The sustainability and employment creation potential of bivalve mariculture: A case study of mussel and oyster farms in Saldanha Bay

by
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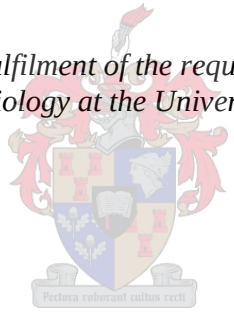

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Declaration

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Abstract

This study addresses the sustainable development and employment creation potential of bivalve mariculture with reference to the case of Saldanha. The first section of the study looks at various theoretical perspectives relating to sustainable development. The development of modernist theory is presented, as are its shortcomings. The People-Centred Development theory is presented as an alternative theoretical perspective. This theory is relevant to the present study because it prioritises the participation of local individuals in the development process, rather than prioritising the increase of capital gain. One of the development approaches within people-centred development is the Learning Process Approach. The learning process approach provides a development model through which people-centred development can take place. The study then focuses on empirical cases.

The development of four mariculture case studies from different countries and farming different organisms is then considered. The development process of these case studies is used to draw lessons on what factors affect the sustainable development of a mariculture sector. It is shown that five key factors play a role in the sustainable development of each of the four cases. The five factors are the state, the market, funding, the environment and the local community. These five factors provide a typology with which to measure the potential for the sustainable development of the bivalve mariculture sector in Saldanha. Literature on Saldanha is then reviewed, giving a background to rising unemployment in Saldanha and the need to consider the expansion of alternative sectors. This is followed by presenting the methods and results of empirical research involving the collection of primary data in Saldanha.

The research methods used in conducting empirical research in Saldanha are presented. This research elicited data on bivalve mariculture employees and bivalve mariculture directors in Saldanha as well as state representatives. The key findings of this study are that the restrictive state policies on mariculture and a lack of funding are the primary limitations to the sector's expansion. The sector has the potential to expand by a factor of four, providing employment for over 200 households in Saldanha.

Opsomming

Hierdie ondersoek fokus op die volhoubare ontwikkeling en werkskeppingspotensiaal van tweekleppige marikultuur met verwysing na die geval van Saldanha. Die eerste gedeelte van die ondersoek handel oor verskillende teoretiese perspektiewe met betrekking tot volhoubare ontwikkeling. Die ontwikkeling van modernistiese teorie word aangebied, tesame met sy tekortkominge. Die Mens-Gesentreerde Ontwikkelingsraamwerk word as 'n alternatiewe teoretiese perspektief aangebied. Die mens-gesentreerde ontwikkelingsraamwerk is relevant tot die huidige ondersoek omdat dit die deelname van plaaslike individue in die ontwikkelingproses, eerder as die verhoging van kapitaalwins, vooropstel. Een van die ontwikkelingsbenaderings binne mens-gesentreerde ontwikkeling is die Leerproses Benadering. Die leerproses benadering bied 'n ontwikkelingsmodel waardeur mens-gesentreerde ontwikkeling kan plaasvind. Die leerproses benadering word dan gebruik om die ontwikkeling van ander marikultuur gevalleondersoeke te bespreek.

Die tweede deel van die huidige ondersoek beskou die ontwikkeling van vier marikultuur gevalleondersoeke uit verskillende lande wat met verskillende organismes boer. Die ontwikkeling van hierdie gevalleondersoeke is gebruik om lesse op te stel oor watter faktore 'n invloed op die ontwikkeling en volhoubaarheid van 'n marikultuursektor het. Dit is getoon dat die vyf belangrikste faktore wat 'n rol in die volhoubaarheid en uitbreidingspotensiaal van elk van die gevalle gespeel het die staat, die mark, finansiering, die omgewing en die plaaslike gemeenskap behels. Hierdie vyf faktore is gebruik as 'n tipologie om die volhoubaarheid en uitbreidingspotensiaal van die tweekleppige marikultuursektor in Saldanha te meet. Die geval van Saldanha word eerstens in die literatuur aangebied vir 'n agtergrond oor stygende werkloosheid in Saldanha en die noodsaaklikheid om die uitbreiding van alternatiewe sektore te oorweeg.

Derdens is primêre navorsing oor Saldanha se tweekleppige marikultuursektor onderneem. Data is versamel vanaf werknemers, direkteure en staatsverteenwoordigers. Die belangrikste bevindings van hierdie ondersoek is dat die beperkende staatsbeleid oor marikultuur en 'n gebrek aan fondse die primêre beperkings op die uitbreiding van die sektor is. Die sektor het

die potensiaal om met ‘n faktor van vier uit te brei. Teen hierdie grootte sal meer as 200 huishoudings in Saldanha 'n inkomste hê.

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To my wife, thank you for your constant faith and encouragement. With your companionship, I found the journey of thesis writing rather enjoyable.

Abbreviations

BAPPENAS - Indonesian National Planning Board

BCA - British Colonial Administration

BCLME - Benguela Current Large Marine Ecosystem

BEE - Black Economic Empowerment

CPUE - Catch per Unit Effort

CSIR - Council for Scientific and Industrial Research

DAFF - Department of Agriculture, Forestry and Fisheries, Republic of South Africa

DEA&DP - Department of Environmental Affairs and Development Planning, Provincial Government of the Western Cape

DEAT - Department of Environmental Affairs and Tourism, Republic of South Africa

DSP - Diarrhetic Shellfish Poisoning

DTI - Department of Trade and Industry, Republic of South Africa

FAO - Food and Agriculture Organization of the United Nations

GDP - Gross Domestic Product

HKS - Hemorrhagic Kidney Syndrome

ICM - Integrated Coastal Management

ICTSD - International Centre for Trade and Sustainable Development

IDP - Integrated Development Plan

IMO - International Maritime Organisation

IRDPs - Integrated Rural Development Projects

ISO - International Organization for Standardization

ISA - Infectious Salmon Anaemia

IWMP - Integrated Waste Management Policy

MAM - Directorate of Marine Aquaculture Management, Department of Agriculture, Forestry and Fisheries. Republic of South Africa

MCM - Directorate of Marine and Coastal Management, Department of Environmental Affairs and Tourism, Republic of South Africa

MFMR - Ministry of Fisheries and Marine Resources, Republic of Namibia

MLRA - Marine Living Resources Act

NDP - National Development Plan

NIPF - National Industrial Policy Framework

OPC - Oil Pollution Control, South Africa

POC - Particulate Organic Carbon

PDI - Previously Disadvantaged Individual

Portnet - Transnet National Ports Authority, South Africa

PSP - Paralytic Shellfish Poisoning

SABS - South African Bureau of Standards

SADC - Southern African Development Community

SMEDP - Small and Medium Enterprise Development Programme

UAE - United Arab Emirates

USAID - United States Agency for International Development

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CHAPTER ONE: INTRODUCTION

Introduction

In South Africa, as in other countries, coastal fishing communities are experiencing rising unemployment, largely due to globally declining fish stocks (Costa-Pierce, 2008: 2; Naylor, Goldburg, Primavera, Kautsky, Beveridge, Clay, Folke, Lubchenco, Mooney & Troell, 2000: 1017; Pitcher & Calder, 1998: 15; Rönnbäck, Bryceson & Kautsky, 2002: 537). These fishing communities are typically characterised by being relatively isolated, having a low income and experiencing high levels of food insecurity. Therefore, the loss of income for these communities is a growing concern for governments, not only because of the vulnerable position such communities find themselves in in relation to food and income security and the social ills relating to rising poverty, but because of the shortage of alternative livelihood options in these areas (Van Zyl, Barbour & Hamann, 2008: i & 11). Aquaculture has come to be seen as a potential source of employment in many such situations.

The accelerated growth of the aquaculture sector worldwide has attracted the attention of many development agencies and governments seeking to provide employment opportunities in impoverished fishing communities. The suitability of aquaculture for such settings is that it is relatively labour intensive and, in the case of marine-based aquaculture (mariculture), the bulk of operations take place on the coast or in the sea. Nevertheless, although cases exist in which mariculture operations have provided employment, the employment potential of the sector is limited by challenges to its sustainable development.

Both the employment potential and the susceptibility of the sector to anthropogenic and natural challenges are illustrated in the four cases presented in Chapter Three of the present study. The cases differ from each other in terms of country of origin and specie farmed, from salmon culture in Canada and oyster farming in Namibia to prawn farming in South Africa and seaweed farming in Indonesia. However, all cases have in common that the sector contributed to local employment, yet endured considerable challenges to its sustainable development. The most extreme example is provided by the Indonesian case. In the three years after the sector began, 93% of local households were participating in seaweed farming. Yet, within the next two years, the sector experienced a total collapse. The challenges faced by all four cases highlight the need for the sustainable development of the mariculture sector if its employment potential is to be realised.

The sustainable development of a mariculture sector is significantly influenced by five key factors. These are the state, the market, funding, the natural environment and the local community. The same five factors continually emerged during consultation of the literature on numerous case studies. It was found that the state's greatest influence lay in its ability to regulate and protect the sector. The market has the potential to either generate income or bankrupt the sector. Funding allows for greater efficiency of production through expansion, as well as providing a buffer against the inconsistencies of the market and the natural environment. The natural environment is the basic foundation upon which the sector is built, and the quality of which is the sector's greatest asset. The local community provides the workforce upon which production depends, as well as presenting a possible source of conflict with other interest groups. These five factors were considered a helpful typology to assess the potential of a mariculture sector for sustainable development in an empirical context.

In South Africa, the national government has identified rising unemployment in coastal fishing communities as a major concern and has proposed that aquaculture is a possible alternative livelihood option in these coastal towns (Joemat-Pettersson, 2010). One such town, Saldanha, on South Africa's West Coast, is an important site for the development of a bivalve mariculture sector (oyster and mussel farming in this case) because of its historical heavy reliance on fishing as a livelihood, its high unemployment rate and the suitability of the natural environment for bivalve mariculture. Therefore, the development of a bivalve mariculture sector appears to be a fitting solution to rising unemployment. However, the questions that need to be asked are, "Would Saldanha's bivalve mariculture sector be sustainable?", "Will government invest in it?", "How many people can it employ", "Is the sector labour-intensive?", "Would the development of the sector be economically viable?", and "Will increased employment opportunities benefit the local unemployed?" The rationale behind this study stems from the need to address these questions.

Rationale

Saldanha Bay Municipality has identified the town's rising unemployment rate as one of the most important challenges to overcome (Socio Economic Profile, 2006: 101). Census data shows a decline in labour participation over the past five years, possibly related to reductions in fishing quotas and the declining employment opportunities in the labour-intensive fisheries sector that has historically been a major employer. Saldanha Bay Municipality's concern is that the region's growing sectors of manufacturing and tourism are not labour-intensive

(Saldanha Bay Municipality, 2007: 10). Saldanha Bay Municipality has been unable to identify a clear solution to the town's rising unemployment.

Bivalve mariculture has been in operation in Saldanha Bay since the 1980s. Strangely, however, after approximately thirty years the sector has not expanded to fill either its water-use area or Saldanha Bay's carrying capacity (Grant, Stenton-Dozey, Monteiro & Heasman, 1998: 47). In the light of the dire need for the sustainable development of a labour-intensive sector that can compensate for the reduced contribution made to local employment by fishing, one wonders why Saldanha's bivalve mariculture sector has not expanded to a far greater extent after all these years. The present study aims to address this question.

Aim

This case study aims to provide an in-depth description of the five bivalve mariculture farms operating in Saldanha. The purpose of the present study is to determine whether the development of the bivalve mariculture sector in Saldanha is sustainable and what the sector's job creation potential is.

Preliminary Literature Review

There are many debates around how development projects should be instituted. Since modernist rural development began in the 1940s, development theory has been developed to right the wrongs of prior schools of thought. Since the 1940s, development theory has ranged from the British Colonial Administration's (BCA) top-down models, which aimed to follow western industrial development, and the Integrated Rural Development Projects (IRDPs) of the 1970s, which sought to place control in the hands of local officials, to the local economic growth models of the 1980s. In spite of the difference in agreement as to who is in control of these approaches, it was not until the "new paradigm" of the 1990s that people, rather than economic gains, became central to community development theory (Shepherd, 1998: 2). Within this new paradigm, People-Centred Development has been a theoretical approach promoted by Ackhoff (1984) and Chambers (1993). Their theory was based on the work of David Korten (1980), who, by studying the development of both successful and unsuccessful rural development projects, developed a theoretical approach to programme development called the Learning Process Approach. The learning process approach is the most relevant theoretical approach for the present study, because it prioritises the development of a locally-based programme that uses local resources to address locally-defined needs in a sustainable

way. The present study thus falls within the broad theoretical parameters of people-centred development theory.

The learning process approach was used to study the literature on mariculture sectors elsewhere around the world, as well as for the case of Saldanha. The purpose of the literature study on the development of other mariculture sectors was to discover what lessons could be learned from the successes and failures in other examples. As mentioned in the introduction to the present chapter, the examples were salmon farming in Canada, oyster farming in Namibia, prawn farming in South Africa and seaweed farming in Indonesia. The leading authors for these cases were: Marshall (1999, 2001, 2005) on Canada; Mapfumo (2009) on Namibia; Evans (2009), Enslin (2004, 2006) and Sadek (2002), respectively, on South Africa; and Crawford (2000, 2002), Pollnac (2000, 2002, 2003) and Tulungen (1998), respectively, on Indonesia.

In studying these four cases studies I discovered that five key factors constantly re-emerged as the factors that affect the sustainable development of the sector. These five factors are the state, the market, funding, the environment and the local community. These factors, referred to as the Five Factors in the present study, have been used as a typology with which to analyse the case in Saldanha.

Little has been written on the bivalve mariculture sector in Saldanha. Thus, a wide range of literature was consulted to construct an idea of the case study of Saldanha. The literature can be divided into various fields. Natural science publications that were most influential were by Grant (1998), Pitcher (1998), Calder (1998), Monteiro (1998), Haupt (2010) and Tonin (2010). These authors outline the carrying capacity of Saldanha Bay and the development of Saldanha's bivalve mariculture sector. The main authors on the aquaculture market in South Africa are Britz, Lee and Botes (2009), who provide a South African Aquaculture Benchmarking Survey. Two reports on the state of Saldanha Bay, written by Clark (2009) and Atkinson (2006), were helpful for describing the various users of Saldanha Bay and the influences of these users on water quality. Government publications such as Heinrichsen (2007) and Joemat-Pettersson (2010), as well as municipal publications such as the Integrated Development Plan (Saldanha Bay Municipality, 2007) were useful for statistics on Saldanha and some perspective on the South African state's stance on bivalve mariculture. However, there are some gaps in the literature on Saldanha's bivalve mariculture sector. No data has yet been published on the production figures, size or structure of individual bivalve

mariculture farms in Saldanha for the years 2010 and 2011. Neither is there any research on the employment profile of Saldanha's bivalve mariculture sector or the employee's perspectives on the sector. Finally, no study has been undertaken on the key limiting factors to sustainable development of Saldanha's bivalve mariculture sector. Thus, it was necessary to address these questions through empirical research in order to answer the research problem.

Research Problem

The research problem for the present study is, "What factors influence the sustainable development and employment potential of Saldanha's bivalve mariculture sector?" In order to answer this question it is necessary to address the following:

1. What factors influence sustainable development from a broader theoretical perspective?
2. What are the key variables influencing the sustainable development and employment potential of mariculture ventures globally?
3. What is the sustainable development and employment potential of mariculture in South Africa?

Research Methodology

As indicated by the key research question, an in-depth description of Saldanha's bivalve mariculture sector was needed. The case-study design therefore was the most suitable for the present study. Saldanha was chosen for the case study because it is historically one of South Africa's biggest fishing towns, it has a growing level of unemployment, it has an optimal environment for bivalve mariculture, as well as a long-standing bivalve mariculture sector, and a network of contacts already existed that would enable the researcher to gain access to directors of companies involved in bivalve mariculture in Saldanha. A brief description of the units of analysis and method of data collection follows. The research methodology is discussed in greater detail in Chapter Five.

The units of observation are the bivalve mariculture farms with which these individuals are directly involved on a daily basis. The groups of individuals that participate in the present study are farm directors, farm employees and state representatives. A different sampling design was used for each study population. Both qualitative and quantitative data were

gathered in order to provide an overview of of the sector, as well as an in-depth description of experiences from the respondents' points of view.

State representatives were selected using non-probability sampling and were selected to present the state's perspective on the issues raised by the mariculture directors. Two state representatives were selected. One was employed by the Department of Agriculture, Forestry and Fisheries (DAFF), and the other by the City of Cape Town Municipality. Qualitative data were collected from this population using semi-structured interviews.

A director of each of the bivalve mariculture farms in Saldanha was interviewed, giving a total of five directors interviewed. Qualitative and quantitative data were collected from this population with semi-structured interviews.

A sample of employees from each of the farms was selected using non-probability sampling. Due to the high pressure of the working environment, employees were selected subject to availability. Care was taken to ensure that there was sufficient diversity to be representative of company employment profiles. Twenty-eight employees were selected, representing 34% of the sector's total. When the sample was compared to the company profile, it was found to be representative. The sample consisted of twenty male and five female labourers, one male and one female supervisor and one male skipper. Twenty-seven of the twenty-eight employees are black. The average level of education for the sample was grade nine. Seventy-five percent of the sample had been living in Saldanha for five years or more. Qualitative and quantitative data were collected from group questionnaires and focus group interviews with this population. The research findings are discussed in greater detail in Chapter Six.

Ethical Clearance

The method of research and the publication of the results for the present project present a very low level of risk to the participants. Nevertheless, the possibility of harm to the participants was further allayed by maintaining the confidentiality of the data collected. The research participants were all adults, were all able to understand that they were participating in research and that they were free to decline participation at any time, without any detrimental effects. Due to the ethically low-risk nature of the research for the present project, ethical clearance was obtained from the University of Stellenbosch for the completion of the present study.

Limitations

Possible limitations to the representivity of the data came primarily from the interviews with the mariculture employees. There are two possible limitations, namely the use of non-probability sampling and on-site interviews.

Non-probability sampling for selecting an employee sample was unavoidable due to the high-pressure working environment, as will be discussed in Chapter Five. This limitation was addressed in two ways. Firstly, as mentioned, a diversity of employees was selected to capture as broad a sample of all the employment categories within the company for it to be representative of company employment profiles. Secondly, a company profile was constructed in consultation with the directors during the director interviews. The employee sample profile was then compared with the company profile to gain an idea of how well the company was represented by the sample.

A second potential limitation was presented by on-site interviewing. Interviewing employees at their place of work could influence the data through performance effects. However, due to the intense nature of the work, after-hours interviews would have been difficult. This quandary was resolved by acquiring permission from the directors to interview a group of employees for forty-minutes during work hours. To reduce performance effects, the employees were asked to identify a place that was relatively private, out of earshot and eyesight. Delicate subjects, such as household income, were handled tactfully. For example, employees were asked about 'any other sources of income for the household' and the relative proportion of household income these contributed to. Data on employee salaries was gained from the interviews with the directors.

The findings of the present study cannot be generalised to all other mariculture or aquaculture ventures in South Africa. However, the present study does provide a basis for comparative analysis, despite its specific focus on Saldanha.

Value of the Study

No previous study has yet compiled data on Saldanha's bivalve mariculture sector, as is done by the present study. By so doing, the present study makes a unique contribution to the body of scholarly work. However, it is not in the generation of new knowledge *per se* that the present study finds its value, but in the use to which that knowledge is put.

The manner in which the Saldanha case was studied provides a typology for research elsewhere. Using the Five Factors typology and the results that it elicited in the case of Saldanha, a similar approach could be taken to researching the same challenges elsewhere. However, the present study also has a more immediate and practical value.

The South African state has expressed a belief in the potential of the aquaculture sector to create employment in South Africa, yet the directors of aquaculture farms in general still feel largely unsupported by the state. Saldanha's local municipality has expressed the need to create employment that is sustainable and relevant to the majority of the town's unemployed, yet no sector has been identified that could fulfil this need. The South African government, the Saldanha Bay Municipality and the directors of bivalve mariculture farms in Saldanha all understand that the aquaculture sector could become a source of sustainable employment for many people, but this potential remains untapped. The true value of the present study is in its summary of a diversity and depth of data on Saldanha's mariculture sector, as well as its demonstration of how this sector could be expanded to sustainably provide employment for a large proportion of Saldanha's unemployed. In this way the study is relevant not only to academia, but also to the state and the market and, indirectly, to local households in Saldanha.

Chapter Outline

Chapter Two provides the groundwork for the present study by describing the theoretical framework. The different theoretical approaches to development are discussed, beginning with the modernist origins of rural development theory and working through the evolution of development theory to people-centred development theory, from which the learning process approach originates that is adopted for the present study. Both people-centred development and the learning process approach are described.

Chapter Three uses the learning process approach to ask what lessons could be learned from the successes and failures of four case studies of mariculture development. The four case studies that are considered are: salmon farming on Grand Manan Island, Canada; oyster farming in Namibia; prawn farming in KwaZulu-Natal, South Africa; and seaweed farming in Bentan/Tumbak, Indonesia. Based on the analysis of the factors affecting the sustainable development of the mariculture sector these case studies, the Five Factors typology is presented. This typology is then used to study the case of Saldanha.

Chapter Four introduces the case of Saldanha. The chapter sets Saldanha in the broader context of globally declining fish stocks and the implications of this decline for livelihoods in coastal fishing towns. The global recognition of aquaculture as an alternative livelihood is then presented, along with a discussion of the merits of aquaculture. The discussion then narrows to discuss the effects of global declines in fisheries for South Africa, as well as for South Africa's aquaculture sector. The fishing sector in Saldanha is then discussed. Finally, the limiting factors on Saldanha's mariculture sector are discussed, framed by the Five Factors typology. This discussion provides the outline upon which the fieldwork is based.

Chapter Five describes the methodology that was used to gather primary data on Saldanha's bivalve mariculture sector. The chapter discusses sampling design, instrument construction, fieldwork, data recording, data capturing and data analysis. The results of the fieldwork are presented in the following chapter.

Chapter Six presents the findings from the fieldwork. Each mariculture farm is described in detail. Thereafter the profile of mariculture employees is presented, followed by employee sample characteristics and the results of interviews with employees. The results of interviews with the directors are presented according to the influence that the state, the local community, the market, funding and the environment has on Saldanha's mariculture sector. The results of the interviews with state representatives are then presented in the same way.

Chapter Seven discusses the findings from the fieldwork in the light of the theoretical framework and the Five Factors typology. The development of Saldanha's bivalve mariculture sector is discussed according to the learning process approach. Thereafter, the most significant influences of the Five Factors in the sustainable development of Saldanha's bivalve mariculture sector are discussed. The employment potential of the bivalve mariculture sector in Saldanha is then calculated.

Chapter Eight concludes the present study by drawing out the main points of the argument. The chapter shows that certain factors are of primary importance in the case of Saldanha and play a role in limiting the beneficence of other factors to the sector's sustainable development. The employment potential of the sector is such that it would be in the interest of the state to address these factors and promote the growth of the sector.

CHAPTER TWO: THE THEORETICAL FRAMEWORK

Introduction

Over the past sixty years, development theory has evolved away from its post-colonial origins. A common motivation for each stage of evolution has been the response to fundamental errors in prior schools of theory. For example, the Integrated Rural Development Projects (IRDPs) of the 1970s were a response to the British Colonial Administration's (BCA) top-down, post-colonial programmes. Equally, the development theory of the 1980s emphasised village-level control of economic production in response to corrupt state officials exploiting IRDPs. However, in addressing the shortcomings of prior development approaches, none of the new approaches reviewed the westernised, economy-centred goals of the old schools. It was not until the emergence of people-centred development theory that locally rooted, sustainable solutions were sought for locally defined problems. This chapter aims to outline the principles of people-centred development, as well as to present one of the theoretical approaches within people-centred development, namely the learning process approach. The chapter begins by describing the evolution of development theory. People-centred development is then described, followed by a summary of its development objectives. Finally, the learning process approach is introduced as the theoretical ideal against which the case study will be compared.

Modernist Development

The modernist rural development approach, beginning in the middle of the twentieth century, sought to move societies along a linear path that strove to replicate the development history of western countries (Shepherd, 1998: 1). The initiators of modernist development were the British Colonial Administration and the United States government under Harry Truman in the late 1940s. Modernist development started as an attempt to develop self-reliant communities in the economically and politically unstable ex-colonies. Although the aim of stability and self-reliance was commendable, the development approach was problematic. The principle focus of early modernist development theory was economic growth and development was defined as rapid industrialisation (Blomström & Hettne, 1984: 19). Development was considered to be a universal process and to follow a linear trajectory, upon which western countries were advanced and primarily African and Asian countries were behind (Blomström & Hettne, 1984: 21). Development was considered simply a matter of "removing the contraints" to development within such countries to allow development to continue (Burkey,

1998: 27).Thus, local problems and solutions were defined and prescribed by western development agencies (Greenberg, 2003: 2; Wright, 1990: 41 & 45). The underlying theoretical understanding to this Eurocentric development model was the social Darwinism that motivated much of British colonial policy (Buller & Wright, 1990: 42). Following the Second World War and decolonisation, development theory remained based on colonisation's theoretical foundations and "took on an economic dimension" in which "[d]evelopment and economic growth became synonymous with progress and higher levels of civilisation" (Burkey, 1998: 27). Understandably, such projects were not well received by the local 'beneficiaries'.

By 1965, the British colonial government had accepted that, in cases such as the agricultural development projects in Tanzania, the attempt "to produce capitalist farmers among the Africans" had failed because of "[local] attitudes towards innovation … from outside" (Omari, 1976: 6 & 7). More so, social and economic conditions were even worse than when the projects had begun (Greenberg, 2003: 4; Wright, 1990: 49). Funding dried up, the expatriates that were running the projects returned home and the projects that were still not embedded in the community – after twenty-five years – dissipated (Cleaver, 1997: 8).

Western development assistance agencies such as the International Monetary Fund and the World Bank recognised in the 1970s that the benefits of macroeconomic growth had evaded the majority of rural households. In response, the focus of donor-supported programmes shifted from technological urban development to natural resource endowments, and 'Integrated Rural Development Projects' (IRDPs) were born (Greenberg, 2003: 3, 7; Uphoff, Esman & Krishna, 1998: 1). Although the IRDPs contrasted the new approach of locally led development against the top-heavy approach of the previous decades, the IRDPs' had two great hindrances to addressing the beneficiaries' basic needs. The first was was the air of professionalism with which research was conducted and the second, the idea that wealth would "trickle down" to the poor if maximum economic growth was achieved (Dixon, 1990: 58).

An air of professionalism was held by practitioners who adopted the local state's definitions or studied secondary data rather than allowing the local people any voice in defining their problems and proposing solutions (Greenberg, 2003: 8; Uphoff *et al*, 1998:1; Wright, 1990: 50). Maximum economic growth was achieved primarily through large-scale agricultural production. However, the IRDPs were based upon the social hierarchies that perpetuated

poverty (Dixon, 1990: 60). Donors for these integrated development projects contributed towards the production of the projects, but left training, supplies and policy to the local government. However, the poor majority did not profit from the donations, as many of these local governments exploited the donations for their own benefit (Cleaver, 1997: 6). Thus, the poor "remained absolutely poor ... [or] worse off" while the better-off minority "improved their position markedly" (Shepherd, 1998: 2).

Consequently, from the 1980s to the turn of the century, modernist development approaches adopted an emphasis on village-level control of resources, thereby bypassing local governments. Development in the 1980s was based primarily upon large-scale agriculture. International development agencies ran the development programmes, but encouraged and assisted local producers. International donors provided fertilizers, equipment and expertise to increase the scale and efficiency of production, and profits came largely from the exportation of produce (Greenberg, 2003: 8; Halseth, 2005: 328). Although local authorities were no longer lining their pockets with the donations, the income from large-scale production only benefitted a minority of wealthy local farmers. Subsistence and small-scale producers became increasingly marginalised as they continued to lose their share in the local market to the larger-scale producers (Greenberg, 2003: 10). Thus, the problem of rising poverty continued unabated.

After fifty years of implementing rural development projects, the problem of rising poverty in the ex-colonies was worse than it had been at the start. Clearly, in spite of the constant readjustments made to development theory, the approach to development had a fundamental flaw. The work of David Korten in 1980 highlighted a common problem in all of the mainstream modernist development approaches and, ultimately, sparked the new development paradigm of the 1990s. Korten demonstrated that the traditional approach to development used a programme "blueprint" according to which a project was to be executed. The blueprint was often based on the work of researchers from outside the community. These programme organisers would then draw up specific objectives and a time frame, and the success of the project was measured by how true the programme remained to this blueprint. By studying five successful rural development case studies, Korten found that the successful projects had allowed the needs and resources of the local community to shape the project's development. The mark of the successful projects was that they were effective in addressing local problems, they empowered local people and the solutions were sustainable (Korten, 1980: 496 & 498). Korten's work emerged at a time when rural development theory

was being re-assessed and a "New Paradigm" of development thinking was emerging (Shepherd, 1998: 1 & 2). This new paradigm was people-centred development.

People-Centred Development

People-centred development is relevant to the present study as it provides an approach that goes beyond economic growth and aims for social development and low or positive environmental impact. In contrast to the economy-centred approach of past development models, people-centred development is "a process in which the ordinary people ... play the leading part with government, experts and elite playing a facilitating role" (Swanepoel, 1992: 6). In people-centred development approach, everyone who is involved in the development project participates in the decision-making process (Swanepoel & De Beer, 1996: 26). Thus, development becomes "a matter of motivation and knowledge" (Ackoff, 1984: 195) in which the local poor maintain the relevance of programmes by providing the input that allows the "continuous adaption" that maximises "well-being in changing conditions" (Chambers, 1993: 10).

To inspire motivation and to generate knowledge requires the improvement of social, environmental and political well-being, as well as the sustained ability to control such improvements. Thus, development includes the improvement of wellbeing, but moves beyond it to empower local people to gain access to the means to sustain improvements as well as to develop the capacity within the community to see and pursue new opportunities for positive change (Buller & Wright, 1990: 3). Five objectives need to be met to create an empowering environment: assisted self-reliance, resource mobilisation, capacity development, adding value and continual innovation. Assisted self-reliance is used to initiate the development process, along with resource mobilisation and capacity development. Thereafter, adding value to local human, social and natural capitals increases the marketability of local products. Finally, continual innovation aids sustainable development.

Assisted self-reliance

Assisted self-reliance is an objective that sets people-centred development apart from its modernist precursors because it aims to help communities to become independent in achieving their own development. However, assisted self-reliance does not deny that the help of outsiders is necessary, especially to begin the development process. Thus, a key aspect of this approach is the empowerment of locals. Local empowerment is achieved by encouraging

community members to identify problems in their community, as well as to identify locally sourced solutions (Neefjes, 2000: 88-91; Uphoff *et al*., 1998: 38-39, 158). In this way, community members are regarded as the professionals in their community. Because level partnerships are encouraged from the beginning, the concept of assisted self-reliance encourages local individuals to take ownership of a project more so than when a project follows a blueprint approach (Uphoff *et al*, 1998: 40). The keys to the success of assisted self-reliance are the development of local leadership and management capacity so that, eventually, the community can run the project independently, as well as the mobilisation of local resources, so that outside aid is no longer needed (Hoggart & Buller, 1987: 26). Assisted self-reliance is needed to begin the development process. Important ingredients for assisted self-reliance are capacity development and resource mobilisation.

Capacity development

Capacity development is about developing, within individuals and sectors, an ability to be self-reflective, adaptable and able to overcome new challenges. This definition encompasses, but goes beyond, the traditional definition, which refers only to the provision of "technical and vocational training" (De Wet, 2009: 37). Kaplan (1999: 19) critiques such a definition as applying only to the sector's ability to produce results according to the specifications of western donors. In Kaplan's view, capacity development includes the empowerment of local people and sectors "to act decisively to impact on and change their circumstances and social context" (Kaplan, 1999: 20). Thus, in Kaplan's definition, the focus is not limited to training for specific skills, but to developing resourcefulness, creativity and a reflexive view of a sector's practice. A sector with capacity knows its strengths and weaknesses, and is open to addressing its own problems to increase the impact it has on its context (Kaplan, 1999: 21). Such a sector has a strong sense of identity and has voice with which to enter into dialogue with political and social authority figures in order to address limiting factors and to create an environment for development. Thus, capacity development is vital to sustainable development because it enables a sector to exercise agency in its context. Agency is essential to development because limiting factors often hinder a community's access to its own resources.

Resource mobilisation

Resource mobilisation is about removing the limitations to a community's development. This is done through freeing local resources to be used for development. Local resources can

be defined as the natural, human or social capital present in a given community (Neefjes, 2000: 88-90). Such resources may be available to a community, but factors may limit a community from utilising the resources.

Limiting factors could be active or passive. Passive limitations could originate, for example, from history, the social setting, financial shortages or geographical location. An example of active limitations would include social structures, policies or processes that mediate the access that communities have to resources and their utilisation (Hart, 2009: 367; Neefjes, 2000: 90). Because a network of limiting factors may be the reason behind a community's social ills, the introduction of outside capital will do little to address those ills unless the limiting factors are addressed first. If development is to be sustainable, an awareness of limiting factors and a proactive approach to empowering a community to address them is necessary. Thus, in any development project, communities must be made aware of the limitations to their development and must be empowered with the means to address such limitations. When a community has the capacity to mobilise its own resources, it is able to sustain its own development. However, the local resources that are available may not be used to their full potential. It is often necessary to add value to local resources.

Adding value

Adding value may be defined as the sustainable use of a previously underutilised local resource that can generate wealth and employment. Local resources include a range of livelihood capitals, of which the most significant for the present study are natural and human capitals. Value can be added to natural capital by promoting the unique characteristics that the natural environment lends to the quality of local products. Promoting local products in this way increases the value of the product on the market and the income that a product could generate for a community. Human capital relates to a number of factors, such as experience, education, positive attitudes towards change, capacities for leadership and even the simple availability of labour. Human capital could be increased in value through training, experience and a positive working environment (Carner, 1984: 134; Moseley, 2003: 47–51; Singh 1986: 92 & 94). Adding value to local resources is important, not only to stimulate the local economy, but also to reassert within local people a sense of belonging and a pride of place (Moseley, 2003: 48). Adding value contributes to the development of a sector, but continual innovation is necessary for sustainable development.

Continual innovation

For the development of a sector to remain sustainable, the sector "must remain flexible, open to new information ... [and] must be checked against new realities and revised accordingly" (Uphoff *et al,* 1998: 19). Continual innovation is needed to keep a sector operational in a constantly changing context. The sustainable development of a sector depends on the sector's ability to remain relevant to its task, context and design (Korten 1980; 184). A fundamental flaw in the blueprint design of development is that it quantifies success based on how well an operation adheres to pre-defined programme objectives. Such a programme would have a predefined task and a rigid organisational structure. The weakness in such an approach is that it does not acknowledge that the context is constantly changing over time. The incompatibility of the rigid task and organisation with a fluctuating context is the greatest weakness of modernist development.

People-centred development acknowledges that if a context changes the task should be adapted accordingly. Additionally, if the task changes, then the organisational design would have to be adapted to accommodate the new approaches to the task. Such a model utilises an organisational structure that is well defined, yet flexible. Therefore, continual innovation is necessary to keep a sector's task and organisational design relevant to the context, ultimately to maintain sustainable development. The ability that a sector has to keep up with a changing context depends on whether the sector is developed in a way that allows it to be continually learning. Developing such a model is done through a learning process approach to development.

The Learning Process Approach

The learning process approach was named by David Korten in 1980 after a common thread emerged in five successful rural development projects he was studying. Korten (1980: 480) defines the learning process approach as "a capacity for embracing error, learning with people, and building new knowledge and institutional capacity through action". The learning process approach is presented as the alternative of a "new professionalism" to the modernist "blueprint" approach to rural development (Chambers, 1993: 1 & 85; Korten, 1984: 181).

The purpose of the learning process approach is to maintain a high degree of compatibility between a sector's task, design and context. This is supported by the underlying assumption that "not enough is known about the many elements involved [in the development process] or

their varied causal relationships" to justify constructing a detailed blueprint for development to follow. The strength of the learning process approach is that the task and organisational design are developed from a deep understanding of the context. This is made possible at every stage through participation and evaluations (Korten, 1984: 185; Shepherd, 1998: 141 & 145; Swanepoel, 1992: 3; Uphoff *et al*, 1998: 19).

Participation in the learning process approach does not mean that labourers from the surrounding community are given employment, although the development process may include that. Rather, participation should be inclusive of all members of the communities involved from the beginning of the project (Swanepoel, 1992: 3). The role of the elite and government could include giving the marginalised from local communities the opportunity – and the help if necessary – to begin taking initiative in the development process. Historically marginalised individuals may be hesitant to take initiative, and those used to leading may find it difficult to relinquish the role. However, all participants should view themselves as learners in the process and should be evaluated on their progress (Swanepoel & De Beer, 1996: 25). In this way the marginalised from local communities may learn to pursue their own development and to gain self-sufficiency (Swanepoel, 1992: 3).

In essence, the learning process seeks to ensure that a project is making the best use of models of organisation and technologies to increase productivity, to advance the participation of the rural poor and to reach both the long-term and short-term goals set out by the project (Oka, 1997: 194; Shepherd, 1998: 138; Uphoff *et al*, 1998: 19, 32;). Korten (1980: 499) identifies three stages of the learning process that a project passes through as it matures, namely learning to be effective, learning to be efficient and learning to expand.

Learning to be effective

An effective sector is one that has a high degree of fit between its task and its context. Thus, the first stage of the learning process concerns the development of a task that is effective in the local context. Such a degree of fit is established by defining locally identified problems, as well as by establishing how local resources can be utilised to create solutions. Problems are defined over time by immersion in the context. Finding solutions also requires time in the field and may be done through learning from one's own experience or from the experience of

others, from academic research or from trial and error in the context of "Learning Laboratories"[1] (Korten 1984: 184; Shepherd, 1998: 138; Uphoff *et al*, 1998: 25, 27 & 28).

During the first stage, learning to be effective, an environment free from excessive bureaucratic and administrative control is conducive to the learning experience. A restrictive environment limits opportunities to learn. Due to the experimentation and acquisition of knowledge and experience during the first stage of the learning process, the stage of learning to be effective is a slow-moving one (Korten, 1980: 500). At this stage, the sector operates on a small scale, efficiency is low and the level of error is high (Korten, 1984: 184; Swanepoel, 1992: 3). An accepted way to begin the learning process "is through some kind of pilot project" or learning laboratory (Uphoff *et al*, 1998: 26 & 27). In this way development models are tested on a small scale so that workable designs are created upon which further development can be based. However, participants in the learning process need not learn solely from trial-and-error. Others with experience or education may contribute to the growing understanding of the sector's context. The stage may begin with academic research in order to gain an understanding of the social, ecological, economic or other contexts the sector operates within (Korten, 1980: 499; Uphoff *et al*, 1998: 25 & 28).Additionally, an understanding of the context may be developed from the "experience of someone who has been immersed" in the context (Uphoff, 1998: 25). When a workable design is created that is relevant to the local context, the sector is ready to move into the next phase: learning to be efficient.

Learning to be efficient

An efficient sector achieves a high degree of fit between its design and the task. Stage two of the learning process is about increasing the efficiency of a sector. This is done by strategically eliminating the activities that are not productive, while the activities that are productive are simplified and adopted into the organisation's problem-solving routines (Korten, 1984: 184).

Increasing the efficiency of operations at the second stage of the learning process is done with an understanding of the requirements gained in the first stage. Based upon the lessons learned in the first stage, the sector is able to assess the ability of its operations to solve specific problems and to eliminate those that are not productive. At this stage the boundaries

[1] Learning Laboratories are small-scale pilot projects that allow for experimentation with various approaches to development in the field (Korten, 1984: 184).

are laid as to which activities it is capable of handling well. The resources of the sector are focused on addressing these areas. Once the sector has defined what its specific tasks will be, employees are hired and trained according to the problem-solving routines that were simplified at the beginning of this stage (Uphoff *et al*, 1998: 33). By the end of the second stage – learning to be efficient – the sector is designed to address specific areas of expertise, with the body of employees that are trained in these tasks. The specification of tasks and a cadre of trained employees form the foundation for expansion.

Learning to expand

An expanded sector achieves a high degree of fit between its design and the context. Stage three of the learning process is about increasing the capacity of the sector to meet the volume of need in its context. Thus, in this stage the sector learns to expand.

A risk associated with expansion is the dilution of local effectiveness. In the past, expansion has often been accompanied by the centralisation of power and dissociation from ground-level interaction (Shepherd, 1998: 244; Uphoff *et al*, 1998: 204). While this is true of modernist expansion, expansion in the learning process approach is based on a model that, through the learning process, has developed a high degree of fit between its task and its context and that has developed the organisational design needed to maintain a high level of fit. Where modernist expansion occurs in order to increase capital growth, expansion in the learning process occurs in order to develop the capacity of local individuals to provide for themselves and to make meaningful contributions to the sustainable development of their community. Thus, expansion in the learning process is adopted according to the community-defined needs of the context. Chambers (1993: 95) describes three ways in which expansion could occur, namely laterally, vertically and diversely.

Lateral expansion occurs when the organisation continues to use the same tasks, but increases the scale of operation. Vertical expansion occurs when a sector takes on new tasks. The need to address new tasks may arise over time as a sector continues to operate in the same context. The need to address new tasks in other contexts may also arise. Thus, a sector may expand diversely to address different tasks in different contexts, especially as the experience and confidence of sector's members to handle new tasks increases.

By the time that expansion has taken place and a degree fit between the organisational design and the requirements of its context has been optimally achieved, the sector has completed the

final stage of the learning process. At this point, a sector would have reached a level of stability, having achieved a good fit between its design, task and context. A stabilised sector may begin to identify new problems and begin the process anew.

Conclusion

Rural development theory over the past 60 years has produced mixed results when applied to an empirical context. With the failure of each old school of development theory, a new theory would emerge to compensate for the prior model's shortcomings. Yet, as one theoretical approach after another was applied, each seemed only to exacerbate the social ills of the 'beneficiaries'. The fundamental flaw of the approaches was the rigid design and task of the development organisation applied to a dynamic context. Korten's work was indicative of the "new paradigm" to development, namely people-centred development, which was emerging at the time. People-centred development critiqued the economy-centred development goals of the previous modernist era of development and emphasised the need to utilise local resources to bring about sustainable development in terms of addressing community-defined needs. Korten's learning process approach draws the objectives of people-centred development into an empirically based typology for development. The learning process approach is based upon the hypothesis that maintaining a high degree of fit between the task, context and organisational design is crucial to sustainable development. The present study will use the criteria of the learning process approach to evaluate the development of other mariculture sectors. It is believed that such an exercise will highlight key factors to anticipate in the case of Saldanha, as well as to propose how the development of Saldanha's bivalve mariculture sector should take place.

CHAPTER THREE: THE LESSONS LEARNED FROM OTHER MARICULTURE CASES

Introduction

> If we look to these experiences for a programme or an organisational blueprint for replication elsewhere we are only likely to be disappointed. It is to the *process* of their development that we must look for the most useful lessons (Korten & Klauss, 1984: 181).

This chapter provides a literary overview of four case studies of local marine-based primary production industries that offered significant employment opportunities. In each of the four cases, the local sector experienced major challenges. Two succeeded and two failed. The four cases are (1) a salmon-farming venture in Grand Manan, Canada; (2) oyster farming in Walvis Bay, Namibia, (3) Amatikulu Prawns, a prawn farm in South Africa, and (4) seaweed farming as part of a development project in Bentenan/Tumbak[2], Indonesia.

Although each case is situated in a different country and produces different products, they all illustrate factors that affect the sustainable development of mariculture ventures. After considering all four cases, the present chapter concludes with a discussion of five major factors and the role they played in the sustainable development of the local sector, namely state support, the surrounding community, funding, the environment/disease, and the market. By considering the development of each sector and the lessons learned in the process, parallels can be drawn with other case studies regarding their expansion and employment potential.

Salmon Culture, Canada

Setting the scene

Grand Manan, an island off the east coast of Canada in the province of New Brunswick, was settled by loyalists fleeing the American Revolution two hundred years ago. Since that time, local wild fisheries have played a significant role in supporting the five villages[3] that

[2] The villages of Bentenan and Tumbak are referred to as a unit by the literature on the case study. This is because "[i]n the case of Bentenan and Tumbak it was felt that this field site should encompass both villages as each of these communities exploit marine resources in the common marine area and island just offshore of these two villages" (Tulungen, Kussoy & Crawford, 1998: 1). For the sake of convenience, the present study abbreviates the name to Bentenan/Tumbak.

[3] The five villages on Grand Manan Island are considered collectively by Marshall (2005: 72) for the in-depth ethnographic study she began in 1995, and were officially amalgamated by the government in 1996 (Marshall,

developed subsequent to the original settlements (Marshall, 2001b: 393). The geographical isolation of these villages and the livelihoods based on local wild fisheries contributed to a strong sense of belonging (Marshall, 2005: 69) and the emergence of a unique "local culture" (Marshall, 1999: 96).

This fishing-centred way of life remained largely unchanged until the latter half of the twentieth century. Beginning in the 1970s, new state policies informed by research on the scarcity of marine resources began mediating access to marine commons (Marshall, 2001a: 343). All fishers who were not "*bona fide*" were denied fishing rights, and access to marine resources became mediated by means of licensing and quotas (Marshall, 2005: 70). These changes left many fisher folk in Grand Manan without a livelihood (Marshall, 2001b: 393 & 398; 2005: 70). As a result, rising levels of unemployment painted a "bleak picture" for the future of the residents of Grand Manan (Savoie, 1995, cited in Marshal, 2001a: 336). The state came to see the farming of Atlantic salmon (*Salmo salar)* as the solution to this problem (McGeachy & Moore, 2003: 145).

Early developments in salmon mariculture

Grand Manan's first mariculture site was started in 1980 by a local entrepreneur, John L'Aventure. Although disease led to high numbers of stock being lost, the high market value of salmon helped his farm pull through in its early years. However, disease caused the failure of the second mariculture site in Grand Manan, which lasted only two years, from 1988 to 1990. Nonetheless, by 1990, Grand Manan's third mariculture farm had been established, followed by a fourth in 1992 (Marshall, 2001a: 339 & 340; 2005: 73). Grand Manan's mariculture industry began to develop rapidly from 1992 onwards, with forty-seven mariculture sites having been established by 2003. This rapid expansion can be attributed to two factors that materialised in the early 1990s, namely a new policy on mariculture development and the construction of a more efficient ferry to the mainland.

A new policy was developed in 1991 that gave preference to local participation in mariculture. Preference for the ownership of mariculture sites was based upon the traditional ownership rights of weir fisheries that were held by individual families and passed down over generations. The rights to develop these fishing sites into salmon farms were given to "traditional fishers who already held title to areas of the marine commons through their

2001b: 392 & 399). The five villages are collectively addressed as Grand Manan for the purposes of the present study.

construction and operation of the weir fishery" (Marshall, 2001a: 345). In many instances, however, weir owners simply sub-let their property to outside investors for an attractive fee[4] (Marshall, 2001a: 344; 2005: 73; Walters, 2007: 146).

The construction of the new and significantly larger ferry in 1990 played a decisive role in increasing the accessibility of outside investment, both through a stronger sense of connection to mainland Canada and through the increased efficiency of the transport of goods from the mainland. The new ferry, with almost double the capacity of the old one, allowed for the access of heavy machinery to the island, with important implications for technological development. A greater sense of connection to the rest of the world also saw a growth in interest from mainland and foreign investors. Between 1996 and 1998, the booming mariculture industry saw the number of mariculture sites functioning off Grand Manan's coast expand rapidly, from ten to eighteen (Marshall, 2001a: 345; 2005: 73).

Infectious salmon anaemia

Directly because of the expansion of Grand Manan's salmon mariculture sector, the efficiency of production dropped. This is because the industry was not sufficiently supported by "organisational structure, regulation and scientific understanding of environmental impacts and harvesting practices" and exceeded sustainable levels of production (Marshall, 2005: 73). A lack of efficiency in production resulted in salmon farms being overstocked, which created an environment for disease spread. In 1995 stock began dying from hemorrhagic kidney syndrome (HKS) but it was only in the summer of 1996, when fish mortalities began to rise rapidly, that serious research began trying to locate the cause of HKS. By September of the following year, the infectious salmon anaemia (ISA) virus was isolated as the cause of the HKS that was killing the salmon. The ISA virus was previously unheard of outside of Norway (McGeachy & Moore, 2003: 146; O'Halloran, L'Aventure, Groman & Reid, 1999: 352). The New Brunswick Department of Fisheries and Aquaculture

[4] With the rapid expansion of the aquaculture industry, local herring weirs increased in value as potential aquaculture sites. A particularly suitable weir could be hired out for over $100 000 per annum on a four-year contract. Often, such lease agreements had a time period after which the 'privilege' of weir ownership was to be sold or ceded to the lessee. The growing demand for aquaculture sites put pressure on weir owners to convert or hire out weirs, as aquaculture sites were not permitted within 1 km of an existing weirs in most cases. In addition, if weir sites were not operated for three years, the government was permitted to licence them to someone else. In some cases where weir owners were allowed to establish aquaculture sites near to their weirs, some of the farmers chose to hire out the sites while continuing to use their weirs to earn an additional income through fishing. In addition to the pressure exerted on weir owners, the choice to hire out a weir site may also be linked to the high capital investment necessary to run a salmon aquaculture site, especially in the light of the October 2000 policy that made the ownership of multiple sites necessary for efficient production (Marshall, 2005: 73; 2001a: 343; Walters, 2007: 145 & 146).

drew up an Eradication Programme that ordered the culling of infected fish (McGeachy & Moore, 2003: 147). Additionally, the province declared a moratorium on the development of any new sites. The freeze was implemented from 1998 until the announcement of the new policy on aquaculture in October 2000 (Marshall, 2001a: 345; 2005: 73).

The commercialisation of traditional sites

The new policy announced in October 2000 aimed to protect the sustainable development of mariculture. One key factor that increased the risk of ISA infection was the "production of multiple year-class generations on a given farm" (McGeachy & Moore, 2003: 149). The new policy stated that all the fish on any single site had to be in the same grow-out cycle. As a result, the new policy also limited access to the industry by already established fish farmers. While this worked well on paper, in practice it was difficult to implement. Many local farmers were reluctant to make the financial investments to run mariculture sites on a same-year grow-out cycle, as harvesting and returns for the investment only happened every 18 to 24 months (Marshall, 2001a: 364 & 348; 2005: 73; Walters, 2007: 144). Therefore, it became necessary for fish farmers to stagger grow-out cycles over additional sites. A variable that limited such expansion was the availability of weir sites. Such sites were the only available property for salmon farming and thus became rare and valuable commodities (Marshall, 2005: 73). Local weir owners who had not farmed salmon were prohibited from beginning, while others had either lost their mariculture businesses or were bought out as a result of the events of 1998. In cases such as these, hiring out weir sites to mainland investors or multinationals appeared a better opportunity than the risk of making a living from these sites through fishing. By 2001, only one mariculture company was locally owned (Marshall, 2001a: 347 & 348).

Recovery and expansion

In spite of the shock to the industry in 1998, salmon mariculture was once again growing by 2001. Expansion was vertical, through the increase in size and capacity and improved management, and horizontal, with the announcement of an additional fifteen sites. This almost doubled the eighteen sites already active in Grand Manan (Marshall, 2001a: 340; 2005: 73 & 74; Walters, 2007: 145). Regarding these eighteen sites alone, it was estimated that gross sales could reach $80 million Cdn by 2001, over seven times the revenue of 1994.

This major contribution to the province generated by mariculture was roughly equal in value to the wild-caught fish landings (Marshall, 2001b: 395; Walters, 2007*:* 146).

Mariculture began making a considerable contribution to local employment figures. Most of the workers on salmon farms were local and labour positions such as site divers, site construction and maintenance, fish feeding and boat transport, as well as management, administration and accounting positions, were providing direct employment in the form of 177 summer jobs and 80 full-time positions by 2001. In addition to direct employment, spin-off employment opportunities were provided in manufacturing and input businesses that produced infrastructure components and supplies, fish feed and medications. Salmon hatcheries that raised eggs and smolts were established to meet the need for low-cost salmon smolts, while, on the other end of production, post-harvest processing operations also benefitted from the expanding local industry (Marshall, 2001b: 393 & 395; Walters, 2007: 145 & 148).

User group conflict

While many local residents felt the benefits of increased employment opportunities, few of the positions were filled by fishers. The primary complaint of the local fishers was that the Department of Agriculture and Fisheries (DAFA) had taken no action to investigate the community's perceptions of the expanding industry, nor had DAFA requested local input until after the new sites had been approved. The growth of foreign large-scale business not only went against the conservative nature of the community, but also had other, more concrete, effects.

Mariculture farms interrupted the migration routes of lobsters, upon which lobster fishers relied for their livelihood. Therefore, following the granting of permission by the Grand Manan government for the development of three new sites on the south coast – a particularly rich lobster-fishing ground – lobster fishers blockaded two wharfs to prevent the deployment of the new farm sites. A positive outcome of the protest was negotiations between the provincial government and the local fishers that led to a multi-stakeholder working group composed of provincial and federal government representatives, as well as representatives of the lobster fishers and salmon industry (Walters, 2007: 146). However, the counter-effect of the protest created ripples in the community. A blockade of an airport where a local aeroplane owner held the position of Manager of the Fishermen's Association was organised in retaliation by salmon fishers, and two separate accounts record a salmon worker spitting on

a lobster fisher. In addition, the President of the Lobster Fishermen's Association was threatened with a lawsuit if organised opposition to the expansion of mariculture was continued (Marshall, 2001a: 349, 335 & 336). The government argued, however, that the merits of mariculture were reflected in the jobs that it created for the local community.

However, opinions over the benefits of mariculture remained divided. The Salmon Growers' Association saw salmon farming as a significant source of local employment. On the other hand, traditional fishers and environmentalists were concerned about the environmental implications of the expanding industry and related threats posed to traditional livelihoods (Marshall, 2001a: 336; Milewski, 2001: 207; Walters, 2007: 146). A view commonly held by local fishers was, "No, I'm not against aquaculture at any cost", but there needs to be "a fair balance" between the interests of mariculture and the fisheries (Marshall, 2001a: 350). Most of the lobster fishers in Walters' (2007: 149) study acknowledged that salmon mariculture contributed to the local economy and created employment, especially for young people. The decisions that were made by policy-makers were not done with the participation of those whom the decisions affected. The example of Grand Manan indicates the need to engage local communities in the development process.

Oyster Culture, Namibia

Setting the scene

One country that has recognised the potential of mariculture as a means to develop local businesses, attract foreign exchange and create employment is Namibia (Vision 2030, 2004: 158). As a result, Namibia's Ministry of Fisheries and Marine Resources (MFMR) has demonstrated a commitment to develop mariculture through various policies and development goals (Mapfumo, 2009: 3). Since its inception in the 1980s, the Namibian government has given its active support to the industry and has been central to the industry's success.

Commercial mariculture in Namibia can be traced back to 1987 when Jürgen Klein began experimenting with oyster farming in salt pans about 30 km outside of Walvis Bay (Mapfumo, 2009: 3). Although oyster production in the 1980s was negligible, the lessons learned provided an important stepping-stone for early developments in Namibia's oyster industry. By the 1990s, three companies had become established in Walvis Bay, and increasing numbers of entrepreneurs were showing an interest in the industry and its export

potential. The results showed significant promise for growth (Mapfumo, 2009: 4). The 1990s began with important events for the future of Namibia's oyster industry. With the independence of Namibia in 1990, Namibia's government began expanding its mariculture sector. The 1990s saw a steady growth in the number of mariculture sites in both Namibia and Walvis Bay (Mapfumo, 2009: 4).

Recognising mariculture's potential

The expansion potential of Namibia's mariculture sector can be attributed to the optimal marine environment provided by the Benguela upwelling system. The Benguela upwelling system off Namibia's coast carries nutrient-rich waters into its sheltered bays, where the water quality is optimal for the farming of oysters (Iitembu, 2005: 9; Mapfumo, 2009: 3 & 6). As a result, the main cultured oyster species, *Crassostrea gigas*, or Pacific Oyster, takes nine to 15 months to grow to a commercial size, putting Namibia on a good footing against its competitors in Europe, Japan and the USA, where oysters can take 18 months or longer to reach the equivalent size (Mapfumo, 2009: 6).

By the beginning of the new millennium, Namibia had a healthy fledgling oyster industry that was producing N$6 million per annum (Iitembu, 2005: 36) – 90% of which was coming from Walvis Bay (Mapfumo, 2009: 4) – and the MFMR saw it necessary to begin implementing policies to protect the development of the industry. For this reason the Aquaculture Act of 2002 was drawn up to "promote sustainable aquaculture and to manage, protect and conserve marine and inland aquatic ecosystems" (Aquaculture Act, 2002). The effectiveness of oyster mariculture was further enhanced in 2003 by the setting up of an Aquaculture Directorate in the MFMR (Mapfumo, 2009: 4).

Shortly thereafter, in May 2004, the first strategic plan for aquaculture was launched. The plan set out to define short-, medium- and long-term priorities in the development of aquaculture in accordance with the Aquaculture Act of 2002 (Iitembu, 2005: 10; Mapfumo, 2009: 3, 4). The year 2004 also saw the commencement of Vision 2030, a strategy "to improve the quality of life of the people of Namibia to the level of their counterparts in the developed world by the year 2030" (Nojuma, 2004). Aquaculture was seen to play a significant part in the objectives set out to reach this goal. Therefore, the Namibian government aimed to develop the country's marine and freshwater aquaculture industry into an intensive, commercial enterprise (Vision 2030, 2004: 159).

Creating an 'enabling environment' for expansion

Five years into the new millennium, the support of Namibia's government in preparing the ground for an effective, efficient and expanding mariculture industry was beginning to bear fruit. Some 1 250 hectares of marine space, previously owned by Namport, were designated as 'aqua parks', areas designated for oyster farming, by the MFMR "in conjunction with the local municipal and Walvis Bay port authorities" (Mapfumo, 2009: 3; Springer, 2008). The purpose of these parks was to create an "enabling environment for expansion" as envisioned in Vision 2030 (Mapfumo, 2009: 3). While the physical and legislative conditions were conducive to expansion, the industry faced market-related challenges.

From the industry's inception, South Africa had been Namibia's primary market. However, the development of competing mariculture industries in South Africa affected Namibia's market share. This necessitated a break from the South African market and the need to look further afield for buyers in international markets. From early in 2006, Namibian representatives began to research overseas markets and began visiting international trade shows to learn about international product specifications, meet overseas clients and develop networks. Entry into the European market was limited because of stringent health and safety standards. Hence, the focus shifted to the Southeast Asian market and soon large orders flooded in (Mapfumo, 2009: 4,5 & 10).

The increased demand from international markets highlighted the need for Namibia's industry to expand and diversify (Mapfumo, 2009: 3). Consequently, the industry sought to diversify its processing plants to include a facility to freeze oysters for export (Mapfumo, 2009: 10). There was also further horizontal expansion in the form of more hatcheries. When the oyster industry began in Namibia, oyster spat was imported from Chile (Mapfumo, 2009: 9). Investment in locally produced oyster spat had the double benefit of increasing the autonomy of the local industry from international market prices and fluctuations, as well as reducing the risk of unintentionally importing diseases (Haupt, Griffiths, Robinsons, Tonin & De Bruyn, 2010: 158; Mapfumo, 2009: 9). By 2006, two oyster hatcheries were in operation and, by 2009, the construction of additional hatcheries was planned (Mapfumo, 2009: 4 & 9).

Harmful algal blooms

Namibia's oyster industry may have been further along the road to achieving the objectives of Vision 2030 if it were not for the eruption of devastating algal blooms in 2008. By 2007,

20% of Namibia's oyster products were being sold to Asian markets, at higher prices than South Africa had been paying (Mapfumo, 2009: 5). The 'enabling environment' of the aqua parks significantly raised production, so that Walvis Bay alone was producing 700 tons. The industry looked so promising that financial institutions began investing in the industry (Mapfumo, 2009: 4, 5). Then disaster struck.

The industry collapsed due to a harmful algal bloom in 2008. "I expect total production in 2008 to be down by at least sixty percent..." was the prediction of the chairperson of the Namibian Mariculture Association (Springer, 2008). Overall, Namibia lost 75% of its oyster stock (Mapfumo, 2009). The blooms of March and May 2008 struck a significant blow to the rapid acceleration that Namibia's oyster industry had begun to experience in 2007. Prior to 2008, seven companies were utilising the aqua park. Since the algal blooms, one has closed down, three temporarily stopped producing and two were rescued by the addition of new partners (Springer, 2008).

Recovery and expansion

The oyster industry is important for the Namibian economy. The autonomy from South African markets for sales and from Chilean markets for supply, and the aqua parks functioning to capacity bode well for the sector. The sector also serves as a major employer. Mapfumo (2009:2) reports that in Walvis Bay, which produced 90% of Namibia's oysters, 120 jobs have been created directly and indirectly. In 2007, at its most productive, the industry directly employed an estimated 200 people (FAO, 2007). The level of employment in primary production and in aquaculture-support industries should increase as the industry recovers and expands.

Prawn Culture, South Africa

Setting the scene

North of Durban, on the Tugela River estuary on South Africa's east coast, ocean currents from Mozambique provide water temperatures warm enough for wild prawn populations to thrive (Enslin, 2004; Evans, 2009: 3; Sadek *et al*., 2002: 33). It is near this location, on the Amatikulu River estuary, that Amatikulu Prawns (Pty) Ltd. was established in 1981. Initial efforts to farm prawn commercially were not successful, and the company found it necessary to diversify production to include freshwater ornamental fish. By the end of 1980, after a period of research and experimentation, the owner, Stephanus Myburgh, established basic

standards for the commercial production of *Penaeus monodon*, or giant tiger prawn, and constructed a pilot farm of six hectares for this purpose (Evans, 2009: 3; Sadek *et al*., 2002: 19, 33). By 1997, the success of the venture allowed for the pilot farm to be expanded by an additional four hectares and for a neighbouring prawn farm, Mtunzini Prawns, to be purchased (Enslin, 2004; Evans, 2009: 3). However, due to a deterioration in quality and the increasing scarcity of wild *P. monodon* brood stock from the offshore Tugela Bank, it became necessary for Amatikulu Prawns to change to farming *Fenneropenaeus indicus* (Indian white prawn), which were a far more available wild resource and also spawned more easily than *P. monodon*. From the time that production began, with the exception of the changes in feed and species farmed in the early 1990s, Amatikulu Prawns saw steady growth, from producing 10 000 tons in 1992 to 129 000 tons in 2000 (Evans, 2009: 3, 22; Sadek *et al*., 2002: 19, 33, 34). At this time, Myburgh's Amatikulu Prawns (Pty) Ltd. was the only commercial prawn farm in South Africa and the biggest employer in the area, providing 70 full-time and 30 part-time positions, most of which were filled by people from the local communities (Enslin, 2004; Evans, 2009: 4; Sadek *et al*., 2002: 33).

Production figures post-2000 record a turn in the success story. After the record figures of 2000, the subsequent four years recorded a gradual decline in production. Major contributors to this decline include the gradual drop in the local prawn market, as well as the strengthening Rand and the shock of market saturation with cheaper imported prawns from India. Other stresses included crime, a lack of supportive regulations and insufficient funding.

The dropping market

At an early stage, Amatikulu Prawns tried to avoid dependence on the local market for sales and on the international market for resources. The company sought to obtain EU accreditation "to bypass the likes of I&J and Lusitania", the local corporate seafood giants (Enslin, 2004). However, the company was soon "at the mercy of European corporates" and so changed its focus to selling directly to local "restaurants, hotels and the retail market", while continuing to balance local sales with offshore exports (Enslin, 2004).

The South African prawn market took a bad turn in 2004, when tiger prawns from India flooded the local market. This unexpected shock to South Africa's local market was the result of an anti-dumping regulation imposed on several countries by the USA. The Indian

products that could not make it to the USA market were being sold in South Africa at a price far lower than South Africa's equivalent product. In addition, India, which was producing double harvests per annum as opposed to South Africa's single harvest, could continue to produce at a lower cost (Evans, 2009: 29; Sadek *et al*. 2002: 33 & 35). The strong South African Rand at the time hindered the export market, in effect closing all opportunities for local products to sell at a profit (Enslin, 2004).

Marginally acceptable climate

One reason for the difficulty Amatikulu Prawns experienced with Indian competition had to do with KwaZulu-Natal's subtropical climate, which is "only marginally acceptable for [prawn] farming" (Sadek *et al.*, 2002: 33). The cold subtropical winters limit prawn harvests to one per year. This significantly raises production costs in relation to the competition in tropical regions, such as in India, where bi-annual harvests double production figures. The only solution for Amatikulu Prawns would have been to invest in increasing their efficiency, either by including an alternative winter crop, or through constructing covered structures for winter production (Evans, 2009: 29).

Crime

The opportunity for farming a winter crop was not entirely neglected. Broodstock of *Argyrosomus japonicus*, or mulloway, a cold-tolerant fish, had been collected for the purposes of establishing a winter crop. At the time, however, neither the financial nor professional resources were available to pursue such a possibility, so the stock was kept in a holding pond. This plan never materialised, as the broodstock were stolen (Evans, 2009: 28). Both prawn farms, Amatikulu and Mtunzini, suffered from theft. Prawns were stolen by individuals for bait and by gangs to sell as seafood (Enslin, 2004; Evans, 2009: 22).

No strategic government plan

The root cause underlying many of Amatikulu Prawns' difficulties related to the fact that the South African government at the time had "no targeted, comprehensive plan ... for the [prawn] industry" (Sadek *et al.*, 2002: 35). The Directorate of Marine and Coastal Management (MCM) under the Department of Environmental Affairs and Tourism (DEAT) (now the Directorate of Marine Aquaculture Management, under the Department of Agriculture, Forestry and Fisheries) oversaw the jurisdiction of prawn mariculture. The MCM required producers to take the initiative to identify and follow the relevant laws and to

keep detailed records, which had to be reported to MCM as a prerequisite for the authorisation of permits (Evans, 2009: 21; Sadek *et al*., 2002: 35).

Evans (2009: 29) asserts that, even with the strong Rand, the declining prawn market and the cheap imports, South Africa's prawn industry [embodied in Amatikulu Prawns (Pty) Ltd.] could have survived "had there been some form of government support". Government support was not requested, however, and may have been provided if it was asked for. Aside from the obvious financial backing, even sufficient research on and development of the industry may have provided the necessary footing for the industry to withstand the shocks and changes of the market (Evans, 2009: 21 & 29).

Lack of financial investment

Under the difficult conditions, one of the only chances of survival that Amatikulu Prawns had was to find the funding to expand and produce at a sufficiently competitive rate (Evans, 2009: 29). Due to an absence of any government support, Amatikulu Prawns' financial backing came entirely from private investors (Evans, 2009: 21; Sadek *et al*., 2002: 35). An international Norwegian consulting group, Akvaplan-niva, was employed, along with a black economic empowerment (BEE) investment team funded by KwaZulu-Natal Growth Fund, "to design an intensive [prawn] production system based on new ... technology" (Evans, 2009: 29). These plans had not been realised by 2004 and fell through by 2006 due to the inability to secure sufficient funding. In the interim, Amatikulu Prawns explored various other opportunities for investment, but without success. By the time of the 2004 harvest, the management of Amatikulu Prawns realised that without sufficient funding for expansion and greater operational efficiency, they would go bankrupt in 2005. Amatikulu Prawns' last harvest was in June 2004 (Evans, 2009: 3, 28).

Seaweed Culture, Indonesia

Setting the scene

Seaweed production in Indonesia started increasing after World War II. In the space of about 20 years, production increased six-fold from about one-million tons. By 1984, production in Indonesia was around nine-million tons and, by 1991, nineteen-million tons were being produced (Crawford, 2002: 1). Crawford (2002: 4 & 5) postulates that the ease with which seaweed can be cultivated, the low levels of start-up capital required, the relatively high

return on the investment and the rapid turnaround for the investment are major contributors to the popularity of seaweed farming in Indonesia.

By the 1980s, international development agencies had noticed seaweed farming's potential to provide a profitable livelihood and so began encouraging seaweed cultivation as part of community development projects. A decade before, in the 1970s, the global demand for the most popularly farmed seaweed in Indonesia, *Eucheuma*, had been exceeding the supply of cultured *Eucheuma* and research began into culture methods, product quality and market trends. Thus, by the 1980s there was a decade of research upon which community development projects that made use of seaweed cultivation could be based (Crawford, 2002: 2).

Seaweed cultivation

Eucheuma seaweed is typically cultured above coral, on the sandy sea floor or on sea grass beds. In shallower water, stakes are driven into the ground, between which is suspended a line to which a "bud" or cutting is tied every quarter of a metre. In deeper water, the line is suspended between two buoys that are each anchored to the sea floor. It takes about two to three months for the seaweed to reach a harvestable size of one to four kilograms (wet weight) each (Pollnac & Crawford, 2000: 78; Pollnac, Crawford & Sukmara, 2002: 17).

Due to the ease with which seaweed can be farmed and the great demand on the market, it played a considerable role in generating additional income for many coastal communities, including Bentan/Tumbak, which rapidly adopted this form of livelihood. The income from seaweed farming (averaging US$ 50 per month per individual farmer) is said to be more reliable than the income generated by fishing, which is the primary source of income in the villages. However, residents were reluctant to adopt seaweed farming as their sole source of income, preferring to stagger their work and income in order to allow time for other activities (Pollnac & Crawford, 2000: 77 & 80; Sievanen, Crawford, Pollnac & Lowe, 2005: 305).

Shortly after the boom of the 1980s, seaweed farming went bankrupt in Bentan/Tumbak, possibly due to a slump in demand on the international market (Crawford, 2002: 16; Sievanen *et al*., 2005: 307). It was again reintroduced in 1996, this time as part of a large-scale integrated coastal management (ICM) project encompassing three provincial locations in Indonesia (Pollnac & Crawford, 2000: 78; Sievanen *et al*., 2005: 307; Tulungen *et al*., 1998). Just fewer than ten major components form the management plan for this project, which aims

to develop "community-based village-level models of coastal resources management" (Tulungen *et al*., 1998). Seaweed farming forms one of these components (Pollnac, Crawford & Rotinsulu, 2003: 14 & 22).

Community-based coastal resource management

One objective of the ICM project was "to decentralise and strengthen natural resources management in Indonesia ... by developing models of decentralised and participatory coastal resource management initiatives in several provincial locations" (Tulungen *et al*., 1998: 2). Seaweed farming was identified by the project as one of several means to achieve this objective, as well as to attain a "stable quality of life" for coastal communities (Tulungen *et al*., 1998: 3). It was also recognised that seaweed farming was an environmentally benign livelihood, and it was suggested that seaweed farming could form an alternative livelihood strategy to fishing, thereby reducing pressure on wild fish stocks (Crawford, Pollnac, Sukmara & Tulungen, 2000a: 25).

By 1999, the project plans were accepted by the village leaders and integrated into the community (Pollnac & Crawford, 2000: ix). Although it has not been proven that seaweed farming does indeed relieve pressure on wild fish stocks, the project's objective to provide a stable quality of life for households was taking effect. Those who cultivated seaweed found that it did not clash with their fishing, but rather supplemented it. The seaweed farms also appeared to attract fish, resulting in a greater reward for the time spent fishing (Pollnac & Crawford, 2000: 79; Pollnac *et al*., 2002: 16).

New policies required

At first, the seaweed farms appeared to benefit fishing activities and a symbiotic relationship of sorts existed between the two enterprises; farms encouraged the aggregation of herbivorous fish, and fishing removed the fish that grazed the seaweed (Pollnac & Crawford, 2000: 79). However, as seaweed farming rapidly began to expand, outdated laws began to cause tensions and user-group conflict. The law on ownership of offshore areas was based on a first come, first served logic. As seaweed farming began to expand rapidly between the years 1997 to 2000, space became limited and the interests of seaweed farmers, gillnet fishers and boatmen began to clash (Pollnac *et al*., 2003: 18).

In response to these conflicts, a "sea use zoning scheme" was decided upon by the community that ordered the use of sea space into sections. Certain sections were designated

for seaweed farming, lanes were kept open for the passage of boats, and other areas were reserved for traditional fishing practices, tourism or conservation (Pollnac *et al*., 2003: 18).

A "revolving fund" was introduced in order to increase the efficiency and volume of production. The revolving fund was a cash loan made available to a group of nine farmers, three farmers at a time, selected by lottery to double the current size of their farm. The loan was to be repaid by the first harvest and 2.5 percent of the loan was to be paid to the local village. The fund would keep revolving until all the farmers had expanded their farms (Crawford *et al*., 2000a: 25). By the turn of the century, the volume of production by Indonesia's seaweed farms was experiencing rapid growth.

A market boom ... and bust

The growing demand for *Eucheuma* was linked to the recession experienced by Asia in late 1997. The recession was the result of a crisis in the banking sector. The devaluation of currency caused high prices to be paid for export products (Crawford, Pollnac & Sukmara, 2000b: 15; Pollnac *et al*., 2002: 10; Sievanen *et al*., 2005: 300). As a result, Indonesian seaweed suddenly became much more competitive on the international market and production expanded to over three times the size (Pollnac *et al*., 2002: 16 & 45). This expansion created extensive employment opportunities.

Between 1997 and 2000, ninety-three percent of the households in the sample farmed seaweed (Crawford *et al*., 2000a: 25). This shows a remarkable increase from the twenty-five percent indicated in 1997 (Pollnac *et al*., 2002: 15). For example, in 1997, no household ranked seaweed farming as their most important means of income. Fishing and related activities were ranked first by almost the entire population. However, by 2000, sixty-nine percent of the sample population of the two towns listed seaweed farming as of primary importance. An average-sized seaweed farm run by a single farmer could earn the farmer US$ 50/month (Sievanen *et al.*, 2005: 305). The mass move to adopt seaweed farming was visibly evident in the plastic bottle 'buoys' that speckled "almost the entire surface of the sea between Bentenan village and Bentenan Island" (Pollnac *et al*., 2002: 15). This boom was short lived, however, due to a combination of a disease outbreak and market saturation.

In 2001, a disease called *ice-ice* wiped out the entire population of *Eucheuma cottonii*, the most popular variety of *Eucheuma* in Bentenan/Tumbak. Problems with disease had already been mentioned in 2000, but production was at its peak at the time and, evidently, little was

done to assess and curb the potential for damage. A less popular variety, *E. spinosum*, suffered far less from the disease and it was suggested that this variety be used to restock the devastated farms. However, the additional pressure on seaweed farming caused by the drop in the market, combined with the already low market value of *E. spinosum*, rendered such a move impractical (Pollnac *et al*., 2003: 22 & 29).

The apparent vulnerability of the seaweed market in this example can largely be attributed to the dependence of seaweed production on the world market (Pollnac & Crawford, 2000: 28). The high demand for seaweed on the world market may lead to a sudden acceleration in production, which saturates the market and leads to a drop in value, causing a seaweed farm that is highly valuable one moment to be unproductive in a short space of time (Crawford, 2002: 6; Pollnac & Crawford, 2000: 28). Such a situation is recorded to have occurred in Bentenan/Tumbak in 2001 (Crawford, 2002: 14).

The combination of the drop in market value of seaweed and the sudden obliteration by disease in the space of about one year struck an irrecoverable blow to Bentan/Tumbak's seaweed industry (Sievanan *et al*., 2005: 308). A local village head commented that, in addition to these two major challenges, the availability of seaweed buds for planting had dwindled. Other local interviewees recounted that herbivorous fish ate the newly planted crops. When large tracts of seaweed are planted, the grazing of herbivorous fish is spread out and thus inflicts negligible damage to individual crops. However, the scarcity of buds and the resulting low levels of cultivation concentrated the grazing on small farms, with greater damage done to individual crops (Pollnac *et al.*, 2003: 30, 32). Thus, the local seaweed industry was unable to start up again on a small scale.

Set against such a background of seaweed farming's success in 2000, the total absence of seaweed farming as a livelihood for the Bentenan/Tumbak population by the close of Proyek Pesisir in December 2002 is quite extraordinary (Pollnac *et al*., 2003: 3 & 29). The expansion and collapse of the seaweed farming industry in Bentan/Tumbak between the years of 2000 to 2002 are an abbreviated copy of the larger-scale experience of the Indonesian seaweed market played out in the second half of the twentieth century until the 1980s. Seaweed farming had already risen and fallen in Bentan/Tumbak before the ICM project reintroduced it in 1996 (Sievanen *et al*., 2005: 307). With the collapse of the Bentenan/Tumbak seaweed industry, the majority of villagers returned to fishing and fish-related activities as livelihood strategies (Pollnac *et al.*, 2003: 28).

The Five Factors

Regardless of the geographical location of or the product farmed in each case, all four cases were affected by the presence or absence of five major factors, which influenced their sustainable development. These five factors are: state support; the surrounding community; funding; the environment; and the market. The interplay among these five factors influences the sustainable development of the mariculture or aquaculture ventures and, by implication, their ability to create employment.

The state

It is telling that both Grand Manan and Walvis Bay, the two successful cases, had strong support from the state, in the form of policies for guiding the early development of the sector, or for protecting it from collapse. The 1991 policy on traditional ownership in Grand Manan and the second National Development Plan in Namibia are two examples of early policies aimed at nurturing the young sector. Grand Manan's policy of October 2000 demonstrated strong leadership from the state in the protection of the sector from collapse, and Namibia's Vision 2030, as well as financial support for research on the development of the sector, played a decisive role in the recovery of Walvis Bay's sector following the harmful algal blooms of 2008. The support received from the state in Grand Manan and Walvis Bay contrasts sharply with the "absent state" in the examples of Amatikulu Prawns and Bentenan/Tumbak. Evans (2009: 29 & 21) postulates that, had the South African government provided research and development as well as financial support for the local prawn sector, it may have survived.

Funding

The influence of funding, or the lack thereof, on a mariculture enterprise is exemplified most by the case of Amatikulu Prawns. According to the account given by one of the stakeholders (Evans, 2009: 3), the inability of management to secure funding for expansion was the main reason for Amatikulu's closure in 2004. All funding for Amatikulu Prawns came from private investors, as no state funding was made available for prawn farming in South Africa at the time. The only case in which state funding was made available was recorded in the literature on the Namibia case. Here, government support was provided in the form of grants, allowing for the attendance of international conferences on oyster production and marketing. No state support was recorded in the form of funding for any of the other cases. Private

funding was the only source of funding for the remainder, except in the case of Bentenan/Tumbak in Indonesia, where the expansion of seaweed farms was funded by donor grants made available by the ICM project's revolving fund as a supplement to private investment from the farmer's own earnings.

The environment

The case of Bentenan/Tumbak probably best illustrates the debilitating effects of disease on a mariculture sector. Seaweed farming went from being the primary source of income for sixty-nine percent of the population and providing some form of income for ninety-three percent of the population, to not even appearing on a survey two years later. Combined with a drop in market value, the incidence of *ice-ice* disease, which wiped out almost an entire seaweed species in the area, was the main contributor to the total collapse of the sector. In two other cases, the local sector survived the shock of natural disasters.

In Walvis Bay, almost the entire year's crop of oysters was lost to harmful algal blooms and, in Grand Manan, ISA resulted in a two-year moratorium. The algal blooms in Walvis Bay were unavoidable and unrelated to oyster production, but plans were made to protect the sector from such catastrophes. In the case of Grand Manan, however, the outbreak of ISA was directly the result of the inefficiency of salmon culture techniques, but the rapid response from provincial government saved the sector from collapse. Amatikulu Prawns is the only case that does not mention disease threatening the sector; rather, it was the subtropical environment temperatures and the resulting higher production costs that played a detrimental role in the sustainable development of sector.

The market

The crippling effect of market volatility on a sector is best illustrated by the case of Amatikulu Prawns. South Africa's prawn sector was already struggling under a dropping market value for prawns locally, and internationally due to the strong Rand, but the flooding of the local market with cheaper imports from India was the final straw for Amatikulu Prawns. Bentenan/Tumbak also caved in due to declines in the market. It is possible that the sudden boom in the seaweed sector saturated the market, leading to a repeated boom-and-bust cycle. Walvis Bay experienced a slight drop in its export market to South Africa, their primary market, due to competition from South African oyster farms starting up. However, a decision to expand to overseas exports to Asia and Europe led to a broadening of their

customer base and the stabilisation of Namibia's oyster sector. The Grand Manan case did not experience a drop in the market, but is the only case of the four that records the domination of local production by multinational corporations.

The local community

In all four cases, the local community played a significant role in the well-being of the local sector, most marked, perhaps, in the example of Grand Manan. The initial hopes for salmon mariculture to be a locally run enterprise were lost, primarily through poor research and the resulting lack of appropriate planning. It was assumed that local individuals would prefer taking the risk of starting a salmon farm of their own to renting out their property to large salmon-farming corporations. No research was mentioned on the effects that a growing sector may have on local property use, local livelihoods and societal structures. As a result, the growing sector has deeply cleft the structure of Grand Manan society, leading to increasing social conflict.

The other case in which a major influence from the local community was experienced is that of Bentenan/Tumbak. The leading role played by the local community in the expansion of the seaweed sector, with input from local farmers and village heads, contrasts with the case of Grand Manan, with its side effects of community division. Because seaweed farming in Bentenan/Tumbak was initiated as part of a community development project, the growth of seaweed farming originated with the understanding that it was a means to provide employment and food security. The fulfilment of this purpose played a significant role in the rapid adoption of seaweed farming by almost all of the residents. Although the two cases differ significantly in terms of the funding required and the actors initiating the development, the primary reason behind the relatively low levels of community division and user-group conflict in the Bentenan/Tumbak case can be attributed to local participation in all aspects. Local people were therefore empowered to resolve user conflicts quickly through negotiation. In contrast, Grand Manan's ongoing and escalating incidents of social conflict occurred because development decisions were made by the state, without local participation. Amatikulu Prawns experienced social conflict through incidents of crime. Syndicates and individuals stole prawns for bait or for sale on the black marketThe most notable influence on the local community in all four cases was the provision of locally based employment. The cases demonstrate how important the sustainable development of a mariculture sector is to the provision of stable employment for the households in the neighbouring poor areas. In

Grand Manan, mariculture provided 177 seasonal jobs and 80 full-time positions. The controversy over Grand Manan's sector was, however, that the growth of mariculture led to a loss of other local livelihoods, such as fishing. In addition, the provision of labour in Grand Manan was a poor substitute for the local empowerment that salmon farming was intended to achieve through local ownership of weir sites. In Namibia, the bivalve mariculture sector was also intended for local empowerment, and the Namibian government continues to succeed in this endeavour. Employment in bivalve mariculture increased to 200 by 2006, while the majority of mariculture sites are locally owned. Most likely as a result of the local ownership of and state support for Namibia's mariculture sector, there appears to be no user conflict and there was a rapid recovery after the large loss in production. The lack of state support for Amatikulu Prawns meant that the 70 full-time and 30 part-time employees from the surrounding communities lost their jobs when the sector closed down. The case of Bentan/Tumbak is the most dramatic in terms of employment figures. Ninety-three percent of the 655 households came to adopt seaweed farming as a form of income. For 69% of these households it was the primary income. All of these households lost this income within a year when the sector collapsed. The residents resorted to fishing as their primary income. However, not all such coastal communities have the option of alternative livelihoods.

Conclusions

The purpose of the present chapter was to discover what the major influences are on the local mariculture sector as a source of employment. In order to answer this question, an overview of the literature on four case studies was provided. Each of the case studies was selected on the basis of the following similarities: the sector in question was related to the farming of marine organisms; the sector was an influential source of local employment; and in each case the sector experienced a significant challenge to its sustainable development. In order to ensure a diversity of cases, they differed in the organism being farmed and the country within which they were located.

From the above case studies we can conclude that five major factors play a role in the sustainable development and success of mariculture ventures. These five major factors are: state support, funding, the environment, the market and the local community. In none of the cases did any single factor have a total effect on the sustainable development of the sector; rather, the interrelationship of the factors determined the influence of each factor. In two cases, the sector recovered from near disaster because of the beneficence of some of the

factors, and in the other two the overwhelming challenges presented by some factors led to the collapse of the sector. It was noted, however, that in each case, one factor seemed to have overarching importance, while the influence of another factor may be negligible. An awareness of the ways in which these factors may influence the sustainable development of a local mariculture sector remains important for the present study, which is a case study of the expansion and employment potential of the bivalve mariculture sector in Saldanha, South Africa.

CHAPTER FOUR: BIVALVE MARICULTURE: ITS STATUS AND EXPANSION POTENTIAL IN SALDANHA

Introduction

Global declines in fish stocks and the implications of this for food security in already vulnerable population groups provide the backdrop to the present case study of Saldanha, a fishing village on the West Coast of South Africa. A significant percentage of the population in Saldanha is employed in fishing and related industries. Global declines in fish stocks affect this community through job losses related to lowered fishing quotas and a diminishing catch per unit effort (CPUE) ratio. The growing bivalve mariculture sector in Saldanha is seen as an alternative provider of employment. In order to assess the potential for Saldanha's bivalve mariculture sector to provide sustainable employment, the present chapter looks at the context of growing unemployment in Saldanha and the factors that may play a major role in the sustainable development of bivalve mariculture.

This chapter briefly describes the global decline in fish stocks before relating this to South Africa and the effect it has on growing unemployment in Saldanha. The potential of bivalve mariculture as an alternative source of employment is then discussed. Following this discussion, the chapter moves to focus on the factors that affect the sustainable development of bivalve mariculture in Saldanha.

Globally Declining Fish Stocks

Over 200 million people worldwide are directly employed in fishing activities, and a further 150 million people are employed in sectors related to fishing. This translates into some 350 million people in total whose livelihoods depend on fishing. The overwhelming majority of these people live in the developing world and run artisanal and small-scale fishing operations (ICTSD, 2006: ix & 20). However, since its peak in the 1980s, the global fishing sector has begun to decline, affecting livelihoods in many communities.

The reason for this decline is overfishing (ICTSD, 2006: 13; Pauly, Watson & Alder, 2005: 6). Wild fisheries are no longer able to provide the increasing demand for fish. This has necessitated cuts in quotas and stricter regulation of fishing worldwide. As a result, many fishing companies have cut production and staff.

The number of people employed by capture fisheries declined by 12% between 2001 and 2006 (FAO, 2009: 7). Pauly *et al*. (2005: 5) predict a collapse of the seafood sector within the next few decades if the current trends of exploitation continue, leading to increased unemployment and food insecurity. In order merely to sustain wild fish stocks, drastic measures need to be taken, such as reducing fishing quotas, abolishing subsidies for unprofitable fleets, creating marine reserves and placing restrictions on equipment. Although such measures may save fish populations from collapse, the effect on unemployment and food insecurity remains, as the global fishing sector would be forced to scale down *per capita* fish supply (Pauly *et al*., 2005: 10). In South Africa, reduced fishing quotas have already led to increased job losses.

The Impact of Globally Declining Fish Stocks on South Africa

South Africa's fishing sector has an annual turnover of about R80 billion and contributes between 0.5 and 1% of the gross domestic product (GDP). However, the Minister of Agriculture, Forestry and Fisheries, Tina Joemat-Pettersson, noted in the 2010 Budget Vote Speech that "[d]espite the economic fortunes that big players make, there is an ecological dilemma and a social dilemma of the changing fortunes of ordinary fisher folk and their communities" (Joemat-Pettersson, 2010). Most of South Africa's fisheries are either fully exploited or over exploited. This means that opportunities for new entrants are limited and current employees face the possibility of losing their positions (Martin & Raakjaer Nielson, 1998: 163; Van Zyl *et al*., 2008: 5).

An estimated 27 000 people are directly employed by South African fishing sectors – most of which are based in the Western Cape. A further 81 000 people are employed indirectly by fisheries-related enterprises (Joemat-Pettersson, 2010; Martin & Raakjaer Nielson, 1998: 153). However, the livelihoods of many subsistence and small-scale fishers are undermined by overlapping legislation, unclear administrative responsibilities and policies favouring commercial fisheries, thus perpetuating the inequalities that were institutionalised prior to the democratic transition (Hauk & Sowman, 2001: 175; Sowman & Cardoso, 2010: 6).

Since the colonial exclusion of black fishers from commercial and recreational fisheries, state policies have made little space for the livelihoods of impoverished fishing communities (Hauk & Sowman, 2001: 174; Sowman & Cardoso, 2010: 5; Van Sittert, 2003: 199). The new dispensation that began in 1994 proposed to target food insecure populations, allowing them access to productive resources, income and job opportunities. However, on the ground,

policies still favoured commercial production, allocating inadequately low quotas through the issuing of recreational fishing permits for fishers who had previously relied on subsistence fishing for a livelihood. This situation has exacerbated coastal poverty and food insecurity (Burnett, 2010; Sowman & Cardoso, 2010: 5). Only 0.75% of the sum of the total allowable catch (TAC) for all species was allocated to all black fishers, with the vast majority of the TAC being allocated to a small number of large companies (Hauk & Sowman, 2001: 175). Thus, although shareholding for previously disadvantaged individuals (PDIs) has increased since 1994, the increase was nominal and "new entrants were adamant that the quantities allocated to them were usually too low to establish their own ... economically viable enterprises" (Raakjaer Nielson & Hara, 2006: 46). In many such cases, the holders of new rights sold their TAC quotas to the large fishing companies (Raakjaer Nielson & Hara, 2006: 46). However, employment opportunities in the large fishing companies were not increasing either. The pressure on large fishing companies relates both to TAC reallocations to PDIs and to the shortage of wild fish stocks. Some of the fisheries most severely affected by overfishing include South Africa's biggest fishing sectors, the pelagic purse-seine and the deep-sea hake trawl sector.

The largest fishery in South Africa in terms of total landings and the second most valuable is the purse-seine fishery for small pelagics, based primarily on anchovy (*Engraulis encrasicolus*) and sardine (*Sardinops sagax*). This fishery directly employs 7 700 people, of which 4 500 work full time. The majority of the factories are located in Saldanha and St Helena Bay, on South Africa's West Coast. Employment security in the pelagic sector is affected by the sector's vulnerability to large fluctuations in its TAC. This is because the sector functions on a high volume/low profit basis (Raakjaer Nielson & Hara, 2006: 45). The most valuable of South Africa's fisheries is also experiencing the TAC reductions for large companies.

The most valuable of South Africa's fisheries is the deep-sea hake trawl fishery based on deep-sea hake (*Merluccius paradoxus*) and shallow-water hake (*Merluccius capensis*). The deep-sea hake fishery is highly labour intensive, employing 8 600 people full time. The two largest deep-sea hake producers, Sea Harvest and Oceana, held 55% of the TAC quota almost equally between them in 2002 (Raakjaer Nielsen & Hara, 2006: 45). Although South Africa's TAC increased rapidly between 2001 and 2005 (to accommodate rights allocations to PDIs), large companies such as Sea Harvest have experienced sharp declines in their TAC over the same period (Van Zyl *et al*., 2008: 4).

The hake sector has been experiencing declining annual harvests since the late 1970s, as they have consistently surpassed the regenerative capacity of wild stocks (van Zyl *et al.*, 2008: i & 3). After the high catch rates of the early seventies, the annual catch rate almost halved between 1982 and 1991. Van Zyl *et al.* (2008: 5) suggest that a five-year moratorium on deep-sea hake trawling would allow stocks to become replenished. However, such measures would have far-reaching impacts on employment and the food security of households in a town such as Saldanha, within which both of these fisheries have historically provided significant employment (Raakjaer Nielsen & Hara, 2006: 45).

The Impact of Globally Declining Fish Stocks on Saldanha

In Saldanha, one of the bigger towns in the Saldanha Bay municipal district, fishing has historically been the sector making the largest contribution to local employment. However, major fishing companies in Saldanha have been forced to downscale their operations in recent years. This downscaling has been linked to both global fish stock shortages and the reallocation of quotas to smaller enterprises run by previously disadvantaged individuals (PDIs) (Van Zyl *et al.*, 2008: i). The fishing sector is no longer growing, and future growth is also not foreseen. The future implications of negative growth and quota cuts include the increase of unemployment through limited job opportunities and retrenchments. The decline in employment from fisheries is serious for Saldanha, as alternative employment opportunities in other sectors are limited (Van Zyl *et al.*, 2008: 10).

The agriculture, forestry and fishing sector has historically been the sector providing the most employment in Saldanha Bay municipal district. In 2001 it employed 23,6% of the working population, just under 6 000 people, of which roughly half worked in the fishing sector (Socio Economic Profile, 2006: 111; Van Zyl *et al.*, 2008: 12). Employment in Saldanha's fishing sector is made up mostly of large hake and purse-seine fishing companies, of which the largest is Sea Harvest, specialising in deep-sea hake (Raakjaer Nielsen, 2006: 45; Van Zyl *et al.*, 2008: 11).

Sea Harvest is situated in the town of Saldanha. It employed 1 702 permanent employees and 1 031 seasonal employees (contracts are usually six to nine months long) in 2008 (Van Zyl *et al.*, 2008: iii). Of the permanent employees, 73% (1 244 people) live in the Saldanha Bay municipal district, while 83% (852) of the contract employees live in the Saldanha Bay municipal district. Therefore, 2 096 individuals were employed by Sea Harvest in the Saldanha Bay municipal district in 2008.

Pelagic purse-seine fisheries are another major source of employment in the Saldanha Bay municipal district. Pelagic fisheries employed 4 500 permanent employees and 2 500 seasonal employees and 700 fishers in 2006, the majority of which were by factories situated in the Saldanha Bay municipal district. Major employers specialising in pelagics include Oceana and Southern Seas (Raakjaer Nielsen & Hara, 2006: 45).

In addition to the jobs provided by Saldanha's fisheries, it is estimated that at least 0.50 to 0.75 indirect jobs are created for every fishery employee (Van Zyl *et al*., 2008: iii). Therefore, Saldanha's hake and pelagic fishing sectors combined create a few thousand additional jobs in the Saldanha Bay municipal district. If one considers the dependency ratio of 51% in Saldanha Bay, about one in three families in the Saldanha Bay municipal district depend on the fishing sector for a livelihood (Socio Economic Profile, 2006: 109; Van Gass, 2006). The large-scale dependence on fisheries for livelihood opportunities in Saldanha is concerning, in the light of the sector's decline (Socio Economic Profile, 2006: 106).

Both of Saldanha's major fishing sectors, based on pelagic and hake fisheries, are experiencing notable declines. Such a drop in productivity inevitably means that the fishing sector will not be providing employment for the growing population in Saldanha as it used to, or that some employers will be forced to close down. Ultimately, this means that fishery employees will lose their jobs.

The pelagic fishery sector has experienced severe strain on productivity since Raakjaer Nielsen and Hara (2006: 45) published their statistics on the sector. Within two years after the publication, one of Saldanha's major employers, Southern Seas, closed down (Clark, Orr, Hutchings, Angel & Turpie, 2009: 6). The pressure on the sector also affected secondary operations that depend on the sector, such as processing. For example, Saldanha Bay Canning, a sardine- and pilchard-canning factory, and Oceana's fishmeal factory closed down in the early 1990's (Driver, Platzky & Shapiro, 1993: 36 & 55). Hake stock shortages and quota reallocations had an impact on large deep-sea hake fishing companies as well.

In 2006, Sea Harvest's TAC was cut by 19%, resulting in a record low harvest of 130 557 tons, the lowest since 1985 (Enslin, 2006; Van Zyl *et al*., 2008: i). Employees had already lost their jobs or faced the threat of job loss following the quota cuts in 2006. Sea Harvest retrenched 52 people in May 2006 because of the lower productivity that resulted directly from quota cuts and stock shortages (Bailey, 2006; Enslin, 2006). At the time, Sea Harvest was considering the retrenchment of 500 employees (Van Gass, 2006). An online news

article reported that 400 employees were retrenched in the same year, while an African National Congress (ANC) MP at the time, Jenny Schreiner, was reported to have said that "[h]undreds of Saldanha residents have been retrenched from fish process factories" (Cape Business News, 2006). With the downscaling of Saldanha's fishing sector, not only are jobs being lost, but employment opportunities are reduced in the face of a growing population. Clearly, the expansion of a labour-intensive sector is needed to provide alternative livelihood options for the increasing levels of jobless labourers.

A potential for creating labour positions is presented by bivalve mariculture (mussel and oyster farming), a relatively labour-intensive sector that is well suited to the environmental conditions of Saldanha Bay. The mariculture sector has exhibited tremendous potential for employment creation in coastal communities around the world.

Mariculture in the Global Context

> Mariculture has been identified by both fisheries and economic management authorities as a coastal industry with enormous growth potential that can contribute significantly to wealth and job creation, sustainability of the fishing industry, other coastal developments and the socio-economic well-being of coastal communities (Cardoso, Fielding & Sowman, 2006: 30).

Being relatively labour intensive, this sector has the potential to create sustainable economic growth in income and employment (Britz, Lee & Botes, 2009: 39). In this regard, the potential that bivalve mariculture has for providing food security has been identified by both NEPAD and SADC (Cardoso *et al*., 2006: 30).

Globally, the aquaculture sector has grown to contribute 47% of the fish consumed by the human population worldwide (FAO, 2009: iii & 3). Aquaculture is currently the fastest growing animal food-producing sector, at 6.9% per annum, outpacing population growth, with per capita supply increasing from 0.7 kg in 1970 to 7.8 kg in 2006 (FAO, 2009: 6; Frankic & Hershner, 2003: 517; Hinrichsen, 2007a: 2). This rate of expansion is partly because of the declining fishing sector and the growing demand for aquatic and marine products.

Aquaculture's growth not only matches the growing demand for food products, but provides employment in marine and freshwater-related livelihoods, both directly through the sale of products, as well as through ancillary activities such as boat, net and gear building, maintenance, ice production, manufacturing of processing equipment, packaging, marketing

and distribution services, research and development, and management. The rate of employment in the aquaculture sector increases at 8% per year globally (FAO, 2009: 7, 23, 26; ICTSD, 2006: 17 & 20). The FAO (2009: 7) estimates that, for each position of direct employment in primary sector production, four are employed in the secondary sector, creating a total of 170 million jobs worldwide. Furthermore, calculating on the basis that there are three dependants for each employee, 520 million people worldwide rely on the aquaculture sector for some form of income or food security (FAO, 2009: 7).

South Africa's Aquaculture Sector

Historically, South Africa's aquaculture sector has developed at a slower rate than that of many other countries because of policy changes and the political transition (Hinrichsen, 2007b: 3). The South African Provincial Nature Conservation Departments changed policies relating to the stocking of exotic species in indigenous waters at the end of the 1980s/beginning of 1990s. As a result, government support was withdrawn from the aquaculture sector. Some facilities closed down, while others became privatised. With the political transition in the mid-1990s, aquaculture research and development lost government funding and supportive policies.

Notwithstanding the past difficulties, South Africa's "young and developing" aquaculture sector has exhibited remarkable growth potential in the past ten years, and has increasingly provided employment in coastal communities (Britz *et al.*, 2009: 30). The merits of an expanding aquaculture sector in South Africa match up with Altman's (2009: 345) statement that "poverty and food insecurity [in South Africa] would be addressed by *expanding employment* opportunities, thereby enhancing household incomes" (italics in original). This is especially relevant to coastal communities in the Western Cape, where employment in the fishing sector has historically been a primary form of livelihood (Glavovic & Boonzaier, 2007: 9).

In contrast to the decline in livelihood opportunities in wild fisheries, South Africa's aquaculture sector grew by 80% between 2005 and 2008, providing employment for 1 837 full-time and 355 part-time workers in 2008 (Britz *et al.*, 2009:8). Over the same time, South

Africa's mariculture sector grew by 7.8% in tonnage and by 32% in value[5] (Britz *et al*., 2009: 20). The Minister of Agriculture, Forestry and Fisheries, Tina Joemat-Pettersson (2010), has recognised the possibilities presented by the sector. In the 2010 Budget Vote Speech, Joemat-Pettersson (2010) stated that South Africa has the environmental potential to increase its aquaculture production "from the current level of 3 543 tons (worth R218 million) to more than 90 000 tons (worth R2.4 billion) per annum". She added that the employment potential of aquaculture in South Africa would then increase to more than 44 000 jobs[6] (Joemat-Pettersson, 2010). Saldanha Bay has been earmarked as an ideal location for such a sector (Haupt *et al*., 2010: 156; Karaan, 2009: 246; Monteiro, Spolander, Brundrit & Nelson, 1998: 3; Pitcher & Calder, 1998: 15).

Bivalve Mariculture in Saldanha

Saldanha Bay is the largest and one of few sheltered bays along South Africa's West Coast. The combination of shelter and the nutrient rich Benguela current makes Saldanha a prime location for bivalve mariculture. Both mussel and oyster production in Saldanha have some of the highest growth rates in the world (Haupt, *et al*., 2010: 156; Karaan, 2009: 246; Montiero, Spolander, Brundrit & Nelson, 1998: 3; Pitcher & Calder, 1998: 15).

Commercial bivalve mariculture operations began in Saldanha thirty years ago with the production of oysters and mussels. Indigenous black and brown mussels (*Choromytilus meridionalis* and *Perna perna* respectively) were the popular species for mussel farming (Haupt *et al*., 2010: 156; Safriel & Bruton, 1984: 53). However, by this time the alien Mediterranean mussel (*Mytilus galloprovincialis*) had already been introduced to South African waters and was spreading rapidly (Atkinson, *et al*., 2006: 7).

The Mediterranean mussel was first noted in Saldanha Bay in 1979. It is believed that it was introduced to Saldanha Bay through the discharge of ballast waters from international ore carriers entering the bay. By 1984, when genetic confirmation of *M. galloprovincialis* was first published by Grant, Cherry and Lombard (1984), it had already invaded the inter-tidal zone and was the dominant mussel along sections of the West Coast (Robinson, Griffiths, McQuaid & Ruis, 2005: 300). It continued spreading as far north as Namibia and down to

[5] The marked increase in value is largely due to the growth of the high-value abalone sector, the leading sector in the country, which is valued at R268 million and accounts for 88% of the total rand value of aquaculture. After abalone, the next major contributors are trout, with R28 million, contributing 8.5%, and bivalves (oysters and mussels), with a combined contribution of R14.5 million and together contributing just over 4% (Britz *et al*., 2009: 8, 20).

[6] Almost double the 27 000 people currently employed by South Africa's fisheries.

the Cape, even reaching up the east coast to Port Elizabeth. The highly competitive Mediterranean mussel displaced the brown mussel as a cultured species. This Mediterranean mussel and the black mussel are currently farmed in Saldanha Bay (Atkinson *et al.*, 2006: 7; Clark *et al.*, 2009: 9 & 41; Republic of South Africa, 2010: 13). The only oyster species farmed in Saldanha Bay, *Crassostrea gigas* or the Pacific oyster, is an alien species that was imported for cultivation because of its faster growth rate than the indigenous species (Haupt *et al.*, 2010: 156).

The cultivation of oysters in Saldanha begins with the purchase of spat from hatcheries. In 2010, the South African bivalve mariculture sector imported all its oyster spat from Namibia, Chile (South America) and Guernsey (United Kingdom) (Republic of South Africa, 2010: 12). The spat are raised in nurseries until they are approximately 30 g each in total wet weight. At this stage, they are called 'seed oysters' and are ready for growing out. The seed oysters are suspended in the upper two to four meters of the water column in plastic mesh grow-out bags. Every two months these oysters are removed, cleaned and graded according to size. It takes three to four months to grow oysters to a marketable size of 45 to 120 g (Haupt *et al.*, 2010: 156).

While oysters are grown in mesh grow-out bags, the cultivation of mussels makes use of six-meter ropes that are suspended in the water column. The ropes are suspended either from long-lines or from rafts. Mussel larvae from the surrounding environment may attach themselves to the ropes, or they may be planted deliberately. It takes six to eight months for mussels to grow to a marketable size, whereupon they are harvested (Heasman, Pitcher, McQuaid & Hecht, 1998: 33). Before 2008, the available estimates suggested that production in Saldanha Bay could expand by 37% (Clark *et al.*, 2008: 39; Grant *et al.*, 1998:47; Heasman *et al.*, 1998: 39). However, the question remains: what are the factors affecting the sustainable development of mariculture in Saldanha Bay and how many jobs can be created? To determine this, one first needs to establish the potential for thesustainable development of mariculture in the context of Saldanha Bay.

The Five Factors and Saldanha's Mariculture Sector

The state

South Africa's Minister of Agriculture, Forestry and Fisheries, Tina Joemat-Pettersson (2010), has recognised the role of the state in the development of agriculture, forestry and

fisheries (which includes mariculture). For development to take place there have to be enabling policies in place. Two of the frameworks in which these policies are used in the Republic of South Africa are the Department of Trade and Industry's National Industrial Policy Framework (NIPF) and the Provincial Government of the Western Cape Department of Environmental Affairs and Development Planning's (DEA&DP) regulatory framework.

A goal of the NIPF is to assist the development of entrepreneurship through small enterprise support in the form of "finance and technical support, together with finding ways to strengthen market opportunities" (Republic of South Africa, *s.a.*: 14 & 49). The DEA&DP's regulatory framework sets out to assist best management practices in the Western Cape's aquaculture and mariculture sectors (see Hinrichsen, 2007a & b). Although these policies aim to guide the development of the sector, on the ground the complex framework of regulations leaves small-scale farmers frustrated, and this inhibits entry into the market. Britz *et al*. (2009) have found that the regulatory environment has inhibited the development of a local aquaculture sector.

Many in the sector claim that the regulatory environment surrounding the development of an aquaculture sector in South Africa is too strict and hinders the development of the sector. In a survey of South Africa's aquaculture sector for the period from 2005 to 2008, Britz *et al*. (2009: 99) found that the strict regulatory environment of the aquaculture sector has not been conducive to small business development. Britz *et al*. (2009: 54) concluded that the "overriding impression" gained from interviews with small business owners in the aquaculture sector was that "odds are stacked heavily against the entry of small business into aquaculture" and that small-scale owners felt "lonely and unsupported" by the state. Britz *et al*. (2009:99) claim that, in reality, the NIPF's support structures "were really aimed at medium size enterprises and specialist consultants were required to complete these applications". However, since the publication of Britz *et al*.'s (2009) report, the South African government has been talking about playing a more proactive role in promoting the aquaculture and mariculture sectors.

Joemat-Pettersson, in the 2010 Budget Vote Speech, describes the new focus of the sector away from "unsustainable growth based on credit extension and consumption ... in production sectors" (read fisheries) towards "sustainable economic growth" (Joemat-Pettersson, 2010). She specifically mentions that the economic potential of mariculture needs to be investigated. Joemat-Pettersson (2010) claims that the economic opportunities provided

by the South African coast can be used for social development, and that the traditional fisheries present an ecological and social problem. Sustainable aquaculture is seen as a solution (Joemat-Pettersson, 2010).

These macro policies affect Saldanha's mariculture sector and have been seen as a development opportunity. For example, the promotion of mariculture is mentioned in Saldanha Bay Municipality's Integrated Development Plan (IDP) for 2006 to 2011. The IDP sets out to develop a strong local economic base through the promotion of local economic development in the form of private sector job creation (Saldanha Bay Municipality, 2007: 16, 23, 24 & 46). The IDP includes a Strategic Policy Framework for food security and sustainable livelihoods that presents "options for developmental interventions in food security" (Saldanha Bay Municipality, 2007: 17). These options include granting access to land and water, skills training and small-scale farming. The IDP stipulates that "the exact nature of a particular intervention" is not prescribed, but should be determined by "community dynamics as well as market options" (Saldanha Bay Municipality, 2007: 17).

The Saldanha Bay Municipality has expressed the hope that the industrial base of Saldanha will broaden to include smaller scale activities. Mussel farming has been identified as one of the activities targeted for industrial development (Saldanha Bay Municipality, 2007: 11; Van Zyl *et al*., 2008: 14). In addition to mussel farming, the fact that there has been a 44.9% increase in employment in the oyster sector in South Africa from 2005 to 2008 suggests that bivalve mariculture as a whole is an ideal means to provide employment for those with experience in fishing or agriculture (Britz *et al*., 2009: 39). This bodes well for Saldanha residents who have lost their jobs in the fishing sector.

The local community

Unemployment is one of the greatest challenges facing Saldanha. Saldanha was recorded to have a population of 21 640 in 2001, with the projection for 2010 being over 28 000 (Clark, 2009: 26 & 27; Saldanha Bay Municipality, 2007: 6). Thus, according to the average household size of 3.8 for the Western Cape Province it can be estimated that Saldanha has 7 368 households according to the projected population size of 28 000 for 2010 (Saldanha Bay Municipality, 2007: 6; Vorster & Heinecken, 2009: 7). Most households live close to the poverty line, for example 65% of Saldanha's households bring in R3 200 per month or less, 22% have an income that falls below the poverty line of R800 per month, while 11% of

Saldanha's households have no income (Socio Economic Profile, 2006: 118; Van Zyl *et al*., 2008: 13).

The majority of Saldanha's population older than 14 years is able to read and write, although 22% of residents from this age upwards are considered functionally illiterate (below Grade 8). Almost half (48%) of the population has completed primary school or have some form of secondary education below Grade 12. Those who have matriculated make up 22% of the population. A small segment of the population (8%) has a higher education qualification (Saldanha Bay Municipality, 2007: 7). Although these statistics show a slightly higher level of education on average than that potentially found in Saldanha's informal settlements, only 22% of Saldanha's population has a Grade 12 qualification, while another 22% of the population is considered functionally illiterate (Vorster & Heinecken, 2009: 4). Therefore, a large proportion of Saldanha's population has very limited livelihood opportunities outside of manual labour.

More recently, Saldanha's economy has been moving away from reliance on fishing and agriculture to include manufacturing and tourism in order to stimulate economic growth (Saldanha Bay Municipality, 2007: 10). This transition may be good for the economy in the long term as the Saldanha/Vredenburg area becomes a 'regional motor' in the Cape Town region (Pieterse, 2010: 224 & 225; Saldanha Bay Municipality, 2007: 10). However, the local municipality has expressed concern that the growth of these sectors may not translate into job creation for the locally unemployed, because both sectors are relatively less labour intensive than the fishing sector. The local municipality has expressed its concern that many of Saldanha's residents do not have the skills needed to participate in the manufacturing and tourism sectors (Socio Economic Profile, 2006: 123; Van Zyl *et al*., 2008: 10). In the meantime, unemployment continues to grow.

The unemployment rate is increasing rapidly, almost doubling between 1996 and 2001, from 12.4% to 21.4% (Saldanha Bay Municipality, 2007: 8 & 46; Van Zyl *et al*., 2008: 11 & 19;). From 1996 to 2001, the labour force participation rate in Saldanha dropped from 71% to 67%, possibly contributed to by the job losses in the fishing sector (Van Zyl *et al*., 2008: 4). The unemployment rate in the town of Saldanha was even higher than the municipal average, at 27% in 2001 (Socio Economic Profile, 2006: 110; Van Zyl *et al*., 2008: 11). The unemployment rate in Saldanha's informal settlements has been recorded to be as high as 55% in some cases (Vorster & Heinecken, 2009: 12). In addition to the downscaling of the

fisheries, a major contributing factor to rising unemployment is the in-migration of job seekers.

In-migration reached a peak in the mid-1990s, as labourers came seeking construction work related to the development of the Saldanha Steel project. The labour positions that opened up in construction did not provide sustainable local employment, as an influx of job seekers from all over South Africa filled the temporarily available positions. Some of the immigrants became "economically stranded" in Saldanha when they could not find work, or after their contracts had expired, while others elected to stay (Van Zyl *et al*., 2008: 11).

Real or perceived job opportunities in Saldanha continue to be a major contributor to population growth (Clark *et al*., 2009: 27; Saldanha Bay Municipality, 2007: 9). Data on Middelpos, one of Saldanha's informal settlements, records that 31% of the residents had migrated there within the previous five years. The vast majority (75%) of the migrants were from the Eastern Cape (Vorster & Heinecken, 2009: 8). In-migration levels are declining, however, and it is calculated that levels will continue to decline, from 1 000 people per year in 2010 to 775 people per year in 2025. Outmigration is forecast to be roughly 130 people per annum over the same time. Therefore, in-migration will continue to grow Saldanha's population by about 800 people per year for the next 15 years (Socio Economic Survey, 2006: 109).

As Saldanha's population continues to grow, labour-intensive fisheries continue to decline and developing sectors require a skilled workforce, Saldanha's labour force participation rate may continue to drop. The large portion of Saldanha's population that is functionally illiterate, or has a low education level, is limited in terms of the availability of work, and therefore the possibility of finding labour work continues to decrease. No alternative sources of employment are foreseen by the local municipality. Unemployment and poverty in Saldanha may be expected to increase under these conditions, along with the accompanying social ills that are already a cause for concern (Socio Economic Profile, 2006: 123). Understandably, the Saldanha Bay Municipality see growing unemployment as the greatest challenge that Saldanha faces. Sustainable employment creation is an urgent need.

The market

Employment in bivalve mariculture is linked to the growth of local and international bivalve markets. There are, however, certain aspects that local producers need to consider in terms of

market growth for oyster and mussel products. These include increasing production to meet local and international demand, processing the products and marketing them both nationally and internationally.

Between the years 2005 and 2008, the value of South Africa's oyster production increased by 42%, contributing R8.5 million to South Africa's aquaculture sector in 2008. Mussel production increased in value by 43% to R6 million in 2008 (Britz *et al*., 2009: 20). The recently released Marine Aquaculture Annual Farm Operation Report 2010 (Republic of South Africa, 2010: 8) reports that the value of oysters and mussels has risen to a further R9.8 million and R8 million respectively. Oysters and mussels were recorded to be the second and third most valuable mariculture sectors in South Africa in 2010, overshadowed only by the R320 million abalone sector. Oyster producers reported steady market growth and were optimistic about the future of the sector (Britz *et al*., 2009: 57). Mussel production has strong market potential as well due to a 30% global deficit in mussel products (Karaan, 2009: 246). South Africa is poised to begin supplying these market deficits to a far greater degree and, as one producer commented, after twenty years of cultivation the sector is finally beginning to make some "real progress", especially in terms of value-added and export product development (Britz *et al*., 2009: 97).

There is great potential for South African oysters and mussels on the international market, as international demand for seafood is increasing and South Africa's natural environment provides a competitive edge over other countries (Karaan, 2009: 246). Currently, one of the great challenges to export is South Africa's lack of international standards of health certification, which prevent exportation to most countries. At present, oysters are exported to Southeast Asian countries, such as Hong Kong, where standards are not as stringent. No mussel products are exported, as production does not fill the local market's demand. The large scale of production and the strong economies of leading mariculture producers in northern countries also pose a challenge to South Africa's mussel export industry. However, South African mariculture production has the advantage of working to a different seasonal calendar than that of northern countries. As a result, South Africa's production is at its peak when the northern countries are in their off-season.

In addition to the competitive harvest times, the growth of oysters and mussels cultivated in Saldanha Bay is faster than in the Northern Hemisphere (Karaan, 2009: 246; Monteiro *et al*., 1998: 3; Saxby, 2002: 19;). In addition, the lower production costs and turnover give

Saldanha Bay's mariculture sector a competitive edge in international markets. Locally, the produce is also preferred.

Britz *et al*. (2009: 97) found that many consumers "would like more information about where their products were farmed ... and indicated a preference for local seafood products". The most important local buyers for oyster and mussels, namely restaurants and wholesale buyers, also expressed their preference for local products, but commented on the shortage of local oyster and mussel products on the market (Britz *et al*., 2009: 97). Local produce is largely limited to the fresh market for both mussel and oyster products. The only smoked and canned products on South Africa's shelves are imported. The majority of frozen mussel and oyster products on the market are also imported. In terms of post-harvest value adding, imports still dominate the local market, which leaves huge potential for development and employment in terms of local processing and value-adding industries. The steady growth of the local market for oyster and mussel products indicates that local products have the opportunity to increase their share of the market. The future growth of Saldanha is an additional benefit of the local oyster and mussel market.

The planned upgrading of Saldanha harbour includes the development of residential and commercial waterfront properties (Van Zyl *et al*., 2008: 14). The continuing expansion of industrial infrastructure, which already caters for other major national and international markets, places Saldanha's mariculture production on a good foot to meet growing market demand, both locally and abroad. For this reason, producers of local mariculture products have identified the hindrance to the sector's expansion as not being related to the market, but being related to the availability of funding.

Funding

Access to adequate finance was one of the highest priorities listed in Britz *et al*.'s (2009: 102) survey for the growth of South African aquaculture. The development of oyster and mussel culture in South Africa has hitherto been dependent on private-sector finances (Haupt *et al*., 2010: 155). Even so, a lack of investment has limited the sector's expansion. The respondents stated that "a government supported aquaculture loan fund" would be required to encourage investment in the sector (Britz *et al*., 2009: 102). Botes, Thompson and Louw (2006: 12) suggest that the regional government ought to intercede in the development process of small and medium enterprises. A government funding initiative tailored to the

mariculture sector is needed, as previous government funding initiatives have not been of any benefit to the bivalve mariculture sector.

Until recently, the Department of Trade and Industry's National Industrial Policy Framework (NIPF) provided the criteria for government to support sectors with high growth potential. Incentives such as the Small and Medium Enterprise Development Programme (SMEDP) provide cash grants to new or expanding operations (Britz *et al.*, 2009: 99; Republic of South Africa, *s.a.*; SMEDP, 2007). The purpose of the grants was to "promote the growth of local and foreign investment in South Africa" (SMEDP, 2007). The application process was complicated, however, and specialist consultants were required to complete the complex application forms (Britz *et al.*, 2009: 99). Britz *et al.*, (2009: 99) state that the SMEDP was not suited to aquaculture enterprises and suggest that a "customised set of incentives with a facilitated, user-friendly interface is required to deliver [support measures] ... to the aquaculture sector".

According to the Minister of Agriculture, Forestry and Fisheries' 2010 Budget Vote Speech, a new funding model for farmers, foresters and fishers will be introduced in the 2011/12 financial year that aims to guarantee affordable financing for "rural entrepreneurs", based upon "joint venture funding models" (Joemat-Pettersson, 2010). Such assistance to entrepreneurs is needed, as "few farmers have the collateral or assets to secure a loan due to historical reasons of lack of assets to resources and ownership rights" (Botes *et al.*, 2006: 12). Such a grant may open up opportunities for cooperatives and black economic empowerment (BEE) projects, such as Masiza Mussel Farm in Saldanha (Botes *et al.*, 2006: 3). The benefit of a grant would relate not only to the provision of capital for expansion, but also as protection from the unforeseen challenges posed by the natural environment.

The environment

The marine environment is influenced by both natural and anthropogenic factors that affect the sustainable development of mariculture. In Saldanha Bay, natural factors, such as wind-driven upwelling and extensive coast-bay exchanges, play a role in creating an optimal environment for bivalve growth, while anthropogenic factors such as infrastructure development facilitate the cultivation and sale of bivalve products. However, there are also negative impacts exerted by these factors. In Clark *et al.*'s (2009: 3) study on the state of Saldanha Bay, five anthropogenic factors were shown to affect the ecology of Saldanha Bay

and have a direct impact on bivalve cultivation. These factors are shipping, dredging, fish factories and mariculture, sewage, and storm water.

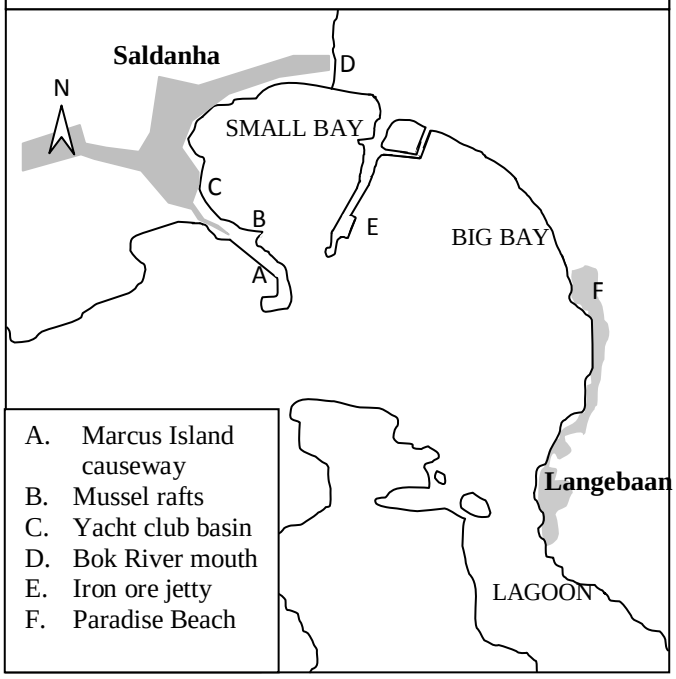
The port of Saldanha is an international port, receiving over 400 ships per year. High concentrations of shipping traffic carry high risks for hydrocarbon pollution through oil spills and the introduction of toxins or alien species in ballast water discharges[7] (Clark *et al*., 2009: 41). Crude oil, bunker oil, petrol and diesel are types of hydrocarbons that might be introduced into Saldanha Bay through spills from tankers or other ships, and from refineries, storage tanks or other industrial and domestic sources. There have, however, been no recorded oil spills in Saldanha to date. Transnet National Ports Authority and Oil Pollution Control South Africa (OPC) have signed an agreement to improve procedures to prevent oil spills and to clear them at the Port of Saldanha (Clark *et al*., 2009: 44). Oil spills are a minor threat when compared to the effects of shipping, both directly and indirectly, on the quality of water in Saldanha Bay.

Ballast water from iron ore carriers in Saldanha is a direct impact of shipping. Ballast water contains high levels of trace metals such as copper, zinc and lead that exceed South African Water Quality criteria. Possible solutions to contamination by ballast water discharge have been put forward by the International Maritime Organisation (IMO), such as the treatment of water while on board the ship as well as regulation of the management of ballast water while at sea (Clark *et al*., 2009: 22). However, because no measures have been put in place to deal with the discharge of trace metals into Saldanha Bay to date, this poses a great shipping-associated risk to Saldanha Bay. Trace metals can be toxic and tend to accumulate in the flesh of oysters and mussels. The levels of trace metals in bivalve flesh could become too high for human consumption if the water is polluted. Trace metals that have accumulated in the sediment on the seabed in Saldanha Bay also pose a risk if activities such as dredging and blasting re-suspend the sediment (Atkinson *et al*., 2006: 6, 31, 36; Clark *et al*., 2009: 7, 44).

[7] Ballast water is fresh or marine water taken in by the ship at its port of departure to stabilise the ship on its voyage. This water may be discharged at its destination, depending on the cargo load. The introduction of invasive alien species or pathogens from ballast water discharge is recognised as one of the greatest threats to the world's oceans (Clark *et al*., 2009: 41).

Dredging and blasting are indirect impacts of shipping on Saldanha Bay. Saldanha Bay has undergone extensive dredging and blasting since the construction of the Marcus Island Causeway (Illustration 1)[8], while further dredging and underwater blasting have been proposed for maintenance and expansion operations in Saldanha Bay (Clark *et al*., 2009: 29 & 31). Studies on the quality of water in the bay following a dredging event that occurred in Small Bay in 1997/98 revealed that dredging causes the re-suspension of sediments. Such sediments decrease water transparency and oxygen levels, while the re-suspended sediments may release toxic metals, pollutants and high levels of organic waste trapped in the silt of the seabed. High levels of organic waste result in eutrophication, algal growth and anoxia. Eutrophication causes a rapid increase in the levels of algae and phytoplankton blooms, known as a red tide event. Such blooms exert a high oxygen demand, depleting the water of oxygen, which results in hypoxia. Hypoxia causes the release of toxic sulphide and methane, which result in black tides that are fatal to marine organisms, including bivalves (Atkinson *et al*., 2006: 34 & 46; Clark *et al*., 2009: 29). Although the release of organic waste from dredging is infrequent, organic waste in the form of sewage is a constant occurrence in Saldanha Bay.

Illustration 1: Monitoring Stations



The most significant source of nitrogen loading from discharge into the bay in terms of continuous environmental impact comes from sewage (Clark *et al*., 2009: 22). A study conducted in 1998 (Monteiro *et al*., 1998: 11) describes the treated sewage effluent as making a "minor contribution" to anthropogenic nitrogen inputs into Saldanha Bay. However, since that time, the towns of Saldanha and Langebaan have expanded rapidly, putting pressure on sewage systems and elevating the levels of effluent in Saldanha Bay to unhealthy levels (Saldanha Bay Municipality, 2007: 13).

[8] For a panoramic illustration of Saldanha Bay, see Addendum A.

Faecal coliform counts, an indicator of sewage pollution, in Small Bay have frequently been in excess of safety parameters for mariculture use (Atkinson *et al*., 2006: 5; Clark *et al*., 2009: 7). Disease-causing microorganisms that may be present in untreated sewage or storm water runoff pose a health risk to the consumers of infected seafood. Data from monitoring stations in Small Bay have indicated, over a period of six years, that almost all stations exceeded target limits of faecal coliform counts for mariculture (Illustration 1). Only the station at the mussel rafts showed slight improvements. Counts were highest at the Bok River mouth, from which treated effluent enters Small Bay. The faecal coliform counts in Big Bay were much lower, but untreated sewage entered the Langebaan Lagoon and Saldanha Bay from leaking septic tanks and overflowing sewage pump stations situated at points along the coastline of the towns of Saldanha and Langebaan. Ongoing erosion along Paradise Beach threatens to damage sewage collection tanks that currently lie buried three to four meters below the surface. Seasonal spikes in faecal coliform counts correspond to holiday periods, when sewage systems become overloaded, and during periods of high rainfall, when storm water discharge into Saldanha Bay is at its highest (Atkinson *et al*., 2006: 14, 27 & 28; Clark *et al*., 2009: 6 & 7, 17, 34 & 35).

Increases in storm water discharges into Saldanha Bay are directly linked to and are exacerbated by the expansion of development in Saldanha and Langebaan, and continue to increase with growing urbanisation. In addition to sewage, storm water discharge may wash other contaminants, such as metals, fertilizers, hydrocarbons, plastics and solvents or bacteria, into Saldanha Bay via numerous storm water drain outlets or tarred surfaces (Clark *et al*., 2009: 22). Due to the multiplicity of storm water outlets, it would be impossible to manage the water entering Saldanha Bay. In order to prevent increasing contamination from storm water runoff, the waste and sewerage infrastructure need to be reviewed and residents should be educated about waste disposal (Clark *et al*., 2009: 5, 7, 22; Saldanha Bay Municipality, 2007: 19).

The Integrated Development Plan for Saldanha (Saldanha Bay Municipality, 2007: 19) stated that there was not yet a "coherent, forward-looking and full policy document and plan for the development, upgrade and expansion of a municipal-wide storm water management system" in Saldanha. However, the Saldanha Bay Municipality has developed an Integrated Waste Management Plan (IWMP) at policy level, along with a 10-year Integrated Waste Management Policy. The IWMP may help to reduce the levels of certain contaminants

entering storm water runoffs, but more needs to be done to expand the capacity of the sewage plants (Saldanha Bay Municipality, 2007: 11 & 19).

Some suggest that the presence of the mussel farms in Small Bay are a contributor to nitrogen loading in Saldanha Bay (Clark *et al.*, 2009: 8). On the contrary, however, Shumway *et al.* (2003: 16) assert that bivalves not only actively remove nitrogen from a system, but the bacteria associated with the sediments of an oyster bed can remove 20% or more of the nitrogen in oyster waste. This assertion is supported by Grant *et al.* (1998: 41), who add that bivalves improve water quality by regulating phytoplankton populations, and improve water clarity by playing a role in the recycling of nutrients in the marine ecosystem. Furthermore, both the quality of water and the amount of space available allow for the expansion of bivalve mariculture in Saldanha Bay. The expansion of bivalve farming in Saldanha may lead to reduced levels of nitrogen loading in the bay and the improvement of water quality in general.

Further benefits from the presence of bivalve mariculture activities are found in the monitoring of trace metals in the water (Atkinson *et al.*, 2006: 5, 89). A metal contamination monitoring programme called the Mussel Watch Programme, initiated in 1985 by the then Directorate of Marine and Coastal Management of the Department of Environmental Affairs and Tourism (now the Directorate of Marine Aquaculture Management the Department of Agriculture, Forestry and Fisheries), measures levels of trace metal concentrations in samples of mussel flesh taken from within Saldanha Bay. Data collected from these samples indicates that the levels of trace metals in the bay are acceptable and pose no risk to mussel mariculture. It may be concluded, therefore, that overall water quality in the bay is suitable for mussel and oyster culture. However, the question remains, "What rate of production is the water able to support?" This question addresses the issue of the bay's carrying capacity.

Carrying capacity is an important consideration for bivalve mariculture, because rates of production will drop as a direct result of over-stocking (Heasman *et al.*, 1998: 37). It is therefore of importance to the bivalve mariculture sector, as well as to the environment, that production does not exceed Saldanha Bay's carrying capacity.

Grant *et al.* (1998: 44) calculated the carrying capacity of Saldanha Bay using a case study of 60 mussel rafts at a stocking density of one raft per hectare. Their study found that there was a 37% surplus of particulate organic carbon (POC) in Saldanha Bay, indicating that mussel

stocking could increase by 37%[9]. Grant *et al.*'s study is vital for the present project's objective of calculating the sector's expansion potential. However, Grant *et al.* (1998) do not state how many tons live weight of bivalve products per annum Saldanha Bay can support. Heasman *et al.*'s (1998) work is helpful in this regard. Heasman *et al.* (1998) calculated the total live mass produced in a six-month grow-out cycle based on the same case study as Grant *et al.* (1998).

Heasman *et al.* (1998: 39) calculated that each raft produces from 26.121 tons to 43.785 tons of mussels per six-month grow-out cycle, depending on the rope spacing and raft size. Therefore, it may be estimated that annual production ranges from 52.242 to 87.570 tons per raft per year, or double the six-month cycle[10]. By multiplying these figures by 60, it is possible to estimate the annual production for Grant *et al.*'s case study of 60 rafts. Thus, the mussel farms in Grant *et al.*'s study produced an estimated 3 134.5 to 5 254.2 tons per annum. By multiplying these figures by the 37% expansion potential, it is possible to conclude that Saldanha is capable of supporting the production of 4 294 to 7 198 tons per year, assuming that environmental factors remain stable.

For all the anthropogenic influences affecting the marine environment within the Saldanha Bay, it would appear that the natural processes, such as the Benguela upwelling system and currents circulating this water, play a significant role in the "physical and chemical water characteristics of the bay" (Atkinson *et al.*, 2006: 33). Although contamination levels require monitoring, the levels of nutrients, chlorophyll, oxygen and salinity in Saldanha Bay "show no or negligible variation from the natural baseline" (Atkinson *et al.*, 2006: 89). Hence, the natural environment in Saldanha Bay is suitable for bivalve growth and for the sector's expansion.

Conclusion

Declining fish stocks are negatively affecting employment levels globally, locally and at the community level. In Saldanha, jobs have already been lost and many more are at stake

[9] Grant *et al.*'s (1998: 4) calculation is based on mussel production figures, not oyster production. The present study applied the 37% potential to both mussel and oyster culture. Although mussel and oyster production are not identical, they are not too dissimilar. In the light of no such research yet having been conducted on carrying capacity for oyster culture in Saldanha Bay, applying the same rates of production to both oysters and mussels is considered sufficient for the purposes of the present study.

[10] Heasman *et al.*'s (1998) tests ran from September to March, thus recording summer production figures (Heasman *et al.*, 1998: 37). Doubling the six-month production figures over-estimates annual production, because summer production is higher than winter production. However, no research exists for winter production per raft. Heasman *et al.*'s calculations are considered sufficient for the purposes of the present study.

because of wild fisheries having reached their capacity for exploitation. Bivalve mariculture has been identified internationally and by local government as a source of employment for disenfranchised fishers, as it is a relatively labour-intensive sector that is comparable in terms of skills to the fishing sector. The question is whether this sector is sustainable and what potential it has to expand.

Judging from the five factors that play the greatest role in the sustainable development of the sector, it appears that the bivalve mariculture sector in Saldanha has the potential for sustainable development and employment creation. However, the state and funding appear to play a limiting role to the sector's expansion potential. Nevertheless, there is considerable space in the local market for bivalve products, and there enormous expansion potential in Saldanha Bay. Therefore, the factors that may pose the greatest challenge to the sustainable development and volume of production are very much in the sector's favour. In addition, there is a wealth of human capital in the form of labour to support the expansion of this labour-intensive sector.

A study of the literature on Saldanha has indicated that there is a great need for a labour-intensive sector such a bivalve mariculture to develop in Saldanha Bay. Furthermore, the natural environment, market and local community appear to be contributing factors to the development of such a sector. An idea has also been established of the limiting factors that may challenge the sustainable development of the sector. What remains to be answered, however, is the contribution that the bivalve mariculture sector is currently making to local employment, as well as the specific challenges faced by bivalve mariculture farms. To do so requires empirical research. Thus, the following chapter introduces the fieldwork process by which data were collected and thereby these questions were answered.

CHAPTER FIVE: METHODOLOGY

Introduction

Three groups are involved daily in the primary production of bivalve mariculture in Saldanha: 1) state-employed agents with the role of managing the relationship between the bivalve mariculture sector and the state, here referred to as state representatives, 2) the directors of bivalve mariculture farms and 3) all those employed by the directors during the course of a year, here called bivalve mariculture employees. In order to respond to the research question that deals with employment creation potential and the sustainable development of the sector, it was necessary to gather data from all three groups. The units of analysis are, therefore, individuals. The units of observation are bivalve mariculture farms.

Sampling Design

The sampling designs differed according to the requirements of the data collected from each population. To this end, two different sampling designs were used. A census was used for the directors, and non-probability sampling was used for the state representatives and bivalve mariculture employees.

The participation of state representatives in the present study was required, as the development of the bivalve mariculture sector in South Africa is guided by a regulatory framework constructed by the state. In prior research, the predominant cause for bivalve mariculture farm directors' complaints related to the functioning of the state, thus the perspectives of state representatives were important (Britz *et al.*, 2009:57). Non-probability sampling was used to select two representatives, one from the City of Cape Town Municipality involved in bivalve mariculture in the Western Cape, and the other from the Department of Agriculture, Forestry and Fisheries (DAFF) who is directly involved in Saldanha. The criteria for the selection of these two representatives were based upon their experience of the sector. The representation of one municipal staff member and one DAFF staff member was considered sufficient for the present study.

All the directors involved in this sector in Saldanha were interviewed. A census of directors provided a dual function: not only were the views of the entire population recorded, but the directors provided data on the employee profile of the entire sector (Table 1), as well as the characteristics of all of the bivalve farms.

Table 1: Total industry employee profile

Position		**Farm1**		**Farm2**		**Farm3**		**Farm4**		**Farm 5**		*Male Total*		*Female Total*		**Position Total**	
Gender		*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	#	**%**	#	**%**	#	%
Labour	P*	2	1	7	4	9	2	31	1	9	1	58	**87%**	9	**13%**	**67**	**82%**
	C*	0	1	0	2	0	0	0	0	0	0	0	**0%**	3	**100%**	**3**	**4%**
Supervisor		0	0	2	0	0	1	2	0	2	0	6	**86%**	1	**14%**	**7**	**8%**
Skipper		1	0	1	0	0	0	2	0	0	0	4	**100%**	0	**0%**	**4**	**5%**
Secretary		0	0	0	0	0	1	0	0	0	0	0	**0%**	1	**100%**	**1**	**1%**
Gender Total		3	2	10	6	9	4	35	1	11	1	68	**78%**	14	**22%**		
Employees		**5**		**16**		**13**		**36**		**12**							
Industry Total																**82**	**100%**

*P (permanent)
*C (casual)

For this study, a sample of the employees was selected using non-probability sampling. Due to the fast-paced nature of the industry, the directors were reluctant to interrupt or slow down production. A compromise was reached in that interviews were conducted on-site with the employees who were available at the time. The directors nominated employees who were available, but these employees were given the choice to decline participation. Out of a population of 82 bivalve mariculture employees, 28 took part in this study. Care was taken that the sample (Table 2) was representative by comparing it to the profile of the total population (Table 1). When comparing the categories recorded in the population profile, such as contract hours, gender and position, with the same categories of the sample, the comparison revealed very little difference.

Table 2: Employee sample profile

Position		**Farm1**		**Farm2**		**Farm3**		**Farm4**		**Farm5**		*Male Total*		*Female Total*		**Position Total**	
Gender		*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	#	**%**	#	**%**	#	%
Labour	P*	2	1	1	2	4	2	10	0	3	0	20	**80%**	5	**20%**	**25**	**89%**
	C*	0	0	0	0	0	0	0	0	0	0	0	**0%**	0	**0%**	**0**	**0%**
Supervisor		0	0	0	0	0	1	0	0	1	0	1	**50%**	1	**50%**	**2**	**7%**
Skipper		1	0	0	0	0	0	0	0	0	0	1	**100%**	0	**0%**	**1**	**4%**
Secretary		0	0	0	0	0	0	0	0	0	0	0	**0%**	0	**0%**	**0**	**0%**
Gender Total		3	1	1	2	4	3	10	0	4	0	22	**79%**	6	**21%**		
Employees		**4**		**3**		**7**		**10**		**4**							
Sample Total																**28**	**100%**

*P (permanent)
*C (casual)

Instrument Construction

Two corresponding, semi-structured individual interview schedules were constructed for the state representatives and the bivalve mariculture farm directors respectively. These instruments sought to record the perspectives of each group on the same issues. In order to do so, both interview schedules followed the same sequence of questions. The only variation between the two instruments was that the interview schedule for the bivalve mariculture farm directors included an additional section in which quantitative data on employee profiles were recorded in a table on the response sheet. Once all the interviews with the directors were concluded, the employee profiles provided an overview of the entire population of bivalve mariculture employees in Saldanha. This overview was used as a measure of external validity for the sample of bivalve mariculture employees that was drawn at a later stage.

A structured group interview schedule was constructed to collect quantitative and qualitative data from a sample of bivalve mariculture employees. The structured group interview schedule concluded with a short focus group discussion facilitated by the question, "Is there anything that I have not thought of asking that you feel will be important for my research?"

The Fieldwork Process

Fieldwork was conducted in three phases. The first phase of fieldwork began in November 2010 with the interviewing of state representatives. A representative from the City of Cape Town Municipality was interviewed. The second representative, from the Department of Agriculture, Forestry and Fisheries (DAFF), was interviewed in February 2011. The contribution made to the present study by these two representatives provided a response to the matters raised with the bivalve mariculture farm directors.

The second phase of fieldwork began in February 2011 and ran for two weeks, during which all five bivalve mariculture farm directors were contacted. Of the five directors that were interviewed, three were interviewed in their office on-site during work hours, and two were interviewed off-site after hours. The same semi-structured interview schedule was used for the directors throughout.

Interviewing the bivalve mariculture employees constituted the third and final phase of fieldwork , which began in March 2011 and ran for three months. The third phase was only possible upon completion of phase two, during which the directors were asked permission for access to their employees. All groups of employees were interviewed on site, but in a

location that was private. The structured interview utilised during this phase was pilot tested in January 2011 with the consent of one of the directors. During the pilot test, two employees (a supervisor and a labourer) were interviewed. The pilot-tested instrument was intended for individual interviews and was thirteen pages long, taking forty minutes to complete. The impracticality of the time required to conduct the individual interviews on-site escaped the notice of the researcher during the pilot phase of the fieldwork, but was pointed out by some directors as the beginning of phase three. The structured interview was subsequently adapted to accommodate a group of up to nine individuals for a period of roughly forty minutes[11]. The revised instrument eliminated questions that would be unethical to ask in a group context and restructured delicate questions that were essential to the study. For example, the question of income was addressed by asking if there were other sources of income for the household, as well as what portion of household income the bivalve mariculture salary contributed. The going rate was established during the interviews with the directors. A sufficient understanding of household income could be established in this manner without having to ask individuals how much they or other family members earned.

The revised instrument proved beneficial in many respects. Not only was a fraction of the time required for an equally useful amount of data, but the need for a translator that would have been necessary for some individual interviews was overcome due to the composition of the multilingual group. Furthermore, rapport was established between the researcher and the members of the group far more rapidly than between the researcher and individuals during the individual interviews of the pilot study. A third advantage of the revised structured interview was that it provided an opportunity for a short focus-group discussion. Upon concluding the interview, the opportunity for open discussion was introduced with the statement, "I am still learning about bivalve mariculture and so I may have left out some important questions. Is there anything that I have not thought of that you think I should include in my study?" Many interesting points were raised by the employees during these interviews.

Conducting the interviews on-site allowed for participant observation. I could observe the operations on the factory floor and, on two occasions, had the opportunity to accompany a

[11] The reconstruction of the instrument was done in consultation with the work of Robert Chambers, who presents the challenge that a researcher should not conduct fieldwork with the attitude, "What do I need to know?", but rather to consider "How much does the information cost?", "What can be left out?", and "What simplifications can be introduced?" – in short, "What do [I] *not* need to know?" (Chambers, 1993: 19, italics in original).

team to work on the oyster lines at sea. Seeing and participating in the process of how oysters are grown, harvested, cleaned, sorted and packed and how the long-lines are maintained at sea provided an in-depth understanding of the primary production process.

Data Recording and Capturing

The interviews with the directors and state representatives were recorded using a hand-held digital recorder in conjunction with written field notes. Each recording was transcribed within 48 hours of the interview. The focus group interviews with the employees were not voice-recorded due to the impracticality of transcribing a discussion in three different languages, often with multiple individuals talking simultaneously. Rather, responses were written down by the researcher during the interviews, with key points recorded on the response sheet next to the participant's number. This method proved adequate for the purposes of the present study because the analyses were based on the grouping of discussion topics into themes that emerged during the discussion.

The data collected were both qualitative and quantitative. Capturing the data required two different approaches. Quantitative data from the employee interviews were captured in SPSS 15.0 for Windows (2006), with some degree of post-coding for open-ended questions. Key points recorded by hand during the employee focus group interviews were grouped according to emerging themes. The responses were categorised beneath generic headings both for ease of communication and for protecting the confidentiality of the participants' responses. Data in the transcripts of the semi-structured interviews with the state representatives and bivalve mariculture farm directors were categorised according to the issues they address.

Data Analysis

After capturing the data from the bivalve mariculture employee interviews in SPSS, the data were processed using uni-, bi- and multivariate tables. Level of education, qualifications, level of work experience, gender, household size, number of dependants, term of residence in Saldanha, seasonality of labour, how employment opportunities are communicated and hours of work per week were analysed. The data from the focus-group discussion were grouped as positive responses to and typical challenges in the working environment.

The data captured during the semi-structured interviews were grouped according to the set themes that were addressed in the interview schedule. The data were analysed according to the five factors influencing the sustainable development of bivalve mariculture. The

interviews with the bivalve mariculture farm directors elicited valuable quantitative data, such as a profile of each operation's workforce, the organisms farmed, the volume of live mass produced in the past year, the culture technique, the organisational composition, the source of investment and the size of the farm.

CHAPTER SIX: FINDINGS

Introduction

The literature on Saldanha provided a broad background to the factors that may play a role in the sustainable development of the bivalve mariculture sector. However, a deeper understanding of these factors is needed in order to understand the employment and expansion potential of the sector. Such an understanding requires empirical research. The following chapter presents the findings of this research. Firstly, a description of each of the five main bivalve mariculture farms in Saldanha is provided. Thereafter, an employee profile for Saldanha's bivalve mariculture sector is described, followed by the results from the employee interviews and the focus group discussion. The discussion with bivalve mariculture farm directors on the influence of the five factors on Saldanha's bivalve mariculture sector is then presented, followed by the state representatives' perspective on the same five factors. The research findings present the findings on Saldanha's bivalve mariculture sector, which will be used to discuss the sector's sustainable development and employment potential in the next chapter.

Bivalve Mariculture Farm Profiles

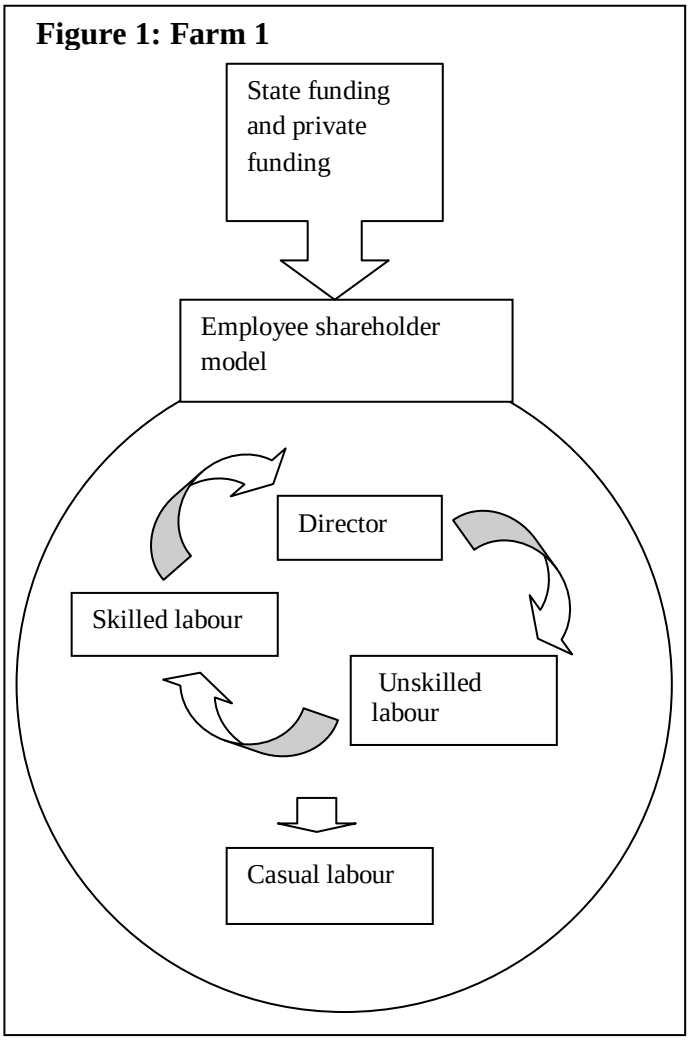
There are five main bivalve mariculture farms in Saldanha, utilising a total of 135 hectares of water area, 110 in Small Bay and 25 in Big Bay. Three farms cultivate only oysters (*Crassostrea gigas*); one farm cultivates only mussels (*Mytilus galloprovincialis* and *Choromytilus meridionalis*); and one farm cultivates both oysters and mussels (*C. gigas, M. galloprovincialis* and *C. meridionalis*). All oyster cultivation in Saldanha Bay uses the long-line system, in which "ropes of 150 m are strung with stacks of approximately 5 bags each at 1 m intervals", although one of the farms uses only two bags per one-meter interval (Haupt *et al*., 2010: 157). Of the farms cultivating mussels, one makes use of long-line[12] culture, while the other uses rafts from which ropes of 6 m in length are suspended at a density of approximately 1.5 to 2 ropes/m^2 (Diza, 2005:8; Saxby, 2002: 19). All the farms except one operate in Small Bay. The on-shore processing facilities of all the farms are located in the same area.

[12] Long-line culture of mussels differs from oyster culture in that mesh-covered ropes are suspended at similar intervals instead of stacks of bags.

Farm 1 (Figure 1)

Farm 1 is the smallest and youngest farm operating in Saldanha Bay. It is approximately two hectares in size and is three years old. The farm is structured as an employee shareholder model[13]. It is managed by one white male director with training in marine biology. Farm 1 produces oysters commercially on long-lines. The oysters are sold as seed oysters to another farm in Saldanha Bay. Approximately 5.5 tons of live mass oysters were produced in the previous production year. The farm is located in Small Bay and depends on both private and state funding.

Figure 1: Farm 1



Farm 2 (Figure 2)

Farm 2 is approximately thirteen hectares in size and commercial operation began in 2006. It is structured hierarchically and is run by one white, female director. The director has many years of experience in bivalve mariculture, as she farmed oysters in Port Elizabeth prior to moving to Saldanha. Farm 2 produces oysters commercially on long-lines[14]. The oysters are sold to consumers and retailers in South Africa and are exported to Asian markets. An estimated 59 tons live mass of oysters were produced in the previous production year. The farm is located in Small Bay and is privately funded.

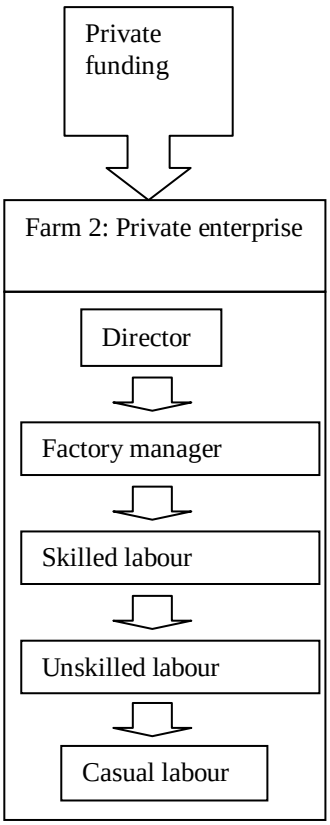
Farm 3 (Figure 3)

Farm 3 is the largest oyster farm in Saldanha, at 25 hectares. It began in 2005, but two of the directors have been farming mussels in Saldanha since the late 1980s. One director has a

[13] The farm is not owned by the director alone; all permanent employees hold shares in the business.
[14] The director stated that they currently had mussels on the farm as well, but the mussels were a pilot test and were not yet produced commercially. For this reason, Farm 2's mussels were not included in the study.

degree in marine biology. The farm is also structured hierarchically, but has two black directors and one white male director. Farm 3 produces oysters commercially on long-lines. The oysters are sold to consumers and retailers in the South African market, as well as to an exporter who sells to Hong Kong and China. An estimated 110 tons live mass of oysters were produced in the previous production year. The farm is located in Big Bay. It is built on the investment of private shareholders, three of whom operate as the directors on the farm.

Figure 2: Farm 2

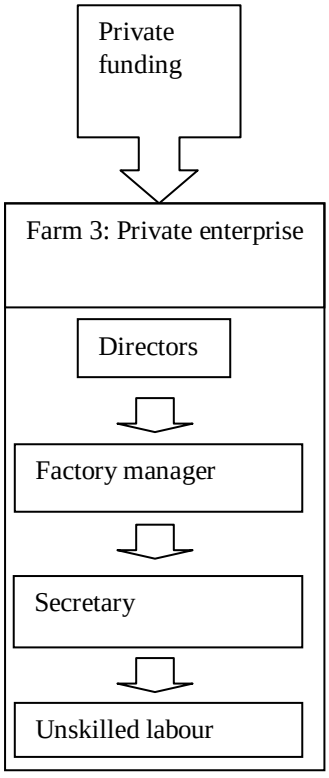


Farm 4a & b (Figure 4)

Farm 4a was purchased from Sea Harvest in 2000 on the condition that it was used to start a black economic empowerment (BEE) project (Botes *et al.*, 2006: 4). Farm 4b is the BEE project in question. Farm 4b works in partnership with Farm 4a. Farm 4a interacts with the government on the behalf of Farm 4b for permitting and testing. Farm 4a also provides insurance for Farm 4b by means of a savings fund.

Farm 4a is 50 hectares in size and is structured hierarchically. It is run by a white male director with a degree in marine biology. The farm produced 700 tons live weight in mussels in the past year of production. The raft system of production is used. Mussels are sold to a mussel-processing factory. All the mussels are sold in South Africa. The farm holds 26% of the shares in the partnership, with the cooperative that owns the remaining 74%. The farm is located in Small Bay and depends on private funding.

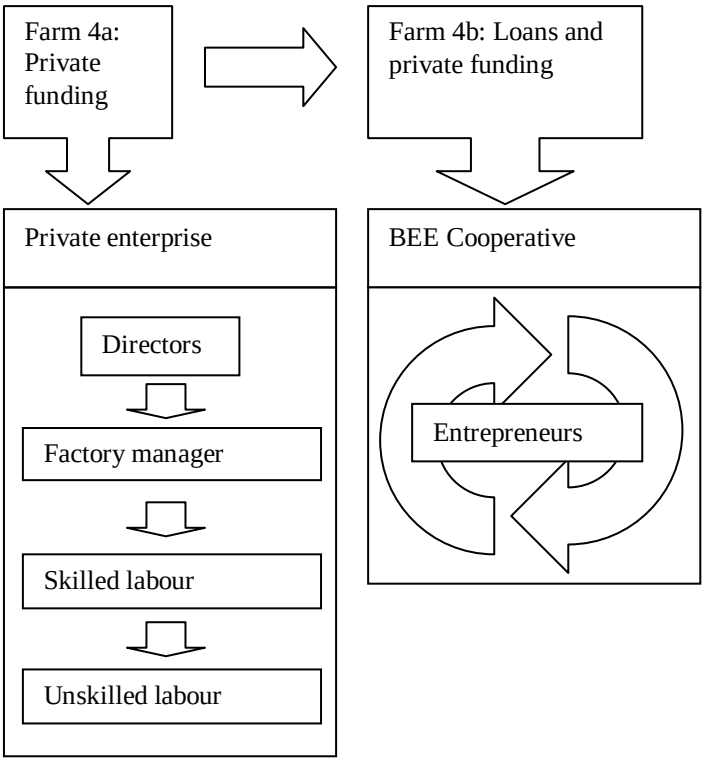
Figure 3: Farm 3



Farm 4b is 30 hectares in size and is structured as a cooperative. Six people work in two groups of three. They co-own nine rafts that have been purchased from Farm 4a. All of the cooperative members would be classified as previously

disadvantaged individuals (PDIs). All are black South Africans and have been resident in Saldanha for over five years. None of the cooperative members has completed primary school education. Each group works as a team, with each individual completing the same work required for the production process. Farm 4b produced an estimated 200 tons live weight of mussels in the previous production year. The harvested mussels are sold to the same mussel-processing factory as Farm 4a. Farm 4b is located in Small Bay and depends on private funding and loans from a financial institution. All mussel products from Saldanha are sold on the South African market.

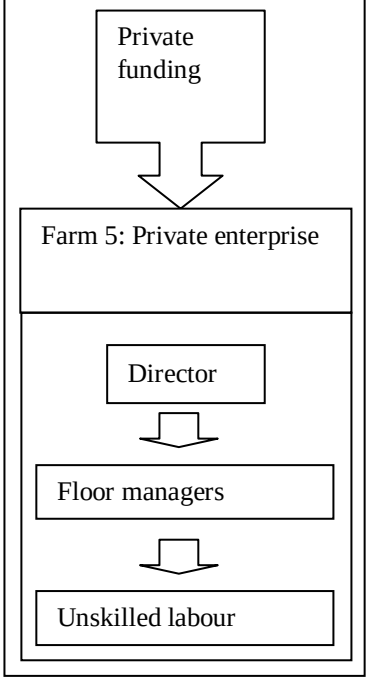
Figure 4: Partnership Model



Farm 5 (Figure 5)

Farm 5 began in 2005. The farm is an estimated 15 hectares in size and is located in Small Bay. Farm 5 is structured hierarchically. It is run by a white male director with a degree in information technology. It is the only farm in Saldanha producing mussels commercially with a long-line system. Farm 5 produced an estimated 1.6 tons live mass of oysters and 100 tons live mass of mussels in the previous production year. All produce is sold on the South African market. Farm 5 is located in Small Bay and depends on funding from private shareholders.

Figure 5: Farm 5



Bivalve Mariculture Employee Profile

A profile of the entire population of bivalve mariculture employees was constructed in consultation with the directors. The employee population was described according to three characteristics: employment position, gender and work hours. The entire population of bivalve mariculture employees (minus the directors) is 82. Of the 82 employees, 67 (82%) are employed in full-time labour. The remaining 18% are made up of seven supervisors, four skippers, one secretary and three casual labourers.

Saldanha's bivalve mariculture sector is strongly divided along gender lines. Interviews with the employees and with the directors highlighted the gendered aspect of labour roles. The structure of the labour force, where only men work at sea, is seen as a natural division of labour. Work at sea is considered physically demanding so that "only men are strong enough to do it". Because most of the work is done at sea, the sector employs over six times more men than women in full-time labour positions. Women are hired for processing and grading the product in the factory, although this job is also performed by men. Some of the farms hire casual labour for momentary spikes in demand, such as before long weekends in the summer. On these occasions, extra female labourers are hired for grading and cleaning. The idea that men alone are capable of work at sea is the probable explanation for all the skippers in the sector being male. The gendered nature of the bivalve mariculture sector is also evident in higher positions: out of ten management positions in the sector there is one female supervisor, and out of five directors only one is female.

Results from Interviews with Mariculture Employees

The current impact that the bivalve mariculture sector is having on employees and their households was established by means of a survey among the bivalve mariculture employees. The survey sought to establish who qualifies for employment in bivalve mariculture, what contribution bivalve mariculture makes to local employment and how bivalve mariculture affects household incomes.

Although there is a distinct gendered division of labour in bivalve mariculture, there was no difference in the level of education between men and women. The average grade for both male and female employees in the sample was grade 9. Neither was there a division in terms of level of education and employment position. For example, one supervisor had a grade 3 education, and 82% of the sample of employees had completed primary school education.

Six employees (21%) had completed additional training to the basic sea training that is standard for all bivalve mariculture employees. This additional training included two individuals with skippers' and driver's licences, one individual with fire-fighting training and one individual with forklift training.

Half of the sample population of bivalve mariculture employees, namely 14 employees, had two years or less experience in the bivalve mariculture sector. It may be deduced that the majority of new labourers are a result of the expansion of the sector. The employment of new labourers was recorded on all farms. No correlation emerged when factoring for recent immigration, indicating that the increase in employment positions over the past two years has benefited the local community.

Migration patterns are relevant in terms of local employment. The sector's employees come predominantly from the Western Cape (75%) and the Eastern Cape (25%). Within the segment of the population from the Western Cape, all 21 employees are from the Saldanha Bay Municipality: one employee is from Vredenburg, while the rest are from the town of Saldanha. While the segment of the sample from Saldanha Bay Municipality has both male and female employees, all of the employees from the Eastern Cape are male.

The recruitment for positions in the Saldanha bivalve mariculture sector appears to rely entirely upon informal means. Three categories emerged after coding responses to the question, "How did you find out about the job you are now in". In the vast majority of cases (83%), work in Saldanha's bivalve mariculture sector was advertised by word of mouth. The remaining two categories, 'came looking for work' and 'already working for director before farm started' were equally represented. When factoring for migration trends it was found that all of the employees from the Eastern Cape were told about the position by someone in the sector.

For over half of the sample population (57%), the income from employment in bivalve mariculture was the only source of income for the household. The vast majority (89%) of bivalve mariculture employees in the sample provide at least half the household income. The remaining three employees contributed 40%, 25% and 20% to their household income respectively.

The average household size for the sample was 4.2. Almost half (45%) of the members of the employees' households who are of employable age were employed. In 55% of these

cases, the household member was also employed in bivalve mariculture. Therefore, out of the total working-age population of household members (20 people), only four people were employed outside of bivalve mariculture. For the rest of the cases in which the households have an additional income, it is from various state grants. Therefore, additional sources of income for the households of bivalve mariculture employees are scarce. There are an average of 2.9 dependants per bivalve mariculture employee. None of the employees reported living alone. Thus, the estimated wage for a labourer of R2 500[15] per month supports almost four people on average. This implies a per capita income per household from bivalve mariculture of R609 per month.

Four focus group interviews with the 28 employees indicated a relatively even spread of positive and negative responses to the work environment. Discussion was opened with the question, "Is there anything that I have left out that you think is important for my study". The responses were coded into positive responses and typical challenges. The most popular positive theme related to a feeling of purpose. The employees felt they were part of a team, that the business that they were part of was growing, and stated that, notwithstanding some difficulties, "we like our job". Another positive theme related to customer interaction. The employees felt pride that their customers "always come away satisfied" and they enjoyed answering customers' questions. The final positive theme related to the interest that employees had in the work itself. One response was that the work was interesting, while another respondent specified that "I like the way the oysters grow even though you do not see that it is a living thing".

The majority of challenges related to the employer-employee relationship. Common complaints were that the labour employees felt overworked. Employees felt "driven and pushed" or "too overworked". Some employees stated that too many inexperienced labourers were hired, which slows production and increases the workload of the established labourers, who have to help them. Another challenge related to the harsh treatment of labour employees. A common complaint was that "the boss shouts at people" or that employees are told do something in a harsh or disrespectful way. The employees also stated that they would like to be paid more. They reported that they were not paid enough or that the wage that they were paid was different to that of another employee in the same position. The least-

[15]A labourer, a state representative and a director testified to roughly the same figure, averaging R2 500. The labourers explained that pay may vary based on the nature of the labour or term of employment.

mentioned challenge related to red tide events. The employees stated that they did not like the temporary closures that accompanied red tide events.

Results from the Interviews with Bivalve Mariculture Farm Directors

Both the bivalve mariculture farm directors and state representatives were asked questions that related to the sustainable development of bivalve mariculture as affected by: the state, the local community, the market, funding and the environment. The responses to these questions provide an indication of the factors that affect the sustainable development of Saldanha's bivalve mariculture sector.

The state

Discussion of the state addressed three questions: "What contributions can the state make towards the development of bivalve mariculture?", "Do you see this coming to pass in the future?" and "Have you experienced any changes that suggest the state is becoming more supportive of the bivalve mariculture sector?" The general impression gained from the interviews on the state was that the directors felt that the state was becoming more supportive of the sector in word, but not yet in deed.

All the directors mentioned financial support as their most important need. The directors stated that health monitoring costs were expensive. Testing for health monitoring includes tests for biotoxins, microbiology and inorganic compounds. Biotoxins are normally associated with red tide. Biotoxins such as those causing paralytic shellfish poisoning (PSP) are potentially lethal to humans and are tested for twice weekly. The non-lethal biotoxin causing diarrhetic shellfish poisoning (DSP) is tested for once per week. Microbiological testing is done monthly. Inorganic compounds such as radionuclides, heavy metals and pesticides are tested for once per annum. The tests cost each farm an estimated R60 000 per annum. If the tests confirm that the product or water is contaminated, the farm is temporarily closed until samples test clean.

Some directors felt that the closure of farms for health reasons was made without consideration for expenses accrued due to the loss of production. Unnecessarily long periods of closure were often due to inefficient state equipment or health-monitoring officials, with far-reaching implications. Sometimes one farm is closed while another is not, without due explanation. One director gave the example of when a water sample was sent for a monthly *Escherichia coli* test. It took two weeks for the results to come back. The *E. coli* count was

abnormally high, far exceeding the limit. The negligence of the testing was not queried, but the farm was closed. A new sample was immediately sent, but because it was a Thursday and the test takes two days, the laboratory refused to test it. The sample sent on Monday tested clean and so, after ten day's loss of income, and at the expense of three tests for which the director had to pay, the farm was reopened.

The provision of funding for – or the subsidisation of – health-monitoring costs was the most important contribution that the directors suggested the state could make.

Other examples of funding needs included:

1) Insurance
2) Grants and loans, and
3) Tax breaks

Some directors felt that the possibility of state funding being injected into bivalve mariculture has been hampered by the corruption that upset previous attempts by the state to assist bivalve mariculture operations[16]. However, one director reported on some funding that was beginning to come from the Department of Trade and Industry (DTI).

Another state-related issue affecting bivalve mariculture concerns the policy framework. State participation in the sector has increased in recent years. DAFF had made use of foreign best practices, setting up health monitoring in order to standardise the product quality in the sector, but requiring substantial expense from bivalve mariculture operations to conduct the tests or else face closure. Directors felt that the regulation of South Africa's bivalve mariculture sector was considered too advanced for where the sector is at present and, as a result, is "stifling the sector". The directors explained that the state needs to develop an enabling policy framework because the permit procedures are unreasonable, expensive and complicated. One director who commented on the need for an enabling policy gave the example of having to apply for a permit for every vehicle on which stock is transported: "You can put any flipping vehicle on there … I've got BMWs and Mercedes on there, it's not

[16] A director described how, a few years ago, the Land Bank gave funding to 11 individuals to start a BEE empowerment scheme based on mussel farming. Each individual was to get an interest-free loan. None of the individuals paid the loan back, however, and the individual steering the scheme apparently stole an amount of funding money. The director gave no names. Botes *et al*. (2006: 3) makes reference to the black-owned propriety limited company called Saldanha Mussel Growers, which was constructed to take over from "an empowerment initiative in the area that was failing" in 2000. Saldanha Mussel Growers closed down, however, "after a few years ... due to internal dynamics among the owners, a lack of capital, and no business support mechanisms" (Botes *et al*., 2006: 3).

like they check … why do we have to do it?" The same director complained that "the same goes for the boat, I say, 'why do I need a permit for the boat?' I mean the boat is my tractor and trailer". The cumbersome regulations are the result of bivalve mariculture being associated with marine exploitation such as fishing and wild stock harvesting, instead of being recognised as an agricultural activity.

One director contrasted the strict regulatory environment for local production with the leniency of import restrictions. This director noted that the state was jeopardising the wellbeing of the local sector by allowing cheaper, inferior products to command up to 75% of the South African market. The suggestion was made that the state should combine stricter import regulations with the assistance of marketing locally produced mussels and oysters to increase the market share of local products. Help with the exportation of products was also required from the state, specifically with export certification. The suggestion was also made that the importation of seed oysters indicated the need for a state hatchery. The directors noted that DAFF had arranged quarterly meetings to address the issues raised by the bivalve mariculture sector.

The DAFF established a research component about seven years ago that meets quarterly to engage with the sector on relevant issues. The utility of the meetings received a mixed response from bivalve mariculture farm directors. A concern was that the research component was cumbersome and overstaffed. One director complained that the meetings were "so slow; they talk about this and they want to change the meeting to this, and nothing is of any value ... ja, that is a boring day". The director explained that "you sit there and I only know about oysters and a guy comes and he goes ballistic about permits to export abalone and he goes on and on and on and on and they hardly touch on oysters".

Other needs for state assistance included state-employed mentors to facilitate black empowerment. The directors specified that such a mentor should have a developmental role and that mentors are needed to educate employee shareholders on what it means to own shares and how to make the best use of such an investment.

Two directors stated that the limited allocation of area for bivalve mariculture activities in Saldanha Bay presents a challenge to the future expansion of the sector. One director stated that the originally designated 1 000 hectares had been reduced to a total of 400 hectares since the late 1990s, 150 hectares in Small Bay and 250 hectares in Big Bay. The director

commented that other industries using Saldanha Bay may take priority for the leasing authority, Portnet, who "want to make money out of everything".

The rental rates that Portnet charge for lease areas in South African ports are a hindrance to the expansion of the bivalve mariculture sector. According to a director who has researched rental rates for other countries with bivalve industries, South Africa's rates are the highest in the world. South Africa's lease fees are thirteen times higher than those of its neighbour, Namibia, despite the water quality being similar. The director sees this as the fault of the South African government, because the leasing authority in South Africa belongs to the South African government. However, the government is allowing Portnet to determine rental rates.

The local community

The next set of questions addressed matters relating to the local community. The discussion focussed on conflicts among different user groups and how these could potentially impact on the sector.

In response to the question on the incidence of crime, the greatest damage done to the bivalve mariculture sector is from fishers stealing mussels for bait. One director reported that the mussel ropes were sometimes cut in the process. The loss of product and damage to equipment amounts to R200 000 per year. Oyster grow-out bags were also reported to have been cut, but apparently the thieves "[did not] know what the size of the oysters in the bags were" and had "no ... clue what it [was] that they wanted to steal". A case in which oyster were stolen from one farm by another farm in the bay was mentioned. The director relating this case stated that one could "detect that sort of activity fairly quickly", however, and follow it up because the sector is small and the directors know each other well. The director stated that intra-industry theft might become a greater problem if the sector expands to consist of many small-scale farmers. Weekend petty theft from the factory was also mentioned, was seen as more an annoyance than a threat to the sector.

The pursuers of recreational activities are also responsible for inflicting damage on bivalve mariculture equipment. Motorboats are driven without regard for the farms, with the result that the propellers cause damage to the partially submerged long-lines[17].

[17]This was illustrated on one occasion when I was on board an oyster boat participating in harvesting. A recreational user, presumably interested in buying cheap oysters or simply out of curiosity, according to the director, came directly towards us as we were packing the oysters on the sorting raft, with total disregard for the

Questions on the local community were also related to employment. The directors were asked what criteria they looked at before employing employees. The directors did not require the employees to have any qualifications, even for skilled labour positions, other than the necessary certification for skippers and drivers. Those in positions of management were hired according to their experience and ability. Labourers were hired according to recommendations from other employees and demonstration of a good work ethic. Two directors expressed opinions on hiring ex-fishermen. One director preferred hiring employees with an employment history in the fishing sector. Such employees have a "fishing culture" and do not expect to be paid if there is no work. Such employees can be paid per day, not on a contractual basis. Another director preferred to hire Xhosa individuals, due to "bad experiences" with "Coloured" employees from the Western Cape. This director believes that Xhosa employees are more "trustworthy [and] hardworking" than "local people and ex-fishermen" and can be left unsupervised. The director added, "Alcoholism does not seem to be a problem with [Xhosa] Eastern Cape guys". However, most of the directors did not appear to hire employees on the basis of their race or employment history.

Each farm has a different approach to its terms of employment, especially concerning payment during temporary closure. Two farms in Saldanha adopt a 'no work, no pay' approach to employment, reasoning that they do not have the funds to pay employees when there is no income. Because mussel farms are more severely affected by closures during algal blooms, one mussel farm has an informal insurance mechanism whereby a 'kitty' is set aside into which a percentage of the employees' salaries is deposited. This is used to pay the employees during closures. At the end of the year, any leftover funds are included in the Christmas bonus. An oyster farmer stated that they had never needed to short-pay their employees. The director stated that "if it gets desperate" they give employees time off that they can work back later on. Another director stated that, by farming both mussels and oysters, the production of one organism can continue if the other has been temporarily closed.

The market

Discussion on the market addressed three questions relating to national and international markets. Two farms export oysters to the Asian market and to the local consumer market.

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submerged long-lines. It was only when the recreational motorboat was passing over the line that an employee noticed it. After much shouting and gesticulating by the mariculture team, the person on the boat, unable to hear them, performed a u-turn and drove back over the lines. The director reflected that it may have been the same person who had damaged the lines before.

One farm sells seed oysters directly to another farm in Saldanha Bay and not directly to the market. Two farms supply only the local market with mussels and oysters. A mussel producer stated that export at this stage was not viable due to the competition in the international arena and a shortage of mussels on the local market.

South African mussel products currently make up 30% of the local market. The difference is filled by "cheap international imports". The directors believe that if the local industry could expand to 60% or 70% of the market they would be able to out-compete the imports. However, such expansion is limited by a lack of funds. South African oyster products hold a much larger percentage of the local market. According to one director, 63% of the oysters sold in South Africa are farmed in Saldanha. Namibia is apparently one of the biggest exporters of oyster products to South Africa and is the greatest competitor of South Africa's local producers. Nevertheless, oyster producers were optimistic about the potential of the local market, which has grown "enormously" in the past twenty years, but "the problem is that production has grown faster". Oyster producers stated that the local oyster sector could be developed through better marketing to the public. The difficulty with marketing local produce is, however, its high cost. Local producers do not have the capital to afford marketing. One director said that the first step in developing the local market is for supermarkets to "get involved".

Supermarkets are an effective way to sell to the public. A limitation to selling in supermarkets is the lack of post-harvest processing facilities. Saldanha's mussel and oyster sectors rely predominantly on the fresh market. In order to increase the representation of local products in South African supermarkets, smoked, canned and frozen mussel and oyster products are required. Many oyster producers had plans to install freezing facilities, but were limited by a lack of funds. All of the oyster producers stated that being able to freeze oysters would increase their market opportunities because the product could be stored and transported for long distances. An oyster producer also stated that he "would like to" have smoking and canning facilities "one day", but that "no one is doing that yet in Saldanha or [in] South Africa".

Mussel producers also emphasised the need to increase marketing for local products. According to a mussel producer, imported products, mostly from New Zealand, are cheaper, but are of poorer quality and often labelled incorrectly as being of a higher quality than they are. The competition offered by locally produced mussels on the local market could be

increased through a marketing scheme that promotes the superior quality and reliability of South African products. The director suggested that branding such items with the "Proudly South African" logo might assist in this regard. Again, the greatest hurdle to marketing and branding was cost.

Some oyster producers were exporting to Asian markets. They stated that the relatively relaxed import restrictions permitted importation from South Africa. The directors were optimistic about the potential that existed to export to the United Arab Emirates (UAE) and the Southern African Development Community (SADC) countries, as importation from the south would be cheaper than importation from the north. Export to European markets does not appear to be an option due to Europe's import restrictions. The directors believed that these restrictions existed more to protect Europe's local sectors than because of South Africa's quality standards. The mussel producers stated that they were not interested in exportation yet because of the large gap in the local market, and because of the large-scale production in European countries in comparison to which South Africa's production levels paled.

Funding

Funding is a factor so significant to Saldanha's bivalve mariculture sector that a lack of funds affects all the other four factors. As mentioned by the directors in the interviews above, a lack of funding is exacerbated by the constraints that state legislation, in terms of permitting and testing, places on farms. A lack of funding intensifies the shock of closure for employees when production and, in some cases, employee incomes are halted. A lack of funding limits participation in the market, because the scale and diversity of production as well as marketing are unaffordable. A lack of funding also increases the sector's vulnerability to the natural environment, because temporary closures that result from biotoxins in the water have a severe effect on cash flow when there is no insurance for salaries and no production.

All five directors listed private funds as their most important source of funding, even if some examples of formal or state funding were given. For three directors, private funding, either through private investors or personal funds, formed the sole source of funding for the farm. One farm that practices BEE had received funding from a formal financial institution. Another farm, also practicing BEE, had received some financial support from the state.

None of the farms had any insurance for their stock. A director explained that the premiums on insuring stock were "impossible". As mentioned in the discussion above about the local community, one farm had created informal insurance schemes by setting aside portions of the employees' own earnings. Another diversified the species that were farmed in an attempt to maintain cash flow if the production of one species was halted.

All the directors reported that the expansion of their farm had been limited by a lack of funds. One director explained that "...you get to a size where you kind-of break even, making a living, and you can't get out of it ... artisanal [farming] only works up to a point, it is not efficient. To get past that into bigger production and higher efficiency, you need funding".

The environment

The fifth factor affecting bivalve mariculture producers was the environment. Environmental influences may stem from human activity in Saldanha Bay or from natural causes.

In general, the directors expressed concern over the increase in pollution from industrialisation. The greatest concern was that Portnet might decide to expand shipping operations. Shipping poses threats in the form of direct pollution through oil spillages and fuel leakages. However, in the event of an oil spill, the vessel's insurance would cover the loss of production for the bivalve mariculture sector. Oil spillage was thus less of a concern than the indirect threats from shipping that include the dredging and blasting undertaken for maintenance operations and port expansion. Dredging and blasting cloud the water with fine sediments that clog the filtering apparatus of bivalves. The re-suspension of sediment also carries the danger of increasing levels of heavy metals in the water. Heavy metals become concentrated in the flesh of bivalves and may render them unfit for human consumption. Dredging and blasting may also re-suspend nitrogenous waste that has been silted over on the seabed. A major source of nitrogenous waste in Saldanha Bay has been fish processing.

One director stated that a fishmeal factory had been operational in Saldanha Bay five years previously and that it had had a negative impact on the water quality. The director stated that the water quality in Saldanha Bay had improved since the factory stopped working. The company that owned the factory is "on a strong drive to get it restarted". He believes that the presence of the factory will negatively affect the quality of the water in Small Bay if it becomes operational. The director stated that the factory would have to comply with the requirements of the International Organisation for Standardisation (ISO), of which the South

African Bureau of Standards (SABS) is a member, to keep its environmental impact low. However, the director believed that the factory might be able to "find ways around the ISO standards", as fish processing in Saldanha Bay is poorly monitored. The director concluded: "Those sorts of threats are there ... and you can't quantify any of them until they are reality." Bivalve mariculture farm directors appeared to be unconcerned about the contribution that fish factories were currently making to nitrogen levels in Saldanha Bay. A director stated that these factories "do not have a serious impact on bivalve mariculture". Pollution from sewage and storm water runoff has a more significant influence on water quality because it is less controllable, and is on the increase.

Storm water runoff and sewage pollution are at their highest in the winter. During this time, *E. coli* counts increase and could lead to farms being closed down temporarily. According to one director, the source of the problem is related to poor municipal planning, waste regulation and infrastructure maintenance. Small Bay, having a relatively slower circulation of water than Big Bay, is more susceptible to a build-up of pollutants. Aside from directly affecting bivalve products, pollutants can intensify algal blooms.

The algal bloom known as red tide was the most frequently cited environmental challenge to production. The frequency with which the subject of red tide was raised during interviews may have been motivated by the presence of red tide during the months that the interviews were conducted (February and March). A director related that red tides have been increasing in frequency and duration in recent years. While they used to occur once every few years, red tides have been occurring every year since 2009. The red tide lasted for twenty days in 2009 and approximately thirty days in 2010, and it had been in Saldanha Bay for the whole of February 2011. Although stock is not killed, productivity suffers because sale to the public is restricted during these times.

Public sales of bivalves are restricted during red tide-related closure because of DSP and PSP that may occur due to biotoxins in the bivalve flesh. However, the restrictions did not apply to the director who sold seed oysters to another farm in Saldanha Bay, as the sale was not to the consumer market. Black tides, which kill stock, have never occurred in Saldanha and are not a concern. The closest occurrence was in Eland's Bay in the 1980s.

Two directors expressed concern about a proposed gas plant. Apparently, the plant will make use of desalinised seawater. One director said, "We are all very worried because they are going to dump the salt into the sea. They assured us that, according to the study, it showed

that [it will be] such a little bit of salt that it will wash away ... but then they want to have the boats coming here to offload the stuff and have a pipe system ... so we still don't know what's going on".

Another concern is the increase in ocean temperatures due to global climate change. One director stated that the acidification of ocean water and the increase in pathogens are directly related to increasing ocean temperatures. Ocean acidification is a concern because it corrodes the alkaline shell of oysters. Oyster eggs and larvae are especially vulnerable to the effects of acidification. The impact of the increase in ocean temperatures could be felt in increasing losses in the early growth phases.

Results from the Interviews with State Representatives[18]

The state

According to the state representatives, the Department of Trade and Industry has moved responsibility for primary production from the Department of Environmental Affairs and Tourism (DEAT), previously under the then Directorate of Marine and Coastal Management (MCM), to the Department of Agriculture, Forestry and Fisheries (DAFF) under the directorate of Marine Aquaculture Management (MAM). This was done to overcome the problem of multiple departments involved in aquaculture and a lack of communication between them. A problem was that bivalve mariculture was driven by the Marine Living Resources Act (MLRA), which was written for fisheries and does not adequately address bivalve mariculture (Republic of South Africa, 1998). The shift in responsibility allows DAFF to produce a marine aquaculture[19] policy and the Marine Aquaculture Policy Implementation Plan, as well as to establish the marine aquaculture forum to facilitate communication between the state and the sector.

According to the state representatives, to simplify the regulation of the sector, the state intends to take aquaculture out of the MLRA and to categorise it as an agricultural activity. The current legislation is confusing because the MLRA is written to regulate the fishing sector and protects wild stock from being overexploited. The bivalve mariculture sector

[18] All statements, comments or opinions on the industry that are recorded beneath the subheading, "*Results from the Interviews with State Representatives"*, are those of the two state representatives and do not necessarily reflect those of the Department of Marine and Coastal Management.

[19] It would appear from the fieldwork that the term 'mariculture', used in scientific publications and adopted for the present study, is synonymous with the term 'marine aquaculture' adopted for all official publications in South Africa.

cultivates stock, as does the agriculture sector, and so the regulatory environment supported by the MLRA is not suitable for bivalve mariculture. A representative stated that an aquaculture act needs to be promulgated in order to increase the efficiency of the regulations relating to bivalve mariculture. The drawing up of an aquaculture act is only conceptual at this stage.

Local community

The next factor that was discussed was the local community. The issues that emerged included employment, the efficiency of production and recreational users.

The perception that the labour employees working in Saldanha's bivalve mariculture sector can be divided into two distinct ethnic groups, each with a different work ethic, again resurfaced when talking to one of the state representatives. This individual stated that the fisher people on the West Coast are used to the seasonality of the fishing sector, which allows time to relax between terms at sea. The representative juxtaposed this perspective on work with that of the labour employees who had emigrated or migrated from the Eastern Cape who, he states, are used to a farming way of life and are thus better suited to bivalve mariculture. Hence, at a local level, some "racial" ethnic groups are seen as being more suited to the sector than others. Bivalve mariculture farms differ not only in terms of the employment history of employees, but also in terms of the methods used.

According to a state representative, research into a more efficient method of mussel farming is under way. Apparently, a director in Saldanha is using long-line methods for mussel farming as opposed to the raft method. The director is said to claim that the long-line method is more efficient. The state representative also gave an example of inefficient bivalve mariculture practices. A certain bivalve mariculture farm has allegedly not been disposing of broken equipment properly.

There is a need for better standards for sector practice and equipment. For example, in some cases, rafts breaking apart or equipment breaking loose from rafts has presented navigation hazards to other users. In addition, Portnet has struggled to secure the lease fees from some of the bivalve mariculture farms in Saldanha Bay. The representative drew the conclusion that these factors shed a negative light on bivalve mariculture in the area. However, it was admitted that lease fees in Saldanha are extremely high in comparison with global rates. Bivalve mariculture needs to be better marketed to Portnet, as it appears that Portnet "don't

seem to want to be bothered with it". Portnet assesses market trends before deciding how much area to allocate to each sector. An area that may be allocated to bivalve mariculture one year may be allocated to something else the next. However, the representative stated that there still was a large area available for bivalve mariculture in Big Bay.

A potential source of future conflict was from residents who had bought property along the shoreline between Saldanha and the iron ore jetty. The view of the bay raises the value of the property. Some property owners dislike seeing the bivalve mariculture sector's buoys or rafts in that area of Small Bay, as they believe that the presence of rafts or buoys diminishes the natural beauty of the view and thus the value of the property. At times, the beach has been littered with plastic buoys that have broken off the lines. However, producers do attempt to pick them up regularly.

The market

Discussion of the third topic, the market, touched on gaps in the local market and the marketing of local produce. Suggestions were put forward on how to render the sector more competitive.

The state representatives suggested that there was no need to consider exporting at this stage because of the gap in the local market. They claimed that there was a market share of 60% to 75% in the local mussel market that is currently being filled by imports. The representatives suggested that there is short-term potential to double mussel production. If the current sector, producing 1 000 tons of mussels per year, is filling 25% of the market, there is space for a 4 000-ton industry. Therefore, it would be possible to double local production and still have 50% import parity. A limitation is presented to local mussel production by the high mark-ups by distributors on mussel prices.

The state representatives queried the mark-up on mussel products, but stated that such a large mark-up is made possible because the local market is monopolised by one large distributer, La Vie Seafood. One representative stated that this processor buys mussels from the farms at R3 to R4 per kilogram. Therefore, the mark-up of R17 to R20 per kilo at which mussels are sold to retailers is inexplicably high.

The state representative also queried the mark-up placed on oysters. Although oyster distributers only put a 30% mark-up on top of their distribution costs, the restaurants that buy

oysters at about R3.50 each sell them for R12 and R15. The representative suggested that, if restaurants dropped their profit margins, the sale of oysters might improve.

Funding

According to the state representatives, prior to funding the state measures all projects by criteria of economic viability. These criteria were introduced in 2009 as a result of funding being wasted on projects that failed in the past. The criteria of viability include:

1. Number of jobs provided
2. Available infrastructure
3. Partnership models
4. Black economic empowerment (BEE)

The state representatives said that the state considered employment potential as the foremost criterion before allocating funding. One representative stated, "If [something] is going to create [only] ten jobs we [would] say, 'Go away!' because we need to put in water, sewage, roads, electricity … the rate of return on our investment is [not worth it]". According to one state representative, bivalve mariculture has an advantage over other mariculture sectors because of the relatively greater number of jobs created per unit of investment – more than South Africa's leading mariculture sector, abalone.

Apparently there are many projects that apply for state funding that are not economically viable. Infrastructure, such as the availability of water, sewage and transportation, needs to be evaluated to determine the feasibility both of beginning an industry and of supporting future development. The representatives concluded that Saldanha does not present any concern in this regard. Another factor relating to viability is the quality of testing equipment. One representative explained that the state was reluctant to invest in expensive testing equipment for a sector that was small in comparison to other food-production industries. Another consideration of economic viability is cash flow. In the case of bivalve mariculture, the time it takes to complete one grow-out cycle is a determinant of cash flow. One representative recalled examples of empowerment projects that failed because they did not have the capital to survive until the end of the grow-out cycle. One representative suggested that a good partnership model could help a small business to establish a cash flow cycle.

The state representatives described partnership models that have proven successful in the past. One example was Farm 4, because it was a BEE scheme in partnership with a large-

scale mussel farm and a mussel-processing factory. Another example of a partnership model that the state approves of is provided by Farm 1, an employee shareholding scheme with black shareholders in a worker's trust. In a worker's trust model the shares are held in a trust fund and dividends are paid to the employees on a regular basis. The logic behind such a model stems from the failures of past shareholder models. For example, in the past, employees owned shares individually, but were restricted from selling the shares for a five-year period. After that period, many employees who needed the cash would sell the shares, invariably to white people, with the company's BEE status dropping as a result. The workers' trust model ensures sustained empowerment for black employees through the shares being held in a trust, and not by individuals.

A closely related funding criterion to partnerships is BEE. One state representative related that the state does not give money away for no reason; it wants black equity. The state representatives expressed concern about the shortage of candidates for BEE funding. The Draft Marine Aquaculture Policy Implementation Plan that was given to the researcher by a state representative lists transformation as a key implementation programme, as "[f]ew PDIs own or are involved in aquaculture operations at a senior management level" (Republic of South Africa, 2009: 9).

Some bivalve mariculture operations in Saldanha fulfil the funding criteria described above. During the time of the interview, the national empowerment fund had pledged to supply one operator in Saldanha Bay with a R9 million loan and a mussel raft valued at R300 000 by the end of the month. The farm in question was participating in BEE. The national department applied for R120 million for aquaculture for 2012, of which some would be allocated to mariculture. The state representatives were optimistic about funds for mariculture increasing in the future, because the state recognises the returns in jobs the sector provides per unit of investment. According to a state representative, one mussel raft valued at R300 000 translates into roughly one job in primary production and another 2.5 jobs in the processing factory. The representative stated that a R9 million loan, such as the one awarded by the empowerment fund, could translate into 60 permanent positions.

Environment

The environment was the last of the five factors discussed. The iron ore industry, sewage, storm water and the carrying capacity of the bay were the issues that arose.

According to the state representatives, the greatest threat to water quality came from the iron ore industry. The representative stated that Portnet had plans for doubling the size of the iron ore jetty. However, development was on hold due to the instability of steel prices.

The threat presented by *E. coli* contamination of the water is increasing, according to one director, who blamed the poor management of the sewage and storm water systems by the Saldanha Bay Municipality. The representative reiterated that although this was not affecting the sustainable development of the bivalve mariculture sector at the time, it could become a problem if the poor management continued.

Finally, one state representative stated water quality was not a limiting factor to the expansion of the sector. The representative stated that, although the carrying capacity of Saldanha Bay was far greater than the current capacity of the sector, the growth of the sector was limited by the zoning of water-use areas by the leasing authority, Portnet. Portnet evaluates the development trajectory of industries in Saldanha Bay each year and reassigns usage areas accordingly. Therefore, what may have been assigned to bivalve mariculture one year may not be available the next.

Conclusion

The present chapter sought to provide a deep description of the sustainable development and employment potential of Saldanha's bivalve mariculture sector. The interview data were presented to this end. First, the bivalve mariculture farms were described, followed by a description of the employee profile and, finally, the perspectives of directors and state representatives on factors influencing the sector's sustainable development.

Interviews with bivalve mariculture employees provided considerably insight into the impact that the bivalve mariculture sector is having on local households in terms of providing household income. It also appears as if alternative livelihood options are limited. Interviews with the bivalve mariculture farm directors and state representatives appeared to support the main points in the literature, namely that state policies and funding play the most significant role in limiting the sector's expansion. However, the interviews provided a far greater depth of insight into the challenges facing the sector, as well as the sector's advantages. The expansion potential of the sector appears to be considerable. The present chapter provides the material for data analysis and an interpretation of the factors that influence the sustainable

development of Saldanha's bivalve mariculture sector in order to estimate its expansion and employment potential. Such a discussion is undertaken in the following chapter.

CHAPTER SEVEN: DISCUSSION

Introduction

Government has recognised the employment potential of South Africa's mariculture sector. However, one of the key questions asked in this study is whether Saldanha's bivalve mariculture sector is sustainable. This chapter argues with reference to Saldanha's bivalve mariculture sector that it is sustainable, but that certain factors limit its development, growth and employment potential. The discussion begins by applying the people-centred development and learning process approach to the findings. The application of the theory shows that Saldanha's sector is in the first phase of development and has the potential for sustainable development goes beyond the provision of employment to include environmental sustainability and black economic empowerment. The challenges that may affect the sector's future development were identified by the lessons learned from other case studies. From these lessons, the discussion demonstrates how challenges to Saldanha's sector originate from the state, the market, a lack of funding, the environment and the local community. An assessment of the sector's employment potential concludes the chapter.

People-Centred Development

People-centred development goes beyond economic growth. It even goes beyond the provision of employment. People-centred development sets out to achieve well-being through the process of empowering the local community. A discussion of Saldanha's past employment booms and busts through the lens of people-centred development aims to demonstrate that sustainable development is not a matter or employment creation, but of "ordinary people [playing] the leading part" in their own development (Swanepoel, 1992: 6).

Large-scale employment opportunities in Saldanha's past, such as the construction of Saldanha Steel, had an inverse effect on local employment levels than what was expected. Rather than reduce local unemployment, the sudden availability of work instigated a mass-migration of job seekers from outside the area, mostly from the Eastern Cape, with the result that local unemployment increased – especially after the construction phase ended. The fishing sector is currently having a similar effect; increasing local unemployment as positions are limited or workers are retrenched. The modernist assumption that massive industrial development in Saldanha was going to trickle down to the local poor has failed, leaving the majority of low-income households "marginal to their society's development path"

(Shepherd, 1998: 2). The lessons from the past illustrate that sustainable development goes beyond economic growth and employment provision.

The mariculture sector in Saldanha is unique in that it demonstrates the potential for well-being in a way that no other leading sectors in Saldanha exhibit. The low impact of bivalve farming on the natural environment that has been discussed in Chapter 6 demonstrates the sector's contribution to environmental well-being. However, due to the sector still being in the first phase of the learning process, the full potential for social well-being remains to be demonstrated. Nevertheless, a model for empowerment is presented by the case of Farm 1 and Farm 4b. In the case of Farm 1, the majority of shareholders are black farm labourers. In the case of Farm 4b, the farm is entirely owned by individuals who used to work as labourers.

These cases demonstrate that Saldanha's mariculture sector has the potential for people-centred development because "real participation does not mean labourers are employed – participation should be long before that. People should be in right at the start..." (Swanepoel, 1992: 3). Those that have been there since the beginning have grown in their capacity to shareholders, managers and owners, some without having completed primary school. Saldanha's mariculture sector demonstrates through these examples that the development of the sector does not only bring about the "improvement in physical and social conditions" but it has provided individuals who may have had no employment opportunities elsewhere with the opportunity to "control and sustain" their source of income (Buller & Wright, 1990: 3). The possibility of Saldanha's mariculture sector to continue with people-centred development requires a learning process approach.

The Learning Process Approach

According to the learning process approach, the sustainable development of a sector is determined by the fit between that sector's task, context, and organisational design (Korten, 1980: 497). In the case of the bivalve mariculture sector, its 'task' is to meet the requirements of its stakeholders. The context is constructed by the five factors: the state, the market, funding, the environment and the local community. The organisational design of the sector determines its ability to accomplish its task and to stay relevant to its context. In this regard, Korten (1984: 184) claims that the learning process approach to development proceeds through three stages: learning to be effective, learning to be efficient, and learning to expand. These stages may overlap, but are completed sequentially.

The first stage of the learning process is the stage of learning to be effective, where knowledge and experience are acquired through trial and error. The primary concern at this level is developing a model that has a high degree of fit with the stakeholders' requirements. At this stage, the sector requires a high level of intellectual input and a low level of administrative constraints. During this stage, the sector "learns to learn" and develops the organisational capacity required to maintain a high level of fit (Korten, 1980: 500). Experimental pilot projects, or "learning laboratories", are tested on a small scale (Korten, 1980: 500). These learning laboratories play an important role in providing basic models on which to base expansion (Korten, 1984: 184). When a sector can adapt its capabilities to maintain a high degree of fit, it begins to move into stage two. The second stage, learning to be efficient, is a time of decreasing the input demands for each unit of output. Based on the understanding of fit gained in stage one, beneficial activities are established, while superfluous activities are reduced. At this stage, a cadre of employees may also be trained to form a core team to maintain the sector's fit as it moves into the expansion stage (Korten, 1980: 500). The third stage, learning to expand, is a stage during which the sector's capacity is expanded. Expansion is phased and orderly to maintain as high a level of fit as possible, although some degree of effectiveness and efficiency are inevitably lost during this stage. At this stage the sector depends on the organisational capacity that was developed during the first two phases to maintain a high level of fit, especially as changes occur in the sector's structure as part of the expansion process. Expansion generally includes scaling up the volume of production and increasing the range of products. The goal of the learning process would be achieved by the end of stage three, when a sustainable, large-scale sector has developed that meets the requirements of its stakeholders.

Relating this to the bivalve mariculture sector in Saldanha, one gets the sense that the first stage, 'learning to be effective' through trial and error and the experimentation with different farming methods, is advanced. In discussing the learning process approach, Uphoff (1998: 25) relates that learning can be undertaken through learning laboratories, intellectual input and "knowledge and experience of someone who has been immersed in ... conditions". Saldanha's bivalve mariculture sector is positively positioned on all three counts. Firstly, for almost 30 years, the sector has been operating in Saldanha during which farms have experimented with farming techniques to suit the conditions unique to Saldanha. Secondly, academic research on Saldanha's bivalve mariculture sector has been ongoing during this

time. Thirdly, some of the farmers have qualifications in marine biology as well as long-term experience, having established the first bivalve mariculture farms in Saldanha,

Some of the farm employees have also been working in the sector for many years. The value of experience held by these individuals is found not only in their experience in bivalve mariculture, but in the local community. Farm 4a is made up of people immersed in both the local living conditions of farm labourers and the bivalve mariculture sector.

The opportunity to use bivalve mariculture for community development is demonstrated in the case of Farm 4b, in which directors from Farm 4a and government played the "facilitating role" in collaborating with nine employees to launch Farm 4b, the cooperative (Swanepoel, 1992: 6). This case demonstrates how community development is possible through elites and government helping local individuals to take initiative. More such examples may be possible if the sector was less restricted by administrative constraints.

Saldanha's bivalve mariculture sector does not benefit from a freedom from administrative constraints, which is the second requirement for development in learning to be effective. On the contrary, the regulatory framework for South African mariculture is renowned for its restrictiveness. Therefore, although the bivalve sector has developed a degree of robustness, accumulated a wealth of experience, and has been able to operate within the context of a highly fluctuating natural environment, the current permitting regulations, high rental and high health-monitoring costs have negatively affected the sector's development. These constraints reduce the profits needed for reinvestment, which obstructs the growth potential, profitability and competitiveness of the sector. Thus, the import market is able to out-compete local produce in terms of consistency and pricing. The market, although it prefers locally produced mussels and oysters, requires a consistent supply at a low price. At its current size, the bivalve sector does not meet these requirements. The sector's sustainable development also depends on the fit it has with its context, as described by the five factors typology.

Context: the Five Factors

Lessons learned from the four case studies (Chapter Three) suggest that the success or failure of a mariculture sector is associated with five factors. These factors are the state, the local community, the market, funding and the environment. These 'Five Factors' provide a typology with which to evaluate the key influences that affect the functioning of mariculture

operations and are useful in order to discuss the sustainable development and employment potential of Saldanha's bivalve mariculture sector.

The first factor, the influence of the state, is paramount to the success or failure of mariculture ventures. The state regulates the sector, protecting it from haphazard expansion, disease, market saturation and user conflicts. The state is also a facilitator of the sector, providing policies that promote the sustainable development of the sector and local participation. The facilitating role of the state includes the provision of mariculture zones and creating an enabling environment for sector expansion. The state may function as a source of funding for the sector, promoting development through sponsoring marketing and networking or providing loans and grants.

The Namibian case demonstrates how bivalve mariculture may benefit from protection, provision and promotion by the state. In Namibia, the state drew up legislation to promote sustainable bivalve mariculture, provided start-up capital, research and development funding, designated bivalve mariculture zones, and sponsored marketing. As a result, the Namibian sector has experienced accelerated growth, established a strong export market and diversified the sector to include sanitation programmes and oyster hatcheries. However, the regulatory role of the state also has the potential to alienate local participation.

The sector in Grand Manan, Canada illustrates how state regulation affected local small-scale finfish mariculture producers. An epidemic of infectious salmon anaemia (ISA) broke out because of inefficiency in the control of stocking density in Grand Manan's finfish mariculture sector. In order to check the spread and further outbreaks of the disease, the state drew up policies that limited access to the sector to already established fish farmers and stipulated that the fish on each site were to be in the same grow-out cycle. These policies significantly decreased cash flow and had the unintended consequence of pushing local producers out of the sector. Only large-scale producers had enough capital to participate in the new regulatory environment. What had started as a locally owned sector became a multinational one. Where local empowerment had initially been the goal, local participation in the sector was in the end limited to labour.

As seen in the case of Grand Manan, the state's overregulation led to small-scale production becoming impossible. Similarly, we see in South Africa that the regulation of the sector has meant that small-scale aquaculture producers feel neglected by the state (Britz *et al.*, 2009: 54). Bivalve mariculture farmers are required to obtain permits to farm with oysters or

mussels, to transport the product from the lines/rafts to the jetty and from the jetty to the factory a few hundred meters away. The legislation is considered too advanced for a sector of the current size. The state representatives and directors felt that the regulatory role of the state in South Africa is more restrictive than protective. Regulations governing the transport of organisms, the permits regulating which species are to be handled and processing licences were seen as vestigial regulations from the Marine Living Resources Act (MLRA), which was written for the fisheries sector but to which aquaculture regulations have been appended (Republic of South Africa, 1998).

Some degree of permitting is necessary to protect South Africa's natural environment. Oyster spat are imported to South Africa and bivalves are transported around the country. Both bivalves and the epibionts that they carry on their shells have the potential to be invasive. Thus, permitting to regulate the transportation of bivalves is essential. However, the bivalve farmers felt that, because the regulations were originally written for the fisheries sector, the manner in which permitting is administered is unnecessarily time-consuming, expensive and illogical.

Farming area leases pose other administrative challenges. In harbours, bivalve mariculture farmers lease a portion of the marine 'commons' from Portnet (Transnet National Ports Authority), a subsidiary of the parastatal organisation Transnet, which is administered by the South African Department of Public Enterprises. Unlike agricultural farmers, bivalve mariculture farmers cannot own land, so they have no surety with which to acquire loans from financial institutions. Institutions are also hesitant to insure bivalve mariculture stocks because this is considered a 'high risk' enterprise. In addition, Portnet does not only designate water area for bivalve mariculture use, but also determines the lease fees (Mapfumo, 2009: 3; Springer, 2008). Both the bivalve mariculture farm directors and the state representatives describe the rates that Portnet charged bivalve mariculture users as the highest in the world – 13 times higher than those in Namibia. The concern is that high lease rates and restrictive regulations may lead to the closure of smaller developing bivalve mariculture farms (as in the case of Grand Manan) and takeovers by giant producers. The bivalve sector is also ideally suited to subsistence farming, but current regulations make this impossible.

The second factor that is essential for the sustainable development of a mariculture sector is market demand. Without a market for its products to generate an income, a sector is doomed.

The market is a changeable influence, however – at times greatly contributing to the generation of profit, and at other times contributing to a sector's struggle or collapse. Competition from cheap imports or market saturation may cause a local sector to collapse. Therefore, a healthy, protected local market is essential to the establishment of a sustainable sector.

The benefit of establishing a strong market is evident in the Namibia case. The state assisted in the development of a market for Namibia's bivalve mariculture sector by assisting with marketing, sponsoring representatives to attend international trade shows and establishing standards for export certification. Strong marketing support contributed to the rapid expansion of Namibia's bivalve mariculture sector and reduced its dependence on South Africa as its prime market.

As seen in the Namibian case, market demand is a prerequisite for sector expansion. The directors stated that their share of the local market could be increased by post-harvest value adding in the form of freezing, smoking and canning. There are no locally canned smoked mussel or oyster products in South Africa. The directors stated that the local bivalve market needs to be diversified, as South African oyster products supply only the fresh market. According to one director, freezing is the next necessary step, followed by smoking and canning facilities in the future. However, market demand may be filled by cheaper imports.

The strain that competition with imported products can place on a sector is illustrated by Amatikulu Prawns in KwaZulu-Natal, South Africa. The South African prawn sector, consisting solely of Amatikulu Prawns from the mid-1990s until the mid-2000s, grew to produce one-million tons per annum. For half a decade, the sector struggled to compete against cheap imports on the local market. In 2004, a global drop in the prawn market, a strong ZA Rand and the dumping of excess prawns from India struck the final blow to South Africa's prawn sector. The sector collapsed in 2006.

Another example of the rapid collapse that is brought on by market saturation is provided by Bentan/Tumbak. The seaweed sector in Bentan/Tumbak relied entirely upon exportation. The nature of seaweed farming – its rapid reproduction, the low cost of production and the fast grow-out cycles – contributes towards boom-and-bust cycles. Therefore, after a five-year boom, the world market became saturated and Bentan/Tumbak's sector collapsed.

According to the directors in Saldanha's bivalve mariculture sector, there currently is a gap for mussel and oyster products on the South African market. In addition, the quality of locally produced oysters and mussels is preferred by local clients. The demand on the local market should translate into economic gains for Saldanha's bivalve mariculture sector. However, this is not the case because lenient import regulations permit underpriced imported products to outcompete local products. These imports may come from countries that subsidise their production or may be incorrectly labelled as being of a higher quality. Local producers are forced to cut their profit margins to compete.

A low profit margin reduces the capital that is available to invest in increasing the efficiency of production. According to the bivalve mariculture farm directors, investment could lead to expansion, higher productivity and competitiveness. Coupled with effective marketing, the sector has enormous growth potential, given that the physical environment is ideal for mussel and oyster cultivation. In addition, the export potential is vast and can be a valuable source of foreign exchange.

The export potential is evident in two of the Saldanha farms that supply Asian markets. A director was also optimistic about the potential that UAE and SADC countries present for exportation, as it would be cheaper for them to import from South Africa than from the Northern Hemisphere. However, a limitation to export is health clearance certification. Such certification would need to be established and supported by the South African government.

The third factor, funding, is essential for a sustainable mariculture sector. Funding in the form of investment or insurance will allow this sector to expand in order for it to overcome shocks from the market or the natural environment. As seen in other examples, without insurance a temporary market or environmental shock can cripple a sector . This is aptly illustrated by the case of Amatikulu Prawns, where market saturation by cheaper, substandard products crippled operations.

The bivalve mariculture sector faces similar challenges. The directors described how the lack of subsidisation and insurance increases the financial strain of compulsory health-monitoring costs and temporary closures. The expenses for health monitoring are carried by the individual farms. The temporary closures that intermittently result from test samples in excess of safety parameters cause undue strain due to a lack of insurance. On two farms, employees are without a salary for the duration of any closure. The directors of these farms stated that they could not afford to pay employee salaries while production was halted.

Although one director had applied for the subsidisation of employee salaries, no such subsidisation was available. Some directors felt that the state should subsidise monitoring costs as well as employee salaries during temporary closures.

The state's financial contribution to the bivalve mariculture sector is not substantial. The state representatives explained that the state has recognised the sector's potential to generate revenue and create jobs. Therefore, the state is willing to invest in companies that can demonstrate their ability to create jobs, develop viable ventures, create sustainable partnerships and promote BEE. According to the state's criteria, the bivalve mariculture sector has the potential to qualify for all of the funding criteria.

The criterion of job creation is fulfilled by the bivalve mariculture sector, as it offers the highest employment per unit of investment of any of South Africa's aquaculture sectors. Oyster culture is one of the most labour intensive of all aquaculture industries (Britz *et al.*, 2009: 39). According to a state representative, mussel culture employs more people per unit of investment than South Africa's leading aquaculture sector, abalone.

The bivalve mariculture sector in Saldanha is economically viable, because very little investment in the surrounding infrastructure is needed to accompany an expanding sector. Transport, communication and basic services are well established, because Saldanha supports large-scale international industries. Furthermore, freezing and canning facilities are already established for the fishing sector, and some of these are vacant due to the fishing sector's decline. Such infrastructure may be of use to an expanding bivalve sector.

Saldanha's bivalve sector has demonstrated that both oyster and mussel farming provide a platform to develop partnerships. For example, Farm 1, a small-scale oyster farm with employee shareholding, sells its produce to the largest oyster farm in Saldanha, Farm 3. Farm 1 has received state funding. In another example, Farm 4 is a partnership between Saldanha's largest mussel farm and six black entrepreneurs. The entrepreneurs own nine mussel rafts. The BEE partnership has also qualified for funding, but, according to some members, this has not yet been released.

Bivalve mariculture farms in Saldanha demonstrate a great potential for BEE. Three of the five have a high BEE rating. Two of these farms are 66% black owned: one due to the shareholder model of the farm and, in the other, two of the three directors are black. One farm is in a partnership with a 100% black-owned empowerment scheme. Furthermore, four

of the seven supervisors in the sector are black. One of the black directors is also qualified as a skipper.

A fourth factor that has a tremendous impact on the viability and sustainable development of mariculture is the environment. The marine environment has an immediate effect on the productivity of an operation, as it affects the efficiency of production and the quality of the product. However, the environment is susceptible to change. It is vulnerable to anthropogenic influences as well as natural fluctuations. Therefore, the marine environment requires continual monitoring and conservation.

The benefit of an optimal marine environment is evident in the Namibian case. The environmental conditions in Namibia facilitate some of the fastest bivalve growth rates in the world. As a result, the Namibian sector was able to expand rapidly and establish export quality certification and a strong export market. However, the Namibian case also illustrates the instability of the natural environment. A harmful algal bloom devastated the sector in 2008.

In Saldanha, the natural environment is one of the sector's greatest assets, as the quality of the water and relatively sheltered bay are optimal for bivalve production. For example, Saldanha Bay exhibits some of the fastest bivalve growth rates in the world (Haupt *et al.*, 2009: 156; Karaan, 2009: 250). The bivalve mariculture farms in Saldanha Bay are only using 24.9% of the carrying capacity of the bay, which means that there is the potential for the sector to expand to four times its current size. However, maintaining the quality of the water is essential for the bivalve sector's development.

In recent years there has been an increase in algal blooms in Saldanha Bay. The blooms occurred in Saldanha in 2009, 2010 and 2011, increasing in duration with each successive year. Although such occurrences do not harm the stock, the biotoxins that proliferate during red tides are absorbed into the flesh of bivalves and may be harmful or lethal to humans if eaten. For this reason, farms are often temporarily closed when the water has tested positive for biotoxins. Temporary closure of the affected farms results in a loss of income for the farm.

Although algal blooms are a natural phenomenon, anthropogenic influences can exacerbate the blooms by increasing nitrogen levels in the water. Significant contributors to algal blooms, such as organic waste, may come from processing, sewage, storm water or the re-

suspension of sediment from underwater blasting and dredging; these are typically associated with iron-ore related construction and maintenance activities (Clark *et al.*, 2009: 6 & 104, Probyn, Pitcher, Pienaar & Nuzzi, 2001: 405). These anthropogenic influences are being managed in various ways. Fish processing operations are subject to the National Water Act (1998), governed by the Department of Agriculture, Forestry and Fisheries (DAFF) (Clark *et al.*, 2009: 39). Therefore, if monitoring is reliable, processing waste should not exceed safety parameters. Similarly, the re-suspension of sediments related to construction activity is regulated by the National Ports Authority (National Ports Authority, 2007). The greatest challenge to the quality of Saldanha's water is sewage discharge (Clark *et al.*, 2009: 22). The Integrated Development Plan (IDP) of the Saldanha Bay Municipality has identified this as a problem (Saldanha Bay Municipality, 2007: 11). According to some directors, increasing algal blooms may also be linked to global climate change.

Two directors stated that global climate change is the greatest concern for the bivalve sector. The directors expressed concern about the effects of global climate change, including an increase in diseases and harmful algal blooms and increasing acidification of seawater. The acidification of seawater is apparently already causing losses of oyster eggs and larvae in some countries (Kurihara, 2008: 276).

The risk of invasion by alien species from shipping and the importation of stock were not mentioned as a concern during the fieldwork. One director stated that South Africa has strict regulations on shipping and has banned bivalve imports from countries with infected stock. The importation of oyster spat from France is currently banned due to a recurring viral infection in French stock, according to one director.

The marine commons in Saldanha Bay is utilised by many interest groups. At times these interests clash with those of the bivalve mariculture farmers. The most common challenges arise from recreational users and fishers. Recreational users' motorboat propellers damage the long-lines that are partially submerged. Fishers steal mussels for bait, sometimes in large quantities, and occasionally cut mussel ropes in the process. The loss of stock to theft and vandalism amounts to R200 000 per year, according to one director. Cases of intra-sector theft were also mentioned on oyster farms. The director stated that such incidences could be followed up, as the sector is still small and the farmers know each other.

The fifth factor that is critical to the success of the mariculture sector is the availability of the necessary skills and labour. An experienced body of directors/farmers, with longstanding

experience, helps the sector to overcome challenges. The availability of labour is also important. The sector depends on a relatively large labour force to be available to work for 40 to 50 hours per week, plus overtime during peak times. Thus, the labour force would need to live close by and would ideally be large enough to support a growing sector. In rural coastal towns where fisheries have collapsed, the potential growth of mariculture as a means to create employment is viewed positively by the state.

The cases of Grand Manan (Canada) and Namibia both illustrate how important it is that directors/farmers have longstanding experience in the sector. In Canada and Namibia the mariculture sectors began with pilot projects initiated by local entrepreneurs. Shortly thereafter, a few other pilot projects started up and the new sector spent roughly a decade gaining experience through experimentation with small-scale production. These learning laboratories established the fit between the new sector and its context and raised a cadre of farmers with the experience to manage large-scale production.

The cases of Bentan/Tumbak (Indonesia) and Canada illustrate the positive and negative impact that the local labour force could have on a mariculture sector. In the case of Canada, mariculture was supported by the state as a means to provide alternative employment in the light of the declining fisheries sector. However, the policies led to a loss of local participation in the new finfish mariculture sector. The losses lead to user-group conflict between those who relied on traditional livelihoods and the local individuals who were employed in the finfish mariculture sector. These conflicts were manifest in incidents of abuse, legal action and blockades.

The benefits of community support are evident in the case of Indonesia. In Indonesia, the local community rapidly adopted seaweed farming as an alternative to the declining traditional livelihoods of fishing and related activities. The community support permitted the sector to expand rapidly. Conflicts relating to expansion were limited to disagreements over the use of marine space for boat lanes. The conflicts were easily resolved, however, because the community was well disposed towards the locally owned seaweed mariculture sector.

As seen in the cases of Canada and Namibia, the longstanding experience of mariculture directors is important for developing a sector that can sustain a high degree of fit with the natural environment. In the case of Saldanha, most of the directors have worked in the sector for a long time – most are marine biologists with extensive experience in the sector. These directors have established relationships and support networks over the years. For the actual

farming and processing of the product, the sector does not demand a high level of skill and this is an ideal sector to create jobs for people with a lower level of education, even those who are presumed 'functionally illiterate'. In this regard, the large population of unskilled and unemployed labourers in Saldanha is an asset, while the sector has the potential to create many jobs. The sector thus has the potential to create poverty relief for many, even though the wages (as in the case of agriculture) are comparatively low.

The income of the bivalve mariculture employees was roughly R2 500 per month, which translates into R609 per capita per month based on the average household size of 4.2. This is only slightly higher than the minimum wage in South Africa. Yet despite this low wage, this was the sole source of income in more than half of the households. What is important to realise is that, for every one job, three to four dependants are supported. Furthermore, the Food and Agriculture Organization of the United Nations (FAO, 2009: 7) estimates that, for every primary sector position in aquaculture, four positions are created in the secondary sector. One could thus calculate that Saldanha's bivalve mariculture sector creates 360 additional positions. If one were to deduce, as the FAO proceeds to calculate, that there are three dependants for every secondary position, then 1 350 individuals rely on Saldanha's bivalve mariculture sector for their wellbeing.

A concern of the Saldanha Bay Municipality is that unemployment levels will continue to increase as the population continues to outgrow the economy (Saldanha Bay Municipality, 2007: 10). The rapid population growth was previously encouraged by the construction of the steel processing plant and is sustained by the perception of job opportunities in Saldanha. Thus, a great contributor to population growth in Saldanha is the in-migration of work seekers, especially from the Eastern Cape (Saldanha Bay Municipality, 2007: 9; Socio Economic Profile, 2006: 109; Vorster & Heinecken, 2009: 8). In-migration not only counteracts employment creation, but leaves those who fail to find work economically stranded.

Over the past two years, during which the majority of employees in the sector were recruited, three quarters of the new employees had been residing in Saldanha for at least five years. No specific preference for recruitment exists in terms of employment history for the sector as a whole, except for one farm that preferred ex-fishers. In general, however, recruitment appears to favour Saldanha residents, regardless of their employment history.

Bivalve Mariculture's Employment Potential

The employment potential of Saldanha's bivalve mariculture sector is directly related to its sustainable development. The five factors provide a typology with which to evaluate the key influences that affect the functioning of mariculture operations and are useful to discuss the sector's sustainable development and expansion potential. By applying the five factors to the case of Saldanha, it has been shown that the sector holds great potential for sustainable development and expansion. Based on the understanding of Saldanha's expansion potential, the data can be used to calculate its employment potential.

Saldanha Bay's production potential was calculated to be 4 294 to 7 198 tons per year (see Chapter Four). Based on the production figures obtained during the fieldwork, it would be possible to estimate the employment potential of the sector by multiplying the current employment capacity of the sector by its expansion potential[20].

The bivalve mariculture sector in Saldanha Bay produced a total of 1 761 tons live weight of bivalve products in 2010 (1 000 tons of mussels and 761 tons of oysters). If the carrying capacity is 4 292 to 7 198 tons per year, then Saldanha's sector is able to expand by 2.44 to 4.09 its current size. Thus, if the sector currently directly employs 82 individuals, it will be able to employ between 200 and 335 individuals at its full potential. Roughly two-thirds of these, or 223 in the case of the maximum number of potential employees, would be residents of Saldanha.

The potential of the sector to provide local employment could also be estimated using the above calculation. The bivalve mariculture sector currently provides 70 labour positions, three quarters of which are filled by local residents. At its maximum size, the bivalve mariculture sector could provide 286 unskilled labour positions, of which three quarters (214 individuals) would be residents of Saldanha. Thus, the income from bivalve mariculture could benefit over 200 households in Saldanha's informal settlements. In Saldanha's informal settlements, 41% of households have an income of less than R500 per month (Vorster & Heinecken, 2009: 10). Direct employment in the bivalve mariculture sector has the potential to significantly reduce the number of households without income because

[20] This is assuming that the individuals employed per unit of production will remain constant throughout expansion. The ratio of individuals employed per unit of production is based on the employment profile of Saldanha's entire bivalve mariculture sector, as acquired through the fieldwork. The relationship between employment and units of production was not consistent from one farm to another. The relationship between individuals employed per unit of production is therefore used as a guideline that satisfies the requirements of the present study.

bivalve mariculture provides employment to individuals of both genders who are functionally illiterate. Such individuals experience extremely limited livelihood options. Saldanha's bivalve mariculture sector has significant potential to increase food security and to provide sustainable livelihoods, especially for those who lack the skills to participate in Saldanha's other growing sectors.

Conclusion

A key factor when considering the employment potential of Saldanha's bivalve mariculture sector is its potential to expand sustainably. The sector, notwithstanding still being in an early stage of development in terms of the learning process approach, has demonstrated tremendous growth since 2005 (Britz, 2009: 7). While the majority of farms in Saldanha have been in existence for over five years, oysters and mussels have been farmed in Saldanha since the 1980s, and farming techniques have been refined to suit the local conditions. Measured against the five factors that provide a typology with which to assess the potential for sustainable expansion, it has been shown that the sector has significant potential to expand and therefore to create employment. However, hampering the development of the sector are two main issues. These are state legislation and finance. These and other limiting factors are highlighted in the following chapter.

CHAPTER EIGHT: CONCLUSION AND RECOMMENDATIONS

Given the declining fishing sector and related job losses, the South African government has identified mariculture as a sector that can create jobs for the many unemployed labourers in rural fishing villages. This study used the case of Saldanha to assess the employment potential of the bivalve mariculture sector. It was proposed that the sector's employment creation potential is directly related to its sustainable development and its potential for expansion. This chapter highlights some of the key findings and conclusions on the sustainable development of the sector as it relates to South Africa with specific reference to the case of Saldanha. The main conclusions are discussed with reference to the five factors that influence the sector's sustainable development. These are the state, the market, funding, the environment and the local community.

The state plays a vital role in protecting the sustainable development of a mariculture sector. A supportive regulatory environment can be a key element to developing a healthy, sustainable sector. However, a regulatory framework that is unduly restrictive can alienate local producers and investors from participating in the sector. This was the case in Grand Manan and is currently the position in South Africa. The regulatory environment in Saldanha is considered by the local producers to be restrictive. Regulations governing the transport and handling of stock are redundant and stem from the incorrect classification of mariculture in the Marine Living Resources Act (MLRA) (Republic of South Africa, 1998). The alternative, of moving the governing of mariculture to the agriculture sector, is no better solution, as mariculture is dissimilar to agriculture in terms of property ownership, insurance and loan qualifications. Saldanha's bivalve mariculture directors foresee the bivalve mariculture sector either closing down or being taken over by giant corporations if the restrictive regulatory conditions continue. If that should happen, the government would have lost the opportunity to promote small enterprise development, local employment creation and black economic empowerment (BEE). As indicated, large-scale industrial development has had a negative impact on unemployment levels. Therefore, South Africa would do well to follow Namibia's example by drawing up policies specifically for the bivalve mariculture sector that promote local participation, as well as define a strategic plan to implement such policies. Furthermore, the state could designate mariculture zones that fall under the management of the DAFF instead of Portnet to overcome the exceptionally high rates that are currently being charged to bivalve mariculture operations and to prevent the constant reallocation of and reductions in bivalve mariculture zones. Creating an 'enabling

environment' will also allow the local sector to become more competitive on the local market.

Critical to the success of mariculture is the market. In the case of Amatikulu Prawns in KwaZulu-Natal, the constant challenge was competition from cheaper imports. Local producers of mussels and oysters face similar challenges, but appear to have the advantage in that the local produce is both preferred and price competitive, and that the market is far from saturated. Hence, South Africa has great potential to expand its local market but, due to its current size, cannot supply the demand. This is a good position to be in and, should the sector be able to deliver consistently and compete with cheaper imports, it would gain the greater share of the local market. Investment capital is needed for the sector to expand to a competitive size. Thus, one of the greatest challenges to the sector's sustainable expansion relates to funding.

A lack of funding hinders expansion. Investment, subsidisation and insurance are needed by the sector as are the reduction of lease rates and the cost of biotoxin testing. The long-term impact of financial strain is illustrated by Amatikulu Prawns, as it struggled for more than five years to expand to compete with producers that were more efficient before it finally collapsed. Bivalve mariculture directors in Saldanha stated that a lack of funding prevented them from expanding and hindered their ability to remain competitive in the market. Compounded with the expense of compulsory testing, the financial strain on Saldanha's bivalve mariculture farms is severe. Temporary closures further exacerbate the strain, as running costs are not covered when production is suspended due to biotoxins in the water. A lack of insurance such as is provided to the agricultural sector in the case of natural disasters or market failure is a serious challenge to the bivalve mariculture sector's sustainable development. A temporary shock from the natural environment or market that could be overcome with a financial injection may bankrupt a sector that is not insured. However, no stock insurance is currently available for bivalve mariculture.

The state has described how businesses may qualify for investment capital if they comply with four criteria: job creation, economic viability, partnership models and BEE. In a broad sense, Saldanha's sector fulfils all the state funding criteria. Some of the operations that satisfy funding criteria have either received funding or a promise of funding from the state. This bodes well for the expansion of the sector. As state support increases and the regulatory environment becomes supportive, the likelihood is that private funding will increase.

Saldanha Bay is a prime site for bivalve mariculture, given the nature of the bay, the benefits of the Benguela upwelling system that contributes to exceptional bivalve growth rates, and the existing infrastructure. For example, Saldanha's sector could expand to almost four times its current size without detriment to the marine environment. However, for the sector to grow and develop, the anthropogenic sources of pollution need to be contained. These include shipping-related threats, such as the spread of alien pathogens, oil spills and heavy metal contamination. Such threats can be curtailed with bans on the importation of stock from infected countries, high shipping standards and the monitoring of contamination levels. The threat of increasing sewage and storm water pollution has been recognised by the Saldanha Bay Municipality. At this stage, none of these poses a major threat, but all these factors need to be strictly controlled and regulated if this sector is to prosper.

Optimal natural resources are not the only benefit of Saldanha's sector. It also benefits from human resources. The directors' level of experience and the strong intra-industry support networks that have been established are important factors contributing to the longstanding success of Saldanha's sector. The empowerment potential of the sector is also illustrated in the examples of a BEE empowerment partnership and an employee shareholding scheme, as well as the numerous examples of employees who would be considered 'functionally illiterate' who have worked their way up to supervisory positions. The sector is therefore positively situated in terms of the state's intention to invest in small enterprises that can create employment. The benefit of the small enterprise model that is currently developing in Saldanha is that it does not encourage rapid in-migration, as large enterprise development has done in the past.

Should this sector receive the necessary state support and funding, it has the potential to expand to create 223 jobs. Approximately two-thirds of these positions could go to Saldanha residents, and many previously disadvantaged individuals with low levels of education could be empowered through shareholding and cooperatives. Developing bivalve mariculture into a sustainable sector can go a long way in terms of poverty relief and job creation, but this requires more investment from the state and the private sector.

The findings of this study clearly indicate the need for a more 'user-friendly' policy framework and an intervention to ensure that the zoning of a bivalve mariculture area is secure and that rental is reasonable. For the rest, the market and environment pose manageable challenges. The sector has now reached the level of maturity where investors

can bring tangible rewards not only to those directly involved in the sector, but also to the local community, consumers and retailers. If the limiting factors of funding and state regulations are addressed, the sector will be able to move into the second and third stages of development. According to the learning process, these are an increased efficiency of production as well as the increase in the volume produced and the range of products. An expanded sector will bring rewards to not only the local market and to investors in terms of financial returns, but to the state and the local community in the form of employment creation and empowerment. In addition, the expanded bivalve mariculture sector will continue to be one of the most environmentally friendly sectors utilising Saldanha Bay.

The present study set out to deal as thoroughly as possible with the central research question on the sustainable development and employment potential of Saldanha's bivalve mariculture sector. Inevitably, however, there are some limitations to consider. These limitations are intrinsic to the research design and theoretical approach.

The research design, being a case study, has by nature limitations on the generalisability of the results. Thus, it is proposed that further research on bivalve mariculture in South Africa is undertaken that uses the same theoretical framework to provide a fuller understanding of the sustainable development and employment potential of the bivalve mariculture sector in the country. The theoretical approach used for the present study is applicable to the social sciences, but unavoidably is weak in its representation of business science and law, disciplines that have been touched on in answering the research question. It is proposed that research on the same topic from the perspective of business and law may build a more complete body of scholarship on the question of the bivalve mariculture sector's employment and expansion potential in South Africa.

Finally, community development is a complex process involving many interlinking variables. To imagine that the mere increase in employment opportunities will solve the rising social ills in impoverished coastal fishing communities is naive. The present study estimates the employment potential of the bivalve mariculture sector in Saldanha as a possible source of employment for unskilled labourers, but it does not assume that the bivalve sector at its full potential will solve the social challenges that the town currently faces. In order for Saldanha's poor communities to experience sustainable development, a holistic approach is required, of which employment creation is a small but important part. Nevertheless, important limiting factors to the expansion and employment potential of Saldanha's bivalve

mariculture sector have been exposed through the five factors typology. It is hoped that the contribution made by the present study will provide a foothold for capacity development and resource mobilisation in Saldanha's bivalve mariculture sector, one of the few sectors with the potential to employ the growing number of unemployed labourers in Saldanha.

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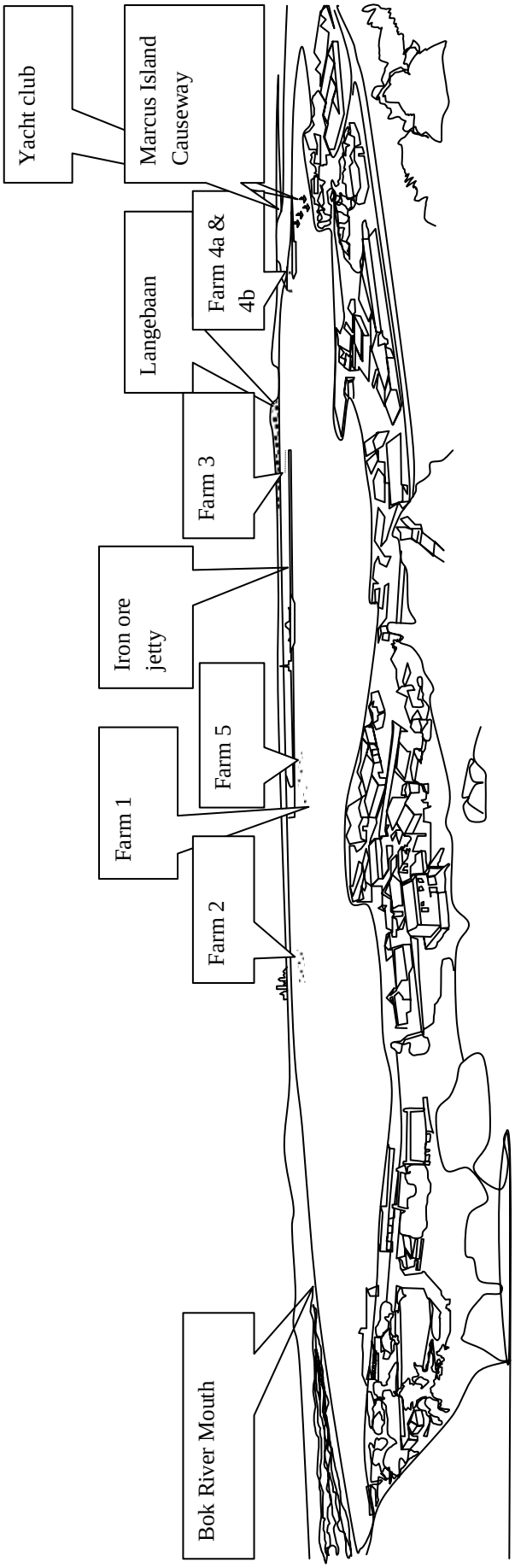
ADDENDUM A: SALDANHA BAY, FROM SALDANHA, LOOKING SOUTHEAST



ADDENDUM B: SEMI-STRUCTURED INTERVIEW SCHEDULE FOR STATE REPRESENTATIVES

STATE REPRESENTATIVES: SEMI-STRUCTURED INTERVIEW

Representative Number .....

Date .....

INTRODUCTION: Hello, my name is David Olivier. I am currently studying for my Master's degree in Sociology at Stellenbosch University. My thesis investigates the potential for Saldanha's mariculture sector to expand and generate local employment. The information that you provide through this interview will be used along with the information from others to inform my thesis question. Your identity will be kept anonymous and anything that you choose to say will be treated with total confidentiality. You may choose to skip any question you do not want to answer and you can call the interview to a close at any time you want, if you feel the need. The questions are general questions that aim to generate discussion on South Africa's mariculture sector. Would you like to continue?

SCHEDULE:

- **THE STATE** has recognised the potential for freshwater and marine aquaculture to provide socio-economic development and food security, but **what is it doing at the moment to develop a robust and expanding sector?**
    - **On a macro level?**
        - **Policies**
        - **Grants**
        - **Information**
        - **Permitting**
        - **Access of small businesses**
        - **Access to local and international markets**
    - **On a micro level (specifically Saldanha)?**
        - **Zoned areas (how much space is available)**
        - **Assistance with water quality monitoring**
        - **Infrastructure development**
- **THE LOCAL COMMUNITY** may benefit from the availability of more low-skill positions becoming available with an expanding mariculture sector, but **what could be done to ensure that the locally unemployed do not miss out on this opportunity or end up worse off for it as has happened in other cases?**
    - **Influx of in-migration as work opportunities open up**
    - **User-group conflicts**
        - **Conflict between retrenched 'local' fishers and newly arrived job-seekers from elsewhere**
        - **Port expansion; industrial/residential development ; fish-processing factories versus water quality**

- **THE MARKET** for freshwater and marine aquaculture products appears to be expanding, but not without significant international competition.
    - **Is the space available in Saldanha for mariculture sufficient to support the demands of an international market?**
    - **Is the current infrastructure in Saldanha sufficient to support the demands of an international market?**
- **FUNDING** has been identified as one of the major limiting factors to the expansion of South Africa's mariculture sector; most of the growth thus far has been sustained by private sector funding. Stakeholders in the aquaculture sector suggested a "government supported aquaculture loan fund" (Britz et al., 2009) being made available.
    - **What is the government's approach to the provision of funding for small-scale entry to the market? (small-scale operators reported not being able to benefit from the SMEDP)**
    - **What is the government's approach to financially protecting the mariculture sector from shocks such as crop failure or a market drop?**
    - **Could the mariculture sector benefit from the funding model for rural entrepreneurs mentioned in the 2010 Budget Vote Speech that proposes to provide funding for farmers, foresters and fishers in the 2011/12 financial year? (Joemat-Pettersson, 2010)**
- **THE ENVIRONMENT** plays a crucial role in the sustainability of local mariculture industries. The Benguela upwelling provides Saldanha Bay with premium quality water for oyster and mussel farming, but **what future risks are there from ongoing development around Saldanha Bay? What is being done to monitor and avoid shocks from the environment?**
    - **Shipping**
        - **Heavy metals, oil spills**
    - **Fish-processing waste**
    - **Sewage**
        - **Leaks and processed waste**
    - **Storm water**
    - **The natural environment**
        - **Toxic algal blooms**
        - **Parasites and disease**
- **CONCLUDING QUESTION:** My knowledge of Saldanha's mariculture sector is still very limited. **Is there anything that you feel is important that I have not addressed during this interview?**

Thank you for your participation. The information you have provided for the study will be used along with that from other interviews to address the question of the sustainability and expansion of a mariculture sector in Saldanha Bay. Everything that you have said will be treated with total confidentiality. Your identity will be kept anonymous at all times.

ADDENDUM C: SEMI-STRUCTURED INTERVIEW SCHEDULE FOR MARICULTURE DIRECTORS

MARICULTURE DIRETORS: SEMI-STRUCTURED INTERVIEW

Farm Number .....

Date .....

INTRODUCTION: Hello, my name is David Olivier. I am currently studying for my Master's degree in Sociology at Stellenbosch University. My thesis investigates the potential for Saldanha's mariculture sector to expand and create local employment. The information that you provide through this interview will be used along with the information from others to inform my thesis question. Your identity will be kept anonymous and anything that you choose to say will be treated with total confidentiality. You may choose to skip any question you do not want to answer and you can call the interview to a close at anytime you want, if you feel the need. The questions are general questions that aim to generate discussion on your experiences of South Africa's mariculture sector. Would you like to continue?

SCHEDULE:

- **THE STATE**, according to the Aquaculture Benchmarking Survey (Britz et al., 2009), has been unsupportive towards the entry of small-scale businesses into aquaculture in the past. Since the survey, the Department of Environmental Affairs and Development Planning (DEA&DP) of the Provincial Government of the Western Cape has published guidelines for starting an aquaculture business in which they express their interest in becoming a stakeholder in the local aquaculture sector. Other developments have also taken place to suggest that the government is becoming more supportive of South Africa's aquaculture sector.
    - **What would you say are some of the most important contributions the state can make towards the development of South Africa's mariculture sector?**
        - **Do you see this coming to pass in the near future?**
    - **Have you experienced any changes in the past year or two that may suggest that the state is becoming more supportive of the aquaculture sector in SA?**
- **THE LOCAL COMMUNITY**
- Projecting the sector's employment potential depends on knowing the annual/monthly production of oysters (or mussels).
    - **In tons fresh weight, and/or in numbers of oysters/mussels sold per month and size, what was the production output for the last year?**
- The local community may benefit from an expanding sector, but the majority of unemployed individuals could miss out on the opportunity if specific skills sets are required that they do not have and if an increased in-migration quickly saturates the demand for labour positions.

- **What positions are there on your mussel/oyster farm? What are the corresponding skills requirements? May the job be filled by either gender or both? How many people are employed in these positions? [*use graph below*]**

BEGIN WITH HIGHEST POSITION OF AUTHORITY, WORKING DOWNWARDS

	Position title	Contract type *(Permanent/Casual)*	Gender	Number Employed
1			F M	
2			M F	
3			F M	
4			M F	
5			F M	
6			M F	

- **THE LOCAL COMMUNITY**; continued...
    - **What do you look for before employing someone for a labour position?**
  - User-group conflict
    - **Are there any users of the bay that you or your employees have conflicting interests with besides the competition from other mariculture farmers? [*such as shipping, fishing companies, recreational users etc...*]**
      - **What has been the cause for this conflict in interest?**
    - **Has there been any conflict in interest with other mariculture farmers?**
      - **What has been the cause for this conflict in interest?**
    - **Has conflict in interest ever led to direct action being taken, either formally or informally, against the conflicting party? Please explain.**
    - **What measures are there to limit or mediate user conflict?**
  - Has your business experienced any incidents of crime in the past 12 months?
    - **What was the nature of the crime?**
    - **Have you felt that the sustainability of your business is threatened by crime?**

- **THE MARKET** for mariculture products in South Africa is growing. However, major competition exists on the international market.
    - **Do you currently supply an international market, or if not, do you plan to expand to do so?**
        - **What have been, or are, some major limitations to doing so?**
        - **What have you done, or could you do, to overcome these limitations?**
        - **What strengths does your business have that make it competitive on the international market?**
        - **Which products do you, or do you plan to, sell to the international market? [*List in rank order of value, with 1 being highest in value*]**
    - **The South African market**
        - **What are some of the limitations to your expansion on the South African market?**
        - **What can be done to overcome these limitations?**
- **FUNDING/ ACCESS TO FINANCE** was named as one of the highest priorities for the expansion of South Africa's aquaculture sector in Britz et al.'s (2009) *Aquaculture Benchmarking Survey*.
    - **Has the expansion of your business been limited by inadequate funding?**
    - **Have you received any financial support from the government?**
        - **If so, what qualified you?**
    - **What have been, in order of importance, the sources of funding that your business has used?**
    - **What sources of insurance do you have against sudden shocks to your business?**
- **THE ENVIRONMENT** plays a crucial role in the sustainability of local mariculture industries. The Benguela upwelling provides Saldanha Bay with premium quality water for oyster and mussel farming, but certain environmental influences may impact negatively on production.
    - **What environmental influences have threatened production or have brought on unexpected expenses in your experience?**
        - **What can be done to address or monitor such influences in future?**
- **CONCLUDING QUESTION:** My knowledge of Saldanha's mariculture sector is still very limited.
    - **Is there anything that you feel is important that I have not addressed during this interview?**

Thank you for your participation. The information you have provided for the study will be used along with that from other interviews to address the question of the sustainability and expansion of a mariculture sector in Saldanha Bay. Everything that you have said will be treated with total confidentiality. Your identity will be kept anonymous at all times.

ADDENDUM D: SEMI-STRUCTURED INTERVIEW SCHEDULE FOR BIVALVE MARICULTURE EMPLOYEES

MARICULTURE EMPLOYEES, SALDANHA, SOUTH AFRICA: SEMI-STRUCTURED INTERVIEW

Farm Number .....

Date .....

INTRODUCTION: Hello, my name is David Olivier. I am currently studying for my Master's degree in Sociology at Stellenbosch University. My thesis investigates the potential for Saldanha's mariculture sector to expand and create local employment. The information that you provide through this interview will be used along with the information from other interviews to inform my thesis question. Your identity will be kept anonymous and anything that you choose to say will be treated with total confidentiality. You may choose to skip any question you do not want to answer and you can call the interview to a close at anytime you want, if you feel the need. The questions are general questions that aim to generate discussion on your experiences of South Africa's mariculture sector. Would you like to continue?

Employee	**Gender**	**What is your role at work?** [Write in]	**Size of household** [Number of people]	**How many people over 16 and under 65?** [Number of people]	**For how many years have you been living in Saldanha?** [Number of years]
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Employee	**Highest grade Completed?**	**Have you received any other training?** [Such as practical courses, qualifications or permits] **If 'yes', what?**	**Hours per week?**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Employee	**How did you find out about this job?** [Write in]	**How many total years of experience do you have working on oyster and mussel farms?** [write number]
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Employee	**What other sources of income are there for your household?** [Write in]	**How much does this job contribute to the household income?** [Percentage]	**Is there anything that I have not thought of that you think would be important for my research?**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Thank you for your participation. The information you have provided for the study will be used along with that from other interviews to address the question of the sustainability and expansion of a mariculture sector in Saldanha Bay. Everything that you have said will be treated with total confidentiality. Your identity will be kept anonymous at all times.