South Africa's Aquaculture Yearbook 2013

agriculture,
forestry & fisheries

Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

South Africas Aquaculture Yearbook 2013

AQUACULTURE YEARBOOK 2013 SOUTH AFRICA

Compiled by Chief Directorate:

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FOREWORD

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CONTENTS

EXECUTIVE SUMMARY

The Aquaculture Yearbook 2013 is an annual publication providing the previous year's information on the status of the aquaculture sector in South Africa. The Aquaculture Yearbook 2013 is based on data from the aquaculture sector collected in 2012. Species cultured in South Africa in 2012 were abalone (*Haliotis midae*), Pacific oyster (*Crassostrea gigas*), mussels (*Mytilus galloprovincialis* and *Chromomytilus meridionalis*), dusky kob (*Argyrosomus japonicus*), seaweed (*Ulva* spp. and *Gracilaria* spp.), trout (*Onchorynchus mykiss* and *Salmo trutta)*, tilapia (*Oreochromis mossambicus, Oreochromis niloticus* and *Oreochromis rendalli)*, catfish (*Clarias gariepinus*), carp (*Cyprinus carpio*), marron crayfish (*Cherax tenuimanus*), and a number of ornamental species (i.e. koi carp, etc.).

A total of 195 farms were recorded in 2012, of this 34 were marine aquaculture farms and 161 were freshwater aquaculture farms. The Western Cape Province had the highest number of marine aquaculture farms in 2012, amounting to 23, comprising the four subsectors, namely, abalone, finfish, oysters and mussels. Mpumalanga had the highest number of freshwater farms, amounting to 42 with the majority of farms culturing tilapia and trout. The province with the highest number of farms (freshwater and marine) was the Western Cape, recording a total of 50 farms. The province with the least number of farms (freshwater and marine) was Free State, recording a total of seven farms.

In 2012, three new Marine Aquaculture Rights were granted. The rights were for abalone (*Haliotis midae*), sea lettuce (*Ulva capensis, Ulva lactuca*) and red seaweed (*Gracilaria gracilis*). During 2012, 441 permits for Marine Aquaculture were issued in South Africa to rights holders, agencies, importers, exporters, Fish Processing Establishments (FPEs) and transportation companies. Of these permits a total of 56 permits were issued to Engage in Marine Aquaculture Activities.

The total production of South Africa's aquaculture industry (excluding sea weed, carp, ornamentals and koi carp) in 2012 was 3 926,89 tons with the marine aquaculture industry recording 2 261,22 tons and the freshwater aquaculture industry recording 1 665,67 tons. The sector increased by 25,64% from 3 125,47 tons produced in 2011. Exclusion of a number of freshwater sub-sector were due to information not being supplied to the DAFF during the period of 2012.

The abalone subsector was the highest contributing subsector and recorded 1 111,41 tons, followed by mussels and oysters recording production of 859,77 tons and 241,58 tons respectively. The finfish subsector was the least contributor to total production, recording a production of 48,46 tons.

The freshwater aquaculture subsector with the largest aquaculture production in 2012 was trout, which contributed 1 428 tons. The second largest subsector was tilapia which had a total production of 234 tons. The third subsector includes marron crayfish which contributed 3,5 tons. The catfish subsector produced zero tons in 2012.

The total value of the aquaculture sector was estimated at R504 million, increasing by 33% from 2011. This total estimated value includes freshwater the aquaculture industry which was not accounted for in the previous years, and was based on sales of aquaculture production. Locally aquaculture continues to be dominated by abalone production, which was estimated to be R405 million in 2012, representing 80,4% of the total rand value for the entire aquaculture sector. Trout production was the second largest contributor at R60 million, representing 11,9% of the total value. Mussels were worth R18 million, followed by oysters at R10,5 million, dusky kob at R3,3 million representing 3,7%, 2,1%, 0,7% respectively. Marron crayfish and catfish contributed the lowest in terms of value, only contributing an estimated value of R630 000 and R330 000 each representing 0,12% and 0,1% respectively.

Capital investment of approximately R241 million, representing an increase of 34,6%, was realised in the sector during 2012. The abalone subsector invested approximately R162 million during this period. Investment by the trout subsector increased substantially by 72% to R7,8 million in 2012, illustrating the potential of the commercial trout market in South Africa.

The sector employed 2 227 people directly on farms during 2012 on a full-time basis. The marine aquaculture industry was the largest employer with over 78,5% while the freshwater industry was responsible for contributing 21,5% towards employment.

The department conducted site surveillance of 13 marine aquaculture rights holders and six Fish Processing Establishment (FPE) exemption holders between February and November 2012. This included site surveillance of six abalone farming operations, four mussel and oyster farming operations, three finfish (dusky kob) farming operations and three marine aquaculture FPEs processing cultured shellfish, between Velddrif on the West Coast and East London on the east coast.

There were 26 farm closure notices sent to shellfish farms by the SAMSM&CP office in 2012. West of Cape Point there were 21 notices issued and five notices were issued for farms to the east of Cape Point. Most of the farm closures were the result of microbiological contamination (16), and a few the result of the presence of biotoxins (11). There were no closures owing to other hazardous substances *viz.* heavy metals, pesticides, PCBs or radionuclides. The high recorded number of farm closures may have contributed to the decrease in oyster production in 2012.

During the year 2012 a number of aquaculture research projects were undertaken by DAFF researchers and some were done in collaboration with universities. These projects included animal health research, which focuses on the development of novel methods for the diagnosis of new and emerging pathogens to provide accurate and reliable disease diagnosis for aquatic animals; collection of epidemiological data for significant aquatic animal diseases in Southern Africa to inform management and contingency interventions; and, finally, the development of effective preventative and treatment strategies for existing and emerging marine aquaculture diseases. Finfish research has also been conducted by the department in 2012, these projects include the dose-dependent effect of commercially utilised chemotherapeutants on juvenile (160 - 400 g) dusky kob (*Argyrosomus japonicus*); implementation of an experimental design to condition broodstock dusky kob to prespawning status, followed by artificially induced spawning; and Investigation into the use of macro algae in the diets for dusky kob. Other research includes work done on oysters, which focused on optimising oyster culture in South Africa.

The Biodiversity Risk and Benefit Assessment for Alien Species of Aquaculture was finalised in December 2012 and seven species' profiles were produced in order to promote the consideration of the appropriateness, and the effective management of specific alien species used in aquaculture, and to ultimately contribute to the ecologically sustainable development of the sector.

The Qolora land-based ADZ in the Eastern Cape received a positive Environmental Authorisation from the Department of Economic Development, Environmental Affairs and Tourism and will be the first established ADZ once the relevant infrastructure has been installed.

In 2012, the department appointed a qualified independent Environmental Assessment Practitioner (EAP) to undertake the Environment Impact Assessment for the proposed Buffelsrivier ADZ in the Western Cape. Unfortunately, after consultation with various stakeholders and a vegetation assessment, the EIA process was cancelled owing to outcomes of the vegetation assessment that rendered the area as not suitable for aquaculture because of it being a highly sensitive area with endemic flora.

During 2012 a number of officials within the DAFF and other departments as well as employees from the aquaculture private sector participated in various training programmes through a cooperation agreement with the People's Republic of China. A total of six courses were arranged in the People's Republic of China.

The DAFF has identified several stakeholder engagement meetings/forums to serve as vehicles that need to direct the activities relating to the aquaculture sector. A number of stakeholder engagement meetings took place during 2012, the MAIL meeting had four meetings; the AIF had four meetings; the PAIF had two meetings and the AVCRT met twice. The DAFF held an Aquaculture Investment and Policy Dialogue in KwaZulu-Natal from 4 to 5October 2012.

ACRONYMS

ADZs	Aquaculture Development Zones
AED	Chief Directorate: Aquaculture and Economic Development
ADEP	Aquaculture Developmental and Enhancement Programme
AIF	Aquaculture Intergovernmental Forum
AR	Directorate: Aquaculture Research and Development
ARC	Agricultural Research Council
ARTDP	Aquaculture Research and Technology Development Programme
ASP	amnesic shellfish poisoning
ATDC	Agricultural Technology Demonstration Centre
ATS	Directorate: Aquaculture Technical Services
BEE	Black Economic Empowerment
BMPs	Better Management Practices
CGA	Catfish Growers' Association
Cites	Convention on International Trade in Endangered Species
CSIR	Council for Scientific and Industrial Research
CTPAET	Critical Thinkers' Platform in Aquaculture and Emerging Technologies
DAFF	Department of Agriculture, Forestry and Fisheries
DBSA	Development Bank of Southern Africa
DDG	Deputy Director-General
DEA	Department of Environmental Affairs
DFIs	Development Funding Institutions
DSP	diarrhoetic shellfish poisoning
DST	Department of Science and Technology
dti	Department of Trade and Industry
DWA	Department of Water Affairs
ECDC	Eastern Cape Development Cooperation
EIA	Environmental Impact Assessment
EIF	Environmental Integrity Framework
ELIDZ	East London Industrial Development Zone
EOP	Environmental Officer Production
EUS	Epizootic ulcerative syndrome
FAIL	Freshwater Aquaculture Industry Liaison
FAO	Food and Agriculture Organization of the United Nations
FR&D	Chief Directorate: Fisheries Research and Development
FPE	Fish Processing Establishment
GAP	Good Aquaculture Practice
GDP	Gross Domestic Product
GIFT	Genetically Improved Farmed Tilapia
HAB	Harmful Algal Blooms
HDI	Historical Disadvantaged Individual
HDPE	high density polyethylene
IDC	Industrial Development Corporation

IPAP	Industrial Policy Action Plan
MAIL	Marine Aquaculture Industry Liaison
MAWG	Marine Aquaculture Working Group
MLRA	Marine Living Resources Act (No. 18 of 1998)
MOFCOM	People's Republic of China Ministry of Commerce
MPTA	Mpumalanga Tourism and Parks Agency
MRM	Chief Directorate: Marine Resources Management
MSC	Monitoring, Control and Surveillance
NAPF	National Aquaculture Policy Framework
NASF	National Aquaculture Strategy Framework
NEF	National Empowerment Fund
NEMBA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NGP	New Growth Path
Non – HDI	non-historically disadvantaged individual
NRCS	National Regulator for Compulsory Specifications
OIE	World Organisation for Animal Health
PCB	polychlorinated biphenyls
PAIF	Provincial Aquaculture Intergovernmental Forum
PSP	paralytic shellfish poisoning
PUA	Public Understanding of Aquaculture
qPCR	quantitative Polymerase Chain Reaction
RoI	Return on Investment
SAM	Directorate: Sustainable Aquaculture Management
SAMSM&CP	South African Molluscan Shellfish Monitoring and Control Programme
SETA	Sector of Education and Training Authority
SEZ	Special Economic Zone
SOE	state-owned entity
TCP	Technical Cooperation Programme
TCPf	Technical Cooperation Programme facility
MDARLA	Mpumalanga Department of Agriculture, Rural Development and Land Administration

DEFINITION OF TERMS

Active surveillance	Also referred as stock inspection) shall include (as amended from EU regulation (Reg. 2006/88/EC)) a) Routine inspection by the department or by other qualified health services provider on behalf of the department b) Examination of the aquaculture animals on the farm for clinical disease c) Diagnostic analysis of samples collected on a suspicion of a disease or observed increased mortality during inspection
Commercial scale	Status at which project is producing a product for sale primarily for widespread distribution and consumption
Disease	Any condition whereby the normal functions of any organs or the body of an animal is impaired or disturbed by any bacterium, virus, parasite, fungus or other organisms or agent in a culturing environment (as amended from Animal Diseases Act, 1998)
East Coast	East of Cape Point to border of Mozambique
Farm closures	A period in which shellfish farms are temporally not allowed to sell products owing to microbiological contamination, detection of biotoxins and as well as other hazardous substances such as heavy metals, pesticides, PCBs or radionuclides.
Intra-trading	Trading of organisms between farms within the same subsector
Pilot scale	Status at which a project is testing or conducting trials in order to demonstrate the effectiveness of a full programme
Production	Amount of organisms produced from a farm
Targeted surveillance	Prescribed samples of aquaculture animals to be taken and tested for specific pathogen(s) by specific methods
West Coast	West of Cape Point to border of Namibia

1. OVERVIEW OF AQUACULTURE YEARBOOK 2013

1.1 Introduction

Aquaculture is the fastest growing food production sector in the world. In the last three decades, world food fish production of aquaculture has expanded by almost 12 times, at an average annual rate of 8,8% . The initial data for both capture fisheries and aquaculture in 2011 indicated a production of 154 million tons, of which 131 million tons were destined for food consumption. Aquaculture production contributed 63,6 million tons, representing a total of 41% of the total world fish landings (FAO, 2012). China has been responsible for most of the increase in world *per capita* fish consumption, owing to the substantial increase in its fish production, particularly from aquaculture. Apart from the primary production sector, world fisheries and aquaculture provide numerous jobs in ancillary activities such as processing, packaging, marketing and distribution, manufacturing of fish-processing equipment and others (FAO, 2012). Aquaculture makes crucial contributions to the world's wellbeing and prosperity in terms of food security and sustainable livelihoods (FAO, 2012).

Aquaculture in South Africa is still in its developmental stage and it has the potential to reduce poverty and reliance on wild fisheries, ensure food security and create skills-based employment. The two industries in aquaculture include marine and freshwater aquaculture. Aquaculture operations can be found across South Africa in every province, producing a few species using a variety of culture methods. It is also perceived as being able to contribute to income generation for the inland and coastal communities in South Africa. Current status shows that the aquaculture sector in South Africa employs 2 227 people and approaches half a billion rand annually in direct and indirect economic activities. Aquaculture in South Africa also faces numerous similar challenges as does the global community, ranging from economic crisis to climate change, and at the same time needs to assemble the required food and nutritional demands for the growing population in the country. The wild capture fisheries are under considerable pressure as fish stocks are either stagnant or declining and the only avenue for increased protein production and to satisfy the population demands is through aquaculture (DAFF, 2012).

Governance of aquaculture in South Africa has become increasingly important and has made remarkable progress in terms of planning and policy development for the sector. In 2007 the *Policy for the Development of Sustainable Marine Aquaculture Sector in South Africa* was developed to ensure growth of an economically sustainable and globally competitive marine aquaculture industry. Recently aquaculture was identified as one of a government priorities and included in the government's Industrial Policy Action Plan (IPAP). The National Aquaculture Strategic Framework (NASF) has been published, aiming to provide guidance to government and its partners under the leadership of the Department of Agriculture, Forestry and Fisheries (DAFF). The NASF has identified much needed government interventions and support measures, which will facilitate the reduction of constraints and create an enabling environment for the development of an equitable, diverse, viable, competitive and sustainable aquaculture sector.

1.2 South Africa's Aquaculture Yearbook 2013

The Aquaculture Yearbook is an annual publication providing the previous year's information on the status of the aquaculture sector in South Africa. It highlights the status of both marine and freshwater aquaculture, also reflecting on aquaculture research, aquaculture environmental integrity, aquaculture training, projects undertaken by DAFF and stakeholder engagement.

In 2009 and 2010, South Africa experienced some changes with regard to aquaculture management and administration. Formerly, the sector had been managed by two government departments, namely the Department of Environmental Affairs and Tourism (DEAT) and the Department of Agriculture (DoA) responsible for marine and freshwater aquaculture respectively. The two departments were restructured and the DAFF was formed as a leading agent for the development and management of aquaculture in South Africa. The Marine Aquaculture Annual Farm Operations Report (MAAFOR) was changed and renamed Aquaculture Annual Report (AAR) to accommodate both marine and freshwater aquaculture sector. In 2012 the name Aquaculture Annual Report was changed to the Aquaculture Yearbook.

The main purpose of the Aquaculture Yearbook is to promote access to information and transparency related to the status of the aquaculture sector. The transparency will ensure awareness, promotion of the sector and enable potential decision makers and investors to identify those investments that will be most likely to create the best Return on Investment (RoI). The objective of this Aquaculture Yearbook includes recording and monitoring progress of the sector; to make provision of reliable statistics and information to stakeholders; facilitation of public awareness; identify deficiencies in management systems; and contribute to the business cases for future development.

South Africa's Aquaculture Yearbook 2013 has been compiled, based on the data collected from farms operating in South Africa during 2012. Data were collected, using different methods for marine and freshwater aquaculture as the management and regulatory framework for these industries differ.

Data for the marine aquaculture industry were collected from the Marine Aquaculture permit holders who submitted monthly reports to the DAFF. According to the condition of the operational permits issued in terms of section 13 of the Marine Living Resources Act, 1998 (Act No. 18 of 1998), marine aquaculture permit holders are obligated to submit a monthly report to the DAFF. The data for animal health and for the South African Molluscan Shellfish Monitoring and Control Programme were collected during the site visits and through the data submitted by the farmers to the DAFF.

Freshwater aquaculture data was collected through questionnaires which were sent to the freshwater aquaculture associations. The questionnaires mainly focused on the type of species farmed, farm location and production data for 2012. It is essential to note that the freshwater aquaculture data is based on the farms affiliated to aquaculture associations. The data presented may not be a complete and accurate reflection of the freshwater aquaculture industry as some farmers may not be affiliated to these associations. In some instances lack of cooperation from the farmers con-

tributed to the gaps observed in the freshwater data. It is important that the farmers comply with submission of data to allow the Department to portray an accurate depiction of the aquaculture sector.

2. STATUS OF AQUACULTURE IN SOUTH AFRICA 2012

2.1 Overview of aquaculture in South Africa in 2012

Species cultured in the marine aquaculture industry include abalone (Haliotis midae), Pacific oyster (Crassostrea gigas), mussels (Mytilus galloprovincialis and Chromomytilus meridionalis), dusky kob (Argyrosomus japonicus) and seaweed (Ulva spp and Gracilaria spp). Species from thecultured in the freshwater industry include trout (Onchorynchus mykiss and Salmo trutta), tilapia (Oreochromis mossambicus, Oreochromis niloticus and Oreochromis rendalli), catfish (Clarias gariepinus), carp (Cyprinus carpio), marron crayfish (Cherax tenuimanus), and a number of ornamental species (i.e. koi carp etc). However, the major cultured species are rainbow trout, koi carp, ornamental species and tilapia.

Total of 195 farms were recorded in 2012, of this 34 were marine aquaculture farms and 161 were freshwater aquaculture farms. The Western Cape Province had the highest number of marine aquaculture farms in 2012, 23, comprising the four subsectors, namely, abalone, finfish, oysters and mussels. Mpumalanga had the highest number of freshwater water farms, 42, with the majority of farms culturing tilapia and trout.

The total production of South Africa's aquaculture industry (excluding sea weed, carp, ornamentals and koi carp) in 2012 was 3 926.89 tons with the marine aquaculture industry recording 2 261.22 tons and the freshwater aquaculture industry recording 1 665.67 tons. The sector increased by 25.64% from 3 125.47 tons produced in 2011.

3. STATUS OF MARINE AQUACULTURE 2012

3.1 Marine aquaculture in South Africa in 2012

In 2012, marine aquaculture species cultured included abalone (*Haliotis midae*), Pacific oyster (*Crassostrea gigas*), mussels (*Mytilus galloprovincialis* and *Choromytilus meridionalis*), dusky kob (Argyrosomus japonicus) and seaweed, both Ulva spp and Gracilaria spp. A number of species were kept on farm premises for conditioning and research, these species included yellowtail (*Seriola lalandi*), mangrove snapper (*Lutjanus argentimaculatus*), spotted grunter (*Pomadasys commersonnii)*, yellow belly rockcod (Epinephelus marginatus) and bloodworm (Arenicola loveni). DAFF conducted some research on potential species during 2012, these species where held at the DAFF Aquaculture Research Facility in Sea Point (Cape Town) and included the following species, white stumpnose (*Rhabdosargus globiceps*), South Coast sea urchin (*Tripneustes gratilla*) and the South African scallop (*Pecten sulcicostatus*). Table 1 illustrates the species cultured in South Africa during 2012 and its operational scale in the sector.

Table 1. Marine aquaculture species and their operational scale in South Africa during 2012.

Marine aquaculture species in South Africa, 2012		
Common name	**Scientific name**	**Operational scale**
Abalone	*Haliotis midae*	Commercial
Pacific oyster	*Crassostrea gigas*	Commercial
Mediterranean mussel	*Mytilus galloprovincialis*	Commercial
Black mussel	*Choromytilus meridionalis*	Commercial
Seaweed	*Ulva spp.*	Commercial
Seaweed	*Gracilaria spp.*	Commercial
Dusky kob	*Argyrosomus japonicus*	Commercial
Yellowtail	*Seriola lalandi*	Research
White stumpnose	*Rhabdosargus globiceps*	Research
Spotted grunter	*Pomadasys commersonnii*	Research
Yellowbelly rockcod	*Epinephelus marginatus*	Research
Mangrove snapper	*Lutjanus argentimaculatus*	Research
South Coast sea urchin	*Tripneustes gratilla*	Research
South African scallop	*Pecten sulcicostatus*	Research
Bloodworm	*Arenicola loveni*	Research

3.2 Marine aquaculture farms operating in 2012

By the end of 2012 a total of 34 marine aquaculture farms were in operation in South Africa. There was an increase of five new abalone farms in the marine aquaculture industry. Table 2 presents the number of farms operating, species cultured and the province in which they are situated. The Western Cape Province had the highest number of operating farms in 2012, amounting to 23 and comprising four subsectors, namely abalone, finfish, oysters and mussels. In the Eastern Cape Province five farms were in operation and comprised three subsectors, namely abalone, finfish and oysters. The Northern Cape had four farms and consisted of two subsectors, namely abalone and oysters, while KwaZulu-Natal had the least number of farms with only one finfish farm in operation. The distribution of the farms is presented in Figure 1.

Table 2. Total number of marine aquaculture farms operating in South Africa by subsector and province in 2012.

Number farms cultivating species in each province					
Species	Western Cape	Eastern Cape	Northern Cape	KwaZulu-Natal	Total
Abalone	13	1	4	0	18
Finfish	1	2	0	1	4
Mussels	3 (1)*	0	0	0	3
Oysters	6 (2)**	2	1	0	9
Total	23	5	5	1	34

()* One oyster farm cultured mussels as well, however, the farms have not been captured under mussels as their primary species is oysters

()** Two mussel farms cultured oysters as well, however, the farms have not been captured under oysters as their primary species is mussels

Key	
Blue	Finfish farm
Red	Oyster farm
Green	Abalone farm
Brown	Mussel farm

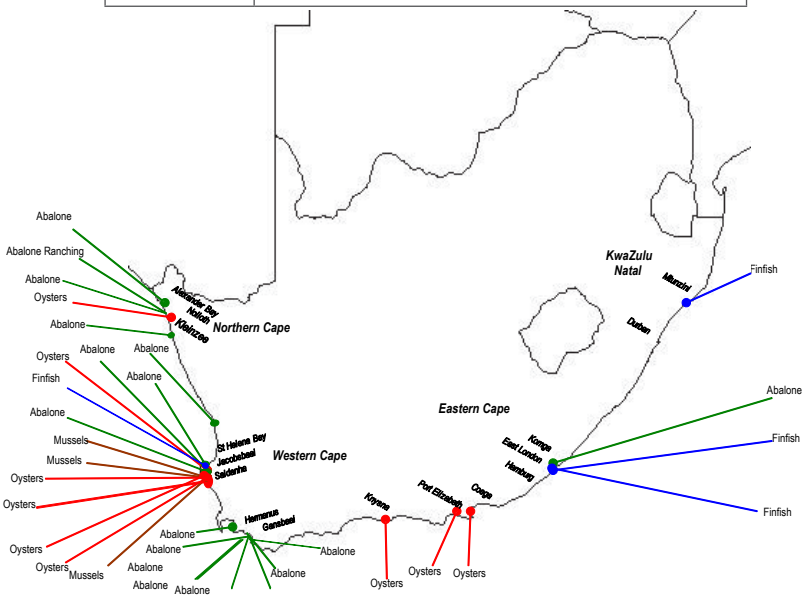


Figure 1. Farms in operation during 2012 and the distribution of cultured marine aquaculture species in each province.

3.3 Marine Aquaculture authorisation

The promulgation of the Marine Living Resources Act, Act No. 18 of 1998 (MLRA) created the regulatory framework for the conservation of ecosystems, the sustainable utilisation of marine living resources and the orderly access to exploitation, utilisation and the protection of certain marine living resources. Marine aquaculture also formed part of the activities that are regulated in terms of the MLRA, meaning that it was necessary for proper regulation to be implemented in the form of issuing of rights, permits and exemptions where necessary.

3.3.1 Marine Aquaculture Rights

Marine Aquaculture Rights are granted in terms of section 18 (1) of the MLRA which states that:

"No person shall undertake commercial fishing or subsistence fishing, engage in mariculture or operate a fish processing establishment unless a right to undertake or engage in such an activity or to operate such an establishment has been granted to such a person by the Minister".

The Marine Aquaculture Policy, gazetted in September 2007, provides for the department to grant marine aquaculture long-term rights which are valid for a period not exceeding fifteen (15) years. On 27 March 2009, the Minister gazetted a General Notice No. 313 of 2009 inviting applications for long-term rights.

In 2012, three Marine Aquaculture Rights were granted (Table 3). The rights were for abalone *(Haliotis midae*), sea lettuce (*Ulva capensis, Ulva lactuca*) and red seaweed (*Gracilaria gracilis*). Applications for a marine aquaculture right can be submitted to the DAFF on a continuous basis. The application process is open to any individual or registered business entity that has shown interest in exercising the activity. The applicant must meet the criteria as set out in the application form and submit the relevant supporting documentation.

Table 3. Rights to engage in marine aquaculture granted in 2012

Company name	Operational area	Species	Duration of right
Buffeljags Abalone Farm (Pty) Ltd	Farm 357, Bredasdorp, Western Cape	Abalone (*Haliotis midae*) Sea lettuce (*Ulva capensis, Ulva lactuca)* Red seaweed (*Gracilaria gracilis*)	01/07/2012-31/12/2027
Diamond Coast Abalone (Pty) Ltd	Erf 64, Portion 1 of the farm Hondeklip Bay, Western Cape	Abalone (*Haliotis midae*)	01/09/2012-31/12/2027
Doring Bay Abalone (Pty) Ltd	Portion 1 of Farm 421, Doring Bay old crayfish factory, Doring Bay, Western Cape	Abalone (*Haliotis midae*)	01/07/2012-31/12/2027

3.3.2 Permits

To activate a right or exemption, a permit is issued in accordance with section 13 (1) of the MLRA which states that:

"(1) No person shall exercise any right granted in terms of section 18 or perform any other activity in terms of this Act unless a permit has been issued by the Minster to such a person to exercise that right or perform that activity:

(2) Any permit contemplated in subsection (1) shall-

(a) be issued for a specific period not exceeding one year;

(b) be issued subject to the conditions determined by the Minister in the permit; and

(c) be issued against payment of any fees determined by the Minister in terms of section 25(1).

(3) The holder of a permit shall at all times have that permit available for inspection at the location where the right or activity in respect of which the permit has been issued, is exercised.

(4) A permit to exercise an existing right in terms of the Act may be refused if the conditions of a previously issued permit had not been adhered to."

During 2012, 441 permits for marine aquaculture were issued in South Africa to rights holders, agencies, importers, exporters, Fish Processing Establishments (FPEs) and transportation companies (Table 4). Import permits issued exceeded exports. This is a clear reflection of increased fish demand in the country and general economic trends of net importation into South Africa. There were 39 permits issued to "Possess and sell Undersized Cultured Abalone obtained from a Rights Holder".

Table 4. Permit type and total number of permits issued in South Africa during 2012.

Permit type	**Number issued**
General imports	119
Ornamental imports	36
Exports	74
Transport	22
Engage in marine aquaculture activities	56
Possess broodstock and operate a hatchery	25
Possess and sell undersized cultured abalone obtained from rights holder	39
Permit to possess and sell undersized kob obtained from a rights holder	1
Engage in ranching activities of marine species: Harvesting	1
Right to engage in abalone ranching and Stock Enhancement Pilot Project: Seeding	3
Collect broodstock for marine aquaculture purposes	14
Operate a Fish Processing Establishment	18
Scientific Investigations and practical establishments	11
Vessel licence	15
Permit for the purposes of diving and possession of prohibited gear within the listed areas in terms of Regulation 3(3) of **Government Gazette** no. 30716 of 1 February 2008 (regulations for the protection of wild abalone)	7
Total issued	**441**

3.3.3 Rights to Engage in Abalone Ranching and Stock Enhancement Pilot Projects (Ranching Right)

The process of the allocation of rights for abalone ranching or stock enhancement pilot projects (herein referred to as "Ranching rights") was guided by the ***"General guidelines for Marine Ranching and Stock Enhancement in South Africa"*** which were gazetted on 20 August 2010. The process of the allocation of Ranching rights began with the publishing of an ***"Invitation to Apply for Rights to Engage in Abalone Ranching and Stock Enhancement Pilot Projects"*** in terms of section 18 of the Marine Living Resources Act, 1998 (Act No.18 of 1998).

All applications for Phase 1 were assessed using Exclusionary Criteria as stipulated in the **"Criteria for allocating a Right for Abalone Ranching or Stock enhancement pilot projects"** which was gazetted on the 21st April 2011. The Exclusionary Criteria that was applied was the **Completed Application form; Compliance; Access to Finance; Access to seed/spat and Transformation.** Thereafter, the applications were screened and presented to DAFF which provided its recommendations. All qualifying applicants were advised to proceed to Phase 2 of the Ranching application process.

The completion of a Phase 2 application involved the submission of a comprehensive proposal and undertaking a public participation process. The proposals were evaluated in a multidisciplinary manner by the Marine Aquaculture Working Group (MAWG). Various MAWG members assessed the applications according to their area of expertise to ensure that all areas within the balancing criteria were properly addressed. The balancing criteria was applied in Phase 2 of the ranching application and included; ***Equity and Job Creation; Capacity (Technical); Future Investment in the Sector*** and ***Environmental Considerations.*** Table 5 below illustrates the ranching rights which were granted in 2012.

Table 5. Abalone ranching rights issued in South Africa during 2012.

Rights holder	Concession area	Concession area begins	Concession area ends	Length of concession area
Ulwandle Fishing (Pty) Ltd	EC 1	Skoenmakerskop Marine Protected Area	Cape Recife	+-15 km
Lidomix Investment (Pty) Ltd	EC 2	Hamburg	East London	+- 50 km
Lidomix Investment (Pty) Ltd	EC 3	Cintsa	Mazeppa Bay	+- 65 km
Turnover Trading 284 (Pty) Ltd	NC 1	Boegoeberg Noord	Beach north of North Point	+- 60 km
Really Useful Investment No. 72 (Pty) Ltd	NC 2	Rocks outside south end of McDougall Bay	Rob Island	+- 32 km
Port Nolloth Sea Farms Ranching (Pty) Ltd	NC 3	Beach at Kleinzee	Swartduine	+- 43 km
Diamond Coast Abalone (Pty) Ltd	NC 4	Skulpfontein	2 small rocks 200 m from the shore	+- 40 km
Earmarked for community based aquaculture intervention	WC 1	Sandy beach north of Cape Hangklip	Sandy beach east of Maasbaai	+- 8 km
Earmarked for community based aquaculture intervention	WC 2	Jock-se-baai	Sandy beach at Betty's Bay	+- 10 km
Earmarked for community based aquaculture intervention	WC 3	Sandy beach west of Hawston	Sandy beach at Onrus	+- 8 km

3.4 OVERVIEW OF SOUTH AFRICA'S MARINE AQUACULTURE PRODUCTION IN 2012

In the South Africa's Aquaculture Yearbook 2013 production is defined as the quantity of organisms produced from a farm specifically for human consumption and is expressed in tons. This definition excludes seaweed which in South Africa is used as feed on abalone farms. South Africa's total marine aquaculture production (excluding seaweed) in 2012 was 2 261,22 tons. Table 6 below illustrates the total production per subsector and province. In 2012 the Western Cape recorded a production of 1 985,92 tons and was the main contributor of South Africa's total marine aquaculture production followed by the Eastern Cape with a production of 275,3 tons. There was no production recorded in Northern Cape and KwaZulu-Natal in 2012, however, there were aquaculture facilities in operation. The abalone subsector was the highest contributing subsector in terms of production and recorded 1 111,41 tons, followed by mussels and oysters recording production of 859,77 tons and 241,58 tons respectively. The finfish subsector was the smallest contributor to total production, recording a production of 48,46 tons. Figure 2 below illustrates production levels for each subsector. The percentage contributed by each subsector to total production was abalone 49,2%, mussels 38%, oysters 10,7% and finfish 2,1% (Figure 3).

3.5 SOUTH AFRICA'S MARINE AQUACULTURE PRODUCTION FROM 2000 – 2012

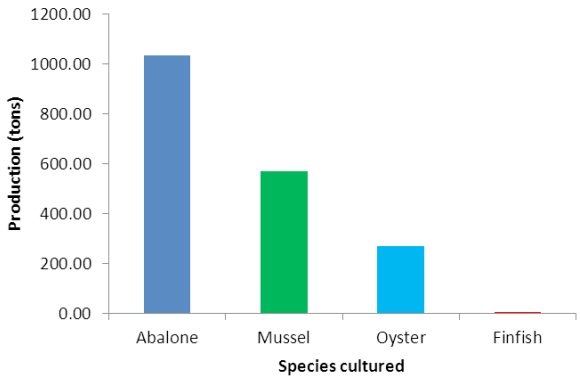
South Africa's total marine aquacultureproduction in 2012 increased by 377,72 tons from 2011, increasing by 20,1%. This is the highest recorded marine aquaculture production to date. The increment in production is attributed to abalone, mussels and finfish recording the highest production to date. The increase in these sub-sectors' production output is outlined in more detail in Section 3.6 of the Aquaculture Yearbook 2013.

The abalone, mussels and finfish subsectors recorded an increase in production of 75,4 tons (7,3%), 289,61 tons (50,79%) and 40,47 tons (606,51%) respectively. The oyster subsector recorded a decline in production in 2012, decreasing by 27,76 tons (10,23%). Table 7 below illustrates the production from 2000 to 2012 and the growth rate of the industry. The marine aquaculture industry (excluding aquatic plants) displayed a growth rate of 6,52% from 2000 to 2012 (Figure 4). Seaweed production in 2012 was 2 000 tons.

Table 6. 2012 Marine aquaculture total production for human consumption per subsector and province.

Production (tons) per species and province					
Species	Western Cape	Eastern Cape	Northern Cape	KwaZulu-Natal	Total
Abalone	935,21	176,20	0	0	1 111,41
Finfish	0,66	47,8	0	0	48,46
Mussels	859,77	0	0	0	859,77
Oysters	190,28 (40)	51,3	0 (30)	0	241,58
Total	1985,92	275,3	0	0	2261,22

() Oysters sold or moved to other provinces for grow out to market size



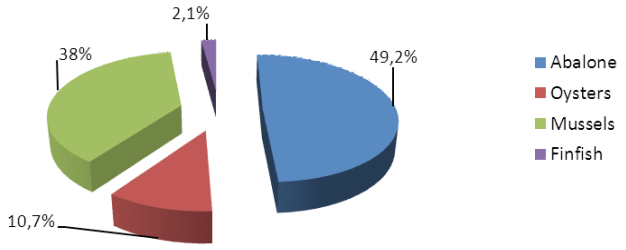


Figure 3: The percentage contribution of each sub-sector to total production.

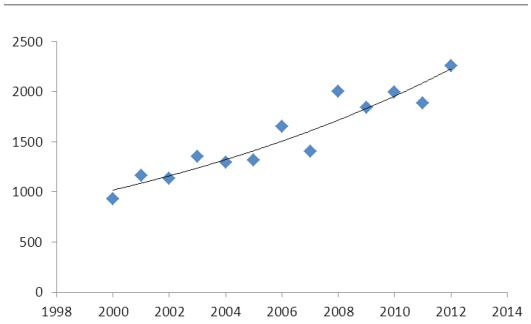


Figure 4: Graph illustrating growth rate of the marine aquaculture industry from 2000 to 2012.

3.6 ANALYSIS OF MARINE AQUACULTURE INDUSTRY

3.6.1 Abalone Subsector

The abalone species currently being cultivated in South Africa is *Haliotis midae*. In 2012, the abalone subsector contributed 49,2% to South Africa's total production recording a total of 1 111,4 tons. The abalone subsector experienced the highest production to date with an increase of 7,3% from the 1 036 tons produced in 2011 (Figure 5).

The abalone subsector has also seen an increase in the number of operating farms. An additional five new farms were fully operational during 2012, increasing the number operating of abalone farms to 18 farms from the 14 recorded in 2011. Of the 18 operating abalone farms in 2012, 12 were land-based facilities with independent hatcheries and four operated grow-out facilities only. The other two abalone farms included one sea cage farm and one ranching operation.

The abalone subsector distribution range stretches from the Northern Cape and Western Cape to the Eastern Cape. Four farms were operating in the Northern Cape in 2012, one situated in Port Nolloth, one in Hondeklip Bay and two were operating in Kleinzee, one of them being an abalone ranching operation. A total of 13 abalone farms are situated in the Western Cape, of which nine are located within the Overberg region (Figure 6 and 7) and four are located along

the West Coast in Doring Bay, Jacobs Bay and St Helena Bay (two abalone farms found in St Helena Bay). In the Eastern Cape there was only one abalone farm in operation during 2012. The farm is situated in Haga-Haga, a few kilometres outside East London. The Western Cape dominated production of abalone and contributed 84,1% to the total abalone production in South Africa, followed by Eastern Cape with 15,9%.

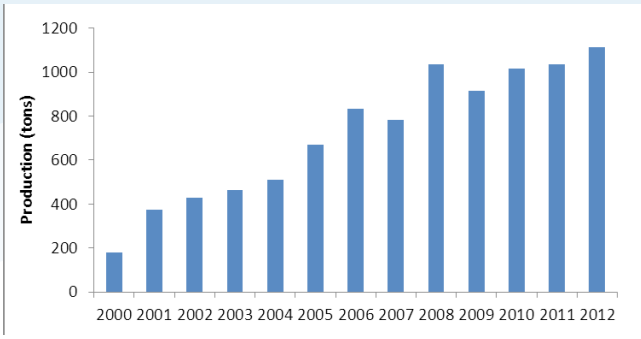


Figure 5. Abalone production for the years 2000–2012

Figure 6. Abalone farm using concrete tanks in Gansbaai, Western Cape.

Figure 7. Abalone farm in Hermanus, Western Cape.

3.6.2 Finfish subsector

The finfish subsector in South Africa is an emerging industry. Over the years a number of species have been piloted to assess the feasibility and market access. Currently the only commercial species being cultured in the industry is the dusky kob (*Argyrosomus japonicus*). Other marine finfish species that were held on farm sites for research purposes were yellowtail (*Seriola lalandi*), mangrove snapper *(Lutjanus argentimaculatus*), spotted grunter (*Pomadasys commersonnii)* and yellow belly rockcod (*Epinephelus marginatus*).

The finfish subsector has been growing over the last two years and in 2012 the sub-sector recorded the highest production to date, recording a total of 48,46 tons of dusky kob (Figure 8). The finfish sub-sector experienced a dramatic increase in production of 606,51% from the 7,99 tons produced in 2011. By the end of 2012 the subsector had a total weight of 180,31 tons of dusky kob on the farm sites with the majority of this tonnage in the Eastern Cape.

Four farms were in operation in 2012, the operations include a recirculation facility in the Western Cape, pond culture facility in KwaZulu-Natal (Figure 9) and two recirculation facilities in the Eastern Cape (Figure 10).

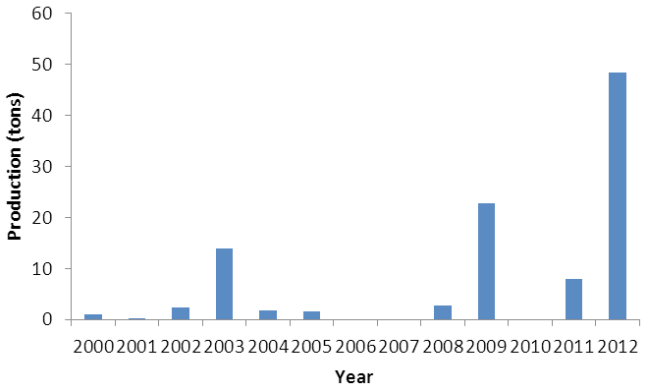


Figure 8.Finfish production for the years 2000–2012

Table 7. South Africa's marine aquaculture production 2000 – 2012

	Year and production (tons)													Total production (tons)
Sub-sector	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000 – 2012
Abalone	181,03	372,88	429,42	462,02	509,2	670,8	833,36	783,25	1 037,11	913,58	1 015,44	1 036,01	1 111,41	9 355,51
Finfish	1,04	0,3	2,38	14	1,81	1,68	0	0	2,71	22,75	0	7,99	48,46	103,11
Mussels	500	600	429,11	623	640	472	542	466	736,74	682,4	700,14	570,16	859,77	7 821,32
Oysters	247,01	187,53	272,1	255,24	147,66	174,91	279,87	157,86	226,62	223,53	276,57	269,34	241,58	2 959,83
Prawns	126,84	120,19	157,7	124,88	0	0	0	0	11,44	17,92	0	0	0	558,97
Seaweed	0	0	0	0	0	0	664	0	1 833,49	1 900,18	2 015,01	2 884,61	2 000	-*
Totals**	1 055,92	1 280,9	1 290,71	1 479,14	1 298,67	1 319,39	1 655,23	1 407,11	2 014,62	1 860,18	1 992,15	1 883,50	**2 261,22**	20 798,74

*Seaweed culture data not confirmed for previous years

**Totals exclude seaweed cultured

Figure 9. Finfish farm in East London Industrial Development Zone, Eastern Cape.

Figure 10. Pilot finfish pond culture system in Mtunzini, KwaZulu-Natal.

3.6.3 Oyster subsector

The species cultivated in South Africa is the exotic Pacific oyster (*Crassostrea gigas*). Nine farms were in operation in 2012. There are two mussel farms which culture oysters, however, they have not been included in the total farms of the oyster sub-sector as they produce oysters as a secondary crop. The production of oysters in the subsector was 241,8 tons, displaying a decrease of 10,23% from the 269,4 tons produced in 2011 (Figure 11). The industry has been declining over the last three years. This decrease in production can be attributed to the large number of farm closures experienced in 2011 and 2012. According to the South African Molluscan Shellfish Monitoring and Control Programme (SAMSM&CP) a total of 26 farm closures were experienced during 2011 and a further 26 farm closure notices were sent to shellfish farms by the SAMSM&CP office in 2012, some farms were closed for a period of six months and these farms were not allowed to market live products (detailed information on the SAMSM&CP found in section 3.9 of the Aquaculture Yearbook 2013). One farm stopped operation during 2012 and closed down completely, which may have contributed to the decrease in production. The oyster subsector contributed 10,7% to the total production in 2012.

Oyster farms are currently situated in the Northern Cape, Western Cape and Eastern Cape. One oyster farm is located in Kleinzee. A total of six farms in the Western Cape were operational and include four in Saldanha Bay (Figure 12, 13 and 14), one in Knysna and one in Paternoster. The Western Cape oyster farms contributed most of the production, contributing 78,8% of the total oyster production. Oyster farming in the Eastern Cape is represented by two farms, one located in Port Elizabeth and one in Jeffrey's Bay.

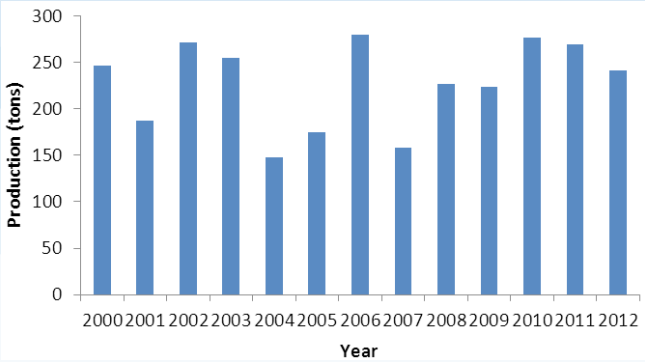


Figure 11. Oyster production for the years 2000–2012

Figure 12. Oyster farm in Saldanha Bay, Western Cape

Figure 13. Oyster farm using bags to culture oysters in Saldanha Bay, Western Cape

Figure 14. Workers harvesting oysters from the oyster farm in Saldanha Bay, Western Cape.

3.6.4 Mussel subsector

Mussel farming in South Africa is situated in Saldanha Bay, Western Cape, and is represented by three farms in the area (Figure 16 and 17). One oyster farm started cultivating mussels in 2012, however, this farm has not been represented in the total farms as it is producing mussels as a secondary production. The species cultured in South Africa are the exotic Mediterranean mussel (*Mytilus galloprovincialis*) and the indigenous black mussel (*Choromytilus meridionalis*).

In 2012 the mussels subsector recorded the highest production to date, recording a total of 859,77 tons. The subsector recorded an increase in production of 50,79%, increasing by 289,61 tons from the 570,16 tons of mussels recorded in 2011 (Figure 15). This increase in production can be attributed to one mussel farm completely stopping the production of oysters and concentrating on increasing its production of mussels. The mussel subsector contributed 38% to the total production in 2012. This sub-sector is currently the second highest contributor to the total production.

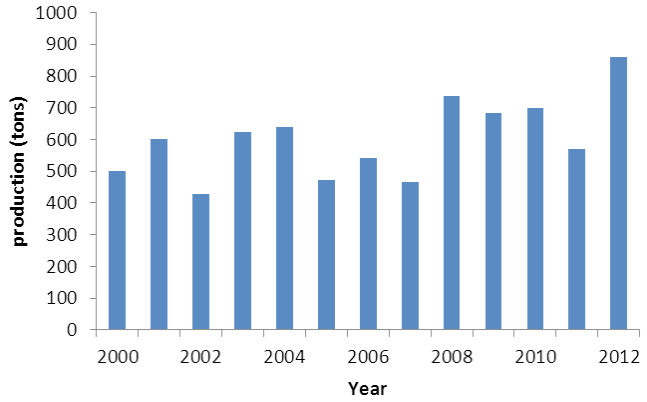


Figure 15. Mussel production for the years 2000–2012.

Figure 16. Mussel farm in Saldanha, Western Cape.

Figure 17. Workers sorting the mussels after harvesting in Saldanha Bay, Western Cape.

3.7 AQUACULTURE FOOD SAFETY

3.7.1 Overview South African Molluscan Shellfish Monitoring and Control Programme

The SAMSM&CP is a programme within the Aquaculture and Economic Development Chief Directorate, which falls within the Fisheries Management Branch of the DAFF.

The programme aims to provide the necessary guarantees to local and international markets that the food safety risks associated with the production of molluscan shellfish are adequately managed and minimised. To assure that this aim is achieved, the SAMSM&CP is working closely with the Fisheries Compliance Officers (FCOs) of DAFF, South African molluscan shellfish farmers, laboratories, National Regulator for Compulsory Specification (NRCS), Department of Health (DoH) and Municipalities.

The molluscan shellfish species farmed in South Africa include *Haliotis midae* (abalone), *Crassostrea gigas* (oyster), *Mytilus galloprovincialis* (Mediterranean mussel) and *Choromytilus meridionalis* (black mussel).

The shellfish farms are monitored by the SAMSM&CP for human health hazards such as biotoxins, microbiological organisms, heavy metals, pesticides, polychlorinated biphenyls (PCBs) and radionuclides during the production phase. Should the regulatory limit for any of the hazardous substances in the shellfish be exceeded the farms are temporarily closed for harvesting until the contaminant reaches acceptable limits.

3.7.2 Shellfish farm status

There were 22 shellfish farms monitored by the SAMSM&CP during 2012, of which 12 of the farms were to the west of Cape Point and 10 farms to the east of Cape Point (Figure 18). The farms to the west of Cape Point included six abalone farms, three mussel farms and three oyster farms. The farms to the east of Cape Point included nine abalone farms and one oyster farm.

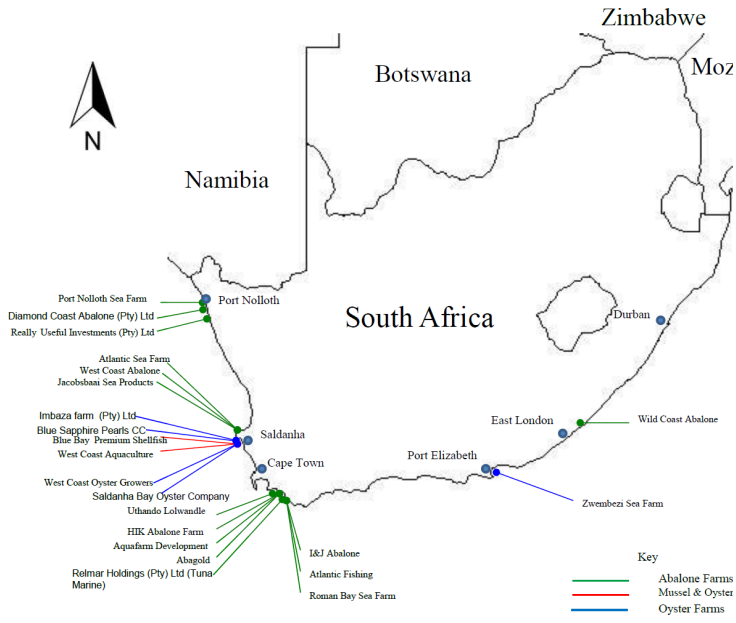


Figure 18. Distribution of shellfish farms along the South African coast.

Most abalone farms were land based and one was sea based. On the land based farms the abalone is grown in tanks and the water is pumped into the tanks through free flow and/or recirculation systems. The abalone in the sea-based farm was cultured in sea cages that were anchored to the sea bottom.

The oyster and mussel farms were sea-based and grown on ropes suspended from floating rafts or buoys; though on one farm the oysters were grown on racks that were planted into the substrate.

Shellfish farms are susceptible to contaminated water as a result of harmful algal blooms (HABs), sewage and industrial and domestic contamination. The farms which are at most risk of pollution are those situated near developed areas. Most of the farms in South Africa, however, are situated in areas that are relatively free of pollution. Generally the farms to the west of Cape Point are more at risk of biotoxin contamination than the farms to the east of Cape Point.

3.7.3 Monitoring data and farm closures

Data have been captured and analysed for molluscan shellfish farms along the South African coast. The biotoxins were analysed separately for two regions *viz.* west of Cape Point and east of Cape Point. The other hazardous substances were analysed for the entire coast.

There were 26 farm closure notices sent to shellfish farms by the SAMSM&CP office in 2012. West of Cape Point there were 21 notices issued and five notices were issued for farms to the east of Cape Point. Most of the farm closures were owing to microbiological contamination (16), and a few to the presence of biotoxins (11). There were no closures because of other hazardous substances *viz.* heavy metals, pesticides, PCBs or radionuclides.

3.7.4 Biotoxins

During 2012 two farms were closed because of non-compliance to the biotoxin testing schedule; other farms were only closed because of PSP and DSP causing toxin levels exceeding the regulatory limits.

3.7.5 Paralytic shellfish poison

The PSP toxin concentrations for all the abalone, oyster and mussel farms to the west of Cape Point are represented in Figure 19. The concentrations that exceeded the regulatory limit prompted farm closures. When the PSP toxin levels exceeded the regulatory limit on the abalone farms they were closed for the marketing of the live product. They were only allowed to market processed products where the abalone was eviscerated and scrubbed to remove the PSP toxins. The mussel and oyster farms were not allowed to market any product when closed for PSP toxins exceeding the regulatory limit.

There were no PSP toxins detected in shellfish farms to the east of Cape Point and as a result no closures because of PSP toxins exceeding the regulatory limit.

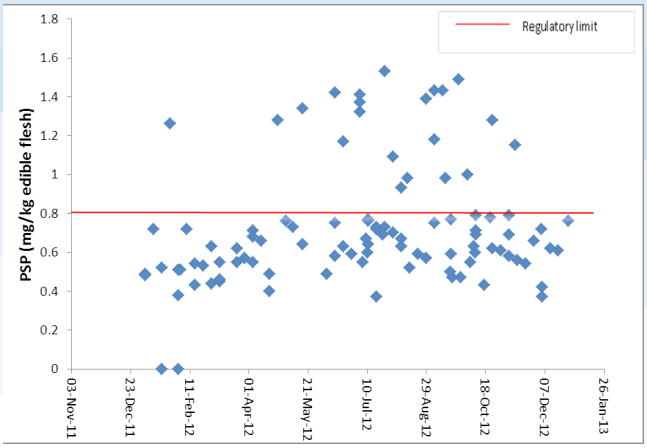


Figure 19. PSP results for farms to the West of Cape Point

3.7.6 Diarrhoetic shellfish poison

The mussel and oyster farms in Saldanha Bay were the only farms that experienced closures in 2012 owing to DSP toxins (okadaic acid and yessotoxin group toxins) exceeding the regulatory limit. Farm closures owing to DSP toxins were only between April and May 2012.

3.7.7 Amnesic shellfish poison

Though low levels of amnesic shellfish poison (ASP) toxins have been detected in mussels in Saldanha Bay, no shellfish farms were closed owing to ASP exceeding the regulatory limit. There has been no ASP toxin detected in abalone to date.

3.7.8 Microbiological contaminations

E. coli, which is used as an indicator species, is used for the classification of growing areas and is an important indicator of sewerage pollution and associated diseases. The farms were all classified as "Approved" based on the data received. Other microbiological organism data analysed included *Salmonella* and *Vibrio*. Data for wet storage facilities for the oyster farms are also analysed.

3.7.9 Escherichia coli

In 2012 there were eight farms that were sent closure notices owing to *E. coli* levels exceeding the regulatory limit. The closures were mostly between April and October 2012 (Figure 20) and in some cases appeared to be associated with high rainfall events.

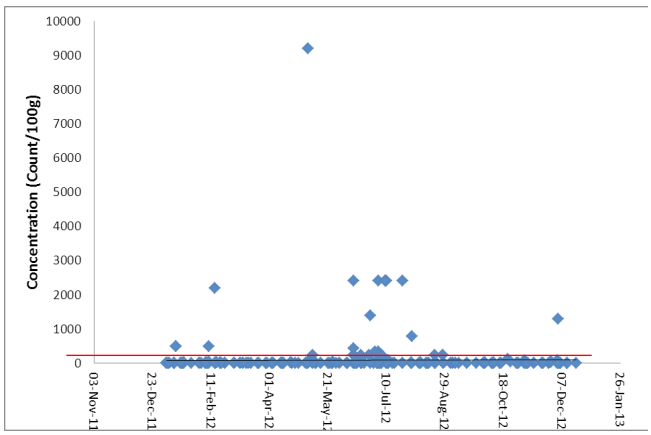


Figure 20. *E. coli* results for farms on the South African Coastline

3.7.10 *Salmonella* and *Vibrio*

Only one farm was temporarily closed owing to the presence *Salmonella* in the sample that was tested. There were no closures owing to *Vibrio parahaemolyticus* being present in the samples.

3.7.11 Heavy metals, pesticides, PCBs and radionuclides

The levels of heavy metal tended to be higher in mussels and oysters than in abalone (Figure 21 and 22); particularly those oyster and mussel farms situated in Saldanha Bay. There were no farm closures owing to heavy metals exceeding the regulatory limits.

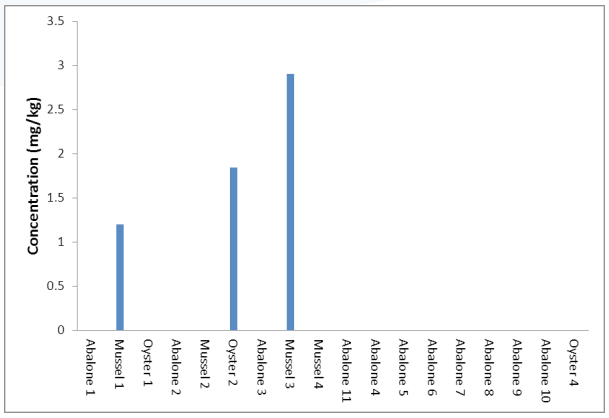


Figure 21. Cadmium results for farms along the South African coast

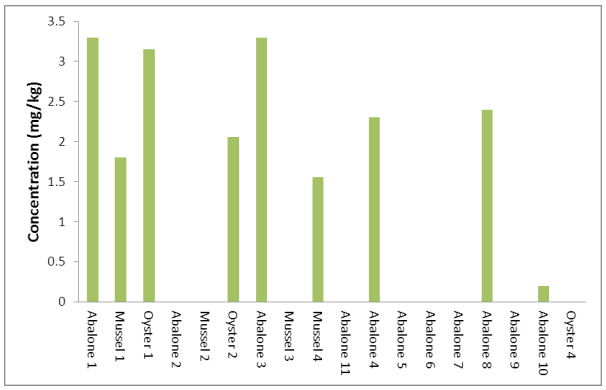


Figure 22. Arsenic results for farms along the South African coast

There were no detectable levels of pesticides, PCB or radionuclide present in any shellfish farms along the South African coast.

3.7.12 Compliance history

Most of the farms have complied with the requirements of SAMSM&CP. There was only one farm that did not comply with the requirements. The main non-compliance was failure to do the required tests according to the frequency stipulated in the SAMSM&CP.

3.7.13 Shellfish Monitoring Programme progress

During 2011/12 the SAMSM&CP was reviewed and updated. The South African shellfish farmers have accepted the new SAMSM&CP and are prepared to comply with its requirements. The SAMSM&CP staff have assisted farms to understand the requirements of the SAMSM&CP and have enabled them to comply with its requirements.

The SAMSM&CP office reinstated the official phytoplankton monitoring programme and implemented an on-farm phytoplankton monitoring programme to assist as an early warning system for toxicity in molluscan shellfish. These programmes and associated standard operation procedures (SOPs) that were drafted by the office were implemented on the relevant farms and the farm managers were assisted where required to ensure the smooth implementation of the phytoplankton monitoring programme.

The SAMSM&CP office drafted and implemented a Joint Biotoxin Monitoring Programme for the Saldanha Bay mussel and oyster farmers at the request of the farmers to alleviate the high costs associated with biotoxin monitoring. The biotoxin test results of the samples taken from the sentinel sites are shared by the programme members, who all contribute to a joint fund managed by the farmers themselves.

The SAMSM&CP office, in collaboration with the Council for Scientific and Industrial Research (CSIR), implemented the use of an LCMS for DSP toxin analysis to replace the mouse bioassay. The MoU between DAFF and CSIR has been updated to allow for the housing of the LCMS at the CSIR to ensure effective and efficient service delivery to the farmers in terms of the testing of DSP toxins and the reporting of test results. The CSIR and DAFF are currently in the process of upgrading the LCMS maintenance contract to improve on the maintenance and servicing of the instrument to ensure minimal down-time of the instrument.

Currently the CSIR is making progress in the validation of an AOAC method 2005.06 to test for PSP toxins on the Liquid Chromatography Fluorescence Detector (LCFLD). The SAMSM&CP staff have improved the communications with relevant stakeholders involved in the programme. Various meetings were held to exchange ideas to assist with the improvement of service delivery of the office, for example, the improvement of turnaround times for the availability of results to the SAMSM&CP office and farmers. Some concerns relating to laboratories not being compliant with the SAMSM&CP requirements were addressed at these meetings.

The SAMSM&CP office assisted the shellfish farmers with meeting China's import requirements, particularly with regard to the testing of heavy metals where the heavy metal concentration appeared to exceed the regulatory limits set by China and motivating for instruments to test for dioxins and inorganic arsenic.

3.7.14 Shellfish Monitoring Programme conclusion for 2012

The SAMSM&CP report for 2012 outlines the status of marine aquaculture shellfish farms and the implementation of the programme. The report furthermore provides a summary of the compliance data and the level of compliance. The 22 farms that are monitored by SAMSM&CP include abalone, mussel and oyster farms.

Though the mussel and oyster farms are more susceptible to contaminant accumulation and have experienced closures owing to PSP and DSP toxin concentrations exceeding the regulatory limits, the abalone farms are also susceptible to PSP toxin accumulation, particularly on the West Coast. Implementing the use of the LCMS instrument has significantly

decreased the number of farm closures attributed to DSP toxin accumulation in shellfish. However, challenges are still being experienced when the LCMS is not operational, which is in the process of being remedied.

There were a number of farm closures as a result of *E. coli* concentrations exceeding the regulatory limit, which appears to be associated with heavy rainfall periods.

3.8 MARINE AQUACULTURE SITE SURVEILLANCE IN 2012

Site surveillance of the marine aquaculture sector has played a vital role since 2008 in ensuring compliance with the department's marine aquaculture permitting frameworks and regulations promulgated under the Marine Living Resources Act, 1998 (Act No. 18 of 1998). This has been essential in ensuring that non-compliant operations are communicated through proper channels such as our directorates that deal with the enforcement of legislation.

The Chief Directorate: Monitoring, Control and Surveillance (MCS) has the responsibility of ensuring that all legislation is enforced, that rights holders and other aquaculture permit holders abide by the permit conditions and transgressions are adequately dealt with. The department conducted site surveillance of 13 marine aquaculture rights holders and three Fish Processing Establishment (FPE) exemption holders between February and November 2012. This included site surveillance of six abalone (*Haliotis midae*) farming operations, four mussel (*Mytilus galloprovincialis*) and oyster (*Crassostrea gigas* and *Striostrea margeritacea)* farming operations, three finfish (dusky kob (Argyrosomus japonicus) farming operations and three marine aquaculture FPEs processing cultured shellfish, between Velddrif on the West Coast and East London on the east coast.

The department is continually conducting an economic survey through the Directorate: Aquaculture Technical Services (ATS) and a cultured shellfish sanitary survey through the Directorate: Sustainable Aquaculture Management (SAM) of the marine aquaculture sector. This has been an ongoing exercise implemented since 2010 and has performed an integral part in evaluating the economic and food safety status of the sector. The department aims to work closely with industry to ensure open channels of communication from the marine aquaculture sector, through the continued support provided in implementing continued site surveillance. The department initiated an oyster biosecurity survey of the marine aquaculture sector in 2012 through the D: SAM in collaboration with site surveillance. This will prove vital in evaluating the biosecurity status of existing oyster farms operating between Kleinzee in the Northern Cape and Port Elizabeth in the Eastern Cape.

3.9 ANIMAL HEALTH

3.9.1 Aquaculture and animal health

The management, control and regulation of aquatic animal health, welfare and disease management are considered to be essential to the development and sustainability of the aquaculture sector and commercial fishery. The ability of the department to effectively provide these services is constrained by a lack of coordination between relevant government departments and a lack of capacity both in terms of human resources and technical competence. The lack of a legal mandate to impose certain restrictions, policies and standards in aquaculture as these relate to aquatic invertebrates further compounds this problem.

In order to address these shortcomings, the department has endeavoured to provide the basic services relative to aquatic animal health and welfare through partnerships with competent service providers, and through the development and advancement of a National Aquatic Animal Health Strategic Framework. This is intended to provide strategic guidance for the development and implementation of a coordinated national aquatic animal health and welfare programme, and will integrate the existing, independently developed aquatic animal health and welfare mechanisms from both the freshwater and marine industries. This will guide other provincial departments, research institutions and the private sector on matters relating to aquatic animal health and disease management.

3.9.2 National Aquatic Animal Health Strategic Framework

The initial draft of the National Aquatic Animal Health Strategic Framework for South Africa, was developed by a committee of stakeholders from various government departments, industry, veterinarians in private practice and university academics, towards the implementation of the Policy for the Development of a Sustainable Marine Aquaculture Sector in South Africa, which was gazetted in 2007. Subsequently the framework has been expanded to include all aquaculture activities, including the freshwater aquaculture industry. The draft framework has been sent for public comment, in November 2011, and is currently undergoing internal departmental reviews. The department is currently in the process of establishing a National Aquatic Animal Health Working Group tasked to coordinate and develop an amalgamated Implementation Plan and a National Aquatic Animal Health and Welfare Programme.

3.9.3 Animal Health Surveillance and Disease Control system

Surveillance represents the collection of disease information from host populations for the purpose of early detection of emerging diseases, disease control, and understanding the health and productivity of aquatic animals, under various farming conditions, in order to mitigate disease risks to or from an aquaculture facility. This information is required to: identify which diseases and pathogens exist in the country; determine the importance of the various diseases; determine the level and geographical distribution of diseases; respond to disease outbreaks to meet the reporting requirements of international organisations; and demonstrate disease status to trading partners (Cameron, 2002). The surveillance activities of the Fisheries Branch of the department are essentially achieved through the services of an appointed aquatic animal health service provider in the form of the annual stock assessments, conducted on all marine aquaculture facilities.

Furthermore, the DAFF, in collaboration with the Chief State Veterinarians and Epidemiologist of the Western Cape Provincial Department of Agriculture: Veterinary Services, are developing a targeted surveillance programme, in order to

provide the required aquatic animal health assurances for exported fishery products, from both the aquaculture sector and capture fisheries.

3.9.4 Disease events in 2012

3.9.4.1 Abalone Tubercle Mycosis

There were four reported cases of abalone tubercle mycosis (ATM) to the department in 2012. These cases were reported by the affected farmers. In all of these cases, samples were received from the farmers, or their animal health service providers, or collected by the DAFF. *Halioticida noduliformans* was confirmed from two of these cases, using polymerase chain reaction (PCR).

3.9.4.2 Further confirmation of epizootic ulcerative syndrome

In October 2012, epizootic ulcerative syndrome (EUS) was again confirmed by the PCR and histology, from catfish (*Clarias gariepinus*) samples collected from the Eerste River system, near Stellenbosch in the Western Cape.

3.9.5 Animal health training

The department funded and hosted an aquatic animal disease management training workshop, which was presented by an independent service provider on 11 to 12 April 2012 at the Aquaculture Research Facility in Sea Point. The training was attended by government officials from the relevant provincial and national departments and representatives of the NRCS.

The training aimed to:

- Improve the understanding of diseases on farmed fish both nationally and internationally;
- Highlight the responsibilities of key players in aquatic animal health and disease management;
- Raise awareness of the requirements for effective aquatic animal health management; and
- Provide practical guidance on the analysis of epidemiological data obtained from disease events.

4 STATUS OF FRESHWATER AQUACULTURE 2012

4.1 Overview of the freshwater aquaculture industry in South Africa 2012

The South African freshwater aquaculture industry is still developing in terms of production contribution towards the South African economy, even though it was introduced in the early 1800s. This is because of the lack of skills development, transformation and as well as awareness about the aquaculture sector, which creates a major challenge in the development of the industry. Recently associations for certain subsectors have been developed, namely: the Tilapia Association of South Africa (TAASA) and the Catfish Growers' Association (CGA) which will assist in the development of the industry as well as guide the department in obtaining a clear vision of the freshwater aquaculture industry in South Africa. Note that the production data analysed was based on data provided by the associations and may not be a true reflection of the entire aquaculture industry as many freshwater farmers do not belong to an association. Production data for subsectors such as ornamental fish, koi carp and common carp were not added in the aquaculture yearbook as there was insufficient information to present.

The freshwater aquaculture subsectors include trout (*Onchorynchus mykiss* and *Salmo trutta*), tilapia (*Oreochromis mossambicus, Oreochromis niloticus* and *Oreochromis rendalli*), catfish (*Clarias gariepinus*), carp (*Cyprinus carpio* and *Ctenopharygodon idella*), marron crayfish (*Cherax tenuimanus),* and a number of ornamental species (i.e. koi carp, etc.). (Table 8).

Table 8. Freshwater aquaculture species cultured in South Africa in 2012 and their operational scale.

Freshwater aquaculture species culture in South Africa, 2012		
Common name	*Scientific name*	*Operational scale*
Rainbow trout	*Oncorhynchus mykiss*	Commercial scale
Brown trout	*Salmo trutta*	Commercial scale
Mozambique tilapia	*Oreochromis mossambicus*	Commercial scale
Nile tilapia	*Oreochromis niloticus*	Commercial scale
African sharptooth catfish	*Clarias gariepinus*	Pilot scale
Common carp	*Cyprinus carpio*	Commercial scale
Koi carp	Cyprinus carpio	Commercial scale
Marron (freshwater crayfish)	Cherax tenuimanus	Commercial scale

The Western Cape Province had the highest number of farms operating in 2012 and the majority of these farmed rainbow trout. Other provinces dominated by freshwater aquaculture activity were Mpumalanga followed by KwaZulu-Natal and Gauteng. Free State, North West, Northern Cape and Limpopo are still developing aquaculture provinces. Trout is the most cultured freshwater species and its distribution is across the Western Cape, Eastern Cape, Mpumalanga and KwaZulu-Natal. Tilapia is the second largest cultured species in the country and farms are located nationwide.

4.2 Freshwater aquaculture production 2006 to 2012

The reported freshwater aquaculture production in 2012 was 1 665,67 tons (Table 9). The freshwater aquaculture subsector with the largest aquaculture production in 2012 was trout, which contributed 1 428 tons (Figure 23). The second largest subsector is tilapia, which had a total production of 234 tons. The third subsectors include marron crayfish, which contributed 3,5 tons. The catfish subsector produced zero tons in 2012, however, the subsector produced fingerlings for export. Total freshwater aquaculture production has shown an increase of 205,7 tons (12.35%) from the year 2011 to 2012 for the four subsectors (Figure 23).

Table 9. South Africa's freshwater aquaculture production 2006-2012.

Sub-sector	Year and production (tons)							Total production (tons)
	2006	2007	2008	2009	2010	2011	2012	2006–2012
Tilapia	0	0	0	10	10	100	234,17	**354,17**
Trout	807	658	943	948,62	950	1 199*	1 428	**6 933,62**
Catfish	180	180	180	180	180	160	0	**1 060**
Marron	0,2	0,4	0,4	0,4	0,8	0,8	3,5	**6,5**
Totals	987,2	838,4	1 123,4	1 139,02	1 140,8	1 459,8	1 665,67	8 354,29

***Trout data were corrected for the year 2011.**

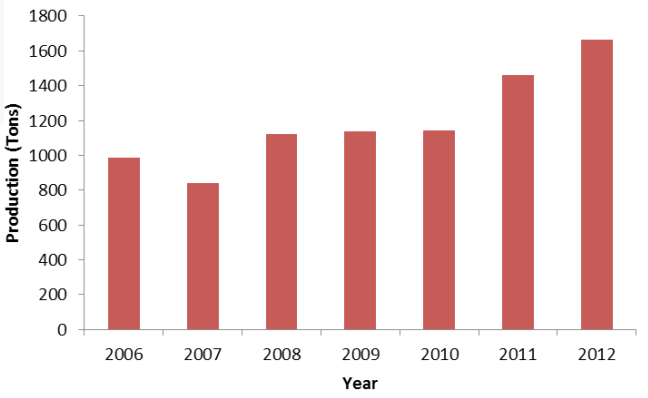


Figure 23. Freshwater aquaculture overall production 2006–2012.

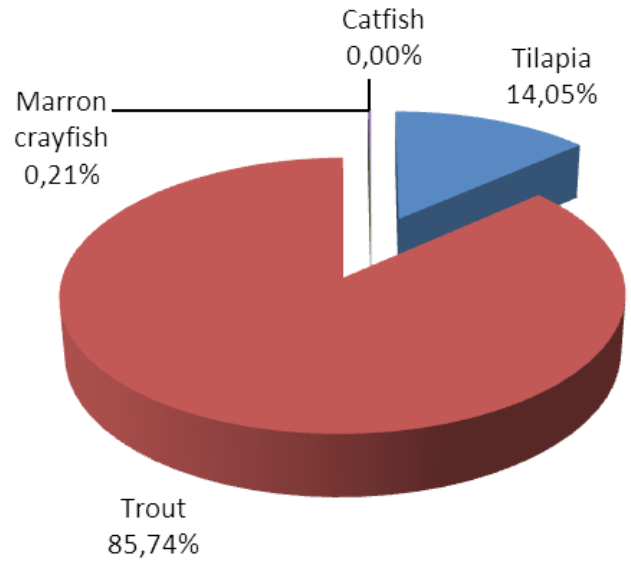


Figure 24: The percentage contribution of each subsector to total production in 2012.

4.3 Analysis of the freshwater aquaculture industry

4.3.1 Trout subsector

The trout species cultured in South Africa are *Onchorynchus mykiss* and *Salmo trutta* and these have contributed 85,74% of South Africa's total production in 2012 (Figure 24), recording a total production of 1 428 tons (Figure 25). The trout farms are currently located in the Western Cape, Mpumalanga, Eastern Cape and KwaZulu-Natal provinces. Note that production data were not obtained for KwaZulu-Natal and Eastern Cape and therefore not included in the total production for 2012. The technology used to cultivate the species includes raceway, pond, cage culture and recirculating systems.

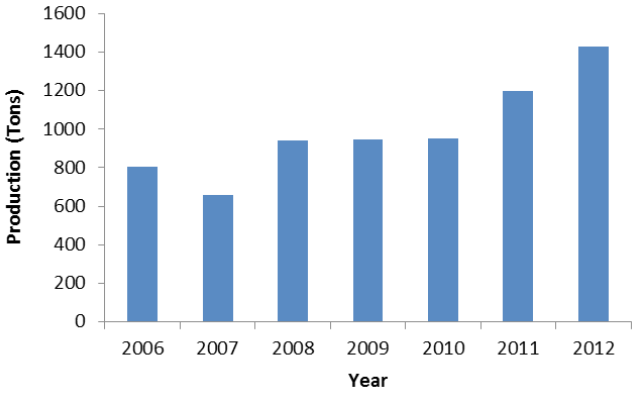


Figure 25. Trout production for the years 2006–2012.

4.3.2 Tilapia subsector

The tilapia subsector in South Africa is based on a number of indigenous species, the two major species cultured are the Mozambique tilapia (*Oreochromis mossambicus)* and Nile tilapia (*Oreochromis niloticus*). The subsector contributed 14,05% to South Africa's total production, recording 234 tons (Figure 26). The subsector had an increase of 134 tons between the years 2011 to 2012, which illustrates the development of the subsector. Most tilapia farmers are small-scale farmers and they employ recirculation systems and pond culture methods, but recently farming tilapia in greenhouses has been implemented.

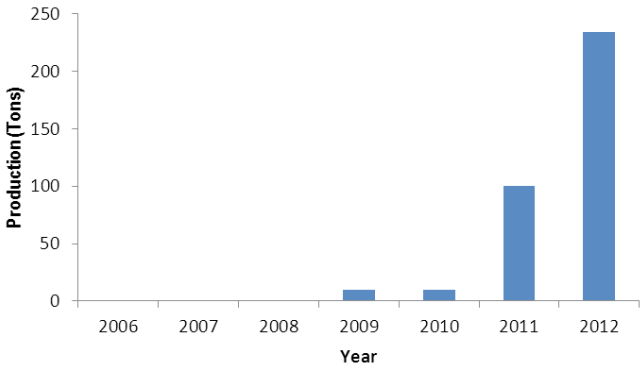


Figure 26. Tilapia production for the years 2006–2012.

4.3.3 Catfish subsector

The catfish subsector in South Africa is based on the indigenous species sharptooth catfish (*Clarias gariepinus*). At present the catfish production has been stable for the past few years and recently a decrease in production has been recorded in 2012 (Figure 27). In terms of 2012 production the catfish industry recorded zero production owing to farmers mostly concentrating on producing fingerlings for the export market rather than growing the fish to market size on site. South Africa's technology for catfish culture is well developed, and the majority of farmers utilise high-density pond, raceway and recirculation systems.

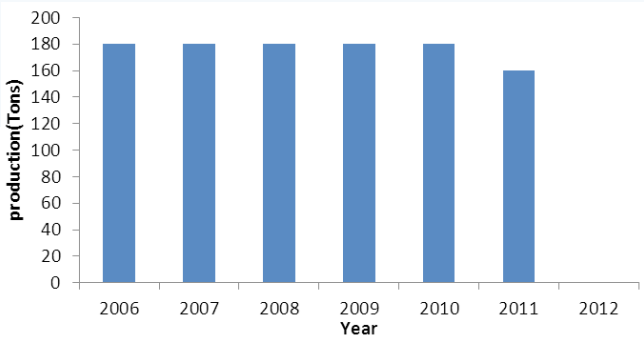


Figure 27. Catfish production for the years 2006–2012.

4.3.4 Marron crayfish subsector

Marron crayfish (*Cherax tenuimanus*) is exotic to South Africa. The subsector is still developing and there is only one farmer culturing the species in the country. A total of 3,5 tons were produced in 2012 with an increase of 2,7 tons (Figure 28). The marron crayfish subsector is located in the Eastern Cape. Production of marron crayfish is primary in tank culture for the juvenile phase of production, and semi-intensive pond culture for the grow-out phase of production.

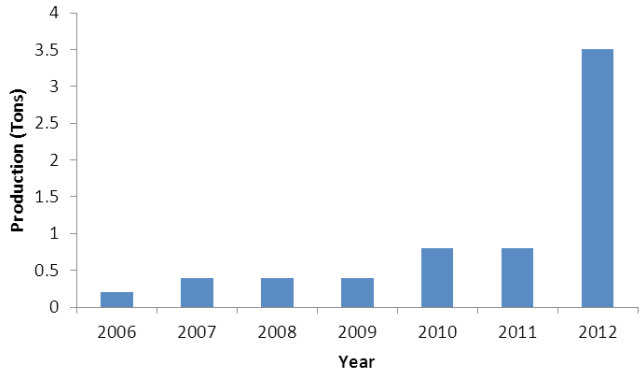


Figure 28. Marron crayfish production for the years 2006–2012. 5.

5. PROVINCIAL ANALYSIS OF SOUTH AFRICA'S AQUACULTURE SECTOR IN 2012

Note that the number of freshwater aquaculture farms may not be a true reflection of the entire freshwater aquaculture industry as some farms may not be in operation. The data are based on information provided to DAFF by aquaculture associations and Provincial Departments of Agriculture.

5.1 Eastern Cape

The Eastern Cape had 16 farms in 2012, including both marine and freshwater aquaculture. These farms contributed to 279,13 tons (excluding carp, koi carp and ornamentals) to South Africa's total production. The production was made up of five subsectors, namely abalone, finfish (dusky kob), oysters, tilapia and marron crayfish. Table 10 and 11 provides an overview of the aquacultures subsector's total number of farms and production per species and province.

With regard to the marine aquaculture industry in the Eastern Cape there were five farms in operation, these include an abalone farm, two dusky kob farms and two oyster farms. The total marine aquaculture production recorded for the Eastern Cape was 275,30 tons.

With regard to freshwater aquaculture there were 11 farms in operation during 2012. These farms included two tilapia farms, three trout farms, one catfish farm, one marron crayfish farm, one koi carp farm and three farms cultivating ornamental species. The freshwater production in the Eastern Cape was 3,83 tons, which included two subsectors, namely tilapia and marron crayfish. Note that the trout subsector's production data for the Eastern Cape were not recorded as there was insufficient information.

5.2 Free State

Total numbers of farms operating in the Free State was seven and were freshwater aquaculture farms. These farms produced a total of 1,9 tons in 2012 (excluding carp, koi carp and ornamentals). The subsectors that made up the aquaculture industry in the Free State included tilapia, catfish, koi carp and a farm cultivating ornamental species.

These farms included one tilapia farm, three catfish farms, two koi carp farms and one farm cultivating ornamental species. Note that the catfish farms were not producing any fish during 2012. Tilapia accounted for the total production in the province with a total of 1,9 tons.

5.3 Gauteng

The total number of farms recorded in 2012 for Gauteng Province was 24 and only included freshwater aquaculture farms. These farms contributed 45 tons (excluding carp, koi carp and ornamentals) to South Africa's total production. The production was made up of five subsectors, namely tilapia, catfish, carp, koi carp and farms cultivating ornamental species. Tilapia accounted for the total production and amounted to 45 tons in 2012.

The farms which made up the freshwater industry in Gauteng Province included 11 tilapia farms, one catfish farm, two carp farms, six koi carp farms and four farms cultivating ornamental species.

5.4 KwaZulu-Natal

In 2012, 17 aquaculture farms were operating in KwaZulu-Natal. These farms contributed a total of 0,68 tons (excluding carp, koi carp and ornamentals) to the total production of the sector. This tonnage was from one subsector namely tilapia.

In terms of marine aquaculture there is one marine aquaculture operation in KwaZulu-Natal and it is culturing finfish

(dusky kob) using a pond culture system on a pilot scale. Total marine aquaculture production for the province in 2012 was zero. There is only one marine species currently being farmed in KwaZulu-Natal, namely is dusky kob. There is great potential for marine aquaculture growth in KwaZulu-Natal as the warm water of this region makes it suitable for the farming of many finfish species, including dusky kob, yellowtail and spotted grunter, among others.

With regard to freshwater aquaculture there were 16 farms in operation during 2012. A total of five farms were farming tilapia, five farms were culturing rainbow trout and six farms were operating ornamental farms, two farms culturing koi carp and four culturing a verity of ornamental species. Total freshwater aquaculture production in KwaZulu-Natal was 0,68 tons.

5.5 Limpopo

Limpopo Province recorded a total of 19 farms in 2012. The following subsectors were active in the province, tilapia, catfish, koi carp and farms cultivating ornamental species. The total production recorded (excluding carp, koi carp and ornamentals) for Limpopo was 90,6 tons was made up of only tilapia production. The freshwater industry in Limpopo Province included 13 tilapia farms, three catfish farms, one koi carp farm and two ornamental farms.

5.6 Mpumalanga

In 2012, 42 farms were recorded in Mpumalanga. These farms produced a total production of 861 tons, which is the second highest production recorded out of all the provinces. The subsectors making up the industry consisted of tilapia, trout and koi carp. The two subsectors contributing to the total production included tilapia and trout recording 21 tons and 840 tons respectively. The industry in Mpumalanga consisted of 20 tilapia farms, 19 trout farms and three koi carp farms.

5.7 Northern Cape

The Northern Cape recorded a total of nine farms in the province, including freshwater and marine aquaculture farms. The total production for the province was 9,2 tons in 2012. The tonnage was contributed by one sector, namely tilapia. It is important to note that the oyster and abalone sub-sectors recorded production, however, these farms sell the product to farms situated in other provinces for further grow-out.

The Northern Cape was represented by marine and freshwater aquaculture farms and recorded a total of four marine farms and five freshwater farms. The marine aquaculture industry consisted two sub-sectors, namely abalone and oyster. There were three abalone farms and one oyster farm recorded in the province.

The subsectors which made up the freshwater industry in the province included tilapia, catfish and koi carp. There were three tilapia farms, one catfish farm and one koi carp farm recorded in the province in 2012.

5.8 North West

The North West Province has 10 farms producing freshwater aquaculture species. These farms contributed a total of 65 tons of production in 2012. The subsectors which made up the industry included tilapia, catfish and koi carp. The only subsector that recorded production was tilapia with a total of 65 tons.

Farms that made up the industry in the North West included eight tilapia farms, one catfish farm and one koi carp farm.

5.9 Western Cape

The Western Cape recorded the most number of farms in South Africa recording a total of 50 farms. There are both marine and freshwater farms in the sectors which produced a combined total of 2 574 tons which was the highest recorded production of all the provinces in South Africa. The sub – sectors contributing to the total production included abalone, finfish, mussels, oysters, tilapia and trout.

With regards to the marine aquaculture industry, the total number of farms recorded in 2012 was 23. The farms making up the marine aquaculture industry included 13 abalone farms, one finfish farm, three mussel farms and 6 oyster farms. The total marine aquaculture production recorded for the Western Cape was 1 985.92 tons.

The total number of farms recorded in the freshwater industry in 2012 was 27. The sub-sectors making up the industry were tilapia, trout, carp, koi carp and ornamentals. The sub-sectors contributed 588.46 tons which came entirely from the tilapia and trout sub-sectors contributing 0.46 tons and 588 tons respectively.

Table10.Total number of farms recorded in South Africa's aquaculture sector in 2012.

Species	EC	FS	GP	KZN	LP	MP	NC	NW	WC	Total
Abalone	1	0	0	0	0	0	4	0	13	18
Finfish	2	0	0	1	0	0	0	0	1	4
Mussels	0	0	0	0	0	0	0	0	3	3
Oysters	2		0	0	0	0	1	0	6	9
Total Marine	**5**	**0**	**0**	**1**	**0**	**0**	**5**	**0**	**23**	**34**
Tilapia	2	1	11	5	13	20	3	8	2	65
Trout	3	0	0	5	0	19	0	0	20	47
Catfish	1	3	1	0	3	0	1	1	0	10
Marron Crayfish	1	0	0	0	0	0	0	0	0	1
Carp	0	0	2	0	0	0	0	0	1	3
Koi Carp	1	2	6	2	1	3	1	1	1	18
Ornamental species	3	1	4	4	2	0	0	0	3	17
Total Freshwater	**11**	**7**	**24**	**16**	**19**	**42**	**5**	**10**	**27**	**161**
Total Marine and Freshwater	**16**	**7**	**24**	**17**	**19**	**42**	**10**	**10**	**50**	**195**

Table 11. Total production recorded in South Africa's aquaculture sector in 2012.

Species	EC	FS	GP	KZN	LP	MP	NC	NW	WC	Total
Abalone	176.2	0	0	0	0	0	0	0	935.21	1111.41
Finfish	47.8	0	0	0	0	0	0	0	0.66	48.46
Mussels	0	0	0	0	0	0	0	0	859.77	859.77
Oysters	51.3	0	0	0	0	0	0	0	190.28	241.58
Total Marine	275.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1985.92	2261.22
Tilapia	0.326	1.9	45	0.68	90.6	21	9.2	65	0.46	234.17
Trout	0	0	0	0	0	840	0	0	588	1428.00
Catfish	0	0	0	0	0	0	0	0	0	0.00
Marron Crayfish	3.5	0	0	0	0	0	0	0	0	3.50
Total Freshwater	3.83	1.90	45.00	0.68	90.60	861.00	9.20	65.00	588.46	1665.67
Total Marine and Freshwater	279.13	1.90	45.00	0.68	90.60	861.00	9.20	65.00	2574.38	3926.89

6 STATUS OF PROVINCIAL AQUACULTURE HATCHERIES

6.1 Overview

South Africa possesses a number of state hatcheries some of which have been severely vandalised and have fallen into a state of disrepair as a result of changing policies, poor management and lack of demand for their services. The main purpose of the hatcheries was either stocking of fish for recreational purposes (trout, carp) or aquaculture development.

6.2 Limpopo

6.2.1 Turfloop Hatchery

The Turfloop Fish Breeding Station (Hatchery) was originally established in 1982 as a catfish production and research facility under the former Lebowa homeland authority. The facility, which ceased operation in the early 1990s, began operating again following investment from the Limpopo Department of Agriculture. In 2008, catfish were spawned again on the site for the first time in ten years. The rearing systems inside the hatchery building are in a poor condition however the infrastructure is still in relatively good condition (Figure 29 and 30).

At present the hatchery produces catfish fingerlings to fish farmers in the Limpopo province. It also produces tilapia and carp fingerlings for community fish projects.

Whilst the Turfloop Fish Breeding Station has been reduced to a state of limited fingerling production due to poor maintenance, plans are afoot to revitalise the hatchery to bring it in line with modern facilities and to significantly improve fingerling production.

Figure 29. Turfloop Fish Breeding Station, Limpopo.

Figure 30. Revitalised ponds at Turfloop Fish Breeding Station.

6.3 Mpumalanga

6.3.1 Lydenburg and De Kuilen Hatcheries

Lydenburg and De Kuilen hatcheries are managed by the Mpumalanga Tourism and Parks Agency (MPTA). Both these cold water hatcheries were designed to support trout angling and aquaculture.

Lydenburg is the older facility and was built for fish breeding, research and restocking. The De Kuilen hatchery was built on the Sterkspruit Reserve. It was constructed as a dedicated trout hatchery which in 1975 was capable of producing 2–3 million ova in a year for the export market (Figure 31 and 32). The change in conservation mandate to conserving indigenous aquatic fauna resulted in the termination of the stocking roles of both facilities in the 1980's.

Figure 31. The De Kuilen hatchery in Mpumalanga.

Figure 32. Abandoned egg rearing trays at De Kuilen hatchery.

The Lydenburg Hatchery is in a good condition and still produces fish on a limited scale (Figure 33 and 34). The hatchery however faces severe water challenges as it has to share its water with extensive new housing developments. It is vital that the facility is transferred from the MPTA to the Mpumalanga Department of Agriculture, Rural Development and Land Administration (MDARLA). This hatchery was mothballed in the 1980's and has since been severely vandalised.

Figure 33. The Lydenburg hatchery in Mpumalanga.

Figure 34. Tanks used to rear larvae at the Lydenburg hatchery.

6.4 Eastern Cape

Historically, the province mainly produced carp species. It stopped operating in the past three decades, resulting in all state-owned facilities being extensively vandalized. These facilities include Mthatha Dam Station, Tsolo Agricultural and Rural Development Institute and Piere Hatchery.

6.4.1 Umtata Dam

The Umtata Dam hatchery was constructed during the 1980's for the purpose of promoting rural aquaculture by the University of Transkei. Its purpose was to conduct research and to produce Chinese carp, silver carp, bighead carp, common carp and grass carp for stocking into local dams, and to develop an integrated polyculture system appropriate to local conditions. The facility has not produced any fish since the last scientists left in 1987, mainly due to lack of funds and lack of policy regarding freshwater research and development.

The facility, which now falls under the Department of Rural Development and Agrarian Reform, is presently staffed by a small component. The current status of the hatchery is in bad condition. The structure (walls, roof and floor) is in good condition (Figure 35), however the interior has been extensively vandalized.

Figure 35. Umtata Dam hatchery in the Eastern Cape.

6.4.2 Piere Hatchery

The Piere hatchery has been completely vandalized and only ruins are left.

Figure 36 and 37. Aquaculture breeding facility in Piere, Eastern Cape.

6.5 KwaZulu Natal

6.5.1 The Makhatini Research Centre and Hatchery

The Aquaculture Unit at Makhatini Research Centre was the only government facility in KwaZulu Natal involved in aquaculture. The facility is situated in a communal area approximately 20 kilometers below the Jozini Dam, and forms part of a research center that was established in 1985. The facility is small, comprising of a hatchery building and four ponds (Figure 38 and 39). This subtropical area has a traditionally fish-eating population.This facility was research orientated, and did not directly promote aquaculture or provide extension services. No active production is presently taking place. The unit is small and is in a poor condition.

Figure 38. The Makhatini hatchery in KwaZulu Natal.

Figure 39. Small grow-on area inside Makhatini hatchery.

6.6 Free State

6.6.1 China – South Africa Agricultural Technology Demonstration Centre (Gariep Dam Aquaculture Demonstration Centre)

South Africa and China have formed a partnership to build a fish hatchery at Gariep Dam in the Free State Province, in order to develop rural aquaculture and create employment in the country. The China – South Africa Agricultural Technology Demonstration Centre is located near the Gariep Dam in the Xhariep District of the Free State Province (Figure 40). The project was established to replace the existing fish breeding station which occupies an area of about 44.28 hectares.

The China–South Africa Agricultural Technology Demonstration Centre was developed to serve as a modern research, demonstration, promotion and training facility for freshwater fish farming technologies. Key project activities will include training and promotion, breeding and technology demonstration as well as research and development. The hatchery was initially designed to breed tilapia however sufficient flexibility was built into the design which will allow the hatchery to also breed other indigenous fish species including catfish and common carp (Figure 41).

The hatchery is a flow-through system, capable of heating water up to 28°C (Figure 42). The hatchery has several fibreglass tanks. Outside the hatchery there are 34 ponds. There are also some specialised laboratories to support research and breeding activities.

Figure 40. China – South Africa Agricultural Technology Demonstration Centre administrative building housing laboratories and training areas.

Figure 41. The China – South Africa Agricultural Technology Demonstration Centre hatchery building.

Figure 42. Fibreglass tanks Inside the Agricultural Technology Demonstration Centre hatchery.

7. AQUACULTURE ECONOMIC OVERVIEW OF SOUTH AFRICA'S AQUACULTURE SECTOR 2012

7.1 Introduction to the Economic overview of the aquaculture sector

The aquaculture economic overview provides a summary of economic performance, growth and development in South Africa during 2012. Economic data contained in this section was collected from questionnaires submitted to individual farmers, industry associations, and different data sources referenced in this section. Its main objective is to provide aquaculture stakeholders with information and statistics on economic trends and growth of aquaculture sectors on a year to year basis in South Africa.

7.2 Supply availability

The South African aquaculture production volume continues to grow. In 2012, local production of farmed fish was 3 926.89 tons (excluding seaweed, carp, koi carp and ornamentals), increasing by 25.64% from 3 125.47 tons produced in 2011 (excluding seaweed and ornamentals). Marine finfish production volume has increased gradually since its pilot phase and this resulted in farmed fish being available for the market continuously. South Africa's aquaculture production includes finfish, crustaceans and molluscs. The reported grow-out production from aquaculture is almost entirely destined for human consumption.

Marine aquaculture industry achieved an increase of 20.1% to 2 261.21 tons (excluding seaweed) during 2012 in comparison to 2011. Three marine aquaculture sub-sectors increased their supply excluding the oyster sub-sector which dropped in terms of production due to one farm closing down.

The freshwater aquaculture industry recorded an increase of 14.1% to 1 665.67 tons in 2012. The increase was mainly attributed to an increase in production of trout and tilapia. The trout sub-sector has continued to show strong growth and has demonstrated a 19.09% increase in production over the past year, with two major producing regions being the Western Cape and Mpumalanga. This clearly demonstrates the ability to meet the soaring demand for farmed trout.

The production of tilapia over the past five years has been inconsistent. In 2012, tilapia's recorded production was 234 tons, increasing the sub-sectors production volume by 134% from the 100 tons produced in 2011. This is the highest recorded production figure over the last five years. The tonnage could be much higher as some farmers have not submitted production figures to the DAFF.

The catfish sub-sector has consistently produced on average production of 180 tons per year from 2008 until 2011. During 2012, no market size catfish was produced; as only fingerlings were sold to the export market for further grow-out.

The marron crayfish is one of the smallest sub-sectors in aquaculture with an average production of 0.6 tons for the past five years. Limited production of marron could be associated with only one active farmer notwithstanding the fact that there is an existing market for the marron crayfish.

7.3 Value of Aquaculture Sector

The total value of the aquaculture sector was estimated at R504 million, increasing by 33% between 2011 and 2012. This total estimated value includes freshwater aquaculture industry which was not accounted for in the previous years, and was based on the sales of aquaculture products. Locally aquaculture continues to be dominated by abalone production which was estimated to be R405 million in 2012, representing 80.4% of the total rand value for the entire aquaculture sector (Figure 43).

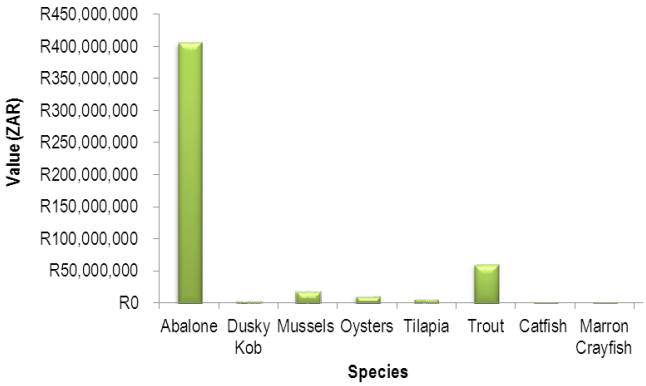


Figure 43. The estimated contribution in value (ZAR) of South African aquaculture sector in 2012.

Trout production was the second largest contributor at R60 million, representing 11.9% of the total value. Mussels were worth R18 million, followed by oysters, R10.5 million, dusky kob at R3.3 million representing 3.7%, 2.1%, 0.7% respectively. Marron crayfish and catfish contributed the lowest in terms of value, only contributing an estimated value of R630 000 and R330 000 each representing 0.12% and 0.1% respectively (Figure 44).

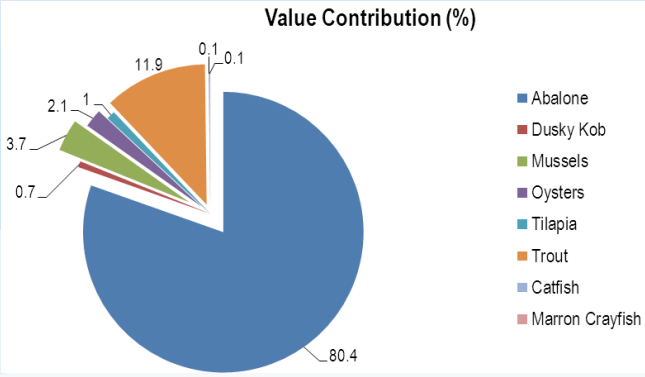


Figure 44. The estimated percentage contribution of the total value of South Africa's aquaculture sector in 2012.

7.4 Contribution to Gross Domestic Product

Aquaculture in South Africa has been identified as a priority sector that can contribute to economic growth and development. Although the sector has been growing steadily over the past years, its contribution towards the global total production has been minimal. The aquaculture estimated contribution to the Gross Domestic Production was less than one percent, it was estimated at approximately 0.024% in 2012.

7.5 Aquaculture investment

In terms of capital investment, there has been tremendous growth of investment in the sector, especially the marine aquaculture indusry where the private sector invested substantial amounts of money. There are a number of dedicated Development Funding Institutions (DFI) that provide financial support within the sector. These institutions have played an integral role in the development of the sector. The government has continued to support the development of the aquaculture sector. The DAFF and the Department of Trade and Industry's (**the dti**) recent initiative, Aquaculture Development and Enhancement Programme (ADEP), illustrates this point, which seeks to promote and encourage investment into the sector. Furthermore, the provincial Departments of Agriculture have also provided financial support through the Comprehensive Agricultural Support Programme (CASP) for funding aquaculture projects.

Capital investment of approximately R241 million representing an increase of 34.6% was realised in the sector during 2012. The abalone sub-sector invested approximately R162 million during this period. These investments were primarily for further expansions to meet increasing demand. The marine finfish sub-sector has been growing rapidly over the past years and more than R60 million was invested in the sub-sector during 2012. The total recorded investment for mussels was R10 million and oysters at R905 000.

Investment by the trout sub-sector increased substantially by 72% to R7.8 million in 2012, illustrating the potential of the commercial trout market in South Africa. A total of R300 000 was invested in the marron crayfish sub-sector. No known investment was recorded for tilapia, ornamentals and catfish sub-sectors for 2012 (Figure 45).

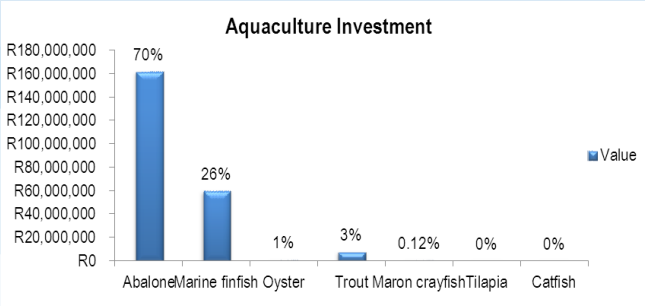


Figure 45. Represents the capital investments made by the different aquaculture sector by species group during 2012.

7.6 Employment Status

The aquaculture sector contributes to economic growth and development by creating employment opportunities, being a food supplier and income generator. The sector employed 2 227 people directly on farms during 2012 on a full time basis. This figure could be doubled to 4 454 if indirect jobs and services such as; feed manufacturing, fish processing, security, transport, packaging, manufacturing of equipment, research and government services is taken into consideration. Marine aquaculture industry was the largest employer with over 78.5% while the freshwater industry was responsible for contributing 21.5% towards employment. The aquaculture sector continues to create sustainable job opportunities which contribute to poverty alleviation and food security through income generated.

The abalone sub-sector is the leading employer with more than 1 245 full-time jobs, followed by the tilapia and trout sub-sectors employing an estimated total of 298 and 189 jobs respectively. The oyster and marine finfish sub-sectors are relatively labour intensive even though they had few farmers in the sector, with each contributing 180 and 152 full-time jobs respectively. The mussel sub-sector created 79 jobs while marine ornamentals created 74 full-time jobs. The Marron crayfish and catfish sub-sectors had one producer each which resulted in few jobs created by the two sub-sectors. Both sub-sectors combined created a total of 10 full-time jobs, with marron creating six and catfish four. These two sub-sectors appear to be less labour intensive. Figure 46 below indicates the full time employment opportunities created by the South African aquaculture sector for different species during 2012.

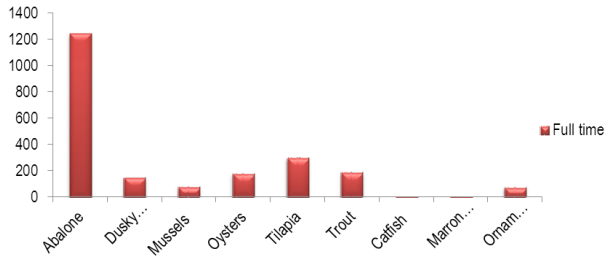


Figure 46. Full time employment in the South Africa's aquaculture sector, represented by species group during 2012.

The Western Cape is still the largest employer with 1 304 employees, representing 58% of the total employment, followed by the Eastern Cape with 358 and Limpopo with 179.

Furthermore Mpumalanga recorded 138 employees while the North West, KwaZulu Natal and Northern Cape employed 89, 83, and 46 employees respectively. Gauteng recorded the least number of jobs, employing 30 individuals during 2012. Lastly no employment was recorded for the Free State province (Figure 47).

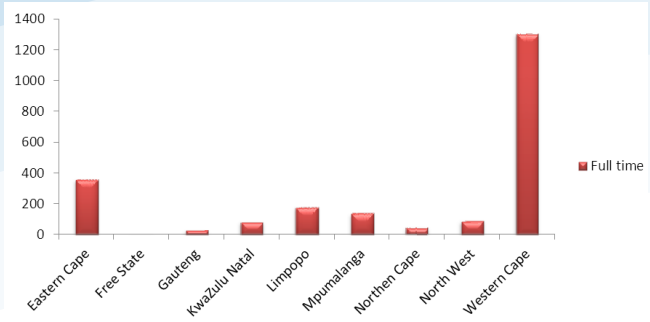


Figure 47. Full time employment in the South Africa's aquaculture sector in 2012.

7.7 Market Structure

South Africa's aquaculture products are traded both locally and internationally. This is influenced by a wide range of factors such as the exchange rates, demand, supply availability, and relative prices for competing sources of protein and substitute products.

7.8 Export Market

7.8.1 Abalone

The abalone production increased over the past year resulting in higher export volume. A total of 1111.41 tons of abalone with an estimated worth of R405 million was exported to the Asian market (Table 12). Abalone products are exported in variety of forms, but mostly as canned, dried and live products. During 2012, locally farmed abalone was exported to China, Hong Kong, Singapore, Malaysia, Taiwan, Korea and Japan. The exported volume increased by 7.3% compared to 2011. The value of exports was based on unprocessed abalone production (Wet weight).

Table 12. South Africa's farmed abalone exports during 2012.

Species	Region	Export quantity (tons)	Value (ZAR million)
Abalone	Asia	1111.41	405
Total		1111.41	405

Data compiled from monthly production reports submitted to DAFF.

7.8.2 Oysters

In 2012 South Africa exported approximately 177.24 tons of oysters valued at R6.7 million. Exports increased by 133% from 2011. The main destinations for exports were Thailand and Hong Kong, with more than 106 tons of oysters exported to Thailand, followed by 64 tons exported to Hong Kong. China imported 3 tons, increasing by 37.2% as compared to the previous year. Vietnam, Zambia and Mozambique imported the least, with 1.87, 1.03 and 0.15 tons respectively. Over 98% of the South Africa's oyster exports were destined to Asia whilst a small proportion was exported to the African market. Table 13 and Figure 48 demonstrate the export volumes of South Africa's oysters to the global market.

Table 13. South Africa's oyster exports during 2012.

Species	Country	Exports quantity (tons)	Value (ZAR millions - FOB)
Oysters	China	3.02	0.12
Oysters	Hong Kong	64.76	5.76
Oysters	Thailand	106.41	0.69
Oysters	Vietnam	1.87	0.15
Oysters	Zambia	1.03	0.05
Oysters	Zimbabwe	0.15	0.003
Total		**177.24**	**6.773**

Source: Data collected by South African Revenue Services Statistics 2012

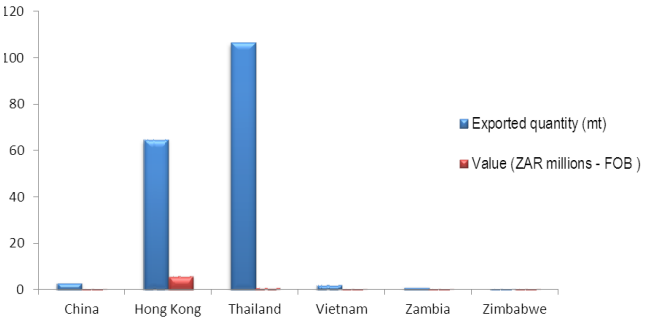


Figure 48. Countries that imported oysters from South Africa in 2012.

7.8.3 Mussels

South Africa exported approximately 64 tons of mussels valued over R2 million in 2012. The mussels exports increased significantly with 131% as compared to the previous year. The bulk volume of exports was destined to African countries and a small quantity to different islands. Mauritius and Angola were the main importers with over 14 and 13 tons. Table 14 demonstrates South Africa's mussels exports to the African and Asian countries during 2012.

Table 14. South Africa's exports of mussels during 2012.

Species	Country	Exports quantity (tons)	Value (ZAR millions - FOB)
Mussels	Angola	13.7	13.7
Mussels	Democratic Republic of Congo	0.04	0.01
Mussels	Ghana	0.63	0.21
Mussels	Malawi	0.74	0.027
Mussels	Mauritius	14.67	0.68
Mussels	Mozambique	4.7	0.19
Mussels	Nigeria	4.75	0.11
Mussels	Seychelles	1.8	0.106
Mussels	China	3.82	0.108
Mussels	ST Helena	0.04	0.01
Mussels	Uganda	0.32	0.088
Mussels	Zambia	10.73	0.2
Mussels	Zimbabwe	8.28	0.3
Total		**64.22**	**2.039**

Source: South African Revenue Services Statistics 2012

7.8.4 Catfish

South Africa exported approximately 2.2 million catfish fingerlings with an estimated value of R330 000 to Nigeria in 2012 (Table 15). In terms of data collected, it seems as if there was no market size catfish exported during that period. This could be attributed to the fact that there were few active catfish farmers and none produced market size fish in 2012.

Table 15. South Africa's catfish fingerlings exports during 2012.

Species	Country	Exports quantity (units million)	Value (ZAR thousand)
Catfish	Nigeria	2.2	330
Total		**2.2**	**330**

Source: Catfish Producer Association

7.8.5 Tilapia

Access to markets has been identified as one of the biggest constraints affecting tilapia farming locally. The majority of the farmers supply the local market and this includes selling fish from their farms to farms stalls, fish traders and local communities. In contrast, South Africa exported more than 30 tons of fish valued approximately at R1.2 million during 2012. The top three export destinations for tilapia were United Arab Emirates with 12 tons, United States of America (USA) with 7 tons followed by Zimbabwe with just over 1 ton. This is illustrated in Table 16 below, representing the exported quantity volume of tilapia during 2012.

Table 16. South Africa tilapia exports during 2012.

Species	Country	Exports quantity (tons)	Value (ZAR millions - FOB)
Tilapia	Angola	0.3	0.07
Tilapia	Belgium	0.022	0.002
Tilapia	Ethiopia	0.007	0.054
Tilapia	France	0.04	0.002
Tilapia	Malawi	0.021	0.002
Tilapia	Mauritius	0.01	0.001
Tilapia	Mozambique	13	0.14
Tilapia	Nigeria	0.05	0.003
Tilapia	United Arab Emirates	12	0.71
Tilapia	United States	7	0.27
Tilapia	Zimbabwe	1.3	0.08
Total		33.75	1.33

Source: South African Revenue Services Statistics 2012

7.8.6 Trout

The trout sub-sector to a great extent pioneered aquaculture development in South Africa. It is one of the oldest aquaculture sub-sectors. Trout at the moment is the most commonly grown freshwater fish species in the country. The local demand for trout products was projected to be more than the local production. South Africa did not export large volumes of trout because most of the production was supplied to the local market. The trout sub-sector is still too small to focus on producing fish for export, however there is also a small market to export disease free ova to European farmers. This market is relatively small, but it is a high value seasonal market that ships ova into Europe during the European summer months when some farmers are unable to produce ova. It is important to note that more than 10 tons with an estimated value of R1.12 million was exported to different countries during 2012 (Table 17). Mozambique was the leading importer for trout with more than 7 tons, followed by Japan importing 1 ton and rest of the countries with less than 1 ton each (Figure 49).

Table 17. South African exports of trout during 2012.

Species	Country	Imports quantity (tons)	Value (ZAR millions - FOB)
Trout	Australia	0.01	0.027
Trout	Dem Rep Congo	0.06	0.012
Trout	Denmark	0.27	0.23
Trout	Ecuador	0.07	0.086
Trout	Ghana	0.02	0.0002
Trout	Greece	0.10	0.18
Trout	Iran	0.11	0.19
Trout	Japan	1.00	0.075
Trout	Mozambique	7.98	0.16
Trout	Romania	0.06	0.12
Trout	ST Helena	0.03	0.0028
Trout	Zambia	0.65	0.032
Trout	Zimbabwe	0.05	0.0095
Total		**10.40**	**1.12**

Source: South African Revenue Services Statistics 2012

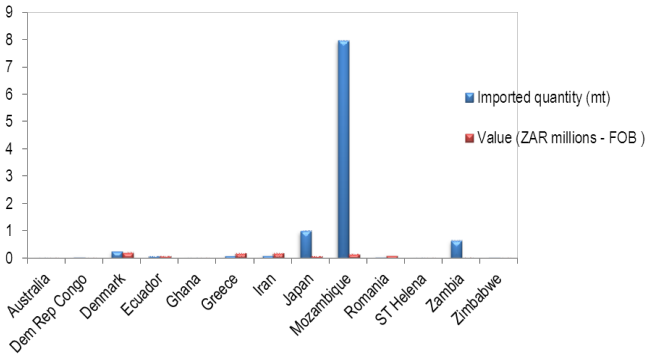


Figure 49. Countries that imported trout from South Africa in 2012.

7.8.7 Salmon

During 2012, there were no salmon commercial farmers in South Africa. However, an assumption was that the fish was imported by processors for value addition and exported to the respective countries at a premium price. Approximately 92.88 tons of salmon valued at R4.65 million was exported. The USA was the main exports destination with more than 70 tons valued at R3.5 million, followed by Zimbabwe importing approximately 5 tons worth R270 000 (Figure 50). Table 18 below illustrates the markets supplied by South Africa.

Table 18. South Africa's salmon exports during 2012.

Species	Country	Exports quantity (tons)	Value (ZAR millions - FOB)
Atlantic Salmon	Angola	2.17	0.1
Atlantic Salmon	DRC	3.15	0.18
Atlantic Salmon	Ghana	1.64	0.093
Atlantic Salmon	Malawi	0.08	0.0021
Atlantic Salmon	Mauritius	0.12	0.018
Atlantic Salmon	Mozambique	2.40	0.16
Atlantic Salmon	ST Helena	0.00	0.00017
Atlantic Salmon	Tanzania	0.05	0.0004
Atlantic Salmon	Uganda	0.08	0.0004
Atlantic Salmon	United States	75.00	3.5
Atlantic Salmon	Zambia	3.06	0.33
Atlantic Salmon	Zimbabwe	5.15	0.27
Total		**92.88**	**4.65**

Source: South African Revenue Services Statistics 2012

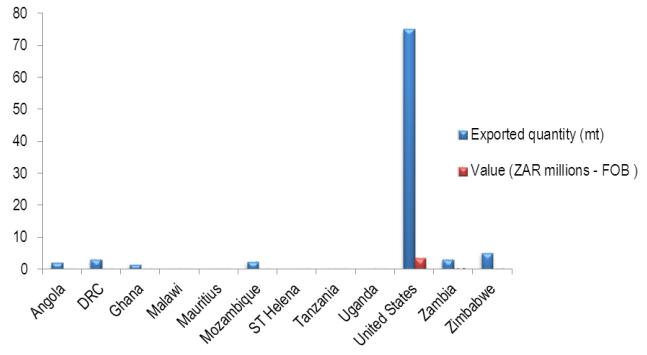


Figure 50. Countries of origin for South Africa's salmon imports in 2012.

7.9 Import Market

7.9.1 Oysters

Two countries exported to the domestic market in 2012, Chile and the USA. Chile was the main exporting country with 17 tons valued at R1.3 million and the USA with one ton valued at R11 000. Table 19 illustrates the quantity and country of origin for oyster products imported into South Africa during 2012.

Table 19. South Africa's imported oysters in 2012.

Species	Country	Imports quantity (tons)	Value (ZAR millions - FOB)
Oyster	Chile	17	1.34
Oyster	United States	0.01	0.02
Total		17.01	1.36

Source: South African Revenue Services Statistics 2012

7.9.2 Mussels

South Africa's farmed mussels continue to face competition from imported mussels. A total of 443 tons of mussels were imported, doubling the quantity volume as compared to 2011. This increase could be attributed to increased import quantity from countries such as Chile, China and the recent imports by Mozambique. Imports from Chile increased by 130% to 98 tons compared the previous year, followed by China with 40.7% to 96 tons (Figure 51). In contrast, New Zealand's mussel exports to South Africa decreased by 26% to 82 tons from 2011. Table 20 demonstrates South Africa's imports of mussels by different countries.

Table 20. South Africa's imported mussels in 2012.

Species	Country	Imports quantity (tons)	Value (ZAR millions - FOB)
Mussels	Chile	98	2.73
Mussels	China	96	1.96
Mussels	Mozambique	167	0.85
Mussels	New Zealand	82	3.38
Total		**443**	**8.92**

Source: South African Revenue Services Statistics 2012

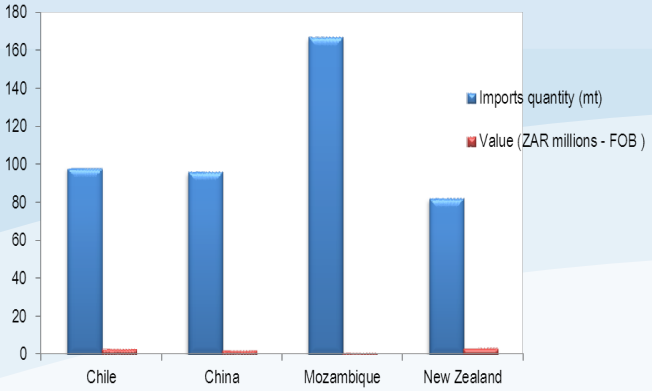


Figure 51. Countries of origin for South Africa's mussels imports in 2012.

7.9.3 Marine ornamentals

Different marine ornamental species were imported from more than 20 countries in 2012. The quantity imported was estimated at 211 tons valued at approximately R15.89 million. The main exporters for marine ornamentals were Singapore with 52 tons, Indonesia with 47 tons, Israel at 21 tons and Sri Lanka with just over 20 tons. Table 21 below illustrates total quantity of marine ornamentals imported by South Africa.

Table 21. South Africa's imported marine ornamentals in 2012.

Species	Country	Imports quantity (tons)	Value (ZAR millions - FOB)
Marine Ornamentals	Australia	0.02	0.06
Marine Ornamentals	Brazil	0.1	0.03
Marine Ornamentals	China	2.4	0.18
Marine Ornamentals	Colombia	2.2	0.12
Marine Ornamentals	Congo	0.2	0.09
Marine Ornamentals	Great Britain	1.5	0.7
Marine Ornamentals	Hong Kong	1.3	0.96
Marine Ornamentals	Indonesia	47	1.71
Marine Ornamentals	Israel	22	1.89
Marine Ornamentals	Japan	1.5	0.21
Marine Ornamentals	Kenya	12	0.37
Marine Ornamentals	Malaysia	0.2	0.13
Marine Ornamentals	Netherlands	0.7	0.38
Marine Ornamentals	Nigeria	1.3	0.11
Marine Ornamentals	Philippines	7.7	0.33
Marine Ornamentals	Singapore	52	5
Marine Ornamentals	Sri Lanka	21	1.2
Marine Ornamentals	Taiwan	14	1
Marine Ornamentals	Thailand	18	0.88
Marine Ornamentals	United States	2	0.33
Marine Ornamentals	Vietnam	3.6	0.21
Total		**210.72**	**15.89**

Source: South African Revenue Services Statistics 2012

7.9.4 Catfish

Vietnam was the only known country that exported catfish to South Africa during 2012. A total of 143 tons of Vietnamese catfish was imported. The estimated value of catfish imports was R3.4 million in 2012 (Table 22). Although the market for catfish is not well structured locally, the imported quantity could be interpreted as a potential market that needs to be developed and structured properly.

Table 22. South Africa's imported catfish in 2012.

Species	Country	Imports quantity (tons)	Value (ZAR millions - FOB)
Catfish	Vietnam	143	3.4
Total		**143**	**3.4**

Source: South African Revenue Services Statistics 2012

7.9.5 Tilapia

On average between 400 and 500 tons of tilapia is entering Africa on a monthly basis, mainly from China. The majority of this is destined for countries like Angola and the Democratic Republic of Congo to name a few. Approximately 50 to 60 tons per month are finding its way to South African fish traders and processors (Tilapia situation report, 2010). In 2012, a total of 745 tons of tilapia was imported by South Africa. The imported tilapia was mainly for value addition but also targeting the lower end of local fish consumers. China was the leading exporter with 478 tons, followed by India with 226 tons and lastly Zimbabwe 41 tons. Table 23, shows the quantity and value imported by South Africa from these three countries during 2012.

Table 23. South Africa's imported tilapia in 2012.

Species	Country	Imports quantity (tons)	Value (ZAR millions - FOB)
Tilapia	China	478	0.96
Tilapia	India	226	5.33
Tilapia	Zimbabwe	41	2.64
Total		745	8.93

Source: Data collected South African Revenue Services Statistics 2012

7.9.6 Trout

South Africa's trout sub-sector at times cannot supply the local market demand with trout throughout the year especially during the summer season. This resulted in South Africa importing in order to meet the required demand during those months. Approximately 554 tons of trout valued at R21.66 million was imported in 2012. Great Britain was the leading exporter with 225 tons, Norway with 222 tons, Chile with 107 tons and Denmark with less than 1 ton (Figure 52). The sub-sector faces competition from cheap imports which at times are dumped within the local market and this could have a negative impact on the price of the product for local farmers. In addition, trout and salmon are substitute products which also pose a threat for locally produced trout. Table 24 demonstrates the total quantity imported and value for trout in 2012.

Table 24. South Africa's imported trout in 2012.

Species	Country	Import quantity (tons)	Value (ZAR millions - FOB)
Trout	Chile	107	3.36
Tout	Denmark	0.05	0.51
Trout	Great Britain	225	8.77
Trout	Norway	222	9.02
Total		**554.05**	**21.66**

Source: South African Revenue Services Statistics 2012

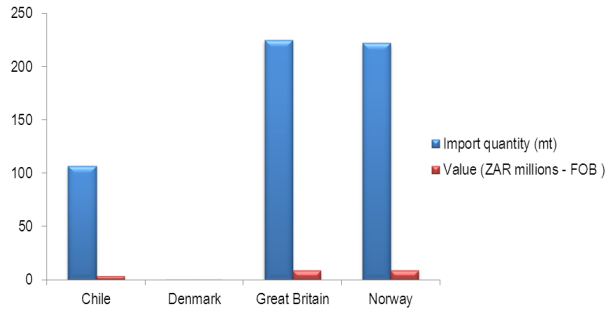


Figure 52. Countries of origin for South Africa's trout imports in 2012.

7.9.7 Salmon

The market for salmon is well-established in South Africa. It comprises of experienced and knowledgeable processors including a well-established value chain network. South Africa at the moment relies heavily on imports to supply the domestic market with salmon products. More than 2 000 tons of salmon products valued at R72 million were imported in 2012 (Table 25). The main exporters to the local market were Norway with 1 462 tons, followed by Faroe Islands with 203 tons and Great Britain with 196 tons. Demand for farmed salmon remains steady, despite the economic turbulence experienced in many developed markets including the sudden drop in salmon prices that was experienced world-wide around the second quarter of 2012 (FAO GLOBEFISH, 2012). This can be seen from Figure 53 below, which illustrates imported salmon by South Africa in 2012.

Table 25. South Africa's imported salmon products during 2012.

Species	Country	Imports quantity (tons)	Value (ZAR millions - FOB)
Atlantic Salmon	China	110	5.34
Atlantic Salmon	Great Britain	196	4.82
Atlantic Salmon	Norway	1462	54.96
Atlantic Salmon	Faroe Islands	203	1.24
Atlantic Salmon	Canada	1	0.14
Atlantic Salmon	Nigeria	4	0.02
Atlantic Salmon	Chile	71	3.04
Atlantic Salmon	United States	1	0.5
Atlantic Salmon	Ghana	0.01	0.08
Atlantic Salmon	Hong Kong	0.03	0.17
Atlantic Salmon	Thailand	0.03	0.8
Atlantic Salmon	Cameroon	0.32	0.2
Atlantic Salmon	Mauritius	16	0.71
Atlantic Salmon	France	0.03	0.18
Atlantic Salmon	Zimbabwe	0.42	0.21
Atlantic Salmon	Sweden	0.02	0.41
Total		**2064.86**	**72.82**

Source: Data collected by South African Revenue Services Statistics 2012

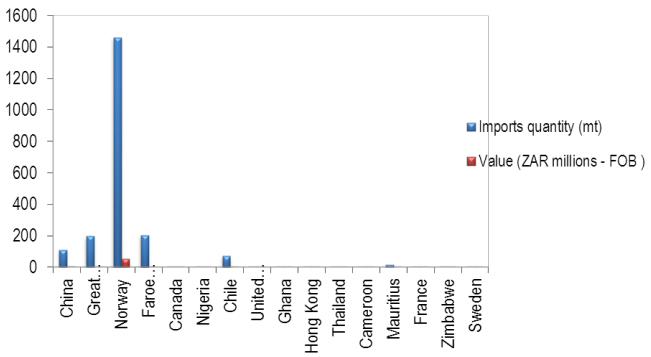


Figure 53. Countries of origin for South Africa's salmon imports in 2012.

7.10 Trade Balance

South Africa achieved a negative trade deficit with respect to volumes but maintained a positive trade surplus in terms of value, recording a net of trade of R289 million. According to data on Table 26, the total export volume for aquaculture products was estimated at 1 490 tons valued R422 million. Major export destinations for South Africa's exports were China, Hong Kong, Japan, Mozambique, and Zimbabwe which jointly accounted for more than 92% of the total export revenue. In addition, total import volume doubled that of exports at 4 177 tons with an estimated value of R132 million (Figure 54). The key sources of imports, which accounted for more than 90% for fish included Norway, Chile, Great Britain, China, Vietnam, Faroe Islands, Chile, Mozambique and New Zealand.

Table 26. South Africa's trade balance for 2012.

Trade	Quantities (tons)	Value (ZAR millions)
Exports	1490.49	422.1
Imports	4177.69	132.9
Total	-2687.20	289.20

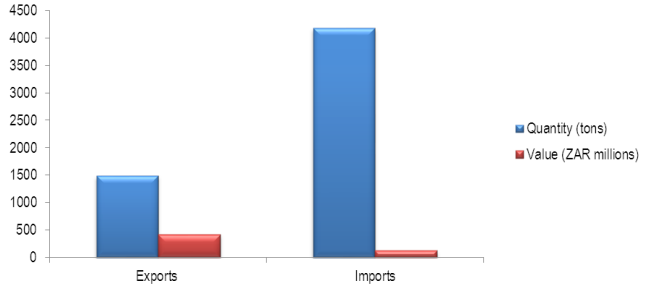


Figure 54. South Africa's trade balance for 2012.

8. AQUACULTURE RESEARCH AND DEVELOPMENT

8.1 Aquaculture Research and Technology Development Programme

Aquaculture is a knowledge and technology driven industry which relies heavily on research to develop new techniques, species and the efficient technology for sustainable commercial production. For the industry to be competitive there is a need to promote expansion and diversification of the sector. A research strategy to address the main focus areas of the aquaculture policy is a crucial enabler and has also recently been developed. There are several areas of aquaculture that require research support, including the development of new species, breeding, alternative feeds, improved production systems, environmental impacts of aquaculture operations, new culture technology focusing on local species, post-harvest technology, understanding markets' needs, food safety and animal health research. These research areas are of crucial importance for a competitive, viable and vibrant aquaculture industry.

In recognition of the fact that more needs to be done towards aquaculture research, the Department recently prioritized aquaculture by establishing a dedicated Aquaculture Research Unit. This unit is expected to drive the research direction and agenda for the country by implementing the Aquaculture Research and Technology Development Programme. The outcomes to be realised once the Programme is implemented include:

- Positioning South African aquaculture industry as a globally competitive sector;
- Direct and indirect contributions towards employment and gross domestic product (GDP);
- Contribution towards food security through increased production of fish products;
- Increased diversity of economic activities and skills base; and
- More efficient technology that will lower production costs and environmental impacts.

Currently there are more than 20 research projects undertaken by the Department in collaboration with the Universities and industry. For the current year of reporting, three main projects were identified are summarised:

8.2 An overview of aquatic animal health research at DAFF

Aquaculture development continuously brings new challenges to aquatic animal health that require varying degrees of governmental response. Diseases have been known to significantly disrupt the aquaculture sector, international trade and ultimately food security, but the impacts are more extensive and have social and financial consequences as well. Surveillance programs that focus on early detection of a pathogen, through the development of improved or novel diagnostic methods, combined with epidemiological research enable a rapid response to disease epizootics to prevent the spread and establishment of diseases in cultured and wild aquatic animal populations. Generating scientific information of this nature in support of biosecurity assessments is indispensable. Consequently, there are three main aquatic animal health focus areas within the Directorate of Aquaculture Research, namely (1) the development of novel methods for the diagnosis of new and emerging pathogens to provide accurate and reliable disease diagnosis for aquatic animals; (2) collection of epidemiological data for significant aquatic animal diseases in Southern Africa to inform management and contingency interventions; and finally (3) the development of effective preventative and treatment strategies for existing and emerging marine aquaculture diseases.

Despite the impact that diseases have on aquatic organisms, relatively little information exists about which pathogens affect fish and shellfish. This is of particular concern for the cultivation of indigenous fish and shellfish species in South Africa. Baseline taxonomic data for the pathogens responsible for existing and emerging aquatic animal diseases forms the foundation for disease diagnoses and applied epidemiology. Furthermore, this data is fundamental for effective disease management; the assessment of disease risks and impacts posed by the movement of aquatic animals; and the establishment of aquaculture facilities and aquaculture development zones. Accurate morphological, phylogenetic, and biological characterisation of aquatic animal pathogens and parasites are also essential for the validation of molecular diagnostic tools (Hoberg, *et al.*, 2002). A proactive approach toward aquatic animal health management has consequently been adopted by DAFF scientists and comprises the integration of baseline taxonomy and systematics of potential pathogens early on in the assessment of candidates for aquaculture. The relevant biologi-

cal and ecological requirements of pathogens posing the greatest risk to the culture of the respective host species are further elucidated, both naturally and within different culture systems and conditions, in order to develop and assess pathogen specific control measures and optimise the efficacy thereof. This approach has for example identified five monogenean genera from both dusky kob (*Argyrosomus japonicus*) and silver kob (*A. inodorus*). Of these, *Diplectanum sp.* have been found to be most prevalent in wild caught and captive populations of both kob species in South Africa. These parasites are known to cause significant pathology to the gills of their hosts due to their mode of attachment and feeding and the high infection intensities frequently encountered, especially in farmed kob populations. These pathogens have either directly or indirectly been associated with fish mortalities and are consequently regarded as a notable constraint to the captive husbandry of kob. We have shown that the completion of the life-cycle of *D. oliveri* (Figure 55A) is temperature dependant and eggs hatch spontaneously after approximately 4 days at 20-25°C (Figure 55B). Thereafter the emergent larvae or onchomiracidia actively seek out a host, migrate to the gills and produce eggs of their own from 12-19 days after hatching (Figure 55C). These data provide valuable information regarding potential windows of opportunity to strategise treatment interventions in order to ensure optimal exposure to susceptible life-cycle stages of the parasite, thereby increasing the likelihood of treatment success. Our data suggest that treatment interventions are unlikely to be effective in a single application and treatment success can be further augmented through appropriately timed follow up interventions.

Diagnostic tests that are rapid, reliable and highly sensitive are of the utmost importance for effective control of diseases in the aquaculture sector. Histopathology and transmission electron microscopy are techniques that are frequently used in the observation and diagnosis of aquatic diseases, but these techniques are often not sensitive enough to provide accurate and reliable diagnosis (Greeff, *et al*. 2012). Furthermore, these techniques are time consuming and require the use of highly specialized equipment as well as staff (Berthe, 2005). Remarkable improvements in the field of molecular biology, particularly DNA-based diagnostic techniques such as the polymerase chain reaction (PCR), have however revolutionized the detection, identification and enumeration of pathogens. PCR, and variations thereof, are based on the principle that every species carries unique DNA sequences, or signatures, which can be targeted in an assay to specifically differentiate it from other organisms (Berthe, 2005). Moreover, PCR based techniques offer the advantages of specificity, sensitivity and rapid diagnosis of disease agents in both clinically and sub-clinically infected animals (Greeff, *et al*., 2012).

Real-time quantitative PCR (qPCR) and loop-mediated isothermal amplification (LAMP) are two variations of PCR that are currently utilized or under development in our laboratory and offer the advantages of high specificity and sensitivity. Unlike conventional PCR, qPCR allows for the amplification and simultaneous quantification of target DNA and provides early, sensitive and specific confirmation of a disease. We have, for example, developed a qPCR assay for the Peronsporomycete *Halioticida noduliformans* (Macey, *et al*., 2011), the causative agent of tubercle mycosis in farmed abalone (Figure 56A, B). We have demonstrated that qPCR can specifically detected *H. noduliformans* in a mixed genomic DNA background and no cross-reactivity has been observed for related and non-related fungi isolated from seaweeds, crustaceans and healthy abalone (Greeff, *et al*., 2012). Furthermore, qPCR detected less than 2.3 *H. noduliformans* spore equivalents in fresh, frozen and ethanol-fixed tissues, clearly demonstrating the sensitivity of this method. The disadvantages of this technique are that it requires specialized equipment and training to perform the reactions. LAMP, on the other hand, is a nucleic acid amplification method that amplifies target DNA with high specificity, efficiency and rapidity under isothermal conditions (Saito, 2005). This eliminates the need for specialized equipment (thermal cyclers) or expertise. LAMP products can also be detected without electrophoresis using ambient light after the addition of a number of DNA dyes to the reaction tube (Figure 56C). Furthermore, since this assay uses a set of four specifically designed primers that recognize a set of six distinct sequences, the reaction is highly specific and purported to be more sensitive than qPCR (Notomi, *et al*., 2000). LAMP primers have been designed for *H. noduliformans* as well as *Aphanomyces invadans,* the causative agent of epizootic ulcerative syndrome (EUS) of freshwater fish. Reaction specificity and sensitivity are currently being determined and will be compared with other diagnostic methods currently utilized for each respective disease.

In addition to the paucity of information on the identity of pathogens affecting indigenous aquacultured species in South Africa, relatively little is known about how cultured organisms fight diseases and what can be done to prevent and treat diseases. High stocking densities typically associated with aquaculture, together with other farming practices, cause significantly raised stress levels, alter the composition of the indigenous protective flora and consequently increase an organisms susceptibility to pathogens (Macey, *et al*., 2005). Methods to enhance disease resistance of cultured organisms and a better understanding of the effects of the environment on host-pathogen interactions is of paramount importance to disease management on farms. To this end, we have developed a bacterial clearance assay for abalone whereby live bacteria (green fluorescently labelled with antibiotic selective markers) are injected into abalone and their clearance and inactivation is monitored in real-time, using selective plating and/ or PCR, under varying environmental conditions. We have shown that healthy abalone are very efficient at dealing with an infection and are currently monitoring the effects of varying temperature as well as diet on the ability of abalone to clear injected bacteria, hence providing an assessment of their health (Figure 57A, B). Simultaneously, other immune (phagocytosis, total haemocyte counts) and physiological (blood glucose, tissue glycogen, gut pH, etc.) mechanisms as well as gene (heat shock protein (HSP70) gene/ biomarker) responses are being assessed to evaluate the whole-organismal response to different stressors. The effects of beneficial bacteria as well as yeasts (probiotics) on the health of cultured abalone and dusky kob are also being assessed as an alternative to the use of drugs and antibiotics for the alleviation of certain diseases.

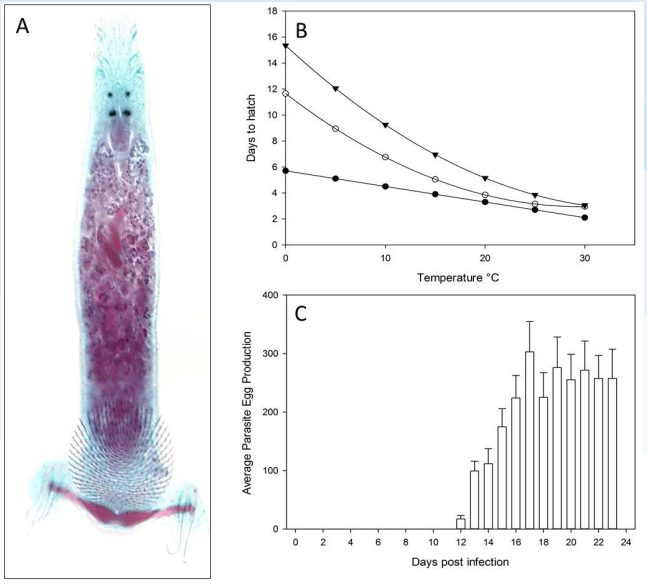


Figure 55. (A) Light micrograph of *Diplectanum oliveri*. (B) Effect of temperature on *Diplectanum oliveri* egg embryonation and hatching. • - Beginning of hatch, o- 50% of eggs hatched, ▶ - End of hatch. (C) Average egg production of *Diplectanum oliveri* from hatching (Day 0) through infection (~day 3) to initial egg production (Day 12) to sustained egg production (from day 16).

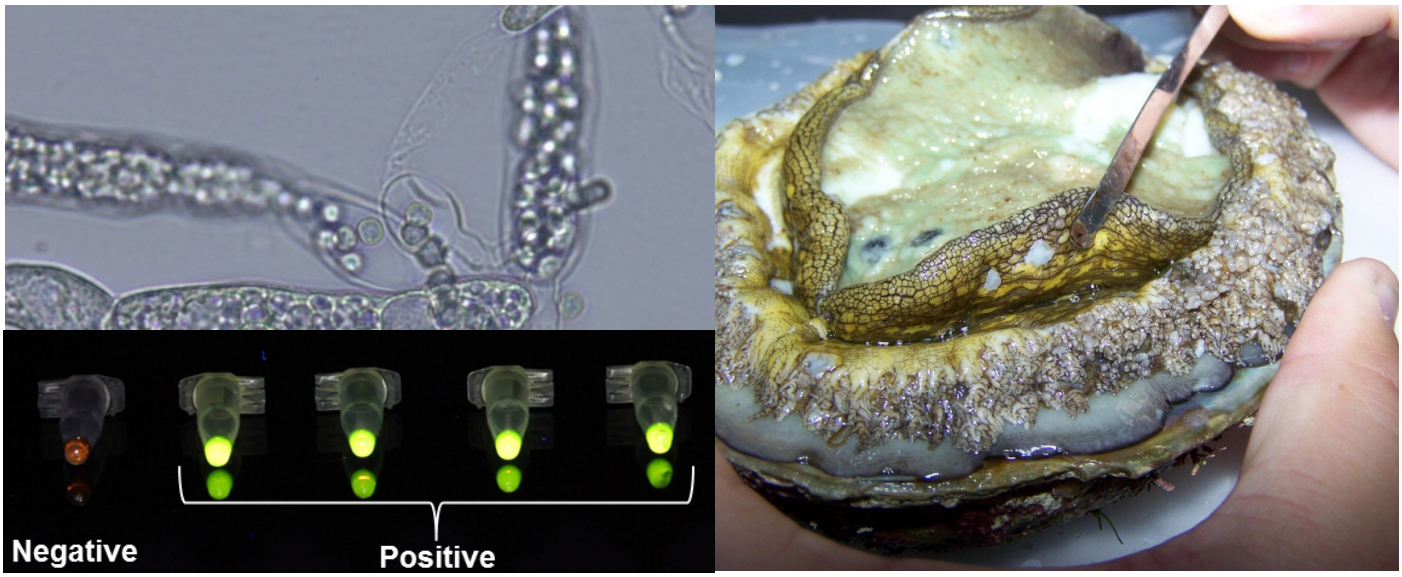


Figure 56. (A) Light micrograph showing a typical aseptate, branched hyphae of Halioticida noduliformans with a discharge tube releasing motile zoospores. (B) Haliotis midae exhibiting typical clinical lesions of tubercle mycosis caused by H. noduliformans. (C) LAMP reaction results showing a positive reaction for tubes containing H. noduliformans DNA (green) and a negative reaction (orange) following staining with SYBR green and UV light exposure.

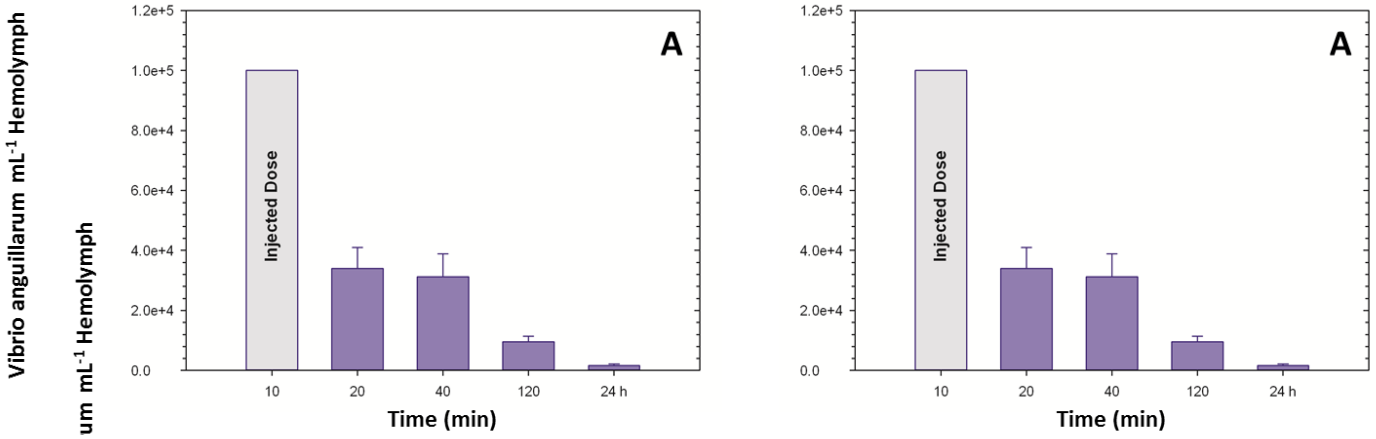


Figure 57. (A) The mean number (±SE) of culturable Vibrio anguillarum recovered from the hemolymph (blood) of healthy abalone injected with 1×105 bacteria. Results indicate that more than 60% of injected bacteria are inactivated within 20 min by healthy abalone maintained at 16 °C. (B) Mean number of culturable bacteria recovered from the hemolymph of abalone (30 min post-injection) fed either Abfeed® or fresh Ulva spp. Abalone fed Ulva spp. inactivated bacteria more rapidly, suggesting that they are healthier.

8.3 Finfish Aquaculture Research at DAFF

The efficiency of the primary brood stock, grow-out and hatchery systems at the Marine Research Aquarium (Sea Point) were evaluated and it was concluded that all these systems would require substantial upgrading to comply with the stringent physico-chemical parameters required to undertake research programs. The systems include the double tank brood stock unit (24m^3), the 20-tank hatchery (12 m^3) and the 4-tank grow-out (16 m^3) system.

The period prior to upgrading was utilized to focus on three research programs:

8.3.1 Dose-dependent effect of commercially utilised chemotherapeutants on juvenile (160–400 g) dusky kob (Argyrosomus japonicus)

Tests included dip, bath and indefinite treatment procedures that will have significant value in industry applications. The latter include quarantine, prophylactic and therapeutic treatment protocols. A summary of treatment procedures and outcomes are as follows:

Most of the selected chemotherapeutants and/or the application dosages were novel for dusky kob (Argyrosomus japonicus) in marine water. Higher than normally used dosages were tolerated well by test animals and should have potent prophylactic and therapeutic efficiency during quarantine holding strategies. Dip treatments should be particularly useful when fish are transferred to the quarantine facility. Juvenile kob tolerated dip treatments when exposed to potassium permanganate (20 ppm for 60 seconds), sodium chloride (115 ppt for 60 seconds) and Trichlorfon (500 ppm for 15 minutes). Bath treatments (24 h) were also tolerated well during applications with respective combinations of Acriflavin (5 ppm) and methylene blue (4 ppm), Acriflavin (5 ppm) and malachite green (0.1 ppm), which effectively removed gill-dwelling protozoans. Bath treatments (24 h) with single agents such as methylene blue (8 ppm), quinine hydrochloride (10 ppm) and Trichlorfon (1 ppm) were also well tolerated by juvenile kob. A one hour bath with formalin (300-400 ppm) at 21 °C cleared all ectoparasites on test animals. Bath treatments (4 h) using Chloramine T at 5 ppm (water pH = 7.0) and 10 ppm (water pH = 8.2) will be useful for the quarantine treatment of kob. This investigation demonstrated in particular that three chemotherapeutants were efficient in clearing gill fluke (Diplectanum oliveri) from treated animals. Trichlorfon (1 ppm for 24 hours), formalin (300 – 400 ppm for 1 hour) and dietary Nitroscanate (0.6-1.2g/kg food - 24 hours) were effective in destroying (eradicating) gill flukes. The latter treatment should be an effective method to control epizootic gill fluke infestations specifically in cage culture operations, but should be registered first for such use. Further investigation is required to determine if sick infected kob will tolerate the treatment dosages applied.

8.3.2 Implementation of an experimental design to condition broodstock dusky kob (Argyrosomus japonicus) to pre-spawning status, followed by artificially induced spawning

Dusky kob breeders were subjected to a four month conditioning period under controlled photo-thermal conditions. The photothermal changes during the four month conditioning period were a compressed version of similar changes that occur annually within the natural habitat of this species. The four month photo-thermal program successfully conditioned dusky kob breeders to pre-spawning status as reflected by egg cannulation data and induced spawning success. More than 2.4 million floating, fertilized eggs were collected and about 2.3 million were donated to industry growers of dusky kob (viz. Oceanwise and Blue Cap Trading). The progeny of this spawning session are considered as F2 offspring and the growth and survival of this fish will be compared with the performance of F1 offspring produced independently by industry.

The remaining eggs of the above-mentioned spawn were allowed to hatch and the larvae reared on a feeding program which successively included live feed such as rotifers (Nannochloropsis enriched) and Artemia. The fry were weaned with high quality imported and graded food granules (55% protein) from day 30 post hatching. The fry were subjected to weekly handling in order to capture morphometric data but such activities were detrimental to the survival of the fragile developmental fish. Subsequently significant losses were suffered in an effort to obtain data on the mass, length and weight relationship of kob fry and larvae. This relationship will be a valuable tool for the industry to determine food ration and fish growth performance by using less invasive methods like body length to determine approximate mass in order to adjust feeding programs which are based on percentage body mass feeding per day.

Rotifer and algae (Nannochloropsis oculata) were successfully produced in semi-continuous batch cultures to feed kob fry until weaning. Rotifers graze on the algae and the synchronized production between this species ensured maximal nutritional value of the former which is then fed to fish fry. Green water culture of fish fry gave the best results in terms of growth and survival and required the addition of excess algae to the fish culture water that was continuously stocked with approximately 10-15 rotifers per ml.

8.3.3 Investigation into the use of macro algae in diets for dusky kob

Some species of seaweed are generally rich in vitamins, mineral and dietary fiber and should hypothetically contribute as a supplemental additive in cheaper formulated fish diets. A green macro-algal seaweed classified as Ulva lactuca was tested as formulated diet additive to determine the influence thereof on growth performance, nutritional quality and carcass fatty acid composition of dusky kob (Argyrosomus japonicus) (Figure 58). A 90 day trial was conducted in the DAFF Marine Research Aquarium and fish with an initial average mass of 48g were used. A formulated fishmeal based diet was used in three trials that incorporated 0% (control), 2.5% or 5% Ulva respectively. Water quality parameters measured were temperature (20 °C -24 °C), salinity (35.5 ‰) and pH (5.84 mg/l - 6.98). Fish fed the 5% dietary Ulva inclusion grew by comparison significantly faster and reached an average mass of 170 g at a low FCR (0.84) within 90 days. Also, this diet mediated the highest content of n-3 fatty acid in fillet tissues. Ulva included diets caused the highest waste accumulation in the effluent of experimental tanks. Further investigation is therefore required to increase the bio-availability of Ulva in refined food formulations to prevent pollution in intensive production systems. However, the current application may favor the increased large scale extensive pond production of dusky kob since fecal waste stimulates planktonic blooms which can be utilized as live food.

Figure 58. Seaweed Ulva lactuca collected for study

8.4 Optimising oyster culture in South Africa

South Africa has a 29-year history of Pacific oyster culture with a maximum production of 8 million oysters in 1991. Twelve commercial oyster farms were operational in South Africa in 2011. These farms import oyster spat and seed from Namibia, Chile and the United States for grow-out on longlines (Figure 59), a practice that carries substantial environmental risk through importation of bivalve pathogens and invasive alien species. Although growth of the Pacific oyster has been well studied worldwide few studies have been undertaken locally and little is known of the suitability of different sites on the South African coast for the culture of this species. In 2010, a joint project led by the University of Stellenbosch, was initiated in an effort to optimize oyster growth in South Africa through genetic and environmental assessment. As part of this study the growth and condition of different oyster cohorts imported from the United States and from Chile was compared at 3 sites on the South African coast: two sea-based farms, one in Algoa Bay and another in Saldanha Bay, and a land-based farm at Kleinzee in the Northern Cape (Pieterse et al., 2012).

Figure 59. The Pacific oyster Crassostrea gigas cultured on longlines in Saldanha Bay where growth rates are reported to be among the fastest in the world (Pieterse et al., 2012).

Oyster growth rate and condition were related to observations of sea temperature and phytoplankton biomass on farms. Growth rates expressed as live or dry mass gains were 2-10 times higher than those reported elsewhere in the world and dry weight condition indices were also high. The environment influenced growth rate to a much greater extent than oyster origin. Dry meat mass gain and condition were highest for oysters in Saldanha Bay, with high food availability offsetting the advantages of the warmer Algoa Bay site (Figure 60). Interestingly, oysters in the bottom layers of the cages grew significantly faster than those in the top layers, particularly in Saldanha Bay, possibly reflecting the development of subsurface phytoplankton biomass maxima under stratified summer conditions. Phytoplankton biomass was 2-6 times higher in Saldanha Bay and for this reason Saldanha Bay was considered the best of the 3 locations in producing market-ready oysters. Oysters in Algoa Bay demonstrated fast growth but oysters were lean, as were oysters from Kleinzee which generally yielded the lowest growth. However, good shell growth and high shell density for spat at this locality in winter and early spring confirm that its use as a nursery is appropriate at this time of the year.

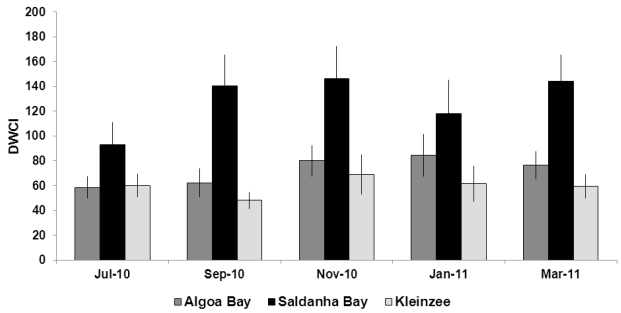


Figure 60: Dry weight condition index [DWCI] for oysters grown in Algoa Bay and Saldanha Bay, and on a land-based farm at Kleinzee in the Northern Cape. The consistently higher DWCI for Saldanha Bay oysters was attributed to higher food availability (Pieterse et al., 2012).

9 AQUACULTURE ENVIRONMENT INTEGRITY

9.1 Environmental Integrity Framework for Marine Aquaculture

The Environmental Integrity Framework (EIF) for Marine Aquaculture was finalised in 2012 and consisted of a detailed document as well as a summary version. The EIF is a source of information for aquaculture investors to manage the potential environmental impacts of their operations and further serves as a tool for governmental decision-makers and other interested stakeholders.

9.2 Biodiversity Risk and Benefit Assessment for Alien Species of Aquaculture

The Biodiversity Risk and Benefit Assessment (BRBA) for Alien Species of Aquaculture was finalised in December 2012 and seven species profiles were produced in order to promote the consideration of the appropriateness, and (if appropriate), the effective management of specific alien species used in aquaculture, and to ultimately contribute to the ecologically sustainable development of the sector. The Department reformatting the species profiles to produce a single

document which meets the requirements of the Department of Environmental Affairs (DEA) for a Risk Assessment as stipulated in the National Environmental Management: Biodiversity Act (NEMBA).

It is envisioned that the BRBA's can be utilised by potential investors as part of their permit application for authorisation to farm an alien species in South Africa. It should however, be noted that NEMBA does not make provision for conducting national risk assessments. The site specific details may still be required by the applicant as part of the approval process by the DEA.

9.3 Aquaculture Environmental Impact Assessments

The construction of new aquaculture operations as well as the expansion of existing aquaculture operations frequently trigger an environmental assessment as required by the National Environmental Management Act's Environmental Impact Assessment (EIA) regulations (as amended). The level of environmental assessment required is dependent upon the nature, production capacity and type of activity. Further information regarding the EIA as it relates to aquaculture is contained in the EIA Guideline for Aquaculture in South Africa (DEA, 2011). The Directorate: Sustainable Aquaculture Management (SAM), Sub-Directorate Aquaculture Animal Health and Environmental Interactions renders technical advice regarding EIA's. The Sub-Directorate also provides review and comment EIA's for aquaculture operations and any developments that may have an adverse impact on existing aquaculture farms.

9.4 Undertaking Environmental Impact Assessments for the establishment of Aquaculture Development Zones

The Department aims to create an enabling environment to facilitate the development and growth of the South African aquaculture sector through the establishment of Aquaculture Development Zones (ADZ's). The locations of ADZ's are based on the availability of state-owned land, as well as suitable sea-space conducive to the cultivation of various aquaculture species, in and along coastal provinces. These suitable areas are subject to undergoing EIA processes and receiving Environmental Authorisation prior to being declared as ADZs.

In 2012, the Qolora land-based ADZ in the Eastern Cape received a positive Environmental Authorisation from the Department of Economic Development, Environmental Affairs and Tourism and will be the first established ADZ once relevant infrastructure has been installed. The authorisation contained a number of requirements that needed to be completed in prior to the construction of basic infrastructure. The Department is currently in the process of appointing a suitable qualified consultant to undertake the work required and meet the stipulations.

In 2012, the Department appointed a qualified independent Environmental Assessment Practitioners (EAP's) to undertake the Environment Impact Assessment for the proposed Buffer-Isrivier ADZ in the Western Cape. Unfortunately, after consultation with various stakeholders and a vegetation assessment, the EIA process was cancelled due to outcomes of the vegetation assessment that rendered the area as not suitable for aquaculture due to it being a highly sensitive area with endemic flora.

The EIA process for the establishment of a Sea-based ADZ in the Eastern Cape is currently being conducted by an independent qualified EAP. The EIA is in its final stages and awaits a decision from national Department of Environmental Affairs for an outcome. The availability of suitable sea-space for the establishment of sea-based aquaculture operations was refined through conducting a Strategic Environmental Assessment (SEA). The SEA site selection methodology made use of quantitative criteria that were developed in conjunction with key industry, academic and government stakeholders. Areas not suitable in terms of the identified criteria were eliminated and depicted using Geographic Information System software. The SEA for identification of potential marine aquaculture development zones for fin fish cage culture (DAFF, 2012) is available for download on the Departmental website.

10 STAKEHOLDER ENGAGEMENTS

10.1 Aquaculture Stakeholder Engagement Forums

As in many sectors, stakeholder involvement plays a crucial role in sector development. The DAFF has identified several forums to serve as vehicles that need to drive the activities related to the aquaculture sector. The forums are focused and specialized to allow specific deliberations regarding the industry. To allow industry to provide input and communicate specific challenges they are experiencing, two forums were identified, that is the Marine Aquaculture Industry Liaison (MAIL) and Freshwater Aquaculture Industry Liaison (FAIL). Both these forums are chaired by the DAFF.

Aquaculture sector development is led by the DAFF and several government Departments in all spheres of government. National and provincial government plays a crucial supporting role. The roles of other government Departments in the sector needed to be coordinated to minimize duplication of efforts and to align activities towards one government goal and position on aquaculture development. To address this, two important forums have been formed on a national and provincial level, that is Aquaculture Intergovernmental Forum (AIF) and Provincial Aquaculture Intergovernmental Forum (PAIF) and both forums are chaired by the DAFF.

10.2 Marine Aquaculture Industry Liaison

The MAIL consists of Marine Aquaculture Rights and Permit Holders representatives, the DAFF under the Branch: Fisheries includes all Chief Directorates within the Branch, i.e. Aquaculture and Economic Development (AED) as a lead Chief Directorate; Fisheries Research and Development (FR&D); Monitoring, Control and Surveillance (MCS) and Marine Resources Management (MRM); and the Department of Environmental Affairs (DEA), Branch: Oceans and Coasts. The forum had four meetings during 2012 and discussed strategic programmes that are aimed at industry development. The issues for discussion include the harmonization of Marine Aquaculture and Wild Fisheries permit conditions; Aquacul-

ture Information Management System (AIMS); SAMSM&CP; NASF; Export Health Certification; European Union regulations related to bio-toxins; Animal Health Services; DEA's Coastal Waters Discharge Permit Regulations; Health Certification for Algoa Bay oyster farms; Finfish monitoring working groups; Best Management Practices (BMP) for Marine Aquaculture; and Guidelines ASP testing in abalone Local Sales Permit Applications.

10.3 Freshwater Aquaculture Industry Liaison

The Freshwater Aquaculture Industry Liaison (FAIL) is a forum which will be established in the next financial year. It will provide a platform for industry to engage and communicate with government on issues that affect the freshwater aquaculture industry. Its members will be DAFF officials from relevant Chief Directorates such as Fisheries Research and Development, Aquaculture and Economic Development, Monitoring Control and Surveillance, and Freshwater Aquaculture industry members.

10.4 Aquaculture Intergovernmental Forum

Aquaculture Intergovernmental Forum (AIF) was established to ensure better communication amongst national government Departments that have a mandate in aquaculture management and development. This forum is led by the DAFF and its main objective is to provide better management and development of the sector through joint facilitation, planning, coordination, resource mobilization, monitoring and evaluation. In addition, the AIF ensures oversight for aligned implementation and reporting of all key programs of Government in order to achieve sustainable aquaculture development in the country. The targeted participants for the AIF are key national government Departments that have a role to play in aquaculture management. State-owned entities (SOE) and affected provincial Departments are invited when need arises. AIF participants included DAFF as the lead agent for aquaculture development; Department of Trade and Industry (**the dti**), Department of Science and Technology (DST); the Department of Environmental Affairs (DEA) and the Department of Water Affairs (DWA).

During 2012, four meetings of the AIF took place and the participants included DAFF as the lead agent for aquaculture; Department of Trade and Industry **the dti**, DST; the DEA and the DWA. The main deliverables that resulted from the forum included the following; The AIF continued with the joint implementation of the projects identified in the NASF Implementation Plan projects. These projects include the finalization of ADEP, the continuation of the Aquaculture Guideline project, the continuation of the Aquaculture Development Zones Programme, the finalization of IPAP interventions.

10.5 Provincial Aquaculture Intergovernmental Forum

Provincial Aquaculture Intergovernmental Forum (PAIF) was established to ensure coordination between the aquaculture programmes within both national and provincial Governments especially with Freshwater Aquaculture being a concurrent function and shared mandate. The PAIF is also a key platform to information sharing and providing directions to the provincial Departments. Target stakeholders of the forum include DAFF, provincial Departments that have a role to play in aquaculture development.

During 2012, two meetings were held, one in the North West and the other in Mpumalanga. During 2012 the DAFF reported to the provinces on key aquaculture projects that are being implemented at the national level as guided by the NASF, such as the Aquaculture Development and Enhancement Programme, Biodiversity Risk and Benefit Assessment project, the 6th FAO COFI Sub-committee on aquaculture that took place in the country. The provincial Departments updated each other and the DAFF on the current aquaculture sector development activities, the existing capacities and those that are required to achieve the set goals as well as challenges currently being faced in the province. The Forum proposed recommendations on how to overcome the challenges that were hampering aquaculture development in each province.

10.6 Aquaculture Investment and Policy Dialogue

The Aquaculture Investment and Policy Dialogue (AIPD) provided a platform for interested and affected stakeholders to have a policy dialogue and discuss what should be contained in the new Aquaculture Policy for South Africa. The financing institutions and the Departments also had an opportunity to present their financing products that are aimed at supporting the aquaculture sector. The sector associations from the different aquaculture sub-sectors also had an opportunity to present their sub-sector profiles to assist the representatives from the finance institutions to have a clearer understanding of the different aquaculture sub-sectors. Overall, the event was also aimed at information sharing.

The event was open to all interested and affected stakeholders such as government Departments, investors, researchers, aquaculturists, policy developers, finance institutions, research institutions, academia, science councils and industry representatives.

This event was held in Durban, Balitto, from 4th to 5th October 2012 and was very successful. Day one of the AIPD event focused on aquaculture investment related issues and the discussions included eliciting, attracting and directing of investment(s) that will lead to increased production, employment and geographical spread which will contribute towards economic growth and development. The key note address was provided by Professor Peter Britz from Rhodes University, focusing on *"Past and future scenarios in Aquaculture towards vision 2020"*. Six aquaculture sector representatives (Marine finfish, trout, mussels and oysters, abalone, Catfish and Ornamentals) provided the current status of the sub-sectors and investment opportunities. The DFIs and government financing and funding programmes presented the current funding opportunities and the possibilities of funding aquaculture initiatives. They also briefly outlined processes that need to be followed to access finance and funding opportunities that they provide and qualifying criteria.

The Investment Sessions created a platform for exposure to all interested parties, unlocked the potential for investment opportunities in South Africa's aquaculture sector, and facilitated information sharing regarding the sector. In addition, the event created an opportunity for investors, aquaculturists and policy makers to meet and discuss issues which are currently affecting the growth and development of the sector.

The second day focussed on policy issues and it started on a high note with Prof Kevern Cochrane (a former Director of Fisheries at the FAO, and now Honorary Professor at Rhodes

University) being the guest speaker talking about *'Developing an aquaculture policy in South Africa: key issues and trends'*. Prof Cochrane, who is an international expert on managing fisheries and aquaculture emphasized on the need to adopt an ecosystems approach to aquaculture, the need to implement the FAO Technical Guidelines on Aquaculture Certification and the need to strengthen governance in the aquaculture sector. An open discussion on issues that should be considered in the new aquaculture policy followed. The participants suggested that there is a need to have a Developmental Aquaculture Policy that addresses issues relating to aquaculture legislation, land tenure/sea space leases, the inclusion of vulnerable groups into the aquaculture sector, clarifying institutional arrangements, the need for clear integrated permitting/authorizations process, need for aquaculture zones and the need to address issues relating to access to finance.

The AIDP ended on a high note with participants providing recommendations to senior managers within DAFF on policy direction and possible developmental aspects of the sector. Amongst other recommendations, it was clear that Aquaculture Awareness is still lacking and the current awareness approach by DAFF and its partners should be strengthened to address rural and fishing communities in the country.

10.7 Aquaculture Value Chain Roundtable

The Aquaculture Value Chain Round Table (AVCRT) aims to strengthen industry-government partnerships. It is a platform used by the government to consult with industry on issues/challenges that affect the aquaculture sector throughout the entire aquaculture sector value chain. The aim is for government to engage collectively with representatives of the aquaculture sector and identify solutions aimed at developing the sector. Representatives from all relevant stakeholders throughout the aquaculture value chain including hatchery representatives, producer representatives, universities, government Departments, relevant Councils, (such as the National Marketing Council), fish processors, wholesalers and feed manufacturers.

During 2012 the AVCRT met twice. The Forum engaged on issues affecting the aquaculture value chain. Some of the major issues that were discussed include the SASSI Aquaculture Initiatives, ADEP, the Aquaculture Market Analysis and Development Programme, the need for an Aquaculture Export Council. One working group was established to deal with Marketing and Labour issues.

11 AQUACULTURE PROJECTS

11.1 DAFF Projects background

Globally, most wild capture fisheries are peaking at their maximum sustainable yields and the only real growth avenue for fisheries is aquaculture. It has become a sustainable alternative in fulfilling the increasing world seafood demand. The Department of Agriculture, Forestry and Fisheries (DAFF) is currently implementing a number of community based aquaculture projects that are aimed at increasing aquaculture production, large scale job creation, empower local communities through skills development and technology transfer. The National Aquaculture Strategic Framework (NASF) has been developed to *"provide guidance to DAFF and its partners as it identifies the much needed government interventions and support measures which will facilitate the removal of constraints and create an enabling environment for the development of an equitable, diverse, viable, competitive and sustainable aquaculture sector"*

The projects are in line with the DAFF's NASF and recently approved NAPF which promotes sustainable job creation and increased investment in the aquaculture sector. The projects are supported by other key policies such as New Growth Path, Industrial Policy Action Plan, Comprehensive Rural Development Plan and National Development Plan which enhance sustainable development of various economic sectors such as aquaculture.

A number of projects are implemented at a national level that contributes to and embraces economic growth, job creation, rural development, sustainable use of natural resources and food security. These projects include projects located in the Eastern Cape and Free State provinces as highlighted below.

11.2 Eastern Cape Development of Processing Facilities (Hamburg Aquaculture Project): Hamburg, Eastern Cape

Aims of the project are to revitalise an existing oyster farm, construct a 20 ton dusky kob pilot farm and undertake an Environmental Impact Assessment (EIA) study for a 1 000 ton dusky kob commercial farm. The status quo of the project is that the oyster farm has been revitalised and is currently operational (Figure 61). Infrastructure development for kob pilot project has been completed (Figure 62) and the EIA report submitted for final comments and inputs from the competent authority.

Figure 61. Project workers maintaining the oyster racks in Hamburg, Eastern Cape.

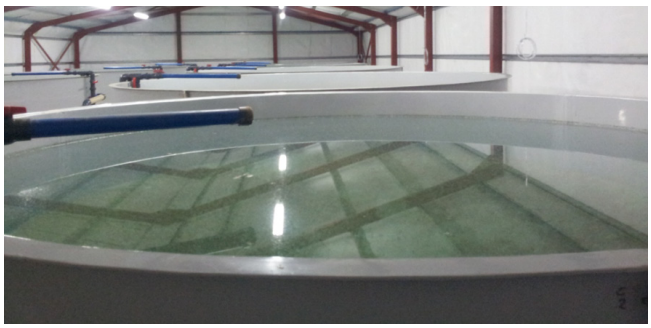


Figure 62. Recirculation Aquaculture System for dusky kob pilot farm in Hamburg, Eastern Cape.

11.3 Camdeboo Satellite Aquaculture Project: Graaf-Reinette, Eastern Cape

The aim of the project is to establish a catfish central farm which will support satellite farms. In 2012, training of beneficiaries was undertaken; EIA approved and Environmental Authorisation obtained; pilot project operational and the central farm infrastructure development initiated (Figure 63).

Figure 63. Camdeboo Satellite Aquaculture Project in Graaf-Reinette, Eastern Cape.

11.4 China-South Africa Agricultural Technology Demonstration Centre: Gariep Dam, Free State

The aim is to establish an aquaculture demonstration centre. To date the construction phase is completed and the administration process for the operation phase is underway (Figure 64 and 65).

Figure 64. China-South Africa Agricultural Technology Demonstration Centre at the Gariep Dam, Free State.

Figure 65. Flow through system in the hatchery.

11.5 Provincial Aquaculture Projects

The provincial Departments of Agriculture are implementing a number of projects through the Illima-letsema fund, CASP and other means. The Western Cape projects focus on both marine (oysters, mussels and abalone) and freshwater (trout) aquaculture sub-sectors. Other provinces such as Limpopo, Free State (Figure 66), Gauteng, North West and Mpumalanga only focus on the freshwater aquaculture and the species that are currently farmed are tilapia, trout and catfish.

Figure 66. Catfish farm in Koffiefontein, Free State.

11.6 Public Understanding of Aquaculture Project in partnership with the United Nations Food and Agriculture Organisation (FAO)

The DAFF is currently implementing a project called "*Public Understanding of Aquaculture*" in partnership with the FAO through the Technical Cooperation Programme Facility (TCPf) (Figure 67). The project is aimed at developing and improving a series of documents that provide information on: Market analyses with a focus on freshwater systems/species; Public Understanding of Aquaculture (PUA); and enhanced aquaculture monitoring and evaluation mechanisms including expanded databases linked to a GIS that provides for improved reporting and monitoring of the industry.

12 TRAINING AND CAPACITY BUILDING IN 2012

12.1 Training and capacity building overview

This section outlines training and capacity building programmes and initiatives for the year 2012. Officials within the DAFF, other Departments and private sector participated in various training programmes through a cooperation agreement that was signed with the People's Republic of China in 2006. The agreement was supported by the development of an action plan in the field of Aquaculture with the aim of building capacity and skills development in aquaculture. This section focuses on training courses that were offered from April -August 2012. The courses are outlined below.

12.2 Training Course on Aquaculture for Developing Countries, China, Wuxi, 20th April – 14th June 2012

The training course on aquaculture for developing countries took place in Wuxi, China from the 20th April to the 14th June 2012. Forty five (45) participants attended the course, countries included South Africa, Democratic People's Republic of Korea, Sri Lanka, Nepal, Vietnam, Palestine, Iraq, Egypt, Guinea-Bissau, Ghana, Cameroon, Malawi, Mozambique, South Sudan, Sudan, Sierra Leone, Uganda, Uruguay, Samoa, Tonga and Vanuatu (Figure 68). The training course consisted of lectures, practicals and study tours which focused on key areas such as:

- Development of Chinese aquaculture;
- Induced breeding of major carps;
- Farm design;
- Fish nutrition and feeding technology;
- Polyculture; and
- Integrated fish farming.

Practicals on feed formulations were conducted and several study tours were undertaken to various farms and feed processing facilities as part of the course.

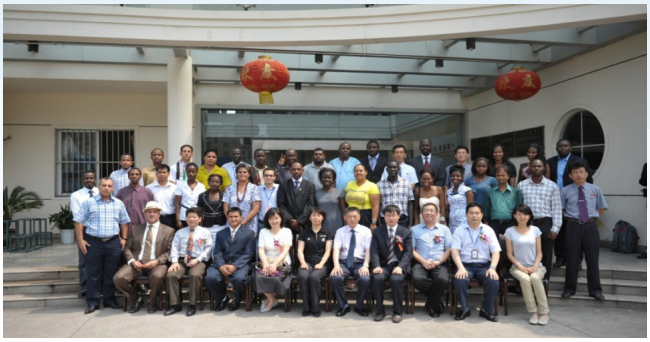


Figure 68. Participants of the training course on aquaculture for developing countries, 20 April to 14 June 2012.

12.3 Training Course on Mariculture for Developing Countries, China, Xiamen, 6th June – 31st July 2012

The course took place at the Fu Jian Institute of Oceanography, a scientific research facility in Xiamen, which is a Special Economic Zone (SEZ) adjacent to the Chinese South East coast from 6th -31st July 2012. The sector manager for aquaculture in the East London Industrial Development Zone (ELIDZ) was invited for the training with the primary aim of exchanging aquaculture sector development models and investment attraction in the context of an IDZ. Modules offered included:

- Introduction on Chinese Economy and Trade Status;
- Survey of Mariculture in China;
- Abalone, shrimp, grouper, oyster, golden pomfret, tilapia, flounder and tongue sole Culture Techniques;
- Living Food Organisms and their Cultivation,
- Aquatic Feed Production Techniques Promoting the Economy through Science & Technology; and
- Disease Occurrence and Control Strategy in Marine Organisms and Water Quality Management.

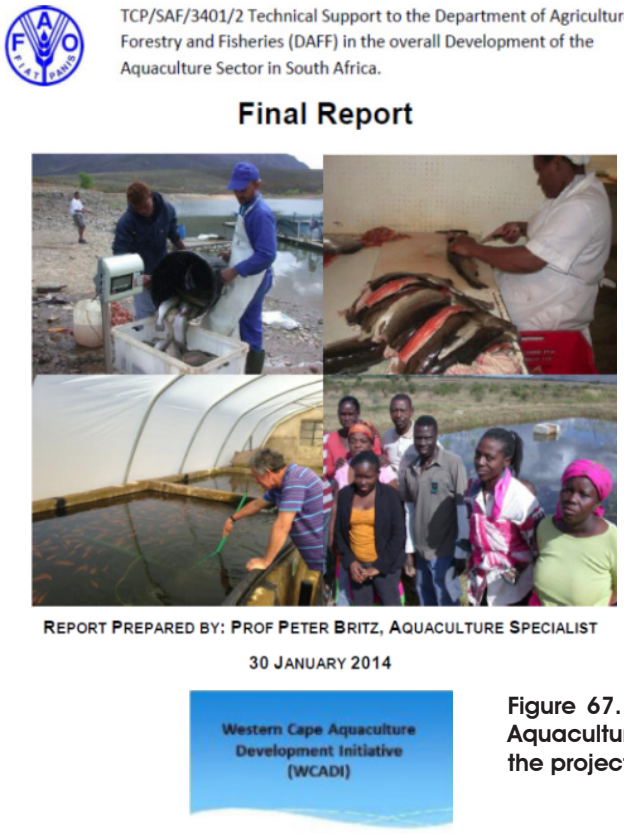


Figure 67. Public Understanding of Aquaculture of Aquaculture Report, the project was initiated in 2012.

The course delivery mode followed lectures, presentations and discussions, symposia, excursions, practicals, exercises and a final examination. The course highlighted opportunities for ELIDZ such as:

- Natural environmental features – The harnessing of local environmental features (e.g. turning the Agulhas current on the East London coastline into carbon free, renewable and uninterrupted electrical power supply) to also power land based aquaculture facilities;
- Fish Species Diversity – Broadening of the identified species that could present an opportunity for the ELIDZ; and
- Fish Life Stage Commercial Focus - Farms that were visited tended to specialize in a particular stage of the life cycle of the species of interest, which means that the risk is spread to a broad base of farmers.

12.4 Integrated Fish Farming Course, China, Wuxi, 23rd July – 22nd August 2012

The course took place in the People's Republic of China, Wuxi, from 23rd July to 22nd August 2012. Officials from the Agriculture Research Council (ARC) represented South Africa (Figure 69). The course included both theoretical and practical work and study tours to different aquaculture facilities and/or organizations around the areas of, Jiting in Yixing Province, Nongtong, Wuxi, Shanghai and Wujin in Jiangsu Province. Other topics that were covered during the course include:

- Induced breeding techniques;
- Natural live food cultivation;
- Rearing of fish seed;
- Food fish production;
- Marine aquaculture/mariculture;
- Fish bacteria and virus diseases;
- Applications of fish machinery in aquaculture;
- Basic conditions of disease outbreak;
- Community-based coastal research management and traditional; and
- Improved technologies of fish farming.

Figure 69. Seminar Participants at the Integrated Fish Farming Course, Wuxi, China.

12.5 Aquaculture Extension System Development and Management Course, China, Wuxi, 1st August – 20th August 2012

The course took place from 1st to 20th August 2012 at the Freshwater Fisheries Research Centre, in Wuxi, Jiangsu Province, People's Republic of China. Sixteen (16) participants selected from the field of aquaculture and related fields attended the course. Lectures offered during the course included topics such as:

- Aquaculture species and status – China species diversification which include silver carp, big head carp, grass carp, black carp, common carp, crucian carp etc), exotic species (tilapia) and local genetically improved species (GIFT) were explored;
- Good Aquaculture Practice (GAP) – This is a well-known management tool or technique for good aquaculture practice which is adopted worldwide and also referred to as BMP (Better Management Practice or Best Management Practice);
- Healthy Aquaculture and Chemical and Drug Management;
- Chinese Aquaculture Technical Extension Service System;
- Exchange on Construction and Management of Fisheries Technical Extension Systems;
- Development and application of modern fishery information technology;
- Community based Aquaculture;
- Aquaculture Risks; and
- Climate change and Aquaculture.

Several study tours and site visits were conducted to research centres, feed manufacturing companies, and a number of farms with hatcheries, ponds and cages (Figure 75).

Figure 70. Participants from South Africa visiting an ornamental cage culture operation during training.

12.6 Seminar on the Management of China-Aided Agricultural Technology Demonstration Centre for English Speaking Countries in Africa, China, Beijing, 5th– 25th June 2012

The seminar focused on the management of the China-aided Agricultural Technology Demonstration Centers (ATDCs) established in nine (9) African countries which included representation from South Africa, Sudan, Uganda, Mozambique, Zimbabwe, Zambia, Tanzania, Ethiopia and Liberia (Figure 71). The Chinese government through Ministry of Commerce (MOFCOM) has managed to establish fourteen (14) ATDCs in African countries and all of the centres are at the technical cooperation phase. The purpose of the seminar was to facilitate discussions around sustainability and development of the centres. The following centres were discussed during the seminar:

- Liberia - Agricultural machinery for production of hybrid rice;
- Mozambique - Agricultural demonstration centre for (crop production);
- Tanzania - Agricultural machinery crops (rice and maize) and poultry demonstration centre;
- Sudan - Crop production (cotton, groundnuts and wheat) demonstration centre;
- Ethiopia - Cash crop production (coffee and cotton) demonstration centre;
- Zimbabwe - Supply of agricultural machinery and irrigation equipment demonstration centre;
- Zambia - Production of corn and wheat demonstration centre; and
- Uganda - Freshwater aquaculture demonstration centre.

Five (5) site visits were conducted during the seminar to various demonstration centres, aquaculture farms, processing plants and manufacturing companies.

Figure 71. Participants at the Seminar on the Management of China-Aided Agricultural Technology Demonstration Centre for English Speaking Countries in Africa, Beijing, China.

12.7 Seminar on Aquaculture and Technical Extension for Developing Countries, China, Wuxi, 25th September – 24th October 2012

The seminar was hosted in Wuxi, China by the People's Republic of China. It was attended by 36 participants from 17 countries. Topics discussed in the seminar included:

- Chinese Aquaculture Development and Management;
- Fishery Scientific Support and Technology System of Modern Agriculture in China;
- Applications of Fishery Machinery in Aquaculture;
- Fish Feed, Feeding and Feed Industry;
- The Management of Original and Fine Breed in Chinese Aquaculture;
- Healthy Management of Aquatic Animals;
- The Role of Rural Extension in the Sustainable Development of Aquaculture;
- Chinese Aquaculture; and
- Aquaculture and Climate Change.

Study tours were also undertaken to research centers, universities, processing plants, fish wholesale markets and various farms.

13 OVERVIEW OF DIRECTORATES RESPONSIBLE FOR AQUACULTURE FUCTIONS WITHIN DAFF

The DAFF is the lead government Department for the sustainable development and management of both marine and freshwater aquaculture. Three units within DAFF solely manage the sector i.e. Aquaculture Research and Development; Aquaculture Technical Services; and Sustainable Aquaculture Management.

13.1 Directorate Aquaculture Research and Development

Aquaculture is a technology driven industry which relies heavily on research to develop new species and the appropriate technology for commercial production. This is also supported by the NASF which identified the development of aquaculture technology, particularly for indigenous species, as a key strategy for growing the local aquaculture sector. Related to this is a need to make South African producers more internationally competitive by reducing costs through improved aquaculture technology innovations. The Directorate: Aquaculture Research and Development (D: ARD) has been established to oversee, facilitate and conduct aquaculture research in South Africa.

The vision for the D: ARD is *"Excellence in aquaculture research to support the growth of a sustainable and globally competitive aquaculture sector for South Africa - 20:20)"* i.e. 20% growth rate in the next 20 years or growth target to 20 000 tons in the next twenty 20 years. The responsibility of the aquaculture research division is to conduct research in support of a competitive and sustainable development of aquaculture in South Africa. The main focus areas are:

- Research and development of culture technology for aquaculture species.
- Research on aquatic animal health and diseases for aquaculture.
- Research on the interaction between the environment and aquaculture.

13.2 Directorate Aquaculture Technical Services

Aquaculture technical and advisory services has been lacking due to the limited skills in the country. In order to address this aspects, the Directorate: Aquaculture Technical Services (D: ATS) was established with its functions concentrating on technical and socio-economic aspects of aquaculture development. The main pillars and functions of this directorate are:

- **Aquaculture Support Services**: To ensure that farmers are obtaining the necessary support. A sub-unit was established which takes responsibility for developing and implementing farm support programmes; provide technical advisory services; and facilitate training and capacity building within the aquaculture sector.
- **Aquaculture Information Management:** It is important to ensure that the sector information is available to assist in decision making. A sub-unit responsible to drive information collection and dissemination was established. This unit is responsible for sector promotion through awareness programmes; development and dissemination of sector promotion material; and most importantly development and publication of the **Aquaculture Yearbook.**

- **Aquaculture Economics:** The economic assessment of fish farms is crucial to ensure its success. A sub-unit dealing with this function is also placed under D: ATS. Amongst other functions, this unit is responsible for market issues; facilitating access to finance; and economic monitoring of the sector.
- **Aquaculture Infrastructure and Facility Management:** Currently, government has several infrastructure for aquaculture under the management of both national and provincial Departments. To ensure that this infrastructure supports the current sector needs, the D: ATS has been tasked with identifying and managing the infrastructure.
- **Aquaculture Development:** To ensure an enabling environment has been created for the sector. The D: ATS has been tasked with addressing zonation and facilitation of seed supply.

13.3 Directorate Sustainable Aquaculture Management

The Directorate: Sustainable Aquaculture Management (D: SAM) is responsible for the development, management and regulation of a sustainable aquaculture industry that contributes towards job creation, food security, rural development and economic growth. D: SAM aims to achieve the above mentioned strategic objectives through the development and implementation of relevant enabling legislation, policies and programs that are aligned with the government's Industrial Policy Action Plan (IPAP) and New Growth Path (NGP) as well as responsive and compliant to international obligations and agreed standards.

D: SAM's functions comprise of five pillars which are supported by sub-units as follows:

- **Environmental Assessments:** This sub-unit is responsible for aquaculture environmental interactions, this entails the assessment of the impact to the environment associated with aquaculture and related activities.
- **Food Safety:** This sub-unit is responsible for the development and management of food safety programmes. Currently, the sub-unit is managing the SAMSM&CP. The objectives of the SAMSM&CP are, amongst other things, to ensure guarantees to domestic and international markets and consumers that South African farmed shellfish products are safe for human consumption. In order to ensure functional food safety programmes, the sub-unit collaborates with other agencies such as the NRCS and CSIR.
- **Aquatic Animal Health:** Aquatic animal health is a very important aspect in aquaculture development. To address this aspect, a sub-unit has been established which is responsible for the development, implementation and review of the Aquatic Animal Health Strategic Framework; the undertaking of farmed aquatic animal stock inspections; rendering advice to farmers of aquatic animals in terms of health and welfare issues; development of the biosecurity and better management guidelines; reporting of aquatic animal diseases in consultation with the D:ARD; and conducting of training, education and awareness programs on aquatic animal health.
- **Intergovernmental and Policy Coordination: Even though DAFF is the lead Department for aquaculture development and management, other Departments from all spheres of government are contributing through their mandates.** A sub-unit to deal with coordination of stakeholder engagements has been established within DAFF. Amongst others, this unit is responsible for coordinating all intergovernmental engagements (e.g. AIF, PAIF, and AVCRT); and coordination of the review of legislation and aquaculture policies.
- **Aquaculture Authorizations: As per legislative requirements, authorization of aquaculture activities is required hence DAFF established a sub-unit responsible for such. This sub-unit is r**esponsible for the receipt, processing and granting of aquaculture rights, ranching rights and exemptions, issuing of permits and licences; development and review of permit conditions, coordination of aquaculture stakeholder working groups (e.g. MAWG and MAIL); farm visits for data collection and monitoring; and handling of appeals.

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