Master Plan for Marine Aquaculture in Namibia

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Abbreviations, Acronyms and Definitions

**Aquaculture** – Farming of aquatic organisms in inland and coastal areas, involving intervention in the rearing process to enhance production and the individual or corporate ownership of the stock being cultivated

**Crustaceans** – Aquatic animals belonging to the phylum Arthropoda, a major group of invertebrate organisms characterized by their chitinous exoskeleton and jointed appendages, occurring in marine and freshwaters and on land, e.g. crab, lobsters, crayfish, shrimps, prawns, etc.

**EU** – European Union

**FAO** – Food and Agriculture Organization of the United Nations

**Fish** – The term “fish” indicates fish, crustaceans, molluscs and other aquatic animals, but excludes aquatic mammals, crocodiles, caimans, alligators and aquatic plants

**Gastropods** – A member of the largest class of phylum Mollusca; the class includes the snails, slugs, sea hares, sea slugs, limpets, conches and abalone and characteristics include a foot upon which the rest of the body (called the "visceral mass") sits, as well as a protective one-piece shell

**GDP** – Gross Domestic Product

**HACCP** – Hazard Analysis Critical Control Points

**IRR** – Internal rate of return, a financial profitability indicator

**MFMR** – Ministry of Fisheries and Marine Resources

**Molluscs** – Invertebrate animals belonging to the phylum Mollusca with a soft unsegmented body and covered by a calcium carbonate shell, of 1 to 8 parts or sections; major cultured molluscs are mussels, oysters, scallops, cockles, clams (bivalve) and abalone

**NASP** – Namibia’s Aquaculture Strategic Plan

**NDP** – National Development Plan

**NEPAD** – New Partnership for Africa’s Development

**Ranching** – Stocking, usually of juvenile finfish, crustaceans or molluscs from culture facilities for growth to market size or to maturity in the natural environment

**SADC** – Southern Africa Development Community

**Salinity** – The measure of salt concentration of water expressed in part per thousand or ppt

**SME** – Small medium enterprises

**Stocking density** – The number of animals per given area

**SWOT** – Strengths, Weaknesses, Opportunities and Threats

**TAC** – Total allowable catch

**USA** – United States of America

**WHO** – World Health Organisation
1. Executive Summary

The Namibian marine aquaculture industry’s problems are abundantly clear: limited natural potential, challenging environmental risk factors, and a lack of access to and availability of investment and development funding are preventing industry growth. Although these constraints are challenging, they are not insurmountable. The risks in investing in marine aquaculture in Namibia may appear to be high, but risks can be managed, and the rewards can be great.

Growing the marine aquaculture sector requires the immediate implementation of a number of limited duration catalytic actions designed to achieve growth and critical mass during a short window of opportunity by the Government of Namibia.

The rationale for developing a profitable marine aquaculture sub-sector in Namibia remains sound. Aquaculture contributes to GDP growth, with stable and growing economies in turn increasing employment opportunities and per capita income, and promoting the overall well-being of a country’s citizens. Ninety percent of aquaculture production and processing takes place in rural and coastal communities, providing economic stability and growth where economic development options are often limited, particularly in cases where yields from wild fisheries have declined.

The combined effects of market demand and technological innovations have transformed aquaculture from a subsistence food production system to a major agribusiness industry, thereby contributing to changes in the scale and business models in aquaculture operations. The new trends have given rise to more intensive production practices, forcing changes in the industrial organization of aquaculture, the pursuit of greater economies of scale and increased access to capital demands. Accordingly, the master plan reinforces the marine aquaculture sub-sector positioning as an intensive, large-scale commercial industry producing high value species for export markets.

The marine aquaculture master plan provides a roadmap to create a business and social environment which is attractive to a wide range of investment services, including social investors. The master plan sets a production target for the marine aquaculture industry of 1 800 tons by 2017 and 5 500 tons by 2022. Achieving critical mass is essential to create sector credibility and unlock self-sustaining viability, vitality and growth. The following ten-point plan sets out the key actions that will be required to boost the growth rate of the sub-sector so that it can meet its goals:

1. Create a favourable legislative, regulatory, policy and investment environment
2. Promote social, environmental and economic sustainability
3. Attract social investment
4. Create a marine aquaculture business development and investment agency
5. Build business partnerships and strategic alliances
6. Establish an aquaculture development fund
7. Speed up delivery of an essential package of support services
8. Encourage and support pilot projects
9. Maximise opportunities for innovation by building R&D partnerships
10. Develop the market for Namibian aquaculture products
Business first, with sustained profitability the primary objective, is the key pillar on which Namibia must build a marine aquaculture sector that can then also contribute to socio-economic well-being. Ensuring environmental and social sustainability doesn't require large, disruptive change; it can be achieved by taking tasks and activities companies already do to a new level of efficacy.

Achieving the suggested master plan production goals can best be accomplished by growing and supporting existing marine aquaculture ventures. Significant potential exists to increase production at the two existing land-based abalone farming ventures in the Karas region. The projected IRR of a commercial land-based abalone farming venture is conservatively expected to be around 21% before financing. This is an indication that with the appropriate financial leverage it should be possible to structure a business venture in such a manner that attractive returns are generated for investors. The projected IRR of an abalone ranching is also attractive, with a projected IRR of 32% before financing. Oyster production in the Lüderitz lagoon is sustainable and can probably be doubled, whilst the Tetelestai Mariculture “SmartFarm” technology offshore oyster culture pilot project in Walvis Bay has shown promising initial results. The estimated IRR of a longline oyster business is 24% before financing.

Major change and future growth of marine aquaculture in Namibia will require the adoption of new recirculation aquaculture technologies. Recirculation aquaculture could break through water resource constraints but will require considerable investment and management of technological risks. New species that can be considered for marine aquaculture in Namibia include bigeye tuna, *Argyrosomus* marine finfish species, turbot, mussels and clams. Many of these species are already in production elsewhere. Recognizing the importance of both incremental and transformational innovation, the master plan suggests a research and development strategy based on the establishment of international, regional and national knowledge and technology transfer networks.

The master plan also advocates the prioritized completion (by ministerial intervention) of a number of critical interventions identified in Namibia’s Aquaculture Strategic Plan (2004), including the long overdue implementation of the National Shellfish Sanitation Program and capacity building in the area of standards, testing and accreditation to overcome technical barriers to trade. Furthermore it proposes a strategy and intervention to reduce the destructive uncertainty regarding the availability of and access to land and water.

Importantly, the master plan reflects the growing consensus that the marine aquaculture development process is a collaborative multi-stakeholder effort. The implementation framework proposed by the master plan therefore recommends the alignment and establishment of institutional support as well as the formulation of an implementation action plan with clearly defined lines of responsibility.

The long-term interests of government and marine aquaculture businesses in Namibia lie in gaining and keeping the trust of global consumers and investors. Although the master plan advocates a near term focus on accelerating production growth, in the long term, a holistic approach incorporating other aspects such as policy frameworks, long-term institutional development, capacity building, social equality and sustainable aquaculture should be developed.

It is important to note that the assessment of the potential for marine aquaculture growth in Namibia is based on available technologies, markets and macro infrastructure development and that the master plan has a 10 year timeframe.
2. Introduction

Almost a decade after the publication of Namibia’s Aquaculture Strategic Plan in 2004, marine aquaculture production in Namibia has not expanded as forecasted. Oyster production in 2011 (7.5 million oysters) was only slightly higher than production in 2004 (6 million oysters); abalone production has increased by less than 20 tons and seaweed production has ceased altogether. Apart from two new abalone ranching pilot projects, no new significant marine aquaculture venture has been established in Namibia in the past 6 years.


The rationale for developing a profitable marine aquaculture sub-sector in Namibia remains sound. Aquaculture in the rest of the world has continually outstripped growth projections, and there is little reason to believe that it will not continue to do so. Aquaculture is a crucial source of income and livelihood for hundreds of millions of people around the world, with the increase in employment in the sector outpacing world population growth and employment in traditional agriculture and fisheries. Massive productivity gains and the increasing control over aquaculture production systems are in stark contrast to the faltering management of capture fisheries, for which rising fuel prices are having a disproportionately higher impact on costs. Furthermore, 90% of aquaculture production and processing takes place in rural and coastal communities, providing economic stability and growth where economic development options are often limited, particularly in cases where yields from wild fisheries have declined.

Aquaculture contributes to GDP growth, with stable and growing economies in turn increasing per capita income and promoting the overall well-being of a country’s citizens. With its limited manufacturing base and a small domestic market (a population of only about 2.1 million people), Namibia is heavily dependent on primary industries (agriculture, mining and fishing) for the generation of foreign exchange needed for the purchase of manufactured, capital and intermediate goods from the international market. Job creation is a priority in Namibia (as described in the Targeted Intervention Program for Employment and Economic Growth, 2011) with the latest labour force survey showing that the unemployment rate has increased to 51%.

Against this backdrop, the Namibian Ministry of Fisheries and Marine Resources (MFMR) commissioned AquaStel (Pty) Ltd to undertake a study to assess and advise on the potential and economic viability of mariculture in Namibia (along the coast in the Karas, Erongo and Kunene regions). MFMR also commissioned AquaStel to assess the demand for Namibian grown shellfish. AquaStel is a wholly owned subsidiary of Stellenbosch University (South Africa) with expertise extending to the development of national aquaculture policy and strategies; project feasibility assessment (technical, financial and market); project management; production system design; research and development; as well as education and training.

This master plan briefly explores reasons for the lack of forecasted growth, but ultimately focuses on the formulation of a development strategy and implementation framework that will establish a base for future industry growth and sustainability. Importantly, the master plan reflects the growing consensus that the development process is a multi-stakeholder effort.
Since 2001, the Namibian government has put in place a number of macro-economic policies and programmes which have been primarily aimed at promoting growth and development. The Namibian economy realized a real economic growth (real GDP growth) of 4.6% over the almost two decade period 1990 – 2008. It was driven by impressive growth in gross fixed investment, and it represented a significant improvement in economic performance over the immediate pre-independence decade. High rates of growth were realized in five sectors: electricity and water supply; fishing; wholesale, retail trade, hotels and restaurants; transport and communication; and finance, real estate and business services. The country’s first National Development Plan (NDP 1) and NDP 2 placed emphasis on the implementation of policies and programmes which encouraged the expansion of productive investment, while discouraging excessive consumption. These policies and programmes improved the rate of investment to an average of 23.4% over the sub-period 1990 – 2008. During the same period Namibia also consistently scored above average (against comparator economies) in the World Bank’s “Doing Business” rankings. In addition, the effect of the global financial crisis was not transmitted to the Namibian economy until late in 2009. At the macro level, Africa became increasingly attractive to international investors during the past decade.

So why then did marine aquaculture output in Namibia not achieve its NASP projected 2009 production target? It is now clear that the potential for marine aquaculture in Namibia, and in particular for sea-based aquaculture, were overestimated. Despite having a 1500 kilometer coastline and highly productive waters, less than 100 kilometers of the coastline is serviced by requisite infrastructure and it is largely unprotected with recurring adverse oceanographic conditions, including hydrogen sulphide eruptions and upwelling. In 2008 and 2010 for example, hydrogen sulphide eruptions in Walvis Bay all but decimated the Erongo region oyster farming industry. It is also clear that the conservative lending practices (in terms of cost, required returns and guarantees) of financial institutions in Namibia (and elsewhere in the SADC region) have limited the amount of capital available to both existing and start-up aquaculture companies. Other contributing factors include an over-reliance on the private sector to drive growth and the failure to implement a number of key recommendations contained in NASP (2004), including the failure to create an aquaculture development fund. Uncertainty regarding the availability of land also contributed to the lack of development.

Although, marine aquaculture operating circumstances in Namibia are challenging, they are not insurmountable. The biggest challenges in realizing Namibia’s marine aquaculture production potential are increasing investment and improving access to finance. The risks in investing in marine aquaculture in Namibia may appear to be high, but risks can be managed, and the rewards can be great (both in terms of financial returns and socio-economic impact). Using a participatory, consultative and analytical assessment approach, this study developed an aquaculture development strategy for Namibia based on the unbundling of societal benefits and financial returns to access investment from both the financial markets and organizations devoted to social enterprises. It also identifies key potential species and production systems for marine aquaculture.

The study is organized as follows: Section 1 presents an executive summary; Section 2 is this introduction; Section 3 provides background information; Section 4 assesses the development potential; Section 5 provides a growth strategy; and Section 6 proposes a master plan implementation framework. It is important to note that the assessment of the potential for marine aquaculture growth in Namibia is based on available technologies and macro infrastructure development and that the master plan has a 10 year timeframe.
3. Background Information

3.1. Overview of World and Regional Aquaculture

3.1.1. World Aquaculture Production and Trends

In 2009, total world fish production (capture fisheries and aquaculture) reached a record 145 million tons. While capture production has stayed at around 90 million tons since 2001, aquaculture production has continued to show strong growth, increasing at an average annual growth rate of 6.1%, from 34.6 million tons in 2001 to 55.7 million tons with an estimated value of US$ 105.3 billion in 2009. Total world fisheries production is projected at 164 million tons in 2020, with the only major increases in the quantity of fish produced originating from aquaculture – global aquaculture production is projected to continue to increase, reaching nearly 74 million tons in 2020.

Aquaculture continues to be the fastest-growing animal-food-producing sector and to outpace population growth, with per capita fish supply from aquaculture increasing from 0.7 kg in 1970 to 7.8 kg in 2008. Aquaculture has continually pushed the demand for, and consumption of, species that have shifted from being primarily wild-caught to being primarily aquaculture-produced, with a decrease in their prices and a strong increase in their commercialization, such as shrimps, salmon, bivalves and tilapia.

World aquaculture is heavily dominated by the Asia-Pacific region, which accounts for 90% of production in terms of quantity and 79% in terms of value – mainly because of China, which accounts for 62% of global production in terms of quantity and 51% of global value. Moreover, of the 15 leading aquaculture producing countries, 11 are in the Asia–Pacific region. Despite the overall dominance of Asia, aquaculture is a significant economic activity on most continents and its importance is growing almost everywhere. In fact, Latin America and the Caribbean showed the highest average annual growth in the period 1970 – 2008 (21.1%), followed by the Near East (14.1%) and Africa (12.6%).

Aquaculture production using freshwater contributed 60% to world aquaculture production by quantity and 56% by value in 2008, with carps, tilapia and pangasius the main production species.

Marine aquaculture accounted for 32.3% of world aquaculture production by quantity and 30.7% by value in 2008. Aquaculture in seawater produces many high-value finfish, crustaceans and abalone species, but also a large amount of oysters, mussels, clams, cockles and scallops. The main components of mollusc production in 2008 were oysters (31.8%); carpet shells and clams (24.6%); mussels (12.4%); and scallops (10.7%). While mollusc production as a whole grew at an average annual rate of 3.7% in the period 2000 – 2008, production of the “luxury” group of abalone grew at an annual growth rate of almost 40%. World production of crustaceans was 5 million tons (9.5%) in 2008. The aquaculture production of seaweeds and other aquatic plants reached 17.3 million tons in 2009 with a value of US$ 4.8 billion.

While the demand forecast for increased seafood consumption is bullish, the availability of supply is far less certain. The FAO believes that under current fishing regimes the potential worldwide harvest from marine capture fisheries is no more than the current level of 90 million tons, but even this level of fishing cannot be sustained indefinitely. Aquaculture will therefore continue to expand in all continents in terms of new areas and species, but even in the most optimistic scenario, where aquaculture flourishes, the world’s demand for fish will not be met.
3.1.2. SADC Region Marine Aquaculture Production and Trends

The contribution of sub-Saharan Africa to global aquaculture production remains minimal but is increasing significantly. Between 1998 and 2008 there was a fivefold increase in production from 42,587 to 238,877 tons. This converts into an average annual growth rate of 18.8% for the years 1998 to 2008 and was due to the emergence and intensification of private sector-led small- and medium-size enterprises and the expansion of large commercial ventures, stimulated in some cases by growing public support and the inflow of foreign capital and expertise. International awareness and interest in aquaculture spawned by the New Partnership for Africa’s Development (NEPAD) Fish for All Summit in 2005 and implementation of the FAO Special Programme for Aquaculture Development in Africa (SPADA) also contributed to this development.

The bulk (95%) of production in sub-Saharan Africa is from fresh-water, predominantly of the indigenous and ubiquitous species of tilapias and the African catfishes. The start of brackish water and marine aquaculture date back to less than thirty years ago, with production concentrated in a few countries. In 2008, marine aquaculture production in sub-Saharan Africa was 9,970 tons accounting for only 5% of production quantity. The value of marine aquaculture production, however, was US$78 million and accounted for 12% of the total. The marine aquaculture subsector is primarily operated by private investors as small-medium enterprises (SME), with products mostly destined for export markets.

Only three of the nine coastal states in the SADC region recorded aquaculture production exceeding 1,000 tons in 2010: Madagascar, South Africa and Tanzania. Madagascar produced about 4,750 tons of Black tiger prawns (*Penaeus monodon*) in 2010. Madagascar also produced about 1,500 tons of *Eucheuma* spp. Seaweed in 2010. Tanzania produced about 8,500 tons of seaweed (two red algal species, *Eucheuma denticulatum* and *Kappaphycus alvarezi* for their carrageenan content) in 2010. Seaweed production is primarily small scale community-based, with most production units situated in shallow intertidal lagoons inside the fringing reefs, mainly off the eastern coast of Zanzibar.

Total marine aquaculture production in South Africa in 2010 was 2,503 tons, valued at ZAR 310 million. The greatest growth in marine aquaculture production in South Africa since 2003 was attributed to the abalone (*Haliotis midae*) sector where production increased from about 500 tons in 2003 to 1,120 tons in 2010, with a value of ZAR 274 million. The mussel (*Mytilus galloprovincialis, Choromytilus meridionalis*) sector produced about 1,100 tons and the oyster (*Crassostria gigas*) sector about 300 tons in 2010; production for both sectors were up by about 10% since 2008. Total marine finfish (*Seriola lalandi, Argyrosomus japonicus*) production in South Africa in 2010 was 15 tons valued at ± ZAR 600 000.

Mauritius currently boasts the largest marine finfish farming operation in the SADC region, with production of about 500 tons of red drum (*Sciaenops ocellaus*) in sea cages in 2010.

The general trend for marine aquaculture development in the SADC region is towards intensification and diversification. Most large-scale commercial marine aquaculture ventures are vertically integrated including feed manufacture, fingerling production, selective breeding programmes, processing plants and local and export market arrangements. Strong future marine aquaculture growth is expected in the SADC region with most of the coastal state governments adopting a series of policy and economic reforms that will improve the business climate and permit investment in the sector.
3.1.3. Key Success Factors

**Access to capital:** The role of capital in promoting growth is more apparent than ever as countries across the world struggle to bolster sagging economies and stem job losses brought on by the credit crunch. With the progressive intensification and diversification of aquaculture to systems and species requiring sophisticated technologies and increased economies of scale, access to capital has been a key factor for development.

**Increased economies of scale:** The combined effects of market demand and technological innovations have transformed aquaculture from a subsistence food production system to a major agribusiness industry, thereby contributing to changes in the scale and business models in aquaculture operations. The new trends have given rise to more intensive production practices, forcing changes in the industrial organization of aquaculture and the pursuit of greater economies of scale.

**Market access:** Countries and private sector companies authorized to export fish and fishery products to premium markets (mainly the EU, USA, Japan and China) typically need to ensure compliance with three types of obligations:

i. Obligations of resources: i.e. instruments of production; conditions of handling/processing; Hazard Analysis Critical Control Point (HACCP) and prerequisite programmes; traceability, etc.

ii. Obligations of results: i.e. safety levels of the products (e.g. histamine, contaminants, and microbiological levels); etc.

iii. Obligations of control: i.e. regulatory verification effectively implemented by a competent authority; data storage and management; administrative procedures; legal support; strict control of product certification, etc.

**Government commitment:** Generally, a government’s commitment to provide increased support to the aquaculture sector is a prerequisite for the sector’s sustainable development. The commitment takes the form of clear articulation of policies, plans and strategies; and the availability of adequate funding support. Sustained public support for technology, innovation, and knowledge dissemination under national and regional partnerships is particularly important. State intervention has also often played a critical role in attaining critical mass, which in turn promotes entrepreneurial capitalism.

**Sustainability:** Sustainability can encompass a broad range of issues that affect business — from pollution and climate change to education, poverty, health and human rights. It involves a connected world with a broad range of stakeholders—from employees and communities to governments and NGOs. The aquaculture industry have come to understand that its ability to prosper hinge upon its responses to the challenges of a resource-constrained world and an array of other issues on the sustainability agenda. The sustainability agenda begins with making a commitment to incorporating social, environmental, economic and ethical factors into a company’s strategic decision-making and asks businesses to adopt measures to mitigate risks and take advantage of opportunities.

**Vertical integration:** A few of the most successful aquaculture companies have realized that the highest returns on investment in seafood value chains are in downstream activities. Some of the most progressive companies are actually reversing value chain thinking by shifting their focus from producers and traders to end customers. These companies are differentiating themselves by serving selected
customer segments with specific products; adding real value to the product and market offer; serving high-end markets where quality is paramount; developing branded consumer products; and by geographic origin differentiation.

**Careful site selection:** Site selection is probably the single most important factor that determines the commercial viability of an aquaculture operation. Production facilities should be located, designed and operated to provide optimum water quality and to avoid conditions that may induce stress, reduce growth or predispose the culture species to disease.

**Clear land and water property rights:** Marine aquaculture growth is dependent on the development of a flexible, accountable and transparent approach to granting occupation rights to undertake operations. For both land and water the dominant trope is a system that provides long term leasing and licensing rights to provide security of tenure.

**Innovation:** Winning in business today demands innovation. Companies that innovate reap all the advantages of a first mover. They acquire a deep knowledge of markets and develop strong relationships within them. Innovators also build a reputation of being able to solve the most challenging problems. It is important to differentiate between incremental innovation and transformational innovation. The former is critical to the successful development of an industry, but it is the latter that triggers the use of new approaches and sets off substantial growth.

**Food safety and quality:** Quality is probably the main competitive factor in the global seafood trade, with importers placing a premium on quality that feeds back into the production process and is characterized within HACCP-based regulations as well as the international standards, guidelines and recommendations put forward by the FAO/WHO *Codex Alimentarius*. Generally the agro-food system has changed from a system where buyers were merely interested in the final appearance of a product to one where they are now concerned with the entire production and distribution process (traceability).
3.2. Overview of Marine Aquaculture in Namibia

3.2.1. Namibia Marine Aquaculture Production and Trends

Total marine aquaculture production in Namibia in 2011 was 525 tons, valued at about N$ 35.7 million. Total oyster (*Crassostria gigas* & *Ostrea edulis*) production was about 495 tons. The oyster producers market live fresh and frozen oysters to buyers in Namibia, South Africa and China. Several oyster farms in Walvis Bay closed down following major hydrogen sulphide eruptions in 2008 and 2010. Abalone (*Haliotis midae*) production in Namibia in 2011 was about 30 tons (a single producer). Two abalone (*H. midae*) ranching operations are currently being conducted in Lüderitz in the Karas region. Two oyster farms produced experimental quantities of scallops and clams in 2011. Namibia is not a producer of marine aquaculture goods such as feed and equipment. The following companies operate active marine aquaculture ventures in Namibia:

**Lüderitz Abalone:** Based in Lüderitz and produced 30 tons of abalone (*H. midae*) in land-based flow through tank culture systems in 2011. The farm’s entire production output is exported to markets in the Far East. Lüderitz Abalone is also undertaking an abalone ranching pilot project within the Lüderitz bay area. The company operates an abalone hatchery capable of supplying abalone spat to other potential producers. It was established in 2003 and employs 32 people.

**Lüderitz Lobster Mariculture:** Based in Lüderitz and produces oysters (*C. gigas*) using longline culture systems in the Lüderitz lagoon. The company is also conducting an abalone ranching pilot project within the Lüderitz bay area. It was established in 2006 and employs 19 people.

**Lüderitz Mariculture:** Based in Lüderitz and produces oysters (*C. gigas*) using longline culture systems in the Lüderitz lagoon. The company was established in 2006 and employs 19 people.

**Erongo Abalone:** A new company (with a large South African abalone producer as a major shareholder) currently conducting land-based abalone and pond-based oyster pilot projects in Mining Area 1 in Oranjemund. The company was established in 2010 and employs 5 people.

**Tetelestai Mariculture:** Tetelestai Mariculture, a subsidiary of Namsov Fishing Enterprises, is based in Walvis Bay and produces oysters (*C. gigas*) using suspended longline culture systems. Tetelestai is currently conducting an experimental oyster pilot project at two open ocean sites using “SmartFarm” longline technologies. The company was established in 2006 and employs 19 people.

**Seafresh Investments:** Produces oysters (*C. gigas*) using suspended longline culture systems in Walvis Bay and Lüderitz. The company was established in 2007 and employs 17 people.

**Richwater Oyster Company:** Based in Swakopmund and produces oysters (*C. gigas* and *O. edulis*) using racks in a pond system. It was established in 1987 and employs 12 people.

**Beira Aquaculture:** Based in Swakopmund and operates an oyster hatchery with a production capacity of 20 million oysters per annum. The company was established in 2007 and employs 6 people.

Major change and future growth of marine aquaculture in Namibia will require the adoption of new recirculation aquaculture technologies. Recirculation aquaculture could break through water resource constraints but will require considerable investment and effective management of technology risk.
3.2.2. Review of Previous Studies

Several previous studies (conducted between 1990 and 2011) have assessed and described the potential for marine aquaculture in Namibia and were reviewed for the current analysis. Generally these studies were scrutinized in terms of their identification of potential species, production systems and locations for marine aquaculture ventures. All the previous studies were also assessed in terms of their identification of competitive strengths; development constraints; policy, legislative and regulatory framework interpretation; and intervention recommendations (particularly in terms of stimulating growth).

Applicable recommendations from the previous studies have been included in the current synthesis. It is, however, clear that many of the previous studies should have been more critical in terms of the development constraints affecting the industry and specifically the hydrogen sulphide risk in the Erongo region. Many of the studies should also have been more critical of the lack of infrastructure development. As such it is apparent that the production potential for marine aquaculture has generally been overestimated.

That said, most of the previous studies correctly identified abalone, mussels, oysters and *Argyrosomus* finfish species as the species with the best potential for near term marine aquaculture sector growth in Namibia. The existing master plan has ignored suggestions regarding the open system culture of subtropical and tropical species. Most of the studies also correctly suggested a future focus on the application of recirculation aquaculture systems.

Most of the previous feasibility studies gave an accurate overview of the advantages and shortcomings of the policy, legislative and regulatory framework for marine aquaculture in Namibia. Previous study recommendations for government interventions regarding the establishment of a national shellfish sanitation programme, aquatic animal health, market support, investment incentives and environmental sustainability have generally been repeated in the current master plan.

Apart from the examination of the Namibia specific studies, a large cache of aquaculture documentation pertinent to marine aquaculture development in sub-Saharan Africa were reviewed. A 2007 World Bank study on the promise and challenge of aquaculture in developing countries provided a number of important directives that have been incorporated in the general design of the master plan:

- Aquaculture benefits from participatory preparation of a national aquaculture policy, development strategy and plan, and integration of the process with national economic plans, poverty reduction plans, environmental management plans, development assistance programs, and similar instruments.
- The public sector has a vital role to play in creating an attractive investment climate and securing foreign direct investment.
- Development assistance can foster adoption and application of codes and best practices for environmentally friendly aquaculture, which will increase economic returns while providing effective environmental stewardship and producing healthy products.
- Aquaculture development benefits from creating national and regional knowledge networks to transfer and adapt proven technologies, to cost-effectively build human and institutional capacity and support south-south technology transfer and investment.
3.2.3. Regulatory Overview

The Ministry of Fisheries and Marine Resources (MFMR) has been appointed as the lead agency for aquaculture in Namibia and has since 2001 created a mostly enabling environment for sustainable sector development. Generally, the requisite policy and legislative frameworks are in place to promote and regulate aquaculture in order to ensure the sustainable utilization of available resources as well as the protection and conservation of marine and inland aquatic ecosystems.

Specific regulatory milestones include the development and promulgation of the following documents:

- The Aquaculture Act No. 18 (2002)
- The Regulation of Licensing (2003)
- The Namibia Aquaculture Strategic Plan (2004)

Namibia’s Aquaculture Policy (2001) is guided by the FAO’s Code of Conduct for Responsible Fisheries and in turn provides guiding principles for Namibia’s aquaculture legislative framework. The policy provides specific guidelines for the regulation of aquaculture and establishes a framework for right of tenure and the allocation of commercial aquaculture rights. It is the responsibility of the MFMR Minister to from time to time, taking into account relevant economic, social and environmental factors and on the basis of the best scientific information available and in consultation with an advisory council, formulate the general policy with regard to aquaculture in Namibia.

Regulation of aquaculture in Namibia is done according to the Aquaculture Act (2002) which is the primary legal framework for the aquaculture industry and provides for the establishment, administration and conduct of both marine and freshwater aquaculture. An Aquaculture Advisory Council was established under the auspices of the Act to advise the Minister on related aquaculture policies and matters related to the Act as well as investigate matters referred to it by the Minister.

The Aquaculture Act establishes both the duties and powers of the State and the responsibilities and rights of producers. It is the responsibility of MFMR to manage the Act, which in itself vests regulatory and enforcement powers with MFMR. Amongst others, the Act includes provisions dealing with licensing; management and control measures; ownership of aquaculture products; aquaculture development zones; enforcement; offences and penalties; and health and food safety aspects.

Aquaculture activities are controlled by the issuing of aquaculture licenses by MFMR. Aquaculture licenses specify defined sites of land or water; and species of aquatic organisms that may be cultured and harvested. The Act allows an exemption system to operate to undertake research projects.

Namibia’s Environmental Management Act (2007) governs the process for obtaining environmental clearance to commence and undertake aquaculture production. The Environmental Management Act qualifies the erection or construction of aquaculture structures as requiring an environmental assessment. It does not specify a production threshold.

Namibia’s Aquaculture Strategic Plan (2004) outlines a strategy for the development of a marine aquaculture sector that utilizes intensive rearing methods to produce various types of high-value finfish and shellfish, destined mainly for export markets.
3.2.4. Oceanographic and Physical Environment Overview

Southwestern Africa is strongly affected by the Benguela Current, which is one of the world's four major eastern boundary currents. As in other eastern boundary current systems, the Benguela is characterised by strong coastal upwelling and high primary productivity. The upwelling is induced by equatorward winds that flow nearly parallel to the coast causing offshore Ekman divergence of surface waters. The main upwelling area is along the coasts of Namibia and South Africa, between 16°S and 34°S, with intense upwelling cells found at several locations along the coast. The strongest and most persistent upwelling cell is near Lüderitz (27°S). Wind stress is greatest here and sea temperatures are coldest. The Lüderitz upwelling region effectively separates the Northern Benguela from the Southern Benguela. In the Northern Benguela region, upwelling cells are located around 20°S and near Walvis Bay (23°S) in central Namibia. The intensity of upwelling in the Northern Benguela is far from uniform, with tremendous spatio-temporal variability according to local bathymetry, fluctuations in wind, coastally trapped waves, and periodic intrusions of tropical water. Winds in both regions are primarily southerly and south easterly. Sea surface temperatures along the entire coastline are generally cooler than 16°C during winter and spring, with summer and autumn sea surface temperatures only slightly higher.

Nearshore, toxic hydrogen sulphide eruptions are familiar experiences along the central coast of Namibia. They typically occur during austral summer and are characterized by localized discolorations of the sea surface and an intensive odorous smell. In addition to its direct toxic impact, hydrogen sulphide has the secondary effect of depleting oxygen from the water, so that extensive surrounding areas suffer from severe hypoxia and anoxia.

The 1500 km Namibian coastline is relatively uniform. Sandy beaches account for about 60% of the shore, with 10% rocky beaches and 28% mixed sandy and rocky areas. The remaining areas are lagoons. The entire coast receives high-energy wave action, mainly from the south-southwest. The coastline south of Lüderitz has been significantly altered by diamond mining activities. Lüderitz and Walvis Bay are both natural harbours with well-developed port facilities. Oranjemund, Swakopmund and Henties Bay are the only other urban centres along the Namibian coastline. Opportunities for further expansion of urban centres in the region are limited largely by the scarcity of fresh water.

The following oceanographic characteristics of the region should be considered in an assessment of Namibia’s marine aquaculture potential:

- High primary productivity provides excellent growth conditions for bivalve aquaculture species
- Hydrogen sulphide eruptions can cause mass mortalities of bivalves and marine finfish
- Upwelling causes significant temperature variations which affects target species feeding behaviour and generally decrease optimal culture conditions
- The periodic influx of warmer tropical water in the Northern Benguela region effectively prevents the culture of species with an upper lethal temperature tolerance exceeding 23°C
- The unprotected, high-energy nearshore coastline offers almost no suitable environment for cage aquaculture operations
- The cool water temperatures along the Namibian coastline limits open water aquaculture to temperate species
3.2.5. National SWOT Analysis and PEST Analysis

A strategic assessment of the strengths, weaknesses, opportunities and threats of the marine aquaculture sector has been conducted with inputs from various interested and affected parties, including national, regional and local government agencies; existing producers; fishing companies; financial sector representatives and investors; as well as the National Ports Authority and is shown below.

Table 1: National Marine Aquaculture Sector SWOT Analysis

<table>
<thead>
<tr>
<th>Strengths</th>
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<tbody>
<tr>
<td>1. Mostly enabling policy, legislative and regulatory environment</td>
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<td>2. Reputation as a high quality seafood supplier</td>
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<tr>
<td>3. Unpolluted coastal waters, with high primary productivity and a disease free status</td>
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<td>4. Established oyster and abalone ventures with a proven track record</td>
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<td>5. Available oyster and abalone seed suppliers</td>
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<td>6. Existing seafood processing capacity and fisheries based marketing channels</td>
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<td>7. Coastal land provisionally earmarked for aquaculture purposes</td>
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<tr>
<td>8. Suitable marine, transport, communication and social infrastructure at two key locations</td>
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<tr>
<td>9. Availability of research facilities at SANUMARC in Henties Bay and NATMIRC in Swakopmund</td>
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<tr>
<td>10. Government commitment to achieve sector growth</td>
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<td>11. Abundant availability of labour</td>
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<table>
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<tr>
<th>Weaknesses</th>
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<tbody>
<tr>
<td>1. Narrow range of culture species</td>
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<tr>
<td>2. Challenging biophysical environment constraints</td>
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<td>3. Distance to export markets</td>
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<tr>
<td>4. Small regional seafood market size</td>
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<td>5. Limited availability of government funding and human resources</td>
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<td>6. Limited access to institutional funding and other financing instruments</td>
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<td>7. Complex process and uncertainty for accessing suitable land and water areas</td>
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<td>8. Only two locations with port infrastructure</td>
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<td>9. Large areas of the coast are protected by conservation area zoning</td>
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<td>10. High risk perception for aquaculture</td>
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<td>11. Poor economies of scale</td>
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<tr>
<td>Opportunities</td>
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<tr>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1. Expand and strengthen business – government collaboration / relationships</td>
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<tr>
<td>2. Connect small and new enterprises to large companies</td>
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<tr>
<td>3. Complete implementation of the Shellfish Phyto-sanitary Monitoring Programme</td>
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<td>4. Zone land and sea areas for aquaculture</td>
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<td>5. Establish an aquaculture development fund</td>
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<td>6. Include aquaculture in the export incentive scheme</td>
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<td>7. Share information</td>
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<td>8. Recirculation aquaculture systems</td>
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<td>9. Stock enhancement to improve fisheries production</td>
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<table>
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<tr>
<th>Threats</th>
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<tbody>
<tr>
<td>1. Organisational inertia</td>
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<tr>
<td>2. Trade barriers</td>
</tr>
<tr>
<td>3. Market volatility</td>
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<tr>
<td>4. Exchange rate fluctuations</td>
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<tr>
<td>5. Significant increase in energy and other production costs</td>
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<td>6. Environmental opposition to aquaculture</td>
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<td>7. Competition from other countries</td>
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<td>8. Disease outbreaks</td>
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<tr>
<td>9. Pollution of the marine environment</td>
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<tr>
<td>10. Other user conflicts</td>
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<td>11. Limited electricity supply</td>
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A PEST (political, economic, social, and technological) analysis of the macro-environment affecting marine aquaculture development in Namibia suggests a positive outlook. Namibia has a stable, democratically elected government and is making progress towards macro-economic stability and social development (including access to basic education and primary health care services). The country has well-developed infrastructure, with efficient transport, logistics and communication networks. There is an open government attitude towards foreign direct investment and the country possesses a sophisticated banking system. Namibia’s tax regime also offers various incentives. The inflation rate in Namibia is moderate and the country has a relatively stable exchange rate. As a member of SADC, Namibia is part of Africa’s largest trading pact. Although Namibia has enjoyed economic growth and prudent macroeconomic policies, unemployment remains high and is a government development priority.
3.2.6. Challenges and Constraints

The following challenges and constraints negatively affecting marine aquaculture development in Namibia were identified during two stakeholder workshops held in Swakopmund and Lüderitz as part of the consultative process undertaken to inform the master plan:

Biophysical production limitations: Challenging oceanographic conditions, in particular the frequent and recurring occurrences of hydrogen sulphide eruptions as well as the unprotected, high energy coastline, limit sea-based aquaculture production. Namibia also has limited suitable indigenous species resources for marine aquaculture.

Unproven technologies: Although showing promising initial results, the technology for the offshore longline production of oysters in the Erongo region remains largely unproven and requires additional pilot project production. Worldwide, the application of recirculation aquaculture systems for grow-out operations also remains unproven. Both the technical and financial feasibility of abalone ranching has to be fully demonstrated.

Uncertainty regarding the availability of and access to land and water: The process and systems for the allocation of land and water remains muddled in uncertainty. Although it appears that land has provisionally been earmarked for aquaculture purposes, the zoning thereof has not been completed.

Limited resource availability: Aquaculture development resources at the Ministry of Fisheries and Marine Resources are limited, with existing personnel capacity responsible for overseeing marine aquaculture sector development as well as other research activities. There is a specific need to improve capacities to undertake effective due diligence of marine aquaculture project proposals and to link start-up entrepreneurs with institutional, venture capital and social investors.

Weak access to capital: Most of the existing marine aquaculture ventures in Namibia have been financed by means of private capital and bank loans. The conservative lending practices (in terms of cost, required returns and guarantees) of financial institutions in Namibia (and elsewhere in the SADC region) have limited the amount of capital available to both existing and start-up aquaculture companies. The small production scale of existing producers is also not attractive to large corporate investors. Although Namibia has generous national investment incentives, the exclusion of aquaculture from the export incentive scheme is a particularly important constraint, but one that can be easily overcome.

Start-up nature of most existing businesses: Several of the existing marine aquaculture businesses in Namibia are effectively still in a start-up mode with limited human capital and financial resources. Very few of these businesses have attractive balance sheets to secure significant loan financing.

Certification requirements for export: The lack of an accredited national shellfish sanitation programme prevents the export of Namibian shellfish to potentially lucrative markets in the EU and elsewhere. The lack of capacity and resources in the area of standards, testing and accreditation also negatively affect the export potential of shellfish producers.

Distance to markets: The distance to premium export markets in the EU, USA and Far East adds additional freight costs to production cost of sales and reduces domestic producer competitiveness. It also places an additional strain on cold chain management and transport logistics.
4. Development Potential Assessment

4.1. Potential for Sea-based Marine Aquaculture

4.1.1. Potential Species for Sea-based Marine Aquaculture

It is recommended that, in the near term, the species described below are prioritized for sea-based marine aquaculture grow-out ventures in Namibia. The production technologies for these species are mature, and they supply existing and mainly high value markets.

**Bigeye tuna, *Thunnus obesus***: Bigeye tuna is an important and prized food fish. It is an epipelagic and mesopelagic species inhabiting oceanic waters between 50°N and 45°S. It is one of the largest tuna species, with a maximum recorded weight of 210 kg. Generally tunas are an excellent aquaculture species because they have a good yield, grow fast, are tolerant of a wide range of temperatures, and are an extraordinary high value species with growing global markets. Tuna ranching (capture-based aquaculture) can be defined as the rearing or conditioning of wild caught tuna for a limited period of time to improve meat quality. The technologies for tuna ranching can be considered as mature.

**Mussels, *Mytilus galloprovincialis & Mytilus edulis***: Mussels are bivalve marine molluscs, filter feeders, and have fast growth rates (they can reach market size in less than one year. They have a wide distributional pattern, mainly due to their ability to withstand wide fluctuations in salinity, desiccation, temperature, and oxygen tension. Mussel farming is established in many parts of the world, including Scandinavia, Spain, New Zealand, China and South Africa. Most mussel culture depend on the use of natural spat because of the generally abundant supply thereof. Currently the most common method for culturing mussels is using longline systems with bags.

**Pacific Oysters, *Crassostria gigas***: The Pacific Oyster is a bivalve mollusc native to the Pacific coast of Asia. It has become an introduced species in North America, Australia, Europe, New Zealand and Southern Africa. Oysters are filter-feeders, and are considered obligatory herbivores. Pacific Oysters thrive in waters with a salinity range between 20pppt and 25ppt, and they can survive in waters with salinities in excess of 35ppt and below 10ppt. They can also tolerate a wide range of temperatures, surviving in waters from -1.8 to 35°C. In the Walvis Bay area, oysters typically reach a market size of 60 – 80g within 8 months, which is considerable faster than growth rates obtained elsewhere. Worldwide, oyster culture has expanded to include areas in all temperate oceans and seas. Oyster farming technologies can be considered as mature with racks and longlines the preferred grow-out systems.

**Scallops, *Pecten maximus***: The great Atlantic scallop, *Pecten maximus* is a bivalve mollusc filter feeder with a worldwide distribution. Scallops are a valuable seafood product with large established markets in Europe, the USA and Asia. Scallop species occupy various habitats across a wide range of seasonal temperature amplitudes, but grow best at temperatures between 10° and 17°C. They generally have fast growth rates. The techniques for the production of scallops (including hatchery technologies) are well established in some overseas countries. Currently the most common method for culturing scallops is using longline systems with lantern nets.

A variety of other bivalve molluscs can also be considered for sea-based aquaculture using longline systems in Namibia, including some *Venerupis* species.
4.1.2. Potential Sea-based Production Methods and Systems

**Suspended longline culture systems:** Commonly used, highly productive and efficient, longline systems are used worldwide to grow everything from oysters to scallops to seaweed. In a longline system a length of line is anchored at both ends, flotation is attached and various types of culture systems are hung on the line. These include lantern nets, pearl nets, tubes, trays, or bags. These systems are often preferred in high exposure areas and are already extensively used (for oyster farming) in Namibia.

![Photo showing the experimental “SmartFarm” longline type system currently being trialed (to farm oysters) about 3 nautical miles offshore in Walvis Bay.](image1)

**Fig 1:** Photo showing the experimental “SmartFarm” longline type system currently being trialed (to farm oysters) about 3 nautical miles offshore in Walvis Bay.

**Intensive, offshore surface gravity type cage culture systems:** Recent developments in cage systems, with improved mooring systems, better material selection and better designed assemblies, are making it possible to consider production in genuinely open-water conditions, utilizing HDPE surface gravity-type fish grow-out cages. These cages are highly resilient to wave forces and have a long service life (15 – 20 years). They have now been well tried and tested for numerous years in some of the harshest marine environments yet conquered by aquaculture and can be considered for tuna ranching initiatives in the TRIPP Seamount area, about 150 miles WSW of the Orange River mouth.

![Photo showing a 40m diameter mono-ring gravity surface type cage used for tuna farming in Port Lincoln, Australia.](image2)

**Fig 2:** Photo showing a 40m diameter mono-ring gravity surface type cage used for tuna farming in Port Lincoln, Australia.
4.2. Potential for Land-based Marine Aquaculture

4.2.1. Potential Species for Land-based Marine Aquaculture

It is recommended that, in the near term, the species described below are prioritized for land-based marine aquaculture grow-out ventures in Namibia. The production technologies for these species are mature and they mainly supply higher value niche markets.

**Abalone, Haliotis midae:** Abalone are marine gastropod molluscs. Approximately 56 species of abalone occur worldwide, and all are included within the genus *Haliotis*. *Haliotis midae* is one of the most important commercial species. In the wild, *H. midae* occur in fairly patchy distributions and aggregations in crevices or exposed positions on shallow reefs, particularly in beds of kelp. *H. midae* is an herbivorous species that consumes pieces of drift weed, notably kelp and red foliose algae. They can reach a maximum size of about 200 mm shell length at an age of about 30 years. *H. midae* are good candidates for marine aquaculture because they are highly fecund and can be readily spawned; accept artificial feeds; grow best at temperate water temperatures (14 to 18°C); have a good international market profile and can be processed into a variety of product forms.

**Kob, Argyrosomus species:** Kob belong to the Genus *Argyrosomus* and the Family *Sciaenidae*. *A. inodorus* is highly regarded as a table fish and it is an important commercial and recreational species in Namibia. *A. coronus* is also caught by commercial and recreational fishermen in Namibia. Generally *Argyrosomus spp.* appear to be well suited to marine aquaculture as it matures at a late age, and are tolerant of a wide range of temperature (10 ºC to 28ºC) and salinity (5 ppt to 35 ppt) conditions. *Argyrosomus* species have typically robust larvae. The species have a suitable biology for aquaculture, with relatively fast growth rates (1.4 kg in 14 months) and good feed conversion ratios in experimental systems. Processed fish have a good fillet size with a high yield (12% weight loss on gilling and gutting, and 45% yield on filleting).

Research into developing the techniques for the farming of *Argyrosomus* species was initiated in Australia in the late 1990’s and in SA in 2000. The Australian industry is currently a well-established, mature industry. There is also considerable interest in farming *Argyrosomus* species in Europe with farmed *A. regius* already being sold on markets in the EU. *A. japonicus* is currently being produced at three recirculation aquaculture production facilities in South Africa.

**Turbot, Psetta maxima:** Turbot is a benthic marine species, found living in shallow water to 100m depths. It is a flatfish, with an asymmetrical scaleless body. Turbot are a species well suited to high stocking densities and domestication. Farming of turbot originated in Scotland in the 1970’s and was closely followed by France, Spain and Norway. Current farming technologies can be considered as mature. Post-hatch larvae may be cultured in intensive or semi-intensive culture systems. Both types of systems use temperatures of 16 – 18°C. On-growing facilities mainly utilise onshore tanks and a 1.5 – 2 kg fish can be produced at the end of a 2 year cycle. Turbot have a good international market reputation with potential for the luxury end of the market.

A small number of other species can be considered for secondary (using discharge water) production, including sea urchins, sea cucumbers and marine worms. *A. coronus* and *A. inodorus* should be considered for stock enhancement initiatives.
4.2.2. Potential Land-based Production Methods and Systems

**Intensive, land-based flow-through aquaculture systems:** These systems involve the pumping of fresh seawater from the ocean into ponds and/or tanks and returning the water to the ocean after a single use cycle. Their main potential application in Namibia is for the culture of abalone in the Karas region.

![Photo showing a land-based flow-through system for the culture of abalone in Lüderitz.](image)

**Intensive, land-based recirculation aquaculture systems:** Recirculation aquaculture technology is well-advanced and is readily available as commercial off-the-shelf product offerings from multiple vendors. Recirculation systems allow niche producers to supply specialist, high value markets.

![Diagram showing typical recirculation aquaculture system components.](image)
4.3. Environmental Sustainability Assessment

Aquaculture has been cited as a contributing factor to the collapse of fisheries stocks worldwide due to the use of wild fish as fish feed for culture species; through habitat modification; transmission of diseases; and wild seed stock collection. Such accusations, although influential in a political sense, are not fully supported by scientific information and ignore the major advances and improvements in aquaculture technology, husbandry, hygiene, health and other management practices. It is only realistic to expect that aquaculture, being a human activity, will affect ecosystem health to some extent and with its extremely rapid development aquaculture has indeed been associated with environmental impacts that, in some cases warrant criticism. Aquaculture is, however, a minor environmental offender compared with agriculture and other industries and it should be noted that responsible aquaculture can provide environmental benefits.

Good aquaculture governance draws on codes of practice and best management practices (BMPs) to inform and implement policies and plans and ultimately operations. Other measures to protect the environment include environmental impact assessments, audits, and environmental monitoring. Responsible aquaculture has been further enhanced by the development of standards for aquaculture practices and animal health and certification systems for the health and safety of aquaculture food products and the quality of seeds and feeds. Formal processes exist for stakeholder consultation with adequate provisions for transparency and involvement of environmental NGOs.

Aquaculture may be the only means to markedly increase seafood production, and can be less detrimental to marine ecosystems than fishing. In short, aquaculture is here to stay; the challenge is to ensure this young and growing industry develops in a sustainable manner and does not cause serious ecological damage. The type and scale of any ecological change associated with aquaculture development depend on the method of aquaculture; the level of production; and the biological, chemical and physical characteristics of the affected area.

In recent years the expansion and diversification of aquaculture in Europe, Australia and elsewhere has been guided under carefully designed environmental controls. In addition, the aquaculture industry is increasingly moving towards self-regulation with, for example, the implementation of Codes of Good Practice. Rigorous environmental monitoring and recording standards have accordingly been implemented.

Worldwide, customers are prepared to pay premium prices for healthy food, grown in a healthy environment and overseas buyers increasingly require environmentally certified products and aquaculture producers to be appropriately certified at world’s best practice standards. A number of aquaculture companies in the rest of the world have already been accredited to the world environmental management standard, ISO 14001 as well as other eco-certification programmes. These developments occurred concurrently with an increasing realization in the food processing industry that competing on price alone is not necessarily the most attractive business strategy. Therefore, companies increasingly include “clean and green” as part of their marketing strategy.

Generally, modern human societies have the technical, economic, and management capabilities to cope with natural resource and environment constraints and to hedge against risks and uncertainties. What are needed are flexible, ongoing, adaptive processes that minimize ecological risks from continuing scientific discoveries and technological innovations without curtailing their social benefits.
4.4. Market Feasibility Assessment

Capture fisheries and aquaculture supplied the world with about 115 million tons of food fish in 2008, providing an apparent per capita supply of 17 kg (live weight equivalent), which is among the highest on record. Of this total, aquaculture accounted for 46%. Fish and fishery products are highly traded, with more than 37% (live weight equivalent) of total production entering international trade as various food and feed products. World exports of fish and fishery products reached US$ 102 billion in 2008. In real terms exports of fish and fishery products increased by 50% in the period 1998 – 2008. Exports of fish for human consumption have increased by 57% since 1996. Available data for 2010 indicate further strong growth, and the long-term trend for the trade in fish is positive, with a rising share of both developed and developing country production arriving in international markets.

World imports of fish and fish products reached a new record of US$ 107.1 billion in 2008, up 9% on the previous year and up 95% with respect to 1998. Japan is the world’s largest single national importer of fish and fishery products, with imports worth US$ 14.9 billion in 2008, a growth of 13% compared with 2007; in 2009, its imports decreased by 8% due to the impact of the global financial crisis. The European Union is by far the largest market for imported fish and fishery products with imports in 2008 worth US$ 44.7 billion, up 7% on 2007, and representing 42% of total world imports.

The growing exports of the last few years reflect the increase in consumption of fish and fishery products not only in the EU and the United States of America, but in many other regions of the world, including Asia. Furthermore, progress in processing, packaging, handling and transportation has enabled more rapid and efficient trade. Rising trade quantities (except for fishmeal) and values reflect the increasing globalization of the fisheries value chain, with the outsourcing of processing to other countries. At the same time, the growth of international and global distribution channels through large retailers has furthered this development.

In the short to medium term, the demand for fish will further expand as populations and incomes grow. Generally, improvement of economic conditions is the main force behind the increased per capita consumption of seafood products. Other factors affecting the growth of seafood in international markets include changing consumer tastes, consolidation in retail and distribution sectors, the internet (distributors can get into direct contact with producers), decreases in export tariffs, and the nutritional and health benefits associated with seafood. The growing development of value-added products such as fillets, portion control and vacuum packs, as well as convenience items has also benefited the seafood trade.

While the demand forecast for increased seafood consumption is bullish, the availability of supply is far less certain; the FAO believes that under current fishing regimes the potential worldwide harvest from marine capture fisheries is no more than the current level of 90 million tons, but even this level of fish cannot be sustained indefinitely. Future seafood supply growth can only come from aquaculture.

The position of farmed fish within seafood markets appear to be secure. Aquaculture production is preferentially and competitively meeting market demand through both non-price supply and product advantages. Supply advantages include, for example, the ability to control and thus predict supply. Farmers have far greater control over the timing, consistency and quantity of production than do fishermen. Product advantages primarily refer to quality, traceability and food safety factors.
4.5. Regional Biophysical Assessment

It is important to note that the biophysical assessment was undertaken within a context of existing viable production technologies and costs, current market prices and current macro infrastructure development.

4.5.1. Karas Region

**Description:** The Karas Region (Fig.6) is the southernmost region of Namibia. Its location in Namibia's south means that it shares a long border in the south and east with South Africa. Domestically, it borders only the Hardap Region to the north and the Atlantic Ocean in the west. The western edge of the region is hyper-arid and is part of the Namib Desert. This habitat is open and windswept, and in certain places the topography and the alignment of the coast relative to the dominant southerly winds funnel the wind in corridors where wind and sand transport are particularly strong. The southern part of the Karas coastline comprises fairly uniform sandy shores, large parts of which have been mined for diamonds. Most of the coastline is characterised by rocky terrain, with cliffs and sea arches. Within a few kilometers of the shore are several islands. Lüderitz is the region’s most important coastal town, with Oranjemund the only other coastal town. Industrial infrastructure and port and transport facilities serving Lüderitz is well developed.

**Fig 5:** Map of the Karas Region, showing the location of the region’s coastal towns.

**Existing marine aquaculture operations:** There are several existing commercial aquaculture operations in the Karas Region, including 3 oyster farms in Lüderitz and a land-based flow-through abalone, *Haliotis midae*, farm in Lüderitz. Two abalone (also *Haliotis midae*) ranching pilot projects are currently being undertaken in Lüderitz. Land-based flow-through abalone farming and pond based longline oyster pilot projects are currently being undertaken in Oranjemund.

**SWOT Analysis:** A strategic assessment of the strengths, weaknesses, opportunities and threats of the Karas Region was conducted and is shown in Table 2:

<table>
<thead>
<tr>
<th>Table 2: Karas Region SWOT Analysis</th>
</tr>
</thead>
</table>

Part 1, Section 1
Strengths

1. Low density industrial development and concomitant pollution in the Lüderitz area
2. Established transport and communication networks
3. Developed marine/port infrastructure in Lüderitz
4. Established seafood processing facilities and capacity in Lüderitz
5. Highest occurrence of kelp beds in Namibia presents opportunities for seabed ranching of abalone
6. High availability of suitable pump installation sites for land-based aquaculture
7. Some social facilities (entertainment, schools etc.)
8. Availability of large tracts of land for land-based aquaculture in the Oranjemund area
9. Area with exceptional wind stress provides opportunities for alternative energy supply

Weaknesses

1. Remoteness of the area
2. Primary production is lower than that of the Erongo region
3. Significant water temperature variations caused by upwelling reduces optimal culture conditions
4. Low water temperatures limits marine finfish species options
5. With the exception of the Lüderitz lagoon, a largely unprotected, high wave-energy coastline
6. The Lüderitz lagoon has a limited bivalve production capacity
7. Area with exceptional wind stress
8. Shallow areas inshore and in the Lüderitz lagoon limit cage culture site availability
9. Limited availability of land for land-based aquaculture in Lüderitz
10. Competition for available land
11. Unpredictability of mining operations in the Oranjemund area
12. Limited suitable sites for cost effective pump installations in the Oranjemund area
13. Limited airfreight capacity in both Lüderitz and Oranjemund

Opportunities

1. Successful completion of the Walvis Bay pilot project to prove the viability of offshore longline oyster culture
2. Recirculation aquaculture
3. Stock enhancement
4. Potential synergies with other industrial developments e.g. mining in Oranjemund

Threats

1. Security of Tenure in Oranjemund
2. Increased transport costs
3. External pollution events e.g. ship borne pollution

**Marine aquaculture potential:** There are several opportunities to increase marine aquaculture production in the Karas region. Oyster production in the Lüderitz lagoon is sustainable and can probably be doubled, but ultimately has a finite limit. The disused mining ponds in the Oranjemund area do not offer any potential for oyster grow-out to market size, but do offer some potential for the grow-out of oysters to 30g and sale to
other on-growers. The Oranjemund mining ponds do not offer any potential for marine finfish grow-out due to high salinities in the southern ponds and shallow water depth in the northern ponds. These ponds do offer some potential for small scale extensive marine finfish culture. The Oranjemund area does (utilizing the mining ponds as secondary water reservoirs), however, offer significant potential for marine finfish aquaculture in recirculation aquaculture systems. For marine finfish the application of recirculation technologies is dependent on improvements in the capital and operating costs of such systems or the subsidization thereof. Given its high market value, the production of abalone in recirculation systems in both the Lüderitz and Oranjemund areas could be financially feasible. There is some potential for marine finfish stock enhancement in the Karas region. The Lüderitz lagoon area acts as marine finfish nursery area and could be stocked with larvae, fry or fingerlings produced at the SANUMARC research center in Henties Bay. The existing abalone farm at Lüderitz can be extended, but that is dependent on the allocation of additional land for the purpose thereof. There is some potential to operate a sea based tuna ranching operation in the Tripp Seamount area (from Lüderitz), but this will have to be trialed at a pilot project level. There is also some potential for clam aquaculture in the region, but this will also have to be trialed at the pilot project level.

An assessment of potential production systems is shown in Table 3:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cage Culture</th>
<th>Suspended Line Culture</th>
<th>Near Bottom Rack Culture</th>
<th>Land-based Flow-through</th>
<th>RAS</th>
<th>Seabed Ranching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water quality</td>
<td>Poor</td>
<td>Good</td>
<td>Poor</td>
<td>Good for temperate species</td>
<td>Good for temperate species</td>
<td>Good for temperate species</td>
</tr>
<tr>
<td>Wave climate</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>n/a</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Wind climate</td>
<td>Poor</td>
<td>Good inshore, poor offshore</td>
<td>Average</td>
<td>n/a</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Current</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>n/a</td>
<td>n/a</td>
<td>Good</td>
</tr>
<tr>
<td>Infrastructure availability</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Other users</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
</tr>
</tbody>
</table>

An assessment of potential production systems is shown in Table 9. The cage culture potential of gastropods is poor due to excessive bio-fouling. The land-based potential thereof is average due to lower than optimal temperatures and high sea surface temperature variations. The “poor” classification is due to the failure of a previous seaweed operation in Lüderitz.

<table>
<thead>
<tr>
<th>Production System</th>
<th>Marine Finfish</th>
<th>Gastropod Molluscs</th>
<th>Bivalve Molluscs</th>
<th>Crustaceans</th>
<th>Seaweed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cage culture</td>
<td>Poor</td>
<td>Poor</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Suspended culture</td>
<td>n/a</td>
<td>n/a</td>
<td>Good</td>
<td>n/a</td>
<td>Poor</td>
</tr>
</tbody>
</table>
Figures 6 and 7 show industrial and transport infrastructure as well as land use zoning for the region’s urban areas. In these figures areas already zoned for aquaculture are shown in yellow.

### Table: Aquaculture Systems

<table>
<thead>
<tr>
<th>Aquaculture System</th>
<th>Near</th>
<th>Land-based Flow-through</th>
<th>Recirculation Aquaculture</th>
<th>Seabed Ranching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near bottom rack culture</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Land-based flow-through</td>
<td>Poor</td>
<td>Average</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Recirculation aquaculture</td>
<td>Good for temperate species</td>
<td>Good</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Seabed ranching</td>
<td>n/a</td>
<td>Average</td>
<td>Poor</td>
<td>n/a</td>
</tr>
</tbody>
</table>

---

**Legend**

- 20 m contour line
- NamPower power line
- Power line 5 km zone
- National road
- High water mark
- High water mark 1 km zone
- Sites recommended for aquaculture (±-10 ha)
- Protected area
- Lüderitz Townland
- Compliant area within Local Authority
- Compliant area within National Park

**Fig 6:** Map of the Lüderitz area, showing major infrastructure and selected zoning.
Fig 7: Map of the Oranjemund area, showing major infrastructure and selected zoning.
4.5.2. Erongo Region

Description: The Erongo Region (Fig. 2) is located in the central western part of Namibia. Landmark features of its boundaries include the Atlantic Ocean in the west, the Ugab River in the north, and the Kuiseb River as part of the region’s southern border. Much of the region is occupied by the Namib Desert which stretches parallel to the coast for the length of the country, to about 120-150 km inland. The climate of the Erongo Region is characterised by aridity. Large parts of the Erongo Region are desert and owned by the State as protected areas under conservation management; these include the Namib-Naukluft Park in the south and central area, and the National West Coast Recreation Area in the north. The Port of Walvis Bay is the region’s economic nucleus and is linked to Namibia’s transport infrastructure by both road and rail networks. The region’s other coastal towns include Swakopmund and Henties Bay.

![Map of the Erongo Region](image)

**Fig 8:** Map of the Erongo Region, showing the location of the region’s coastal towns. The green semi-circle shows an area within a 25 km range from the Walvis Bay port.

Existing marine aquaculture operations: There are several existing commercial aquaculture operations in the Erongo Region, including 5 oyster farms in Walvis Bay and an oyster farm and hatchery in Swakopmund. An offshore suspended longline oyster pilot project is currently being undertaken about 5 nautical miles from the Walvis Bay port. Henties Bay is home to the SANUMARC aquaculture research center.

SWOT Analysis: A strategic assessment of the strengths, weaknesses, opportunities and threats of the Erongo Region was conducted and is shown in Table 5:

<table>
<thead>
<tr>
<th>Table 5: Erongo Region SWOT Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
</tr>
<tr>
<td>1. Low density industrial development and concomitant pollution</td>
</tr>
<tr>
<td>2. Established transport and communication networks</td>
</tr>
</tbody>
</table>
### Marine aquaculture potential:

There is limited potential for marine aquaculture in the Erongo region. The frequent and recurring hydrogen sulphide eruptions that occur nearshore and offshore in the region caused mass mortalities in the Walvis Bay based oyster industry in 2008 and 2010 and remain a prohibiting risk factor. The occurrence of these eruptions effectively prevents the culture of any open water aquaculture (note that marine finfish are more susceptible to hydrogen sulphide toxicity than bivalves). The occasional intrusion of higher temperature subtropical water prevents the introduction and land-based flow-through culture of *Haliotis midae*, an abalone species currently being successfully farmed in Lüderitz. It is unlikely that the pond-based oyster operation in Swakopmund will expand its operations.

There is some potential for recirculation based marine aquaculture in the region. Given its high market value, the production of abalone in recirculation systems could be financially feasible. For marine finfish the application of recirculation technologies is dependent on improvements in the capital and operating

<table>
<thead>
<tr>
<th>3.</th>
<th>Well-developed marine/port and logistical infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Established seafood processing facilities and capacity</td>
</tr>
<tr>
<td>5.</td>
<td>High primary production conducive for fast growing bivalve mollusc culture</td>
</tr>
<tr>
<td>6.</td>
<td>Availability of oyster seed supply (Swakopmund)</td>
</tr>
<tr>
<td>7.</td>
<td>Suitable social infrastructure and facilities (entertainment, schools etc.)</td>
</tr>
<tr>
<td>8.</td>
<td>Availability of 270 hectares of land already allocated for land-based aquaculture</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Frequent and recurring toxic hydrogen sulphide eruptions</td>
</tr>
<tr>
<td>2. Frequent and recurring low oxygen conditions caused by hydrogen sulphide eruptions</td>
</tr>
<tr>
<td>3. A track record of mass mortalities in the Walvis Bay oyster aquaculture industry</td>
</tr>
<tr>
<td>4. Significant water temperature variations caused by upwelling reduce optimal culture conditions</td>
</tr>
<tr>
<td>5. With the exception of the Walvis Bay lagoon, a largely unprotected, high wave-energy coastline</td>
</tr>
<tr>
<td>6. Shallow areas inshore limit cage culture site availability</td>
</tr>
<tr>
<td>7. Poor kelp resources limit seabed ranching of gastropod molluscs such as abalone</td>
</tr>
<tr>
<td>8. Competition for available land</td>
</tr>
<tr>
<td>9. Limited suitable sites for cost effective pump installations</td>
</tr>
<tr>
<td>10. No undeveloped land available within the port area</td>
</tr>
<tr>
<td>11. Limited airfreight capacity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Successful completion of a pilot project to prove the viability of offshore longline oyster culture</td>
</tr>
<tr>
<td>2. Recirculation aquaculture of suitable marine finfish species and abalone, <em>Haliotis midae</em></td>
</tr>
<tr>
<td>3. Marine finfish stock enhancement</td>
</tr>
<tr>
<td>4. Potential synergies with other industrial developments</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Another mass mortality and bankruptcy in the Walvis Bay oyster industry</td>
</tr>
<tr>
<td>2. External pollution events</td>
</tr>
<tr>
<td>3. Technical and financial failure of the offshore oyster culture pilot project</td>
</tr>
</tbody>
</table>
costs of such systems or the subsidization thereof. There is some potential for marine finfish stock enhancement in the Erongo region. The Walvis Bay lagoon area acts as a marine finfish nursery area and could be stocked with larvae or fry produced at the SANUMARC research center in Henties Bay.

A technical assessment of potential production systems is shown in Table 6:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cage Culture</th>
<th>Suspended Line Culture</th>
<th>Near Bottom Rack Culture</th>
<th>Land-based Flow-through</th>
<th>RAS</th>
<th>Seabed Ranching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water quality</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Average</td>
<td>Poor</td>
</tr>
<tr>
<td>Wave climate</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>n/a</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Wind climate</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>n/a</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Current</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>n/a</td>
<td>n/a</td>
<td>Good</td>
</tr>
<tr>
<td>Infrastructure availability</td>
<td>Good in WB, poor elsewhere</td>
<td>Good in WB, poor elsewhere</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good in WB, poor elsewhere</td>
</tr>
<tr>
<td>Other users</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
</tr>
</tbody>
</table>

A technical assessment of species suitability by potential production systems is shown in Table 6. In general this assessment demonstrates that only recirculation based aquaculture provides technically viable options for marine aquaculture in the Erongo region. The “average” classification for recirculation based gastropod culture is due to the need to cool water to be able to culture *Haliotis midae*. The “average” classification for land-based bivalve mollusc culture is due to the limited availability of suitable sites. The “poor” rating for the culture of bivalves in offshore suspended longline systems can be improved but that is dependent on the successful completion of the Tetelestai “SmartFarm” pilot project. The potential for seabed ranching of bivalves is poor due to excessive underwater sand transport along much of the coast and low bottom oxygen conditions in the Walvis Bay lagoon area.

<table>
<thead>
<tr>
<th>Production System</th>
<th>Marine Finfish</th>
<th>Gastropod Molluscs</th>
<th>Bivalve Molluscs</th>
<th>Crustaceans</th>
<th>Seaweed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cage culture</td>
<td>Poor</td>
<td>Poor</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Suspended culture</td>
<td>n/a</td>
<td>n/a</td>
<td>Poor</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Near bottom rack culture</td>
<td>n/a</td>
<td>n/a</td>
<td>Average</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Land-based flow-through</td>
<td>Poor</td>
<td>Poor</td>
<td>Average</td>
<td>Poor</td>
<td>n/a</td>
</tr>
<tr>
<td>Recirculation aquaculture</td>
<td>Good</td>
<td>Average</td>
<td>n/a</td>
<td>Poor</td>
<td>n/a</td>
</tr>
<tr>
<td>Seabed ranching</td>
<td>n/a</td>
<td>Poor</td>
<td>Poor</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Figures 9, 10 and 11 show industrial and transport infrastructure as well as land use zoning for the region's urban areas. In these figures areas already zoned for aquaculture are shown in yellow. For land-based marine aquaculture, only areas within 1 km of the high water mark; below 20m above sea level; within 5 km of existing electricity infrastructure; and outside of protected areas can currently be considered.

**Fig 9:** Map of the Walvis Bay area, showing major infrastructure and selected zoning.
Fig 10: Map of the Swakopmund area, showing major infrastructure and selected zoning.
Fig 11: Map of the Henties Bay area, showing major infrastructure and selected zoning.

Legend
- SANUMARC (UNAM) facility
- Proposed site for desalination plant
- National road
- 20 m contour line
- NamPower power line
- High water mark
- Site allocated for aquaculture (+/- 186 ha)
- Desalination plant 1 km buffer zone
- Power line 5 km zone
- High water mark 1 km zone
- Protected area
- Municipality
- Compliant area within Local Authority (+/- 2108 ha)
- Compliant area within National Park (+/- 742 ha)
4.5.3. Kunene Region

Description: The Kunene Region (Fig. 1) is situated in Namibia's remote north-west, bordering Angola to the north and includes the Skeleton Coast National Park, which forms its entire west coast on the Atlantic Ocean. The region gets its name from the Kunene River, which forms the border between Namibia and Angola. It has a semi- to hyper-arid climate. Although the region covers an area of 144,250 km², it is relatively underdeveloped and does not have any coastal towns and logistical or port infrastructure.

![Fig 12: Map of the Kunene Region](image)

Existing marine aquaculture operations: There are no existing marine aquaculture operations in the Kunene Region.

SWOT Analysis: A strategic assessment of the strengths, weaknesses, opportunities and threats of the Kunene Region was conducted and is shown in Table 8:

<table>
<thead>
<tr>
<th>Table 8: Kunene Region SWOT Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
</tr>
<tr>
<td>1. Unpolluted coastal waters</td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
</tr>
<tr>
<td>1. Unprotected, high wave-energy coastline</td>
</tr>
<tr>
<td>2. There is no transport and logistical infrastructure</td>
</tr>
<tr>
<td>3. There is no port infrastructure</td>
</tr>
<tr>
<td>4. There is no electricity infrastructure</td>
</tr>
<tr>
<td>5. The entire area falls within the protected Skeleton Coast National Park</td>
</tr>
<tr>
<td>6. Extensive underwater sand transport prevents seabed ranching and limits pump station availability</td>
</tr>
<tr>
<td><strong>Opportunities</strong></td>
</tr>
<tr>
<td>1. None</td>
</tr>
</tbody>
</table>
Marine aquaculture potential: There is no potential for marine aquaculture in the Kunene Region utilizing existing production technologies and benchmarking current production costs and prices. The region’s primary constraints relate to a lack of industrial infrastructure, an unprotected coastline and its status and zoning as an important conservation area. Seabed ranching is limited by a lack of suitable rocky habitat, poor kelp resources and intense underwater sand transport.

An assessment of potential production systems against key production parameters is shown in Table 9:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cage Culture</th>
<th>Suspended Line Culture</th>
<th>Near Bottom Rack Culture</th>
<th>Land-based Flow-through</th>
<th>RAS</th>
<th>Seabed Ranching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water quality</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Wave climate</td>
<td>Poor</td>
<td>Poor</td>
<td>Good</td>
<td>n/a</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Wind climate</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>n/a</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Current</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>n/a</td>
<td>n/a</td>
<td>Good</td>
</tr>
<tr>
<td>Infrastructure availability</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Other users</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
</tr>
</tbody>
</table>

A technical assessment of species suitability by potential production systems is shown in Table 10:

<table>
<thead>
<tr>
<th>Production System</th>
<th>Marine Finfish</th>
<th>Gastropod Molluscs</th>
<th>Bivalve Molluscs</th>
<th>Crustaceans</th>
<th>Seaweed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cage culture</td>
<td>Poor</td>
<td>Poor</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Suspended culture</td>
<td>n/a</td>
<td>n/a</td>
<td>Poor</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Near bottom rack culture</td>
<td>n/a</td>
<td>n/a</td>
<td>Poor</td>
<td>n/a</td>
<td>Poor</td>
</tr>
<tr>
<td>Land-based flow-through</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>n/a</td>
</tr>
<tr>
<td>Recirculation aquaculture</td>
<td>Poor</td>
<td>Poor</td>
<td>n/a</td>
<td>Poor</td>
<td>n/a</td>
</tr>
<tr>
<td>Seabed ranching</td>
<td>n/a</td>
<td>Poor</td>
<td>Poor</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>
4.6. Potential to Expand Existing Ventures

4.6.1. Abalone Farming

Abalone farming in Southern Africa started in the early 1990’s with the first 10 tons of cultured abalone, *Haliotis midae*, being produced in 1997. The abalone industry expanded rapidly thereafter and by 2001, it had already become the most important and valuable single aquaculture sub-sector in South Africa. A total of 1 150 tons of farmed *H. midae* abalone were produced in 2010, with a farm gate value of approximately N$ 274 million and a unit value of about N$ 245 per kg. There is a single operational abalone farm in Namibia (Lüderitz Abalone, established in 2003), with production of about 30 tons in 2011. An abalone farming pilot project has been conducted in Oranjemund since 2008. Significant potential exists to expand both Namibian ventures: production at the Lüderitz abalone farm can be increased to at least 300 tons over the next 5 to 10 years and the Oranjemund pilot project successfully demonstrated both technical and financial feasibility. The development of a recirculation based abalone farm in the Erongo region should be trialed at the pilot project level.

**Technical feasibility:** The development of abalone culture technologies in SA and Namibia has been based on a combination of technology transfer and local innovation by industry in partnership with research institutions. Current technologies can be considered as established, with regional abalone farming technology probably world leading. Local abalone hatcheries have developed broodstock conditioning protocols and maintain broodstock populations which are spawned on a regular basis. For grow-out operations most farms pump seawater into land-based tanks that are run in flow-through mode, although recirculation technology is also used. Seawater is generally pumped from the sea into header tanks, through some sort of filter and gravity fed into tanks containing the abalone. The abalone tanks are usually rectangular in shape. They contain baskets, which in turn contain a number of plate racks, to which the abalone attach themselves. Water is introduced into the tanks at a number of points, usually above a basket. Effluent water drains out from the end of the long axis of the tank, taking accumulated waste with it. The waste water flows back to the sea. Services to the industry are well established.

**Market feasibility:** The stable population growth in China and elsewhere in Asia, rapid economic growth, cultural emphasis on the importance of fish protein and the luxury value of abalone, and higher disposable income will continue to drive global demand for farmed abalone. In China specifically, after decades of deprivation and conformism, Chinese consumers regard expensive consumer goods as trophies of success. It can therefore be concluded that the opportunities for expanding production of the South African abalone, *Haliotis midae*, are eminently feasible from a market perspective and provide opportunities for further commercial development. This view is confirmed by the aggressive growth strategy currently being considered and implemented by existing abalone farms and new industry entrants in South Africa, with industry output set to grow by between 60% and 70% in the next 5 – 7 years. It is also confirmed by the continued and planned growth of the abalone farming sectors in all the other abalone producer countries.

Although domestic production of abalone in China has increased significantly in recent years, this does not pose a threat to imports, as domestic production caters to the lower end of the market while imports, known for their higher quality, tend to be used in the higher end market. Demand for all abalone still
outstrips supply – differentiation through quality and size is, however, important for best prices; it is also important to offer a diversified product portfolio.

In 2008 and 2009 there was a contraction in imports and exports of abalone due to the global financial crisis, but the market has since rebounded and shown even more robust growth than that prior to 2008. The total supply of abalone to the world market from all sources (fisheries, cultured, and illegal catch) was about 65,500 tons in 2010; which is 33% higher than production recorded in 2008 and includes aquaculture production of 42,500 tons in China. The total production from aquaculture was about 52,000 tons in 2010, with China accounting for 81% of total production. Although abalone prices suffered a drop during the financial crisis, prices will increase in the medium to long term; an indication hereof is the recent (2011, continuing a long term trend) positive price adjustment for *Haliotis midae*.

**Financial feasibility:** Although there are many methods to evaluate the financial feasibility of a project from an investor’s perspective, the internal rate of return (IRR) is a very useful tool. It is defined as the discount rate that equates the present value of expected future cash flows of a project with the initial investment associated with the project. The financial profitability of abalone farming is attractive. The internal rate of return (IRR) before financing is 21% (an IRR of greater than your cost of capital – currently around 14% – is acceptable) with a modified IRR of 17.1% (the modified IRR is just a more conservative measure of IRR where the interest rate at which money is reinvested is set at a more conservative level). This means that the venture can theoretically borrow all the finance required at around 20% and still just break even. It also implies that the net present value (NPV) will be zero if a discount rate of 21% is used.

The net present value (NPV) using a discount rate of 15% is N$ 26 million (note that a NPV > 0 indicates that the project should be accepted given the discount rate used). The return on investment (ROI) and return on equity (ROE) are very high at around 40% once the project is at full production.

The project is capital intensive and requires a capital investment of N$ 62.3 million, of which most (77%) is required in years 2 and 3. Total financing of N$ 99 million is required over the initial 5 years to cover the required capital expenditure and working capital before the project breaks even on a cash flow basis. A key aspect of the project is that the first sales (of 200g abalone) only occur in month 54 (after 4.5 years). The project reaches full production in year 6, where after production stabilises at 243 tons per year and sales at around N$ 70 million per year. The cost of goods sold (COGS) is fairly low at around 24% of turnover. This translates into a high gross margin of 76%. The EBITDA stabilizes at N$ 40 million in year 6, which translates into an exceptionally high EBITDA margin of 57%. The net profit after tax (NPAT) is expected to be a negative over the initial 4 years and then stabilizes at between N$ 20 – 30 million from year 6 onwards. This also translates into an unusually high net profit margin of just over 39%.

A sensitivity analysis was done for the project based on a few key variables. Based on a 10% positive and negative change the project is most sensitive to changes in prices and/or exchange rate followed by changes to the amount of spat procured per month and the growth rate of the spat.

The projected profitability of a business should always be evaluated in context of the risk associated with the business. The abovementioned projections are generally considered to be robust and achievable given that the technology and track record of land-based abalone systems are now well established. The key risk, and defining characteristic of an abalone venture, is the fact that substantial investment in both assets and working capital is required up front with income only being derived from year 4 onwards.
### 4.6.2. Abalone Ranching

**Technical feasibility:** Abalone ranching is the process of placing juvenile abalone in the natural (sea) environment and harvesting market sized abalone after a no additional input required growth period. It has been implemented, with varying levels of success, by various countries including Japan, the United States, Mexico, New Zealand, Australia, Canada, Philippines, Chile and South Africa. Two abalone (*Haliotis midae*) ranching pilot projects are currently ongoing in Lüderitz and have shown promising initial results, with both survival and growth in line with initial financial modeling assumptions.

**Market feasibility:** The market potential for abalone ranching is positive and similar to that described for land-based abalone farming. It is important to note that abalone ranching will in all likelihood target the production of larger sized abalone and that the market pays a premium for large abalone.

**Financial feasibility:** The financial profitability of abalone ranching is very attractive. The internal rate of return (IRR) before financing is 30.32% with a modified IRR of 22%. The project will have a net present value (NPV) of N$ 422 842. The return on investment (ROI) averages about 50% over the 10 years, with a similar return on equity (ROE).

Total financing of N$ 54 million is required over the initial 4 years before the project breaks even on a cash flow basis. This includes capital expenditure of N$ 6 278 400 and a peak working capital requirement of N$ 15 643 287. The project reaches full production in year 6 where after sales stabilize at N$ 53 million per year. The cost of goods sold (COGS) is fairly low at around 22% of turnover. This translates into a high gross margin of 78%. The EBITDA stabilizes at N$ 40.5 million in year 6, which translates into an exceptionally high EBITDA margin of 71.9%. The net profit after tax (NPAT) is expected to be a negative over the initial 3 years and then stabilizes at N$ 27.8 million from year 6 onwards. This also translates into an unusually high net profit margin of just over 51%.

A sensitivity analysis was done for the project based on a few key variables. The sensitivity analysis is useful in getting a feel for the variability of return (IRR in this case) in response to a 10% positive and negative change in the identified variables, keeping the other variables constant. Based on a 10% positive and negative change the project is most sensitive to changes in the mortality rate, followed by changes to the sales price and exchange rate. The project is less sensitive to spat prices and the extent of the initial capital investment.

In conclusion, while the project requires substantial funding, it shows very high levels of profitability albeit with correspondingly high levels of risk. The main risk relates to the startup nature of the business and the largely untested nature of some of the underlying assumptions. The project has no income for the initial 3 years and only comes into full production in year 6. There is a high risk associated with ranching abalone in the sea with the related uncertainty on mortality rates. The project will be most exposed around year 4 and 5 by when it would have spent almost N$ 55 million and be on the verge of harvesting the first large abalone. It must however be recognized that a pilot project will mitigate many of the abovementioned risks and be of tremendous benefit to the project. This upside has not been built into the analysis. The project has relatively low fixed capital requirements and extremely high margins and profitability once in full production. The project should therefore over time provide very high levels of returns that compensate for the initial high risk.
4.6.3. Oyster Farming

**Technical feasibility:** Oyster production in the Lüderitz lagoon area is sustainable and can probably be doubled, whilst the Tetelestai Mariculture “SmartFarm” technology offshore oyster culture pilot project in Walvis Bay has shown promising initial results and offers opportunities for substantial growth. The production technologies utilized by oyster producers in Namibia are mature and have also been extensively implemented elsewhere. Spat supply to the sub-sector is available.

**Market feasibility:** The market potential for Namibian grown oysters is positive. World Oyster production is predominantly from aquaculture and has grown approximately 50% over the last 10 years. World trade of oysters is quite low compared with total production. Despite producing over 80% of all oysters, China accounts for only 5% of world exports. China produced 3.5 million tons in 2009. The next biggest producer, South Korea, recorded 240,911 tons; closely followed by Japan with 210,188 tons. The USA produced 129,110 tons, and France 104,640 tons. All other countries combined produced 114,769 tons. The largest exporters include France, Korea and USA, with the largest import markets including Italy, Hong Kong, and the USA. In 2009, world exports of oysters amounted to 53,600 tons.

Based on FAO Fishstat prices, of the top 20 importing countries in 2009 from a value perspective, French Polynesia was the top payer at US$13.42 per kg, followed by the United Arab Emirates (US$11.05), Russia (US$10.74), the United Kingdom (US$8.67), Singapore (US$8.47), and Australia (US$8.33) per kg. The lowest import prices per kg were Taiwan (US$1.94), Spain (US$3.41), Italy (US$3.77), and France (US$3.92). The average import price in 2009 was US$ 4.27 per kg.

**Financial feasibility:** The financial profitability of a large oyster farming venture is attractive. The internal rate of return (IRR) before financing is 24% with a modified IRR of 20.1%. The net present value (NPV) using a discount rate of 20% is N$ 2.2 million. The return on investment (ROI) and return on equity (ROE) are high at around 36% once the project is at full production.

The project is capital intensive and requires a capital investment of N$ 14.7 million, of which most is required in years 1 and 2. Total financing of N$ 22.3 million is required over the initial 3 years to cover the required capital expenditure and working capital before the project breaks even on a cash flow basis. The project reaches full production in year 3, where after production stabilises at 500 tons per year and sales at around N$ 35.7 million per year. The cost of goods sold (COGS) is around 52% of turnover. This translates into a high gross margin of 48%. The EBITDA stabilizes at N$ 26 million in year 5, which translates into an exceptionally high EBITDA margin of 57%. The net profit after tax (NPAT) is expected to be a negative over the initial 2 years and then stabilizes at between N$ 20 – 30 million from year 5 onwards. This also translates into an unusually high net profit margin of just over 39%.

A sensitivity analysis was done for the project based on a few key variables. Based on a 10% positive and negative change the project is most sensitive to changes in prices and/or exchange rate followed by changes to the mortality rate and achieved growth rates.

The projected profitability of a business should always be evaluated in context of the risk associated with the business. The abovementioned projections are generally considered to be robust and achievable given that the technology and track record of oyster culture systems are now well established. The key current risk of an oyster culture venture in Namibia is related to an unpredictable culture environment.
5. Master Plan

5.1. Overview

The world economy started to recover from the global financial and economic crisis by the end of 2009. Since 2010, the world economy has, however, entered a new phase of economic weakening. Economic growth in major advanced economies has come to a halt and some countries have re-entered recession, notably in Europe. Growth has also slowed down in large emerging and developing countries. The current economic uncertainties created by a combination of fragile demand outlooks and tight credit conditions are restricting investment in real economic activities. This is especially true for small and medium enterprises, not just because of uncertainty, but because they now find it more difficult to get bank credit.

Several types of policy initiatives have been taken in an attempt to mitigate the spill-over effects of the global economic crisis on the Namibian economy. The Namibian Minister for Finance, when tabling the 2009/10 national budget in Parliament, announced that expansionary fiscal and monetary policy measures would be used in combination and be aligned to address and minimize the impact of the global financial crisis. The Minister confirmed that the specific fiscal policy measures to do so would, as far as possible, be coordinated with the other measures set out in the third National Development Plan (NDP 3), Vision 2030 and be sustainable over the medium-to-long-term. In addition, she emphasized that significant resources would be provided for industrial policy interventions.

The Key Result Areas in NDP 3 provide a broad framework for the formulation of a marine aquaculture development strategy and master plan. Particularly important is specific directives to achieve accelerated economic growth, increased job creation and the strengthening of mutually beneficial smart partnerships between the public and private sectors and civil society organisations. It is clear that attaining the goals set out in Vision 2030 and NDP3 will require specific and targeted interventions formulated around a collective ambition. It is also clear that the Namibian government will have to be an important actor in driving economic growth in the marine aquaculture sector. Based hereon, this study proposes a development and growth strategy organized around 6 focus areas:

- Promoting social entrepreneurship
- Providing strategic leadership and management services
- Establishing public private business partnerships
- Creating a favourable aquaculture investment environment
- Providing immediate support to the existing private sector
- Promoting the development of recirculation aquaculture systems

**Promoting social entrepreneurship:** Financial engineering can be a powerful force for change by permitting the mobilization of more capital for investment than would otherwise be available. Financial engineering can make it possible to unbundle societal benefits and financial returns to access investment from both the financial markets and organizations devoted to social enterprises. Social enterprises are entrepreneurial organizations that blend social benefit and financial revenues. Essentially, by positioning planned marine aquaculture ventures within the social enterprise environment, these ventures can offer different risks and returns to different kinds of investors instead of delivering a blended return that holds for all investors but is acceptable to very few.
Although some social enterprises can earn a profit that is sufficient to get the business funded by conventional investors, many, if not most, social enterprises are not profitable enough to access traditional financial markets. Social enterprises, however, can become viable through the largesse of government subsidies, foreign aid, charitable foundations, and a handful of high-net-worth individuals who will make donations or accept lower financial returns on their investments in social projects. In the emerging model of social enterprise capital markets, a venture delivering a social return could obtain seed capital from donors without giving the donors any claim on assets. The seed capital could then be augmented by equity capital with a residual claim on assets and by debt capital with a prior claim on assets and cash flow. With all these types of liabilities available, the funding and growth possibilities for social enterprises start to look a lot more promising.

**Providing strategic leadership and management services:** Strategic management is viewed as the set of decisions and actions that result in the formulation, implementation and control of plans designed to achieve an organisation’s vision, mission, strategy and strategic objectives within the business and regulatory environment in which it operates. Strategy implementation is an integral component of the strategic management process and is viewed as the process that turns the formulated strategy into a series of actions and then results to ensure that the vision, mission, strategy and strategic objectives of the organisation are successfully achieved as planned.

For the past two decades, strategy formulation has been widely regarded as the most important component of the strategic management process – more important than strategy implementation or strategic control. Recent research, however, indicates that strategy implementation, rather than strategy formulation alone, is a key requirement for superior business performance. Leadership, and specifically strategic leadership, is widely described as one of the key drivers of effective strategy implementation. Strategic leadership is multifunctional, involves managing through others, and helps organisations cope with change that seems to be increasing exponentially in today’s globalised business environment. Given the start-up nature of most of the marine aquaculture actors (and their lack of resources) in Namibia, strategic leadership and implementation services will have to be provided by the government. The master plan proposes the establishment of a marine aquaculture business development and investment promotion agency (affiliated to MFMR) to do so.

**Establishing public-private partnerships:** The rise of state capitalism constitutes one of the biggest changes in the world economy in recent years: state-owned companies now make up 80% of the value of the stock market in China, 62% in Russia and 38% in Brazil. They accounted for one-third of the world’s foreign direct investment between 2003 and 2010 and an even higher proportion of its most spectacular acquisitions. The United Nations Conference on Trade and Development defines a state-owned company as one in which the state owns more than 10% of the shares. In many emerging economies, state capitalism increasingly looks like the coming trend. Governments are also becoming more sophisticated owners. New state capitalism is far better at using capitalist tools to achieve its desired ends. Instead of handing industries to bureaucrats, it turns them into companies run by professional managers.

Establishing public-private partnerships (PPPs) based on a minority government shareholder model with ownership in a broad spectrum of different companies is potentially one of the sharpest tools in Namibia’s marine aquaculture master plan. Public-private partnership implies a common understanding of shared
goals, a willingness to repartition responsibilities for their achievement, a continuing public-private dialogue on what needs to be done to promote their realization, and a supportive policy and institutional framework. NDP 3 includes the finalisation and implementation of a Public-Private Partnerships Policy (Sub Key Results Area 4a: Macro-economy). The establishment of an aquaculture development fund as recommended in NASP (2004) will be essential to fund the state’s acquisition of shares. Importantly, establishing PPPs will have to be underpinned by a willingness to pursue opportunities; a parallel willingness to adopt new products and services; social, legal, and economic tolerance for failure; and the ability to efficiently redeploy people and money.

Creating a favourable aquaculture investment environment: In order to attain growth, the marine aquaculture industry in Namibia needs to mobilize investment so as to expand their productive assets and increase their core competencies and competitiveness. Foreign direct investment in particular is an important driver of sub-sector performance, as it is expected to directly improve industrial productivity growth by infusing new capital, technologies and managerial know-how, and by improving the average skills and efficiency levels of industry. Competition for foreign direct investment is, however, such that investors invariably face a number of attractive locations and options for any new project, and they will tend to locate where the combination of investment climate and policy environment is most attractive, and where their investments are welcomed and facilitated.

The Government of Namibia has already introduced numerous generous incentives that are largely concentrated on stimulating manufacturing in Namibia and prompting exports into the region and to the rest of the world. To make manufacturing in Namibia more competitive, the Namibian government has also introduced a further package of tax and non-tax special incentives, applicable to both existing and new manufacturing enterprises, exporters and Export Processing Zone enterprises. It is essential that the marine aquaculture industry, which mainly targets exports markets, be included in this incentive regime. In addition, creating specific aquaculture investment incentives should be considered.

Providing immediate support to the existing private sector: The private sector has until now been the driving force of marine aquaculture development in Namibia. To prosper, the private sector needs an environment that facilitates growth, including easy access to business related information, technical support services, funding, and national and international markets. Offering attractive, effective and transparent investment incentives to the private sector will be an important catalyst for growth. Also important is capacity building in the area of standards, testing and accreditation to overcome technical barriers to trade and sanitary and phyto-sanitary measures constraints.

Consisting mainly of micro, small and medium enterprises, the current development potential of the marine aquaculture private sector in Namibia is limited, as these firms operate in isolation, are locked into uncompetitive production patterns and are unable to approach dynamic business and investment partners that could bring in new expertise and knowhow. Linking government resources to the technical expertise, knowhow and operational base of the existing private sector actors will make them attractive to large firms and financial support institutions and offers the best opportunities for near term sector growth. Linkages will enhance enterprise competitiveness through the realization of economies of scale and scope and are a source of sustainability, as they increase the capacity of all role-players to collectively react to development constraints.
Promoting the development of recirculation aquaculture systems: Recirculation aquaculture systems (RAS) are normally land-based aquaculture facilities utilising containment systems such as tanks or raceways supplied with flowing water which serves to replenish oxygen and remove metabolic wastes, uneaten feed and faeces. Unlike other land-based aquaculture systems, some or all of the outflow water is reused by treating it and returning it to the incoming supply stream. The recirculation of water provides an opportunity not only to reduce water consumption, but also to provide a greater degree of control over water quality parameters such as temperature, salinity, pH, alkalinity, chemical composition and oxygen.

Owing to relatively high capital costs, high energy dependencies and more complex technology, RAS do not currently compete well with conventional aquaculture production systems. Recirculation systems do, however, offer a way for niche producers to supply specialist, high value markets. There is also scope for further technical and cost optimisation as well as scale economies which could lower the barriers to adoption. The application of RAS in Namibia is particularly important given the challenging environmental conditions negatively impacting on marine aquaculture in the country. In the medium to long term it offers the only viable production system for the marine aquaculture industry in Namibia to flourish.

There are no quick fixes for the marine aquaculture industry in Namibia. Modern marine aquaculture has developed into an intensive, knowledge-based, capital-intensive business, often with investment by large vertically integrated corporations. The Namibian marine aquaculture industry’s problems are abundantly clear: limited natural potential, challenging environmental risk factors, and a lack of access to investment and development funding are preventing industry growth. The usual tools of monetary, fiscal, legislative and development policy are of limited effect to overcome these constraints. Not recognizing or not wanting to acknowledge the present conundrum, renders solutions more difficult. To solve a problem, you have to be able to define it.

What, then, can the government do? In the short term, the government of Namibia has to implement a number of limited duration catalytic actions designed to achieve growth and critical mass during a limited window of opportunity. A strategy focusing on the facilitation of growth rather than providing services is required. Growth can only be effectively addressed by a specific and targeted intervention strategy, led by government, with industry support and participation and focusing on promoting investment opportunities for existing enterprises and developing a limited number of new higher risk opportunities. These, in turn, will create employment opportunities and contribute towards economic growth and socio-economic well-being.

Due to the specific characteristics and risks related to the marine aquaculture sector, public capital will be important in attracting private investors who otherwise would not be willing to take an exposure to marine aquaculture. Well-structured joint efforts of the public and private sector can make a sustainable contribution to the development of the marine aquaculture sector in Namibia, thus the coordination of different investors becomes essential. Public participation should be by means of a structured government investment vehicle with a willingness to absorb some investment risk.

The long-term interests of government and sub-sector businesses lie in gaining and keeping the trust of global consumers and investors. Although the master plan advocates a near term focus on accelerating production growth, in the long term, a holistic approach incorporating other aspects such as policy frameworks, long-term institutional development, social equality and sustainable aquaculture should be developed.
5.2. Collective Ambition

5.2.1. Vision
To make significant contributions towards economic growth and socio-economic wellbeing in Namibia.

5.2.2. Mission
To develop a marine aquaculture industry that is both sustainably profitable and engaged with other stakeholders.

5.2.3. Goals
The primary goal of the marine aquaculture master plan is to ensure that by 2022, industry production reaches 5,500 tons. This can be best achieved by securing investment to achieve the following:

- Grow existing oyster businesses to 750 tons by 2017 and 2,000 tons by 2022
- Grow the existing abalone business at Lüderitz to 200 tons by 2017 and 300 tons by 2022
- Establish a new abalone farm at Oranjemund with a planned production target of 150 tons by 2017 and 300 tons by 2022
- Establish a marine finfish recirculation aquaculture venture in Walvis Bay with planned pilot project production of 300 tons by 2017 and commercial production of 2,000 tons by 2022
- Establish a tuna ranching venture with planned production of 400 tons by 2017
- Develop and support at least 5 new species (clams, sea cucumbers etc.) pilot projects by 2017

5.2.4. Core Values
The marine aquaculture master plan is based on and incorporates the following core values:

Leadership, innovation and positive change: MFMR’s aquaculture directorate has the authority to lead, the creativity to innovate and the will to foster positive social and environmental change.

Professionalism, excellence and stewardship: We strive to perform at the highest level of competence. Reliability and responsiveness is standard to our service. We are well prepared, organized, and knowledgeable.

Accountability: We will at all times perform in a manner that makes us accountable, responsible, and answerable to all stakeholders, including our clients, associates, business partners and society at large. We will ensure responsible stewardship of the human, financial, and natural resources as well as data and information entrusted to us.

Risk tolerance and business approach: We promote a culture where entrepreneurship and prudent risk taking are encouraged and rewarded. We believe that a sensible business approach is key to assessing opportunities.

Mutual benefit: We believe that marine aquaculture industry has to be profitable to all parties at all times. Only win-win solutions lead to working results in both the short and long term.

Teamwork and openness: We encourage goal-oriented unity, participation, loyalty, communication, and cooperation. We appreciate open and transparent co-operation with all our customers, partners and business associates. Only openness creates trust.
5.2.5. Strategic and Operational Priorities

Attracting investment is the key to accelerating marine aquaculture growth in Namibia. The approach of the marine aquaculture master plan is therefore to create a business and social environment which is attractive to a wide range of investment services, including social investors. The master plan sets a production target for the marine aquaculture industry of 1 800 tons by 2017 and 5 500 tons by 2022. It also has significant job creation targets. The following ten-point plan sets out the key actions that will be required to boost the growth rate of the sub-sector so that it can meet its goals:

1. Create a favourable legislative, regulatory, policy and investment environment
2. Promote social, environmental and economic sustainability
3. Attract social investment
4. Create a marine aquaculture business development and investment agency
5. Build business partnerships and strategic alliances
6. Establish an aquaculture development fund
7. Speed up delivery of an essential package of support services
8. Encourage and support pilot projects
9. Maximise opportunities for innovation by building R&D partnerships
10. Develop the market for Namibian aquaculture products

Create a favourable legislative, regulatory, policy and investment environment: The vision of sustainable aquaculture demands not only a favourable business climate, but also a governance framework that embraces social objectives and enforces environmental standards. Although policy documents such as Vision 2030, NDP 3 and Namibia’s Aquaculture Strategic Plan (2004) as well as Namibia’s Aquaculture Act, provide a foundation for the marine aquaculture industry to grow, it is clear that legislation will have to be streamlined for marine aquaculture to flourish. The following interventions should be considered:

- Create a 90-day submission to decision process for the allocation of marine aquaculture licenses
- Establish a research and development permitting system (include quarantine for new species)
- Increase the threshold tonnage for undertaking Environmental Impact Assessments to 250 tons for indigenous and existing farmed species
- Facilitate greater collaboration between the marine and freshwater aquaculture sub-sector management services

Investment incentives will catalyze industry growth and have the potential to also push businesses to address market needs. The following aquaculture specific investment incentives should be considered:

- Include export orientated marine aquaculture ventures in the export incentive regime
- Provide loan guarantees to start-up businesses
Create a subsidy on infrastructure, machinery and equipment establishment and acquisition costs (import duty relief)

Create a subsidy on loan repayments

Human resources subsidies e.g. joining fees and contributions to higher salaries for key personnel

Incentives linked to sustainability initiatives such as energy efficiency, eco-labeling certification, or employee based tax credits

Remove import duties on aquaculture feeds

Fuel rebates

Promote social, environmental and economic sustainability: Aquaculture is one of a handful of natural resource industries that can offer truly environmentally sustainable economic growth. Underpinning the marine aquaculture master plan is a firm commitment to further build the environmental sustainability and integrity of the sector. Business leaders who operate sustainably recognise that social, environmental, economic and ethical factors affect their core business strategies. By examining their means of production, marketing and selling, and by considering the implications of unethical corporate behaviour, companies can shift from a defensive to a proactive attitude.

Operating sustainably does not only entail containing risks. For leading businesses, assessing the risks that all stakeholders face can yield rich opportunities. Wherever environmental, social or ethical issues can be addressed, businesses have an opportunity to innovate, differentiate, create value and attract more customers.

In order to enhance sustainability factors, the following actions should be taken:

- Provide sustainability advisory and extension services (e.g. fisheries advisory council)
- Explore the potential for collaboration with environmental NGOs
- Promote the development of a meticulous, self-critical sustainability culture
- Establish an industry bio-security code of practice
- Develop and implement aquaculture best management practices and standards
- Develop and implement best practices in occupational health and safety as well as human capital management
- Promote self-regulation by for example the uptake of eco-labeling schemes
- Develop a sustainability assessment criteria and link it to an incentive scheme
- Coordinate coastal industrial development to prevent environmental services lost through the actions of external actors

Attract social investment: Social and environmental responsibility can be combined with financial success. Over the last ten years various forms of social investment have grown rapidly and new forms thereof have been introduced. This growth reflects a range of developments on both the demand side (a new generation of social entrepreneurs and new opportunities for them) and the supply side (new investor preferences), supported in some contexts by tax incentives or other government policies. Social investors are individuals or institutions (high net-worth, foundations, retirement plans etc.) which choose to apply
non-financial characteristics to their investment decision-making. These non-financial characteristics are often related to the investors' value system or social mission, and may include concern for environmental protection, strong organisational governance, and a desire for improved social equality.

Social enterprises potentially have a larger universe of investors than conventional firms do. If they can structure their funding to treat charitable donations as a form of capital that seeks social, not financial, returns, they can then tap all the conventional sources of capital: venture capital firms, banks, mutual funds, bond funds, and so on. And with access to these sources, all the financial-engineering tools for transferring risk and return become available, allowing social enterprises to free up capital and grow. The following areas are critical for increasing social investment within the marine aquaculture sector:

- Develop a social enterprise policy, strategy and action plan
- Foster a culture of social enterprise
- Increase the social enterprise knowledge base
- Accurately quantify impacts to drive investment
- Identify social enterprise investors
- Define an investment theme or investment policy specific to potential institutional investor's unique objectives
- Facilitate discussions with business leaders regarding social enterprise

Create a marine aquaculture business development and investment agency: A marine aquaculture business development and investment promotion agency is a potentially key institution for delivering increased levels of industrial development through the attraction of foreign direct investment, domestic investment and official development assistance. Such a specialized agency would have a greater comparative advantage than existing development and financial institutions to deliver sector solutions.

The agency’s mission would be to develop, support and promote marine aquaculture ventures throughout the country, ensuring their growth and sustainability in coordination and partnership with various role players, including global partners. The agency has to be empowered with the authority, competence, independence and resources necessary to design, formulate and implement an investment promotion strategy that suits the economic, industrial and social objectives, requirements, advantages and resources of the country. The agency will be responsible for the full investment promotion cycle, from the formulation of business proposals to locating potential investors and sources of funds as well as ensuring the viability and financial/technical soundness of the project and would be carried out in close cooperation with target entrepreneurs.

Amongst its structures, the agency should include specific project task teams. Task teams could include a task team leader (from the financial sector), the aquaculture development fund manager, the project promoter, a technical advisor, a marketing specialist, and a member of the aquaculture advisory council. It is recommended that the marine aquaculture business development and investment promotion agency is established by recognized corporate financial and legal advisors (e.g. PriceWaterhouseCoopers or Ernst & Young). The activities of the above-mentioned agency would need to incorporate the following:

- Facilitating government developmental involvement and building partnerships
• Creating an investment network, including both conventional and social investors
• Establishing and overseeing the activities of the aquaculture development fund
• Identification and promotion of investment opportunities and undertaking due diligence studies
• Dissemination of investment information (marine aquaculture agency website)
• Assessment of current non-operating license holders and submitted applications
• Attracting new investment and retaining existing investors
• Removing administrative obstacles and managerial impediments to investment
• Promoting target ventures through image building

**Build business partnerships and strategic alliances:** Meaningful partnerships are the foundation for success. Strategic alliances enable businesses to gain competitive advantages through access to additional resources, including markets, technologies, capital and people. Effective approaches to attracting marine aquaculture industry investment will inevitably depend upon full cooperation amongst the key actors concerned: governmental bodies, existing producers, target entrepreneurs, financial sector organizations with relevant mandates, social investors (e.g. World Bank, ADB, UNIDO, IDC etc.), research organizations, as well as local and international NGOs. Hence, a first step is to identify and convene such actors in an appropriate forum so that they can exchange information and establish terms and conditions for cooperation and coordination. Ultimately public-private partnerships (PPPs) based on a minority government shareholder model should be established, with the marine aquaculture business development and investment promotion agency responsible for the execution thereof.

**Establish an aquaculture development fund:** Investment funds play an important role in connecting less developed financial markets around the world with international investors, and in promoting joint efforts by the public and private sectors. Funds offer investors the ability to pool capital and take advantage of larger investment opportunities that are not accessible to an individual investor. Furthermore, the fund structure offers diversification of the investor’s portfolio as funds are invested in a number of projects across the sector. Additionally, they offer the advantage of having professional managers whose considerable expertise in the sector far surpasses the business acumen of an individual investor. Fund managers provide careful risk assessment of investment opportunities, administer the portfolio, and have fiduciary responsibilities to the investors. Through specialized fund managers, the investment funds also bring management and often technical support and business linkages, which benefit both the recipients of the investment, as well as the investor through higher returns resulting from the improved management and technical capacity.

The establishment of an aquaculture development fund as an investment vehicle was previously recommended in Namibia’s Aquaculture Strategic Plan (2004) and is reinforced here. Amongst other aspects, the following fund characteristics will have to be determined: the structure of the fund and the source of fund management i.e. internal or external fund management. To achieve the 2017 marine aquaculture development goals, the fund would require an initial minimum capitalization of about N$ 250 million. It is suggested that the fund offers a combination of equity investments and debt instruments.

**Encourage and support pilot projects:** The technical challenges and assembly of all the components needed to make medium to large scale marine aquaculture work are complex, so initial investment in this
arena has been cautious and painstaking. Apart from the normal risks faced by any production business, the aquaculture industry has an extra dimension of uncertainty associated with climatic and other environmental factors that compound investment risk. In order to mitigate risk factors, most significant marine aquaculture endeavors begin with pilot projects. This is especially the case with high risk production experiments, new technology developments, forays into new markets or the introduction of new products to existing markets.

In the best cases pilot projects deliver valuable data about the viability of growth prospects. Pilot projects demonstrate new technologies and products, and lay the groundwork for a positive market reception. Navigating the transition from successful completion of small entrepreneurial pilot projects to large scale business operations should be managed in parallel to the execution of the pilot itself in order to dramatically and significantly scale up initial experiments to yield significant growth and revenue benefits. Cross-functional stakeholder workshops should be created to select pilot projects; to organize design input from a wide talent pool into well-considered pilot projects; and to enhance the integration and commercialization of pilot projects. It goes without saying that the government has to mobilize resources to co-fund pilot projects.

Amongst others, the following pilot projects should be considered and supported in the near term:

- Offshore suspended culture of oysters, *Crassostria gigas*
- Marine finfish (*Argyrosomus japonicus* and *Psetta maxima*) aquaculture in land-based recirculation systems
- Abalone, *Haliotis midae*, aquaculture in land-based recirculation systems
- Abalone, *Haliotis midae*, ranching in the Lüderitz area
- Capture based aquaculture of bigeye tuna, *Thunnus obesus*, in the Tripp Seamount area

**Speed up delivery of an essential package of support services:** Namibia’s Aquaculture Strategic Plan (2004) recommended the implementation of several support services and actions to optimize existing production and improve market access for existing producers. The master plan reinvigorates the importance of executing the following tasks:

- Create a ministerial task team to coordinate and facilitate the implementation of the long overdue National Shellfish Sanitation Program (NSSP)
- Develop a National Aquatic Animal Health Strategy and the necessary infrastructure (including laboratory facilities), capacity and expertise to implement it
- Assist commercial aquaculturists in establishing HACCP systems in the production, handling, distribution and marketing of all cultured species
- Optimize the composition and operation of the aquaculture advisory council

**Maximise opportunities for innovation by building R&D partnerships:** Namibia’s marine aquaculture sector was primarily built on the transfer of existing technologies. Future growth will be dependent on the ability of the sector to innovate in order to generate a higher rate of return through a combination of practical “on-the-water” innovations (e.g. production and process innovation), as well as applied and innovative research to overcome challenging technical constraints. This will include research relating to
new species and production systems, particularly the use of recirculation aquaculture technologies. A key to implementing this component of the master plan will be expanding the number and depth of industry-research partnerships as well as the number and depth of regional and international research partnerships. The following actions should be taken:

- Focus resources on fewer, but bigger initiatives
- Focus research on development and growth priorities
- Support regional co-operation
- Prioritise industrially relevant R&D
- Identify and expand on current innovation within the marine aquaculture sector including formal research and industry innovations
- Provide opportunities for new university-industry research partnerships to get started and flourish
- Initiate exchanges between professionals in industry and academia
- Make it more attractive for small companies to involve students and to hire graduates
- Increase the opportunities for the development of recirculation aquaculture systems
- Narrow the SANUMARC research programme to exclusively focus on marine finfish hatchery technologies as well as an oyster genetic improvement program
- Utilise the NATMIRC facilities for aquaculture research
- Market Namibia as a marine aquaculture research destination
- Intersect with other disciplines to gain new perspectives (associative thinking)

Develop the market for Namibian aquaculture products: To thrive, ventures must reach markets. Markets for fish and fish products are highly complex and influenced by a wide range of factors. Variations in demand exist between different species, between different grades, sizes and products of the same species, between countries and within countries and between age groups and socio-economic classes. Demand is also influenced by seasonal factors, levels of income, availability and relative prices of competing sources of production and substitutes, and by various factors which affect the costs of production, distribution and marketing of fish and fish products.

The following actions have to be undertaken to support this objective:

- Develop market intelligence services
- Continue to seek improvements in access to current markets and to access new markets
- Develop a sector wide country image/brand label
- Support market studies at an early phase of technology development
- Promote value addition
- Promote public confidence in aquaculture products
- Provide marketing support to existing producers
- Develop a strategy to promote Namibia aquaculture sector exports
5.3. Job Creation and Community Participation

Rising knowledge and capital requirements in marine aquaculture may be major barriers to entry for the poor. Despite this, marine aquaculture has an important role to play in coastal community poverty reduction in Namibia, particularly in terms of job creation.

Community participation in the marine aquaculture sub-sector in Namibia can be best defined through an approach that seeks to increase entrepreneurship opportunities in upstream and downstream activities. Communities will also benefit from a strategy whereby aquaculture businesses are encouraged to contribute time, services, leadership or other resources to the community in which the company operates.

5.4. Access to Land and Water

As with many other primary food production industries, marine aquaculture is heavily dependent on access to natural resources. Their availability and cost are important determinants for sector size and expansion. The primary requirement is for water. Most of this is returned to the environment, commonly slightly enriched and sometimes lower in oxygen content. Coastal lands are required for both production and support facilities.

To achieve growth and sustainability, marine aquaculture must be included in strategic development plans for coastal lands and water. Marine aquaculture ventures should also be granted rights of access to coastal land and waters equal to those rights employed by other forms of human development. The following actions must be undertaken to improve access to land and water:

- Create a ministerial task team to reduce the destructive uncertainty regarding the availability of and access to land and water
- Establish a ministerial task team to reduce the uncertainty regarding security of tenure in the Oranjemund mining area
- Initiate the zoning of at least 500 hectares of suitable areas for land-based aquaculture within 90 days following the implementation of the master plan
- Initiate the zoning of at least 100 hectares of suitable areas for sea-based aquaculture within 90 days following the implementation of the master plan
- Allow the zoning of suitable areas for land-based area in protected areas within a 25 km range of existing urban areas
- Initiate the zoning of sea areas for pilot scale production and emergency use
- Issue long term land and water leases for production facilities, with transfer arrangements

5.5. Access to Feed

After water, (and associated land where needed) the second primary input for marine aquaculture is feed. For most bivalve mollusk culture, and some extensive fish and crustacean farming, this is closely associated with the water supply. For more intensive aquaculture, feed is supplied externally, with a significant component (fishmeal and oil) derived from capture fisheries. This is a renewable, but finite source of which aquaculture is using a growing share. Research indicates that much of the current fishmeal requirement could, however, be substituted with terrestrially derived proteins and oils.
Achieving the production goals set by the master plan will not create the critical mass required to justify the development of feed manufacturing capacity in Namibia and as a result near term marine aquaculture feed requirements will have to be imported. It is therefore recommended that imported feeds are exempted from import duties.

5.6. Access to Seed

The third primary input for marine aquaculture is seedstock. Closing the life-cycle has been the single most important technical advance for many aquaculture species, especially marine finfish. This has required a combination of technologies: maintenance of correct environmental conditions; adequate maturation of broodstock with quality gametes; initiation of spawning behaviour; successful fertilization and hatching of eggs; nursing of larvae and fry through early development until weaning on artificial diets etc. Market demands and site/system use also increasingly require out of season seed supply.

In the near term, the facilities and expertise for the production of abalone and oyster juveniles to the Namibian market is sufficient, although further gains in productivity and quality are possible. The potential to produce marine finfish fingerlings is limited. The SANUMARC facility in Henties Bay has the capacity to produce significant amounts of juveniles, but has limited expertise to do so.

With control over reproduction achieved, the next step is greater control over the genetics of farmed populations. This can be achieved through selective breeding programmes using a combination of traditional rearing techniques and genetic markers and statistical methods. The master plan recommends the development of an oyster genetic improvement programme (in collaboration with Beira Aquaculture).

5.7. Access to Finance

Aquaculture businesses are subject to the risks of a variable fiscal environment in the same way as most other enterprises and many aquaculture businesses have in fact failed due to fiscal rather than technical problems. A key feature of many aquaculture systems is the relatively long production cycle. For start-up operations, this can mean a significant time lag between a loan being taken out for site and facilities development, and sufficient product sales to start making repayments. Furthermore, the operating costs also need to be financed, often through overdrafts or other unsecured loans.

Small and medium scale enterprises mainly rely on private capital and bank loans for commercial financing. A typical new venture at a modest level of gearing (i.e. debt:equity) might be financed by 50% equity and 50% loans. The interest repayments associated with this can, however, place a heavy burden if performance does not match expectations and can be a primary cause of business collapse.

Economic development can be enhanced by government through financial incentives e.g. grants for specific activities, or special tax or rates allowances. These are justified on the basis of wider social, national or regional benefits. The master plan recommends the establishment of a specialist marine aquaculture business development and investment promotion agency, as well as the creation of a dedicated aquaculture investment fund to improve access to finance.

5.8. Training, Education and Extension Services

Knowledge and human capacity are fundamental and investment in human and intangible capital is an important priority for sustainable aquaculture. This capital can be cost-effectively generated in Namibia
through the use of industry and regional academic networks and south-south cooperation backed by sustained support from the international community. The initiatives and approaches include joint ventures, formal and vocational and informal training, and applied research alliances. It is particularly important to promote a culture within industry that values personal advancement. In this regard, non-core or sub-speciality training should also be encouraged.

5.9. Research and Development, and Technology Transfer

The flow of aquaculture science and technology in Asia followed several paths: (1) within the region from countries with advanced aquaculture to other countries in the region; (2) from other more mature sectors like crop and livestock husbandry; and (3) into the region from countries outside the region with advanced disciplines and technologies relevant to aquaculture. Building hereon, the policy for marine aquaculture research, development and technology transfer in Namibia should include the following guiding principles:

- Capacity building of institutions and organizations is more cost-effective when a project builds on existing capacities in the region or country rather than tries to establish or develop a parallel capacity.
- Research and development, and technology transfer will benefit from coordinated strategy development and a collaborative approach, with participation from a wide range of stakeholders.
- A mechanism to collate, screen, and disseminate proven and appropriate technology is a priority.
- Aquaculture can draw on the expertise, technology, and research infrastructure of other related and mature sectors.
- Promote the establishment of regional intergovernmental organizations.
- Provide scope for research and development in support of transformational innovation.

The traditional government-based extension system is not sufficiently responsive to the new challenges and opportunities of marine aquaculture, neither of aquaculture technologies and markets, nor to the demand of farmers. Alternative approaches include pooling public sector services, establishing public-private partnerships, e.g. government/NGO extension services and extension services by input providers.

5.10. Trade and Marketing

Globalisation is increasing competition in national markets, but also improving opportunities for export. By the nature of food markets, much of the larger scale aquaculture output is at commodity level, where the most important competition is on price. Achieving a lower cost of production is therefore a key factor in successful competition and any national factors that add to production costs (either directly such as high labour costs, energy or transport costs, or indirectly e.g. increased administrative costs due to regulatory requirements) could affect business investment decisions. The alternative competition strategy is niche marketing, where producers are able to differentiate their product e.g. on the basis of quality, locality, service or brand. Tariffs and non-tariff barriers such as excessive sanitary restrictions have affected trade in aquaculture products, both for developed and developing countries. The cost of compliance with increasingly stringent food safety regulations also tends to exclude small producers and processors from export markets. It is important that the Namibian Government advocates and supports an easing of tariff restrictions.
6. Implementation Framework

6.1. Guiding Principles

Guiding principles are a set of accepted guidelines that capture values and priorities, providing shared standards to guide development plans and implementation processes.

A clear venture-orientated business agenda: In an ever increasingly competitive, globalized business environment, the Government of Namibia has to be seen to be enhancing the competitiveness of marine aquaculture businesses. Business first, with sustained profitability the primary objective, is therefore the key pillar on which Namibia must build a marine aquaculture sector that can then also contribute to socio-economic well-being. A business approach incorporates flexibility, transparency and a willingness to assume risk.

Speed: Speed is an important factor. If new interventions and policies are needed in response to deteriorating conditions in a sector, changes can be of no help if they come after businesses have closed or withdrawn from the market.

Collaboration: Collaboration reduces costs; leverages strengths; accelerates scale; and amplifies influence in order to generate results. Collaboration isn't easy, but when peer organizations embrace shared goals and honestly articulate how they will achieve them, collaboration works. Growing the marine aquaculture sector in Namibia will require collaboration between government departments, financial institutions, the private sector, academic institutions, civil society and NGOs.

Position the government to be an important facilitator of investment: A stable, predictable macro-economic framework is a necessary, yet not sufficient condition for dynamic economic development. Targeted interventions are also necessary. Government driven investment promotion and facilitation is essential and can help to increase both domestic and foreign investment.

Create critical mass: Achieving critical mass is essential to create sector credibility and unlock self-sustaining viability, vitality and growth. In addition critical mass production levels create demand for support services and lead to the development of downstream and secondary industries. Critical mass also contributes to retailer and consumer confidence.

Systemic competitiveness: Dynamic economic development is not only based on functioning markets and individual entrepreneurship, but also on collective efforts to shape a supportive environment for business development. As such, the process to contribute to the development of the marine aquaculture sub-sector in Namibia will require addressing issues at the micro-, meso-, macro- and meta-levels. The micro-level involves primarily companies and markets; the meso-level addresses targeted interventions to shape a competitive advantage or to address market failure; the macro-level looks at generic economic policies and institutions; and the meta-level addresses slow variables such as the economic system and social capital.

Apply a more detailed focus to sub-sectors with high and immediate growth potential: It is a common rule in business that roughly 80% of the effects come from 20% of the causes. Given the limited availability of resources, near term direct interventions should focus on growing existing ventures, whilst encouraging and supporting other initiatives.
Embed environmental sustainability, equality and social welfare into value chain activities: Sustainability doesn't always require large, disruptive change. Nor does it require significant amounts of cash. Often execution requires taking tasks and activities companies already do to a new level of efficacy.

Recognise job creation as the major public sector benefit: Employment creation is a particularly important objective in many government policies in Namibia. Creating a meaningful number of new permanent job opportunities in socio-economically depressed coastal communities will contribute significantly to poverty relief, well-being, opportunity, security and improved quality of life.

Prototyping: Prototyping involves rolling out a new offering in a limited market to see how it does. Prototyping is nothing new in the design profession, but for social and public policy it’s still in its infancy. Prototyping is a fast, effective way to get past the bias associated with uncertainty. It lets us walk into a room not with an idea to be believed but with results to be examined.

6.2. Review Workshop/Conference

A participatory process to implement the master plan will build awareness, guide diagnostics, forge a shared public-private vision, and build partnerships among government agencies and with the private sector, producer groups, and non-governmental organizations. It is particularly important to involve development bank and financial services institutions in the review process. It is also recommended that the review workshop employs an experienced and skilled external facilitator in order to improve individual and group dynamics, engagement and performance.

6.3. Align and Establish Institutional Support

A plethora of institutions is involved in aquaculture licensing, land and water lease, environmental control, sanitary measures, and trade; with responsibilities and jurisdiction split between national and local authorities. Growing the marine aquaculture sector in Namibia will therefore require coordination and collaboration between government departments, financial institutions, the private sector, academic institutions, civil society and NGOs.

6.4. Formulate an Action Plan

Action planning is the process that guides the day-to-day activities of an organisation or project. It is the process of planning what needs to be done, when it needs to be done, by whom it needs to be done, and what resources or inputs are needed to do it. In an action planning process the focus is on the detail, on making sure that things happen as they are supposed to and when they are supposed to.

6.5. Define Lines of Responsibility

Clarity in the respective roles of the public and private sectors transmits clear signals to investors, while establishing a basis for cooperation, synergy, and public-private partnerships.

6.6. Establish Legislative, Regulatory and Policy Frameworks

An effective governance framework will embrace policies and regulations molded by a clear vision of the future for marine aquaculture and a road map to realize that vision. Implementing the marine aquaculture master plan may therefore require further development, adjustments to and harmonization of existing legislative, regulatory and policy frameworks.
6.7. Establish Requisite Agencies, Systems and Capacities

More than anything else, the successful execution of the marine aquaculture master plan is dependent on the establishment of a professionally staffed and capable specialist marine aquaculture business development and investment promotion agency, as well as the establishment of an aquaculture investment fund. Creating these institutions should therefore be executed by a professional corporate advisory service provider.

6.8. Requests for Assistance, Co-operation and Partnerships

Identify sources of finance for marine aquaculture—from public and private sources, from internal and external sources—and prepare proposals to access available funding. Creating international, regional and national partnership is essential to reduce costs and leverage strengths and should target both public and private sector role players.

6.9. Timeframes

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<tr>
<th>Task</th>
<th>Description</th>
<th>Date Completed</th>
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<tbody>
<tr>
<td>1</td>
<td>Review workshop/conference</td>
<td>By Jul 2012</td>
</tr>
<tr>
<td>2</td>
<td>Revise master plan</td>
<td>By Aug 2012</td>
</tr>
<tr>
<td>3</td>
<td>Implement National Shellfish Sanitation Program</td>
<td>By Oct 2012</td>
</tr>
<tr>
<td>4</td>
<td>Initiate the zoning of suitable land and water</td>
<td>By Oct 2012</td>
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<tr>
<td>5</td>
<td>Establish the aquaculture business development agency</td>
<td>By Oct 2012</td>
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<tr>
<td>6</td>
<td>Establish the aquaculture investment fund</td>
<td>By Mar 2013</td>
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<tr>
<td>7</td>
<td>Establish first research partnership</td>
<td>By Mar 2013</td>
</tr>
<tr>
<td>8</td>
<td>Execute first investment decision</td>
<td>By Jun 2013</td>
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6.10. Financing Requirement

The estimated cost to establish and operate (for a three year period) the proposed marine aquaculture business development and investment promotion agency is N$ 12 million. The estimated cost to set up the aquaculture development fund is N$ 5 million. Ultimately these institutions should become self-sustaining.

6.11. Establish Monitoring and Evaluation Structures

Effective monitoring, evaluation and reporting structures inform stakeholders and promote good governance and transparency of government activities, accountability, sound financial management, macroeconomic planning, international comparison, supervision and control.
7. Conclusion

Aquaculture is identified as a prime development priority in Namibia’s Vision 2030 document, NDP 2, and NDP 3. Economic development rests on foundational institutions that provide fertile conditions in which to seed, grow, and renew enterprises. The master plan for marine aquaculture provides a road map for public and private sectors, financial institutions, and the international community to grow the industry and deliver change. The road map is built on three main pillars:

i. Good governance, including establishment of an enabling environment for aquaculture investment through policies and practices, facilitating equitable access to water, land, resources, and markets

ii. The establishment of a business-orientated, professionally staffed and well-resourced development agency to drive future growth

iii. A well-aligned participative and collaborative approach to achieve desired objectives and outcomes

The primary goal of the marine aquaculture master plan is to ensure that by 2022, industry production reaches 5,500 tons. Although the marine aquaculture industry in Namibia has the potential to grow and contribute to job creation and poverty relief in coastal areas, there are no quick fixes to achieve that growth. The prospects of the aquaculture sector depend on multiple interventions, both near term and long term. In the near term, a focus on growing existing businesses by attracting investment and delivering a suite of essential, long overdue services should yield results. Achieving critical mass in the near term is essential to unlock self-sustaining long term viability, vitality and growth.

In the long term, a holistic approach incorporating other aspects such as policy frameworks, long-term institutional development, social equality and sustainable aquaculture should be developed. Ultimately though, more than anything else, future industry growth is dependent on both incremental and transformational change. The former is critical to the successful development and optimisation of an industry, but it is the latter that triggers the use of new approaches and sets off substantial growth. Major change and future growth of marine aquaculture in Namibia will require the adoption of new recirculation aquaculture technologies. Recirculation aquaculture could break through water resource constraints but will require considerable investment.

The risks in investing in marine aquaculture in Namibia may appear to be high, but risks can be managed, and the rewards can be great (both in terms of financial returns and socio-economic impact). The master plan proposes an investment strategy based on the unbundling of societal benefits and financial returns to access investment from both the financial markets and organizations devoted to social enterprises.

A successful marine aquaculture sector in Namibia will contribute to GDP growth, create employment opportunities and increase per capita income in coastal areas, and promote the overall well-being of Namibia’s citizens. Aquaculture success in Asia and elsewhere was due to strategic planning and long-term efforts by government, including special institutional arrangements, supporting laws and regulations, and access to inputs, credit, and markets. The Government of Namibia is committed to providing the resources and leadership to grow the country’s marine aquaculture sector in a manner that makes us accountable, responsible, and answerable to all stakeholders, including our clients, associates, business partners and society at large.