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Overcapacity in the South African Hake Deep Sea Trawl Fishery, South Africa

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Abstract

This study examines the extent, drivers and the management of overcapacity in the South African Hake Deep Sea Trawl (HDST) fishery. The research methods were quantitatively based on input-based capacity measures and qualitatively based on subjective capacity measures.

The majority of the fishing capacity that operates in the HDST fishery was brought over during the recent allocation of fishing rights in South Africa. The utilization of this capacity is limited through TAC reduction and effort control regimes. This leads to capacity under-utilization which reduces employment and increases the costs of the HDST fishery. Further, this capacity under-utilization has facilitated a slight recovery of this fishery's target stock.

In economic terms, there is substantial overcapacity in the HDST fishery, indicated by capacity under-utiization. In biological terms, there is no overcapacity in this fishery as capacity utilization is restricted. In social terms, however, there is inadequate fishing capacity in the HDST fishery as capacity under-utilization induced labour-under-utilization. Hence, the above management measures work in favour of the state which is concerned with the biological aspects of the fishery. The industry which is concerned with economic aspects faces overcapacity.

Keywords: South Africa, hake deep sea trawl fishery, overcapacity, capacity under-utilization

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Abbreviations

ASHQI	Association of Small Hake Quota Industries
BEE	Black Economic Empowerment
CU	Capacity Utilization
CCFR	Code of Conduct for Responsible Fisheries
CPUE	Catch per Unit Effort
DEA	Data Envelop Analysis
DEA	Department of Environmental Affairs and Tourism
EAF	Ecosystem Approach in Fisheries Management
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization
FAWU	Fisheries Association and Workers Union
FCO	Fishery Control Officers
GDP	Gross Domestic Product
GRT	Gross Registered Tonnage
HDST	Hake Deep Sea Trawl
HDI	Historical Disadvantaged Individual
HIST	Hake Inshore Trawl
HHL	Hake Hand Line
HLL	Hake Long Line
HMWG	Hake Management Working Group
IPOA-capacity	International Plan Of Action for the management of fishing capacity
IUU	Illegal, Unreported and Unregulated
I&j	Irvin and Johnson fishing company
KZN	Kwa-Zulu Natal
LTR	Long-Term fishing Rights
MAST	Marine Admistration System
MCM	Marine and Coastal Management
MCS	Monitoring, Control and Surveillance
MEY	Maximum Sustainable Yield
MLRA	Marine Living ReSource Act of 1998
MSY	Maximum Sustainable Yield
MTR	Medium Term fishing Rights
OECD	Organization for Economic Co-operation and Development
OMP	Operational Management Procedure
PTP	Peak to Peak
SA	South Africa
SADSTIA	South African Deep-Sea Trawling Industry Association
SPF	Stochastic Production Frontier
TAC	Total Allowable Catch
UN	United Nations
UNCLOS	Convention on the Law of the Sea
VMS	Vessel Monitoring System
WSSD	World Summit on Sustainable Development

1. Introduction

The present study seeks to examine overcapacity in a particular sector of the South African Hake fishery, i.e., the Hake Deep Sea Trawl (HDST) fishery. Recognized as the most capital intensive fishery, the HDST fishery is structurally and operationally the most complex among South African fisheries. Operationally, the HDST fishery is considered labour intensive since the majority of operating vessels is old and thus requires a great deal of manpower.

1.1. Conceptual Framework

The conceptual framework that guided this study is briefly summarized below (See Fig.1.1). The study is largely based on input based-measures of capacity, corresponding to the technologists' perspective in relation to the concept of fishing capacity.

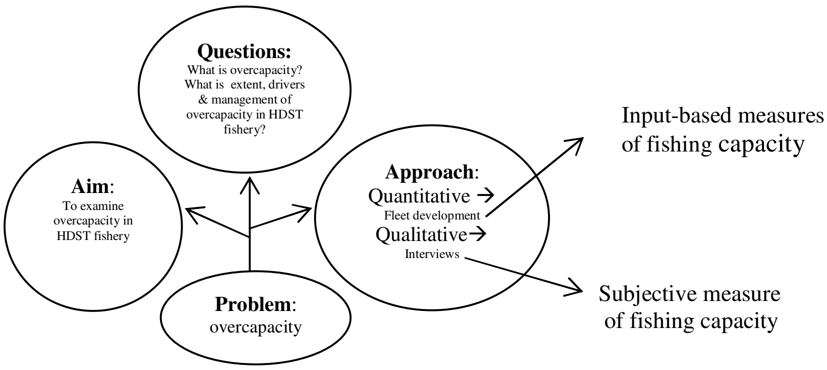

Fig. 1.1. Conceptual framework, answers to typical why, what and how questions of the research

1.2. Setting the Stage

Overcapacity occurs when the fishing fleet is greater than necessary. Sabatella & Piccinetti (2004) associate overcapacity with fisheries which can potentially produce more due to excessive labour and capital. Marine and Coastal Management (MCM) and the HDST fishing industry, define overcapacity as the degree to which an unrestricted fleet can fish more than its Total Allowable Catch (TAC) in a given fishing season. MCM associate overcapacity with vessels but has not implemented any vessel restrictions hitherto, as such restrictions would contradict investment encouraging policies (Barkai & Bergh, 2007).

1.3. Justification

In essence, the South African hake fishery management is faced with challenges such as overcapacity, Illegal, Unreported and Unregulated (IUU) fishing, by-catch and data deficiencies.

1.3.1. Why Look at Overcapacity?

This study explores overcapacity since it poses diverse incompatible impacts in fisheries that often become its sufferers (See Fig. 1.2). Further, the fact that overcapacity exacerbates IUU fishing, enhanced the enthusiasm for this study to explore overcapacity.

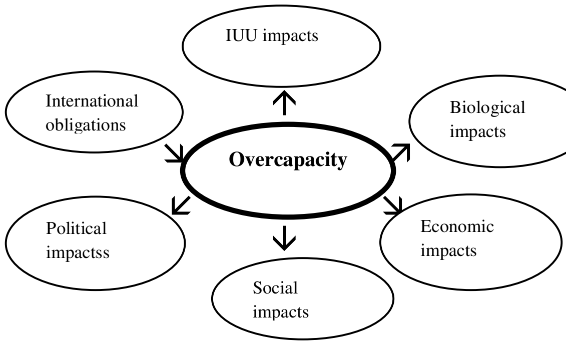

Fig. 1.2. Illustration of why overcapacity is seen an issue (Adapted from Pascoe et al., 2008: 6).

During the World Summit on Sustainable Development (WSSD) in 2001, South Africa (SA) committed itself to achieve an Ecosystem Approach to Fisheries management (EAF) by 2010. SA also signed the Food and Agriculture Organization's Code of Conduct for Responsible Fisheries (CCFR) and the United Nation's Convention on the Law of the Sea (UNCLOS) (MCM, 2005a). The WSSD, CCFR and UNCLOS oblige fishing nations to integrate capacity management in their fisheries management systems (Pascoe et al., 2008). Realizing the above facts further developed the enthusiasm to base this study on overcapacity.

1.3.2. The Extent of the Issue

The majority of industrial fisheries in SA, including the hake and small pelagics' fisheries are facing overcapacity. Overcapacity is not restricted to industrial fisheries in SA. Overcapacity (has also been observed in a traditional line fishery in SA. Cunningham & Gréboval (2001) state that overcapacity affects small-scale fisheries as much as it does large-scale fisheries. Madau (2009) concurs and further explain that overcapacity in small-scale fisheries may be induced by their low revenues and labour intensive nature. In SA, overcapacity is a key challenge in controlling fishing effort and fisheries managers see overcapacity as '*the devil making work for idle hands*', while economists see the capital invested capital as '*rent seeking*' (Barkai & Bergh, 2007).

Tingley et al. (2003) proclaims that overcapacity and overexploitation are inseparables. This is also emphasized by Barkai & Bergh (2007) who states that overcapacity is one of the root causes of overfishing in SA. Claims of overfishing persisted in SA in 2007. This is noteworthy as overcapacity in the HDST fishery was also detected in 2007 (Barkai & Bergh, 2007).

Looking at the Global Context

Overcapacity is not confined to SA, it has rather been a nuisance in many fisheries globally, for example Chinese fisheries (Yu & Yu, 2008), five United States fisheries (Kirkley et al., 2002), eight South and Southeast Asian countries' fisheries (Stobutzki et al., 2006), Norwegian trawl fisheries (Standal & Aarset, 2008) and Taiwanese coastal fisheries (Huang & Chuang, 2010)[1].

Initiatives

The concern about overcapacity was globalised by FAO through several of its initiatives. In 1995, FAO compiled CCFR. In 1997, FAO's committee on fisheries formally raised the need to manage overcapacity. Consequently, FAO organized a working group for the management of fishing capacity to discuss issues associated with the description, measurement and management of fishing capacity. In 2009, this led to the development of an International Plan of Action for the management of fishing capacity (IPOA-capacity). IPOA-capacity encourages fishing nations to address overcapacity (Bayfiff, 2005)[2]. Further, in 1947, overcapacity was among the main topics in an overfishing conference in London. Nevertheless, the majority of nations began addressing overcapacity within the past few decades (Pascoe & Gréboval, 2003) and regardless of the strides taken to address overcapacity, the world's fishing fleet remain increasing (Joseph ., Undated).

Different Perspectives on the Concept of Overcapacity

Generally, there are different perspectives with regard to overcapacity, depending on a fisher's scale. In large-scale fisheries, overcapacity is usually a concern and the majority of such fisheries attempt to reduce it. In small-scale fisheries, overcapacity in terms of many vessels maintains the

[1] For more examples, See Asche et al.,2008; Dupont et al., 2002; Fina, 2005; Guttesen, 1992; Holland et al .,1999; Ibarra et al.,2002; Johnsen, 2005; Madau et al., 2009; Maravelias & Tsitsika, 2008; McCay et al.,1996

labour intensive nature of these fisheries. Hence, the incentive to reduce overcapacity in small-scale fisheries is weak and managers often have hard choices to make (Bayliff et al., 2005)[3].

1.4. Research Strategies, Aims and Questions

This study is inductive and adductive in terms of research strategies (Blaikie, 2000) and aims to examine overcapacity in the HDST fishery through the following questions.

1. *What is overcapacity, how is it defined in technical, biological and economic terms?*
2. *To what extent is there overcapacity in the HDST fishery?*
3. *What are the main factors driving capacity to the current level in this fishery?*
4. *What are the measures used to manage this capacity and what are their implications?*

1.5. Research Methods

Research methods used for this study are quantitatively based on input measures of fishing capacity and qualitatively based on subjective measures of fishing capacity. The quantitative methods were mainly based on the secondary data from MCM's database called Marine Administrative System (MAST). The qualitative methods were more primary in nature through interviews, using a questionnaire (See Appendix 1). A comprehensive literature review was undertaken to address the first and the last research questions.

1.5.1. Input-based Assessment

The input-based assessment was carried out to assess the fishing capacity development between 1998 and 2009 and thus determine the extent of overcapacity in the HDST fishery. Data relating to the total number of vessels, length, gross tonnage and engine power for vessels operating in the HDST fishery and the hake TACs were extracted from MAST. The total number of people employed in the HDST fishery between 1998 and 2009 was calculated based on TAC/employment adjustment ratio[4] for the HDST fishery. The data for the catch per unit effort, sea days and landings from 1998 to 2009 were obtained from MCM's research directorate.

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[2]See also Pascoe et al.,, 2008; Gréboval, 2004; FAO, 1999; Ward et al., 2004
[3] See also Béné et al., 2010; Metzner, 2004; Pascoe et al., 2004;

[4] This implies one full-time job for every nominal tonnes of the fishery's products, i.e. if the HDST fishery's share of TAC increases or decrease by 1000 tonnes, the industry respectively gain or lose 62 people.

1.5.2. Subjective Assessment

This was carried out to investigate the causes and impacts of overcapacity including the implications of the capacity management measures in the HDST fishery (See Appendix 1). The semi-structured, open ended interviews (Blaikie, 2000) were conducted on five representative of selected HDST fishing companies and one representative of the South African Deep Sea Trawl Industrial Association (SADSTIA) (See Appendix 2). Each of the interviewees was contacted prior to the interview to schedule the meeting and the questionnaire was sent prior to the meeting. During the meeting, both the interviewer and the interviewee would go through the questions and answers to straighten out uncertainties. Data capture was through notes and tape recordings.

1.6. Limitations

The field work for this study has been conducted in a short period of time. The following therefore has hindered an in-depth assessment of overcapacity in the HDST fishery. Firstly, the study focused only on fishing overcapacity, it could not assess processing overcapacity, yet fishing and fish processing industries are directly affected. Secondly, the secondary data used for the quantitative methods might not be as accurate as when collected through a primary study. Lack of data about the total crew for other vessels on MAST is another limitation of using a secondary data. Thirdly, the study used input-based fishing capacity measure since it is simpler, requiring less and easily accessible data. The input-based method is not as accurate as output based method and hence a less rigorous way of assessing capacity. Several studies, recommend the use of both input and output based methods. Lastly, only five fishing operation managers were interviewed and no fishery's managers were interviewed. Statistically, this is a very small sample size which could bias the findings and thereby conclusions of the entire study.

1.7. Key Findings

Substantial fishing capacity was brought into the HDST fishery during the recent fishing rights allocation, leading to overcapacity. The utilization of that capacity is restricted through the TAC reduction and effort control regimes, leading to capacity under-utilization at fleet and individual vessel levels. This capacity under-utilization reduces employment and increases the operational costs in the HDST industry. However, it led to the recovery of the deep water hake coupled with improved CPUE. The management of the HDST fishery looks at overcapacity from the state's perspective. It has thus moved overcapacity and the responsibility to deal with it to the industry.

1.8. Relevance

This study is considered relevant due to the following reasons. First, the HDST fishery is very capital intensive and overcapacity is one of the major challenges in its management. Second, the country recently broadened access in fisheries to address past imbalances. Reducing fishing capacity requires excluding fishers in addition to vessels. Therefore, this would affect the fishers who were denied of access in the past. Third, reducing effort is a difficult task in SA, as the state cannot compensate those excluded from fishing, due to limited funds. Fourth, this is the first study to deal with overcapacity in the South African hake fishery. It could therefore recommend measures to ameliorate the current fishing capacity management strategies in the HDST fishery. If published, it may bring information about overcapacity in the HDST fishery to the public.

1.9. The Structure of the Thesis

The rest of this thesis is structured as follows: C**hapter 2** discusses the background of the HDST fishery. **Chapter 3** presents different perspectives with regard to the concept of fishing capacity, defines overcapacity and discusses various fishing capacity assessment methods. **Chapter 4** presents the signals, extent, drivers and impacts of overcapacity in the HDST fishery. **Chapter 5** presents fishing capacity management measures for this fishery with their implications and measures taken by the industry to counter overcapacity. **Chapter 6** discusses the findings. **Chapter 7** concludes the thesis and gives recommendations and further research.

2: Background: The Hake Deep Sea Trawl Fishery, South Africa

2.1. Introduction

South Africa (SA) is located at the southern tip of the African Continent. The country is well endowed with marine resources with a 3000 km long coastline and a 200 nm long Exclusive Economic Zone (EZZ). The coastline is divided into South, West, East and Kwa-Zulu Natal (KZN) (See Fig. 2.1). The West Coast comprises of cold, nutrient- rich waters of the Benguela Current (See Fig. 2.3) and is among the most productive upwelling systems in the world. The East Coast is less productive but with higher species diversity. The KZN coast is typified by the Agulhas Current (See Fig. 2.3), that brings warm nutrient-deficient waters down the East Coast (Badenhorst, 1997)[5].

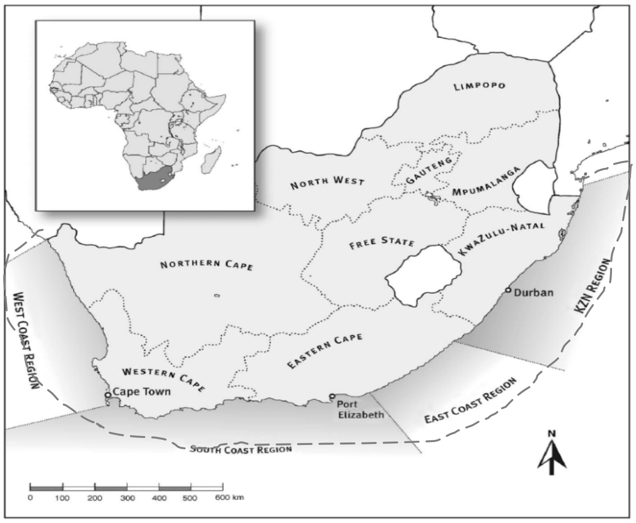

Fig. 2.1. South African coastline and EZZ (dotted line) (Adapted from Sowman, 2006: 62)

The availability of fish is explained by the biogeographical differences of the coast. The most lucrative fish and industrial fisheries are concentrated on the West Coast. The recreational and subsistence fisheries are more prevalent on the South, East and KZN Coasts (Badenhorst, 1997).

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[5] See also Branch & Clark, 2006;Hutton et al., 1999; Payne & Crawford, 1989; Sumaila et al., 2002

2. 2. South African Fishing Industry: An Overview

The South African fishing industry comprises about 20 marine fisheries, ranging from small to large scale (See Appendix 3) (Branch et al., 2002)[6]. It has a value of about 4 billion South African Rands, translating to less than 1 % contribution to the gross domestic product. Hence, it is a relatively small sector in the economy of SA (Ponte & van Sitter, 2006). Since the recent issuing of fishing rights, there are major changes in the South African industry.

2.3. The Hake Fishery: Brief Overview

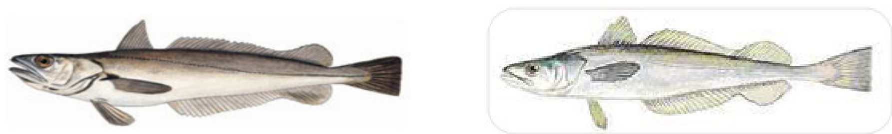
The South African hake fishery is partitioned into the Hake Deep Sea Trawl (HDST), Hake Inshore Trawl (HIST), Hake Long Line (HLL) and Hake Hand Line (HHL) sectors. It began in the 1890s, as a trawl fishery and was broken into HDST and HIST in the late 1970s. The HLL was introduced in 1994 with an unstructured HHL recently being recognized. In commercial terms, the hake fishery is the most important fishery in SA and in terms of quantity, it ranks second after small pelagics' fishery (MCM, 2005)[7].

2.4. The Hake Deep Sea Trawl Fishery

Since HDST fishery catches 84 % of the hake Total Allowable Catch (TAC), it dominates the hake fishery in terms of capital, landings and value (Fairweather, 2001)[8].

2.4.1. Biological Aspects

The HDST fishery targets 90 % of the deep water Cape hake *(Merluccius paradoxus)* and only 10 % of the shallow water Cape hake, (*Merluccius capensis)*. These species are morphologically similar with only few and sublte differences (See Fig. 2.2).



M. paradoxus, the mainstay of HDST fishery   *M. capensis*, the mainstay of HIST fishery

Fig. 2.2. The deep and shallow water Cape hakes (adapted from http://www.ij.co.za)

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6 See also Branch & Clark, 2006; Clark et al., 2002; MCM, 2007; Sowman, 2006

7 See also MCM, 2006-2007; Hutton et al., 1999, Ponte & van Sittert, 2006;Promoting Agribusiness Linkages (PAL), Undated; Tingley et al., 2007

The shallow water hake inhabits the continental down to a depth of 380 m between East London and Port Nolloth (See Fig 2.3). The deep water hake is found between 150 m and 800 m water depths from Port Elizabeth to Port Nolloth (See Fig 2.3)

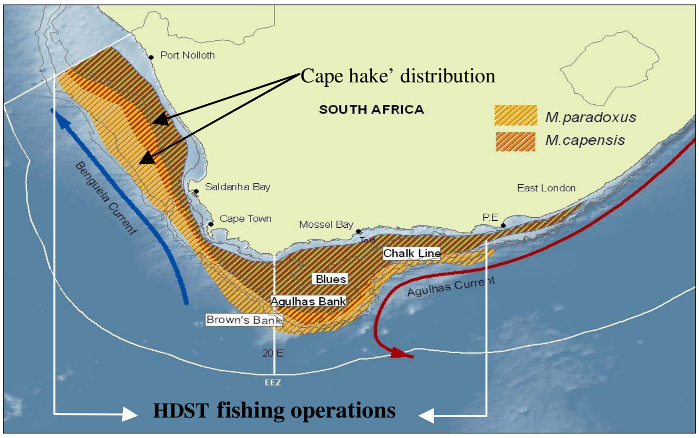

Fig. 2.3. Cape hakes' distribution and HDST operations (adapted from www.capfish.co.za)

The general k-selected[9] life history trait of hakes makes them prone to overexploitation. Cape hakes are omnivorous, feeding on zooplankton when juveniles and get more piscivourous as they grow older. In addition to being dominant dominant predators in the demersal habitat, cannibalism and opportunistic feeding are prominent within each species. Cape hakes are serial spawners and their year-round availability ensures consistent supply and continuity of the market. Kingklip, (*Genypterus capensis*), monk (*Lophius upsicephalus*), snoek (*Thysites atun*) and kob (*Argyrosomus japonicus*) form the by-catch of the HDST fishery (Hutton et al., 1999)[10].

2.4.2. Fishing Operations

The HDST fishery operates in waters deeper than 300 m, in the Western Cape (93 %), i.e. Cape Town (67 %) and out of Saldanha Bay (33 %) (See Fig. 2.3). Only 7 % of operations take place in Eastern Cape with 5 % in Port Elizabeth and 2 % out of Mossel Bay (Hutton et al., 1999)[11].

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[8] See also Hutton et al., 1999; Ponte & van Sittert, 2006; Punt & Butterworth, 1995; von der Heyden et al., 2006
[9] Slow growers with large body size and known to be reaching maturity late in their life span
[10] See also Hutton & Sumaila, 2002; Lombarte & Fortuno, 2005; Payne & Crawford, 1989; Powers *et al*., 2004; Tingley *et al*., 2007; von der Hyden *et al*., 2006
[11] See also Hutton & Sumaila, 2002; Ponte & van Sittert, 2006; Tingley et al., 2007

2.4.3. Fishing Right Holders

Over the years, the development of the HDST fishery has shown an increase in the number of right holders (See Fig. 2.4). This was brought by improved accessibility to fishing rights for people who were deprived of access to the fishery in the past. This is reflected in the number of right holders who have increased from three in 1978 to seven in 1986. In 1992, following the publication of the Sea Fisheries Policy of 1985, 21 right holders operated in the HDST fishery. The Marine Living Resource Act of 1998 (MLRA) which replaced the Sea Fisheries Act acted as a driving force to further increase the number of right holders in this fishery (MCM, 2004)[12].

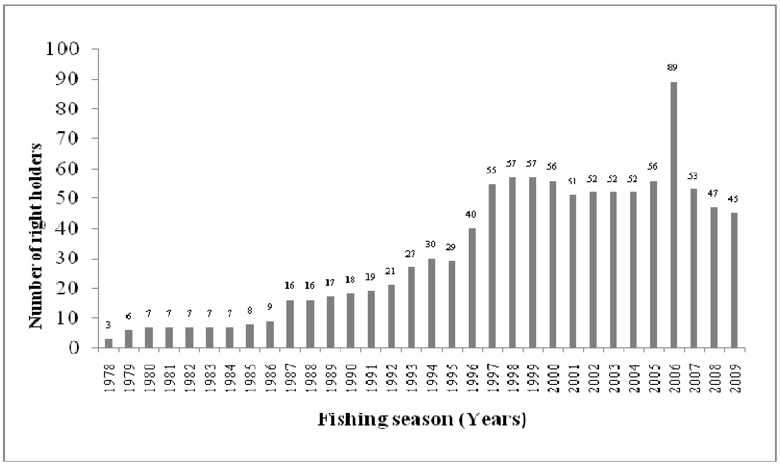


Fig. 2.4. HDST fishery's Right Holders (1978-2009) (adapted from www.envirofishafrica.co.za)

The number of right holders reached 55 in 1997 when the Medium Term fishing Rights (MTR) allocation took place. In 2006, the Long-Term fishing Rights (LTR) allocation was introduced and resulted in 89 right holders in the HDST fishery. This dropped to 45 right holders in 2009 as the newer and smaller entrants continued to sell their fishing rights (See Fig. 2.4).

Since 1978, the established HDST fishery's right holders organized themselves into the South African Deep-Sea Trawling Industry Association (SADSTIA). In 1996, smaller and newer entrants formed the Association of Small Hake Quota Industries (ASHQI) (MCM, 2004).

Paper Quota Holders

There are paper quota holders in the SA's hake fishery since the fishing rights allocation era, as some of the newer and smaller entrants could not afford their own fishing equipments. Their quotas were too small to be profitable and hence proved to be non-viable. This forced them to make joint ventures with established companies and foreign vessels, leading to a category termed '*paper quota holders'* in SA (MCM, 2004) [13].

2.4.4. Fishing Technology

The HDST fishery is capital intensive and in 2009, 59 vessels operated in this fishery (See Appendix 4). These vessels are stern trawlers operating with a bottom trawl. The crew size is normally around 46 people for the freezer and 25 people for wet fish vessels. The wet fish vessels land about 50 tonnes of hake stored on ice in six days at sea and transport it to freezer facilities in more than 50 shore-based hake processing facilities. The freezer vessels process about 500 tonnes of hake in two months at sea (MCM, 2005)[14].

2.4.5. Catch Trends

The development of the South African hake trawl fishery is demonstrated by an increase in catches over the years (Hutton *et al*., 1999)[15]. It began in 1890s, grew steadily after 1952 and increased rapidly in the 1960s (See Fig. 2.5).

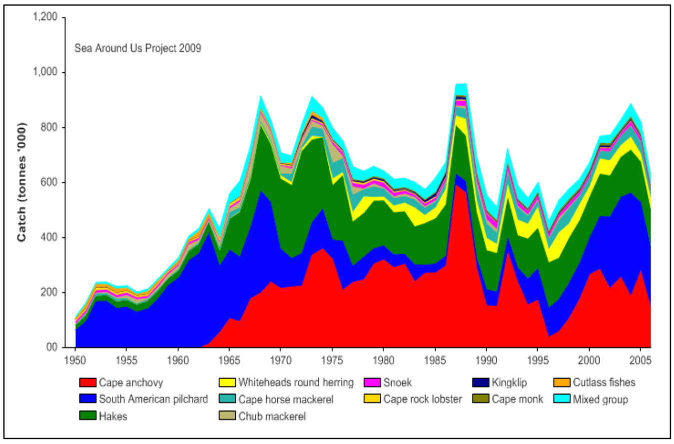


Fig. 2.5. South African hake catches from 1950 to 2006 (Source: http://www.seaaroundus.org)

Following the arrival of foreign trawlers after 1962, the hake catches decreased and increased sharply after 1965 until the late 1960s. They increased again in the early 1970s, declined after

[12] See also Hutton *et al*., 1999; MCM, 2005;Ponte & van Sittert, 2006; Sumaila, 2005
[13] See also Fishing Industry Handbook, 2002 & 2007; Ponte & van Sittert, 2006; Powers et al., 2004; Sumaila, 2005;
[14] See also Hutton et al., 1999; Hutton ,2003; Ponte & van Sittert, 2006
[15] See also Payne & Crawford, 1989; Ponte & van Sittert, 2006

1975 and became relatively stable until the early 1980s, leading to the declaration of an EEZ in 1977. They increased sharply between 1985 and 1990 and hovered around 600 000 tonnes until another sharp increase occurred between 2000 and 2005 (See Fig. 2.5).

2.4.6. Product Characteristics

The HDST fishery's primary products include fresh and frozen products. Fresh products include head-on prime quality gutted, head and gutted including fillets (See Fig.2.6).

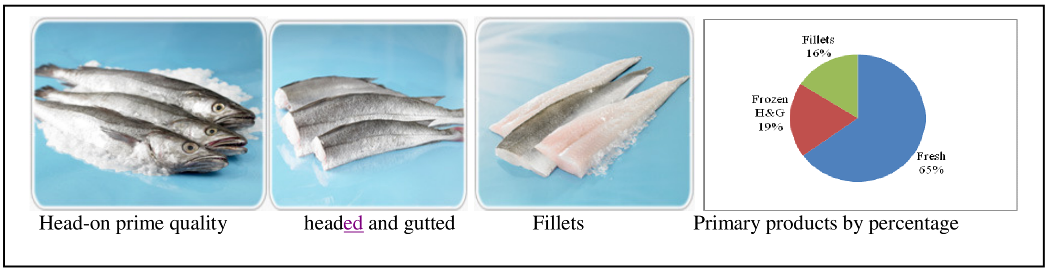


Fig. 2.6. HDST fishery's primary products (Adapted from www.seaharvest.co.za)

Fresh products account for two thirds of the HDST fishery's catch. They are landed on ice and further processed onshore to a range of value-added products. Frozen products include fillets and head and gutted. They are partially processed at sea, mainly for exports (Hutton et al., 1999)[16].

2.4.7. Social Aspects

The HDST fishery provided about 8.938 jobs in 2006 and the majority of which were onshore-based with full-time benefits (See Fig. 2.7).

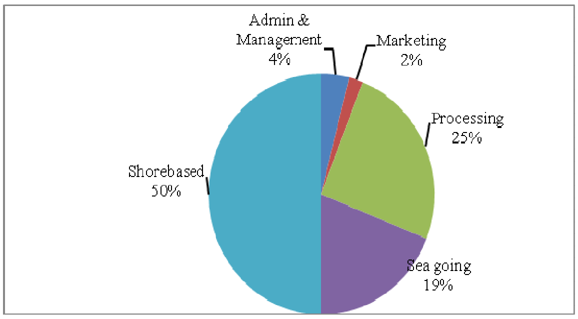


Fig. 2.7. HDST fishery employment by sector (Source: http://www.envirofishafrica.co.za)

[16] See also Hutton 2003; Ponte & van Sittert, 2006

The ratio of onshore to sea employment is 3:1, for the HDST fishery This means for every person employed at sea, three people are employed onshore and vice versa (Powers et al., 2004).

2.4.8. Economic Aspects

The HDST fishery is the most valuable among South African fisheries and accounts for 50 % of the wealth generated from the country's fisheries. The market value of the landed catch for this fishery is about 2 billion South African Rands annually. The value of assets is presumably more than 890 million South African Rands (Crosoer et al., 2006)[17].

Exports

The HDST fishery exports account for 40 % of the total value of fish exports in SA. Cape hakes are mainly exported to Italy, Spain, Germany, France, Holland, Sweden, Switzerland, Portugal, Greece, United Kingdom, United States, Australia, Middle East and Far East (See Fig. 2.8).

Fig. 2.8. Countries importing the South African hake (Source: www.seaharvest.co.za).

European countries import about 80 % of Cape hakes with 38 % of which being imported by Spain alone (Ponte & van Sittert, 2006).

2.4.9. Management

The general fisheries system, revealing interactions among the fisheries governance, biophysical and socio-economic aspects of fisheries in SA, is illustrated below (See Fig. 2. 9).

[17] See also Fishing Industry Handbook 2005; Ponte & van Sittert, 2006

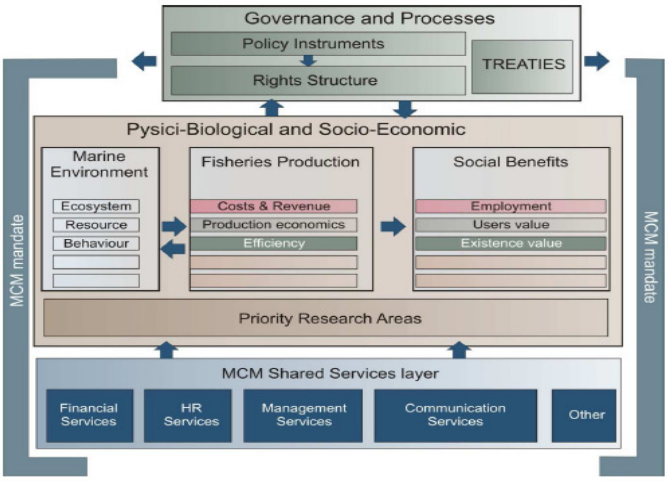


Fig. 2.9. Fisheries system in the South African context (Source: Jayiya et al., 2008: 16).

Goals and Institutions

The governmental body that manages SA's fisheries is called the Marine and Coastal Management (MCM). This is one of the branches of the Department of Environmental Affairs and Tourism (DEAT). It is guided by the Marine Living Resource Act of 1998 (MLRA) which mainly aims to achieve sustainable utilization of marine resources. Further, SADSTIA and ASHQI play a major role in co-managing this fishery (See Fig. 2.10) (Hutton et al., 1999).

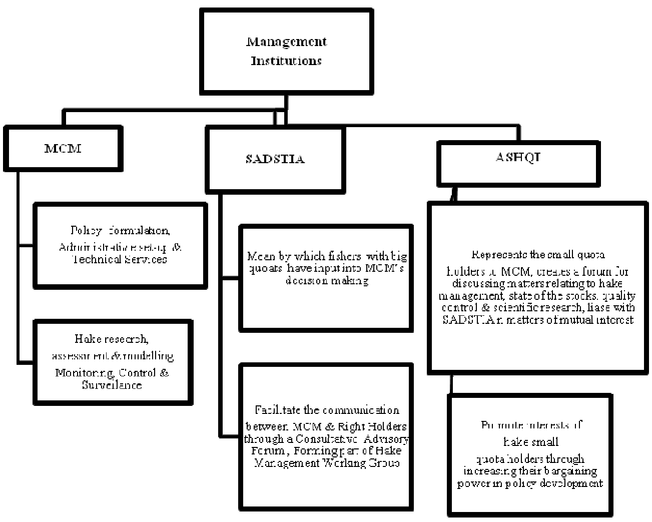


Fig. 2.10. Management institutions for the HDST fishery (Adapted from Powers et al., 2004: 20

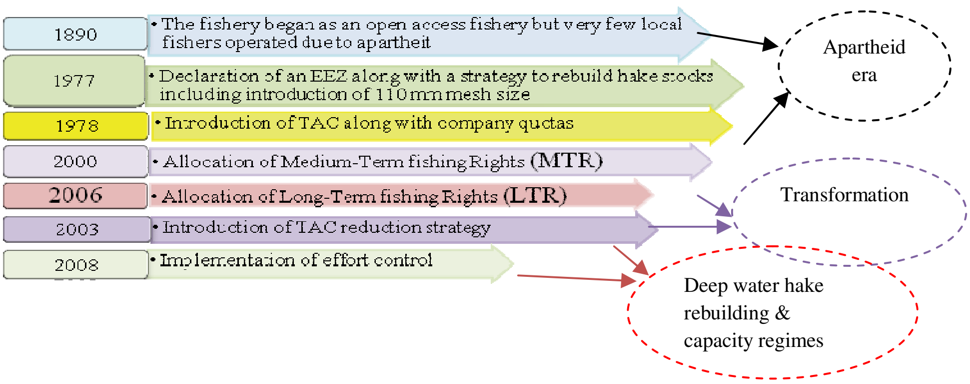
International Co-operations

SA is a member of the Food and Agriculture Organization (FAO) of the United Nations (UN). The country signed the FAO's Code of Conduct for Responsible Fisheries Management, UN's Convention on the Law of the Sea and UN's Framework Convention on Climate Change. In addition UN, the following are international co-operations and agreements that affect the HDST fishery's management and of which SA is a signatory to: Convention on International Trade in Endangered Species, Convention for the Protection, Management and Development of the Marine and Coastal Environment of the East, West and Central African Regions African Region, Southern African Development Community Protocol on Fisheries, Agreement on Conservation of Albatrosses and Petrels, South East Atlantic Fisheries Organization and Montreal Protocol (MCM, 2008-2009). Further, during the World Summit on Sustainable Development in 2002, SA committed itself to achieve an Ecosystem Approach in Fisheries Management (EAF) by 2010 (MCM, 2005b). Currently, the country is making strides to implement EAF locally and across the region through the Benguela Current Large Marine Ecosystem program (FAO, 2008), a trilateral project between South Africa, Namibia and Angola.

Historical Background

The HDST fishery's management shows a dramatic development from an open access fishery with few local operating companies to a dual TAC/effort controlled fishery with many vertically integrated and non-viable operating companies including paper quota holders (See table 2.1).

Table 2.1. The summary of the evolution of HDST fishery's management



Apartheid

South Africans had lived under an apartheid[18] regime for almost 40 years until 1994 when elections for a democratic president took place. Apartheid deprived blacks including coloureds an access to fishing. This resulted in a skewed distribution of fish resources between small-scale and large-scale fishers in addition to a totally uneven regional distribution of catching and processing possibilities. Due to this segregating type of regime, there existed what was then referred to as 'white only' beaches, driving a large number of coastal people to poverty. The fisheries administration was also dominated by whites. Hence, the hake fishery was at first concentrated among few white-owned companies. Since this regime, the fisheries managers have been facing a challenge to address these imbalances through transformation (MCM, 2002)[19].

Transformation

Following the democratic elections, the ownership and management of fisheries in SA altered through transformation. The process can be described in three phases; (i) introduction of MLRA to broaden the fishing access of Historically Disadvantaged Individuals (HDIs)[20]; (ii) MTR allocation and (iii) LTR allocation. Internal transformation within established companies through Black Economic Empowerment (BEE) was also achieved. The fishing quotas of empowered Small and Medium Enterprises (SME) were increased as part of transformation (MCM, 2002)[21].

Rights Allocation

According to section 18 (1) of MLRA for anyone to be granted a fishing permit, a fishing right, should have been issued to them first. The commercial fishing right is considered as a resource management tool and a tool to drive economic development in SA. It is not a property right but a legal permission to harvest marine resources for a specified period (MCM, 2005a).

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[18] Laws implemented and enforced by white governments between 1948 and 1990 in South Africa.

[19] See also Fishing Industry Handbook, 2000 & 2001; Hersoug, 2002; MCM, 2004

[20] People who, prior to democratic dispensation were disadvantaged by unfair discrimination on the basis of their race and this includes juristic persons or associations owned and controlled by such persons

[21] See also MCM, 2004; Powers et al., 2004

Medium-Term Rights

Medium-Term fishing Rights (MTR) refer to four year long fishing rights allocated to the South African fishers and fishing companies in 2001. Investment and experience in the fishing industry coupled with BEE and employment equity were the key criteria during allocation (MCM, 2002)[22].

Long-Term Rights

This refers to eight and fifteen year long term fishing rights which were allocated to South African fisheries 2006. The next round of LTR allocation in the HDST fishery will take place in 2020. The allocation criteria is shown in Appendix 5. In contrast to the MTR allocation, the LTR process design was detailed and thorough and guided by a fisheries general including sectoral policies. This was more transparent as the stakeholders were consulted throughout the process. LTRs are perceived as one of the powerful tools to create jobs and boost economic upliftment in SA (Fishing Industry Handbook, 2004)[23]

Input and Technical Management Controls

MCM implements a range of input and technical management controls for the major South African fisheries including the HDST fishery (See Appendix 6).

Output Management Controls

The hake fishery's output is controlled by a TAC that combines both Cape hakes. The TAC is partitioned through quotas among the hake sectors (See Fig.2.11) and fishing companies.

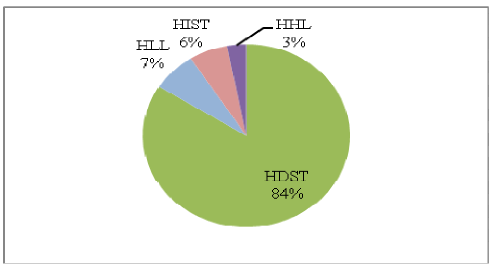

Fig. 2.11. Hake TAC allocations per sector (Source: http://www.envirofishafrica.co.za)

[22] See also Hersoug, 2002; Fishing Industry Handbook, 2003 & 2003; MCM, 2004
[23] See also Fishing Industry Handbook, 2006; Fishing Industry news, April 2006; Ponte & van Sittert, 2006

The HDST fishery gets 90 % of the deep water hake's share of the TAC (See Appendix 7). The hake TAC is calculated based on Operational Management Procedures (OMPs)[24] based on $f_{0.075}$[25] reference point and the TAC is always set below estimated maximum sustainable yield.

The hake TAC fluctuated between 105,000 tonnes (1983) and 140,000 tonnes (1987), hovered around 130,000 to 135,000 tonnes since the early 1990s, was It was set at 151,000 tonnes between 1995 to 1999, increased to 155,500 tonnes in 2000, increased further to 166,000 tonnes in 2002 and was reduced each year since 2003 due to a decline in the biomass of the deep water hake biomass (See Fig. 2.15) (MCM, 2006-2007)[26].

Monitoring, Control and Surveillance

MCM's Monitoring, Control and Surveillance (MCS) includes fishery control officers (FCOs), Vessel Monitoring System (VMS) and vessel patrols (See Appendix 8) (MCM, 2008-2009)[27].

2.4.11. Resource status

The biomass for Cape hakes declined substantially in the previous years (See Fig 2.12). Likewise, the combined catch per unit effort (CPUE) relatively decreased (See Appendix 9).

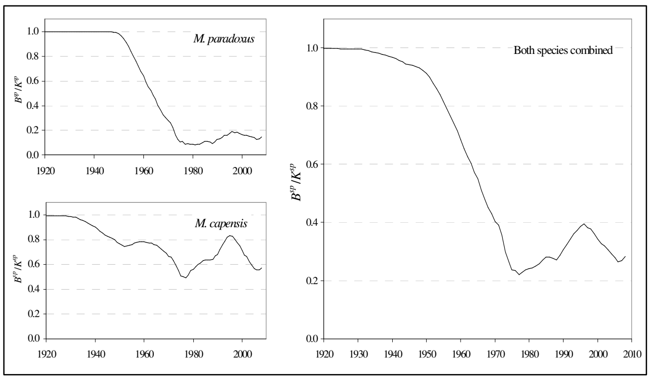

Fig. 2.12. The biomass of Cape hakes (Source: MCM, 2009: 6).

[24]This refers to developing robust management based on projections of management alternatives under uncertainties in the stock assessment. During OMP, various management objectives, risks and constraints are agreed upon, tested in simulations involving projecting impacts of alternative assumptions about population dynamics and reaction of management quantities to those alternatives and ultimately form the basis of management actions.

[25]This refers to the fishing effort where the slope of the yield per recruit curve is 7.5 % of the slope at the origin. During OMPs' formulation this effort level was a compromise between strategies that provided higher probabilities of quick recovery but higher chances of TAC decline and vice versa.

[26]See also MCM, 2008 & 2009; Sumaila, 2005; Plaganyi et al., 2007; Ponte & van Sittert, 2006; Powers et al., 2004; Tingley et al., 2007

[27] See also Powers et al., 2004; Tingley et al., 2007

The South African hake fishery obtained the Marine Stewardship Certification in 2004, as a responsible fishery. In accordance with International Council for the Exploration of the Sea (ICES) biological reference points, *M. capensis* is harvested sustainably (MCM, 2006-2007)[28]. *M. paradoxus* is overexploited but its recovery signs have recently been reported (See Fig. 2.13).

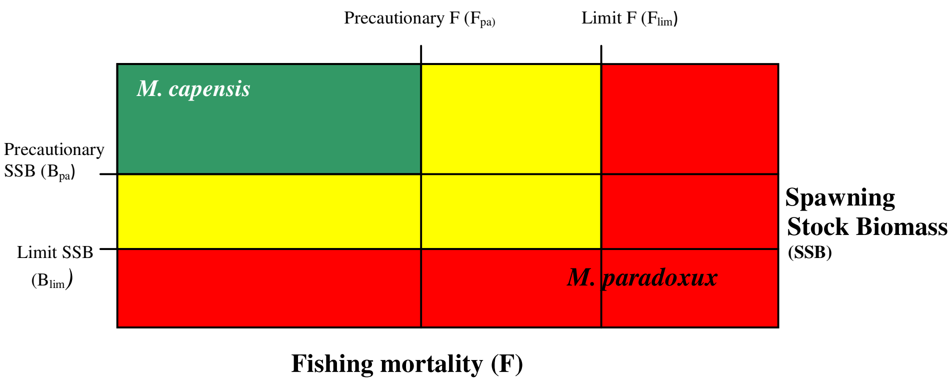

Fig. 2.13. ICES reference points with Cape hakes' state (adapted from Nielsen, 2008: 9). Species in a green colour is safe; in yellow, precautions should be taken and in red, is overexploited.

2.4.12. Stock Recovery Plan

In order to recover the deep water hake stock, the fishing effort applied in the HDST fishery has to be reduced considerably (See Fig. 2. 14).

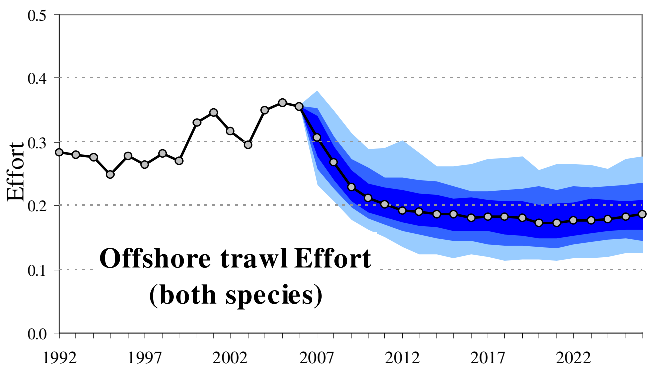

Fig. 2.14. Predicted future effort required for HDST fishery (Source: MCM, 2009: 9). The shaded areas show probability envelopes at the 50th (darkest), 75th and 95th (lightest) percentiles.

[28] See also MCM, 2007-2008; SEAFISH, 2008 & 2009; Powers et al., 2004; Tingley et al., 2007

The figure below (Fig. 2. 15) demonstrate the predicted spawning biomass of the hake deep water hake and the CPUE of the HDST fishery including the changes in TAC that would be achieved in corresponding with the required reduction in effort (See fig. 2.14).

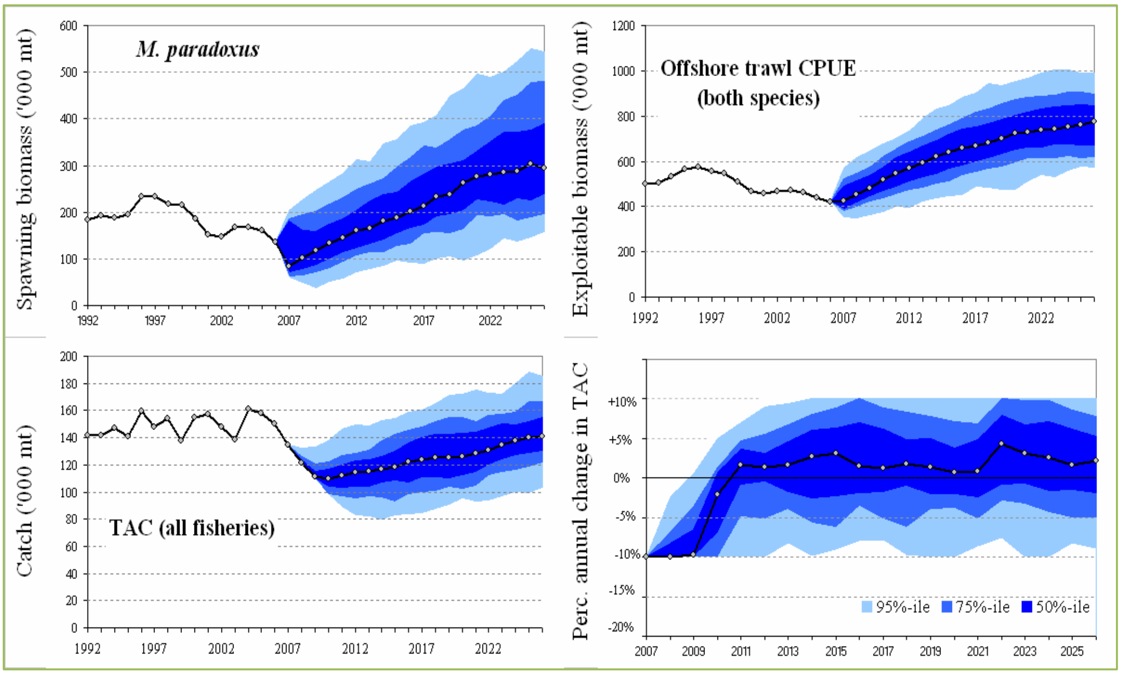

Fig. 2.15. Future trajectory predicted for *M. paradoxus* SSB, HDST fishery's CPUE, hake TAC and change in the TAC (Source: MCM, 2009: 7).

2.5. Summary

The HDST fishery is the most capital intensive fishery in SA. It has shown a dramatic development from being dominated by a few established companies to an extremely capital intensive industrial fishery with largely vertically integrated companies including small-scale non-viable fishing operators and paper quota holders. The management evolved from an open access fishery to a restricted access, dual TAC / effort controlled fishery. Since the mainstay of this fishery (*M.paradoxus*) has shown signals of overexploitation, the hake TAC is reduced each year to facilitate the recovery of this species. Further, the fishing effort has to be reduced considerably over the subsequent years (See Fig. 2.14) to facilitate the recovery of this species.

3. Theoretical Foundation: Fishing Capacity

3.1. Introduction

Following the globalization of overcapacity as a concern in fisheries, fishing capacity definition and assessment methods became of importance in the world of fisheries management. This has led to the development of a range of fishing capacity definitions and assessment methods. In essence, to design effective management measures of overcapacity, it is essential to explicitly understand the fishing capacity definitions and assessment methods.

3.2. Defining Fishing Capacity

The concept of fishing capacity and related concepts are not as clearly understood as other concepts in fisheries (Bayliff, 2005)[29]. The reasons for that are threefold. Firstly, stakeholders involved in fisheries have different notions pertaining to the concept of fishing capacity (Pascoe et al., 2008). Secondly, excess capacity, latent capacity, overcapacity, and overcapitalization are often perceived as synonyms since they are loosely different (Bayliff, 2005)[30]. Thirdly, fisheries multiple outputs, fluctuating prices and the unpredictable nature of fisheries resources make it tricky to practically define the concept of fishing capacity (Hatcher, 2004). Nevertheless, the Food and Agriculture Organization (FAO) of the United Nations' definition of fishing capacity which is adopted worldwide and in South Africa (SA) states that:

> ''*Fishing capacity is the maximum amount of fish over a period of time (year, season) that can be produced by a fishing fleet if fully utilized, given the biomass and age structure of the fish stock and the present state of the technology''* (FAO, 2000: 6).

In this context, full utilization implies unrestricted fishing. In simple terms, fishing capacity is the ability of a fleet to catch fish (FAO, 2000)[31]. As mentioned above, the perception of what constitutes fishing capacity differs among stakeholders involved in fisheries.

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[29] See also Gréboval & Munro, 1999; Joseph et al., 2006; Kirkley et al., 2004; Lindebo, 2004; Metzner, 2005; Reid et al., 2003; Standal, 2009; Ward et al., 2004

[30] See also Metzner, 2005; Pascoe et al., 2004; Pascoe et al., 2008; Morgan et al., 2007;

[31] See also Gréboval & Munro, 1999; Moreno & Majkowski, 2006

3.2.1. Fisheries Technologists' Perspective

Fisheries technologists associate fishing capacity with the technological and practical feasibility of a vessel to achieve a particular level of activity in terms of fishing days and fishing output. Therefore, they define fishing capacity as the amount of catch that the vessel could produce for the technological maximum it was designed for (See Fig. 3.1).

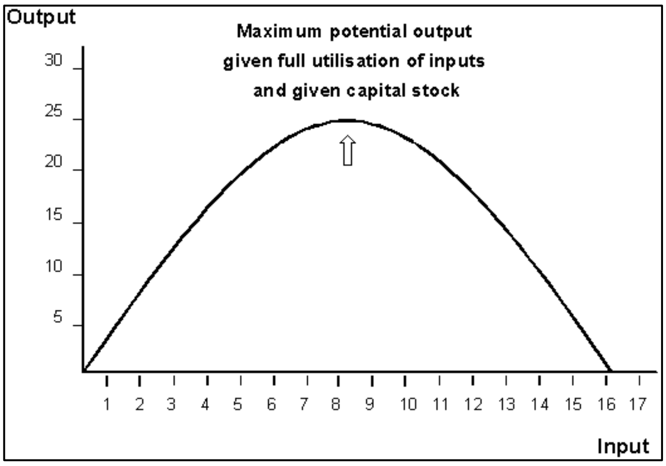

Fig. 3.1. Technological definition of fishing capacity (Source: Kirkley & Squires, 1999: 83)

In previous years, fisheries technologists tended to favor the term 'fishing power' over that of 'fishing capacity'. However, these concepts are different and therefore fishing power could give a misleading impression of the exact fishing capacity. Further, a problem that would arise in such situations is that, once the fishing power gets controlled, the fishers would always find other ways to increase their capacity to fish (Bayliff, 2005)[32].

3.2.2. Fisheries Biologists' Perspective

Fisheries biologists associate fishing capacity with the fishing effort[33] and the consequential mortality. In this regard, when the fishing mortality goes beyond the limit reference point which is usually set at the Maximum Sustainable Yield (MSY) (See Figs. 3.2 & 3.3), the mortality rate is considered too high, due to too much effort applied (Joseph et al., 2006)[34]. This implies, the biologists assume a positive relationship between fishing effort and the fishing mortality.

[32] See also Kirkley & Squires, 1999; Walden & Kirkley, 2004; Ward et al., Undated
[33] Theoretically, fishing effort includes all fishing inputs but since it is practically impossible measure all of them, fishing time and number of gears are used as surrogate measures..
[34] See also Metzner, 2005; Squires, 1999; Pascoe et al., 2008; Walden & Kirkley, 2000; Ward et al., 2004

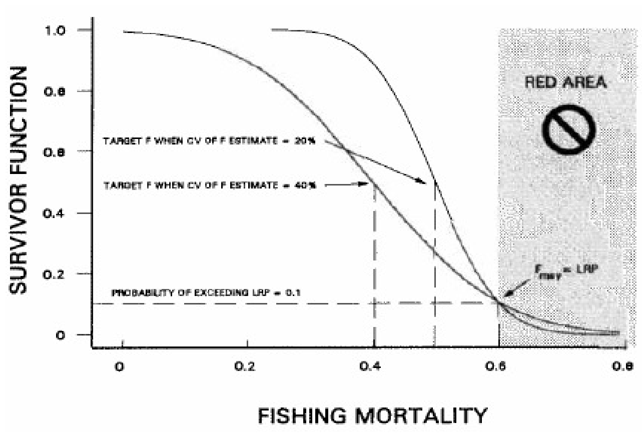

Fig. 3.2. Fishing mortality at MSY (F_{MSY}) (Source: Caddy & Mahon, 1995: 20).

3.2.3. Fisheries Economists' Perspective

Economists relate capacity to the potential catch that a vessel or fleet could attain when operating at maximum profits, i.e., at Maximum Economic Yield (MSY) (See Fig. 3.3) In this context, profit maximization implies full utilization of vessels (Hatcher, 2004)[35].

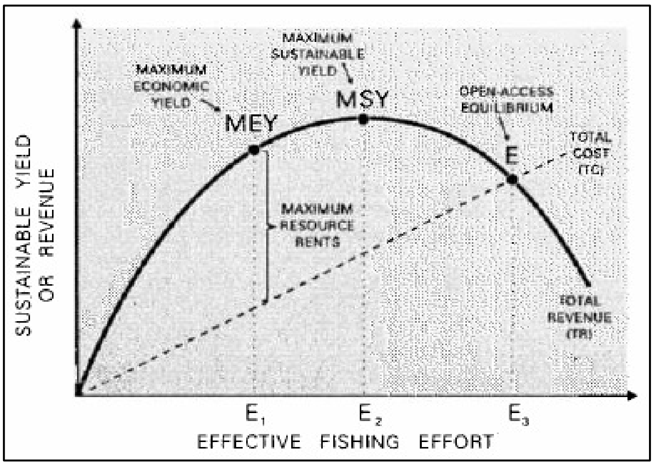

Fig. 3.3. Gordon-Schaefer model, showing: MEY, MSY and open access reference points with their efforts: E_1 (E_{MEY}), E_2 (E_{MSY}) and E_3 (E_{∞}) respectively (Source: Caddy & Mahon, 1995: 19).

3.2.4. Fisheries Managers' Perspective

Fisheries managers relate fishing capacity to the size and the gross tonnage of a fleet. In a fishery that is managed by a Total Allowable Catch (TAC), fishing capacity in this perspective refers to

[35] See also Joseph et al., 2006; Kirkley & Squires, 2004; Lindebo, 2004; Metzner, 2005; Pascoe et al., 2008;

the fleet size that is necessary to catch TAC. This implies that a larger fleet may potentially fish beyond the TAC allocated to it (Hatcher, 2004)[36].

Each of the above definitions is associated with a specific fishing capacity level. To technologists, the fully utilized fishing fleet implies optimal fishing capacity. To managers, a fleet size necessary to attain a given TAC implies optimal fishing capacity. To biologists, the optimal fishing capacity is applied at MSY and to economists it is applied at MEY. The degree of overcapacity therefore, differs with the above fishing capacity levels (See Fig. 3.4).

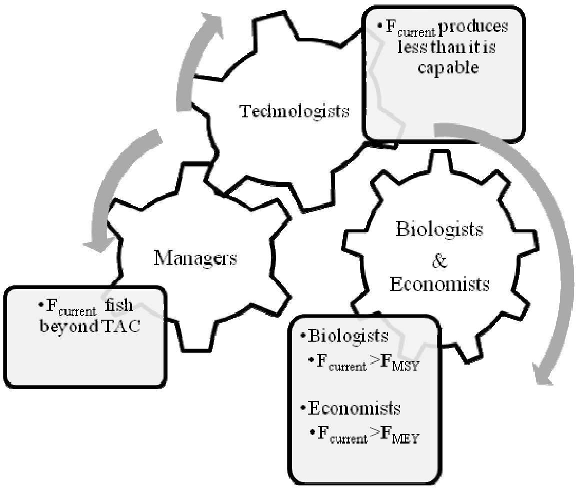

Fig. 3.4. Rough indicators of overcapacity based on the above perspectives. $F_{current}$ implies the current capacity with F_{MSY} and F_{MEY} implying the capacity at MSY and MEY respectively

In economic terms, overcapacity occurs when a fishery fishes beyond MEY. From the biologists' perspective, overcapacity occurs when the fishery fishes beyond MSY. To managers, if TAC could be exceeded, then overcapacity exist in a fishery. However, in a technologists' perspective, overcapacity exists when the fleet is under-utilized (See Fig. 3.4).

3.3. Defining Overcapacity and Related Concepts

The concepts of latent capacity, excess capacity, overcapacity and overcapitalization are used as synonyms in fisheries, yet they are not similar but closely related (Metzner, 2005)[37].

Reid & Squires, 2006; Walden, 2000; Ward, Undated

[36] See also Lindebo, 2004; Metzner, 2005; Pascoe et al., 2008; Walden & Kirkley, 2000; Ward et al., 2004

3.3.1. Latent Capacity

This refers to the trend of capacity that has either never been used or been used previously but currently inactive in the fishery. It is caused by capacity under-utilization (Madau et al., 2009)[38].

3.3.2. Excess Capacity

Excess capacity is a short-term phenomenon implying that a vessel or fleet can produce more than it is currently producing. It could be caused by short-term market constraints, i.e., decreased fish prices or temporal management adjustment, for instance to allow stock recovery and when the fishery conditions get back to normal the excess capacity get back to work (Bayliff, 2005)[39].

3.3.3. Overcapacity

Overcapacity refers to long-term excessive fishing capacity levels relating to a long-term target fishing capacity. The excessive capacity may be demonstrated by too many boats (Gréboval, 2004) or powerful and bigger boats (Utne, 2008). The target capacity may correspond to either a target catch or target fleet size (Metzner, 2005)[40] and depends on the goals of the fishery (Béne et al., 2010)[41]. If the goal is to maximize employment, indicators of overcapacity may be the consequence. Therefore, overcapacity would not be considered an issue. However, when overcapacity indicators are incompatible with the entire set of objectives in a given fishery, overcapacity is considered an issue, that needs to be addressed (Metzner, 2005).

Overcapacities sometimes occur together with excess capacity in a fishery (See Fig. 3.5). In Fig 3.5, a fishery is operates on a long-run yield curve but sometimes operates on the short run curve with V (number of vessels), C_1 (fish quantity). V_u (fully utilized vessels), V (total vessels).Excess capacity exists as C_1 could also be caught by $V_{u.}$ If the managers aim to achieve C_{MSY}, the fleet size would need to be reduced to V_M (i.e., V at MSY). Differences V-V_M and V-V_u represent overcapacity and excess capacity respectively.

[37] See also Pascoe et al., 2004; Pascoe et al., 2008; Morgan et al., 2007
[38] See also Kirkley & Squires, 2004; Ward et al., 2004
[39] See also National Marine Fisheries Service , 2004; Pascoe et al., 2008; Sabatella & Piccinetti, 2004
[40] See also Gréboval, 2004; Metzner, 2005; Pascoe et al., 2004; Sabatella & Piccinetti, 2004
[41] See also Morgan et al. , 2007; Metzner, 2005; Pascoe, 2004; Pascoe et al., 2008

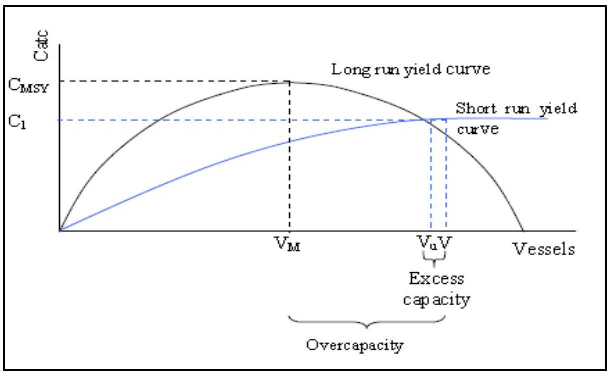

Fig 3.5. An example of overcapacity and excess capacity (Source: Pascoe et al., 2008:12).

Overcapacity may also occur without excess capacity. For example, in a fully utilized fleet with stock biomass (instead of effort) causing the lower catches, excess capacity would not be apparent even though the fishery would be overcapitalized with overcapacity (Metzner, 2005).

Causes and Impacts

Overcapacity usually stems from ill-defined property rights (Metzner, 2005), barriers to exit the fishery (Sumaila et al., 2007), race to fish, subsidies (Porter, Undated), market expansions and technological innovations (Pascoe & Gréboval, 2004)[42]. It typically leads to overinvestment in capital (Utne, 2006), excessive employment of labour, redundant fishing inputs (Gréboval, 2004), overfishing (Bayliff, 2005)[43], potential habitat degradation, rent[44] dissipation (Gréboval, & Munro, 1999)[45], reduced returns of capital and labour, resulting in poor quality of fishers livelihoods including political strife in the entire fishery's management (Gréboval, 2004)[46].

Overcapacity is common in pure and regulated open access[47] fisheries. In both cases, every fisher competes with every other fisher to catch as much as possible in the shortest time leading to 'race for fish[48] in addition to capital stuffing[49] In open access fisheries in particular,

[42] See also Gréboval & Munro, 1999; Ibarra et al., 2000; ; Ward et al., 2004; Weber, 1994
[43] See also FAO, 1999; Joseph et al., Undated; Metzner, 2005; Morgan, 2007; Pascoe et al., 2004
[44] This refers to abnormal profits, i.e., profits greater than normal and the highest rent is found when the maximum economic yield is attained in a given fishery
[45] See also Homas & Wilen; 1997 cited in Gréboval & Munro, 1999; Vestergaard & Frost, 1994
[46] See also Clark et al., 2005; Metzner, 2005; Sinclair et al., 2002; Sumaila et al., 2007; Ward, 2004
[47] In a regulated-open access fishery only the total harvest is controlled through the global TAC that is undivided
[48] A widely-known phenomena where by fisher rush to fish in competition for bigger catches & the profits are usually spent on building up more overcapacity related to what is needed in order to catch the fish
[49] This occurs when fishermen attempt to increase their catches by using more unrestricted inputs in place of the

what makes sense for individuals makes no sense in the aggregate, resulting in too many vessels, too much gear, too much waste, and too little income for fishers (Gréboval & Munro, 1999)[50].

3.3.4. Overcapitalization

Overcapitalization is the long-term issue which occurs when the fleet size exceeds what is required to harvest a given catch (See Fig 3.6).. It may be indicated by excess capacity. For example, if the catch or effort is restricted and the restrictions are likely to persist in future, excess capital indicates overcapitalization and thus overcapacity in the fishery (Bayliff, 2005)[51].

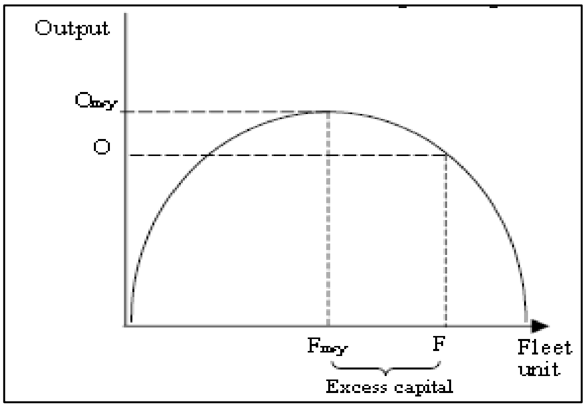

Fig. 3.6. Overcapitalization indicated by excess capital. F (current fleet), produces O (output). F_{MSY} (smaller fleet) can produce O_{MSY} (maximum yield). (Source: Pascoe, 2004: 64).

3.3.5. Capacity Utilization

Capacity Utilization (CU) refers to the extent to which the vessel is utilized. Hence, from a fishery's input perspective, CU refers to the ratio of the actual number of sea days the vessel or fleet fishes to the number of sea days it could potentially fish when unrestricted. Likewise, from a fishery's output perspective, CU refers to the ratio of actual output to potential output (Greboval & Munro, 1999)[52]. CU values range between zero and one with one indicating that the current CU equals to the potential CU. Hence, when the CU value is less than one, a vessel or fleet is under-utilized and vice versa (Kirkley & Squires, 2004).

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restricted inputs usually vessel size in terms of tonnage and engine power.

[50] See also Jensen 2002; Pascoe & Gréboval, 2003; Ward et al., 2004

[51] See also Pascoe, 2004; Pascoe et al., 2004; Metzner, 2005

[52] See also Gréboval, 2004; Kirkley & Squires, 1999; Kirkley & Squires, 2004; Pascoe, 2004; Pascoe et al., 2004; Reid & Squires, 2004; Sabatella & Piccinetti, 2004; Ward et al., 2004

Capacity under-utilization does not indicate technical inefficiency but they are related (See Fig. 3.7) and can sometimes exist together in a fishery (Pascoe et al., 2008).

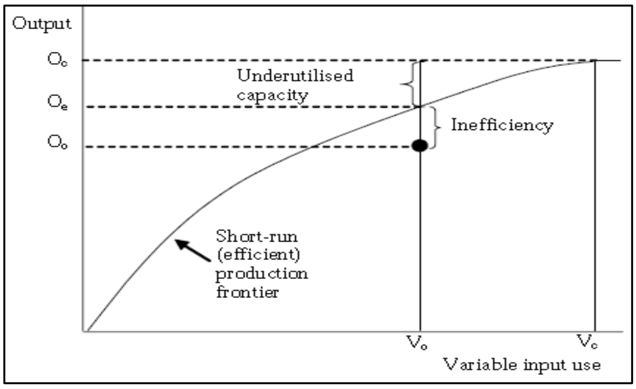

Fig. 3.7. An example of capacity under-utilization and technical inefficiency. Respectively, Vo and V_c (vessels), produce (O_o plus O_e) and O_c (Source: Pascoe et al., 2008:

In Fig. 3.7, a vessel currently operates with V_o to produce O_o . It would have been fully utilized if it had been operating at V_c to produce $O_{c,}$ provided the vessel is operating at full efficiency. However, if the vessel operates efficiently it would produce O_e at V_o. The differences O_c-O_e and O_e-O_o are due to capacity under-utilization and technical inefficiency respectively.

3.4. Measuring Fishing Capacity

The International Plan of Action for the management of fishing capacity (IPOA-capacity) calls for states to regularly asses and monitor fishing capacity, so as to avoid overcapacity. Hence, fishing capacity assessment has recently become a priority for a number of nations. Accordingly, various methods are used worldwide to assess fishing capacity (See Fig. 3.8).

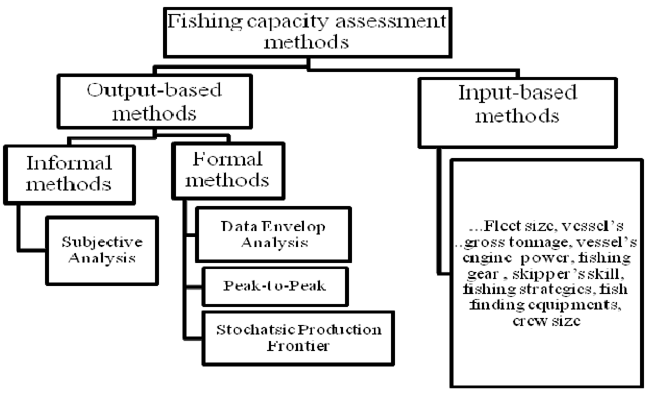

Fig. 3.8. General fishing capacity assessment methods (adapted from Pascoe et al., 2004: 6)

The above methods are either input or output based. In essence, capacity can be simple measured through the size, attributes and utilization of the fleet (Pascoe & Gréboval, 2003).

3.4.1. Input-based Measures

Input-based fishing capacity measures, often referred to as traditional methods, are quantitative but straight forward methods as vessel attributes form fishing capacity measures directly. A total capacity of a fleet is measured by aggregating the capacity of vessels, e.g. total gross tonnage, engine power including vessel numbers and classes (Pascoe, 2004)[53]. Under this approach, the fleet capacity is assumed to be a function of fishing inputs if they are fully utilized in terms of fishing time. Furthermore, the output of the fishery is presumed to be related to inputs applied (Pascoe, 2004)[54]. Gréboval (1999)[55] lists the fleet size; vessel's length and age, engine power, tonnage, skipper's skill and fishing time as constituents of input-based measures.

3.4.2. Output-based Measures

This approach has recently been developed and it refers to quantitative formal methods that measures capacity through potential output or CU of individual vessels. It thus implies that there is a connection between the inputs, their utilization and the output of the fishery (Pascoe, 2004)[56].

Data Envelop Analysis

Data Envelop Analysis (DEA) measures CU by comparing vessel outputs in a fleet (See Fig. 3.9)

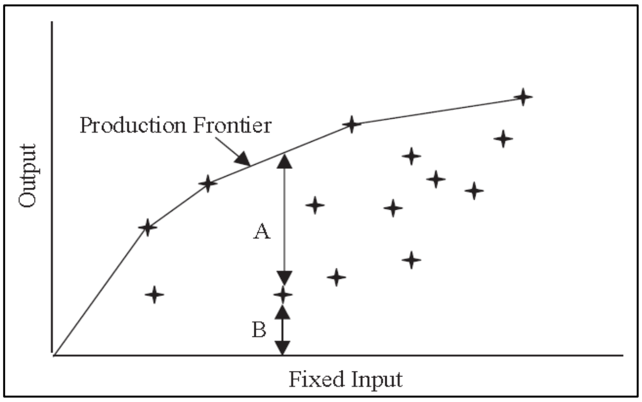

Fig. 3.9. DEA, A is an observed output, A+B is potential output (Source: Reid et al., 2003: 454).

[53] See also Pascoe et al., 2004; Sabatella & Piccinetti, 2004
[54] See also Kirkley & Squires, 1999; Pascoe et al., 2004; Ward et al., 2004
[55] See also kirkley & Squires, 1999; Pascoe & Gréboval , 2003; Ward et al., 2004
[56] See also Lindebo, 2004; Pascoe, 2004; Pascoe, 2004b; Pascoe et al., 2004; Ward, Undated

The best vessels, which have highest outputs, are assumed to be fully utilized, thus lie on the production frontier with under-utilized vessels lying below (See Fig. 3.9) (Gambino, 2004)[57].

Peak to Peak Method

The Peak to Peak method (PTP) is the simplest formal output-based fishing capacity measure. It estimates catch per unit effort (CPUE) and assumes that peak output levels indicate full CU (See Fig. 3.10) (Arrizabalaga, Undated)[58].

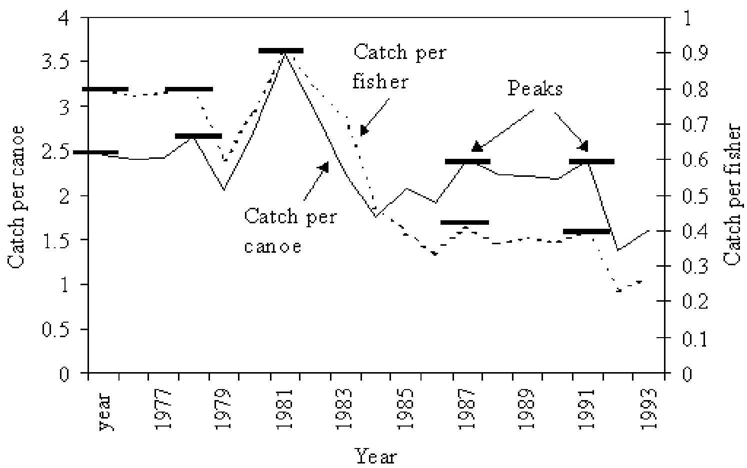

Fig. 3.10. An example of a PTP method (Source: Pascoe et al., 2003: 81)

PTP also assumes that changes in peak CPUE are due to technological changes. In this regard, CU is determined through capacity output which is obtained by multiplying capacity rate by fleet size. The capacity rate is derived through the rate of technical change (Pascoe et al., 2003).

Stochastic Production Frontier

The Stochastic Production Frontier (SPF) is the most complicated among output-based measures of capacity, in particular for multiple outputs fisheries. This method estimates the maximum potential fishing output associated with the best practical use of the inputs (See Fig. 3.11). Therefore, it assumes that the output is a function of inputs and their efficiency. Despite it being

[57] See also Joseph et al., 2006; Squires, 1999; Lindebo, 2004; Mardle & Tingley, 2004; National Marine Fisheries Service , 2004; Pascoe et al., 2004; Ward, Undated

[58] See also Lindebo, 2004; Kirkley & Squires, 2004; National Marine Fisheries Service , 2004; Pascoe, 2004; Pascoe, 2004 (b); Pascoe et al., 2004; Ward, Undated

complicated, it does however, allow for the estimation of standard errors and confidence limits. Hence, it is the most accurate output based measures (Pascoe et al., 2003)[59].

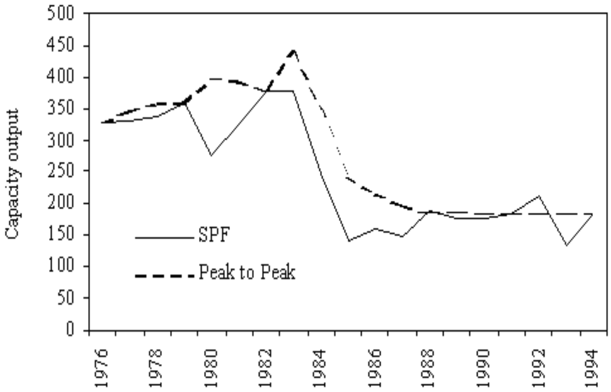

Fig. 3.11. An example of SPF and PTT methods (Source Pascoe et al., 2003: 95)

3.4.3 Subjective Methods

Subjective method is based on the information from fishery's experts, such as scientists and fishers. Based on their experience these experts may provide a picture as to how a fishery including the fleet looked like and changed in the preceding years. The fishers may also provide information about the current and previous CPUE including CU. Subjective assessment is carried out either through discussions or surveys. It is normally used when data are lacking. Since the information obtained may be biased, it should be used with caution (Pascoe et al., 2003)[60].

3.5. Indicators of Overcapacity

The biological status of a fishery, the harvest/target ratio, the TAC versus the length of the season, conflict among fishers and managers, CPUE and value per unit effort could indicate if overcapacity exist or not in the fishery (See Appendix 10) (Pascoe et al., 2008)[61].

3.6. Summary

Each of the above methods has got specific advantages and downsides, and none is perfect. Each method is fishery specific, therefore there is no 'one size fits all'- approach. It is good to use

[59] See also Pascoe *et al*., 2004; Kirkley & Squares, 1999; National Marine Fisheries Service , 2004; Ward, Undated

[60] See also Pascoe, 2004; Pacoes et al., 2004; Ward et al., 2004
[61] See also Lindebo, 2004; Ward et al., 2004; Ward, Undated

various approaches as fishing capacity notion varies considerably among the stakeholders involved in fisheries. The input-based measures, however, have been utilized by the majority of nations, including South Africa, for years. The complex output-based methods have recently been developed. Input-based measures are the simplest and require lesser and easily accessible data. However, they are not as accurate as output-based methods and thus a less rigorous way of measuring capacity. Even so, this study adopted the fisheries technologists' perspective on fishing capacity and is hence based on an input-based capacity measure. This is not by choice but because of lack of data and inadequate time for field work. Further, the fact that the fishing capacity for the South African hake fishery is estimated through input-based capacity measures has facilitated the availability of HDST fishery's input data for this study. The data required for output-based measures were not available in SA during the field work period for this study.

4. Extent, Drivers and Impacts of Overcapacity in the HDST Fishery

4.1. Introduction

The considerable amounts of fishing capacity that makes the HDST fishery as extremely capital intensive as it is today came with the recent allocation of fishing rights. Its utilization is presently restricted, indirectly through TAC reductions and directly through effort control regime.

4.2 The Development of the HDST Fishery's Fleet

4.2.1. The Number of Vessels

A substantial fleet capacity was built by the South African established fishing companies in preparation for Medium-Term fishing Rights (MTR) and Long-Term fishing Rights (LTR) allocation. Hence, the number of vessels in the HDST fishery increased up to 94 prior to MTR allocation in 2000 (See Fig 4.1). Astoundingly, in 2003, only 59 vessels operated in this fishery. However, during LTR allocation in 2006, 82 vessels existed in this fishery in 2006 (See Fig 4.1).

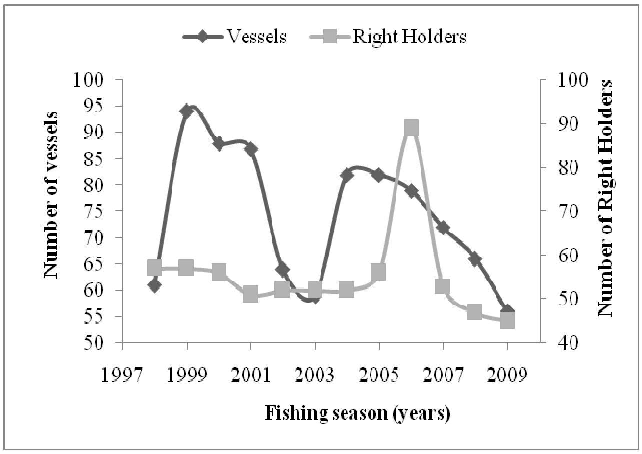

Fig. 4.1. Number of vessels and right holders operating in the HDST fishery (1998-2009).

In addition to Historically Disadvantaged Individuals (HDIs) who merged with the local established companies and with Spanish vessels which occupy about 30 % of the HDST fishing capacity, some HDIs came into the HDST fishery with their own fishing capacity. In spite of this, the number of vessels in the HDST fishery have been decreasing since 2006 and the trend corresponds to the number of right holders (see Fig. 4.1).

4.2.2. The Length, Gross Tonnage and Engine Power

Subsequent to the declaration of an exclusive economic zone, the majority of big vessels which were from other countries were excluded from South Africa. Hence, few big vessels were brought into the HDST fishery during rights allocation. Further, the length and the Gross Registered Tonnage (GRT) of the HDST fishery's vessels seem stable since 2003 (See Fig. 4.2). The engine power's trend slightly increases since 1999. The correlation reflected from Fig. 4.2 is that the bigger the vessel, the bigger is its tonnage and the more powerful it is.

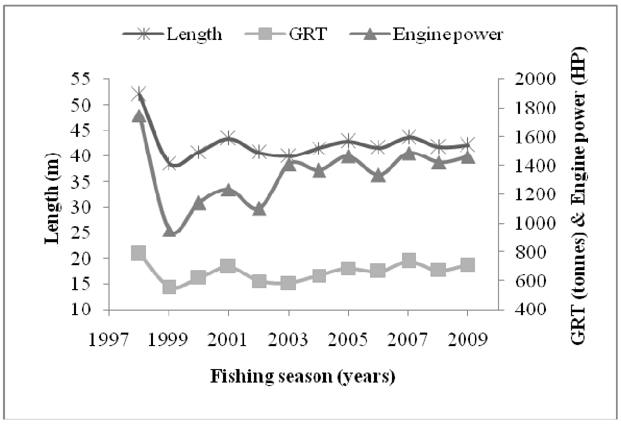

Fig. 4.2: Average length, tonnage and power of the HDST fishery's vessels (1998-2009).

The maximum length of the HDST fishery's vessels hovered around 84 m between 1998 and 2004 and decreased to 72 m in 2008 (See Fig 4.3).

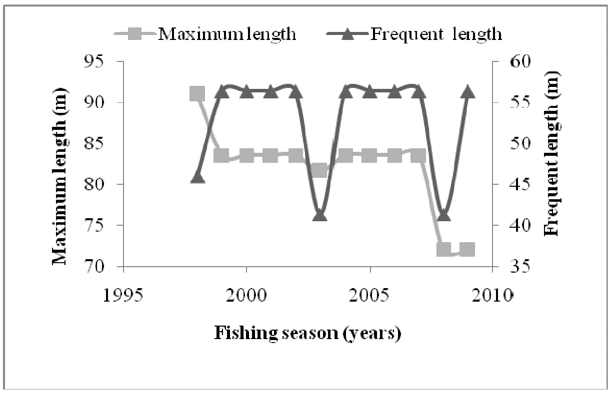

Fig. 4.3. Maximum and the most frequent vessel's length in the HDST fishery (1998 -2009).

The vessels with 72 m in length have a GRT of 1745 tonnes and an engine power of 3000 HP. The HDST fleet is occupied with the majority of vessels that is 56 m in length (see Fig. 4.3), corresponding to 812 tonnes of GRT and an engine power of 1800 HP.

4.3. Signals and Extent of Overcapacity

In the HDST fishery, overcapacity is indicated by capacity under-utilization at both fleet and individual vessel's levels (See Fig 4.4). The fleet's under-utilization is indicated by latent capacity. The vessel's under-utilization is seen through vessels that fish for short periods in a given season.

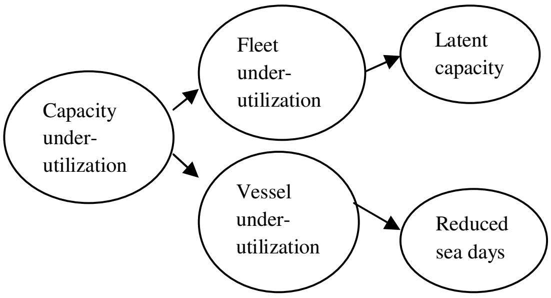

Fig. 4.4. Indicators of overcapacity's indicators in the HDST fishery

Overexploitation of the deep water hake in 2005 and poor catch per unit effort (CPUE) since that year also indicated the existence of overcapacity in this fishery (See Appendix 3). The recent stock recovery and improved CPUE has not hitherto corrected capacity under-utilization in the HDST fishery.

4.3.1. Capacity Under-utilization

The latent capacity mentioned above results form a decreasing trend in the number of operating vessels (See Fig 4.5). The declining sea days (See Fig. 4.5), indicates vessel's under-utilization.

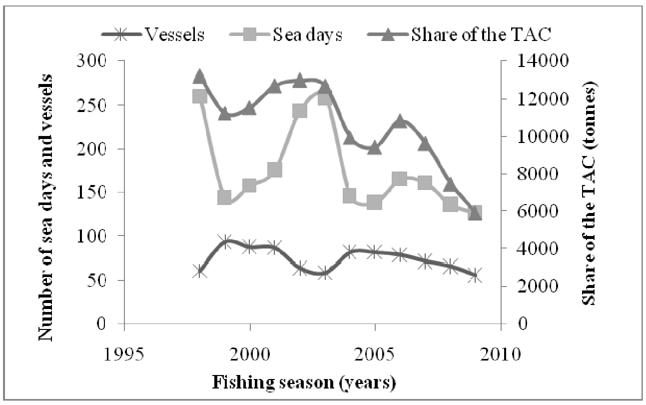

Fig. 4. 5. Average vessels, sea days and the share of hake TAC for HDST fishery (1998-2009).

Latent Capacity

The latent capacity in the HDST fishery increases with the downward trend of the actual number of operating vessels in this fishery (See Fig 4.6)

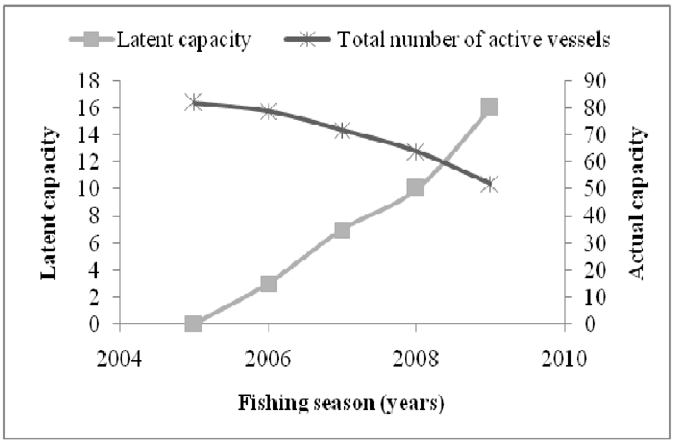

Fig. 4.6. Latent capacity and the capacity that is actually operating in HDST fishery (2005-2009)

The examples of latent capacity in the HDST fishery are as follows. Irvin and Johnson fishing company (I&J) used nine vessels in 2009, twelve vessels in 2008 and twenty vessels in 2005. In 2009, there were eleven latent vessels at I&J. Sea Harvest fishing company used fourteen vessels in 2009 and eighteen vessels in 2008. In 2009, there were four latent vessels at Sea Harvest.

Under-utilization of Individual Vessels

In the HDST fishery, under-utilization of vessels implies fishing for less than 265 days in a given fishing season (See Table 4.1 & Fig 4.7).

Table 4. 1. Selected under-utilized vessels in the HDST fishery (2008-2009).

				Sea days	
Name	Length (m)	GRT (tones)	Power (HP)	2008	2009
Echalar	72	1745	3000	**179**	**106**
Flame Thorn	37	803	2059	**265**	**222**
Khulisa Eyethu	67	1582	2689	**225**	**180**

The number of sea days for the vessels shown in Table 3.1 and Fig. 4.7 declined from 2008 to 2009, thus revealing the ongoing vessel under-utilization in the HDST fishery.

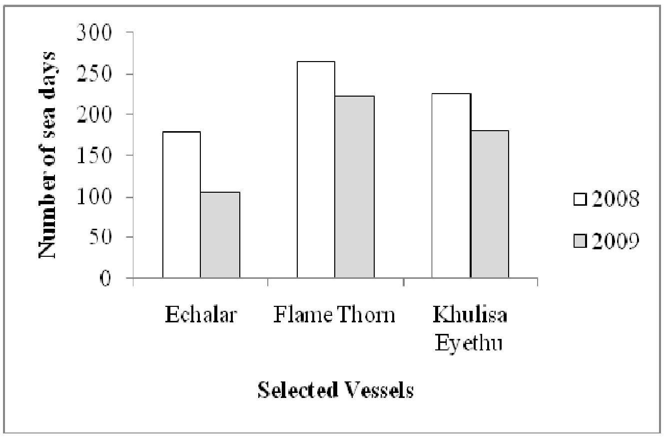

Fig. 4.7. Selected under-utilized vessels in the HDST fishery (2008-2009).

To appropriately quantify vessel's under-utilization, the under-utilization of each vessel operating in the HDST fishery should be measured and that requires substantial time, of which this study did not have. Hence, for the purpose of this study, vessel's under-utilization could only be measured for two years on selected vessels.

4.4. Drivers of Overcapacity

The key driver of overcapacity in HDST fishery is the management of the fishery itself (See Fig 4.8). However, technological creep and market constraints may also have an effect on the capacity under-utilization that indicates over capacity in the HDST fishery (See Fig 4.8).

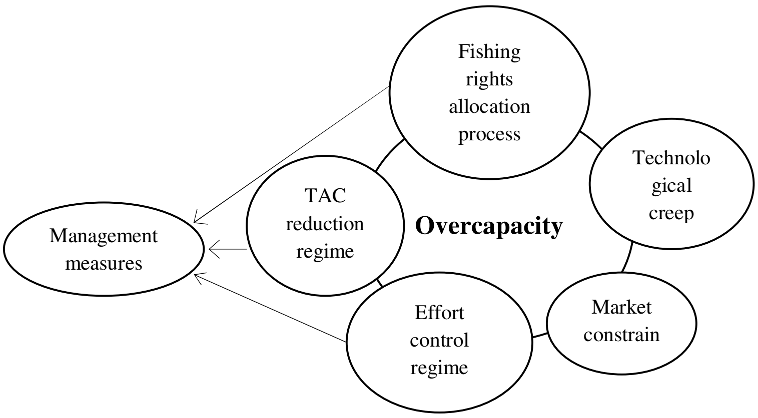

Fig. 4.8. Drivers of overcapacity in HDST fishery with management measures dominating

4.4.1. Management

The figure below (Fig. 4.9) illustrates how overcapacity developed in the HDST fishery due to the management to its management. The capacity brought during MTR allocation led to overexploitation of the deep water hake. This in turn, induced the adoption of a TAC reduction strategy. Subsequently, the capacity available became more than required, leading to capacity under-utilization. The effort control adopted in 2008, worsened this capacity under-utilization.

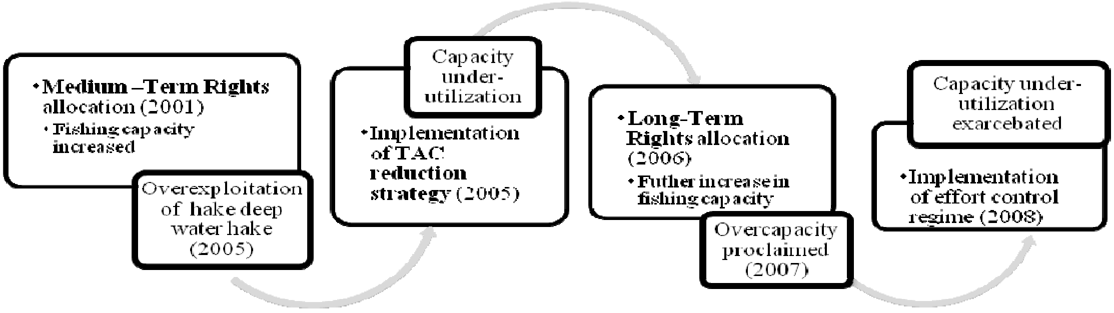

Fig. 4.9. HDST fishery's management (big rectangles) with overcapacity signals (small rectangles)

Fishing Rights Allocation

A considerable capacity accumulated in the HDST fishery after LTR allocation due to the following reasons: (i) job creation and capital investment accounted for 50 % of the LTR allocation criteria; (ii) building small viable business was among the LTR allocation criteria and (iii) some of the HDIs brought new capacity and some merged with Spanish vessels. All this increased the HDST fishery's fleet and made the HDST fishery even more capital intensive. In essence, the state could not dictate how much capacity investments should be made for rights allocation but can influence how that capacity is utilized, as they are doing now.

TAC Reduction Regime

The TAC reduction regime indirectly limits capacity utilization, leading to capacity under-utilization (See Fig. 4.10). In essence, as the hake TAC is continuously reduced, the HDST fishery's fleet size continuously get more than necessary for its share of the TAC. As a result, the actual number of vessels decreases (See Fig. 4. 10) while the latent capacity increases.

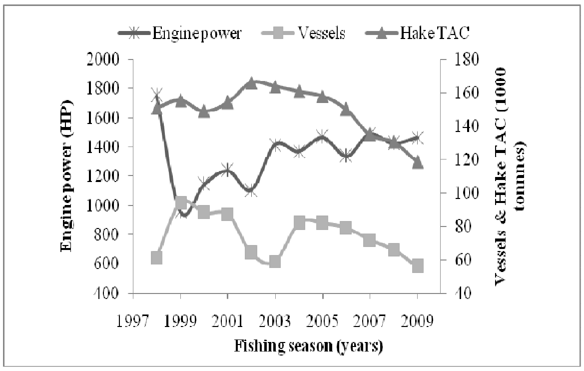

Fig. 4. 10. Average number of vessels, their engine power and hake TAC (1998-2009)

The prioritization of vessels and clustering leads to a preference of more powerful and newer vessels over the small, old and less powerful vessels. This is explained by the observed increase in the engine power while the fleet size declines. Presumably, the less powerful vessels dominate the latent capacity in this fishery.

Effort Control Regime

The effort regime matches the engine power of each active vessel with the quota it intends to catch in a given fishing season and allocates sea days to each vessel accordingly. This leads to capacity under-utilization of vessels with excessive power. Further, this regime also contributes to latent capacity through vessel clustering and prioritization.

4.4.2. Technological Creep

The HDST fishery's right holders consider HDST fishery as always been fairly abreast in technological terms, as they always used the state of art fish finding equipments. However, some right holders state that the capacity required to deliver the daily catch in 2009 was lesser than the capacity required in 2005. This study attributes this to technological creep[62], a fact that seems overlooked by the HDST fishery's right holders. These right holders believe that the recently proclaimed deep water hake stock recovery coupled with improved CPUE is what decreased the capacity utilization in 2009. This could also be true as when the stock size is in bad shape, more fishing effort is typically required.

4.4.3. Market Constraints

Market-induced capacity under-utilization must have occurred in 2009 in the HDST fishery due to the following reasons. First, hake demand was both internationally and nationally low, attributing to the global economic crisis. The global economic crisis resulted in poor exchange rates as the South African Rand became relatively strong. Second, Cape hakes compete with cheaper Vietnamese *Pangassius* in the European markets. Further, the unstable fuel price (See Fig. 4.11) occasionally contributes to the ongoing capacity under-utilization in the HDST fishery.

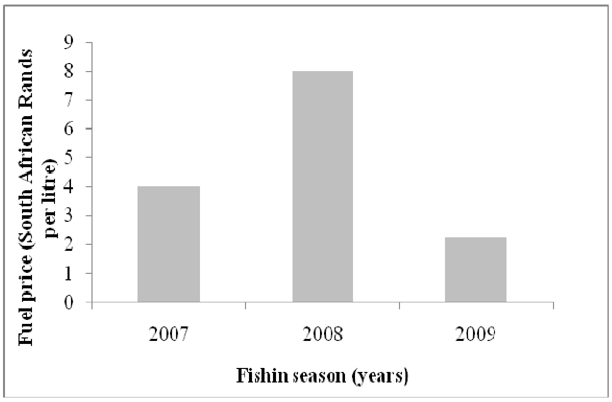

Fig. 4. 11. South African fuel prices from 2007 to 2009 (Source: www.shell.co.za)

4.5. Impacts of Overcapacity

The ongoing capacity under-utilization in the HDST fishery has resulted to a number of biological, economical and social impacts (See Fig. 4.12).

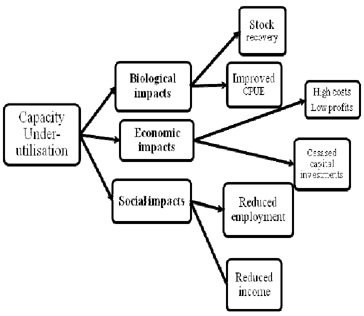

Fig. 4.12. The impacts of capacity under-utilization in the HDST fishery.

[62] This refers to the tendency for the fishing technology to become more efficient over time due to technological progress. Technological progress does not stop and just like any other equipment, vessels and fishing gears are continually upgraded and improved (Barkai & Berg, 2007).

These impacts are positive for the biological part of the HDST fishery. In a social and economic perspective, they are negative. Further, in a socio-economic perspective they contradict the main objective of the Marine Living Resource Act of 1998 to promote sustainable utilization of marine resources. Sustainability is not only about environment (fish in this case) but people and the economy associated with it form part of it.

4.5.1. Biological Impacts

The ongoing capacity under-utilization in the HDST fishery has led the recovery of the deep water hake stock coupled with an improved CPUE.

4.5.2. Economic Impacts

Since hake quotas are small, fishing vessels spend many days at sea catching few fish, thus increasing the operational costs. Further, the latent capacity and under-utilized vessels need to be maintained. In essence, when costs are high, the profits automatically decrease in any fishery. Some vessels are operating below normal profits in the HDST fishery and a number of HDIs continuously leave the fishery due to inefficient profits brought by their non-viable quotas. Investments on capital have been stopped in HDST fishery as the fishing companies are currently stuck with the capital they invested on prior to the recent fishing rights allocation.

4.5.3. Social Impacts

The number of the HDST fishery's employees decreases due to capacity under-utilization (Fig 4.13) and some employees has also experienced a reduction in income.

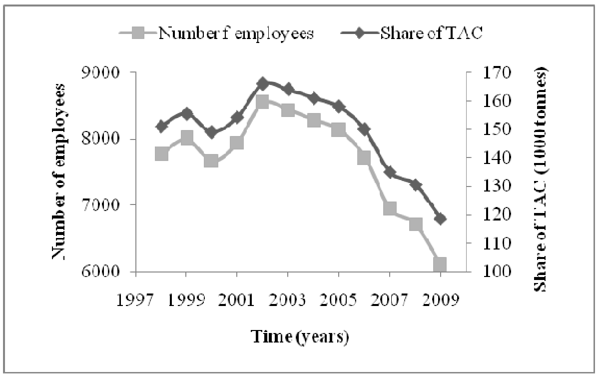

Fig. 4.13. Number of employees in the HDST fishery and the hake TAC (1998-2009).

4.6. Summary

The recent allocation of fishing rights increased the fishing capacity in the HDST fishery leading to overcapacity. The utilization of this capacity is restricted through the TAC reduction and effort control regimes leading to capacity under-utilization. Hence, overcapacity in the HDST fishery does not stem from the constant fishing capacity increase, as the last time capital investments were made in this fishery was prior to the MTR allocation. The fishing capacity in this fishery automatically increases due to the ongoing restrictions in capacity utilization. In an economic point of view, this capacity under-utilization inflicts direct costs to the entire HDST industry through forgone economic profits. In a social perspective, it reduces employment levels in addition to low income for other employees. However, biologically, this capacity under-utilization has resulted to the recovery of the deep water hake and improved the CPUE. Hence, the fishing capacity management in the HDST fishery works in favour of the state. It reduced overcapacity in the biological part of the fishery but led to substantial overcapacity in economic terms and inadequate capacity in the social part of the HDST fishery.

5. The Hake Deep Sea Trawl Fishing Capacity Management

5.1. Introduction

Referring to measures that match the fleet's fishing potential with the desired fishing output, fishing capacity management recently became a concern in fisheries. The increasing occurrence of overcapacity in world fisheries drove the United Nation (UN)'s Food and Agriculture Organization (FAO) to formally raise the need for fishing capacity management through several of its initiatives. The FAO's Code of Conduct for Responsible Fisheries (CCFR) introduced in 1995 urges states to manage fishing capacity. In 1997, FAO created a fishing capacity working group. Consequently, capacity management became a theme in several international conferences leading to formulation of the FAO's International Plan of Action for Fishing Capacity Management (IOPA-capacity) in 1999. IPOA-capacity urges states to base formulation and implementation of fishing capacity management measures on the CCFR. It further urges states to often assess, monitor and manage their fishing capacity, giving priority to fisheries facing overcapacity. It also urges states to strengthen their regional fisheries organizations and comply with international agreements, such as UN's Convention on the Law of the Sea (UNCLOS) in addition to the CCFR so as to improve their fishing capacity management (Bayliff, 2005)[63]

5.2. Management Measures

The management measures affecting the HDST fishing capacity are shown below (See Fig. 5.1).

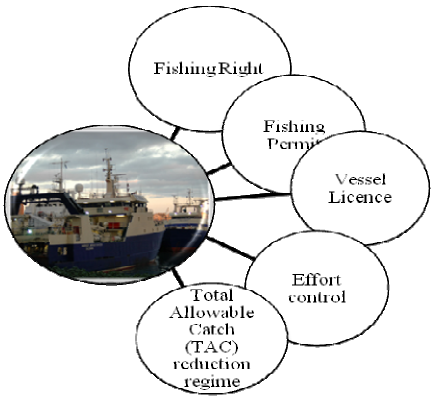

Fig. 5.1. The management measures affecting HDST fishing capacity

[63] See also FAO, 1999; Gréboval, 2004; Pascoe & Gréboval 2003; Pascoe, 2004; Pascoe et al., 2004; Pascoe et al., 2008; Ward et al., 2004

There is no commercial fishing allowed to take place in South Africa (SA) without the fishing right. Once a person becomes a fishing right holder, a yearly fishing permit is required for that person to carry out the fishing activity. The vessel to be used for the fishing activity has to be licensed and in the HDST fishery in particular, sea days are allocated to that vessel based on the amount of its engine power and the quota it intends to catch in a given fishing season.

5.2.1. Effort Control Model

The effort control model for the HDST fishery was proposed by the South African Deep Sea Trawl Industrial Association (SADSTIA) and is now controlled by Marine and Coastal Management (MCM). Regarded as essential for the recovery of the deep water hake, this regime matches vessel's capacity to quota allocations in order to reduce the fishing capacity of the HDST fishery (DEAT, 2007a)[64].

Background

SA's fisheries managers recognize the need to incorporate both input and output controls in fisheries management, as pure input controls lead to effort creep and pure output controls lead to high grading. In 2006, MCM enlisted SADSTIA to suggest an effort control for the hake fishery and a 40 % increase in the hake fishing power occurred in a decade earlier (SADSTIA, Undated).

Consultation

The Hake Management Working Group (HMWG) conducted workshops and road-shows[65] (See Fig. 5.2) to improve the understanding of the need to manage the hake fishing capacity.

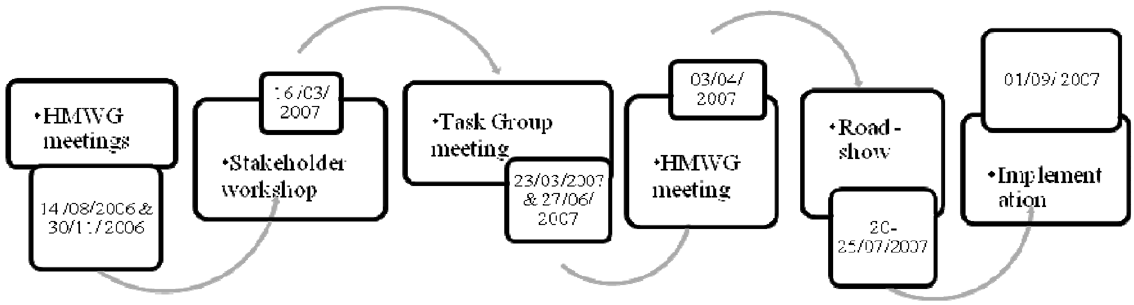

Fig. 5.2. Consultation journey taken to develop the HDST effort model (Source: MCM, 2007).

[64] See also MCM, 2007b; MCM, 2008

[65] This refers to hake fishery's sectoral meetings

The HDST fishery was identified as a priority fishery during the above consultation, thereby the effort model for this fishery was proposed and implemented in 2008. IPOA-capacity principles applied during the above consultation include participation, phased implementation, holistic approach, conservation, priority, new expertise, mobility and transparency (MCM, 2007c).

Institutions and International Co-operations

The institutions that facilitated the design of the HDST effort control model are shown in Fig 5.3. The HMWG consists of hake fishery's managers, MCM's researches and hake right holders. The Demersal Scientific Working Group consists of MCM's demersal researchers.

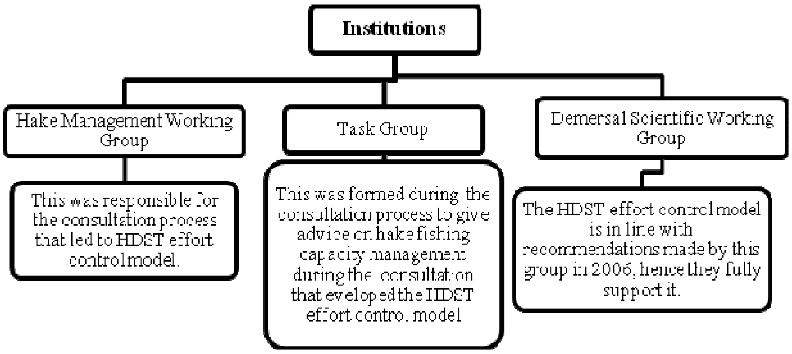

Fig. 5.3. Institutions that facilitated the formulation of HDST effort control model

South Africa has signed the FAO's CCFR and UNCLOS which oblige states to manage their fishing capacity (FAO, 2008).

Administration

The HDST effort control model reconciles the effort of the vessel with the quota it is to catch in a given fishing season. In this context, the vessel's effort refers to its shaft horse power[66] and the number of sea days, it is referred to as horse power sea days hereafter. The principles of the model include vessels clustering, vessel prioritization and horse power sea days' estimation including allocation. The fishing master plan is the output of the model (MCM, 2007a).

[66] SADSTIA believes that the ability of a bottom trawler to catch a fish is its shaft's horse power

Vessel Clustering

The HDST effort control model is cluster based. A cluster refers to a vessel or fleet working under unitary operational management and fishing interchangeably on one or more access rights either whole or in part. The HDST right holders are organized into 15 operational units (See Table 5.1) (MCM, 2007a)[67].

Table 5. 1. The HDST fishery's operational units

		Right Holders	
		Single	Multiple
Vessels	Single	**2 (2%)**	**1 (1%)**
	Fleet	**3 (38%)**	**9 (58%)**

Source: www.sadstia.co.za

Vessel Prioritization

In each cluster, priorities are assigned to vessels. The vessels given the first priority are given the maximum possible sea days before considering vessels with subsequent priorities. Likewise, when a vessel intends to operate in multiple periods during the fishing season, the cluster manager should assign priorities to those periods. It would be wise to give a higher priority to a vessel that can fish as long as possible throughout the fishing season (MCM, 2007a)[68].

Sea Days Allocation

The number of sea days, equivalent to the quota the vessel is to catch for a given fishing season is allocated to each vessel. The total sea days for each vessel is calculated by multiplying the horse power of the vessel with the base factor (See Appendix 9) and divide the product into the quota that vessel is to catch for a given fishing season (MCM, 2007)[69].

[67] See also MCM, 2007b, MCM, 2007c; SADSTIA, Undated
[68] See also MCM; 2007b;MXM, 2007c
[69] See also MCM, 2007b; MCM, 2007c; MCM, 2007d; MCM, 2008; SADSTIA, Undated

Examples: For a vessel with 1500 HP, intending to catch 1700 tonnes of quota. The total sea days would be: 1700 / (4.81 x 1500) = 235 (MCM, 2007)[70]. In Fig 5.4., if vessel A with 3000 HP is to catch 3000 tonnes of quota, it would be allowed to operate for 207 sea days within the fishing season. However, vessel B with 3000 HP as well but intends to catch 1000 tonnes of quota would be obliged to operate for only 69 days (MCM, 2007a).

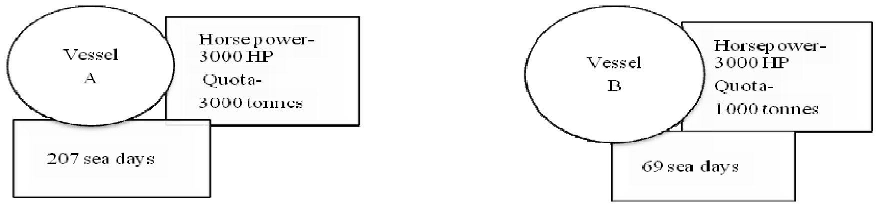

Fig. 5.4. An example of how horse power sea days allocation

Subsequent to the allocation of horse power sea dats, the vessels usually fit into one of the following categories (MCM, 2007a):

- Vessels that deploy less than the horse power allowance needed to catch their quota.
- Vessels with excessive engine power for the allocated quota.

If the effort that matches with the quotas for a cluster is greater than the cluster's actual effort for a given season, all vessels are enabled to fish for the full season. If it is less, the sea days for at least one vessel get reduced leading to some vessels not to fish in some seasons (MCM, 2007a)[71].

Fishing Operational Plan

The cluster manager is responsible for preparing an operational plan for each cluster which is presented to MCM for each fishing season. The plan specifies the right holders in the cluster, the amount of quota to be exploited caught and the vessels operating in that cluster including their technical details which enable MCM to calculate the adjusted horsepower (See Appendix 11). Each cluster manager is provided with the software of the HDST effort control model designed to facilitate operational planning and to guide MCM in issuing the permits (MCM, 2007a)[72].

[70] See also MCM, 2007b; MCM, 2007c; MCM, 2007d; MCM, 2008; SADSTIA, Undated
[71] See also DEAT, 2007b; www.sadstia.co.za
[72] See also MCM, 200b; SADSTIA, Undated

Permits Outlining Sea Days

MCM examines and tests all the fishing plans prior to issuing permits. If the plan is reliable, MCM re-run the model and issue permits outlining sea days. If the plan is not reliable, MCM amends the plan together with the relevant right holder. If the plan is contradictory, MCM does not issue permits until the contradictions get sorted out (MCM, 2007a)[73].

The Fishing Master Plan

MCM compiles a comprehensive master plan from the model (See Appendix 12). The plan sets out the projected sea days for each vessel in a cluster including the cluster's quota. It facilitates monitoring and control and helps to reconcile the effort issued on permits and the quotas held in a cluster throughout the fishing season (MCM, 2007a)[74].

Monitoring

The master fishing plan is given to MCM's Vessel Monitoring System (VMS)'s operations centre for the purpose of monitoring the operations. The vessels with shortened season get marked so as to render them easily identifiable (MCM, 2007a)[75].

5.2.2. The TAC Reduction Regime

The catches were poor in 2005 due to the overexploitation of the deep water hake. The catch per day dropped to 5 tonnes. The hake fishery therefore agreed to reduce hake TAC so as to let the stock recover and increase the daily. Subsequently, the hake TAC reduction regime was implemented (See Fig. 2.15) (MCM, 2006-2007)[76].

5.2.3. Implications

The HDST control model prohibits vessels from fishing beyond the time required to catch the cluster's share of TAC in a given fishing season. It thus controls undesirable fishing practices such as high grading. Since, the fishing operators cannot increase their effort in compensation for low catches, the hake stocks benefit directly from this model. However, it results to capacity under-utilization at both fleet and individual vessel levels in the HDST fishery. The fleet under-

[73] See also MCM, 200b; SADSTIA, Undated
[74] See also MCM, 200b; SADSTIA, Undated
[75] See also MCM, 200b; SADSTIA, Undated
[76] See also MCM, 2007d; MCM, 2008; MCM, 2008-2009; MCM, 2009

utilization is caused by vessel's clustering in addition to vessel's prioritization. Vessel under-utilization results from sea days allocation.

The TAC reduction indirectly leads to capacity under-utilization at both fleet and individual levels as well. The fleet under-utilization occurs since the vessels available for a given fishing cluster get more than necessary to catch the cluster's quota each time the TAC is reduced. Vessel under-utilization occurs due to automatic reduction in the number of sea days as hake TAC get reduced.

Capacity under-utilization results in high costs and reduces employment in the HDST fishery. Nevertheless, it has resulted to the recovery of the deep water hake stock coupled with improved Catch per Unit Effort (CPUE). Therefore, both the effort control and TAC reduction strategies work in the favour of the state, i.e., to protect the deep water hake but increases overcapacity in the industry. The industry has to therefore, devise means to deal with the increasing overcapacity that is worsened by the on-going capacity under-utilization.

5.3. Compensatory Measures to Offset Overcapacity

The fishing companies of the HDST fishery have devised some strategies to compensate for the ongoing capacity under-utilization in the fishery. The strategies include more efficient fishing operations in addition to strategies to reduce latent capacity.

5.3.1. Fishing Operations

The ongoing capacity under-utilization has called for more efficient fishing operations in the HDST fishery. These include clustering the operations and targeting hake by-catch. For under-utilized vessels, fishing companies have to adjust the crew's income with short fishing periods.

Clustering

Most HDST fishery's right holders operate in clusters and joint ventures so as to increase the efficiency of the fishing process. They combine their quotas and share the profits and costs of fishing operations. Clustering however exacerbates the amount of latent capacity as fewer vessels are used in contrary to when the fishing companies operate individual. Further, this presumably leads to the preference of newer and more efficient vessels over the old and smaller vessels. Therefore, the HDST fishery may get even more capital intensive if capacity under-utilization persists for a long period of time. On the other hand, clustering increases the utilization of individual vessels left in the fishery.

By-catch Targeting

Some vessels target hake by-catch at the beginning of the fishing season in order to catch a small amount of hake every month and thus extend the fishing operation period. Since, they are not allowed to land by-catch that is more than hake, they have to catch at most 50 % of by catch.

Income and Fishing Operations

Some fishing companies are looking for strategies to adjust their crew's income with their vessel's operations. Blue Continent Products fishing company for instance, is currently looking at three strategies. The first strategy is to let the vessel operate in eight months and pay the crew for the entire fishing season so as not to lose them for the following fishing season. The second strategy is to catch the quota in eight months and pay the crew only for eight months but the crew would probably not come back in the subsequent fishing season. The last strategy is to catch the quota in eight months and pay the crew the full income during eight months and 50 % for the rest of the year when the vessel is not operating. Mayibuye fishing company, on the other hand pays the crew half of their daily rate when the vessel does not go to sea.

5.3.2. Reducing the Latent Capacity

Some fishing companies have taken some of their latent capacity vessels out of their premises through selling or scrapping. However, since there is always the possibility of returning to business, sometime in the future, some companies choose to keep some of their latent capacity and bear with its high maintenance including security costs.

Selling

Selling a vessel is not an easy task in SA due to the following reasons. Firstly, there is no market for old vessels in the country and the majority of South African vessels are very old. Secondly, there is no company that needs to buy a vessel, unless for direct replacements since the total capacity is more than sufficient in almost all SA's fisheries. Third, the European second hand market for vessels has cheaper prices and their vessels are newer than South Africans. In essence, vessels are generally very expensive. Thereby, to sell it where there is a low vessels' demand as in SA, it would have to be sold cheaper so as to attract the buyers and that would not be beneficial for the seller.

Scrapping

Other companies prefer to scrap their latent capacity. There is no economic benefit from scrapping though, as the company has to send the vessel to India where most of South African vessels get scrapped. Further, scrapping leads to a definite loss of jobs

Switching Operations in between Local Fisheries

The latent capacity and under-utilized vessels cannot operate in other local fisheries. The reasons for that are threefold. First, the issue of overcapacity is mutual in the SA's fishing industry, hence vessels cannot switch operations in between the sectors. Second, it is hard to convert a trawler into other types of vessels. Last, hake is the most valuable fish in South Africa. Therefore switching from hake to a low valuable fishery would only exacerbate the current situation.

Fishing in Neighboring Countries

The majority of Spanish vessels operating in South Africa come from Namibia. Thus, there is no space for South African vessels in Namibia. Further, Namibia has sufficient capacity to catch their quotas and has no extra quotas. Argentina on the other hand, has very strict entry limitations. It is also very expensive to get a license from Argentina. Nonetheless, most SA's vessels are not suitable to fish in foreign countries since they are small and old.

5.4. Summary

The HDST effort and the TAC reduction regimes regulate the capacity utilization of the HDST fleet. This directly leads to capacity under-utilization which is seen through latent capacity and vessel's under-utilization. This capacity under-utilization leads to reduced employment in addition to high costs. The industry is therefore currently devising strategies to offset the costs of this capacity under-utilization. However, the deep water hake has recovered due to this capacity under-utilization. Hence, the fishing capacity management measures in this fishery work in favour of the state, i.e. to protect the deep water hake. It has moved the responsible to deal with overcapacity entirely to the hands of the right holders.

6. Discussion

6.1. Introduction

This study aims at examining overcapacity on the basis of its extent, drivers and managements in the South African Hake Deep Sea Trawl (HDST) fishery. The main findings, corresponding to this aim are summarized below (See Fig 6.1).

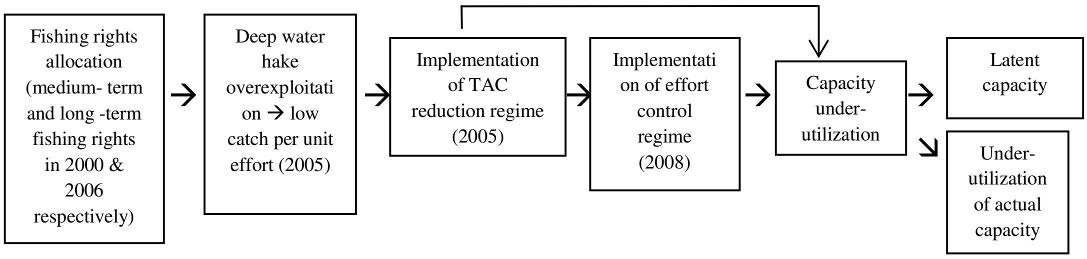

Fig. 6.1. The main findings of this thesis: from rights allocation to capacity under-utilization

Overcapacity came into the HDST fishery with the rights allocation. TAC reduction and effort regimes limit the utilization of this capacity leading to capacity under-utilization (See Fig. 6.1).

6.2. Signals of Overcapacity

Overcapacity in the HDST fishery is indicated by the following. (i) The overexploitation of the deep water hake in 2005 that resulted to declining catch per unit effort (CPUE) (ii) The ongoing capacity under-utilization at fleet and individual vessel's level. It is unlikely for this capacity under-utilization to be corrected when the stock recovers since:

- There is no guarantee that the hake TACs could be set at very high levels
- The fishery was overcapitalized even before the management-induced capacity under-utilization commenced
- The complete recovery of the deep water hake stock may take long time as hakes are growers and technological creep could impede the correction of this under-utilization.
- The recently proclaimed signals of recovery of the deep water hake and improved CPUE have rather exacerbated the capacity under-utilization in the HDST fishery

In standard economics, the firm's actual capital stock can be greater or less than the optimal capital stock at any point in time, resulting in overcapitalization or under-capitalization (Gréboval & Munro, 1999). Relating this to fisheries, the HDST fishery actual fleet would be at point A in Fig 6.2. In contrast, the HDST fleet does not alternate between being under-capitalized and overcapitalized, it has been overcapitalized since a couple of years ago.

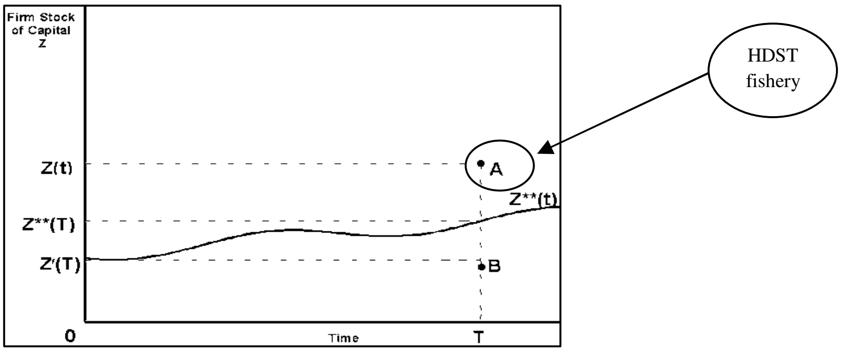

Fig. 6.2. Time path of a firm's optimal stock of capital, representing overcapitalization (A) and under-capitalization (B) (Adapted from Gréboval & Munro, 1999: 4).

Dupont et al. (2002)[77] affirms that, when the fishery's fleet is under-utilized it is overcapitalized, indicating overcapacity. Since capacity utilization (CU) is a short-term concep, thereby capacity under-utilization is a rough indicator of overcapacity (Pascoe, 2004). Further, the HDST fishery is not the only fishery where overcapacity is indicated by capacity under-utilization. Capacity under-utilization, indicating overcapacity or excess capacity was found in a number of recent studies (Asche et al., 2008; Fiina, 2005; Lorenzo et al., 2007; Madau et al., 2010; Maravelias & Tsitsika, 2008; Pascoe et al., 2004; Reid et al., 2003; Sigler & Lunsford, 2009; Vestergaard et al., 2002 and Yu & Yu, 2008).

6.3. Extent of Overcapacity

In the HDST fishery, the extent of capacity under-utilization is equivalent to the extent of overcapacity as overcapacity is indicated by capacity under-utilization in this fishery. However, the under-utilization of individual vessel could not be thoroughly quantified in this study due to time. Hence, this study has not quantified the exact extent of capacity under-utilization and overcapacity in the HDST fishery.

Nonetheless, Pascoe et al. (2004) states that the extent of overcapacity depends on the management goals which determine the optimal capacity in a given fishery.The optimal capacity thus determines the quantity of capacity that could be classified as overcapacity. Kjærsgaard puts it in this way: "*The preferred degree of overcapacity depends on the preferences or goals of involved decision-maker(s)*" Kjærsgaard (2010: 8).

In principle, different fisheries management goals typically have different optimal capacity levels (See Fig 3.3). Morgan et al. (2007) described the typical goals of the fisheries as follows:

- Biological goal, such as maximum sustainable yield (MSY)
- Social goal, such as providing a social safety net or maximizing employment
- Economic goal, such as maximum economic yield (MEY) or maximum profits

The extent of overcapacity thus differs with these goals (See section 3.3). To maintain employment, for instance overcapacity may be the consequence, thus not considered problematic. However, when overcapacity is incompatible with the entire set of management goals, it is considered a problematic (Metzner, 2005)[78]. Pascoe puts it this way:

> "*From a pure profit-maximizing perspective, overcapacity and capacity under-utilization is undesirable as the capital could possibly generate a rent elsewhere in the economy. However, in a socio-economic perspective where multiple conflicting objectives are quite often addressed, overcapacity may not be completely undesirable. For example, in rural areas maintaining employment levels or ensuring sustainable production may be more important in a fishery than profit maximizing*'' (Pascoe, 2004: 54).

[77] See also Gréboval & Munro, 1999; Kjærsgaard, 2010; Kirkley et al., 1999; Kirkley & Squires, 2004; Lindebo et al., 2006; Pascoe & Gréboval, 2003; Pascoe, 2004 Vestergaard et al., 2002
[78] See also Kirkley & Squires, 2004; Pascoe et al., 2004,

This reveals that different stakeholders involved in fisheries have different interests and needs which often lead to conflicting goals. In practice, the optimal fishing capacity should consider all of the above goals. Further, these goals are not independent of each other, and hence it is difficult to isolate them. However, there is practically no ideal capacity that could be applied for all of the above goals (Morgan et al., 2007). In any case, Kjærsgaard (2010) affirms that optimal allowance of fishing inputs may not correspond to a scenario with no overcapacity.

The findings of this study are in agreement with what is said above with regard to conflicting optimal capacity levels and extent of overcapacity. The capacity under-utilization leads to job losses in the HDST fishery. However, increasing fishing access is one of the goals of South African fisheries. Therefore, in a social perspective, the aforesaid capacity under-utilization is not desired in the HDST fishery. However, for the sustainability of the deep water hake stock and economic efficiency of the entire fishery, capacity under-utilization is desired. In short, in multiple goals' fisheries like the HDST fishery, it is difficult to determine the optimal capacity and therefore the extent of overcapacity as the multiple goal context leads to different optimal fishing capacity levels for different stakeholders involved in fisheries. In economic and biological perspectives, the HDST fishery's fleet is larger than optimal. However, in social terms it is less than optimal as employment continues being reduced.

6.4. Drivers of Overcapacity

The capacity under-utilization in the HDST fishery is mainly due to management decisions in addition to market conditions and technological creep. Pascoe et al (2003)[79] lists management and market constraints as general drivers of capacity under-utilization.

6.4.1 Market-Induced Capacity Under-utilization

This is usually due to a temporary increase in fish or fuel prices (Pascoe et al., 2003). It is, however, not of major concern in the fisheries management realm as each fisher is believed to be operating in a rational way. It usually self-corrects when prices get back to normal. Further, the vessels which cannot operate under such market conditions may leave the fishery (Bayliff,

[79] See also Kirkley & Squires, 2004; Pascoe et al.,2004; Pascoe, 2004; Metzner, 2005; Sabatella & Piccinetti, 2004; Vestergaard et al., 2002

2005)[80]. Since, the prices do not take too long to get back to normal, the market-induced capacity under-utilization that occurred due to high fuel prices in 2008 (See Fig 4.11) in the HDST fishery has most probably been corrected in 2009 when the fuel prices went down.

6.4.2. Management-Induced Capacity Under-utilization

The management-induced capacity under-utilization is typically due to stock recovery programs and restrictions on days at sea (as in HDST fishery) including seasonal closures (Pascoe et al., 2003). It usually calls for more effective management of fishing capacity (Pascoe et al., 2003).

The Fishing Rights Allocation Process

Incorporating investments in the criteria for the recent allocation of fishing rights in the South African fishing industry induced the following:

> ''*Preceding the allocation of fishing rights, in addition to upgrading already operating equipments on land and sea, investing in new fishing equipments, and major maintenance of existing equipments took place in the South African fishing industry. Subsequently, a number of boats were tied up. Boat builders were recommended to start looking hard in other directions for income production''* (Fishing News, June 2006: 3).

Increasing fishing access for HDIs was the main aim of allocation of the fishing rights. It brought the persisting overcapacity in the HDST fishery. This concurs with what is said below:

> "*Removing historical access restrictions in Chile (1978) and granting of improved access rights for private entrepreneurs in Mexico and Peru allowed additional fishing effort to enter the fisheries leading to overcapitalization''* (Ibarra et al., 2000: 600).

The TAC Reduction and Effort Control Strategies

These strategies exacerbate the overcapacity that was brought during the recent fishing rights by restricting its utilization. Therefore, overcapacity was brought into the HDST fishery by the management of the fishery itself and it is currently increasing automatically due to management-induced capacity under-utilization. This is not the only fishery the where the fishing capacity management measures exacerbates overcapacity. In China, for example effort controls based on

[80] See also Metzner, 2005; Pascoe et al.,2003; Pascoe, 2004; Sabatella & Piccinetti, 2004

vessel's licensing and engine power including gear restrictions exacerbated overcapacity. The Chinese fishers responded to these effort controls by 'capital stuffing' (Yu & Yu, 2008). The closing of seasons, termed summer moratorium, led to a 'race to fish'.
''*After the mid-summer moratorium, fishing gets more intense as fishers try to catch as much as possible in the shortest time possibly, using as more efficient fishing gears* ''(ibid: 356). Even when the Chinese government implemented what they termed a double control (restrictions on horse power and the number of vessels) replacing a single control (horse power only), the country did not achieve its target fishing capacity. This led (Yu & Yu, 2008) to conclude that the effective capacity management is practical hardly successful due to the multi-dimensional nature of the fishing capacity concept and the fact that overcapacity may arise from a growing number of people fishing for their livelihoods.

6.4.3. Technological Creep

Technological creep, indicated by a slight increase in the average vessel's engine power (See Fig. 4.10) contributes to the ongoing capacity under-utilization in the HDST fishery. However, the HDST right holders overlook this technological creep, as they claim that they have not upgraded their fishing equipment since 2005. The minor fixing and panel beating that these right holders may have regularly taken their fishing equipment to could have led to the technological creep observed in this fishery. The fact that the fishers are technologically friendly as described by Tjemelnd (1993) cited in Standal (2005:255) can make them take for granted the technological improvements they make on their fishing equipments.

The Norwegian fleet, which is still snared in the web of overcapacity in spite of reductions in the number of fishers including vessels, gives a good example of the effects of technological improvements in fisheries (Standal, 2005). Through technological modernization, the fishers left operating in most Norwegian fisheries have replaced the excluded vessels with big, more powerful and effective vessels. Among others, the development of modern stern trawling, automatic hauling of purse seiners and automatic baiting in line fishing reveal the recent technological innovations (Standal, 2005). Technological creep and capital stuffing are what have been impeding the success of the Chinese fishing capacity management efforts. In this regard, even if the management regulations freeze the fleet size or the engine power, technological creep still increase the ability of vessels and gears to fish more (Yu & Yu, 2008).

6.5. Impacts of Overcapacity

Capacity under-utilization has incurred high costs in addition to high unemployment in the HDST fishery. However, capacity under-utilization has also led to the recovery of the deep water hake in addition to improved CPUE (See Fig 4.13). This concurs with what is affirmed below:

> ''*From a pure stock conservation's perspective, the existence of management induced capacity under-utilization does not impose any threat provided the total output of the fishery is constrained to a sustainable level (e.g. through TAC). However, the existence of under-utilized capacity creates a number of socio-economic problems, some of which may have implications for the success of conservation measures''* Pascoe (2004:54).

Capacity under-utilization at an aggregate fishery scale is a waste as the same catch could be taken with fewer but fully utilized vessels (Pascoe, 2004).

In contrast to fisheries, capacity under-utilization in ordinary industrial firms is helpful as it makes the firm flexible when its products' demand increases. It also helps the firm to diversify its products so as to remain competitive in the market (Sahoo & Tone, 2009).

6.5.1. Socio-economic Impacts

The latent capacity has resulted in a permanent loss of jobs in the HDST fishery, with some of the employees left in the fishery experiencing reduced income. Inability to sell and non-beneficial scrapping of the latent capacity worsen the costs of latent capacity in this fishery.

Employment

The social impacts of capacity under-utilization in the HDST fishery were described as follows:

> ''*Crew members often move in and out of the fishery to coincide with shortened fishing seasons. The fishing companies are forced to consider looking at how they can devise ways of retaining jobs as vessels are continuously being tied up in harbours. Union officials Seem to have no idea of the economic realities of the factors facing the industry, and continue promising their members unrealistic wage scenarios which the industry finds impossible to meet* (Fishing News, February, 2009: 10).

Loss of employment and reduced income in fisheries is described by Béné et al. (2010) as push factors with pull factors being the availability of work and higher salaries in other sectors. The loss of employment and low income due to capacity under-utilization in the HDST fishery are push factors. The pull factors might have helped some the crew members who worked for under-utilized vessels. Some of may have stayed in the fishery and put up with reduced income due to the absence of pull factors.

Kjærsgaard (2010) concluded that as employment is maximized in a fishery, overcapacity also increases. For example, the entire Danish fleet had to stay active if the employment had to be maximized (Kjærsgaard, 2010). This corresponds with what is observed in the HDST fishery with regard to employment and capacity utilization. The number of employees are decreasing as the capacity continue being under-utilized.

Costs and Profits

The increased operation costs due to capacity under-utilization automatically decreased the profits of the HDST fishery. Pascoe (2004) confirms that the existence of capacity under-utilization in a fishery induces direct costs on fisheries through forgone economic profits'' The World Bank (2009) substantiate that overcapacity decreases the fisheries profits (See table 6.1).

Table 6.1. Rents losses in five major fisheries

Fishery	**Year**	**Harvest (1000 tonnes)**	**Revenues**	**Rents loss**
Vietnam, Gulf of Tonkin demersal multigear	2006	235	178	29
Iceland cod multigear	2005	215	775	55
Namibian hake trawl	2002	156	69	136
Peru anchoveta purse seine	2006	5,800	562	29
Bangladesh hilsa multigear	2005	99	199	58

Source: World Bank (2009:43).

The rent loses due to overcapacity are not confined in the fisheries of the developing world (Asche et al., 2008). Overcapacity induced loss of potential rents in some developed world fisheries developed world fisheries also lose potential rent due to overcapacity (See table 6.2).

Table 6.2. Potential rents in five European fishing nations.

Country	Potential rents as % of landed value	% reduction in the fleet required to achieve this level of rent
Norway	61	65
Iceland	51	50
Sweden	30	50
Denmark	22	67
UK	32	79

Source: Asche et al., 2008: 926

From the above, it is clear that overcapacity leads to loss of economic rent and likewise, the HDST fishery's profits are going down due to the persisting overcapacity.

6.6. Compensatory Measures

The compensatory measures that the HDST fishing right holders take to counter capacity under-utilization include operating in clusters, targeting by-catch, adjusting the crew's income with shortened fishing seasons and reducing the latent capacity (See section 5.4).

Clustering

Operating in clusters increases the utilization of the individual vessels that are left in the fishery. However, it exacerbates the fleet under-utilization as it leads to fewer operating vessels leading to more labour under-utilization. Further, operating in clusters leads to the preference of powerful and bigger boats. The small and older vessels which the clusters are not likely to prefer continuously add to latent capacity. This clustering seems to be making the HDST fishery more efficient in economic terms, i.e., it gears the HDST fishery towards the direction of maximizing the profit. In the future, this fishery will be left with only large and more powerful vessels. This implies that labour will continue being reduced as the capacity under-utilization in particular of the small and old vessels which require much labour continue to persist. This relates to the capital intensive nature of industrial fisheries. Therefore, the current notion of overcapacity in this fishery, i.e., 'too many boats chasing too few fish' is likely to get replaced by the notion 'fewer but big and more powerful boats' in the future. .

It is confirmed by Asche et al. (2008) that moving towards rent generation, requires substantial reductions in capacity and employment in the fishery. Futher, below is an example of profit maximization scenario that led to capacity under-utilization :

> ''*The Bering Sea Pollock Conservation Cooperative created the incentives to generate substantial additional rents. This was done by removing the less efficient vessels and extending the fishing season''* (The World Bank, 2009:45).

The bove example relates to the HDST fishery's step towards improving efficiency of the fishing operations by clustering and extending the fishing season through by-catch targeting. Increasing economic efficiency at the expense of employment is no surprise. Employment and profit always counter each other (Morgan et al., 2007) [81], thus cannot be maximized simultaneously in a given fishery (See Fig 6. 3).

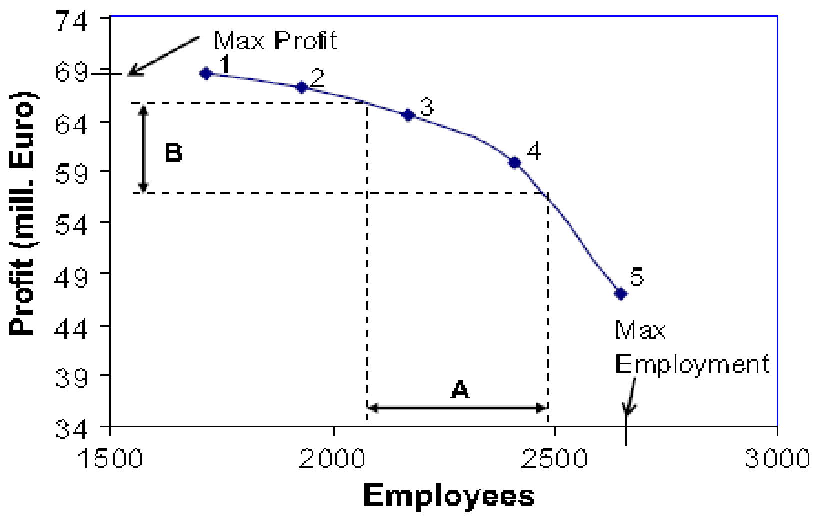

Fig. 6.3. Tradeoffs between profit and employment (Source: Kjærsgaard, 2010: 7)

Fig 6.3 can be used to clarify and quantify tradeoffs between profits and employment through decision making. This Figure could tell how much the fishery managers are willing to reduce employment by A to achieve B profit. Moreover, Kjærsgaard (2010) affirms that 42 % of the vessels and 36 % of the employees in the Danish fleet would have to leave the fishery if the profit

[81] See also Kjærsgaard, 2010; Metzner, 2005; Pascoe et al., 2004

has to be maximized in the fishery. This relates to the following: ''*In the Northern Atlantic the path to economic efficiency has been concentrating on technical modernization and capital investment on behalf of employment*'' Johnsen (2005:492).

It is clear from the above examples that profit maximization takes place at the expense of employment in the fisheries. However, in nations where there are pull factor for the people who lose employment in fisheries, it is easy to maximize profits, in contrast to the HDST fishery. Below is an example:

> ''*In Norway, the capture fishery, which initially served as a labour buffer in early 20th century, was later changed into a rent-extracting sector, especially from 1980s onwards. This did not create serious problems in terms of employment, because substantial growth that was taking place conjointly in other economic* sectors'' (Béné et al., 2010: 336).

In fisheries where the pull factors are barely available, as in most of developing world fisheries, fisheries managers are forced to let the fisheries and in particular the small-scale fisheries, to remain as a labour buffer. Hence, such fisheries would not be able to move towards rent extraction as that direction contradicts with being a labour buffer (Béné et al., 2010).

6.7. Sustainability

The biological impacts of capacity under-utilization in the HDST fishery are positive whereas its socio-economic impacts are negative. This contradicts with the main goal of the Marine Living Resource Act of 1998 (MLRA) to provide for sustainable utilization of marine living resources. The FAO's Code of Conduct for Responsible Fisheries (CCFR), (1995) confirms sustainable resource management as an important goal in most fisheries. Charles (2001)[82] traditionally defines sustainability as a balance between economic, ecological and social related goals. Kay & Alder (2005) refers to the above notion of sustainability as the 'triple bottom line'. However, a more advanced definition of sustainability incorporates the trade-offs found in an attempt to simultaneously achieve these goals, the political dimension of the process and the long-term balance among them (See Fig 6.4).

[82] See also Kay & Alder, 2005; Utne, 2008

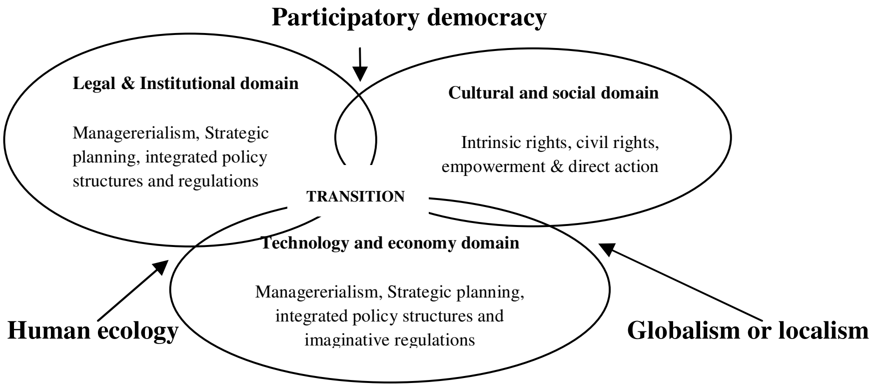

Fig. 6.4. Sustainability domains: a balanced 'triple bottom line' (Source: Kay & Alder, 2008: 15).

In a fisheries perspective, the ecological sustainability means the capability to maintain sustainable harvest, the target fish base, related and affected species and the resilience of the entire ecosystem where the target species lives. The economic sustainability refers to the capability to maintain economic welfare of the fishery with its economic viability. The social sustainability implies maintaining socio-cultural wellbeing of the fishery including the health of the human system, or as phrased by Charles: ''*A sustainable fishery simultaneously maintains the integrity of the marine ecosystem, supports the fishing communities and maintains the economic viability of the fishing sector on a long-term basis*" (Charles, 2001: 111).

From the above definition it is clear that sustainability is not only about environment (fish) or economy (profit), as it seems in the HDST fishery. Sustainability as a concept is vague and complex as Utne (2008) concurs, thereby, when considering sustainability, conflicting situation usually occur. The vagueness and complexity of sustainability is what led to a conflicting situation in the HDST fishery, in an attempt to balance the'triple bottom line'.

In short, employment as part of sustainability is not being prioritized in the HDST fishery. The managers support the ecological domain of sustainability while the fishers are concerned with the economic sustainability. This is in accord with Utne (2008) who states that overcapacity threatens sustainability. The strides to balance the 'triple bottom line' phenomena of sustainability became practically in impossible in the HDST fishery and rather resulted in a conflicting scenario.

6.8. Summary

The HDST fishery is facing substantial overcapacity, particularly in economic terms. This is observed through capacity under-utilization which inflicts direct costs to the entire industry through forgone economic profits. In a social perspective, is reduces the employment in addition to low income for some employees. However, it relatively recovered the deep water hake stock. Maximizing the profit is attempted through operating in clusters, leading to more capacity and labour under-utilization. This profit maximization seem to be replacing the current notion of overcapacity, i.e., '*too many boats facing too few fish*' with that of '*few but big and more powerful boats*' which is more prevalent in the developed world's fisheries.

In contrast to many developed world fishing nations, the issue of overcapacity has rather become the industry's responsibility in the HDST fishery. However, in other countries, for example Norway (Hersoug, 2005) and Taiwan (Huang & Chuang, 2009) overcapacity is the responsibility of both the state and the industry. In Norway, the state pays 50 % for scrapping the vessels and the industry pays 50 % (Hersoug, 2005). In countries where there are vessel buyback schemes, as for example in, Japan, United States, Canada, Australia, European Community and Taiwan (Metzner, 2005), overcapacity is entirely considered a state's responsibility .

7. Conclusions, Recommendations and Further Research

7.1. Introduction

Guided by the research questions, this study looked at overcapacity in the South African Hake Deep Sea Trawl (HDST) fishery. The research questions that this study dealt with are as follows:

1. *What is overcapacity, how is it defined in technical, biological and economic terms?*
2. *To what extent is there overcapacity in the HDST fishery?*
3. *What are the main factors driving capacity to the current level in this fishery?*
4. *What are the measures used to manage this capacity and what are their implications?*

7.2. Conclusions

The conclusions drawn from the findings of the present study, corresponding to the above research questions are as follows.

7.2.1. What is overcapacity?

The perception of what constitutes fishing capacity varies considerable among stakeholders involved in the fisheries due to interests and needs stemming from their unique relationships with fisheries. These different perspectives lead to various optimal fishing capacity levels and thereby overcapacity for a given fishery. To economists, the fishing capacity necessary to achieve Maximum Economic Yield (MEY) is considered optimal. To biologists, a fishing capacity that does not fish beyond the Maximum Sustainable Yield (MSY) is considered optimal. To social scientists, the fishing capacity that achieves open access equilibrium, where employment is maximized would be optimal. To technologists, a full utilization of fishing inputs implies optimal fishing capacity. Hence, there is no universal optimal fishing capacity that would satisfy all of the stakeholders, i.e., an optimal fishing capacity that would simultaneously maximize the profit, yield and employment with all fully utilized inputs in a given fishery. Hence, the perception of overcapacity, determined by the above optimal capacity levels differs among these stakeholders.

7.2.2. To what extent is there overcapacity in the HDST fishery?

The overcapacity in the HDST fishery can be described as ‘‘*too many boats chasing too few fish*’’. However, this will apparently turn into ‘‘*fewer but bigger and more powerful boats*’’ if capacity under-utilization persist for a long time. In economic terms, there is considerable overcapacity in the HDST fishery due to capacity under-utilization. In biological terms the capacity in this fishery is reduced through capacity utilization restrictions which resulted in the recovery of the deep water hake (the mainstay of the HDST fishery) and improved Catch per Unit Effort (CPUE). In social terms, an inadequate capacity occurs in the HDST fishery as the employees continue losing jobs due to capacity under-utilization.

7.2.3. What are the drivers of overcapacity?

Overcapacity came into the HDST fishery with the rights allocation. TAC reduction and effort regimes limit the utilization of this capacity leading to capacity under-utilization. Technological creeps continue making the fishing capacity more efficient, leading to more capacity under-utilization. Market-induced capacity under-utilization occasionally occurs in this fishery.

7.2.4. What are the management measures and their implications?

The utilization of the fishing capacity in the HDST fishery is managed through effort control and TAC reduction strategies. From the state's perspective, this management strategy is working as the deep water hake is recovering. However, from the industry's perspective this management strategy has led to capacity under-utilization resulting in high costs, low profits, job looses and low income for some employees. Therefore, the above management works in favour of the state authorities and has moved the overcapacity and the responsibility to deal with it to the industry.

7.3. Recommendations

The fishing capacity management measures are dissected into incentive blocking and incentive adjusting measures (See Appendix 14). The former try to block economic motives that induce fishers to increase fishing capacity, thus impeding fishing capacity's growth rate. The latter modifies these motives by creating economic forces that can reduce overcapacity (Cunningham & Gréboval, 2001)[83]. The incentive blocking measures often worsen overcapacity, hence Metzner (2005) refers to them as the 'recipe for economic waste'. Though overcapacity ultimately get reduced under the incentive adjusting scenario, hard choices still need to be made, particularly if sustainable utilization is among the goals of the fishery as in the HDST fishery (See Fig 7.1).

[83] See also Gréboval et al., 1999; Gréboval, 2004; Huang & Chuang, 2009; Metzner & Ward, 2002; Metzner, 2005; Pascoe et al., 2008; Sathyapalan et al., 2008

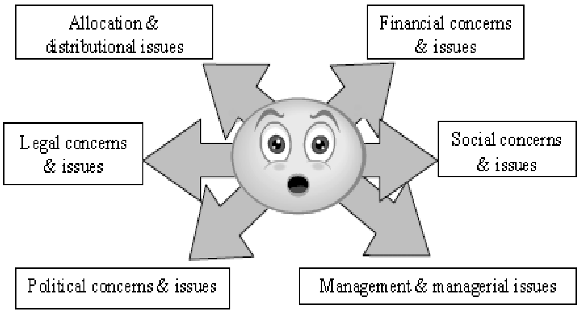

Fig. 7.1. The transitional considerations associated with the development and implementation of effective capacity management measures (Pascoe et al., 2008: 59) (See also Appendix 13).

In countries like South Africa, where there are no compensation for those who loose jobs in the fisheries, the incentive adjusting methods would exacerbate labour under-utilization. Considering the lack of universal optimal capacity for all fisheries' stakeholders and that there is no ''one size fits all approach'', it is hard to determine what management measures could be practically effective for the HDST fishery. Nevertheless, this study recommends the following adjustments in the HDST fishery's management system so as to ameliorate the under-way impacts of the capacity under-utilization that is ongoing in this fishery.

The use of group or community quotas (See Appendix 11) in addition to the ongoing management measures. In this regard, the hake TAC would be set and allocated to the sectors of the hake fishery as usual. The HDST fishery's share of TAC would be allocated into two groups, namely the South African Deep-Sea Trawling Industry Association (SADSTIA) and the Association of Small Hake Quota Industries (ASHQI). Noteworthy, SADSTIA comprises established companies and these companies are currently stuck with the latent capacity brought by fleet under-utilization. ASHQI comprises of small-quota holders with no capacity and operating co-operatively with established companies in addition to joint ventures with Spanish vessels. The hypothesized results of the proposed group quotas are as follows:

- Division of the fishery into small-scale (ASHQI) and a large-scale (SADSTIA) sectors.
- SADSTIA could open up a second hand market for the latent capacity and through loan funds from private organizations, ASHQI could buy these vessels.

- Consequently, ASHQI would maintain the labour of this fishery by employing the old and small labour demanding latent vessels from SADSTIA.
- Further, ASHQI would be increasing value adding into the hake processing sector as the majority of these said old vessels are wet-fish vessels. Further, value adding would increase the employment and profit (if they could export the value added fish products).
- SADSTIA, on the other hand would be maintaining the capital intensive nature of this fishery by continuing to enhance the fishing efficiency leading to more capacity under-utilization at fleet level but increasing the utilization of vessels left in the fishery.
- Both groups could retain their crew members for under-utilized vessels by using them for maintenance and security of these vessels.
- In aggregate, the HDST fishery would be ameliorating the impacts of capacity under-utilization by increasing or maintaining the current employment levels through the small-scale sector (ASHQI) while maximizing the profit through the large-scale sector (SADSTIA). Further, the sustainability of the target stock would be maintained by the TAC which is set based on the biomass of the stock.
- In short, by implementing the proposed strategy, the HDST fishery would be attempting to balance the 'triple bottom line' notion of sustainability.

Moreover, the following would perhaps compliment the proposed strategy. First, proper definition of fishing capacity by stakeholders involved in decision making. This would correct the linear perspective on fishing capacity, endemic in most fisheries that instead exacerbate overcapacity. Second, stressing the fact that different stakeholders have different optimal fishing capacity levels and there is no universal optimal capacity for all these stakeholders. Third, implement education and awareness programs to make the affected stakeholders understand the impacts of managing over capacity, including limitations and hard choices that have to be made. Fourth, regular monitoring and evaluation of the management as new information and data get available, i.e., implementing adaptive management. Lastly, understanding the principles of the the Ecosystem Approach to Fisheries management (EAF) would help the HDST fishery managers to incorporate fishing capacity management into its EAF system.

7.4. Further Research

The following might have made this study to miss some knowledge with regard to overcapacity in the HDST fishery. First, the exact extent of overcapacity in the HDST fishery could not be quantified due to inability to quantify the under-utilization of each vessel. Second, market induced capacity under-utilization could also not be quantified due to data deficiency. Third, this study has been largely based on secondary data for an input-based measure of capacity. Fourth, for a subjective measure of capacity, only five fishing operation managers were interviewed. Last, this study only examined the fishing capacity, processing capacity has been left out. Hence, to improve knowledge about overcapacity in the HDST fishery, further research may consider:

- Assessing the exact capacity under-utilization
- Use primary quantitative data instead of the secondary data
- Use input-based, subjective and output-based measures of capacity
- For the subjective measure, select a bigger sample size
- Finally, assess the processing capacity as well

Additionally, further research can also simulate the impact of the proposed management adjustments using for example, a model which was developed by Santos (20??) for a fishery ecology course to simulate industrial and artisanal fisheries in Mozambique. This model tests the impact of different input controls in the fisheries and use indicators, i.e., yield or profit to check their effectiveness. In this context, the artisanal fishery would be the vessel owners organized through ASHQI and the industrial fishery would be the ones organized in the SADSTIA. The researcher could use yield, profits and employment levels as indicators of effectiveness of simulated management measures. Further, this model could be manipulated so as to simulate the impact of the proposed group quotas on the chosen indicators.

Obviously, this is only a case study. Hence, more into depth research is needed to improve knowledge concerning overcapacity in the HDST fishery. Hopefully more in-depth research could produce data to ameliorate the current fishing management measures in the HDST fishery.

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Appendices

Appendix 1: Questionnaire used for the subjective assessment

Fisheries Transformation

In terms of capacity and investments, how do you think the industry transformed from the medium to the long term rights allocation management process?

Fishing Capacity

1. Do you understand the concept of overcapacity?
2. If yes, what measures do you put in place to ensure it does not occur in your company?
3. If no, would you be interested if MCM organizes a workshop to explain the concept?
4. How many vessels operating in your company since 1998?
5. Any developments made in fishing vessels, gears and fishing strategies in this company since 1998?
6. How has the development referred to above impacted effort?
   a. Any improvement in CPUE since these developments?
   b. If yes, what are the likely causes, technological creep? Improvements in stock size?
   c. Are other companies experiencing the same trends as your company?
   d. How have this change affected profits?
   e. How are the general costs of production?
7. How has economy affected you fleet or fishing capacity?

Management

8. What impacts does effort control have on crew, exports, revenues, costs and investments?
   a. How have the situation been before implementation of effort controls?
9. Have changes in fleet size affected changes in income of employees?
10. How do employees and crew compensate for changes brought by effort control?
11. How do other right holders compensate for such changes?
12. Are there other alternatives for vessels and crew?
    a. If so what do vessels and crew do when they have not gone to sea?
    b. Do vessels go participate in other sectors?
    c. Do they go fish in foreign countries?
13. As a Right Holder, do you frequently sell or purchase new vessels?
    a. If so, why? Is it because you want to build up fleet capacity?
    b. What changes does that bring on the fishery? In terms of effort, catch rates, profits?

Appendix 2: Interviewees and the fishing companies they represented

Interviewee's Name	**Occupation**	**Company name**
Roy Bross	Secretary	South African Deep-Sea Trawling Industry Association
Pierre Rocher	Fishing operations manager	Blue Continent Products fishing company
Rory Williams	Fishing operations manager	Viking fishing company
Suleiman Sallie	Fishing operations manager	Irvin & Johnson fishing company
Boya Chettey	Fishing operations manager	Mayibuye fishing company

Appendix 3: The main sectors of the South African fishing industry

Sector	Description
Recreational	This includes angling, spear fishing, cast-netting and marine aquarium fishing
Subsistence	This is based on low catch value, easily accessible and cheap to harvest reSources such as oysters, mussels, limpets, winkles, red bait and estuarine crabs. There are about 28,300 fisher households and 29,200 individual subsistence fishers in South Africa.
Small-scale commercial	This includes small-scale fishing activities that do not qualify for subsistence criteria. Fishers of this sector operate at the lower end of the commercial fishers. Inshore west rock lobster, line fish, abalone, octopus, kelp and sea weeds form the basis of this sector.
Medium-scale commercial	This is based on squid, inshore pelagic, hake long line and hand line, tuna pole, demersal shark and offshore west coast rock lobster fishing for local and international markets.
Large-scale commercial	This is based on hake trawling, offshore pelagic, patagonian tooth fish, south coast rock lobster and prawn trawling. ReSources harvested in this sector are hardly accessible, fishing thus requires substantial capital and technology. Large vessels and few but strongly vertically integrated companies participate in this sector mainly for international markets.

Appendix 4: Characteristics of the HDST fishery's fleet for 2009

Number of vessels	56
Freezer (Fr), Combined (Com) and Ice vessels (Ice)	21 Fr, 4 Com, 35 Ice
Average age in years	24.5, with the majority between 20 to 30
Average Gross Registered Tonnage (GRT)	717 tonnes
Average (range) length	42 (20 - 72) m
Average Horse Power	1464 HP
Average number of sea days	265
Average catch per sea days (nominal tonnes)	8 to 9

Adapted from http://www.envirofishafrica.co.za

Appendix 5: Criteria used for the long-term fishing rights allocation **process**

In addition to transformation, the allocation of the long-term rights was based on the following:

- **Biological consideration**→ fishing impact on the target fish, primary done through TAC allocation
- **Ecological consideration**→ impact on the ecosystem of the target species
- **Socio-economic consideration**→socio-economic impact of allocations on right holders, workers and consumers, prioritizing those dependent of the resource.
- **Commercial considerations**→investments in fixed assets, fishing, marketing and processing capacity
- **Performance** →financial and fishing performance, value adding, enterprise development, job creation

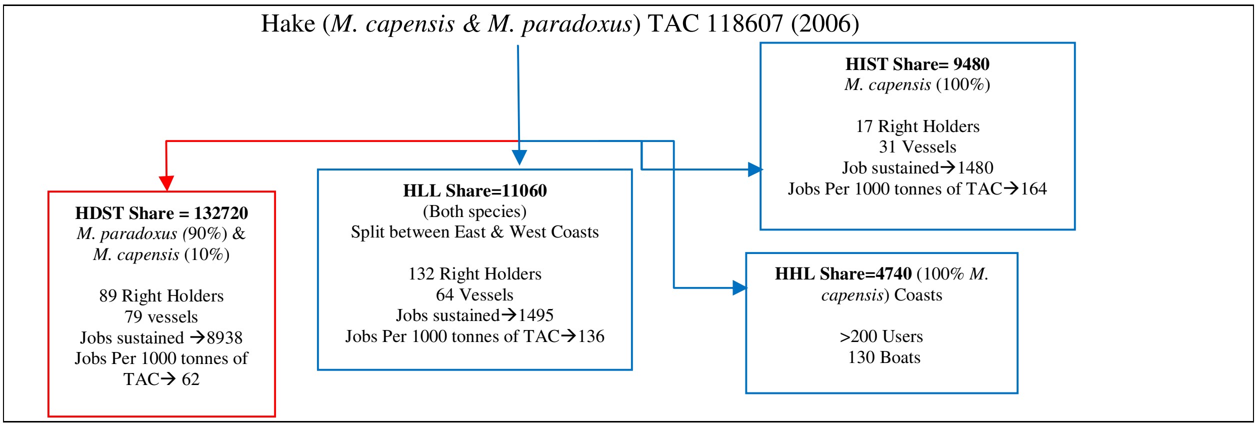
Source: MCM, 2005a

Appendix 6: Management controls used in the HDST fishery

Input Controls	
Permit	A fishing permit is required to undertake fishing activity in South African waters & issued seasonally with accompanying conditions. In addition, a fish transporting permit is needed for transporting the catch from the port where it was landed. Fish export and import permits are also needed to export and import fish respectively. An EZZ permit is issued to foreign vessel for landing catch in any of the South African ports.
Vessel license	Any vessel that is to operate in South African waters has to possess a vessel license
Area Restriction	Fishing on bays is generally restricted since they are nursery areas for fish. The HDST fishery is restricted to fish in areas shallower than 110 m and within 20 nm from the coats
Effort limitation	Effort is limited by limiting the number of vessels that go to sea through allocation of fishing days to vessels based on their horse power and company's quota (See chapter 4). Fishers are not to exceed the current level of vessel capacity when replacing old vessels
Technical Measures	
Mesh size & Catch limits	A codend mesh-size of 110 mm is utilized in HDST fishery with a respective selectivity of at least 2 years old fish
Tori lines	Tori lines are deployed by HDST fishery's operators so as to reduce the incidence capturing of sea birds and thus their mortality.
By-catch limits	The by-catch in HDST should not exceed 50% of hake caught
Taxes and Fees	
Permit fees	The permits are not for free, there is a fee that has to be paid in order to get a permit
ReSource tax	Right Holders pay levies for each catch they land based on the quantity of landings. Permit and levies funds are used for research, compliance and management.

Source: MCM, 2008-2009

Appendix 7: Hake TAC species breakdown



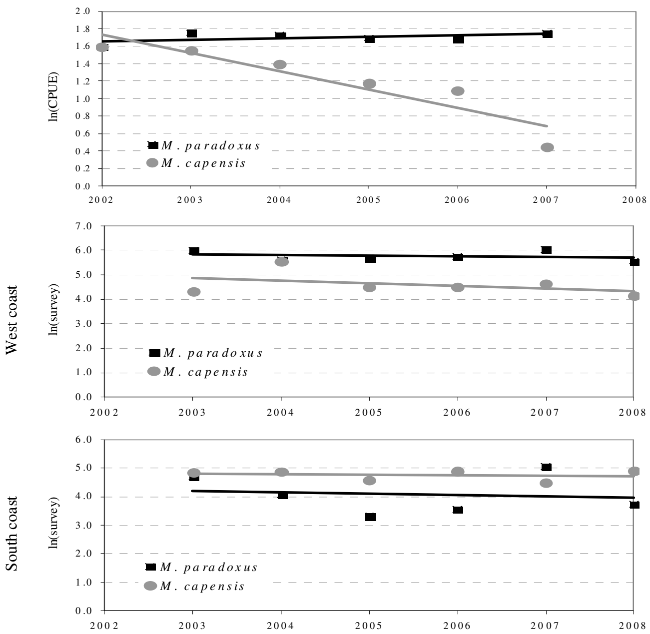
Adapted from http://www.envirofishafrica.co.za

Appendix 8: Monitoring, control and surveillance for the Hake fishery

Logbooks	Landings are monitored at factories and company landing facilities and returned with skippers logbooks to MCM where catch, effort and quotas are reconciled. Trawlers are required to report potential landings within two days in advance of port arrival.
Observers	For each HDST fishery operation, there should be an observer on board the vessel from MCM, responsible for monitoring the fishing activity
Fishery Control Officers (FCOs)	MCM has for the purpose of monitoring and enforcing management regulations distributed FCOs in all harbours where fish are landed to inspect the landings
Vessel Monitoring System(VMS)	VMS should be attached in each vessel during the period of operation so as to convey information with regard to the crew and operations to the MCM's operational room
Vessel Patrols	Vessel patrols along the country's EEZ are carried out for surveillance and enforcement

Source: MCM, 2008-2008

Appendix 9: CPUE and abundance of Cape hakes (Source: MCM, 2008)



Appendix 10: General indicators of overcapacity in fisheries

Indicator	Description
Management category	This refers to open access or limited access or rights-based management system. Open access tend to have high levels of overcapacity as number of participants in the fishery are not restricted. Limited access also tend to have overcapacity but not as severe as in open access. Right-based fisheries eventually remove overcapacity.
Biological status of a stock	An overfished target species of a fishery may reveal the signals of overcapacity as overcapacity and overfishing are likely to occur together. A fishing stock that is fully utilized or almost overfished could also show overcapacity as less inputs could be used than before the stock get overfished but provide the same level of catch as before. This is a reasonable indicator of overcapacity but should be applied carefully.
Harvest/ target catch ratio	Here, overcapacity exists when the harvest levels regularly go beyond the target catch presuming that the target capacity is the level necessary to harvest the target catch during a fishing season. This is not a perfect overcapacity indicator due to the following; (i) the fishery could be closed once the target catch is achieved,(ii) discarding over quota catch could disguise the apparent overcapacity and (iii) when a fishery has been overfished, the harvest may be below the target, especially if the target is set high for social motives
TAC/season length	Here, overcapacity could be indicated by the ratio between TAC and the season length. This is not a perfect capacity measure either, due to the same reasons as for harvest and target catch ratio.
Management conflicts	Controversies relating to the setting of TAC and allocation among user groups and fishery managers may indicate signals of overcapacity. However, due to inability to evaluate the seriousness of such controversies, this is considered a rough measure of overcapacity.
Latent permits	This refers to fishing permits that have never or formerly been used but currently not active in the fishery. Overcapacity could occur when there are many latent permits or low ratio of active permits to total permits in a fishery. This may lead to overestimation of capacity since fishers may lease their permits (if transferable) thus get cancelled from the management system.
Catch per unit effort	When TACs and harvest levels are constant, a decline in catch per unit effort implies overfishing and possibly overcapacity. This is not a perfect measure as catch per unit effort can remain stable even when overcapacity exists in a fishery if TAC increases with the stock recover.
Value per unit effort	Value per unit effort decreases as the quantity of catch declines indicating overfishing and thus overcapacity. Value per unit effort may however decline due to other reasons even if catches rates are increasing, e.g. when juveniles dominated the catches leading to lower prices and revenue per trip even if the total catch weight remains constant.

Source: Lindebo, 2004[84]

Appendix 11: Parameters of the HDST Effort control model

1. The basic parameter of the HDST effort control system is 0,438 kg hake per corrected horsepower per sea day tuned to hake TAC of 150000 tonnes. Tuning works thus, in a year in which the TAC is set at 120000 tonnes, the above base factor becomes 0.534 kg per corrected horsepower per day
2. The second parameter is 265 sea days per year for all classes of vessels
3. The factors taken into account for adjusted horsepower are as follows:
    a. The South African Maritime Safety Authority registered vessel's main engine power in kilowatts or horse power (1 horse power = 0.746 kilowatts),
    b. The kilovolt amp (kva) capacity of power take-off alternators (i.e. alternators coupled to the main shaft)
    c. The presence or absence of a kort nozzle.
4. The power correction to the shaft is calculated as follows:
    a. Up to 30% of main engine power deducted for shaft alternators where the output of the alternators adjusted by a conventional kva power factor would be greater than 30% of engine power,
    b. When the above is untrue an adjusted kva is deducted from maximum engine capacity and
    c. 18% deduction from maximum engine capacity is allowed for vessels without kort nozzles.

The correction (comprise above section 4(a) or 4(b) and 4(c)) is then capped at 20% of engine capacity.

Source: MCM, 2007c

Appendix 12: Master Plan for the HDST fishery's 2009 fishing season

Cluster	Company	Quota	Vessels	Fishing Period 1	Period 2	Manager
Irvin & Johnson	Irvin & Johnson	30716	Bluebell	01 Jan-31 Dec		Suleiman Salie
			Boronia	01 Jan-31 Dec		
			Foxglove	01 Jan-31 Dec		
			Forest lily	01 Jan-31 Dec		
			Fuschia	01 Jan-31 Dec		
			Freesia	01 Jan-31 Dec		
			Stevia	01 Jan-31 Dec		
			Lobelia	01 Jan-31 Dec		
			Godetia	01 Jan-31 Dec		
			Aloe	01 Jan-31 Dec		
			Nerine	01 Jan-31 Dec		
			Flame Thorn	01 Jan-31 Dec		
	Sea Harvest	22858	Harvest Belinda			

[84] See also Ward et al., 2004; Ward, Undated

	Atlantic Trawling	7072	Harvest Bettina			
	Vuna Fishing	2128	Harvest Diana	01 Jan- 31 Dec		
			Vuna Elita	01 Jan-31 Dec		
			Harvest Florita	01 Jan-31 Dec		
			Harvest Kirstina	01 Jan-31 Dec		
			Harvest Lindiwe	01 Jan-31 Dec		
			Harvest Marina			
			Harvest Nandi	01 Jan-31 Dec		
			Harvest Ramona	01 Jan-31 Dec		
			Harvest Selina	01 Jan-31 Dec		Russel Hall
			Harvest Veronica	01 Jan-31 Dec		
			Harvest Zula			
			Staaltind1	01 Jan-31 Dec		
			Harvest Krotoa	01 Jan-31 Dec		
Sea Harvest			Harvest Georgina	01 Jan-31 Dec		
			Harvest Gavina	01 Jan-31 Dec		
			Harvest Gardenia	01 Jan-31 Dec		
			Rover			
	Viking Fishing	2013	Andromeda	01 Jan-31 Dec		
	Algo Mar	353	Armana	01 Jan-31 Dec		
	Hangberg	1621	Lucerne	01 Jan-31 Dec		
	New South African	1015	Lezandi	01 Jan-31 Dec		
	Quayside Fish Suppliers	465	African Queen	01 Jan-31 Dec		
	Selecta Sea Products	467	Svein Jonsson	01 Jan-31 Dec		
Viking	Sistro Trawling	567	Vera Marine	01 Jan-31 Dec		
	Siyaloba	396	Lincoln	01 Jan-31 Dec		
	Saco	1674	Maretje	31 Jan-15 Jun	15 Jul-31 Dec	Trevor Wilson
	Eyethu	1638	Khulisa Eyethu	25 Feb-31 Oct		
	J&J Visserye Bk	407	Lepanto	01 Jan-31 Dec		
	Ziyabuya	1187	Sistro	01 Jan-31 Dec		
	Bayview	398	Lee Anne	01 Jan-31 Dec		
	Luzizi	413	Monie Marine	01 Jan-31 Dec		

Foodcorp	Foodcorp	4766	Beatrice Marine	01 Jan-31 Dec		John Pope
			Maria Marine	01 Jan-31 Dec		
			Isabella Marine	01 Jan-31 Dec		
Lusitania	Fernpar Fishing	1311	Toralla	28 Jan-31 Dec		Rui Ventura
	Hoxies	432	Sandile	21 Jan-31 Dec		
	Community Workers	421	Marie Claire	21 Jan-31 Dec		
	Radaco Sea Products	290				
	Bato Star	857				
	Algoa Bay Sea Products	363				
	Eigelaars Bote	133				
	Port Nolloth	113				
	Hermanus Seafoods	370				
Blue Continent Product	Usuthu Fishing	628	Codesa I	21 Jan-31 Dec		Michael Sands
	Rainbow Nation	389	Okombahe	21 Jan-31 Dec		
	Impala Fishing	475				
	Umoya Fish Processors	113				
	Lorcom Thirteen	100				
	Blue Continent Products	697	Compas Chalenger	21 Jan-31 Dec		
	Calamari	392	Realeka	21 Jan-31 Dec		
	Bhana Coastal Fishing	448				
	Surmon Fishing	796				
	Azanian Fishing	234				
	Premier Fishing SA	560				
	BP Marine Fish Products	240				
United Fishing Cluster	Combined fishing	594	Portunity	15 Jan-31 Dec		Andrew Kaye
	NVO	1163	Esra Cruz	15 Jan-31 Dec		
	Snoek wholesalers	396	Millenium	01 Mar-31 Dec		
	DMA Fishing	1804	Antares Prima	01 Mar-31 Dec		
Offshore	Offshore	1809	Eyodidi	01 Feb-31 Dec		Bill Symmonds
ZMW		1166	Basani	01 Jan-31 Dec		Dave Japp
Viscor	Visko Seeproducts	355				
Ramsauer	Dyer Eiland Visserye	115,983	Boetie Bert	23 Jan- 27 Jun		Lorraine Dyer

	EFH Walters	153,901				
Usuthu/ Rainbow	Usuthu Fishing	628	Codesa I	28 Feb-31 Dec		
	Rainbow Nation	389				
	Impala Fishing	190				
	Umoya Fish Processors	50				
Mayibuye	Mayibuye	1704	Echalar	01 Mar-14 Jun	10 Aug-31 Dec	
	Khoi Qwa	122				
	Tradeforth	112				

Adapted from MCM, 2007c

Appendix 13: Fisheries management tools and effect(s) on overcapacity

Management Approach	Management Tool	Duration	Effects	
			Direct Effect(s)	Longer-term Effect(s)
Incentive Blocking Approaches	limited entry programs	temporary	• limit participation	• capital stuffing – where a vessel's horsepower, length, breadth, and tonnage are increased – typically occurs • drives changes (technological innovations) in gear, in fishing periods or areas • create motives for IUU fishing • capacity will increase
	buyback programs	temporary	• purchase of vessel(s), license(s), and/or gear(s) • capacity *may* be temporarily reduced in the fishery	• any improvements in stock abundance will attract additional capacity • create motives for IUU fishing • capacity will increase
	gear restrictions vessel restrictions	temporary	• initial reduction in harvests	• substitution of unregulated inputs or new gear types to replace restricted inputs • regulations lose effectiveness and additional regulations required • create motives for IUU fishing • capacity will increase
	aggregate quotas total allowable catches (TACs)	temporary	• likely to accelerate the growth of fishing capacity rather than reduce it	• capacity and effort increase if effort and entry unrestricted • race for fish ("fishing derby") develops • create motives for IUU fishing: additional regulations required, particularly to limit discarding and false reporting, ensure traceability and to control transshipment • potential for frequent overruns of the TAC resulting in overexploitation • frequently result in excess processing capacity and processing plant down time during closed season(s) • capacity will increase
	non-transferable vessel catch limits (individual quotas / IQs)	temporary	• overcapacity not addressed • may limit additional growth of capacity	• requires regulations to ensure traceability and to control transshipment • additional regulations required • create motives for IUU fishing • capacity will increase
	individual effort quotas (IEQs) denominated in trawl time, gear use, time away from port, fishing days, etc.	mid-term	• enforcement difficult • additional regulations required to control input substitution	• capital stuffing – where a vessel's horsepower, length, breadth, and tonnage are increased – frequently occurs • requires regulations to ensure traceability and to control transshipment • create motives for IUU fishing • capacity will increase
Incentive Adjusting Approaches	group fishing rights: community development quotas (CDQs), community-based management	potentially enduring	• reallocation of the fishery to the recipient community	• requires group understanding of asset value of user rights, capability to manage • reduction of overcapacity or capacity containment depends on subsequent management
	territorial use rights (TURFs)	potentially enduring	• reallocation of the fishery to the recipient community	• requires group understanding of asset value of user rights, capability to manage • reduction of overcapacity or containment of capacity linked to subsequent management
	taxes and royalties	indefinite duration	• market forces drive out overcapacity • consolidation if overcapitalized	• administratively intensive: require constant adjustment of tax levels to maintain capacity at desired level • politically difficult to impose, easier to rescind
	individual transferable quotas (ITQs), individual fishing rights (IFQs)	enduring	• market forces drive out overcapacity • consolidation occurs if overcapitalized	• capacity managed automatically, overcapacity does not occur / recur • compliance concerns internalized by fishers to protect asset (rally against IUU fishing) • supplementary regulations helpful to reinforce conservation

Source: Metzner, 2008

Appendix 14: Issues hindering the management of overcapacity

Awareness and recognition – and the difficult balance between capacity and long term problems of overcapacity as well as the long-time acquiring of benefits capacity reduction programs
Balances of power and distributional issues – and how these may occur within fleets, between various parts of fleets, as well as between different stakeholder groups;
Development – and how coastal states have the right to fish and how this may affect having fishing vessels, ;
Displacement – and the movement and impacts of fishers when capacity is shifted out of one fishery;
Employment – and using fisheries as an alternative livelihood of last resort;
Financing – and who should pay for capacity reduction programs and of how good financial conditions may inhibit stakeholders' interest in undertaking capacity reduction strategies even when overcapacity exists.
Food security – and using fisheries as food source of last resort;
Globalization – and how market forces are reaching further and creating new incentives and pressures on previously isolated resources before local societies are prepared to deal with these forces; market forces, technological change and innovation, predicting change and continuous adaptation,
Governance and institutions - and how informal systems may perform better but have less formal legitimacy than official processes and how different stakeholder groups may make use of existing institutional arrangements to achieve their particular objectives;
Information and education – and about the real and perceived outcomes, objectives, and goals that different user groups may have; how different cultures may accept or reject capacity reduction programs;
International cooperation – and the need to share knowledge about efforts to reduce overcapacity;
Limitations – and the fact capture fisheries are incapable of providing food, employment and income for all;
Management and management systems – and how existing regulations may influence the fishing behavior, and how to harness technology to it increases the fleet's productivity while supporting capacity reduction;
Objectives and Perceptions – and how much fish different user groups actually caught versus what they should be allowed to catch as well as the disputes that conflicting objectives may create;
Politics – and how management decisions may be influenced or changed by politics;
Range of a fishery and the numbers of participants – and how potentially enormous numbers of participants who may be individually operating at low levels but having significant cumulative impacts; and
Serendipity and Total Chance – and how the adoption of capacity reduction programs may simply depend on a combination of factors that cannot be controlled or predicted.

Source: General Fisheries Commission for the Mediterranean Commission, 2010