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), 1994
- the Western and Central Pacific Fisheries Commission (WCPFC), 2004

The RFMOs are the most central institutions for the allocation of catch rate allowances to the different countries. Havice and Campling (2017) problematise the increasing involvement and influence of firms in the RFMOs. The organisations are not organised to handle private capitalist interests. The challenge of lifting rights-based management is threatened by market interests from firms and regional actors, such as the EU. Seto et al. (2021) identified the principles which were to become the foundation for allocation of fish resources but recognised the principles that does in fact guide the allocation of fish resources. Equity, citizenship, and legitimacy were the desired principles, but historical catches and power of the DWFNs has shown to be the dominant factors affecting allocations today.

DWF have assumed great power in negotiations for fisheries allowances, shaping the patterns of the global tuna value chains. In negotiations for allocations of catches, there is often an opposition between the DWFNs and the coastal countries which have sovereignty over the areas where the fish licences are to be allocated. EU participates in several RFMOs and has much experience with writing proposals for fisheries allowances, which has become a strong advantage for them (Andriamahefazafy et al., 2020). DWFNs from the EU have strong interests in upholding rights to resource extraction.

Within the RFMO of the Indian Ocean (the IOTC), the role and power of the DWFs from the EU is substantial. The coastal countries in the Indian Ocean have formed an alliance named the G16, which negotiate conservation and management issues within their EEZs in the RFMO of the Indian Ocean (Andriamahefazafy et al., 2020). The opposing part to the G16 is the DWFNs which operate in the Indian Ocean, which mainly consist of European countries.

The different coastal states in the WIO relate differently to the EU in negotiations of fishery licenses. The historical relations between the coastal communities and the EU, have a large impact on how they participate in the negotiations. Even though the coastal states created a

cooperative, to have a stronger influence on the negotiations, the individual responses of the states remain. In the IOTC, Mauritius plays a strong role, as a nation-state with strong governance capacity. Madagascar on the other hand, has to negotiate its relationship with the EU based on its reliance on foreign aid from the region, parallel to the negotiation of fishing licenses (Andriamahefazafy et al., 2019; 2020). This complicates the decision-making processes for Madagascar, which takes a more passive approach than Mauritius in the negotiations. The EU has enormous power as a regional stakeholder in the global tuna value chains and in the RFMOs. This imbalance in power has required other coastal states to summon regional alliances to gain negotiation power over their own fisheries resources.

The WCPO provides more than half of the total tuna catches globally (Havice and Campling, 2010). The fishing capacity in the region has grown dramatically since the 1970s. This region is as all the other large ocean areas controlled by a RFMO - the Western and Central Pacific Fisheries Commission (WCPFC). The regional cooperation is challenged by sub-regional coalitions between different countries, which create demands for management and conservation measures. The sub-regional organisations have proven to be important for removing power imbalances at the regional level. The countries that are involved in the purse seining fisheries in the WCPO have established a coalition, the Parties of the Nauru Agreement (PNA), which has become a strong voice in the RFMO in the WCPO.

The WCPFC have tensions between SIDS and DWFNs, but also between countries within the RFMOs. The largest fishery is the purse seine skipjack fishery, where a lot of the SIDS participate - with the largest one being Papua New Guinea (PNG). However, many of the larger and more powerful nations have pole and line fisheries, targeting albacore in the region. Challenges of overfishing have been highly linked to purse seine fisheries using FADs, and the WCPFC have focused management on these types of fisheries. However, the management of purse seine fisheries has been challenged by the PNA. The PNA is a coalition of countries relying on purse seiners as fishing method. The Fisheries Forum Agency (FFA) and the WCPFC, which are the large-scale regional organisation in the area have worked towards a liquidation of purse seiners as an environmental measurement. The PNA have opposed this aim, because of their economic dependency on these fisheries.

### **4.2.3 Distant Water Fleets and Illegal, Unregulated, and Unreported Fishing Activities**

In the 1950s when the national tuna industries of the US and Japan were challenged by industries elsewhere in efficiency and catches, an expansion began through the use of distant water fleets. The tuna vessels that had been operating in domestic waters for decades, would now expand their fishing grounds. Japanese fleets moved into Pacific Island waters using pole and line and longline fishing methods (Barclay, 2014). American fleets moved into the Eastern Pacific Ocean and the Eastern Atlantic Ocean of the coast of West Africa in the 1950s. In the 1980s, when purse seining technology took off, American purse seiners moved into the Western Pacific Ocean and tuna catch rates rose quickly (Barclay, 2014).

The issue of IUU fishing refers to fishing practices and activities that breach national or international laws and regulations, and which are not reported to the RFMOs or other actors which are set out to manage and govern an area (Leroy et al., 2016). IUU fishing is understood as the main challenge for global sustainable tuna fisheries (Miller et al., 2014), and as a threat to food security of those dependent on fisheries (Leroy et al., 2016). Compliance with the management of the RMFOs and reporting back to them on fishing activities, is important for the validity of MSY calculations.

IUU is closely linked to the relationship between DWFNs and coastal nations. The EU has put in strong measures to combat IUU fishing globally, using their market power. Through a strong focus on “rules of origin”, the exporters have to provide the EU with validated information about the vessel that caught the tuna and where the tuna fish was processed (Miyake et al., 2010). If there are irregularities with this information, reports of IUU fishing in the countries` waters or of its flagged vessels, then the country will receive a yellow card. The country then has to address the situation, or it will receive a red card and will be banned from exporting fish products to the EU (Leroy et al., 2016). The EU has strong authority on management of IUU, because it is the largest market for tuna.

### **4.2.4 The Marine Stewardship Council**

In 1997 World Wildlife Fund and agro-food mega-transnational company Unilever established the MSC, based on the principals of the Forest Stewardship Council (Robbins et

al., 2014; Eden, 2011). MSC is an organisation which carries out a certification scheme for tuna fisheries all around the world. They have become a recognised label for sustainable fisheries which represent market-based consumer power. To acquire the MSC certification on products, one must comply with the strict and stringent rules of the MSC. The dolphin-safe tuna certifications which were described earlier, are another such environmental certification. Certifications have become an integrated part of the regulations and governance of the global tuna value chain. Certifications in the tuna value chain have become symbolic of consumer power (Robbins et al., 2014).

# **5.0 Food Loss and Waste in the Global Industrial Tuna Value Chain**

## **5.1 Structure of the Tuna Value Chain**

By taking a value chain approach, the FLW generated at each step of the value chain and activities counteracting FLW is analysed, both in terms of empirical occurrence and regulatory context. The value chain of tuna is divided into four nodes; the tuna fishery node, the tuna processing node, the tuna trading node and the tuna consumption node. Food is wasted all along the value chain, but for production in countries in the Global South, the main focus is on the processing stage and its FLW challenges (FAO, 2011; FAO, 2018). Based on this, the processing node will be the central stage analysed for FLW. However, the analysis of a selected node of the value chain, should be linked to the remaining nodes, to understand the relational causes of FLW. Therefore, the consideration for the nodes of fisheries, trade, retail and consumption will be included.

The first section will take a value chain approach, contextualising the global patterns at the different stages in the value chain; the tuna fisheries, tuna trade and tuna retailing and consumption. The processes, patterns and practices in these nodes of the value chain are highly interlinked with and affect the products that are processed and the FLW at the processing stage. The second section will explore the tuna processing node, FLW in processing, byproducts generated and alternative utilisation of byproducts. The case of Ghana will be used to look closer into regulations causing and preventing FLW in a Global South context.

PART ONE

## **5.2 Tuna fisheries**

There are a wide variety of fishing techniques used for catching tuna, from traditional canoes to large-scale industrial purse-seine fleets. The majority of the global industrial tuna catch going into the industrial production of tuna, is captured by purse seine vessels. The purse-seine vessels capture approximately 66% of the global annual tuna catch (Hamilton et al., 52

2011). The WCPO fisheries, the largest tuna fisheries in the world, are mainly based on purse seining (Parris, 2010). Other large scale, industrial vessels use pole and line and long-liners, fishing techniques based on hooks, fishing lines, and sometimes accompanied by bait. The use of different methods and technologies depend on the tuna species that is targeted. The WCPO includes some of the largest tuna fishery nations such as Indonesia, Japan, the Philippines, Taiwan, Papua New Guinea (PNG) and Kiribati (figure 5). Papua New Guinea is part of the WCPO fishery that targets skipjack tuna and therefore uses purse seiners. Samoa, which is also a tuna fishing country in the WCPO, targets albacore using pole and line (Parris, 2010). The purse seine fisheries are known for catching more juvenile and bycatch species, especially since they more often than others use FADs to attract and capture fish. Juvenile Bigeye and Yellowfin tuna, which both are vulnerable to overfishing, are often found mixing with the skipjack tuna around FADs, and the use of FADs is therefore quite detrimental for these tuna species (Barclay, 2014).

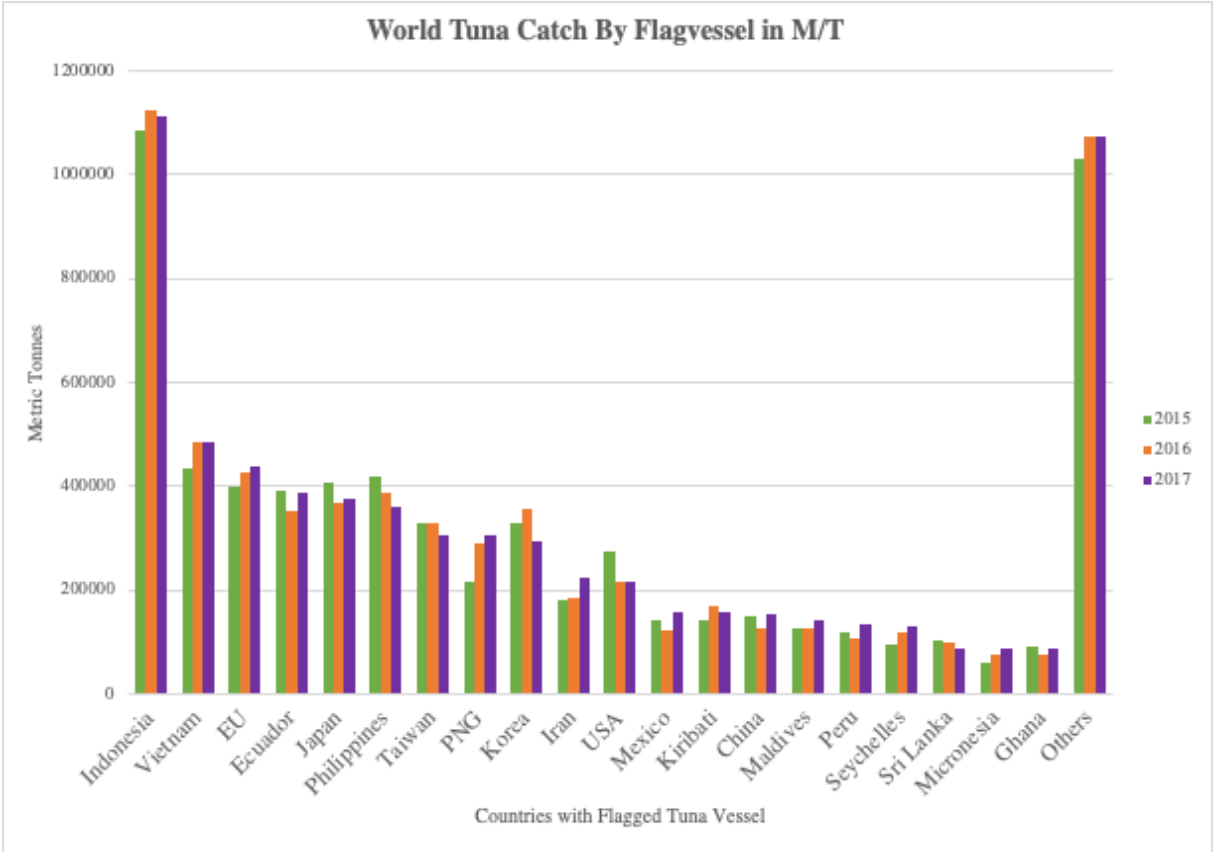


Figure 5. World Tuna Catch by Flag Vessel. (Graph produced based on data extracted from Atuna, 2021, citing FAO, 2020 data base).

Tuna is subject to food loss at the fisheries level - in the form of discards from the tuna fleets. The FLW in tuna fisheries has been addressed through notions of bycatch and discards. The bycatch of the tuna fisheries are unwanted species, which are caught along with the tuna. Discards of the tuna fish that are caught is also a challenge. Gilman et al. (2017) estimates that about 5% of total catch weight ends up as discards in global tuna fisheries. Longline and purse seine fisheries are the greatest producers of discards. Kelleher (2005) has projected that about 10% of total global discards are tuna and tuna-like species. Higher discards are associated with fisheries using FADs (Gilman et al., 2017). The main reason for discarding tuna is if the caught tuna is juvenile (Nunoo et al., 2014) and FADs have been known to attract more juvenile fish. Discards can come from strict catch limits and licenses, which encourage fisheries to desire a certain yield from their catches (Miyake et al., 2010). Strong desires for sizes or species of tuna from the processing industry can also encourage discards in the tuna fisheries. However there are strong regulations prohibiting discards of target species.

Preferences for certain types of tuna fisheries has come from a growing concern for sustainability in the tuna value chains. MSC certified tuna is increasing in expansion and in popularity. Pole-and-line fisheries are often thought to be more sustainable than purse seine fisheries in markets in the US and northern European countries (Hamilton et al., 2011). The use of FADs has also become a trait that buyers want to avoid for sustainable tuna.

## **5.3 Tuna trade**

Tuna is the most important seafood commodity, with regards to monetary value in the world. In 2014 the value of the global tuna industry represented 24% of the total value of seafood trade (Macfayden, 2016). The industry is dominated by a few large traders, which have about 50% of the global processing capacity. These large trading companies are Bolton Group, Calvo, Mitsubishi, Dongwon and ThaiUnion (TUF) (Havice and Campling, 2017). The companies involved in the tuna industry are constantly subject to mergers and acquisitions (Miyake et al., 2010). Since Havice and Campling (2017) analysed the global trading companies, the Fong Cherng Fishery Company Ltd (FCF) has bought Bumble Bee and Brunswick from the Lion Capital in 2020, after all the American tuna brands received large penalties for a conspiracy of price fixing in the American market (Newman, 2020). The acquisition follows a trend of American and European tuna brands that are merged with Asian

trading companies. Large food conglomerates such as Heinz, Unilever and Nestlé have sold the canned tuna brands to financial holding companies such as the Bolton Group, Connor Bros. Income Funds, Lehman Brothers and Emerging Capital Partners. The uncertainties of the financial market have not made the ownership situations any more stable, and mergers and acquisitions continue to create great turmoil in the industry.

Table 5. Brand Ownership of Trading Companies in the Tuna Industry. The flags show the main market of each brand (Table amended from figure in Havice and Campling, 2017, updated information on ownership of Bumble Bee and Brunswick is taken from Newman, 2020)

Trading Company		Country of Origin	Canned Tuna Brands							
Fong Cherng Fishery Company Ltd (FCF)		Korea								
Bolton Group		Italy								
Calvo		Spain								
Mitsubishi		Japan								
Dongwon		Korea								
Thai Union Frozen Foods (TUF)		Thailand								

The branded firms that are involved in tuna processing have great power in the industry and power over non-branded processors (Campling, 2012a). The two modes of branded firms in the tuna industry interact differently with the non-branded processors. The first type is backwards integrated into processing and sometimes fisheries, through ownership of canning factories and tuna vessel fleets. They rely on non-branded processors to supply tuna loins for canning. These companies were often recognised as large European and American food conglomerates, such as Heinz (Campling, 2012a), but have to a greater degree been merged with Asian seafood firms in the last decade (Miyake et al., 2010). The second type are marketing firms, which rely on the non-branded processors to provide finished products. The power imbalance between the branded and non-branded processors are a complex result of international trade system mechanisms, colonial roots and capitalist dynamics (Campling, 2016). The brands are based in Global North markets in the US and Europe, whilst the non-



branded processors often are located in Global South countries. The relationship between branded and non-branded processors could be linked back to colonial ties

Campling (2016) lays emphasis on the role of trade politics and tariffs in shaping the geography of tuna canning and processing. The tuna processing is highly dependent on and linked to the trade policies of the US and the EU. Campling (2016) points to the geographical dichotomy of tuna loining on a global level. Traditionally, tuna was landed at ports which were located close to the canning factories, and was directly processed into cans. With a development towards more globalised tuna value chains, there has been a diversification in the last twenty to thirty years in tuna processors, tuna processing modes and tuna trade. Processors in Europe and the US are importing loins, to be put straight into cans, without requiring any butchering or trimming of tuna (Miyake et al., 2010).

It is only in the Global North, that there are tuna canneries, which rely on imported tuna loins, while processors that specialise in exporting tuna loins only exist in the global South (Figure 6). When tuna canning in the global North is solely based on imported loins, the food waste is minimized. Canneries in the US, Spain, France and other countries in Europe are supplied with products which are ready to insert into tins. The labour intensity and labour cost of processing the whole tuna, is reserved to low cost countries with more affordable labour. The industry in low cost countries is therefore given the task of handling the by-products of tuna to a greater degree than developed countries. The food waste will therefore be greater in these countries, but not necessarily because they are less efficient, or lack technology compared to global North industries. The international division of labour can therefore be linked to processes of food waste.

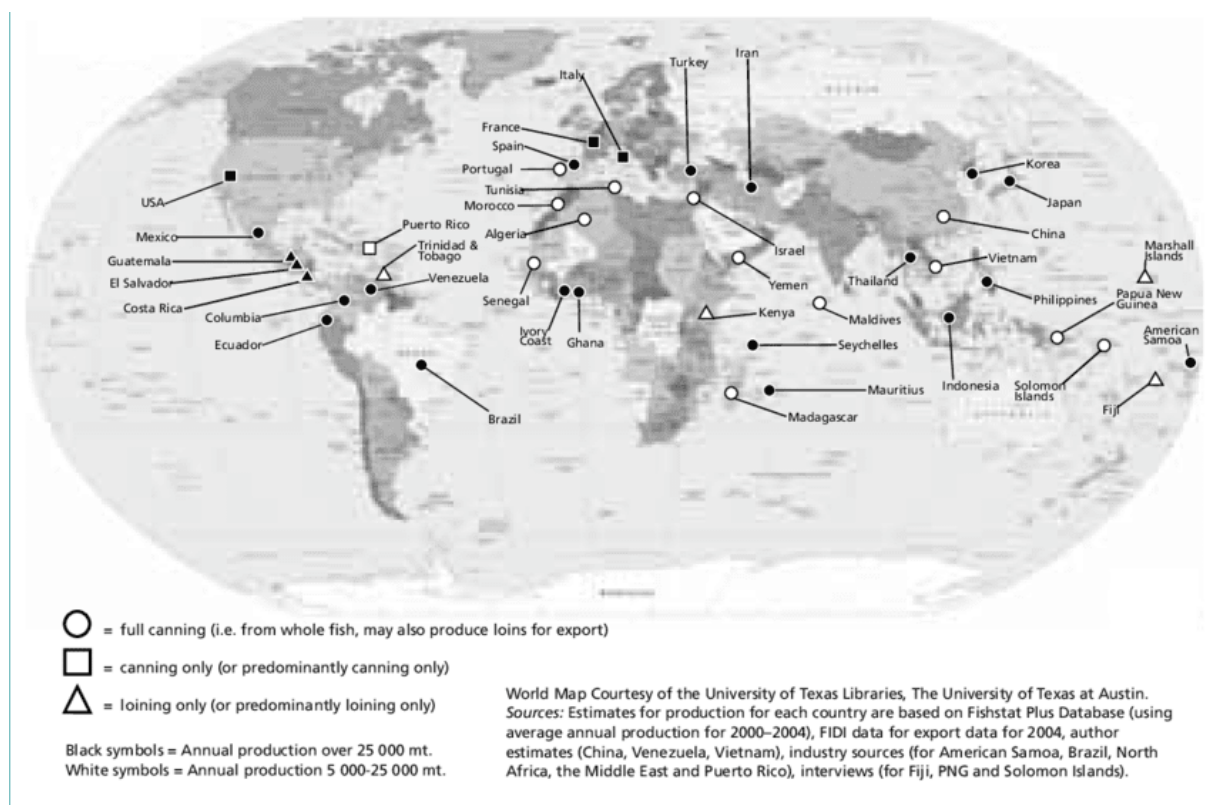


Figure 6. Global distribution of tuna canneries showing tuna loin producers in the Global South and canning of loins in Global North. (Campling, 2016)

Campling (2012a; 2012b; 2016) establishes the concept of the ‘logic of loining’, to explain why there are different modes of tuna processing in different geographical locations. For the European processors the ‘logic of loining’ is based on several mechanisms, which makes importing loins efficient. Issues of transport, labour cost, efficiency, availability and stringent regulations are reasons for the development of a loining industry. The high tariffs that are maintained both in Europe and US for tuna products, are there to protect the processing facilities that still exist in the US and Europe (Campling, 2012a). In the US there are only two tuna canneries left, and a lot of political effort goes into protecting these processors. One of them is located on American territory in American Samoa. Lower tariffs for loins than for canned tuna, help the European and American tuna processors thrive by ensuring cheap loins for canning. By upholding high tariffs for finished tuna products, the competition to the European and American products is limited. This is also an economic incentive for processors elsewhere to supply the Global North markets with pre-cooked loins.

Loins require less space and can be packed more efficiently than an entire tuna fish (Campling, 2012a). Transport is made more efficient by only importing loins which are

packed in vacuum plastic bags. The freezer space is utilised more efficiently. This is seen in Japan as well, where imports of tuna measured in mass have decreased, because the Japanese now only import blocks of belly loins, ready for consumption, instead of whole fish (Miyake et al., 2010).

The majority of labour needed in the processing of tuna is concentrated on butchering, trimming and cleaning of meat (Miyake et al., 2010). The tuna fish has to be handled by manual labour because of the variety in sizes and species of tuna. Processing machinery is not able to adjust to these variations. The processes of butchering and cleaning require about 80% of the living labour needed in the processing of tuna (Miyake et al., 2010). By removing this stage from the Global North processors, the labour needs and costs are cut drastically. For processors, the labour costs in locations in the Global South are lower. The low labour costs are often combined with less stringent regulations and less monitoring capacity in states with weaker governance capacity (Campling, 2016). Locations with low labour costs, such as Ecuador and Thailand, have the advantage of building up economies of scale, with large-scale productions and clusters of processors.

The use of by-products from tuna for fish meal and fish oil to produce fish feed is a lucrative business that is on the rise, due to high demand from the aquaculture sector (Gamarro et al., 2013). The grand increase in aquaculture production around the world has increased the demand for by-product. The use of by-products for animal feed is therefore deemed efficient in a financial sense, because the demand for these products is increasing along with the development of aquaculture around the world.

## **5.4 Tuna retailing and consumption**

Tuna consumption has shaped tuna processing through food culture, food ways and food practices. For tuna the Japanese food culture has been important to the use of tuna products (Robbins et al., 2014; Adolf, 2019). Tuna consumption habits and practices shape the upstream value chain.

Canned tuna is the most common way of consuming fish in the US and Europe (Campling, 2012; McCoy, 2014). UK and Spain import the greatest amount of tuna in Europe (McCoy, 2014). The greatest importers of tuna in Europe are the UK, Germany, France, Spain, Italy and the Netherlands. The countries in the South of Europe, which are still big producers of

canned tuna themselves, have different consumption practices than the Northern European countries. Spain, Italy and to some extent France, consume high-quality canned albacore in oil (Miyake et al., 2010; Campling, 2012b). The UK and Germany consume lower-priced skipjack and yellowfin tuna in water or brine. In the US canned tuna in oil represents a small fraction of the canned tuna market today - only about 3% (Campling, 2016). Canned tuna in water or brine has become the most popular option, because of the promoted health benefits.

When the Japanese began to use the red meat from the bluefin tuna for "maguro"/raw sushi, the demand for bluefin tuna magnified (Robbins et al., 2014). Eventually these traditions from Japanese cuisine became popular worldwide, which drove the demand for bluefin tuna even further. Particularly since the popularity of bluefin tuna coincided with the shift to more efficient purse seine trawlers, which increased the availability accordingly. Global trends in tuna consumption shows an increase in consumption in Europe and North America, and a surge in Japan. Tuna consumption is also increasing in markets in the Middle East, where it has been an untraditional food historically (Adolf, 2019). FAO (2021) reports that the exporters who have diverted into new markets have had greater success compared to the exporting countries which have pertained in the traditional markets of the EU, the US and Japan.

By-products from tuna processing have historical significance within different traditional cuisines. Philippians use the head and fins in traditional seafood soups (Gamarro et al., 2013). The Japanese do also consider the tuna eyes a delicacy (Adolf, 2019). Newer developments in haute cuisine have also uplifted certain parts of the tuna, which was considered waste in earlier times. The fatty tuna belly has now become the ultimate sushi fish (Adolf, 2019). The Ancient Greeks, like the Japanese and the Spanish today, showed a preference for the fatty belly cuts of the tuna, and, like the Japanese, they considered the head a delicacy (Adolf, 2019). Until the 1950s, red meat was the most popular part of the tuna for sushi (Miyake et al. (2010).

The canned tuna is shelf stable and is therefore not as susceptible to food waste at retail and consumption level, as fresh and frozen tuna. Fresh fish is considered to be highly susceptible to FLW, because of its high perishability.

Retail chains that are global in outreach, have great impact on the consolidation of the global tuna value chains, since they are highly involved in the processing. The dominating retailers do often have close relationships with the branded firms that own the processing facilities or they own their own processing facilities (Campling, 2012a).

PART TWO

## **5.5 Tuna Processing**

The tuna loins which are the main product of the tuna for human consumption today. Tuna fish have two back loins and two belly loins. The loins are used for canning in solid packs, chunks, flakes and grated (Herpandi et al., 2011) and preserved in water, oil or brine. In Spain they use special preservation techniques for more exclusive tuna products, such as canned tuna on glass jars instead of tin cans (Gamarro et al. 2013). They are also used for sashimi, sushi and steaks, which are based on fresh or frozen tuna loins. These are not cooked as opposed to the canned tuna loins. The Japanese have also developed a fermented product from the tuna loins, which they call Katsuobushi. This dried, smoked and fermented product is used as a taste additive and in soups (Atuna, 2021b). The Spanish have developed a tuna loin product where they dry and cure the tuna meat. This product is called Mojama and is consumed in the same way as high quality cured ham (Atuna, 2021b).

The clear majority of tuna products are based on the back loins and belly loins of the tuna. Canning is the most common practice in the processing, on a global basis (Campling, 2012). Canning requires the loins to be pre-cooked. After being pre-cooked, they are either put in tins and become a finished product or they are shipped elsewhere in plastic bags. Fresh tuna loins are a second category of processed tuna products. However, they might be frozen and thawed before being consumed, so it is difficult to distinguish between the fresh and frozen market (Miyake et al., 2010).

The tuna is generally landed in round form, meaning that it is not processed on board, but just frozen and delivered to processing facilities as a whole. However, there are different practices for how the tuna is handled at sea, and some may start the processing by removing gills, fins, heads or viscera (Miyake et al., 2010).

Gamarro et al. (2013) give an informative introduction to the processing of tuna for canning (figure 7). Tuna is delivered to the canning facilities in a frozen state and needs to be thawed by spraying hot water on the fish. Depending on the processing done at sea, the fish is gutted after being defrosted. The viscera is removed along with the head and sometimes tail, and the blood is let out. After this first stage of removal of by-products, the remaining part of the fish goes through a pre-cooking stage, which is a steaming of the fish to make sure it reaches a certain temperature. Following the steaming process, the tuna must be cooled, to not overcook the meat. At this point the main part of the by-products are removed. The skin, remaining fins, and gills are removed. There are four loins that are cut from the frame of the tuna fish; two back loins and two belly loins. The belly loins have a higher fat-content than the back loins. Black meat is scraped from the white meat. When the trimming of the tuna and the cleaning of the white meat is finished, the loins are ready to be inserted into cans. Most commonly, the loins are inserted directly at the processing factory, but there is an increasing trend of loins being packed in plastic vacuum bags and sent to processing factories elsewhere, for the processing to be continued there. When the loin is inserted into the can, it is sealed, and then needs to be retorted. The retorting is a second heating process, for commercial sterilization.

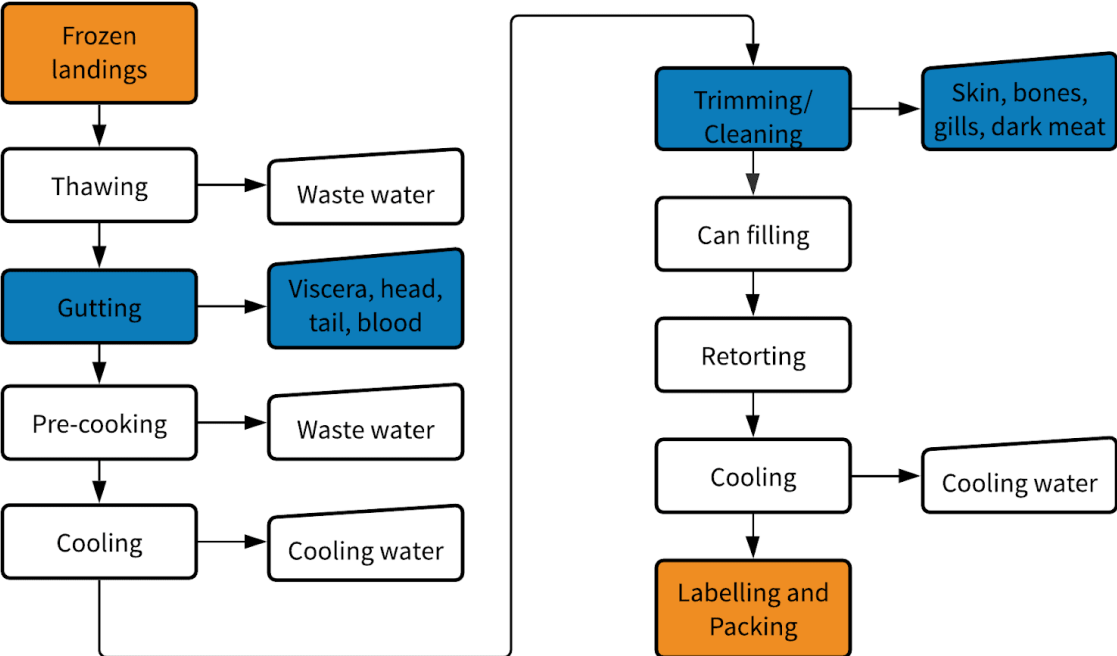


Figure 7. The processing for canned tuna showing by-product generation and different types of by-products (in blue) (based on Gamarro et al., 2013)

Tuna for fresh consumption is processed as raw fish, but can also be frozen and thawed before consumption (McCoy, 2014). Fresh and frozen tuna are processed similarly to canned tuna in regards to butchering and trimming of the fish. The main product of the fresh and frozen tuna value chain is also the tuna loins. Sashimi-grade tuna is tuna destined for markets of sushi consumption, where the most commonly consumed species are bluefin tunas, bigeye and yellowfin (Douglas, 2012). This is mostly Japan, but the consumption of sashimi-grade tuna has increased worldwide in the last decade.

## **5.6 FLW in Tuna Processing**

FLW from tuna processing depends on the type of processing which is performed at the specific tuna processing facility. Whether the tuna fish is cleaned or provided to the facility in ready-made loins, will determine the amount of waste generated at the processing location.

Tuna processing is often put into three categories: canned tuna, fresh and frozen tuna and sushi- and sashimi-grade tuna. However, there are not a lot of differences in the generation of processing for these different modes of processing, because the processing stages where FLW is generated are similar in all of the three modes. FAO reports that approximately 30-40% of the tuna is utilised during processing for products of global demand, such as canned tuna and fresh and frozen tuna loins (Gamarro et al., 2013).

Food safety is highly prioritised and legally required in the seafood sector, exacerbated by the high perishability of fish food products. The fish has to uphold a certain level of sensory, chemical, physical, functional and microbiological characteristics (Guizani et al., 2005).

Reasons for FLW at the stage of processing can be linked to both organisational and structural mechanisms. Based on the High Level Panel of Experts (HLPE) on Food Security and Nutrition (2014) categorisation of FLW explanations and reasons, FLW in the tuna value chain can be understood on a scale based level. HLPE (2014) recognise reasons for FLW on a micro-, meso- and macro-scale. The micro-scale reasons are organisational in nature, such as packaging and transportation. For tuna processing, the organisational mechanisms are based on the labour involved in processing, which are both human and technological. The structural reasons for FLW are linked to the meso- and macro scale based on the systems which lead to practices of waste generation. These dynamics generate, but are also shaped by; market

competition, international division of labour, quality standards and regulations and consumer 'taste' and preferences.

### **5.6.1 Micro-scale causes of FLW**

On a micro-scale, FLW happens at the stage of processing, when the tuna fish goes through different stages of butchering and cleaning. Food loss may occur due to both human and technological shortcomings. There is not much research on FLW in tuna processing.

Thamavit (2019) has researched FLW in the Thai tuna processing industry and Sea Value Public Limited Company. By exploring the causes of FLW in the value chain, the different stages of the canning process are identified and linked to generation of FLW.

#### Human impact

The majority of the human labour involved in tuna processing is concentrated at the butchering and trimming stage. The yield of the tuna is therefore highly dependent on the technique and precision of the people involved in cleaning of the tuna loins. As stated earlier, about 80% of the labour involved in tuna processing is concentrated at this stage. The focus on increasing the yield from the butchering process is an efficiency measure to decrease resource loss in the value chain. Prieto Carolino et al. (2021) point to the Phillipinian tuna processing industry, where women are employed for the cutting jobs which require thoroughness because they are believed to be more careful than men, when handling the fish. Women are used as an efficiency measure to decrease FLW, motivated by increasing yield and revenues.

#### Technological impact

Guizani et al. (2005) emphasise the detrimental effect of cold chain disruption on histamine development in tuna fish, which will, depending on the temperature, degrade the fish to a level unfit for consumption. If the fish is handled at 20 °C at any point in the cold chain, the histamine level increases to a critical level within 24 hours. Research to improve preservation of tuna and to extend shelf life has focused on the efficiency measures and technological development to ensure that the cold chain is not disrupted in the global tuna value chains.



## **5.6.2 Meso- and macro-scale causes of FLW**

### **Unstable demand**

Branded firms and supermarket brands from the EU and US dictate the production premises for non-branded processors. The competition between the non-branded firms become high and the compliance with export conditions become the centre of attention for processing facilities (Campling, 2012a). The margins for being chosen to provide products for a branded firm are small, and the branded firms can use the competition between processors as a tactic to scare. By threatening with the possibility to switch to other processors, the branded firms become in control of and uphold the power in the value chain, without doing the processing themselves (Havice and Campling, 2017). The distance that this system creates between the decision makers and the processors affects the resource efficiency and utilisation in the value chain, since the decision makers only need to consider the finished product. The decision-making power to produce value-added products and utilise by-products, is in the hands of actors who do not handle these resources.

### **International division of labour**

The trends described as the “logic of loining” is dictating increasingly greater proportions of the value chain (Campling, 2012a; Campling, 2016). The international division of labour and the exploitation of low cost labour in the Global South has created a structural division of FLW. The countries in the Global South, doing the manual labour of butchering the tuna, have to deal with the waste products from this processing. The processors in the EU are not handling the waste from tuna processing, but are requiring processors in the Global South to follow the same regulations and standards for food safety and quality as themselves.

Certifications are motivational for uplifting environmental standards. However the sustainability agenda of the certifications for the tuna industry are not based on resource efficiency measures. The incentive for processors to reduce FLW is therefore low. Many processors do not see the economic benefits of decreasing FLW as strong enough to act upon (Thamavit, 2019). This might be based on lack of knowledge on the potential of revenue earnings from more efficient resource use. On the other hand, the economic incentive to increase revenue has encouraged processors to produce animal and fish feed from the un-

utilised parts of the tuna (Gamarro et al., 2013). This may be a sign of the potential to utilise by-products for human consumption in the future.

**Requirements for accessing international markets**

There is a large system of regulations, standards and certification which require compliance from the processor and host country, to ensure access to international markets (table 6). The main priorities of this complicated framework are; food safety, product quality and social, environmental and business compliance (André, 2018).

*Table 6. Regulatory and institutional framework for international market access (Source: André, 2018)*

International Standards and Guidelines	Regulations	Non-Regulatory Standards
<ul style="list-style-type: none"> <li>• Codex Alimentarius</li> <li>• FAO Eco-labeling and sustainable fisheries</li> <li>• RFMO catch/trade documentation schemes</li> </ul>	<ul style="list-style-type: none"> <li>• The EU Food Law and the Hygiene package (food safety and labelling)</li> <li>• The EU rules to combat Illegal, Unreported and Unregulated fishing (IUU)</li> <li>• US Food Safety and traceability regulations</li> <li>• Japan</li> </ul>	<ul style="list-style-type: none"> <li>• ISO 22000 and ISO 12875:2011</li> <li>• Environmental standards for sustainable fishing (MSC)</li> <li>• National Marine Fisheries Service Dolphin Safe Certification (NMFS)</li> <li>• Global Food Safety Initiative (GFSI)</li> <li>• British Retail Consortium (BRC)</li> </ul>

Food safety has been lifted into public attention in recent years. Food safety is important, because contamination of food and the consumption of contaminated food is a severe health problem. However, debates concerned with food safety are often based on false narratives of safe and unsafe food. The strive for food safety can be linked to the generation of increased food loss and waste. Jackson et al. (2010) question the responsibility of ensuring food safety for consumers. The domestic standards authorities, the retailers and lobby groups are all involved in shaping discourses of safe and unsafe food and set the bar for quality of food for protection of the consumer. With Europe as one of the leading markets for canned tuna, their quality and food safety standards become constitutive of the standards in the industry

The EU and the US lay great emphasis on the role of traceability of tuna products (Campling, 2016). All exports of tuna have to be accompanied by a document which can ensure the geographical origin of the tuna fish from the ocean and its processing location. The strict traceability measures leave the responsibility of sustainability and food safety measures on the processing facilities and countries.

In the US it is the US Food and Drug Administration (FDA) is in charge of ensuring food safety for imported fishery products. Based on the Hazard Analysis Critical Control Point (HACCP) principles (McCoy, 2014). US Food Safety Modernization Act enacted in 2011 making the US food safety and sanitary standards for importing countries closer to the EU (McCoy, 2014).

McCoy (2014) and Campling (2016) describe the European regulatory framework as more stringent than the American. The European Commission's Directorate General for Health and Consumer Protection (DG SANCO) has the responsibility for ensuring food safety in the EU. The EU regulations require all fishery processing plants that export to Europe to comply with HACCP principles. Additionally, they require the national authorities to establish Competent Authority (CA) which has to be approved by the EU. The CA's will produce a sanitary certificate for all seafood products that are to be exported, which will ensure that the food safety standards have been followed.

In addition to the food safety regulations, the EU has put in place strict traceability measures, to ensure that the tuna products do not stem from IUU fishing vessels. This catch certification scheme requires a strong traceability system from the state where the processing takes place. The lack of capacity to handle these stringent regulations, can halt exports. The regulation of certificates of origin is also used in the US.

European food safety regulations put the by-products from tuna processing into a category 3 food product, which is deemed to be not intended for human consumption, even though the quality is acceptable (Gamarro et al., 2013). The potential to use by-products from canning in Europe is therefore restricted by the food safety regulations. When the by-products are categorised to level 3, the high cost of equipment and labour is considered too high to

prioritise producing products for human consumption (Gamarro et al., 2013). That is part of the explanation for why most by-products go to animal feed.

The understanding of the relationship between standards and FLW is contested. Fatma (2015) argues for the standards as being a tool to decrease FLW, because the following of these standards will lead to a higher quality product which is less likely to be wasted.

The regulatory context for fish processing is strictly controlling the manufacturing practices to ensure food safety. Ensuring quality of the fish products for human consumption is uplifted in food quality regulations as a measure to avoid deterioration of quality of fish, which will lead to FLW. However, the strict regulations make the utilisation of by-products difficult, because the regulations closely consider the processes at the processing facilities and also the management of waste products. The loss of potential food from lack of by-product utilisation is a great source of FLW.

Esteves and Aníbal (2019) explore the traditional tuna food products in south Portugal and Spain. This region has a long history of tuna fishing, processing and preservation and the sector has traditional knowledge on how to process tuna loins and tuna by-products. Esteves and Aníbal (2019) articulate a concern for the transmission of the traditional knowledge and know-hows. Not only is this “tacit knowledge” largely based on empirics, but it is also challenged by standards and regulations for food safety in the EU. They point to how the young people involved in traditional preservation have shown great capacity at simultaneously gaining knowledge on technological advancements to measure and control nutrient levels and quality parameters for their food products. The ability to uphold a relationship between traditional and modern scientific knowledge is available for the Portuguese and Spanish tuna processors, but could be highly unavailable for processors in less developed settings, with less capital available.

## **5.7 By-products**

The potential for tuna by-products to be used for human consumption has been present in the academic debate for the last twenty to thirty years. Panggat and Shinto (1996) identified the prospects for developing innovative products from sashimi by-products, to reduce waste and increase incomes. In the tuna canning process, only about 30-50% of the whole fish is used -

and about 50-70% becomes solid wastes from original fish materials (Herpandi et al., 2011). Waste consists of muscles, viscera, gills, dark flesh/muscle, head, bone and skin. The blood makes up 7-12% of the fish, while the viscera is about 5-7%. The head, bones and gills are 20-30% of the fish and the dark meat is 10-13% (Gamarro et al., 2013). The by-products are protein-rich. Gamarro et al. (2013) assume that 3-5 % of the tuna are non-edible by-products. This includes the gills and gill covers, called the operculum, and some of the visceral organs. These can be used for fish feed production.

The most prevalent use of by-products in the canning industry is feed for aquaculture and terrestrial animal-production. Most of the by-products that are processed further today, are made into economically low valued products (Herpandi et al., 2011). According to Cashion et al. (2017), as much as 90% of fish destined for non-direct human consumption are food-grade or prime food-grade fish. Between 1950 and 2010 27% of global marine catches went to other uses than direct human consumption.

### **5.7.1 Alternative utilisation of by-products from tuna processing**

Gamarro et al. (2013) provided a Globefish report on the utilisation of tuna by-products in different geographical locations. Gamarro et al. (2013) describe the use of tuna by-products by dividing them into two categories of indirect utilization and direct utilization. Most tuna processors use by-products for indirect utilisation by using it for animal consumption, such as fish meal and fish oil for aquaculture and for land-based animal husbandry.

According to Sayana and Sirajudheen (2017) typical utilisation of by-products from tuna processing are tuna meal, tuna oil, tuna bone powder, tuna silage and tuna sauce. Rustad et al. (2011) describe several different ways of utilising by-products from fish processing for fish protein products such as; fish sauce, fish silage, enzymatic hydrolysis for fish flavour, fish soup and fish paste, collagen, gelatine, protamine used for antibacterial agent in food processing and preservation. These methods are results of both technological innovation and traditional knowledge and are all used by different tuna processors around the world.

The Phillipinian tuna industry utilises by-products from the tuna processing for human consumption in different ways. An explanation for why they are better at utilising by-products than other competing industries, might be linked to their trade relationships with the EU. At

the moment when FAO's report on by-products was written, the Philippines had no preference trade deals with the EU, so they paid full tariffs for exports to the EU. Therefore they did not need to comply by European standards, which limit the ability to utilise by-products. In 2014, the Philippines gained access to the GSP+ preferences, which is the most beneficial trade deal that a country can require from the EU. The tariffs on tuna from the Philippines was then removed, but the Philippines had to oblige by standards and regulations set out by the EU.

Using processes of hydrolysis to isolate nutrients from the tuna by-products is a widely researched field. Fish Protein Hydrolysate (FPH) can be used for a variety of the tuna by-products to produce a wide variety of products for human consumption (Herpandi et al., 2011). Hydrolysates could be used to create food products of functional character, or to create nutritional additives to add to foods, or as bioactive properties to improve qualities of food (Rustad et al., 2011).

Traditional methods for preservation of tuna require less advanced technology and can be more accessible for artisanal and small scale fisheries as well as for the local market of the large tuna processors in countries where undernourishment is a challenge. Traditional methods include curing, salting and drying (Esteves and Aníbal, 2019) and smoking.

### **Dark meat**

Gamarro et al. (2013) identify the use of scrape meat and trimmings in the Philippines, which goes to human consumption. They have developed a product which is based on red or dark meat. The dark meat is canned, either alone or combined with the white meat and sold to the local market or exported to Papua New Guinea. In India there are examples of red meat obtained from the frames and bones of the processed tuna, being used as a form of snack for humans, coated in chaat masala (Gamarro et al., 2013). In Thailand the red meat is colour improved to be included in tuna sausages.

Bertoldi et al. (2004) has explored the possibility of decreasing the bitterness of the dark meat, to make it more attractive to consumer taste. They assume that about 18% of the tuna meat is wasted, based on the colour of the meat and its associated bitter taste.

Hsu (2010) and Saidi et al. (2018) explored the potential of tuna by-product hydrolysate on dark meat. The hydrolysate process could isolate antioxidant peptides which could be used to add nutritional benefits to different types of food. A second benefit of these antioxidant peptides was that they could be added to food to reduce the oxidative stress. That means that the food becomes less perishable. The process is therefore using by-products which would elsewhere become FLW, to reduce the FLW of other food products, which could be considered a win-win situation.

### **Viscera**

The visceral organs do also play an important role in the local food culture in the Philippines, where it is considered a delicacy (Gamarro et al., 2013). The traditional dish - sigsig - is usually made of chicken by-products such as ears, brain tissue and skin, but is often added with other meat replacements, such as tuna viscera. The edible parts of the viscera are the ovary and the milt. The remaining parts of the viscera - the stomach, liver, pancreas and spleen - are great sources of enzymes, if put through a hydrolysis process.

Tuna viscera is used for fish sauce production. Through a fermentation process tuna viscera and salt is combined to create the fish saus. The process needs tropical temperatures and about 6-12 months (Dissaraphong et al., 2006). The fermentation technique is a traditional method of preservation, which does not require high level technologies. However, fish sauce has proven to have high levels of histamines, which should be avoided. Therefore, a hydrolysis process could be used to isolate the parts needed for the sauce production, while decreasing the histamine production. Dissaraphong et al. (2006) explored the risk of deterioration of the tuna fish sauce if the viscera was stored at room temperature before the fermentation process, but found that the histamine content did not rely on the temperature that the viscera was handled.

### **Head and eyeballs**

The tuna head is often seen as a food product of little value. In the Philippines heads and fins are directed to the local market, where they are used for traditional soups (Gamarro et al., 2013)

Miyake et al. (2010) describes an increase in interest for tuna heads, viscera and eyeballs in Japan. Grilled collars have also become a popular dish. Thailand, Korea, Taiwan and Spain are exporting heads, eyeballs and collars to Japan.

### **Bones and frame**

Benjakul et al. (2017) explore the possibility of using tuna frames from skipjack tuna from the Thai tuna industry for bone powder. Tuna frames are high in minerals such as iron, calcium, zinc, iodine and phosphorus. Consumption of fish bones of larger fish could also provide good levels of micronutrients (Windsor and Barlow, 1981). Tuna frames are available in high quantities and at low cost, and are relatively simple to process into edible powder with a nutritional value (Abbey et al., 2012). However, the bones require treatment to be efficient as a collagen provider for uptake (Herpandi et al., 2011).

Nemati et al. (2016) researched the potential of using tuna bone powder that had gone through alkaline treatment in bakery products, as a supplement of calcium for under-nourished lactose-intolerant people. The research was conducted to find the in vitro uptake of calcium from these types of products, but additionally included a sensory evaluation of the bakery products which showed a high acceptance rate among consumers. Nemati et al. (2016) assumed that the results from their study showed potential for tuna bone powder to be used in other food products as well, such as; chips, corn snacks, noodles and cereals. Tuna bone powder is a low cost product, which should be easily integrated into a variety of products for extra nutritional benefits.

### **Skin and fins**

The Indian tuna processing industry has also developed methods and technology to utilise tuna by-products for human consumption. The tuna skin has been put through a hydrolysis process to produce gelatine (Gamarro et al., 2013).

Ahmed et al. (2016) explored ways of extracting oil from skin, scales and bones of bigeye tuna, using a method of extraction under high pressure. They concluded with a method that would provide fish oil from bigeye tuna which would have commercial potential, and could increase the value of tuna waste. The oil extracted from skin, scales and bones had high



values of omega-3 fatty acids, which could bring health benefits if included in western diets (Ahmed et al., 2016).

### **Waste water**

The tuna cooking juice has been used to produce a tuna flavour powder for human consumption (Gamarro et al., 2013).

## **5.8 The case of Ghana**

Tuna fisheries have existed in Ghana for hundreds of years, based on traditional canoes and hand lines as fishing equipment (O'Neill, 2013; Asiedu et al., 2015). StarKist initiated the industrial tuna industry in Ghana in the 1950s, first by exploring the potential for tuna catches in the Ghanaian waters, followed by investments in processing facilities (Hernæs, 1991). They established a tuna industry in Ghana based on incentives to outsource and diversify the American production of tuna and to modernise the existing industry in Ghana. The baitboat fisheries fleets were developed in correspondence with Japanese, Korean and finally local vessels (Mikaye et al., 2010). Ghana had the traditional characteristics to become a tuna landing and processing hub in the 1950s. The access to tuna fish stocks in the Atlantic Ocean and in the Ghanaian waters was a main attribute to develop Tema into a processing location (Miyake et al., 2010). The large existing traditional fisheries sector in the city could provide low-cost labour.

There are two large tuna canning facilities, located in the port-city of Tema. The largest one, Pioneer Food Cannery, is owned by the multinational tuna processing company and food conglomerate Thai Union, which acquired MWBrands in 2010, which was a company linked to the Lehman Brothers. MWBrands had merged with the global food conglomerate; Heinz European Seafood Business in 2006 (Campling, 2016). ThaiUnion owns the American tuna brand Chicken of the Sea, which is, amongst others, produced at Pioneer Food Cannery in Ghana. The second tuna processing factory is the Cosmo Seafood Ltd., a joint venture between the Korean company Silla and the Taiwanese trading company Fong Cherng Fishery Company Ltd (FCF) (Silla Holdings, 2018). The Korean company Silla is the sister company of the largest tuna vessel operating in Ghanaian waters, the Panofi, which is also owned on a joint venture basis by Korean owners. The ownership situations for the two canneries in

Ghana, links the development in the Ghanaian tuna industry with the trends in the global tuna industry, where the American Canned tuna brands have and are still dominating the global tuna production, whilst the traders behind these American brands, have been through merging and acquisition processes with Asian companies in the last couple of years (Miyake et al., 2010).

Ghana has become the African hub for tuna fisheries and processing, with the greatest exports of tuna loins, whole and canned tuna in Africa (FAO, 2016) due to the total modernisation and adoption of modern technology that the Ghanaian industry has been through (Hernæs, 1991). Canned tuna is one of the most important non-traditional export products for Ghana, with a contribution of \$145,706,992 to the Ghanaian economy in 2019 (GEPA, 2020) This was a 22% decrease from the year before. According to GEPA (2020) this was due to a lack of tuna landings in Ghana in 2019. They based the reason for the low landing statistics on the timing for renewal of fishing licenses for the fleets operating in Ghanaian waters, which had increased in price in recent years. This led to a reduction in availability of raw material. The largest tuna processor in Ghana prioritised diverting its imported tuna to a sister company in the Seychelles (GEPA, 2020). This could be done because of a trade deal between Ghana and the Seychelles.

There is a pronounced over-capacity for both tuna fleets and processing facilities on a global scale (Campling, 2012). To secure delivery of tuna catches to realise the capacity of the tuna processing factories, Ghana made a trade deal with the Seychelles (AgriTrade, 2014). The countries have agreed to provide landings of tuna for each other's processing operations. They can benefit from the timing of the tuna fishing season being different for the two countries. This trade deal was made because Ghana and the Seychelles follow the same EU regulations for hygiene standards and standards for tracing origin of the tuna fish.

Today, the European market is the main market for Ghanaian tuna products. Trade deals between the African, Caribbean and Pacific (ACP) countries and the EU, has given Ghana trade preferences which are necessary for the canning industry to be competitively viable in the contemporary tuna market (Campling, 2016). Ghana receives trade benefits on loined and canned tuna. However, these benefits are unstable, and the insecurity of continued preference deals is a challenge for the industry.

According to a report by EJF (2018), the strict regulations of Ghanaian ownership in tuna vessels, is undermined by Chinese interests in Ghanaian tuna fisheries. The flag state ownership of the vessels has become opaque companies for Chinese owners who exploit the tuna resources of the Ghanaian EEZ. The consequences of the Chinese activity in Ghanaian waters are devastating for the sustainability of the tuna stocks, but also for the Ghanaian tuna industry.

The EU has great control over the Ghanaian tuna industry, by making Ghanaian tuna go through inspections for health and safety and quality standards at the production and processing stage (O'Neill, 2013). For the exported tuna to be accepted into the European market, the Ghanaian government has developed an authority, which has had to be accepted by the EU, to carry out controls on quality standards. The Ghana Standards Authority (GSA) has responsibility for all tuna products that go to exports. They follow the fish from port until it is ready to be exported. The canning facilities in Ghana have to follow the HACCP principles (O'Neill, 2013).

Access to the European market is heavily dependent on compliance with hygienic standards and fisheries regulations as well as prevention of IUU fishing. Ghana was given a yellow card in 2014, and lost export access to the EU, which had devastating consequences for the industry (EJF, 2018). The responsibility to tackle IUU fishing is put on the Ghanaian government and the consequences of not complying with the strict EU rules is a punishment of the processing companies. The Ghanaian tuna industry is punished for the illegal activities of Chinese fleets in their waters (EJF, 2018).

The aquaculture industry has become an important market for tuna by-product. Based on information obtained through e-mail contact with a fish feed processor in Ghana, the tuna processors provide tuna by-products for fish feed processing today. The great demand from this sector is driving up the prices for feed. The demand for by-products from tuna for fish feed, has gained such traction that it sparked conflicts in the tuna industry in Ghana about who had the sovereignty of by-products from tuna. In 2012 a small Ghanaian feed production company filed for a lawsuit against Pioneer Food Cannery, because they claimed that they had made a deal with the large processor for acquiring the by-products from the tuna canning for their own fish feed production (NewsGhana, 2012). Pioneer had built their own fish feed production within their own premises and were not interested in providing the by-products to someone else. This case can be seen as a conflict of resource between an international actor

involved in the Ghanaian tuna industry, and a local actor, wanting to utilise the by-products. Even though, their aim for the by-products were the same; to produce fish feed, the conflict could be understood as a struggle for sovereignty over the tuna resource.

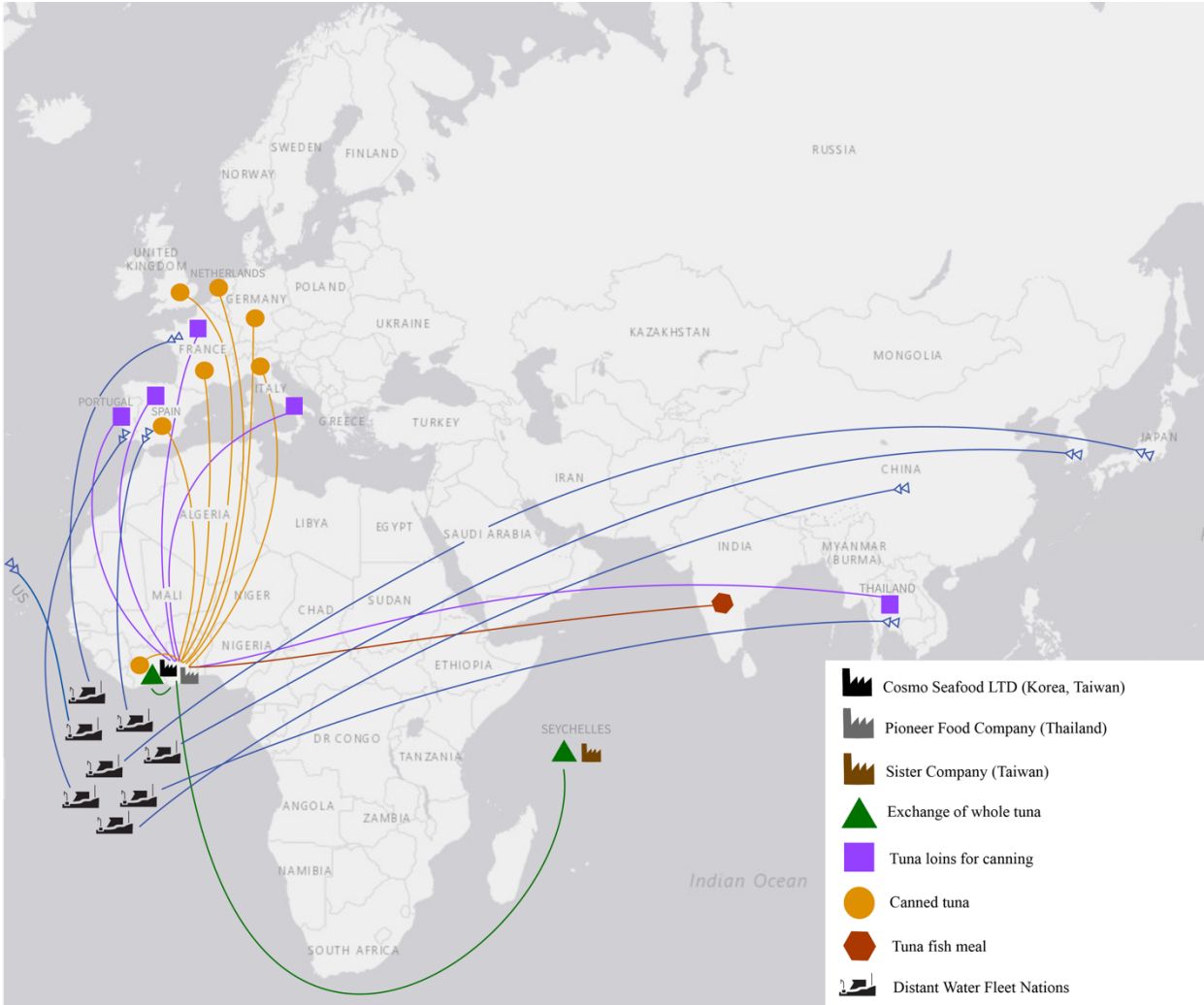


Figure 8. Map of the Ghanaian industrial tuna value chain. (Based on information from Nunoo et al., 2014; Asiedu et al., 2015; O’Neill et al., 2018; GEPA, 2020)

Figure 9 shows a map of the Ghanaian tuna value chain, showing how the tuna products from the processors in Ghana is distributed globally. According to GEPA (2020), the Ghanaian tuna industry is providing both tuna loins and canned tuna for Italy, Germany, Portugal and France. UK and the Netherlands import canned tuna. Due to very limited reporting on export trends in Ghana, it is difficult to trace the value chain of fish feed or the fish oil and fish meal

produced at the tuna canneries. According to the website Export Genius (2019), which posts sample bills of lading, Cosmo Seafood Ltd. exports tuna fish meal to India. However, the domestic aquaculture industry is expanding, so one could assume that a large proportion of the fish feed is traded within the borders of Ghana as well. The map is also showing the presence of DWFs from China, Thailand, Korea, Japan, France, Portugal, Spain and the US (Nunoo et al., 2014; Asiedu et al., 2015; O'Neill et al., 2018) The special trade deal between Ghana and the Seychelles is also depicted in the map.

The use of by-products from the Ghanaian tuna value chain is restricted to the production of fish feed. However, ongoing research explores the potential for use of fish meal for human consumption. In Ghana, research projects have been looking into the potential application of fish meal from tuna frames in school meal programmes, by blending bone powder with porridge and other traditional Ghanaian dishes (Glover et al., 2012). The project gave promising results and showed that the adaptation of tuna by-products into diets is possible and could be a contribution to ensure nutrients for populations with malnutrition and nutrient deficits (Glover et al., 2012).

Stringent food safety measures can be a driver of FLW in a Global South context, because the regulations and standards leave little leeway for alternative utilisation.. An increased focus on food safety, but also environmental compliance to abolish IUU fishing is prioritised over resource efficiency measures. Tuna is seen as an important export article for many of the processor countries, since the target is high-value markets in the EU and the US. Therefore the regulations are carefully partaken by governmental subsidiaries and national authorities control. Developed countries and economies of scale comply with the economic incentive to utilise by-products for aquaculture and animal feed. In the next chapter the empirical findings will be analysed and discussed using the theoretical framework laid out.

## 6.0 DISCUSSION

The theoretical framework of the research is combined with the empirical findings to explore the global system of governance in the tuna value chains and its effect on the resource utilisation and access in the processing node. I will attempt to understand how the governance of the global tuna value chain could increase food security through better utilisation of tuna resources that go to waste today. The discussion is built on the research questions. The use of tuna by-products for human consumption is a component for finding ways to increase food security, along with the access to these by-products.

To explore the empirical findings through the theoretical framework laid out for this research, the horizontal and vertical linkages in the value chain become the matrix in which the global tuna value chain actors are placed. The flows in the value chain are linked to the discourses, the wider value chain architecture and political ecological perspectives on FLW. The discourses that have shaped the industry today were identified to understand how other discourses are left out and excluded from the value chain governance. The discourses have guided and shaped the governance of the global tuna value chain, which affect the utilisation of tuna resources in the processing node.

Based on the first research sub-question on the negotiation of access to tuna resources and GVC analysis, the second section of this chapter looks at how the actors in the value chain interact and negotiate the use of tuna byproducts by incorporating a consideration of power relations and different modes of power founded on Ponté et al's (2019) power typology. The power relations have shaped a network of actors and the links between them.

The third section links the empirical findings of the use of by-products to the political ecology of food waste to discuss how tuna by-products could and should be processed, traded and consumed. By lifting debates about food sovereignty and access as the ability to benefit from a resource, the utilisation of the tuna fish is placed in a political ecology framework.

The last section aims to use the country-specific case study of Ghana to frame and discuss the findings from the GVC in a Global South context and perspective. By using the theoretical

framework of this research, the illustrative case study shows how the globalisation mechanisms at work in the global tuna value chains have not benefited Ghana as a producer in the Global South, to the extent that it could have, to ensure social, economic and environmental sustainability and increase the food security of the population.

## **6.1 How can governance of the global tuna value chains contribute to food security through a greater focus on reduction of FLW?**

Governance of the global tuna value chain is understood as the vertical and horizontal linkages between the nodes, which have decision-making power over the flows in the value chain (Bolwig et. al, 2010). The nodes are governed based on different discourses and narratives of discourses. Food security is incorporated into different narratives, but with very different approaches and ideologies lying behind. All of the research questions add to the discussion of FLW reduction as a food security measure.

### **6.1.1 Vertical governance**

The vertical links between the nodes in the value chain are recognised by the flows of material resources, finance, knowledge and information according to Bolwig et al. (2010). The flows can be understood as travelling in different directions in the value chain network, with some flows oppressing others and pulling in different directions.

With the original approach on value chains, the most important flow was considered the balance of power between the producer and consumer. From the first modernisation steps of the global tuna value chains, the chains were mainly producer driven. The balance shifted abruptly with the consumers' engagement in the fishing methods in the tuna fisheries in the 1980s with the dolphin upheaval, which increased the flow of information between the consumers and producers. The shift towards large multinational trading companies owning the tuna brands, has increased the power at the consumer-end of the value chain, through flows of capital. Consumer safety and preference is consolidated by the power of the trading companies. Even though the consumer-producer linkages can provide an interesting perspective on the value chain, it does not adequately describe the relations between the actors. A relational approach to the value chain requires a deeper consideration of the flow of the value chain and the horizontal linkages of governance.

The flows of material resources may be seen as the main component of the value chain, as the tuna is the main attribute. The product travels through all of the nodes and their flows are essential to the by-product generation and utilisation. The tuna products that go to consumers are dominated by the loins which are used both for canned and fresh tuna. The rest of the products from the tuna fish are mainly used for fish meal and fish oil, which goes to fish feed and not directly to human consumption. However, there is a large inconsistency in the estimates of FLW in the processing node of the global tuna value chains. The data is highly inconsistent and insecure, and range between 10 percent biomass loss up to 50 to 70 percent loss of by-products (Sutanbawa and Aknes, 2006; Herpandi et al., 2011). The need for stronger, more consistent definitions and measurements of FLW is clear and underpinned by the literature on the tuna value chain.

An important aspect of the material flows of resources for the tuna value chain is the end-market. The ability to access the international trade market is important for tuna processors, because of the potential economic gain that lies in the high value markets. The most lucrative markets are the European and US markets, as well as the Japanese. The obligation to follow standards and regulations set out to access the market is therefore an important governing power in the global tuna value chains.

Governance of the tuna value chain is dominated by the western trade regime that regulates the industry. Governance processes led by the nation states are challenged by multilateral institutions. The value chains of nation states worldwide conform to the EU and US trade regimes. The international trade regime is characterised by three governance dimensions; the non-regulatory standards, the regulations and the international standards and guidelines (André, 2018). These three dimensions are based on an architecture of institutions: market-based certification organisations (e.g. MSC), end-market government regulators (e.g. EU) and international institutions. The market-based governance mechanisms of certifications and standards set high limits for production of tuna, and the pressure and responsibility is left on the processors.

Access to end-markets is important for the processor. This requires great insight into regulatory framework, standards and technology to follow food safety measures. For some processors, the lucrative end-markets become inaccessible. These requirements make the dependency on and relations to the large Multinational Corporations (MNCs) vital for



processors in the Global South. When the tuna resources flow into the structures of large MNCs, the ownership of the tuna fish as a whole is left within these companies. The ownership of the tuna resource increases the power of the MNCs over subcontracting processors or processors owned by the companies.

The access to tuna by-products for food insecure populations involved in the tuna industry in developing countries, is reduced by the stringent hygiene and quality standards, which prohibit utilisation of by-products. The by-products are kept within the facilities and hands of large multinational corporations, which have an economic incentive in producing fish feed from the by-products, rather than making more value-added products for human consumption. The development objective is to increase integration and inclusion but is simultaneously encouraging processes of exclusion. Through processes of upgrading a larger global market is reached, and with that follows increased amounts of standards and regulations, which the local producers might not be able to keep up with. The integration will therefore in many cases require the financial and organisational support of MNCs.

The rights-based management approach is based on the ability to exploit the property rights of the EEZs. In addition, the ability to benefit from the tuna resources is defined by several other mechanisms. The MNCs that are involved in tuna processing are backwards-integrated into the fisheries, through ownership in daughter companies or sister companies. The flows of capital that originate from the trading node are constitutive of several other flows in the value chain. These relations give the internationally owned tuna processing companies benefits in the battle for market access and tuna fishing licenses.

The large focus on upgrading in the tuna processing has been followed by the development of methods for utilising the tuna by-products which are technologically demanding, requiring capital-intensive equipment. The different ways of using the hydrolysate process to extract nutrients from the by-products have been heavily researched, compared to other possible solutions (Herpandi et al., 2011). The flows of knowledge are dominated by actors with a focus on technological development and modernisation as a solution to the FLW issues. The by-products of tuna were used in a wide variety of ways for human consumption, which were based on traditional knowledge, preservation and cooking. The strong discourse and focus on technological development, could lead to loss of traditional preservation knowledge. The

modernisation narrative can be seen as the driver for technological by-product utilisation in the tuna value chains.

The demand for fresh tuna has increased the technological demand in the global tuna value chains, with the development of different packaging technologies. The tuna processing as a whole is becoming more technologically advanced and capital intensive. However, the fish cleaning and butchering continue to be a labour intensive process. The link between food waste and technology is therefore quite intricate in the value chain. The mechanisation processes have not been able to integrate the entire processing procedure. Gascón (2018) points to how technology often is presented as the solution to FLW issues at a micro-level, by making food production more efficient. In the tuna value chain, the manual labour has not been replaced, but rather dispersed to countries in the Global South, providing cheaper labour and less strict environmental regulations.

An aspect which should be considered is not just what the consequences of obliging to the standards that an inclusion in the Western market requires, but also what exclusion will mean. The inclusion and exclusion processes are important for the horizontal linkages in the value chain, but are a consequence of the vertical linkages as well. The standards and regulations are strict and may lower the financial motivation to make products for human consumption of the by-products. The exclusion from the global tuna value chains, could therefore allow a more liberal use of tuna resources, which could increase the food security in the local food system. The accessibility of food in local food systems, can be hampered by participation in globalised value chains (Cohen et al., 2019).

The FLW challenge has been framed with a vertical value chain approach. This approach has fostered a sector-based understanding of the solutions. When sectorial solutions are sought, the focus becomes limited to the micro-scale. By approaching the FLW challenge at a meso- or macro-scale, the larger links and structures can be included in the search for solutions. At a micro-scale, the management of the tuna processing can be seen as the reason for the vast amount of tuna biomass that does not go to human consumption. However, perspectives on standards and regulations of the global tuna value chain and industry need to be considered to understand how wider networks have implications for resource utilisation. With a micro-scale perspective, one could easily address the FLW issue with technological solutions for efficiency measures. By including a meso- and macro-scale, one has to address the issues

through a more holistic and social manner and look at ways which can ensure that the value chain allows the by-products to be used for human consumption.

### **6.1.2 Horizontal governance**

Horizontal linkages in the tuna value chain contain processes of inclusion and exclusion. Analysis of horizontal linkages is tightly related to the linkages in the vertical value chain. The horizontal aspects of the value chain incorporates the relational by considering the actors which are a part of and outside of the industry. For this research, the discourses of tuna value chain management has been central, and the horizontal aspects are therefore considered through a discourse lense. Discourses are steering processes of inclusion and exclusion and are therefore important to the horizontal value chain relations. Havice and Campling (2017) draw the link between environmental governance and horizontal governance in the tuna value chain. The discourses which have hegemonic status in the tuna value chain revolve around the concepts of conservation and economic development.

Overarching discourses of international governance, accentuate the power of international management to secure and conserve a resource. This view is established in the tuna value chain, where the RFMOs have an crucial role in the management of the pelagic and migrating tuna fish. The establishment of the RFMOs is based on the narrative that tuna travelling between the world's oceans are best managed on a regional level, conforming to the global environmental management narrative that Adger et al. (2001) described. However, the decision-making power of the RFMOs is reduced to consensus amongst its highly diverse members and voluntary compliance, which has manifestly been quite inefficient (McClunley et al., 2019). The RFMOs are the most important attempt at international governance management of the tuna resources and has been shown to be a poor strategy so far.

The integration of firm-level power into the RFMOs has added a new dimension of concern (Havice and Campling, 2017) for the power balance and the ability of the organisations to protect marine resources and provide fair quota distribution. The power of private actors and public actors in the Global North within the bargaining environment of the RFMOs is important in deciding how the resources are distributed, which affects the accessibility of the tuna resources. The DWFNs in the tuna industry dominate the RFMO negotiations, with an increasing influence of MNCs.

A populist discourse, as described by Adger et al. (2001) would approach the tuna value chain with the narrative that people do not benefit from trade and that SIDS and other tuna fishing countries are reduced to victims of international trade. The 'logic of loining' could be seen as one such signifying practice, which reduces the value of the tuna product coming out of the countries in the Global South, for the benefit of the countries in the Global North. However, the agency of the Global South actors in the value chain is significant. There are a myriad of ways in which coastal countries and SIDS participate in the tuna industry, and understanding the spatial context is essential. Nevertheless, it is important to understand how the power relations in the value chain include and exclude actors from benefiting from the tuna resources.

Tuna-led development has become an important component for domestic economic growth for SIDS and other tuna nations in the Global South. Tuna-led development is a strategy brought forward by the Global South countries themselves as a way to derive benefits from the resource in a manner which is not done today. The agency that these countries are showing through these strategies are important to incorporate into understandings of the tuna value chain and its effects on countries participating in the value chain. The tuna-led development has clear links to the blue economy and the narrative that sustainable fisheries practices can be reached in concurrency with economic growth.

Sustainability has become an integral part of governance in the industry but has been attempted to be combined with economic growth through the notion of blue growth and blue economy. The contradictory narratives that the blue economy discourse builds on is recognised by Andriamahefazafy et al. (2020). The role of the EU in controlling the overexploitation of tuna stocks in the exporting countries, plays a major role in inclusion and exclusion in the global tuna value chains. Exporting to the EU, requires a strong monitoring capacity by the exporting nation states, to hinder IUU fishing in sovereign water.

The blue economy approach has developed differently for different actors. It is founded on a belief in the value of local participation in value chains, to increase economic development, its outcomes are diversified. This can be linked to theories of the benefits of trade. Béné et al.s', (2010) questioning of the role of trade in the fight against poverty is relevant, when looking at the role of tuna-led development. Tuna processing has been beneficial for certain countries, but not for others. The ownership of the tuna resources is regulated through the

UNCLOS “law of the sea” from 1982, and the coastal countries should have ownership of the resources within the EEZs based on jurisdictional legal frameworks. However, the ability to benefit from the tuna resources is controlled by much more than the limitations of the EEZ framework.

Ribot and Peluso’s (2003) theory of access, defines access as the ability to derive benefits from things. One of the ways this is done is through property. The theory of access differentiates between access as ability and as right. The SIDS have embraced the blue economy discourse using a rights-based approach. The tuna resource is seen as an opportunity for the developing countries to spark an economic development in their domestic economy, through a tuna-led development strategy. The rights-based approach has created a discourse or prioritisation of SIDS’ rights to exploit the resources, which should overrun the priority of sustainable management. This conflict between economic and environmental sustainability is grounded in a concern for the social sustainability of the local populations in countries with active tuna industries, who depend on tuna for their livelihoods.

The focus on upgrading is reproduced by the discourse of modernisation, neoliberalism and blue economy. FLW solutions are incorporated as an upgrading strategy of technological solutions. Through this narrative, the discussion is kept on a micro-scale, and is not engaging with the systemic change needed to reach the root of the problem of FLW, which could be traced back to the ontology of nature as capital (Silver et al., 2015).

## **6.2 How do the actors in the tuna value chain negotiate access to and utilisation of the tuna resources?**

The negotiation of use of the tuna resources in the global tuna value chain is founded in the power relations of the participating actors and the flows of communication in the value chain. Ponte et al.’. (2019) formulation of a typology of power in global value chains is operationalised to understand how the different modes of power are activated in the global tuna value chains. The access to and utilisation of the tuna resources includes the by-products which are the largest part of the FLW at the processing stage.

### **6.2.1 Bargaining power**

The relationship between the branded and non-branded firms in the tuna value chain can be seen as a bargaining relationship. The branded firms have power over the non-branded firms, since they operate at a scale where one single producer is easily neglected and outplayed. The bargaining power of the branded processors has created the spatial division of labour in the tuna industry, with Global South producers doing the manual labour and Global North producers doing the capital-intensive labour of packing the ready-made loins into tin cans. The EU and the US have used their tariff systems as a bargaining tool to motivate Global South processors to provide loins for their processors, by setting the tariffs at low rates for these export products. The relationship between branded and non-branded tuna processors is therefore important for the utilisation of tuna resources.

Another type of bargaining power which affects the use of tuna resources is the negotiation between the same branded firms owned by trading companies, and the nation states with tuna fish in their EEZs. Because many of the trading companies are backwards integrated into the tuna fisheries, they can control the access to resources from the initiation of the value chain. The branded trading companies are superior in this relationship as well, with the power to shape the way fishing licenses are distributed in the RFMOs, but also where the tuna is processed.

The access to the tuna resources is shaped by the bargaining power of branded tuna processors and trading companies in negotiation with non-branded processors and nation states.

### **6.2.2 Institutional power**

The institutions of importance in the tuna value chain have the ability to ‘set the agenda’, corresponding to the act of creating a hegemonic discourse. The institutional power which affects the access to and utilisation of tuna resources are based on the three governance mechanisms which dominate the international trade regime; the certifiers, the regulatory framework and the international standards and guidelines.

The institutional power in the global tuna value chains is held by actors in power in the international trade regime, which have formulated sets of standards and regulations to control

the imports of tuna to Western markets, to ensure safe and sustainable tuna for the European and American consumers. However, this institutional power dictates the utilisation of the tuna by-products as well, because they are setting strict food safety standards for the entire processing procedure, which prevents the by-products to become human food.

### **6.2.3 Demonstrative power**

Demonstrative power is important in the tuna value chain, because the involvement of consumers has a historical significance for the discourses of conservation and sustainability in the global tuna value chains. The upheaval against the fishing techniques of the tuna industry in the 1980s created a consensus on ‘dolphin-free’ tuna fishing.

The certifications have become an integral part of the industry, and important for access to the main markets. The demonstrative power of certifications have shaped the industry, because the industry has had to become more transparent. However, one could also say that the context is too complex for a consumer to grasp through some labels on the canned tuna package (Eden, 2011). The introduction of ‘dolphin safe’ tuna in the US, led to a shift in fishing grounds, increasing the environmental pressure on tuna stocks in the WCPO.

### **6.2.4 Constitutive power**

The developing nations in the global tuna value chain have been able to aggregate power in negotiations in RMFOs by forming coalitions. An example of this is the PNA. The developing nations have been able to negotiate their position in the RFMO and the Fisheries Forum Agency (FFA) by creating an alliance. Through this alliance they have kept the right to use purse seiners for tuna fishing. Even though the negative environmental impact of this fishing method is widely recognised, the economic benefits of the tuna fisheries for these SIDS has been prioritised based on the constitutive power they have shown in the negotiations in the RFMO.

Transmission Mechanisms			
Arena of Actors		Direct	Diffuse
	Dyadic	Bargaining Power Branded firms vs. non-branded firms Large tuna trading companies negotiating access to resources with SIDS and other coastal countries	Demonstrative Power MSC certified fisheries Dolphin-safe certification
	Collective	Institutional Power <ul style="list-style-type: none"> <li>National regulations and standards: EU and US trade regime</li> <li>International standards and guidelines: FAO guidelines</li> <li>government regulation, multi-stakeholder initiatives</li> </ul>	Constitutive Power Parties of the Nauru Agreement (PNA)

Table. Typology of power in global value chain (GVCs) operationalised with the power relations of the global tuna value chains (Adapted from: Ponte et al., 2019, p.128)

The different modes of power show how the strongest tuna value chain actors are able to obtain and withhold power. The actors upholding Western discourses of modernisation, neoliberalism and environmental conservation have the greatest aggregated power and can shape the value chain in their favour. However, one must not underestimate the agency that SIDS and coastal states in the Global South are exhibiting.

### 6.3 How, by whom, and where are tuna by-products utilised?

The question of how the tuna by-products is utilised is an empirical question of the flows of material resources, which is explored in section 5. However, the utilisation becomes a topic for discussion, based on what the empirics showed about the use of tuna by-products for fish meal and fish oil. Most by-products from tuna processing and canning go to fish feed production. The argument for using the by-products for this purpose is that it is a value-



adding activity, and therefore can be seen as upgrading the value chain of by-products; rather than letting the products go to waste, it is better to use them for food production. This is a narrative that can be grounded in the discourse of economic growth and the blue economy. However, if one looks at the utilisation of energy and nutrition in the tuna by-products, the act of producing fish feed is not deemed efficient. The exclusion of local consumers from the tuna by-products is rigged by this type of utilisation.

By whom the tuna by-products are used is an important question of inclusion and exclusion in the global tuna value chains. This question can ultimately be linked to the value of knowledge. Traditional knowledge is not integrated well enough into the development of FLW solutions. The traditional knowledge on how to prepare and preserve the tuna by-products is limited by the lack of access to the by-products as food products. The way the value chain is structured where the MNCs have control of and ownership of the tuna by-products, creates a prioritisation for the most available utilisation of by-products, which the aquaculture industry provides with the demand for fish feed.

This is also a question of flows of knowledge. Flows of knowledge are defined by the discourses of food safety and environmental conservation. Narratives of modernisation and neoliberalism have shaped the way the fisheries are perceived as aiming to be industrial, efficient, and modernised, with the developed country industries as the blueprint.

The EU standards for food safety, which grade the by-products of the tuna to a third-grade food-product can be linked to the inability to use the tuna by-products for other purposes than for fish feed. The grading does not mean that it is not edible or safe to consume. However, the value of the product is lowered, and the value that can be achieved from making it into a food-product for human consumption is also lowered. This lessens the economic incentive to find a way to use the by-products for human consumption.

The institutional power in the tuna value chain is limiting the utilisation of the tuna resources through the processes of food safety regulations. The standards and regulations set rules for processing of tuna to ensure food safety for the consumers, which in the case of the tuna value chain are the Western end-markets. Food safety regulations can contribute to the food insecurity of vulnerable populations, and therefore the social dimensions of the structure that is in place to ensure food safety should be reconsidered.

Food waste can be placed in a food sovereignty debate, based on the disparity between the rights and access to the tuna resources that exist in the global value chains today. The industrialisation of food value chains creates food waste due to high standards for quality of food safety. A greater ownership to the resources that belong legally to the nation state and the population, could increase food security for the local population. The by-products do not go to human consumption and should by certain definitions be defined as FLW. By ensuring local access to the by-products, they could be utilised to increase food security by adding valuable nutrients to local diets.

Even though the food safety standards might be a contributing factor to utilisation of tuna by-products for fish feed, it cannot be said to be the single reason for the poor utilisation. Gascón (2018) emphasises the problematic aspects of applying a monetary approach to the generation of FLW. If the monetary value of the food products that go to waste is used as a basis for incentivising alternative uses of this biomass or by-products, then any alternative utilisation can be defended, since it is increasing the monetary value. For the tuna value chain this means that the use of tuna by-products for fish feed can be argued to be a good way of utilising the resource. However, if one applies a different approach to understanding the value of the resource, such as energy or nutritional value, then the utilisation for fish feed becomes more problematic. The use of valuable energy and nutrients from the tuna for feeding other and smaller fish that goes to human consumption in a second stage will not be deemed efficient. It will not necessarily benefit those in most need of these nutrients either.

#### **6.4 How does the global system of governance of the tuna value chain affect access to tuna as a food resource in tuna-producing countries in the Global South?**

The case of the Ghanaian tuna value chain is used as an illustration to show the effects of participation in the globalised tuna industry in a Global South context. To show how the discourses have shaped the industry, the processes of inclusion and exclusion are analysed. The global value chain approach is contextualised for the Ghanaian case. As a summary the political ecology perspective is applied to put the value chain in a framework for social justice and understand its consequences for food security in Ghana.

The establishment of the tuna export industry in Ghana was based on discourses of modernisation. Integration into global value chains and exporting of tuna products was a strategy of economic development for Ghana, but also a product of the neoliberal agenda of the American tuna industry to expand into waters with available tuna stocks. The discourses of economic development have not shown the expected results for the Ghanaian economy.

The discourses that govern the tuna industry in Ghana is shaped by flows of capital and knowledge. The capital flows quite clearly from the trading companies that own the two processing facilities in the country. The knowledge flows from the standards and regulations set out by the end-market for Ghanaian tuna; the European Union. Standards for ensuring food safety and regulations for ensuring sustainability in the industry is decided by the entry regulations to this market.

The number of concerns in the tuna value chain, makes the prioritisation of certain issues difficult. There are a multitude of discourses which are competing and prevail in a contradictory manner. The focus on FLW in the canning industry is limited by a number of other sustainability concerns. Since the EU has strict regulations for rules of origin to tackle the challenge of IUU fishing, the Ministry of Fisheries and Aquaculture Development (MoFAD) must prioritise monitoring and control of the fisheries. The sustainability discourse that is driving the regulations of IUU from the EU, leads to the exclusion of countries which are not able to control the fishing grounds of their EEZ. In Ghana's case the IUU fishing is dominated by DWFs and mainly Chinese fleets. The closing of export routes as punishment for IUU fishing is therefore highly unfair and problematic. The responsibility is put on the processors, even though the problem lies in the fisheries.

The tuna fish is kept within a loop of multinational companies 'exploiting' or utilising the fish resources for economic gain. In Ghana the processors are providing jobs for the local population, but the ability to utilise the fish is reduced to the labour-intensive work of butchering and cleaning the fish. The canned tuna is then fed back into international trade relations for economic gain which is for a large part kept within the companies.

The existence of a tuna by-product value chain for human consumption in Ghana is limited by capital interests in producing fish feed. The aquaculture industry is on a rise both in Ghana and internationally. The possibility to use the by-products for other matters is limited by the strict control within the industrial processing sector, and the sovereignty that the tuna canning

factories have over the tuna byproducts, which was shown in the conflict between Pioneer Food Cannery and Ghana Protein. Ghana Protein was a local small-scale producer of fish feed but was not able to access sufficient amounts of tuna resources, because of Pioneer Food Cannery's entitlement to the tuna by-products from their production. This was not a case of by-product utilisation for human consumption but depicted clearly how tuna resource access was regulated by the owners of the tuna processors.

The Ghanaian case shows how the globalisation of value chains has not worked well for Ghana as a country. The discourses for development of the value chains work well on paper and in a Western perspective but have not been applicable to a Global South context. The discourse perspective is efficient to show how the discourses are contradictory in different contexts.

The discussion has brought together the theoretical framework and the empirical findings for this research. The global system of governance has been analysed with regards to power relations and power typologies. The utilisation of by-products has been scrutinised with political ecology perspectives to understand how contemporary utilisation is affecting food security. The illustrative case study of Ghana is central to understanding how the globalised system materialises in a Global South context. The conclusion will extract the principal points from the discussion chapter to point to the main findings.

# 7.0 CONCLUSION

This master thesis has explored the food loss and waste of tuna resources in the global tuna value chains. The aim was to understand how the global system of governance affects the access to and utilisation of tuna resources and by-products. To conclude, the research questions will be used to bring out the main points of the discussion and lead to the main account of how FLW measures in the global tuna value chain can increase food security.

## **1. How do the actors in the tuna value chain negotiate access to and utilisation of the tuna resources?**

Access to the largest tuna markets is controlled and restricted by tariff systems for tuna products in the US and the EU. These systems control which tuna producing countries can export their products and have furthermore introduced 'environmental' control to restrict IUU fishing in waters of the exporting countries. The countries that represent the largest tuna end-markets are also highly represented as DWFNs. The tuna value chain is dominated by large MNCs that have great power over the network of tuna value chain actors. There are large Asian trading companies which today own or control a large part of the tuna industry. They own the leading tuna brands and control the non-branded producers and processors through mechanisms such as standards setting and order control.

The governance of the global tuna value chains has affected the resource utilisation in the tuna processing, through three governance mechanisms. International standards and guidelines provide strong control over environmental and social aspects of tuna production. Regulations, which are mostly restricted to nation-state policies, control food safety of the tuna production, but also to some degree restrict alternative uses of by-products. Lastly, non-regulatory standards have power to set rules for the industry, both on product safety and quality and on traceability and environmental conservation.

## **2. How, by whom and where are tuna by-products utilised?**

There is a rich research basis and literature on how technologically advanced methods could be used to extract the most nutritiously significant content of the by-products. However, these solutions are costly and capital intensive. The tuna industries in small island developing

countries do not have the economic flexibility to insert such technology into their own production chains.

There are geographically dispersed examples of how tuna by-products are utilised in traditional dishes and using traditional techniques that do not require capital intensive technology. The ability to access tuna by-products for these types of purposes is however restricted by the large MNCs that are involved in tuna processing, the DWFNs that occupy much of the tuna fisheries, and the standards and regulations of the global tuna value chain. Globalisation of the tuna value chains has coupled several mechanisms that restrict local access to tuna resources. Even if this means only accessing the by-products that are not used for human consumption.

### **3. How does the global system of governance of the tuna value chain affect access to tuna as a food resource in tuna-producing countries in the Global South?**

The discourses which have shaped and been shaped by the global system of governance has established an export-oriented tuna processing industry in Ghana based on modernisation and neoliberal discourses. The participation in the global tuna value chains has not sufficiently benefited the population in Ghana or contributed to the food security in the country. Blue growth discourses are attempting to couple continued economic development with environmental sustainability measures. This has led to a responsabilisation of the processing node and the Ghanaian government in protecting and securing their waters against external IUU fishing activities. The international actors that are present in the Ghanaian tuna value chain restrict the access to the country's own tuna resources. The by-products are not accessible to be utilised by local processors or for human consumption in the country.

### **How can governance of the global tuna value chains contribute to food security through a greater focus on reduction of FLW?**

An increased focus on FLW in the value chains of tuna could lead to increased food security if the populations that are experiencing food insecurity could access the tuna resources which they have legal rights to. There is little recognition of traditional knowledge and non-technological solutions to the FLW challenges, and the issue of access to the tuna resources is still challenged by neoliberal narratives of the blue economy discourse.

The FLW challenges are often depicted as streamlined challenges, with streamlined solutions which can easily be implemented in a linear value chain approach. This research has demonstrated the complexity of the FLW challenge, and how truly intricate and scaled the problem of wasting resources in this way is. The issue of FLW must be tackled in a systematic manner by going into the roots of the problem and not by applying technological and behavioural fixes to individual value chain nodes and individual actors. The potential of nutrient rich by-products of tuna to contribute to food security is not at any level substantial enough to solve hunger. Nevertheless, the issue of access to food resources that go to waste in the current food system, is an entry-point for understanding how FLW measures could alleviate food insecurity.

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