MAXIMIZING ECONOMIC RETURNS FROM THE HAKE FISHERY IN SOUTH AFRICA

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ABSTRACT

The future of capture fisheries is currently under threat due to declining stocks. According to the current SOFIA Report, the proportion of overexploited or depleted stocks has increased from 10 per cent in 1974 to 29.9 per cent in 2009. To ensure sustainable development in economic, social and environmental terms, the utilization of by-products has become an important industry in various countries. The focus of this study is therefore to introduce utilization of by-products and increase value of production in South Africa. Currently, there are still tons of fish turned into low value products such as fishmeal, and some parts of fish discarded at sea as waste. With the limited resources, South Africa ought to make the most out of every kilogram of catch by introducing the concept of full utilization. An analysis was done using the diamond model of Michael Porter to evaluate the competitiveness of the South African fishing industry compared to that of Iceland. Using Iceland as a benchmark, the first phase of this study involved conducting research through interviews in the South African hake fishery to determine the current level of utilization as well as in Iceland to learn from their experience of full utilization. The model and research conducted revealed that the South African fishing industry lacks the supporting industry which is the vital part of the full utilization project. Policies were then recommended for south African government to support the industry. It is anticipated that this project will contribute towards job creation in the fishing industry as well as economic growth.

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1 INTRODUCTION

South African fisheries have shown signs of decline in most commercial sectors. The latest assessments indicate that a total of 50% were considered to be of concern. Of these, 22% are considered depleted or heavily fished, and 28% are considered heavily depleted (DAFF, 2014) Amongst other issues, overfishing is believed to be the prime factor responsible for this decline. With South Africa's population continuing to grow, fisheries continue to be under severe threat due to high demand.

Another challenge facing the fishing industry is the issue of value creation. In South Africa, there are still tons of fish turned into low value products such as fishmeal, and some parts of fish discarded at sea. Records indicate that in the hake fishery, there are currently 18 freezer vessels that land headed and gutted hake (SADSTIA, 2016). With the limited stocks, South Africa ought to make the most out of every kilogram of catch through value creation and waste minimization.

South African fisheries resources are managed by the national government. The highest executive office conducting this management is currently the Department of Agriculture, Forestry and Fisheries (DAFF), in accordance with the Marine Living Resources Act, 1998 (Act No. 18 of 1998) (MLRA). The Marine Living Resources Act establishes as an objective the utilization of marine living resources to achieve, inter alia 'economic growth, human resource development, capacity building within fisheries and mariculture, and employment creation'. DAFF therefore, is tasked with managing the development and sustainable use of marine and coastal resources; maximising the economic potential of the fisheries sector; and protecting the integrity and quality of the country's marine and coastal ecosystems (South African Government News Agency, 2016)

South African government has recently embarked on a special project, which aims to "Unlock the Economic Potential of South Africa's Oceans" called "Operation Phakisa". This is an adaptation of the Big Fast Results methodology that was first applied by the Malaysian Government successfully, in the delivery of its economic transformation programme (South African Government News Agency, 2016). In August 2013, the president of South Africa undertook a state visit to Malaysia, where he was introduced to the Big Fast Results Methodology through which the Malaysian Government achieved significant government and economic transformation within a very short time (DEA, 2016). Using this approach, they addressed national key priority areas such as poverty, crime and unemployment.

With the support of the Malaysian government, the Big Fast Results approach was adapted to the South African context. To highlight the urgency of delivery, the approach was renamed Operation Phakisa ("phakisa" meaning "hurry up" in Sesotho) (DEA, 2016). It is anticipated that Operation Phakisa, which is still under development, will place marine resources in a central position in the economy. The fisheries sector is an important element of the Ocean Economy Strategy. This puts DAFF in a position where the department must find strategies to use marine resources to achieve both the objectives of the Marine Living Resources Act and those of Operation Phakisa. In response to that, DAFF in its Strategic Plan 2015/16–2019/20 emphasized that its approach in this sector will continue to be around responsible management of the marine resources supported by extensive research on the declining marine stock (DAFF, 2015). Through Operation Phakisa, DAFF believes that they can potentially grow the sector value from its current R2 billion to R6 billion, with possible job creation of up to 210 000 in this sector by 2030. However, in this plan, nothing is said

about utilization and increased value adding. Therefore, this study aims to inform the department of other possible ways towards success around responsible management other than putting all the focus on aquaculture development.

The study aims to work towards pointing out possible transformation of the underutilized and wasted raw material into more value-added products. This project envisaged to underline many benefits including job creation and increased value of the South African products, which will have a positive impact on both the coastal economy as well as the GDP. The study will also address the political benefits of introduction of full utilization as well as economic and environmental issues related to implementing full utilization.

It is however worth noting that the study will focus on the hake fishery only but the idea to introduce full utilization to other sectors might follow at a later stage.

1.1 Purpose and objectives the of study

Certain systems and structures need to be in place for any country to successfully engage in maximum utilization of fish caught. A country needs to be globally competitive with relevant factors in place. This study seeks to explore and evaluate the feasibility of South Africa to join the movement of full utilization of fish. This will be done by applying the diamond model of Michael Porter (Porter, 1990) to assess the competitiveness of the South African fishing industry comparing it with that of Iceland. Iceland is one of the nations that have advanced fisheries management systems and is also in the lead in terms of full utilization. Based on the results of the comparison between the two countries, recommendations would be provided. Implementation plan would also be suggested should South Africa turn out to be in a position that allows implementation of full utilization.

2 SOUTH AFRICA AND ITS FISHERIES

2.1 Economic situation in South Africa

The Republic of South Africa is situated at the southern tip of Africa forming part of the southern Africa region and is bordered by Namibia, Botswana, Zimbabwe, Mozambique and Swaziland. Lesotho is surrounded by South Africa (Figure 1). The total land area is 1 223 201 Km² (Mbedi, 2016).

Figure 1: Map of the Southern tip of Africa illustrating South Africa and her neighboring countries. Source: www.mapsofworld.com

South Africa is the second largest economy in Africa, after Nigeria. It is the largest fishing nation in Africa, ranked 30th among fishing nations worldwide (FAO, 2010). South Africa is a member of the Southern African Development Community (SADC), an inter-governmental organization which seeks to promote sustainable and equitable economic growth and socio-economic development through efficient, productive systems, deeper co-operation and integration, good governance, and durable peace and security; so that the region emerges as a competitive and effective player in international relations and the world economy (SADC, 2016).

South Africa has the most advanced economy on the African continent. Since 1994 the country's economy has grown rapidly. Its geographical position provides an ideal gateway to sub-Saharan Africa. The most important contributors to the economy include the mining sector, manufacturing and agriculture. South Africa is globally recognised as being a leading supplier of a variety of minerals and mineral products that are exported to as many as 87 countries. Each year, approximately 55 different minerals are produced from more than 700 mining facilities, with gold, platinum group elements (PGE's), coal and diamonds dominating exports and revenue earnings (Stats SA, 2016).

The country is plagued with the problem of large socio-economic inequalities that resulted from the apartheid regime and continue to manifest themselves in the form of high unemployment rates, wide areas of poverty and increase in crime. An informal sector has developed because of unemployment and this poses further challenges to the country's economic development.

In 2010 South Africa had a GDP of $357.3 billion. Exports amounted to 24% of South Africa’s GDP in 2010, with export income of $85.8 billion, mostly from minerals and metals, motor vehicles and parts, and agricultural products. South Africa's major trading partners include China, Germany, the United States, Japan, and the United Kingdom. The ease of doing business in South Africa, however, improved one place in 2011 to rank 35 out of 183 economies, according to the World Bank's Doing Business Report 2012 (The World Bank, 2012).

2.2 South African Fisheries

South Africa has a coastline that spans two ecosystems over a distance of 3,623 km, extending from the Orange River in the west on the border with Namibia, to Ponta do Ouro in the east on the Mozambique border (Figure 2). The western coastal shelf has highly productive commercial fisheries similar to other upwelling ecosystems around the world, while the east coast is considerably less productive but has high species diversity, including both endemic and Indo-Pacific species (FAO, 2010).

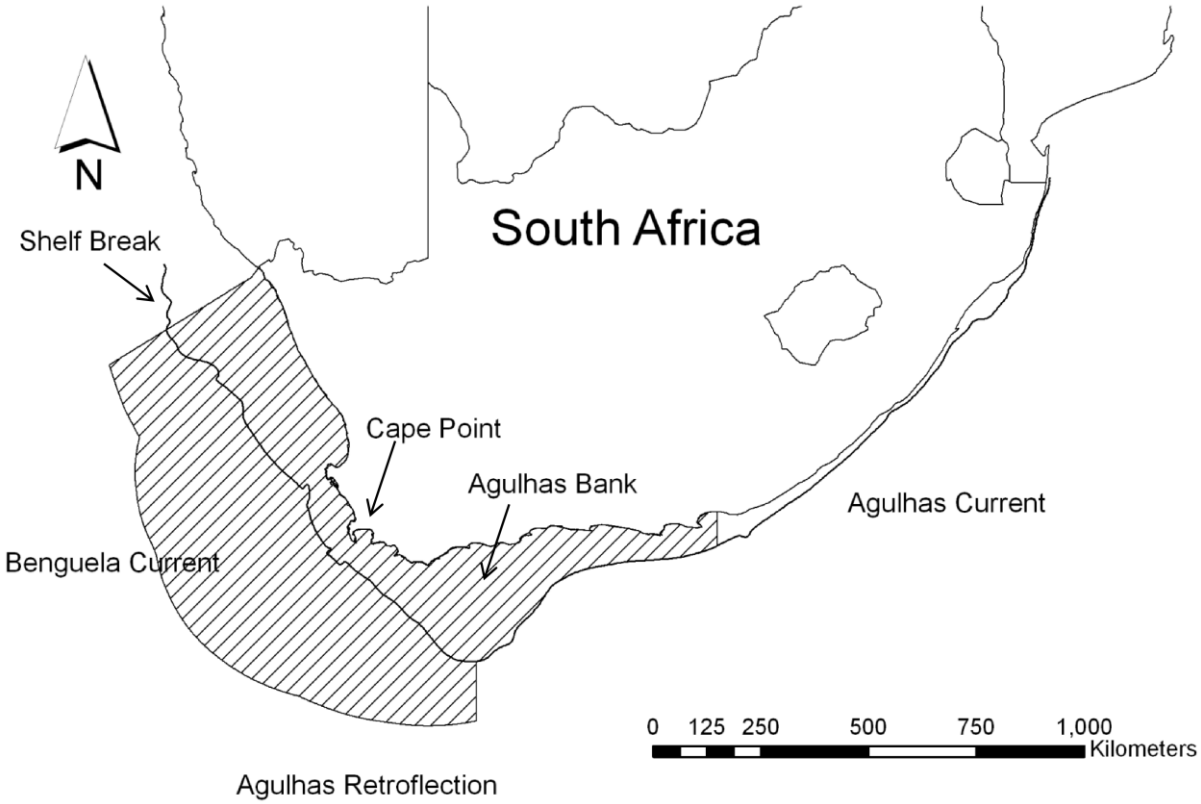

Figure 2: Map showing South African waters and regions of productivity

The South African 200 nautical miles Economic Exclusive Zone (EEZ) was declared in 1977 providing the country with effective control over their fisheries resources (Japp, 2001). South Africa's fishery sector is comprised of two distinct components, which are well-established wild capture fisheries, and an aquaculture component which is currently under development. Wild capture fisheries can be separated into commercial, recreational, and small-scale fisheries, each of which requires specific management interventions. The commercial fishing sector can be further broken down into highly industrialised, capital-intensive fisheries, which generally operate in deep water (e.g. hake trawl and pelagic purse seine fisheries), and near-shore fisheries that are more easily accessible and tend to use traditional types of gear (line fishery and near shore rock lobster hoop net fishery).

The South African fisheries sector plays a small part in direct economic terms in the economy of the country, contributing only about one percent to GDP. However, regionally, fisheries play a major role in the economy. The Western Cape is the centre of industrial fisheries and is the dominant employer in areas such as Saldanha Bay and St Helena Bay. Other major centres where

fisheries-related employment and income generation are important include Cape Town, Mossel Bay and Port Elizabeth.

South African commercial fisheries are managed through fishing rights allocated for a period not exceeding fifteen years. These commercial fisheries are managed by means of determining a Total Allowable Catch (TAC) or a Total Allowable Effort (TAE) or a combination thereof. Determination of TAE may include restricting number of vessels, number of crew, sea days, specifications of fishing gear or a combination thereof. The TAC and/or TAE is reviewed annually and/or when necessary and can be imposed in any time during the fishing right period.

3 THE HAKE FISHERY

The South African hake resource comprises two species, shallow-water Cape hake *Merluccius capensis* and deep-water Cape hake *Merluccius paradoxus.* Cape hakes are targeted by four fishery sectors: deep-sea demersal trawl, inshore demersal trawl, hake longline and hake handline, with most of the catch being taken by the deep-sea trawl sector. Approximately 84% of the hake TAC is allocated to the deep-sea trawl sector. The inshore trawl and hake longline fisheries are each allocated approximately 6% of the hake TAC and the handline fishery presently accounts for about 3% of the allocation (Figure 3) (SADSTIA, 2016). The South African hake trawl fishery holds Marine Stewardship Council (MSC) certification.

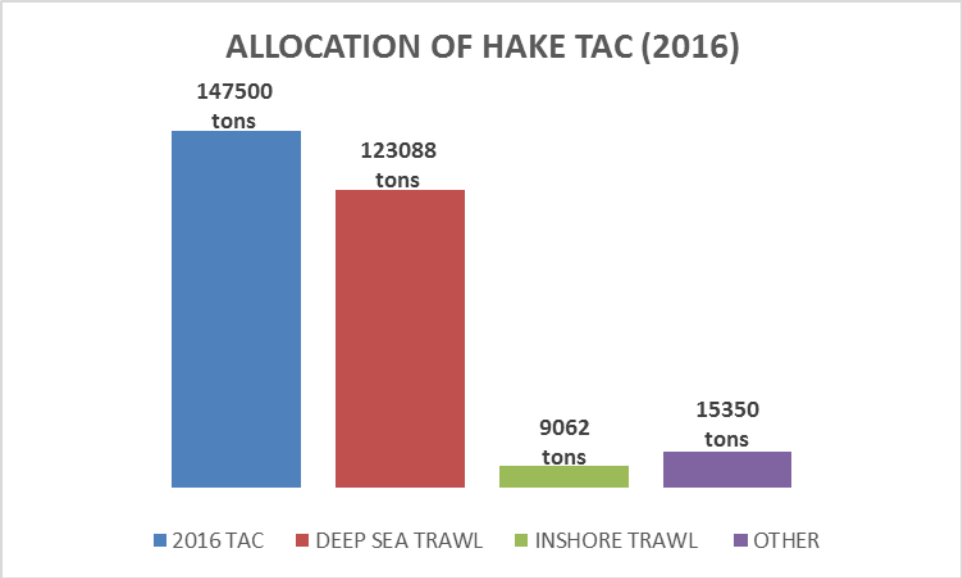

Figure 3: Hake TAC allocation and split among hake fishery sectors (DAFF hake TAC 2016)

3.1 Historical review of the hake fishery

The deep-sea trawl fishery

The deep-sea trawl fishery (also referred to as offshore trawl fishery) commenced in the late 1800s and became established with the formation of I&J in the early 1900s. Initially, the target species

was sole. The emphasis then shifted to hake, which was the most abundant species available. The success of this fishery was then (as it is today) entirely dependent on support infrastructures for cold storage and marketing networks. Hake landings increased from the early part of the 1900s to peak at catches over 200 thousand tons annually by the 1960s (Cape Peninsula University of Technology, 2012). With the influx of distant water foreign fishing vessels off the South African and Namibian coasts, it was estimated that catches increased to more than one million tons a year. The resource could not sustain these catch rates and the hake stocks collapsed by the 1970s. In 1977 South Africa declared a 200 nautical mile Exclusive Economic Zone (EEZ) and efforts to rebuild the stock then commenced. Prior to 1977 the fishery was an "open access fishery". The high capital and running costs and infrastructure required resulted in only a few companies surviving in this industry and these companies were largely self-regulatory and only rudimentary measures to limit catches were imposed. After 1977 a TAC was determined and in 1979 individual quotas were introduced.

3.2 Distribution of hake in South African waters

The Cape hakes are distributed on the continental shelf and upper slope around the coast of southern Africa. On the west coast both species are found in the Benguela system extending northwards into Namibian waters and as far as southern Angola. On the South African south coast both species predominate on the Agulhas Bank and are found in decreasing amounts northwards towards the north eastern border of South Africa (Figure 4). There is a tendency for hake to move offshore into deeper water as they grow older and there appears to be some seasonal movement of adults inshore and offshore. Hake grow to more than 1 m in length and may live to more than 12 years of age. The growth rate of male and female fish differs. Females mature at approximately 4 years old at a length of 47 to 49 cm. Males reach maturity after two years when approximately 30 to 35 cm long (Cape Peninsula University of Technology, 2012).

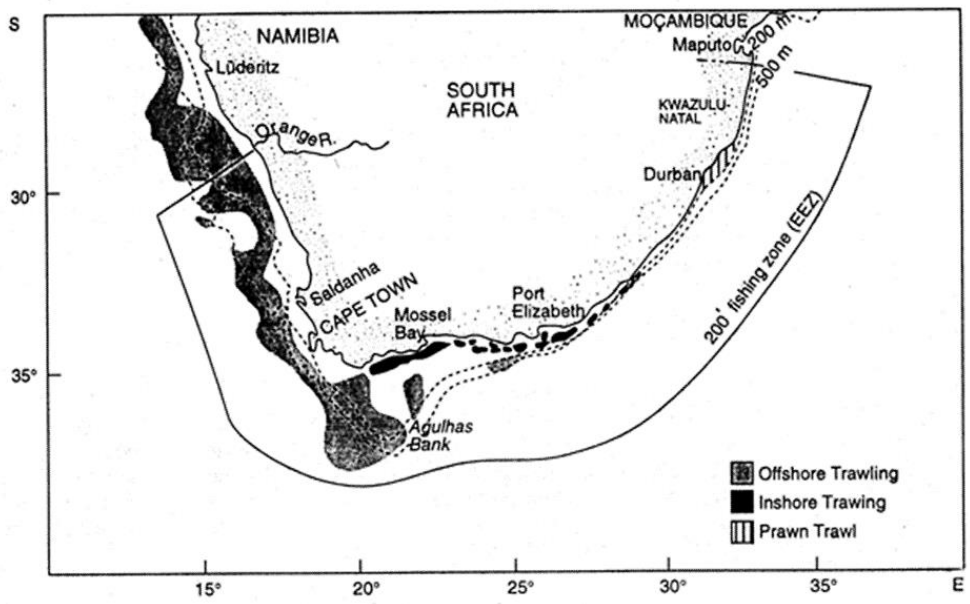

Figure 4: Trawling grounds around the South African coastline indicating the geographical distribution of hake.

The distribution of the two hake species differs with depth, although there is a substantial overlap in their depth ranges. Shallow-water hake are distributed over a depth range of 30 to 500 m with most of the population occurring between 100 and 300 m. In contrast, deep-water hake are distributed over a depth range of 110 m to deeper than 1000 m with most of the population occurring in depths of between 200 and 800 m. As the sizes of both species increase with depth, large shallow-water hake co-exist with smaller deep-water hake (Cape Peninsula University of Technology, 2012).

3.3 Hake management systems in South Africa

The hake fishery is managed in accordance with the ecosystem approach to fisheries (DEAT, 2005). An ecosystem approach to fisheries management is a holistic and integrated approach which recognises that fishing and associated land-based activities impact on the broader marine environment. The hake fishery is the most valuable of the South African fisheries; it is estimated that the hake trawl fleets account for about half the wealth generated by living marine resources in South Africa (SADSTIA, 2016).

Because the two species overlap and the fact that they are not accurately differentiated in the catches, the management system sets a single TAC for hake. The stock assessment model makes use of both fishery-independent survey data and commercial catch data. There is a good level of cooperation between the South African fishing industry and government departments, which has ensured that adequate data are gathered from the fishery to inform the annual stock assessment. According to the Marine Living Resources Act, the TAC is set by the Minister of Agriculture, Forestry and fisheries and this decision should be based on scientific advice from the Chief Directorate: Research and Development**.**

The hake TAC records indicate that there is a slight decline in the Hake fishery (Figure 5). Recently, after a few consecutive years of increased catch rates (2012 and 2013), the fishery entered a downward phase. The TAC was reduced slightly in 2014 and 2015 to 147 500 tons (held constant for two years). There is another decline in of 7375 tons for the 2017 fishing season.

The most recent (May 2016) MSC stock assessment report revealed that this slightly downward trend in stock biomass is resulting from apparently poor recruitment in recent years. However, it is also evident that the spawning stock biomass for both species is either above or fluctuating around BMSY (MSC 2016 stock assessment report).

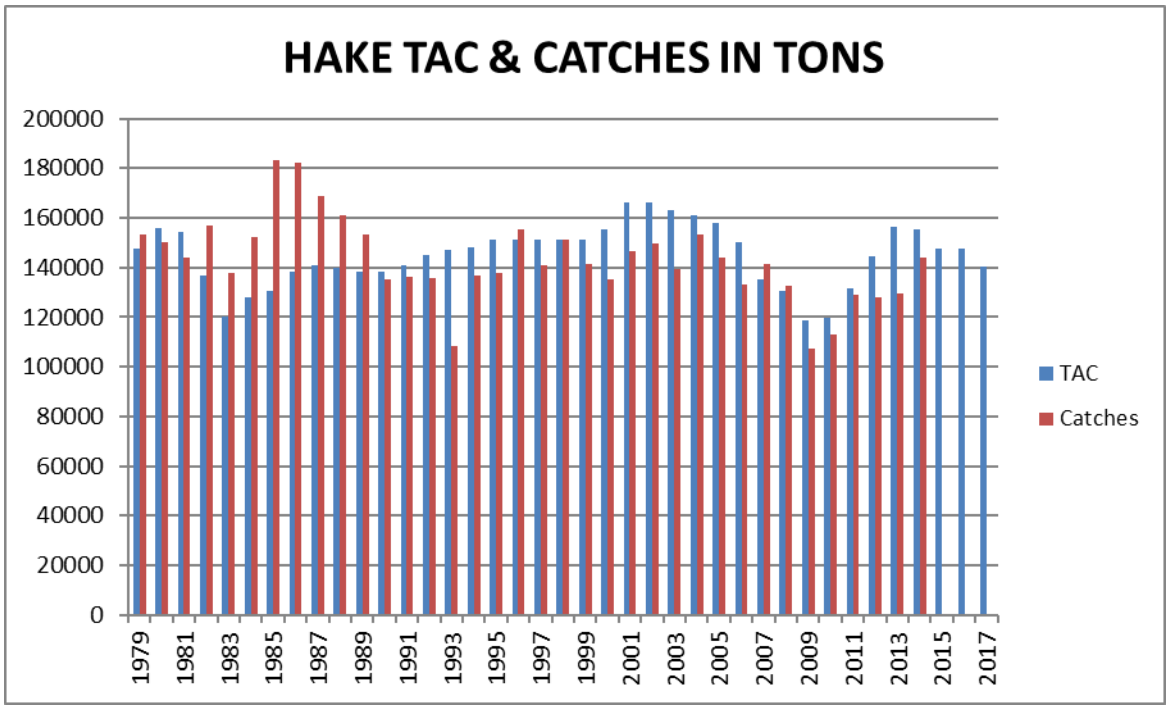

Figure 5: Chart indicating TAC and catch after TAC was imposed in the fishery
Sources: TAC (DAFF) and catch figures (FAO)

3.4 Monitoring, Control & Surveillance

The Department of Agriculture, Forestry and Fisheries employs a range of measures to monitor fishing activities and ensure compliance with fishing regulations:

- Fishery control officers monitor all landings. Catches are weighed and inspected on the quayside and inspections are also made at processing factories.
- Skippers are required to give 24-hour notice of their intention to offload their catch, thereby ensuring an inspector is available to check it. Each skipper's logbook, which records trawling activity, catch size and composition, is submitted to the Department. (Catch data plays a very important role in assessing the size and status of the hake resource and, therefore, the size of the TAC.)
- Three modern fisheries patrol vessels with boarding capabilities patrol South Africa's Exclusive Economic Zone, regularly inspecting licensed fishing vessels at sea. Moreover, each vessel active in the hake fishery carries a Vessel Monitoring System (VMS), which provides real-time information about the vessel's position.
- A dedicated scientific observer programme has been active in the hake fisheries since 2002. The programme enables fisheries scientists to collect accurate information about fishing activity and the status of hake and other offshore fish stocks. Information gathered by the scientific observer programme has been used to guide scientific and management decision-making.

4 THE CONCEPT OF FULL UTILIZATION

Full utilization is the process of creating value from by-products and waste material. It is another way of contributing to fisheries sustainability by making the best possible use of the resource. One of the strategies towards a responsible management of fisheries is to promote the policy of zero-waste production both on-board of fishing vessels as well as on-land. Zero waste is a philosophy that encourages the rethinking, reconciliation of ideas and reconfiguration of processing plants so to ensure that the whole catch is converted into useable products. In order to enhance sustainability of fisheries, such a policy must be accompanied by upgrading strategies for the fish waste and by-products.

4.1 A new utilization movement by Iceland

Iceland decided to propel a Nordic tradition to increase the utilization and value from seafood and by that create new job opportunities, especially for the coastal dwellers. In recent years, fisheries and fish processing jobs have declined in Iceland. Like many other countries, Iceland has faced reduced landings and been mindful not to overfish. With stock sustainability and the ecological effects of fishing and management systems as core concerns, Iceland has managed to become even more competitive in the global marketplace (Sigfusson, 2016).

The Iceland Ocean Cluster, a group of collaborating marine companies and experts, has traced the origin of Iceland's economic success. While Iceland cod landings decreased from 460,000 tons to 180,000 tons between 1981 and 2011, the total export value of cod products actually rose from $340 million to $680 million (Figure 6) (Sigfusson, 2016). The number of fishermen and fish processing jobs decreased, but from a holistic perspective marine related jobs grew significantly in this period. The Iceland Ocean Cluster discovered and supported a network of 120 marine companies that have been instrumental to this success. This growth was in part due to two factors: a value-added approach and the strategy of 100 percent fish utilization, both of which, once again, pushed the limit of what was possible (Sigfusson, 2016).

The value-added approach of the Icelandic industry has created alternative applications for fish products through research and development in cosmetics, health food and pharmaceuticals. This approach has benefited all levels of the supply chain, including fishermen in remote areas who have seen prices of cod liver triple in recent years due to increased interest in value added uses.

In Icelandic, "nýtin" is a positive word that describes a person who uses things to their fullest. 100 percent utilization seeks to use every ounce of the fish. Iceland has moved to 96 percent utilization of cod (Figure 7) while the average utilization around the North Atlantic is closer to 50 percent. By increasing the amount of fish used, it becomes possible to create more value from fewer resources.

Figure 6: Catch levels and value of Icelandic cod in 1981 and 2011

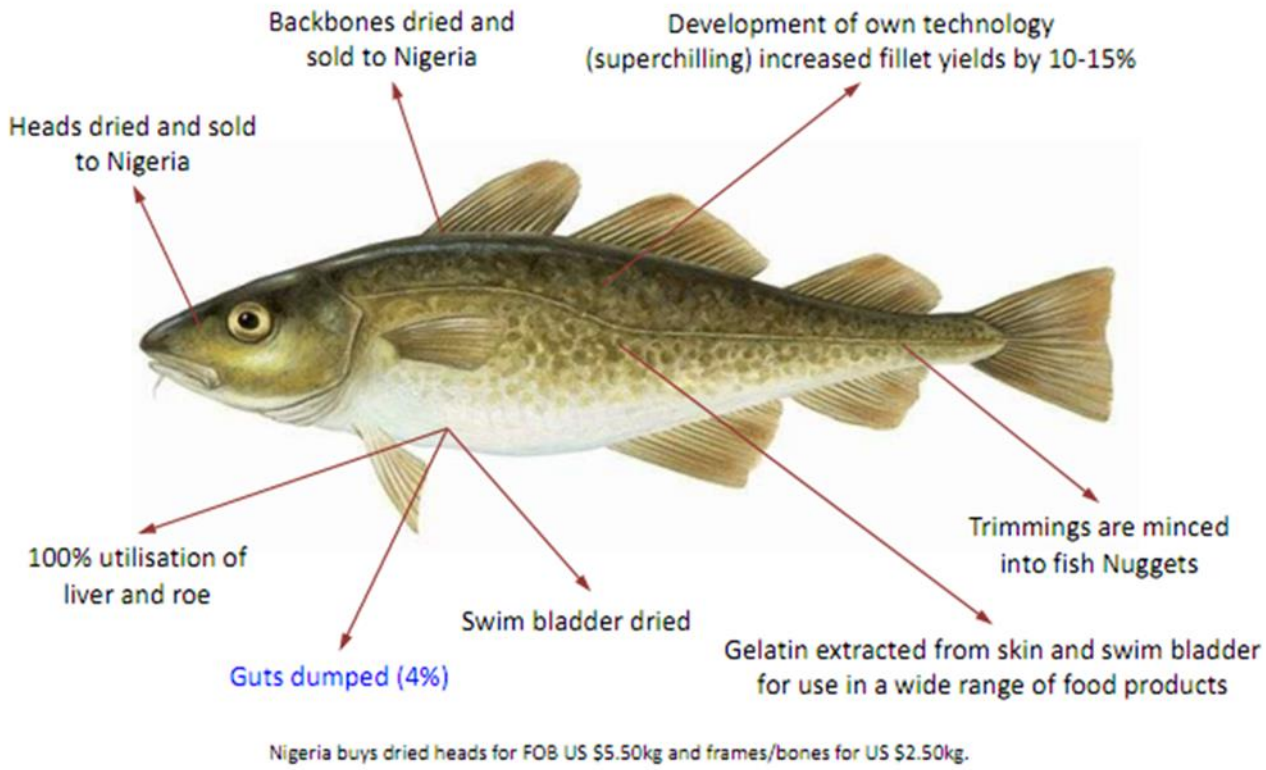

Figure 7: Current level of utilization of Icelandic cod (Knútsson, 2016)

4.2 Full utilization in general

Technological development in food processing and packaging is ongoing in many countries, with increases in efficient, effective and lucrative utilization of raw materials, and innovation in product diversification. The utilization of fish and, more significantly, the processing methods vary by continent, region, country and even within counties (FAO, 2016).

The trend towards more processing of fish products within the supply chain is creating increasing quantities of offal and other by-products, which may constitute up to 70 percent of fish and shellfish after industrial processing. In the past, fish by-products, including waste, were considered to be of low value and used as feed for farmed animals or thrown away. In the last two decades, utilization of fish by-products has been gaining attention also because they can represent a significant additional source of nutrition (FAO, 2016).

In various countries, the utilization of by-products has become an important industry, with a growing focus on the handling of waste in a controlled, safe and hygienic way. Improved processing technologies are also enabling more efficient utilization. Moreover, fisheries by-products serve a wide range of other purposes. Heads, frames and fillet cut-offs can be used directly as food or turned into products for human consumption such as fish sausages, cakes, gelatine and sauces. Small fish bones, with a minimum amount of meat, are also consumed as snacks in some Asian countries. Other by-products are used in the production of feed, biodiesel/biogas, dietetic products (chitosan), pharmaceuticals (including oils), natural pigments (after extraction), cosmetics (collagen), and in other industrial processes (FAO, 2016).

Shark cartilage is utilized in many pharmaceutical preparations and reduced to powder, creams and capsules, as are other parts of sharks, e.g. ovaries, brain, skin and stomach. Fish collagens are of interest for cosmetics, but also to the food processing industry as gelatine is extracted from the collagen. The internal organs of fish are an excellent source of specialized enzymes. A range of proteolytic fish enzymes are extracted, e.g. pepsin, trypsin, chymotrypsin and collagenases as well as lipase enzymes. Protease, for example, is a digestive enzyme used in the manufacture of cleaners to remove plaques and dirt, and in food processing and biological research. A good source of collagen and gelatine, fish bones are an excellent source of calcium and other minerals such as phosphorus that can be used in food, feed or as supplements. Calcium phosphates such as hydroxyapatite present in fish bone can aid rapid bone repair after major trauma or surgery. Fish skin, in particular of larger fish, provides gelatine as well as leather for use in clothing, shoes, handbags, wallets, belts and other items. In addition, shark teeth are utilized in handicrafts (FAO, 2016)

The shells of crustaceans and bivalves are an important category of by-products. Their efficient utilization is important due to the high volumes being generated linked to their increased production and processing, and the slow natural degradation rate of shells. Chitosan, produced from shrimp and crab shell, has shown a wide range of applications such as in water treatments, cosmetics and toiletries, food and beverages, agrochemicals and pharmaceuticals. Crustacean wastes yield pigments (carotenoids and astaxanthin) for use in the pharmaceutical industry, and collagen can be extracted from fish skin, fins and other processing by-products (FAO, 2016).

Mussel shells can provide calcium carbonate for industrial use. In some countries, oyster shells are a raw material used in building construction and the production of quicklime (calcium oxide). Shells can also be processed into pearl powder and shell powder. Pearl powder is used in medicine

and cosmetics manufacturing, and shell powder (a rich source of calcium) serves as a diet supplement in feeding livestock and poultry. Fish scale is used for processing fish silver, a raw material in medicines, biochemical drugs and paint manufacturing. Scallop and mussel shells can be used in handicrafts and jewellery, and for making buttons. Research on marine sponges, bryozoans and cnidarians has discovered a number of anticancer agents. However, following their discovery, for conservation reasons, these agents are not extracted from marine organisms directly but chemically synthesized. Another approach being researched is the culture of some sponge species to be used for this purpose (FAO, 2016).

In addition to the above-mentioned fish quantities, in 2014, about 28.5 million tonnes of seaweeds and other algae were harvested for direct consumption or further processing for food (traditionally in Japan, the Republic of Korea and China) or for use as fertilizer and in pharmaceuticals, cosmetics and other purposes. Seaweeds have long been used to feed livestock and in medicine, e.g. to treat iodine deficiency and as a vermifuge. Seaweeds are industrially processed to extract thickening agents such as alginate, agar and carrageenan or used, generally in dried powder form, as an animal-feed additive. Growing attention is also focusing on the nutritional value of several seaweed species, due to their abundance of natural vitamins, minerals, and plant-based protein. Many seaweed-flavoured foods (including ice creams) and drinks are being launched, with the Asia and Pacific region as main market, but with increasing interest also being shown in Europe and America. However, seaweeds are characterized by a highly variable composition, depending on species, collection time and habitat. More research is also exploring the use of seaweed as an alternative to salt. Procedures are being developed for the industrial preparation of biofuel from fish waste and seaweeds (FAO, 2016).

4.3 Success of the full utilization project

For a country to succeed in the project of full utilization, it is necessary to look at the fisheries management system in place, its objectives and the level at which the objectives have been met. Also, a country needs to understand its global competitiveness in order to realize its strengths and weaknesses and the country's ability to implement full utilization and realize how full utilization can increase its competitive position in the globe. This study used Iceland as a benchmark so as to measure the success of South Africa's fisheries management system and the level of competitiveness to see where improvement can and need to be made. This section will present a comparison of fisheries management systems between South Africa and Iceland.

Because there is no clear theory or theoretical approach for a study of this nature, Porter's diamond framework was used to illustrate the competitive position of South Africa in global competition. This model also helped to examine and investigate the reasons for the success of the Iceland's fishing industry in comparison to that of South Africa. It applied the concept of international competitiveness to critically assess South Africa's potential evolution into an international fisheries management. It also provides an opportunity to look at the competition encountered by South African fishing industry and grasps feasible opportunity in the external environment.

5 SOUTH AFRICAN FISHERIES MANAGEMENT SYSTEM (MLRA)

Since the end of the Apartheid era, legislation and policy have been aimed at transforming the growing commercial fishing sector to ensure previously disadvantaged communities have equitable access to fishing rights. The current management system was established mainly to address such historical imbalances and to promote transformation. Fisheries are managed in accordance with Marine Living Resources Act, 1998 (Act No. 18 of 1998) which is there to provide for the conservation of the marine ecosystem; the long-term sustainable utilization of marine living resources and the orderly access to exploitation; utilization and protection of certain marine living resources; and for these purposes to provide for the exercise of control over marine living resources in a fair and equitable manner to the benefit of all the citizens of South Africa; and to provide for matters connected therewith. The success of this system depends upon achievement of the following objectives and principles:

- The need to achieve optimum utilization and ecologically sustainable development of marine living resources.
- The need to conserve marine living resources for both present and future generations.
- The need to apply precautionary approaches in respect of the management and development of marine living resources.
- The need to utilize marine living resources to achieve economic growth, human resource development, capacity building within fisheries and mariculture branches, employment creation and a sound ecological balance consistent with the development objectives of the national government.
- The need to protect the ecosystem as a whole, including species which are not targeted for exploitation.
- The need to preserve marine biodiversity.
- The need to minimize marine pollution.
- The need to achieve to the extent practicable a broad and accountable participation in the decision-making processes provided for in this Act.
- Any relevant obligation of the national government or the Republic in terms of any international agreement or applicable rule of international law.
- The need to restructure the fishing industry to address historical imbalances and to achieve equity within all branches of the fishing industry.
- The need to promote equitable access to and involvement in all aspects of the fishing industry and, in particular, to rectify past prejudice against women, the youth and persons living with disabilities.
- The need to recognize approaches to fisheries management which contribute to food security, socio-economic development and the alleviation of poverty.
- The need to recognize that fish may be allocated through a multi-species approach.

6 ICELAND FISHERIES MANAGEMENT SYSTEM

In Iceland, management objectives and principles for Icelandic fisheries have been established under the legal framework of the 2006 Fisheries Act. The main objective of fisheries management in Iceland was to promote conservation and efficient utilization of exploitable marine stocks,

thereby ensuring stable employment and settlement throughout the country. In practice, the main emphasis has been on economic efficiency and stock sustainability through the use of ITQ systems for most fisheries. Although no explicit management targets are set in the 2006 Fisheries Act, these have been included in current management plans for some key commercial stocks, for example, capelin, cod, saithe, and haddock (The Fisheries Management Act, 2006).

7 THE DIAMOND MODEL OF MICHAEL PORTER

The Porter Diamond is a model that helps analyze and improve a nation's role in a globally competitive field (Porter, 1990). The model attempts to explain the competitive advantage that nations or groups have due to certain factors available to them (Figure 8).

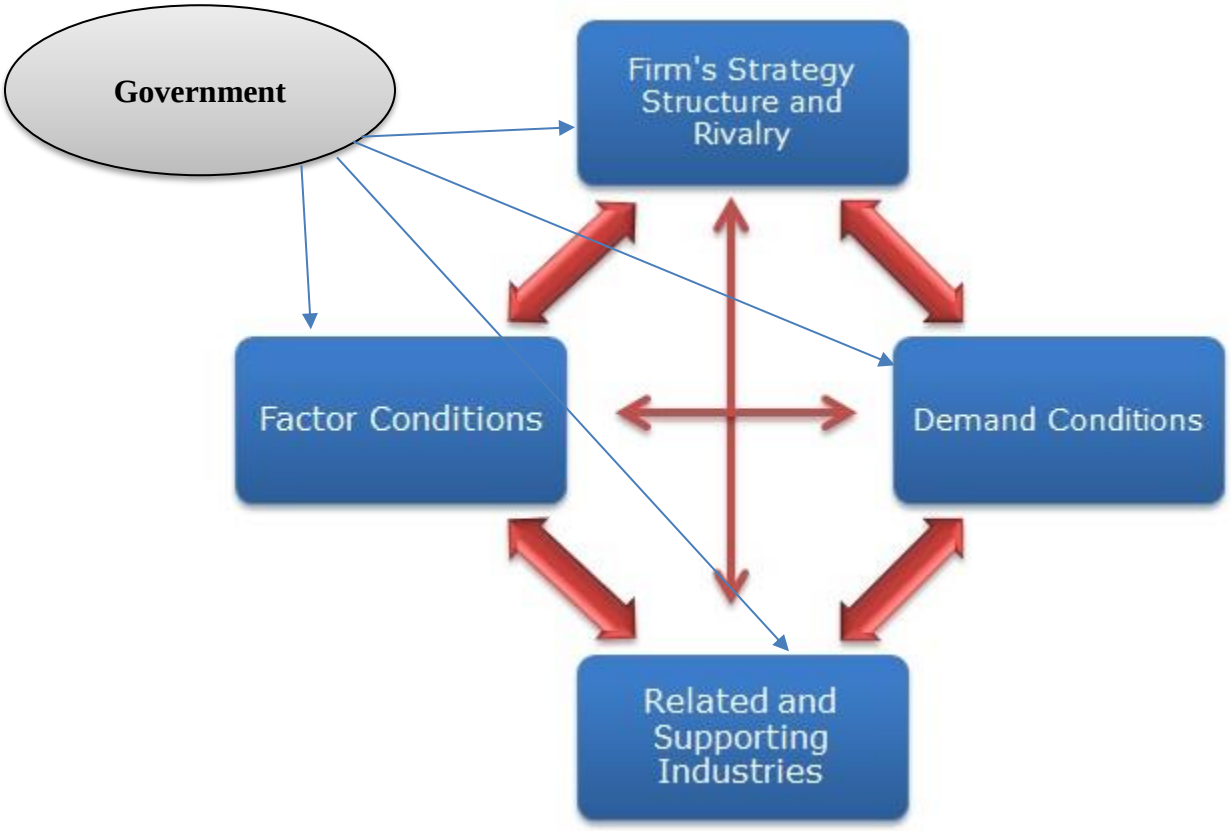

Figure 8: Porter's Diamond Framework.
Adapted from Porter, M.E. The Competitive Advantage of Nations. New York: FreePress,1990

Factor conditions are the first element of the Porter Diamond model. They refer to different types of resources that may or may not be present in the home country such as: human resources, physical resources, knowledge resources, capital resources and infrastructure (Porter, 1990). One can make the distinction between basic and advanced factors. Basic factors include natural resources (climate, minerals, oil) where the mobility of the factors is low. Although these factors may create the ground for international competitiveness, they can never turn into real value creation without the advanced factors. Advanced factors are more sophisticated, such as human resources (skills)

and research capabilities and are normally specific to the industry. The study conducted evaluation on the South African fishing industry to measure availability of resources compared to the Icelandic fishing industry (Table 1).

Demand conditions of the Porter Diamond model are the pressures based on buyers' requirements about quality, price, and services in a particular industry. They involve factors such as; early home demand, market size, market growth and sophistication. These characteristics can help companies create competitive advantage, for instance when sophisticated home market buyers pressure firms to innovate faster and to create more advanced products than those of foreign competitors. In fact, a product's fundamental or core design nearly always reflects home market needs. Often, the needs of the home market even shape the industry that later responds to global markets (Porter, 1990). The table below shows comparison between South African fishing industry and Icelandic fishing industry in terms of the demanding conditions in these respective fisheries which play a significant role where global competitiveness is concerned (Table 2).

Related and supporting industries are the networks of suppliers and distributors that cooperate with the industry to support it in international competition. These can produce inputs that are critical for innovation and internationalization. These industries provide cost-effective inputs, but do also participate in the upgrading process, thus stimulating other companies in the chain to innovate (Porter, 1990). The success of an industry is associated with the presence of suppliers and related industries within a certain region (Table 3).

Firm strategy, structure and rivalry, this element in the Porter Diamond model explains how companies are organized and managed, their objectives and the nature of rivalry in the home market (Porter, 1990). The rivalry is an essential ingredient of the competitive advantage of the industry. The domestic rivalry leads to the visible pressure on the firm to lower costs, improve quality and innovation. Hence, it can upgrade the competitive advantage of the industry (Grant, 1991). The way in which companies are established, set goals and are managed is critical to success on international markets. In addition, the presence of intense rivalry makes companies competitive as it creates pressure and triggers companies to innovate in order to maintain and upgrade competitiveness. Constant pressure from competition makes them develop competitive products, offer them at competitive prices and stay competitive on the whole (Table 4).

Table 1: Comparison of factor conditions in South Africa and Iceland fisheries management systems

Factor conditions	Iceland	South Africa
Human Resources (General)	Sufficient	Sufficient (the country has generally enough human resources with approximately 20% of the working-class population being unemployed)
Human Resources (Skills)	Optimal	Limited (Whilst generally enough human resources, very few or rather handful are skilled or have knowledge of the fishing industry. Most prominent skill or professional jobs are either in education, teaching or in health as a care giver or nurse)
Human Resources (research capabilities)	Optimal	Optimal (Although a handful skilled personnel in the field there are just sufficient to carry basic and specialized research. Government and academic institution have skilled personnel who collaboratively conduct research. Foreign exchange students, Post Docs are also party to research.)
Capital Resources	Sufficient	Limited (Although resources are available for use in handling routine operations there seem to be no excess resources which are not used. Some operators even share cost either by consolidating operations into one vessel using the same fishing gear and personnel and therefore limiting the costs).
Physical infrastructure	Sufficient	Optimal (Available physical infrastructure is optimal with modern roads, electric power, sewage and waste disposal systems in place. Due to limiting resource availability some factories have been closed down with Cape Town being preferred processing hub for most fish caught. Fish landed in other is trucked to Cape Town by road).
Administrative infrastructure	Optimal	Optimal (The industry is well structured administratively. Apart from shareholders, businesses have managing directors for operations, sales including human resources- companies have clerks, secretaries, clearing agencies for various relevant business needs).
Information infrastructure	Optimal	Optimal (basic information about research, stock status, markets are available)
Scientific and technological infrastructure	Optimal	Limited (lack of automated systems)
Natural resources	Limited	Limited (The resource has been on the decline in the recent years)
Availability of ancillary industries	Optimal	Optimal (boat building industry, steel manufacturing industry are examples, however these industries work independently and that the other becomes a buyer and the one a seller. E.g. a Boat builder will buy steel to build a boat and that a fishing company will buy a boat from the boat builder)
Presence of related firms	Optimal	Optimal (boat building industry, steel manufacturing industry are examples, however these industries work independently and that the other becomes a buyer and the one a seller. E.g. a Boat builder will buy steel to build a boat and that a fishing company will buy a boat from the boat builder)

Table 2: Comparison of demand conditions in South Africa and Iceland fisheries

Demand condition	Iceland	South Africa
Regulatory standards	Fisheries Management System Own certification: Iceland Responsible Fisheries. Some companies use MSC certification	Marine Living Resources Act and its regulations are being employed in regulating the users. Marine Stewardship Council (MSC) certification has been awarded to the fishery. The British Retail Consortium (BRC)
Home Demand	Fair and growing, 60-80 kg/capita / year	Low (4kg per capita)
Market Size	Most of fish caught in Iceland is for exports. Domestic market relies on catch from small inshore and longline vessels	Big foreign market for prime products however most of the low value fish is consumed locally or traded within the Southern African Development Community (SADC)
Market Growth	Slowly growing	Relatively stable (there are no new products being introduced in that the market is relatively stable as current products are still being valued)
Foreign competition	Strict regulations prevent foreign ownership in the primary sectors (fishing and processing) of Icelandic fisheries	Yes, with other white fish products. It is argued that mislabelling may result in loss of revenue for South African hake with some other fish products traded as hake. No foreign investment in the hake fishery as fishing rights are granted to South African owned companies. Only South African owned and flagged vessels are permitted in the fishery).
Competitive new products	Limited	Non-significant (there are no new products being introduced in that the market is relatively stable as current products are still being valued).
Sophistication	High-class products, but low level of value added at first level of the value chain. Value added takes place in fish shops.	Yes (difficult to break through branding as some products are marketed as cape hakes although not).

Table 3: Comparison of South Africa and Iceland on fisheries related and supporting industries

Supporting industries	Iceland	South Africa
Presence of capable, locally based suppliers and firms in related fields	Codland Matis and other research and innovation institutes and funds. Marel and other manufacturers of advanced processing equipment and fishing gear Universities	Yes (boat building industry, steel manufacturing industry are examples, however these industries work independently and that the other becomes a buyer and the one a seller. E.g. a Boat builder will buy steel to build a boat and that a fishing company will buy a boat from the boat builder). Other local base suppliers include the net and rope manufacturing, crane and which engineering companies. Also, there are local suppliers for safety and protecting instruments. Other local suppliers although at times they act as agencies of overseas based firms supply electronic materials which may include navigational devices, fish finders and radar which are important and efficient in modern day operations. Organized industry associations also employ private academics or researchers from institutions of higher learning to conduct fishery independent research on any aspects that relates to sustainable fishing activities. The research findings maybe solely for use by the industry or at times sponsored to the government.

Table 4: Comparison of firm strategy, structure and rivalry in South African and Iceland fisheries

Firm strategy, structure and rivalry	Iceland	South Africa
Fair competition (absence of trade barriers)	No trade barriers. The only real barrier is access to quota	No trade barriers. The only barrier is to ensure sufficient supply.
Open and vigorous competition among locally based rivals	The competition mostly takes place abroad, when seeking buyers of fish. Local competition is at the auction market, competing for highest price	Competition is a reasonable level where individual companies are to ensure they secure their own buyers. The companies mentioned catches, process and market their own fish.
Intellectual Property (IP) protection	The market is raw material focused and value-added products are rare. Hence, the need for IP protection is limited, but increases in the supporting industries	There is an established competition commission to guard amongst other things against price collusion to allow for fair trade
Transparency	Good, as landings, trade and exports are open and registered	Good, as landings, trade and exports are open and registered
Local context encouraging investment & upgrading	There is a constant investment and development in the supporting industries as well in the fleet and the processing industry	There is a constant investment and development in the fleet and the processing industry

Government, all the policies and regulations made by policymakers at all levels of government (but particularly federal) can benefit or adversely affect the competency of a country and an industry. Government can have strong influence on the international competitiveness of a firm. In addition, it can influence each of the five other forces in the Porter Diamond model. The government of a country can either promote or hinder export. It can influence the supply conditions of key production factors. It can shape the demand conditions in the home market, as well as the competition between firms.

Another important insight about Porter's Model is the presence of "clusters" around competitive industries. Clusters are formed by networks established among companies, suppliers, service providers, supporting industries and associations (universities, trade associations, cooperative associations) (Porter, 1990). These clusters of industries provide an enormous support because they build strong capabilities that later will develop competitive advantages to compete around the world (Table 5). Government, through its policies helps in creation of new clusters or strengthening the existing cluster. Government can help the cluster to limit or eliminate barriers to growth.

Table 5: Comparison of government policies between South Africa and Iceland

Government	Iceland	South Africa
Presence of clusters	Yes: Iceland Ocean Cluster	None
Intellectual property policies	The legal system supports and protects innovation and IP	The legal system supports and protects innovation and IP
Research & Development (R&D) Tax policies	Aid and grants through for example: RANNÍS, Nýsköpunarmiðstöð.	No government funding schemes set for the industry
Policies to fund R&D activities.	The government sets out its policy on support and encourages innovation through grants given by various institutions and government bodies	No government funding schemes set for the industry
Government support of grants, soft loans and public venture capitals (VCs)	The government sets out its policy on support and encourages innovation through grants given by various institutions and government bodies	No government funding schemes set for the industry
Technology commercialization policies	There is clear focus by the Government to support the growth of the fisheries industry, mainly the sporting industries.	None

These sources of competitive advantages can produce a fertile soil to build an internationally competitive industry in a country (Porter, 1990). According to Porter, productivity (at the national level) can be increased when the industries in a particular country upgrade themselves to improve efficiencies. For instance, an increase in technology can boost productivity and at the same time, can facilitate the production of differentiated products with much added value for customers. By doing so, industries can compete in more sophisticated and international markets. But in order to maintain or improve this position, an industry requires a continual upgrading process (Porter, 1990). Industries can serve as the research and development departments for the companies, as the supportive industry gets to develop their new models inside the companies, who later buy the products

8 RESULTS

According to Porter, the normal support of government to an industry should include: provision of clusters; intellectual property policies; R&D tax policies; policies to fund R&D activities; support of grants, soft loans and public VCs; and technology commercialization policies. The results of Porter's model depict that South African fishing industry lacks the support of Government when it comes to value creation and utilization of raw material as there are no policies in place to support innovation activities. Porter stresses that competitiveness is driven by government policies and in the case of South Africa, such policies are lacking. Also, according to Porter, there are simple basic principles that governments should embrace to play the proper supportive role for national competitiveness: encourage change, promote domestic rivalry, stimulate innovation, etc. The model also revealed that South Africa lacks the supporting industry compared to Iceland which has a fair number of supporting industries including universities and research institutes that provide a wide range of skills relating to fisheries management. However, the main issue that seems to be an obstacle in the development of South African fishing industry is lack of support from government for value creation and utilization of raw material. It is highlighted in the model that South Africa lacks innovation for new products, showing stagnation with its current products and markets. It is of paramount importance for such situations that government starts by working towards changing the mindset of the interested and affected parties; ideology; policy; and strategy.

9 DISCUSSION

South Africa seems to be caught in what is called "the middle-income trap". The middle-income trap is a situation in which a country's growth slows after reaching middle income levels. The transition to high-income levels then seemingly becomes unattainable. According to World Bank estimates, only 13 of 101 middle-income economies in 1960 had become high-income economies by 2008 (Agénor *et al.*, 2012).

In South Africa, this is characterized by deceleration in growth and in the pace of productivity increase. Currently, South Africa is at a point where it attained a certain goal but now stuck at that level. According to the World Bank, factors and advantages that generate high growth during an initial phase of rapid development disappear when middle and upper-middle income levels are reached, thereby requiring new sources of growth to maintain sustained increase in per capita income (World Bank, 2012).

The main purpose of this study was to introduce to South Africa, the methods used by other countries such as Iceland to develop more fish products and increase the overall value from the country's fisheries, by increasing the level of utilization and yield good profits in return. This concept may look impossible or at best very difficult to South Africa at the moment due to factors that need to be in place for such a project to be successful which are currently not available. It is the responsibility of the South African government to learn how other countries transitioned from middle to high income status. The features of East Asia's experience in transitioning from middle to high income status provide important lessons for other countries that are attempting to follow suit (Agénor *et al.*, 2012). The middle-income trap is not an ineluctable outcome; it can be avoided or escaped if governments act early rather than late. Doing so requires timely implementation of public policies aimed at improving access to advanced infrastructure, enhancing the protection of

property rights, and reforming labor markets (Agénor *et al.*, 2012). These policies are central to fostering technological learning, attracting talented individuals into R&D activities, and encouraging the buildup of national and international knowledge networks (Agénor *et al.*, 2012).

It is said that productivity slowdowns are a major cause of middle income trap, however, it differs from the existing literature in terms of the reasons why productivity growth may weaken and what type of public policies can help avoid such a slow-growth equilibrium (Agénor *et al.*, 2012). The following sections will point out the reasons for weakened productivity growth in the South African fishing industry as well as the type of public policies that can help avoid such slow growth.

How can South Africa escape the middle-income trap in a fisheries context?

Building from the model described above, there are a number of policies that South Africa can employ to escape from the middle-income growth trap. South African government can pursue policies such as improving access to advanced infrastructure; enhancing the protection of property rights; technology commercialization policies; government support of grants, soft loans and public VCs; all implemented within a context where technological learning and research and development (R&D) are central to enhancing innovation. Such policies not only explain why some economies, particularly in East Asia, were able to avoid the middle-income trap, but are also instructive for other developing countries seeking to move up the income ladder and reach high income status (Agénor *et al*., 2012).

Porter points it out that it is the responsibility of government, through its policies to help create new clusters or strengthen the existing ones. Today's economic map of the world is characterized by "clusters." A cluster is a geographic concentration of related companies, organizations, and institutions in a particular field that can be present in a region, state, or nation (Porter, 1990). Clusters arise because they raise a company's productivity, which is influenced by local assets and the presence of like firms, institutions, and infrastructure that surround it.

There is an opportunity to increase the value of the products from fishing through more value-added production and increased utilization. Learning from Iceland, the South African fishing industry could benefit economically and environmentally by applying the Icelandic approach to fish utilization. As it stands, South Africa, both government and the industry need innovation and start developing new products. Learning form Iceland's "A New Utilization Movement" which tells a story of how Iceland propelled a Nordic tradition to increase the utilization and value from seafood and by that create new job opportunities, especially for coast dwellers. The next chapter will introduce methods which South Africa can use to maximize economic returns, focusing in the hake fishery as per the study plan.

10 INTRODUCTION OF FULL UTILIZATION IN SOUTH AFRICA

10.1 Current level of utilization in South Africa

Products include fish that is either gutted and sold fresh with the head still on or headed and gutted. The latter are common in local markets whilst grading occurs, and prime quality fish are immediately packed and exported mainly to the European Union and compete in the white fish market. Other products include fillets which are sold locally and abroad fresh or frozen. Fillets are high value products, especial when fresh. Offcuts from the filleting process are reduced into crumbed products with the most common being fish fingers. Heads and bones are alternatively sold to the crayfish or rock lobster industry for use as bait otherwise they go to waste (Figure 9).

In summary the whole fish is utilised and with high value product being the fillets followed by whole fresh fish. Frozen whole fish are common local low value fish which are sold unbranded in local retail stores or fish shops. Commonly, fish processed at sea is gutted and headed with the heads and guts crushed and dumped out at sea.

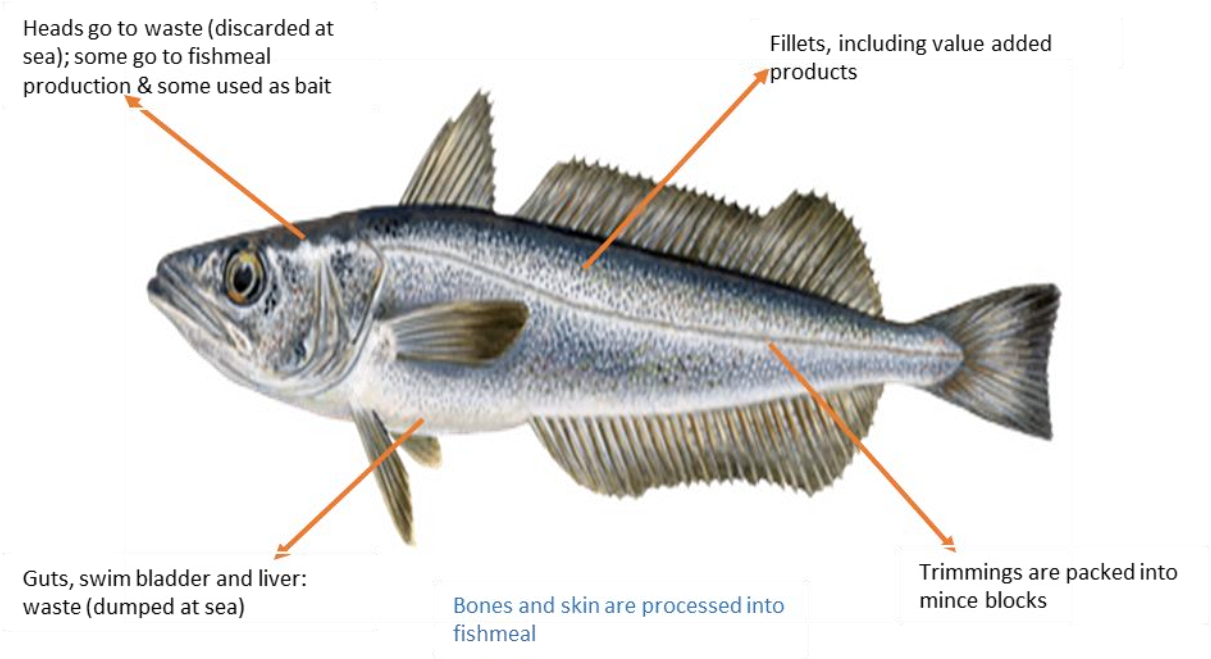

Figure 9: Current utilization level of South African Hake

10.2 Proposed increased level of utilization

Whilst the whole fish is being utilized, it is apparent that there is still a huge element of waste. One can mention the dumping of heads and guts. There are also low value products sold locally where except for freezing no other processing is done and thus loss of revenue. South Africa shall therefore adopt the innovation that the Icelandic industry has explored, limit its waste and increase value of each part of the fish caught as per the zero-waste policy.

According to Tómas Þór Eiríksson, the managing director of Codland (a network of Icelandic companies with a common goal to increase the value of fish products, specializing in total utilization of fish products) the best way to utilize fish by-products is to introduce the concept gradually, not everything at once. Eiríksson also believes that it is better to start with something

simple. In Iceland, the project started with drying of heads and bones for the market in Nigeria and when that was up and running, more by-products were developed, and more markets came on board. It is also stressed that the main thing to do before developing a new product is to find markets first (Palsson, 2016).

Therefore, this study recommends that South Africa, in an attempt to join in the movement of full utilization should start with drying of fish heads and bones. It is worth noting that currently, there are fish heads that are part of the waste discarded at sea (Grange, 2016). Rather than throwing something of value away, this product should be channelled to valuable production:

10.2.1 Fish heads

FAO recently called out the absurdity of this waste, suggesting it's time to get more fish heads on people's plates. We must ensure that these byproducts are not wasted, Audun Lem, chief of FAO's products, trade and marketing branch, said in a statement (Bland, 2014). As greater quantities of fish are processed for export, more by-products such as heads and backbones can potentially be turned into valuable products also for human consumption (Bland, 2014). New markets for by-products are already opening up, noting growing demand for fish heads in some Asian and African markets, while there is also potential to use fish heads and bones to meet the rising global demand for fish oil and mineral supplements (FAO, 2014).

Therefore, South African fish heads can also be dried and consumed locally as protein source either cooked or consumed as dried fish. Cooking of heads may involve preparing them into light meals such as soup with some cooking flavorings added for taste. There is already a traditional custom by local fishermen of preparing fresh fish heads stuffed with onions and microwaved or boiled. The latter is just a fishermen's delicacy and not a hunger relief practice common in inshore fishing day or one night out vessels.

Also, fish heads in South Africa are used for bait in the rock lobster trap fishery which is one of the most lucrative fisheries in the country. There is no formal trade or market for the sale of fish heads for bait. It is therefore proposed that this potential market be formalized and that the heads are properly preserved for this use rather than just opportunity of making use of waste.

10.2.2 Fish bones

During filleting some flesh is left on the back bone of the fish and these like the heads maybe preserved by drying. The same processing for the fish heads shall also be applied with the bones.

11 IMPLEMENTATION

It is believed that the best way to implement the notion of full utilization is to start with one or two companies and bring in more when the project is up and running (Eiríksson, 2016). It is also believed that it is best to start the project with companies that are well established with good marketing strategies in place. It is for that reason that this study selected the two leading companies in the South African hake fishery which take more than 60% of the deep-sea trawl TAC allocation (Figure 10).

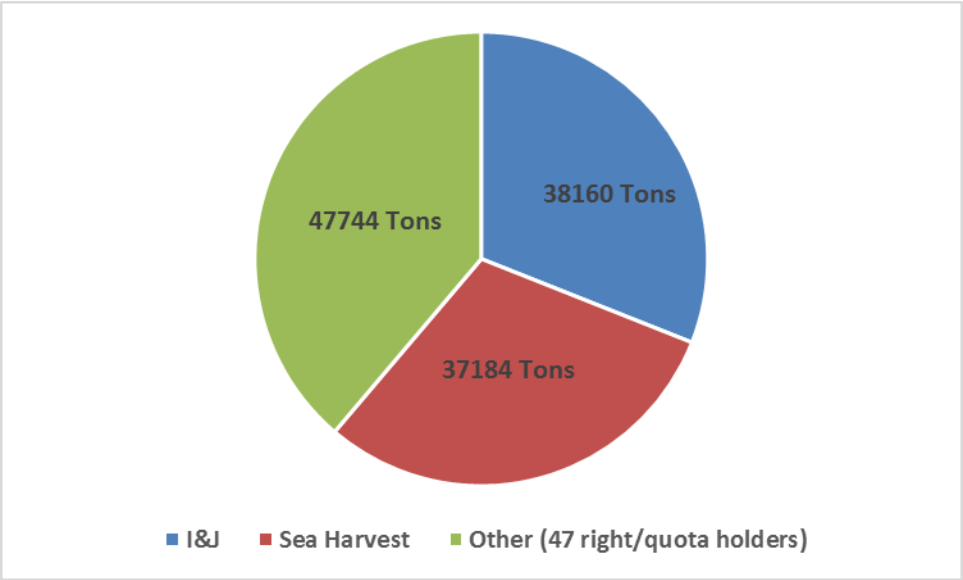

Figure 10: Chart showing Sea harvest and I&J allocations from the TAC split in the deep-sea trawl fishery (DAFF 2016)

11.1 Sea harvest

Sea Harvest is one of the largest vertically integrated Cape hake producers in South Africa, supplying a variety of products under its own brand, including natural cuts such as skinless and skin-on fillets, moulded portions and a range of value-added products. They have also been packing for top international brands since 1964, with a strategy to align themselves with leading brands and role players in the global markets (Sea Harvest, 2016).

Their innovative New Product Development team is tasked with creating new and exciting products to bring to market, and forging relationships with leading suppliers in South Africa and across the world (Sea Harvest, 2016). Sea Harvest creates direct employment for more than 3000 people, adding value to natural marine resources while harvesting responsibly, supporting local communities and contributing to the South African economy. Sea Harvest is a Level 2 Broad-Based Black Economic Empowerment (B-BBEE) contributor and one of the largest empowered companies in its sector (Sea Harvest, 2016).

Sea Harvest products are present in retail and foodservice markets in 22 countries across the world. The company's primary export markets are in Europe and Australia, but products are also exported to North America, the UK, Asia and the Middle East. Their retail products are distributed to all the major local supermarket chains in South Africa and can be bought in more than 2,000 stores countrywide.

The fact that Sea harvest has a team that is tasked for New Product Development to create new products puts it in a better position to understand and accept the proposal to take part in the project of full utilization. Sea harvest currently discards the heads and guts at sea but is looking into projects to utilise this (Grange, 2016).

11.2 Irvin & Johnson

Irvin & Johnson (I&J) is a vertically integrated South African Fishing company that owns and operates a fleet of modern and efficient stern trawlers, a land- based primary processing facility and a sophisticated value – added processing facility. I&J has been a trusted name in seafood for over 100 years and holds the Marine Stewardship Council (MSC) certification on the hake species. An enduring emphasis on quality has resulted in I&J securing accreditation from the world's leading quality assurance organizations including BRC and IFS. The company's fishing vessels and processing facilities are all EU accredited and fully HACCP compliant.

The company has progressive employment practices and training programmes that benefit its employees and the South African maritime community as a whole. Over many years, I&J has developed a deep-rooted global procurement system and a well-established network of international customers, exporting fish to over 25 countries worldwide, either packaged under their own I&J brand or customized to suit respective diverse local needs within the greater global economy (I&J 2016).

12 RECOMMENDATIONS

Learning from countries like Iceland who have excelled in maximising utilisation of fish caught to produce various high value products and also to compete in the international markets. It shall be recommended that South Africa shall strive to achieve the same by employing methods that have led to the Icelandic fishing industry success. The proposals for full utilisation as contained in this study shall be implemented. The target companies shall be those which are vertical integrated and well established in terms of catching, processing and marketing of fish and fish products.

12.1 Government task

Implementation of this project would result in job creation and increased profits in the fishing industry. Job creation and economic growth are part of the MLRA objectives and responsibilities of the South African fisheries sector. The Porter's model has however revealed that for the success of this project, South African government has a big role to play. It is therefore recommended that government considers the implementation approach provided in this report (Table 6).

Table 6: Project implementation approach

Introduction of full utilization in the South African Hake fishery				
Action/Task	Responsible	Start Date	End Date	Notes
1. Policies				
Develop policies to support research and development (R&D)	Government (DAFF)	5/1/17	7/31/17	Daff to formulate a task team accordingly
Policies to fund R&D activities.	Government (DAFF)	5/1/17	7/31/17	
Policies to support grants, soft loans and public VCs	Government (DAFF)	5/1/17	7/31/17	
Incorporate level of utilization in allocation of fishing rights policies	Government (DAFF)	5/1/17	7/31/17	
2. Infrastructure				
Evaluate the current infrastructure and supporting industries	Government (DAFF)	9/1/17	9/30/17	Seek expertise advise
Identify which changes and improvements are needed	Government (DAFF)	9/1/17	9/30/17	
Establish scientific and technological infrastructure	Government (DAFF)	9/1/17	Open	
3. Education				
Evaluate the need for new education	Government (DAFF)	8/1/17	8/31/17	Source relevant services
Work on the stakeholders' mindset	Government (DAFF)	8/1/17	8/31/17	
Train and support to meet the demands of the concept	Government (DAFF)	10/1/17	12/31/17	
4. Markets				
Identify new markets for products made from further utilization	Government (DAFF)	11/1/17	12/31/17	Work closely with the industry
Develop new market segments in exixting markets for those products	Government (DAFF)	11/1/17	12/31/17	

13 CONCLUSION

South African hake industry has been found to lack full utilisation of fish caught and there has been a recognisable element of waste. By-products like heads, guts and bones are of no important use in the South African hake industry. South Africa shall therefore realise this loss of revenue by limiting waste. In that all by-products shall be preserved and be processed further for high value fish products which can be sold locally or destined for international or regional markets. South Africa shall therefore attempt to employ methods as applied by the Icelandic fishing industry.

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