AQUACULTURE YEARBOOK

2014

SOUTH AFRICA

Compiled by Chief Directorate:
Aquaculture and Economic Development
Fisheries Branch
Department of Agriculture, Forestry and Fisheries

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REPORT PREPARED BY

The Department of Agriculture, Forestry and Fisheries
Branch: Fisheries Management
Directorate: Aquaculture Technical Services
Private Bag X2
Roggebaai
Cape Town
8012
Email: www.daff.gov.za
Tel: 021 402 3911
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FOR ENQUIRIES CONTACT

The Department of Agriculture, Forestry and Fisheries
Branch: Fisheries
Directorate: Aquaculture Technical Services
Private Bag X2
Roggebaai
Cape Town
8012
Email: aquaculture@daff.gov.za

OR

Ms Khumo Morake
Director: Aquaculture Technical Services
Email: KhumoM@daff.gov.za
Tel: 021 402 3038/012 309 5727

OR

Mr. Keagan D Halley
Principal Environmental Officer: Aquaculture Technical Services
Email: KeaganH@daff.gov.za
Tel: 021 402 3326

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CONTENTS

EXECUTIVE SUMMARY

The Aquaculture Yearbook is an annual publication providing the status of the aquaculture sector in South Africa. The Aquaculture Yearbook 2014 is based on data collected from the aquaculture sectore in 2013. This publications cover species that were cultured in South Africa during 2013 which included 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.

A total of 229 farms were established in 2013, with 36 being marine aquaculture farms and 193 were freshwater aquaculture farms. The aquaculture industry has shown growth with number of farms increasing by 34 between 2012 and 2013.

The total production of South Africa's aquaculture industry (excluding sea weed, carp, ornamentals and koi carp) in 2013 was 4 802.11 tons with the marine aquaculture industry accounting for 2 985.70 tons and the freshwater aquaculture industry accounting for 1 816.41 tons. The sector has increased the total production by 875.22 tons, which is an increase of 18.22% from 2012 data. The sector has demonstrated a grow rate of 8.7% from 2005 to 2013.South Africa's total marine aquaculture production increased by 724.47 tons from 2012-2013, which is an increase of 30.04%. The abalone, mussels, oysters and finfish sub-sectors recorded increases in production of 358.37 tons (32.25%), 256.37 tons (29.82%), 35.65 tons (14.75%) and 74.09 tons (152.90%) respectively.

The freshwater aquaculture increased by 32 farms while marine aquaculture increased by 2 farms. Mpumalanga province leads the freshwater aquaculture with 42 farms whilst Western Cape lead the marine aquaculture with 24 farms.

Total freshwater aquaculture production has shown an increase of 150.74 tons (8.29%) from 2012 - 2013 for the four sub-sectors (trout, tilapia, catfish and marron crayfish) with a production of 1816.41 tons in 2013. Trout had the most contributing freshwater aquaculture sub-sector with the production of 1521.70 tons in 2013. The second was tilapia at 289.71 tons and the third includes marron crayfish which contributed 5 tons while the catfish sub-sector produced zero tons in 2013.

The total value of the aquaculture sector was estimated at R 696 million, increasing by 38.1% during 2012-2013. This total estimated value includes the freshwater and marine aquaculture industry and was based on the sales of aquaculture products. Locally aquaculture continues to be dominated by abalone production which was estimated to be R529 million in 2013, representing 76.01% of the total rand value for the entire aquaculture sector.
Projected capital investment of approximately R322 million representing an increase of 33.6% was realised in the sector during 2013. The abalone sub-sector invested approximately R223.9 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 R78.6 million was invested in the sub-sector during 2013. The total recorded investment for mussels was R6.6 million and tilapia at R7.7 million.

The employment figure had increased to 2 831 as a result of the projected investment into the aquaculture sector. A total of 604 jobs were created, with the majority of employment increase in the abalone sub-sector with approximately 500 employees employed.

The Department conducted site surveillance of nine marine aquaculture Right Holders, including six abalone farms, one oyster farm and two mussel farms, between Port Nolloth in the Northern Cape and Gansbaai in the Western Cape. There were 52 farm closure notices sent to shellfish farms by the SAMSM&CP office, most of which were due to microbiological contamination (28), due to the presence of biotoxins (20) and a few due to non–compliance with permit conditions. There were no closures due to other hazardous substances viz. heavy metals, pesticides, PCBs or radionuclides.

During the year 2013 a number of aquaculture research projects were undertaken by DAFF Researchers and some in collaboration with Universities. These projects included Finfish Reproduction conducted at the Marine Research Aquarium; a comparative growth performance test (3 months) between captivity bred f1 and wild juvenile cape white stumpnose *(Rhabdosargus globiceps)* by also using the green macro-algae *ulva lactuca* as a 5% dietary constituent; and Identification of the marine diatom *Pseudo-nitzschia* multiseries as a source of the toxin domoic acid in Algoa Bay.

The Biodiversity Risk and Benefit Assessment for Alien Species of Aquaculture was finalised in December 2013 and seven species profiles drafted 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.

ABBREVIATIONS

AASA	Aquaculture Association of Southern Africa
ADZ's	Aquaculture Development Zones
AOAC	Association of Analytical Communities
CD: AED	Chief Directorate: Aquaculture and Economic Development
ADEP	Aquaculture Developmental and Enhancement Programme
AIF	Aquaculture Intergovernmental Forum
D: ARD	Directorate: Aquaculture Research and Development
ARC	Agriculture Research Council
ARTDP	Aquaculture Research and Technology Development Programme
ASP	Amnesic Shellfish Poisoning
ATDC	Agricultural Technology Demonstration Centre
D: ATS	Directorate: Aquaculture Technical Services
BEE	Black Economic Empowerment
BMP's	Better Management Practices
CGA	Catfish Growers Association
CITES	Convention on International Trade in Endangered Species
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DBSA	Development Bank of South Africa
DDG	Deputy Director-General
DEA	Department of Environmental Affairs
DFI	Development Funding Institutions
DSP	Diarrhetic Shellfish Poisoning

ABBREVIATIONS

DST	Department of Science and Technology
The dti	Department of Trade and Industry
DWS	Department of Water and Sanitation
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 Organisation of the United Nations
CD: 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 Individuals
HDPE	High Density Polyethylene
IDC	Industrial Development Cooperation
IPAP	Industrial Policy Action Plan
MAIL	Marine Aquaculture Industry Liaison

ABBREVIATIONS

MAWG	Marine Aquaculture Working Group
MLRA	Marine Living Resources Act No. 18 of 1998
MOFCOM	People's Republic of China Ministry of Commerce
MTPA	Mpumalanga Tourism and Parks Agency
CD: MRM	Chief Directorate: Marine Resources Management
CD: MSC	Chief Directorate: Monitoring, Control and Surveillance
NAPF	The 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
qPCR	quantitative Polymerase Chain Reaction
RoI	Return on Investment
D:S AM	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 Entities
TCP	Technical Cooperation Program
TCPf	Technical Cooperation Programme Facility
MDARLA	Mpumalanga Department of Agriculture, Rural Development and Land Administration

DEFINITIONS

Active surveillance	Also referred as stock inspection, 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 distributions and consumption
Disease	Any condition whereby the normal functions of any organ 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 Disease Act, 1998)
East Coast	East of Cape Point to border of Mozambique
Farm closures	A period where Shellfish farms are temporally not allowed to market and or sell products due to microbiological contamination, detection of biotoxins and as well as other hazardous substances such as heavy metals, pesticides, PCBs or radionuclides.
Pilot Scale	Status at which a project is testing or conducting trials in order to demonstrate the effectiveness of a full program
Production	Amount of organisms produced from a farm
West Coast	West of Cape Point to border of Namibia.

1. OVERVIEW OF AQUACULTURE YEARBOOK 2014

1.1 South Africa's Aquaculture Yearbook 2014

As the lead Department for aquaculture management and development in the Republic of South Africa, the Department of Agriculture, Forestry and Fisheries compile and publish the South Africa's Aquaculture Yearbook annually. The Aquaculture Yearbook provides the status report on aquaculture in South Africa based on the information collected from the industry, and other relevant activities and events within DAFF and South Africa in general from the previous year. It covers key aspects of aquaculture including Support and Development; Promotion; Research; Environmental Integrity; Training and Capacity Building, and Stakeholder Engagements.

The name of the publication has been maintained as the South Africa's Aquaculture Yearbook since 2012. In 2009 it was published under the then Departments of Environmental Affairs and Tourism as South Africa's Marine Aquaculture Industry Annual Report 2009, however after the formation of the Department of Agriculture, Forestry and Fisheries, the publication name was changed to Marine Aquaculture Annual Report 2010 as it covered broader aspects of marine aquaculture development and management. After the formation of DAFF and integrated aquaculture management and development (freshwater and marine aquaculture), the approach to the publication was changed resulting in the renaming of the report to South Africa's Aquaculture Annual Report 2011. The publication was then changed again in 2012 to become Aquaculture Yearbook. The Aquaculture Yearbook reflects all the information from the aquaculture sector.

Even though there have been several changes in naming of the publication, its main intention has not changed. The main purpose of the report is to promote transparency and easy access to accurate and consistent information. The objectives of South Africa's aquaculture yearbook is to monitor progress of the sector; facilitate public awareness; identify deficiencies in management systems; and contribute to business case for future development.

South Africa's Aquaculture Yearbook 2014 has been compiled based on the data collected from the South Africa aquaculture sector during 2013. Data was collected using different methods for marine and freshwater aquaculture as the management and regulatory framework for these industries differ.

According to the condition of the operational permits issued in terms of section 13 of Marine Living Resource 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 was 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. These questionnaires mainly focused on the type of species farmed, farm location and production data for 2013. It is essential to note that the freshwater aquaculture data is based on the farms affiliated to aquaculture associations and so does not include all freshwater aquaculture within South Africa. 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 contributed 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. The Department however continues to strive to build relationships with the current and new entrants into the sector.

2. STATUS OF AQUACULTURE IN SOUTH AFRICA 2013

2.1 Overview of aquaculture in South Africa in 2013

The marine aquaculture species farmed in 2013 included 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 cultured in the freshwater industry included 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. Total of 229 farms were recorded in 2013, of this 36 were marine aquaculture farms and 193 were freshwater aquaculture farms. South Africa's aquaculture industry recorded a total of 34 farms with marine aquaculture increase contributing to 2 new farms whilst freshwater aquaculture contributed 32 new farms.

The total production of South Africa's aquaculture industry (excluding sea weed, carp, ornamentals and koi carp) in 2013 was 4 802.11 tons with the marine aquaculture industry recording 2 985.70 tons and the freshwater aquaculture industry recording 1 816.41 tons. The sector increased 875.22tons, which translates to recording an increase of 18.22% compared to 2012. The sector illustrated a grow rate of 8.7% from 2005 to 2013 (Figure 2).The trout sub sector has recorded the highest production in 2013, followed by abalone and mussels. The marine finfish, tilapia, catfish, oyster catfish and marron are still growing sub sectors as shown in figure 1 below.

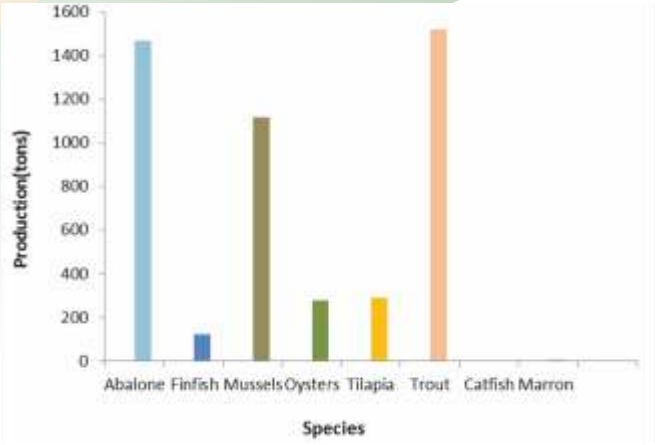

Figure 1. South African aquaculture production per sub-sector for the year 2013.

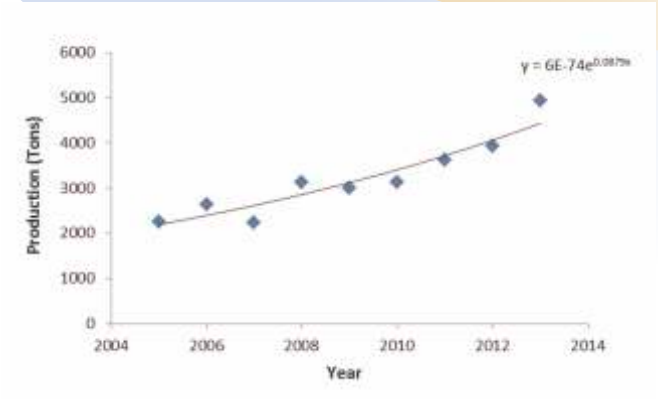

Figure 2. Graph illustrating growth rate of the aquaculture sector from 2005 to 2013.

Figure 3. Aquaculture farms in South Africa in 2013.

3. STATUS OF MARINE AQUACULTURE 2013

3.1 Marine aquaculture species farmed in South Africa in 2013

In 2013, 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 aquaculture 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 2013,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 2013 and its operational scale in the sector.

Table 1. Marine Aquaculture species and their operational scale in South Africa during 2013.

Marine Aquaculture species in South Africa, 2013		
Common Name	Scientific Name	Operational Scale
Abalone	*Haliotismidae*	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 2013

In 2013, a total of 36 marine aquaculture farms were in operational in South Africa. There was an increase of 2 new farms in the marine aquaculture industry, these includes one mussel farm and one finfish farm. The Western Cape Province had the highest number of operating marine fish farms in 2013, amounting to 24 and comprising of four sub-sectors namely abalone, finfish, oysters and mussels with abalone being the major contributor. In the Eastern Cape Province six farms were in operational and comprised of three sub-sectors namely abalone, finfish and oysters. The Northern Cape had five farms and consisted of two sub-sectors namely abalone and oysters, whilst KwaZulu Natal had the least number of farms with only one finfish farm in operation. The distributions of the farms are presented in Table 2.

Table 2. Total number of marine aquaculture farms operating in South Africa by sub-sector and province in 2013.

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	3	0	1	5
Mussels	4 (1)*	0	0	0	4
Oysters	6 (2)**	2	1	0	9
Total	24	6	5	1	36

()* One oyster farm cultured mussels as well, however the farms haven't been captured under mussels as their primary species is oysters
() Two mussel farms cultured oysters as well, however the farms haven't been captured under oysters as their primary species is mussels**

3.3 Marine Aquaculture Authorization

The promulgation of the Marine Living Resources Act (MLRA) created regulatory framework for the conservation of ecosystems, the sustainable utilization of marine living resources and the orderly access to exploitation, utilization and the protection of certain marine living resources. Marine aquaculture also formed part of the activities that are regulated in terms of the MLRA, where by regulation 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 the 27th March 2009, the Minister gazetted a General Notice No. 313 of 2009 inviting applications for long term Rights.

Exemptions are granted in terms of Section 81 of the MLRA, which states that:

"If in the opinion of the Minister there are sound reasons for doing so, he or she may, subject to the conditions that he or she may determine, in writing exempt any person or group of persons or organ of state from a provision of this Act."

Most marine aquaculture Fish Processing Establishments (FPEs) operate under an exemption due to institutional delays in the granting of Fish Processing Establishment (FPE) Rights. Exemptions for "the possession and sale of undersized abalone and kob" (herein referred to as "local sales permits") are drafted to allow for the local sales of the products due to the implementation of wild caught fish size limitations on farmed products. The exemption process is a legislative process that is used as a mechanism to allow for the processing and local sales of undersized products. In the past year, the amount of permits approved for FPE and local sales permit has increased as compared to the previous year, 2012.

In 2013, two Marine Aquaculture Rights were granted. The Rights were for mussels (Mytilus galloprovincialis and Choromytilus meridionalis) and dusky kob (Argyrosomus japonicas) (Table 3). 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 overtaking an aquaculture activity. The applicant must meet the criteria as set out in the application form and provide the relevant supporting documentation as required.

Table 3. Rights to Engage in Marine Aquaculture granted in 2013

Company Name	Operational Area	Species	Duration of Right
African Olive Trading (Pty) Ltd t/a C-Mussels	Inner bay, Port of Saldanha, Saldanha Bay, Western Cape	Mussels *(Mytillus Galloprovincialis and Choromytilus meridionalis*	01/08/2013 - 31/12/2028
Itakane Trading 240 (Pty) Ltd	Sandhurst Farm, Cefane, East London, Eastern Cape	Dusky kob *(Argyrosomus japonicus)*	01/02/2013 - 31/12/2028

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:

"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 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 2013, 590 permits for Marine Aquaculture were issued in South Africa to Right holders, agencies, importers, exporters, Fish Processing Establishments (FPEs) and transportation companies (Table 4). The permits issued for exports exceeded the number of permits issued for imports, this is a clear reflection of increased fish demand in the country and fish packaged and transported to other African countries through South Africa. There were 44 permits issued to "possess and sell Undersized Cultured Abalone obtained from Right holder" obtained from a Right Holder" issued in 2013, depicting increased local demand for abalone.

Table 4. Types of Permits issued in 2013

Permit type	Number issued
General Imports	140
Ornamental Imports	38
Exports	144
Transport	45
Engage in Marine Aquaculture Activities	51
Possess Broodstock and Operate a Hatchery	26
Possess and sell Undersized Cultured Abalone obtained from Right holder	44
Permit to possess and sell undersized kob obtained from a Right Holder	0
Right to Engage in Abalone Ranching and Stock Enhancement Pilot Project: Seeding	7
Engage in Ranching Activities of Marine Species: Harvesting	2
Collect Broodstock for Marine Aquaculture purposes	16
Operate a Fish Processing Establishment	37
Scientific Investigations and Practical Establishments	15
Vessel license	10
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)	15
Total Issued	**590**

3.4 Overview of South Africa's marine aquaculture production in 2013

In the South Africa's Aquaculture Yearbook 2014 production is defined as the quantity of organisms produced from a farm specifically for human consumption and is expressed in tonnage. This definition excludes seaweed which in South Africa is used as feed for abalone. South Africa's total marine aquaculture production (excluding seaweed) in 2013 was 2 985.70 tons. Table 5 below illustrates the total production per sub-sector and within each province. In 2013 the Western Cape Province recorded a production of 2609.15 tons and was the main contributor of South Africa's total marine aquaculture production followed by the Eastern Cape with a production of 376.55 tons. There was no production recorded in Northern Cape and KwaZulu Natal in 2013, however there were aquaculture facilities in operation.

The abalone sub-sector was the highest contributing sub-sector in terms of production and recorded 1469.78 tons, followed by mussels and oysters recording production of 1116.14 tons and 277.23 tons respectively. The finfish sub-sector was the smallest contributor to total production, recording a production of 122.55 tons. The percentage contributed by each sub-sector to total production were abalone 49.2%, mussels 37.4%, oysters 9.3% and finfish 4.1% (Figure 4).

Table 5. 2013 Marine aquaculture total production for human consumption per sub-sector and province.

Production (tons) per Species and Province					
Species	Western Cape	Eastern Cape	Northern Cape	KwaZulu Natal	Total
Abalone	1299.78.	170	0	0	1469.78
Finfish	0	122.55	0	0	122.55
Mussels	1116.14	0	0	0	1116.14
Oysters	193.23 (40)	84	0 (30)	0	277.23
Total	**2609.15**	**376.55**	**0**	**0**	**2985.7**

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

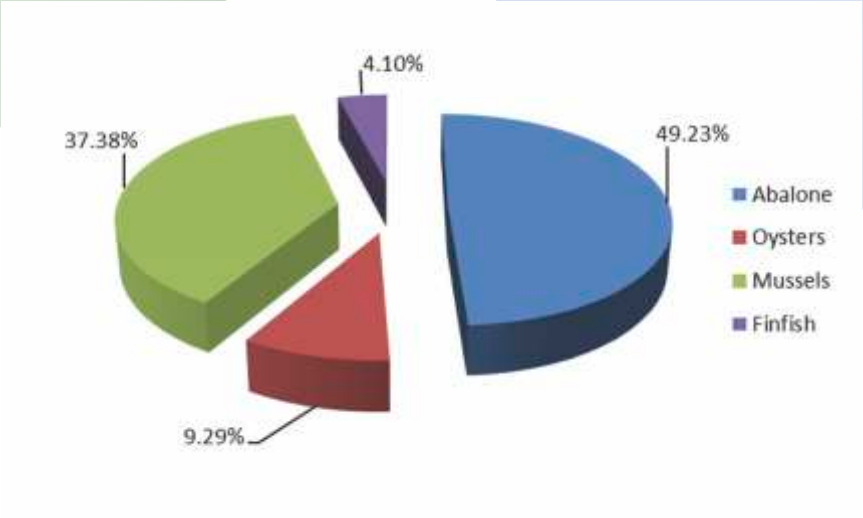

Figure 4: The percentage contribution of each sub-sector to total production in 2013.

3.5 South Africa's Marine Aquaculture production from 2000 - 2013

South Africa's total marine aquaculture production has increased by 1929, 77 tons between 2000 and 2013(32,03 %). Marine aquaculture has recorded the highest production in 2013 which can be attributed to all sectors increasing in production (abalone, mussels, oysters and finfish). The increase in these sub-sectors production output is outlined in more detail in Section 3.6 of the Aquaculture Yearbook 2014.

During 2013, the abalone, mussels, oysters and finfish sub-sectors recorded an increase in production of 358.37 tons (32.25%), 256.37 tons (29.82%), 35.65 tons (14.75%) and 74.09 tons (152.90%) respectively. Table 6 below illustrates the production from 2001 to 2013 and the growth rate of the industry. The marine aquaculture industry (excluding aquatic plants) displayed a growth rate of 6.34% from 2001 to 2013 (Figure 5).

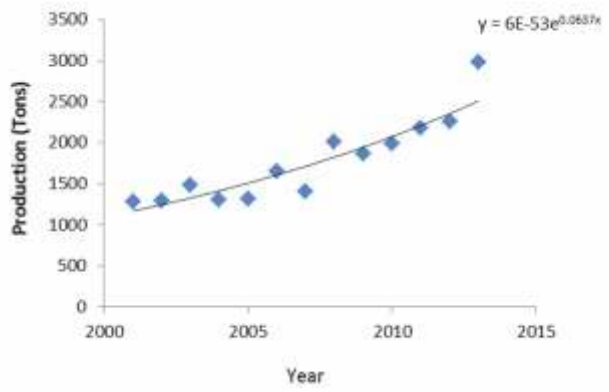

Figure 5: Graph illustrating growth rate of the marine aquaculture industry from 2000 to 2013.

Table 6. South Africa's marine aquaculture production 2001 – 2013

Sub-sector	Year and Production (tons)													Total production (tons) 2000 – 2013
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Abalone	372.88	429.42	462.02	509.2	670.8	833.36	783.25	1037.11	913.58	1015.44	1036.01	1111.41	1469.78	10825.29
Finfish	0.3	2.38	14	1.81	1.68	0	0	2.71	22.75	0	7.99	48.46	122.54	225.66
Mussels	600	429.11	623	640	472	542	466	736.74	682.4	700.14	570.16	859.77	1116.13	9227.07
Oysters	187.53	272.1	255.24	147.66	174.91	279.87	157.86	226.62	223.53	276.57	269.34	241.58	277.23	3237.05
Prawns	120.19	157.7	124.88	0	0	0	0	11.44	17.92	0	0	0	0	558.97
Seaweed	0	0	0	0	0	664	0	1833.49	1900.18	2015.01	2884.61	2000	*	14297.29
Totals**	**1280.9**	**1290.71**	**1479.14**	**1298.67**	**1319.39**	**1655.23**	**1407.11**	**2014.62**	**1860.18**	**1992.15**	**1883.50**	**2261.22**	**2985.69**	**24074.05**

***Seaweed culture data not confirmed for the year 2013**
****Total production exclude seaweed cultured**

3.6 Analysis of marine aquaculture industry

3.6.1 Abalone Sub-sector

The abalone species currently being cultivated in South Africa is Haliotis midae. In 2013, the abalone sub-sector contributed 49.2% to South Africa's total production recording a total of 1 469.78 tons. The abalone sub-sector experienced the highest production to date with increase of 32.25% from the 1111.41 tons produced in 2012 (Figure 6).

The abalone sub-sector has also seen an increase in the number of farms operating. An additional two new ranching farms started operations in 2013, increasing the number of abalone farms operating to 20 farms from the 18 recorded in 2012. Of the 20 abalone farms operating in 2013, 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 there were two ranching operations.

The abalone sub-sector distribution range stretches from the Northern Cape and Western Cape to the Eastern Cape. Six farms were operating in the Northern Cape in 2013, one situated in Port Nolloth, one in Hondeklipbaai and two were operating in Kleinsee, two of them being abalone ranching operation. A total of 14 abalone farms are situated in the Western Cape of which nine are located within the Overberg region (Figure 7 and 8) and four are located along the West Coast in Doringbaai, Jacobsbaai and St Helena Bay (two abalone farms found in St Helena Bay). In the Eastern Cape there was only one abalone farm in operation as well as a ranching farm. The abalone farm is situated in Haga Haga, a few kilometres outside East London and the ranching farm is located in Cape Recife boardering Port Elizabeth. The Western Cape dominated production of abalone and contributed 88.43% to the total abalone production in South Africa, followed by Eastern Cape with 11.57%.

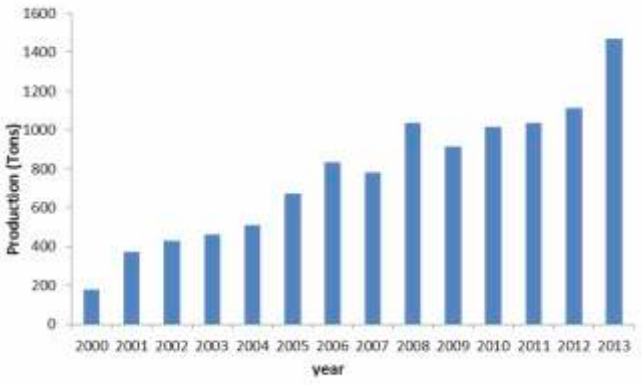

Figure 6. Abalone production for the years 2000 – 2013.

Figure 7. Abalone farm located in Dooringbaai, Western Cape.

Figure 8. Image of an abalone on farm located in Dooringbaai.

3.6.2 Finfish Sub-sector

The finfish sub-sector 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 sub-sector has been growing over the last two years and in 2013 the sub-sector recorded the highest production to date, recording a total of 122.5 tons of dusky kob (Figure 9). The finfish sub-sector experienced a dramatic increase in production of 152.90% from the 48.46 tons produced in 2012. By the end of 2013 the finfish sub-sector had a total standing stock of 147.18 tons of dusky kob on the farms with the majority of this tonnage in the Eastern Cape.

Four farms were in operation in 2013, the operations includes a recirculation facility in the Western Cape,

pond culture facility in KwaZulu Natal and two recirculation facilities in the Eastern Cape (Figure 10 and 11).

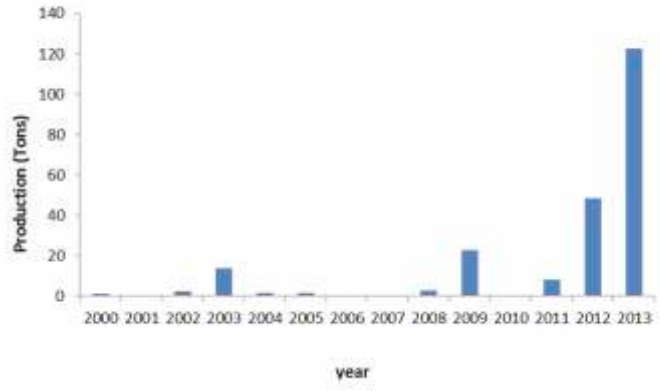

Figure 9. Finfish production for the years 2000 – 2013.

Figure 10. Hamburg kob pilot project located in Hamburg, Eastern Cape.

Figure 11. image of juvenile dusky kob on farm located in Hamburg.

3.6.3 Oyster Sub-sector

The species cultivated in South Africa is the exotic Pacific oyster *(Crassostrea gigas)*. There were nine farms in operational in 2013. 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 sub-sector was 277.23 tons, displaying an increase of 14.75% from the 241.58 tons produced in 2012 (Figure 12).

Oyster farms are currently situated in the Northern Cape, Western Cape and Eastern Cape. A total of six farms in the Western Cape were operational and includes four in Saldanha Bay, one in Knysna and one in Paternoster. The Western Cape oyster farms contributed to the majority of production, contributing 69.70% of the total oyster production. Oyster farming in the Eastern Cape is represented by three farms, one located in Port Elizabeth, one in Jeffery's Bay, one in Hamburg which also farm dusky kob. The Northern Cape is represented by one oyster farm located in Kleinzee (Figure 13 and 14).

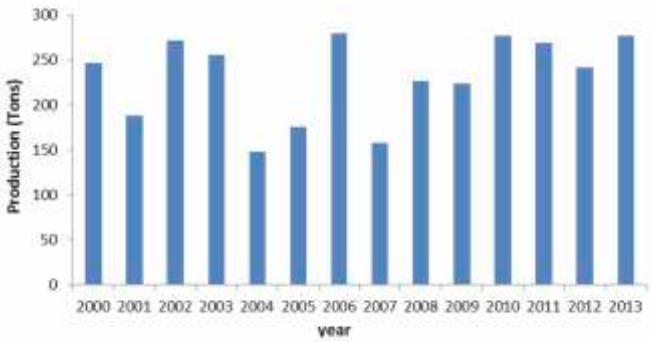

Figure 12. Aquaculture oyster production in South Africa for 2000 – 2013.

Figure 13. Workers sorting oysters in to crates on a farm located in Port Elizabeth, Eastern Cape.

Figure 14. Oysters collected from a farm in Port Elizabeth.

3.6.4 Mussel Sub-sector

Mussel farming in South Africa is situated in Saldanha Bay, Western Cape, and is represented by three large scale mussel farms in the area (Figure 16 and 17) with one new mussel farm established in 2013. The species cultured in South Africa are the exotic Mediterranean mussel *(Mytilus galloprovincialis)* and the indigenous black mussel *(Choromytilus meridionalis)*.

In 2013 the mussels sub-sector recorded the highest production to date, recording a total of 1116.14 tons increasing by 256.37 tons from the 859.77 tons of mussels recorded in 2012 (29.82% increase) (Figure 15). This increase in production can be attributed to one mussel farm completely stopping the production of oyster and concentrating on increasing its production of mussels as well as the establishment of a new mussel farm in Saldanha Bay (Figure 16 and 17). The mussel sub-sector contributed 37.4% to the total production in 2013. This sub-sector is currently the second highest contributor to the total production.

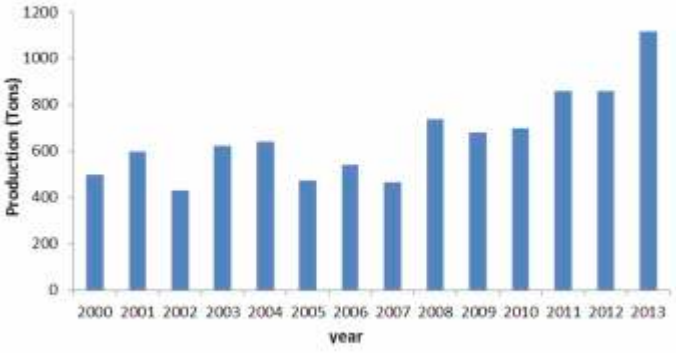

Figure 15. Aquacultre Mussel production in South Africa for the years from 2000 – 2013.

Figure 16. Workers collecting mussels from a mussel raft located in Saldanha Bay, Western Cape.

Figure 17. Mussels sorted into crates on mussel farm in Saldanha Bay.

3.7 Aquaculture Food Safety

3.7.1 Overview South African Molluscan Shellfish Monitoring and Control Programme

The SAMSM&CP is a programme regulated by the SAM directorate, which is based within the Aquaculture and Economic Development Chief Directorate within the Fisheries Management Branch of the DAFF. SAMSM&CP is working closely with the Fisheries Compliance Officers (FCO's) of DAFF, South African molluscan shellfish farmers, laboratories, National Regulator for Compulsory Specification (NRCS), Department of Health (DoH) and Municipalities.

The aims of this programme is to provide the necessary guarantees to local and international markets that the food safety risk associated with the production of molluscan shellfish is adequately managed and minimized.

The molluscan shellfish species farmed in South Africa include *Haliotis midae* (Abalone), *Crassostrea gigas* (Oyster), *Mytilus galloprovincialis* (Mediterranean mussel) and *Choromytilus meridionalis* (Black mussel) as shown in table 1.

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 24 shellfish farms monitored by the SAMSM&CP during 2013 of which 14 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, five mussel farms and three oyster farms. The farms to the east of Cape Point included nine abalone farms and one oyster farm.

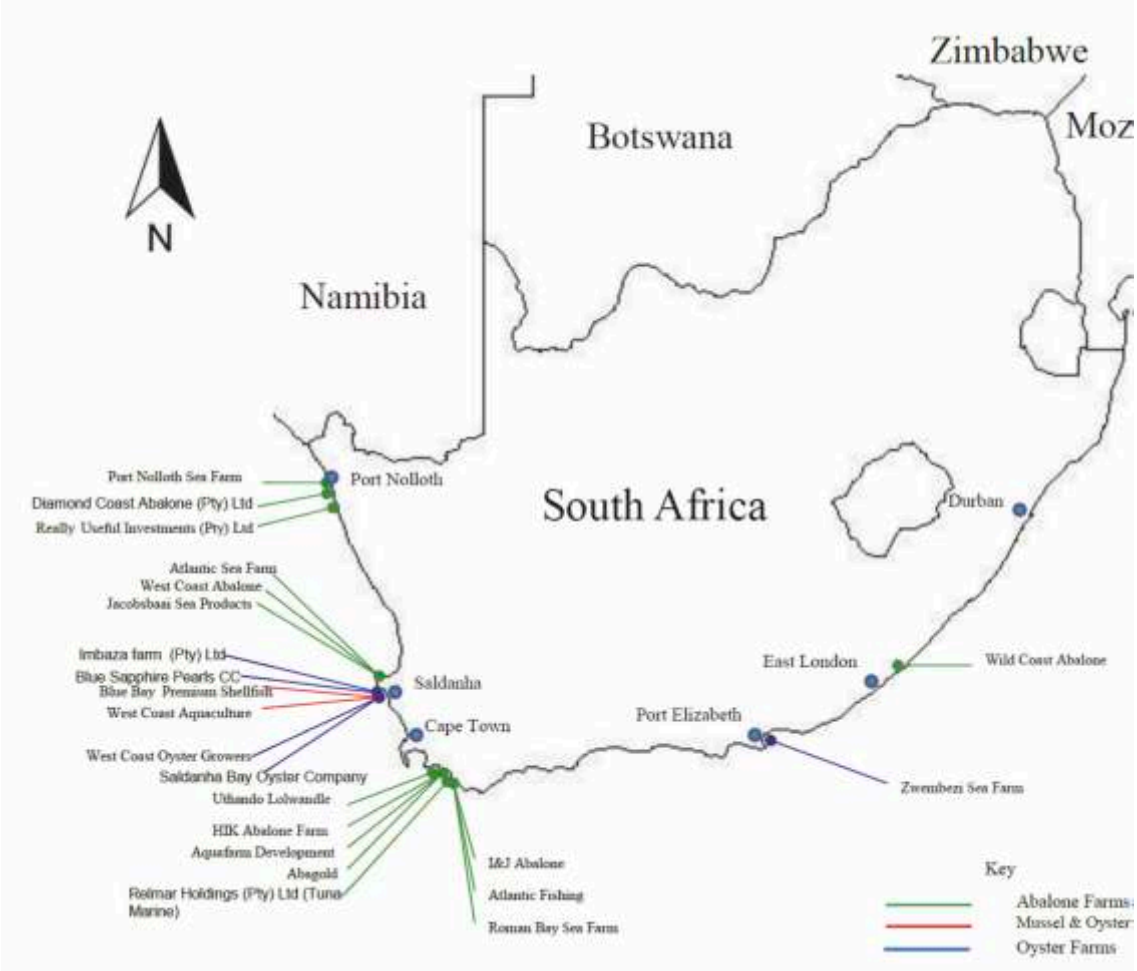

Figure 18. Distribution of shellfish farms along the South African coast.

All the abalone farms that were monitored are land based. The animals are grown in tanks and the water is pumped into the tanks by flow through and/or recirculation systems. Both the oyster and mussel farms were sea-based and grown on ropes suspended from floating rafts or buoys.

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 high 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 has been captured and analysed for marine aquaculture molluscan shellfish farms along the South African Coast. The biotoxins were analyzed separately for two regions viz. west of Cape Point and east of Cape Point. The other hazardous substances were analyzed for the South African coast as a whole.

There were 52 farm closure notices issued to shellfish farms by the SAMSM&CP office in 2013. Most of the farm closures were due to microbiological contamination (28), due to the presence of biotoxins (20) and a few due to non–compliance. There were no closures due to other hazardous substances viz. heavy metals, pesticides, PCBs or radionuclides.

3.7.4 Biotoxins

During 2013, 20 closure notices were issued to shellfish farm informing them that the biotoxin concentration in the shellfish had exceeded the regulatory limit. The biotoxins that resulted in the closures were PSP and DSP. ASP toxins were not detected on any of the shellfish farms.

The farms that were mostly affected by the presence of biotoxins were farms on the West Coast. As a result of this, some of the abalone farms on the West Coast were only allowed to market processed products where the abalone was eviscerated and scrubbed to remove the PSP toxins, this makes the product safe for human consumption (Figure 19). The mussel and oyster farms in Saldanha bay were not allowed to market any product when the biotoxins exceeded the regulatory limit. Each time the closure notices were issued, the Saldanha Bay farms were temporarily closed for an average period of four days. Mussels and oysters sampled from the sentinel sampling station at the mouth of the bay to indicate the presence of toxins in the bay. Therefore all the farms in the bay were closed simultaneously each time the regulatory limit in these samples exceeded the regulatory limit.

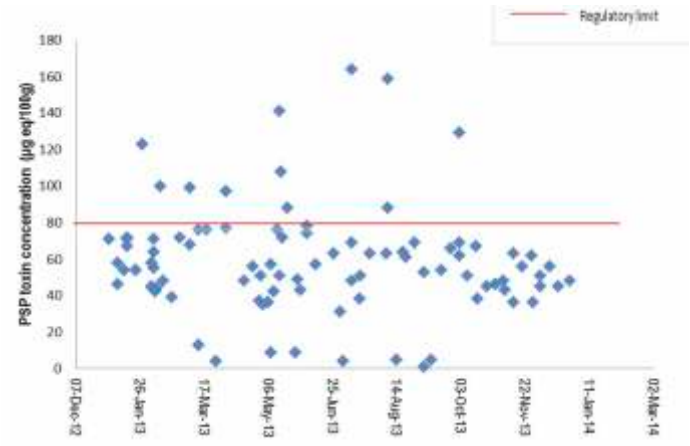

Figure 19: PSP toxin concentrations in shellfish cultured along the South African coast

3.7.5 Microbiological Contaminations

During 2013 the shellfish farms received 28 closure notices from the SAMSM&CP office informing them that the microbiological concentration in the shellfish had exceeded the regulatory level (Figure 20). The farms were prohibited from marketing live products; however, they were permitted to market processed products. Each time the closure notices were sent, the farm were temporarily closed for an average period of 10 days (Figure 21).

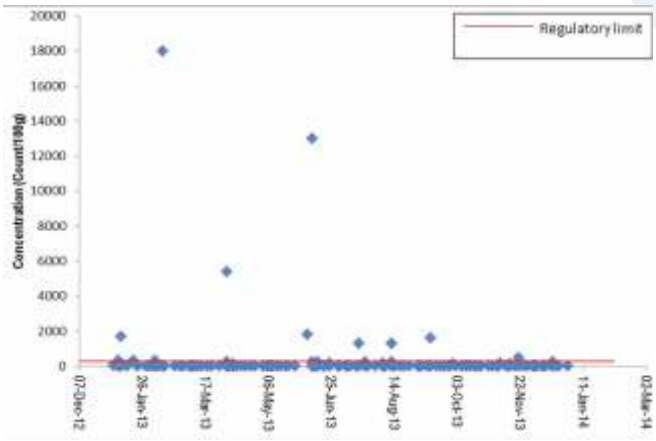

Figure 20: E. coli results for farms on the South African Coastline

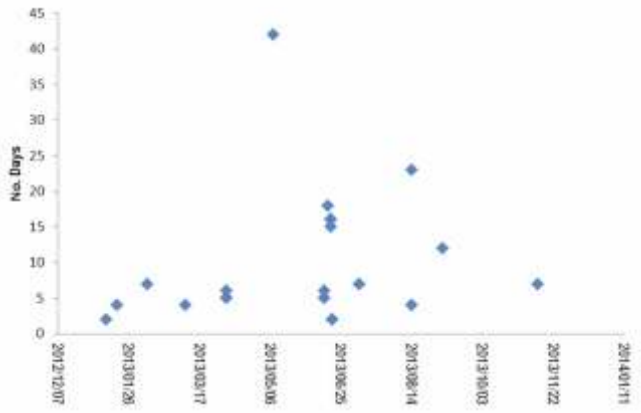

Figure 21: Number of days the farms were closed due to microbiological contamination

E. coli is used as an indicator species for the potential presence of sewerage borne diseases, as well as for the classification of production areas. The farms were all classified as "Approved Class A" based on the data received, except for the mussel and oyster farms that were classified as "Conditionally Approved Class A". Other microbiological species tested for included Salmonella and Vibrio. The E. coli concentrations of oysters in a wet storage facility in Saldanha Bay were also analysed on a weekly basis.

3.7.6 Heavy metals, Pesticides, PCBs and Radionuclides

There were no farm closures due to heavy metal concentrations exceeding the regulatory limits (Table 1). The heavy metals were, however, present in the cultured shellfish in low concentrations (Figure 22, Figure 23 and Figure 24).

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

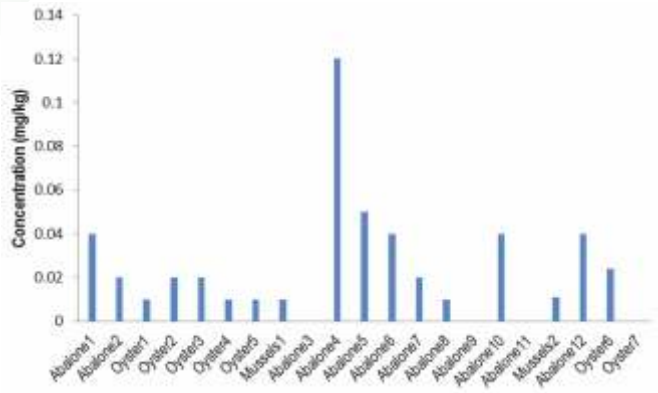

Figure 22. Mercury results for farms along the South African coast

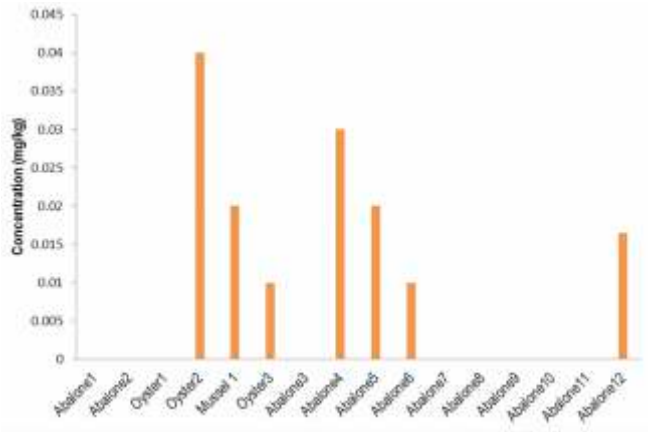

Figure 23. Inorganic arsenic results for farms along the South African coast

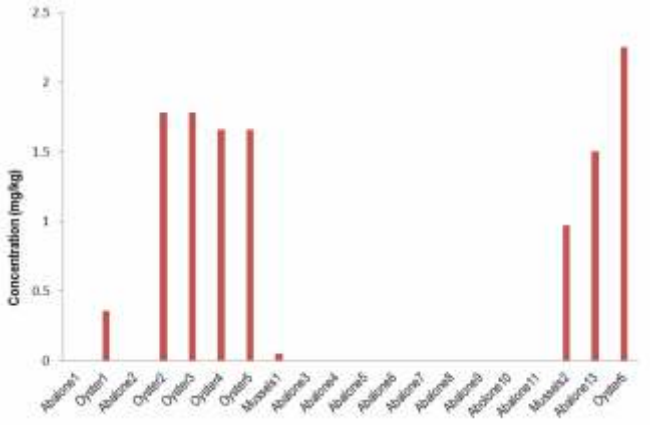

Figure 24. Cadmium results for farms along the South African coast

3.7.7 Compliance History

The farms with two exceptions have complied with the requirements of the SAMSM&CP. The main non-compliance was failure to do the required tests according to the frequency stipulated in the SAMSM&CP. In 2013 there were 4 non-compliance notices issued to these farms, and each time they were closed, they were closed for an average of 80 days. Only one farm was closed once, while the other farms were closed 3 times for 173, 63 and 86 days, respectively. The SAMSM&CP office has advised the farm on several occasions on how to comply with SAMSM&CP requirements. The implicated farms are now currently compliant to all the SAMSM&CP requirements.

3.7.8 Shellfish Monitoring Programme Progress

During 2013/14 the SAMSM&CP has been 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 staffs have assisted farms to understand the requirements of the SAMSM&CP and have enabled them to comply with its requirements. The SAMSM&CP office continued to implement the official phytoplankton monitoring programme and oversee the on-farm phytoplankton monitoring programme.

However, the programme has not been fully implemented as an effective early warning system due to the lack of capacity in the farming areas and the prolonged periods required for training staff.

The SAMSM&CP office has successfully implemented a Joint Biotoxin Monitoring Programme for the Saldanha Bay mussel and oyster farms. The biotoxin test results of the samples taken from the sentinel sites are shared by the programme members who jointly contribute to a joint fund managed by the farmers themselves. During 2014/15 the SAMSM&CP office will implement the Joint Microbiological Action Plan for Saldanha Bay and the Traceability Protocol for aquacultured products in order to bring the farms in line with Codex and national requirements.

The SAMSM&CP office in collaboration with the CSIR implemented the use of a LC-MS/MS for DSP toxin analysis to replace the mouse bioassay. The CSIR are in progress with the validation of an AOAC method 2005.06 to test for PSP toxins using the Liquid Chromatography Fluorescence Detector (LCFLD).

The SAMSM&CP staff has improved the communications with relevant stakeholder involved in the programme. Various meetings were held to exchange ideas to assist with the improvement of service delivery e.g. improvement of turn-around 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 in 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.

3.7.9 Shellfish Monitoring Programme conclusion for 2013

The SAMSM&CP report for 2013 outlines the status of 24 marine aquaculture shellfish farms and the implementation of the programme.

The abalone, mussel and oyster farms located to the west of Cape Point experienced more closures than the farms on the east of Cape Point due to biotoxin (PSP and DSP toxins) concentrations exceeding the regulatory limits. The use of LC-MS/MS instrument has significantly decreased the number of farm closures attributed to DSP toxin accumulation in the shellfish.

The temporary closures due to E. coli concentrations exceeding the regulatory limit were fewer than the closures related to biotoxins. The E. coli that was present in shellfish samples appears to be associated with heavy rainfall periods and will thus be monitored more frequently during heavy rainfall periods.

3.8 Marine Aquaculture Site Surveillance in 2013

Site surveillance of the marine aquaculture sector has played a vital role since 2008 in updating information on growth in the sector and 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 that the Chief Directorate: Monitoring, Control and Surveillance (MCS) performs its role in protecting the wellbeing of the industry. This has also ensured open channels of communication between the Department and the marine aquaculture industry in the development of permit conditions for the sector.

In 2013, the Department conducted site surveillance of nine marine aquaculture Right Holders, including six abalone (Haliotis midae) farms, one oyster (Crassostrea gigas and Striostrea margeritacea) farm and two mussel (Mytilus galloprovincialis) farms, between Port Nolloth in the Northern Cape and Gansbaai in the Western Cape. In 2010, the Department initiated an economic survey through the Directorate: Aquaculture Technical Services (ATS) and a shellfish sanitary survey through the Directorate: Sustainable Aquaculture Management (SAM).

This has been an ongoing exercise implemented in collaboration with site visits to marine aquaculture operations 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 the continuous open channel for communication from the marine aquaculture sector through the continued support provided in implementing continued site surveillance.

3.9 Aquatic 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 lack of co-ordination between relevant government Departments, and also a shortage 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 it relates 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 co-ordinated national aquatic animal health and welfare program, 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 Aquatic Animal Health Surveillance and Disease Control system

A disease is a significant threat to the sustainability of farmed and wild aquatic stocks worldwide. In aquaculture, if a disease is detected early, eradication is possible. However, in wild stocks, once a disease is established eradication is not always possible and control can be difficult. The Department of Agriculture, Forestry and Fisheries is the competent authority primarily responsible for monitoring and conducting disease surveillance; and ensuring disease are not spread between farms and to the wild ecosystem.

In order to assist with minimizing the risk and spread of diseases, to address these short comings the Directorate Sustainable Aquaculture Management has endeavoured to provide basic aquatic animal health and welfare services for monitoring and regulating diseases in the form of annual stock assessments to be conducted on all marine aquaculture facilities.

3.9.3 Establishment of the MINTEC Veterinary Working Group's Sub-Committee on Aquatic Animal Health

Recognizing the critical importance of aquatic animal health for overall sustainability, profitability and public health, the Department has established the Sub-Committee on Aquatic Animal Health, a sub-committee of the MINTEC Veterinary Working Group. The Sub-Committee functions as a forum for communication and coordination amongst government, academia, industry and private parties, with the main objective of providing a formal and coordinated mechanism to develop and drive the implementation of a National Aquatic Animal Health Programme for South Africa.

4. STATUS OF FRESHWATER AQUACULTURE 2013

4.1 Overview of Freshwater Aquaculture industry in South Africa 2013

South Africa's Freshwater Aquaculture industry is still developing in terms of production and contribution towards the South African economy even though it was introduced in the early 1800s. This is due to lack of skills development, transformation and as well as awareness around the aquaculture sector which creates a major challenge in the development of the industry. Recently associations for certain sub-sectors have been developed namely: 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 to have 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 not all freshwater farmers belong to an Association. Production data for sub-sectors 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 sub-sectors include trout (*Onchorynchus mykiss* and *Salmo trutta*), tilapia (*Oreochromis mossambicus, Oreochromis niloticus* and *Tilapia 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 7).

There were 193 freshwater farms operational in 2013. Mpumalanga Province had the highest number of farms operating in 2013 with a total of 42 farms. Other provinces dominated by freshwater aquaculture activity were Gauteng with 36 farms, followed by Western Cape with 27 farms, Limpopo with 25, North West with 23 and KwaZulu Natal with 16. In terms of production, Free State, Northern Cape, North West, kwaZulu Natal and Eastern Cape Provinces are still developing aquaculture provinces with not much commercial production as yet. Trout is the most cultured freshwater species and its distribution expands across the Western Cape, Eastern Cape, Mpumalanga and KwaZulu-Natal Provinces. Tilapia is the second largest cultured species in the country and farms are located nationwide.

Table 7. Freshwater Aquaculture species cultured in South Africa in 2013 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

4.2 Freshwater Aquaculture production 2006 - 2013

The reported freshwater aquaculture production in 2013 was 1816.41 tons (Table 8). Trout was the largest freshwater aquaculture sub-sector with the production of 1521.70 tons in 2013 (Table 8). The second largest sub-sector was tilapia which had a total production of 289.71 tons. The third sub-sectors were marron crayfish which contributed 5 tons. The catfish sub-sector produced zero tons in 2013. Total freshwater aquaculture production has shown an increase of 150.74 tons (8.29%) from the year 2012 to 2013 for the four sub-sectors (Figure 26).

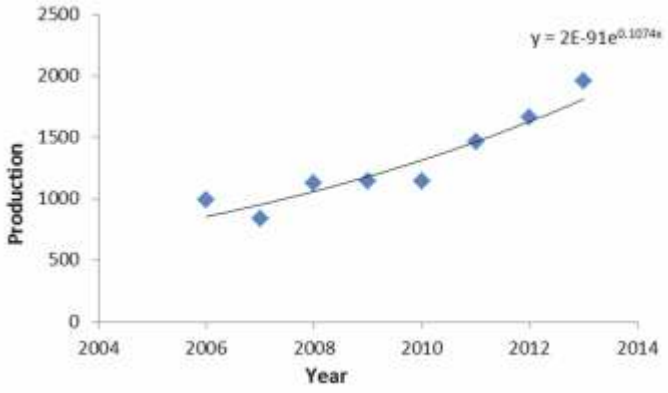

Figure 25. Freshwater aquaculture overall production from 2006 – 2013.

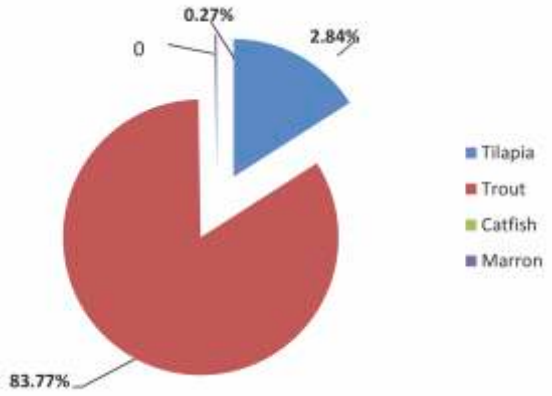

Figure 26: The percentage contribution of each freshwater aquaculture sub-sector to total production in 2013.

Table 8. South Africa's Freshwater aquaculture production 2006-2013.

	Year and Production (tons)								Total production (tons) 2006– 2013
Sub-sector	2006	2007	2008	2009	2010	2011	2012	2013	
Tilapia	0	0	0	10	10	100	234.17	289.71	**643.71**
Trout	807	658	943	948.62	950	1199*	1428	1521.70	**8455.32**
Catfish	180	180	180	180	180	160	0	0	**1060**
Marron	0.2	0.4	0.4	0.4	0.8	0.8	3.5	5	**11.5**
Totals	**987.2**	**838.4**	**1123.4**	**1139.02**	**1140.8**	**1459.8**	**1665.67**	**1816.41**	**10170.53**

4.3 Analysis of the Freshwater Aquaculture Industry

4.3.1 Trout Sub-sector

The trout sub-sector has contributed 83.77% of South Africa's total freshwater production in 2013, recording a total production of 1521.70 tons (Figure 27). The trout farms are currently located in the Western Cape, Mpumalanga, Eastern Cape and KwaZulu Natal provinces (Figure 28 and Figure 29). Note production data was not obtained for KwaZulu Natal and Eastern Cape and thus not added into the total production for 2013. Onchorynchus mykiss and Salmo trutta are the two cultured species in South Africa. The technology used to cultivate these species includes raceway, pond, cage culture and recirculating systems. A total of 47 farms were recorded in the industry in 2013.

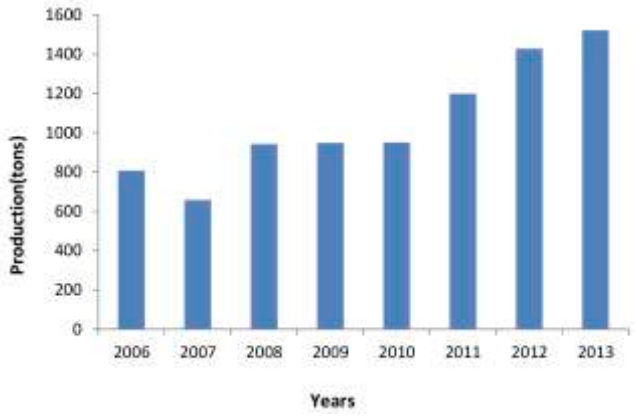

Figure 27. Trout production for the years from 2006 – 2013.

Figure 28. Pond culture system on a trout farm located in the Lydenburg district, Mpumalanga Province.

Figure 29. Trout processed and ready for the market Lydenburg.

4.3.2 Tilapia sub-sector

The tilapia sub-sector 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)*. This sub-sector contributed 14.78% to South Africa's total freshwater production, recording 289.71 tons (Figure 30). The sub-sector also had an increase of 55.54 tons between the years 2012 – 2013 which illustrates the development of the sub-sector. Most tilapia farmers are small scale farmers and they employ recirculation systems (Figure 31) and pond culture methods, but recently farming tilapia in green houses has been implemented. The industry recorded a growth of 32 new farms which contributed to the increase in production. A total of 97 farms were recorded in the industry in 2013.

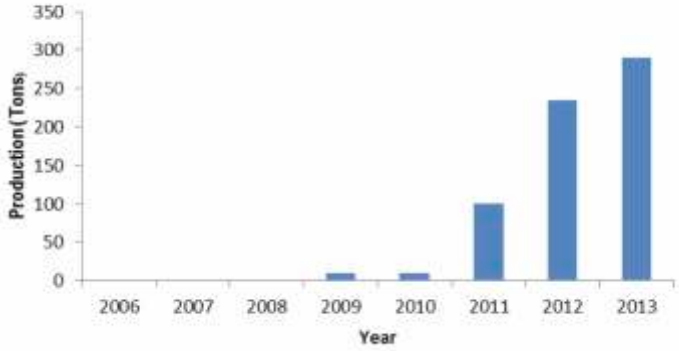

Figure 30. Tilapia production for the years 2006 – 2013.

Figure 31. Tilapia farm located Tierport, Gauteng

4.3.3 Catfish Sub-sector

The catfish sub-sector 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 and 2013 (Figure 32). In terms of 2013 production the catfish industry recorded zero production due 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 utilize high density pond, raceway and recirculation systems (Figure 33 and Figure 34). The industry comprised of 10 farms in 2013.

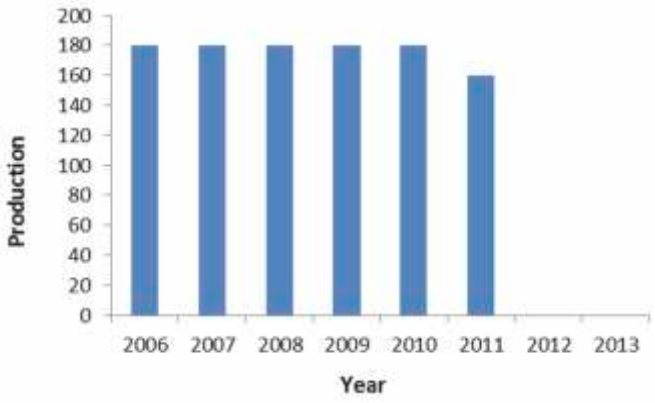

Figure 32. Catfish production for the years 2006 – 2013.

Figure 33. Catfish farm located in Camdeboo, Eastern Cape.

Figure 34. Catfish broodstock on farm in Camdeboo, Eastern Cape

4.3.4 Marron crayfish Sub-sector

Marron crayfish *(Cherax tenuimanus)* is exotic to South Africa. The sub-sector is still developing and there is only one farmer culturing the species in the country. A total of 5 tons was produced in 2013 with increase of 1.5 tons (Figure 35). The current marron crayfish farm is located in the Eastern Cape. This species is primary cultured in tanksduring the juvenile phase of production, and semi-intensive pond culture for the grow-out phase of production (Figure 36 and Figure 37). The industry is set to become well established in the Eastern Cape.

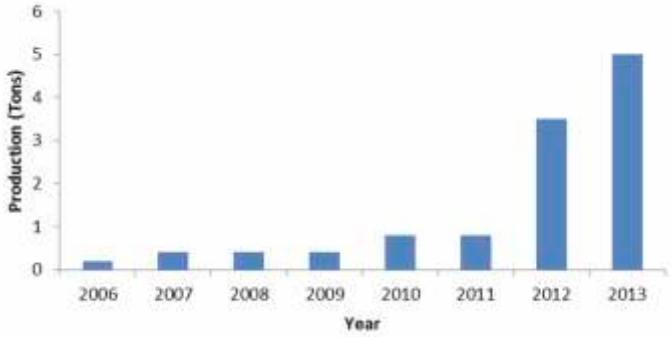

Figure 35. Marron crayfish production for the years 2006 – 2013.

Figure 37. Marron crayfish ready for the market from a farm located in Smiling Valley.

Figure 36. Marron crayfish farm located in Smiling Valley, Eastern Cape.

5. PROVINCIAL ANALYSIS OF SOUTH AFRICA'S AQUACULTURE SECTOR IN 2013

It must be noted 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 is based on information provided to DAFF by aquaculture associations and Provincial Departments of Agriculture (Table 9 and Table 10).

5.1 Eastern Cape

The Eastern Cape had 18 farms in 2013 which includes both marine and freshwater aquaculture. These farms contributed to 399.55 tons (excluding carp, Koi carp and ornamentals) to South Africa's total production. The production was made up of five sub-sectors, namely abalone, finfish (dusky kob), oysters, tilapia and marron crayfish. Table 10 and 11 provides an overview of the aquacultures sub-sectors total number of farms and production per species and province.

Marine aquaculture industry in the Eastern Cape there had eight farms in operation; these include two abalone farms (including one newly established ranching operation), two dusky kob farms and four oyster farms. The total marine aquaculture production recorded for the Eastern Cape was 376.55 tons.

The freshwater aquaculture recorded 12 farms in operational during 2013. These farms included three 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 23 tons which included two sub-sectors namely tilapia and marron crayfish. Note that the trout sub-sectors production data for the Eastern Cape was not recorded as there was insufficient information.

5.2 Free state

Total numbers of farms operating in the Free State Province were seven freshwater aquaculture farms. These farms produced a total of 0.8 tons in 2013 (excluding carp, Koi carp and ornamentals). The sub-sectors 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 2013. Tilapia accounted for the total production in the province with a total of 0.8 tons.

5.3 Gauteng

Gauteng Province recorded a total of 36 farms in 2013 and which only included freshwater aquaculture farms. These farms contributed 53.55 tons (excluding carp, Koi carp and ornamentals) to South Africa's total production, increasing by 8. 1 tons from the production recorded in 2012. The sector was made up of five sub-sectors, namely tilapia, catfish, carp, koi carp and farms cultivating ornamental species. Tilapia accounted for the total production and amounted to 53.55 tons in 2012.

The farms which made up the freshwater industry in the Gauteng Province included 22 tilapia farms, one catfish farm, two carp farms, six koi carp farms and four farms cultivating ornamental species.

5.4 KwaZulu Natal

In 2013, 17 aquaculture farms were operating in KwaZulu Natal. These farms contributed a total of 2.31 tons (excluding carp, Koi carp and ornamentals) to the total production of the sector. This tonnage was from one sub-sector 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 2013 was zero. There is only one marine species currently being farmed in KwaZulu Natal, the species is dusky kob.

With regards to Freshwater aquaculture there were 16 farms in operation during 2013. A total of five farms were farming tilapia, five farms were culturing rainbow trout and six farms were operating ornamental farms of which two farms culturing Koi carp and four culturing a verity of ornamental species. Total freshwater aquaculture production in KwaZulu Natal was 2.31 tons.

5.5 Limpopo

Limpopo Province recorded a total of 25 farms in 2013. The following sub-sectors 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 108 tons was made up of only tilapia production. It should be noted that the 17.4 tons increase in production in the province was primarily due to the increase in tilapia farms from 13 to 25 farmers. The freshwater industry in Limpopo Province included 25 tilapia farms, three catfish farms, one koi carp farm and two ornamental farms.

5.6 Mpumalanga

In 2013, 42 farms were recorded in Mpumalanga. These farms produced a total production of 947.10 tons which is the second highest production recorded out of all the provinces. The sub-sectors making up the industry consisted of tilapia, trout and koi carp. The two sub-sectors contributing to the total production included tilapia and trout recording 23.1 tons and 924 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 11 farms in the province including freshwater and marine aquaculture farms. The total production for the province was 4.5 tons in 2013. 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 six marine farms and five freshwater farms. The Marine

aquaculture industry consisted two sub-sectors namely abalone and oyster. There was five abalone farms (including two established ranching operations) and one oyster farm recorded in the province.

The sub-sectors 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 2013.

5.8 North West

The North West Province has 23 farms producing freshwater aquaculture species. These farms contributed a total of 77.35 tons of production in 2013. The sub sectors which made up the industry included tilapia, catfish and koi carp. The only sub-sector that recorded production was tilapia with a total of 77.35 tons.

Farms that made up the industry in the North West included 21 tilapia farms, one catfish farm and one koi carp farm.

5.9 Western Cape

The Western Cape recorded the most aquaculture of farms in South Africa recording a total of 51 farms. There are both marine and freshwater farms in the sectors which produced a combined total of 3353.25 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 2013 was 24. The farms making up the marine aquaculture industry included 13 abalone farms, 1 finfish farm, 3 mussel farms and 6 oyster farms. The total marine aquaculture production recorded for the Western Cape was 2 609.15 tons.

The total number of farms recorded in the freshwater industry in 2013 was 27. The sub-sectors making up the industry were tilapia, trout, carp, koi carp and ornamentals. The sub-sectors contributed 744.10 tons which came entirely from the tilapia and trout sub-sectors contributing 2.1 tons and 742 tons respectively.

Table 9.Total number of farms recorded in South Africa's aquaculture sector in 2013.

Species	EC	FS	GP	KZN	LP	MP	NC	NW	WC	Total
Abalone	1	0	0	0	0	0	4	0	13	20
Finfish	3	0	0	1	0	0	0	0	1	5
Mussels	0	0	0	0	0	0	0	0	3	4
Oysters	2	0	0	0	0	0	1	0	6	9
Total Marine	**6**	**0**	**0**	**1**	**0**	**0**	**5**	**0**	**24**	**36**
Tilapia	3	1	22	5	19	20	3	21	2	97
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	**12**	**7**	**35**	**16**	**25**	**42**	**5**	**23**	**27**	**193**
Total Marine and Freshwater	**18**	**7**	**35**	**17**	**25**	**42**	**11**	**23**	**51**	**229**

Table 10. Total production recorded in South Africa's aquaculture sector in 2013.

Species	EC	FS	GP	KZN	LP	MP	NC	NW	WC	Total
Abalone	170	0	0	0	0	0	0	0	1299.78	1469.78
Finfish	122.55	0	0	0	0	0	0	0	0	122.55
Mussels	0	0	0	0	0	0	0	0	1116.14	1116.14
Oysters	84	0	0	0	0	0	0	0	193.23	277.23
Total Marine	**376.55**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2609.15**	**2985.70**
Tilapia	18	0.8	53.55	2.31	108	23.1	4.5	77.35	2.1	289.71
Trout	0	0	0	0	0	924	0	0	597.7	1521.70
Catfish	0	0	0	0	0	0	0	0	0	0.00
Marron Crayfish	5	0	0	0	0	0	0	0	0	5.00
Total Freshwater	**23.00**	**0.80**	**53.55**	**2.31**	**108.00**	**947.10**	**4.50**	**77.35**	**599.70**	**1816.41**
Total Marine and Freshwater	**399.55**	**0.80**	**53.55**	**2.31**	**108.00**	**947.10**	**4.50**	**77.35**	**3208.85**	**4802.11**

6. AQUACULTURE ECONOMIC OVERVIEW OF SOUTH AFRICA'S AQUACULTURE SECTOR 2013

6.1 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 2013. 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.

6.2 Supply availability

The South African aquaculture production volume continues to grow. In 2013, local production of farmed fish was 4 802.11 tons (excluding seaweed, carp, koi carp and ornamentals), increasing by 18.22% from 3 926.89 tons produced in 2012 (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 30.04% to 2 985.70 tons (excluding seaweed) during 2013 in comparison to 2012. All four marine aquaculture sub-sectors increased their supply to significantly contribute to the increase in production.

The freshwater aquaculture industry recorded an increase of 8.29% to 1 816.41 tons in 2013. 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 6.16% 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 2013, tilapia's recorded production was 289.71 tons, increasing the sub-sectors production volume by 23.81% from the 234 tons produced in 2012. This is the highest recorded production figure over the last five years.

The catfish sub-sector has consistently produced on average production of 180 tons per year from 2008 until 2011. There was no market size catfish was produced during 2013.

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. Then Marron crayfish sub-sector increase production by 42.87% to 5 tons in 2013.

6.3 Value of Aquaculture Sector

The total value of the aquaculture sector was estimated at R 696 million, increasing by 38.1% between 2012 and 2013. This total estimated value includes both freshwater and marine aquaculture industry and was based on the sales of aquaculture products. Locally, aquaculture continues to be dominated by abalone production which was estimated to be R529 million in 2013, representing 76.01% of the total rand value for the entire aquaculture sector.

Trout production was the second largest contributor at R113 million, representing 16.27% of the total value. Mussels were worth R20 million, followed by oysters, R16.6 million, Tilapia, R 9.9 million and dusky kob at R6 million representing 2.89%, 2.39%, 1.42% and 0.88%, respectively. Marron crayfish contributed the lowest in terms of value, only contributing an estimated value of R1 million contributing 0.14% to the total value of the aquaculture sector (Figure 38).

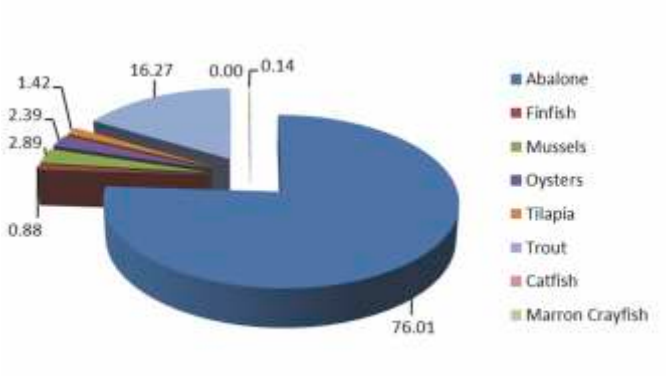

Figure 38. The estimated percentage contribution of the total value of South Africa's aquaculture sector in 2013.

6.4 Aquaculture investment

The launch of the Aquaculture Development and Enhancement programme (ADEP) in 2013 through the DAFF and the Department of Trade and Industry's (the dti) , contributed to the tremendous projected growth of investment in the sector, especially the marine aquaculture industry where the private sector invested substantial amounts of money. The ADEP initiative seeks to promote and encourage investment into the sector.

Projected capital investment of approximately R322 million (A total of R332 million included crocodile farming) representing an increase of 33.6% was realised in the sector during 2013. The abalone sub-sector invested approximately R223.9 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 R78.6 million was invested in the sub-sector during 2013. The total recorded investment for mussels was R6.6 million and tilapia at R7.7 million. A total of R5.7 million was invested into the secondary sector which included a fishmeal and fish oil processing establishment (Figure 39).

The Western Cape Province made up the majority of the total projected investment in 2013, investing a total of R241 million into the aquaculture sector (Figure 40). The sub-sectors which invested in the Western Cape Province included abalone, Dusky kob, processing and mussels. The Eastern Cape Province was the second largest in terms of projected investment, which recorded a total projected investment of R73.7 million and included the dusky kob sub-sector. Gauteng Province recorded the least projected investment with a total R7.7 million and included the tilapia sub-sector.

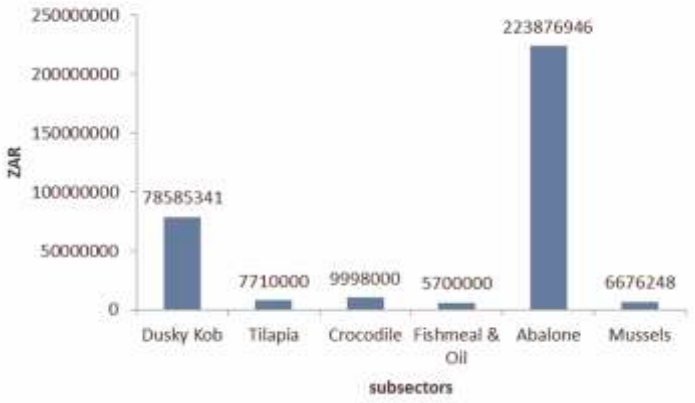

Figure 39. Capital investments made by the different aquaculture sector by species group during 2012.

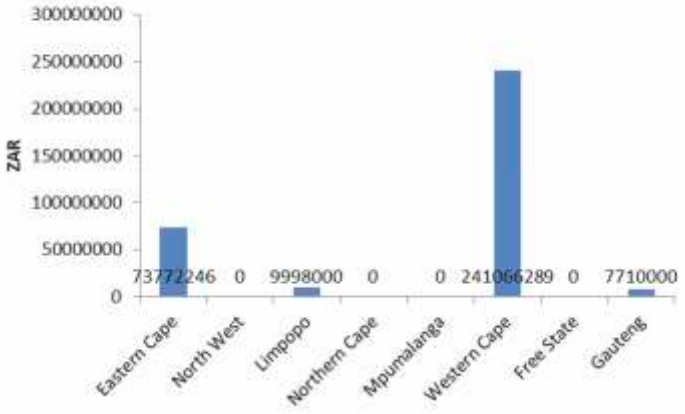

Figure 40. Represents the capital investments made by the different aquaculture sector by species group during 2013.

6.5 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. The employment figure had increased to 2 831 in 2013 as a result of the projected investment into the aquaculture sector.

A total of 604 jobs were created in the sector in 2013, with the majority of employment increase in the abalone sub-sector as illustrated in Figure 41. The Western Cape Province was the major contributor to the increase in employment with an increase of 500 employees in 2013 (Figure 42).

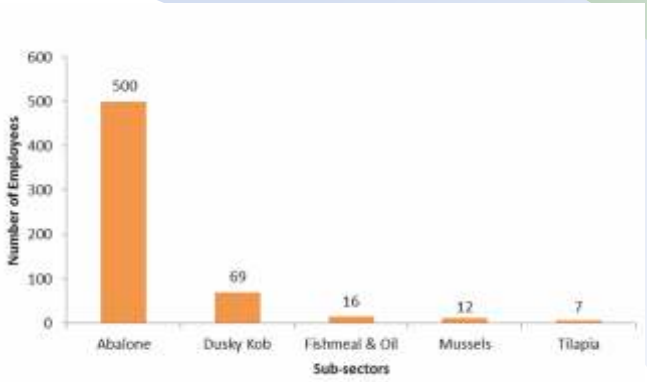

Figure 41. Total aquaculture employment contributed by each sub-sector in 2013.

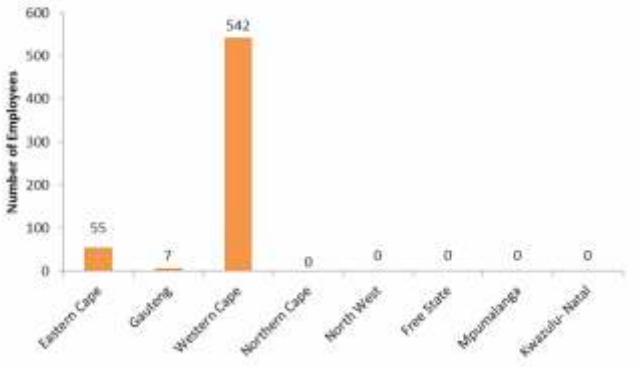

Figure 42. Total aquaculture employment contributed by each Province in 2013.

The Western Cape Province is still the largest employer with 1 846 employees, representing 65% of the total employment, followed by the Eastern Cape Province with 413 and Limpopo with 179. Furthermore Mpumalanga Province recorded 138 employees while the North West and KwaZulu Natal Provinces employed 89, 83 employees respectively. Gauteng, Northern Cape and Free State Provinces recorded the least number of jobs, employing less than 50 individuals during 2013(Figure 43).

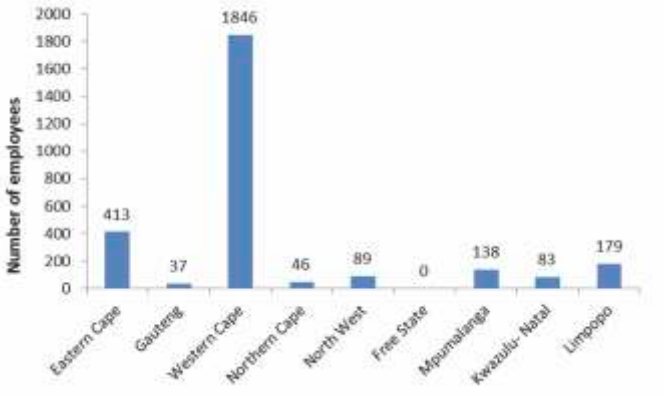

Figure 43. Full time employment in the South Africa's aquaculture sector in 2013.

6.6 Market Structure

Aquaculture products are traded in the local and international market and this varies depending on the species produced and the size of the business (the producer). Most new entrants in the industry sell their products to local retailers, particularly the fresh water species; tilapia and dusky-kob. The more advanced businesses make use of distributing agents, marketing companies or in-house marketing experts. Some producers send their products to processing plants which also sell the processed products in either the local or international market. Marine species such as abalone is mostly traded in the international market to Asian countries such as China.

6.7 Export Market

6.7.1 Abalone

A total of 602.71 tons of abalone with an estimated worth of R237.5 million was exported to the Asian market in 2013. Abalone products are exported in variety of forms, but mostly as canned, dried and live products. During 2013, locally farmed abalone was exported to China, Hong Kong, Singapore, Malaysia, Taiwan, Korea and Japan. Figure 44 and Figure 45 demonstrates the trend in the export of abalone throughout 2013 and the value thereof.

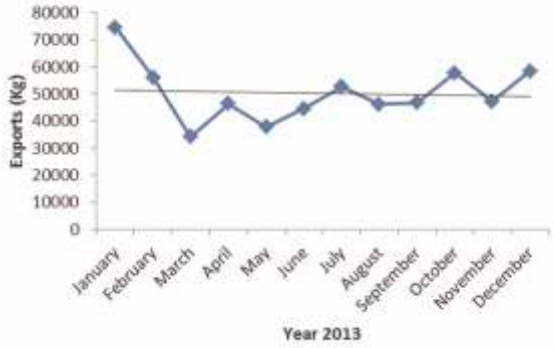

Figure 44. South Africa's abalone exported in 2013.

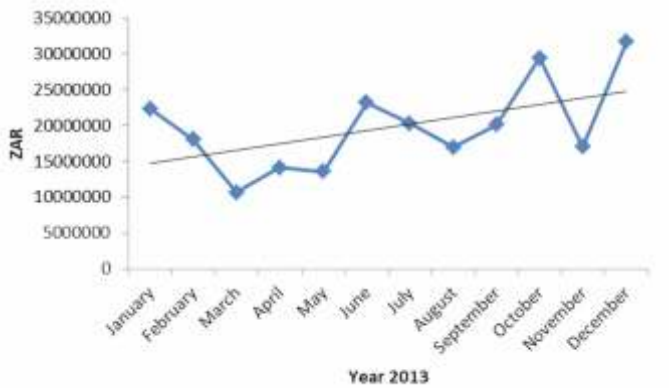

Figure 45. Value of abalone exported in 2013

6.7.2 Oysters

In 2013 South Africa exported approximately 32.97 tons of oysters valued at R2.3 million (Figure 46). Over 98% of the South Africa's oyster were exported to Asia whilst a small proportion was exported to the African market. Figure 47 demonstrate the trend in the export of the value of oysters from South Africa's to the global market. The main destinations for exports were Thailand, Hong Kong, China, Vietnam, Zambia and Mozambique.

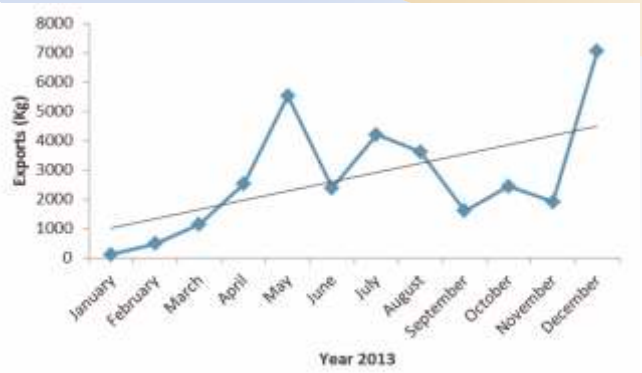

Figure 46. South Africa's oyster exports during 2013.

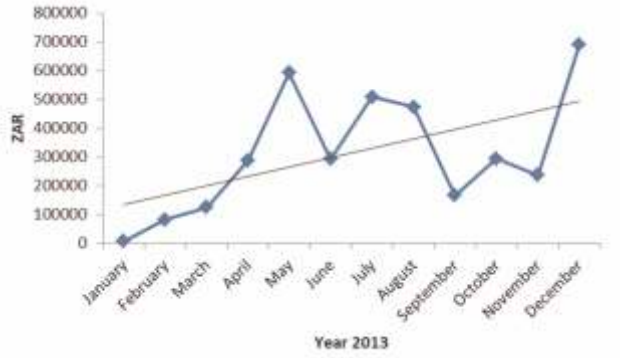

Figure 47. Value of oyster exports during 2013.

6.7.3 Mussels

South Africa exported approximately 63 tons of mussels valued over R6 million in 2013 (Figure 48 and Figure 49). The mussel exports decreased by one tonne 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 of South Africa's mussels during 2013.

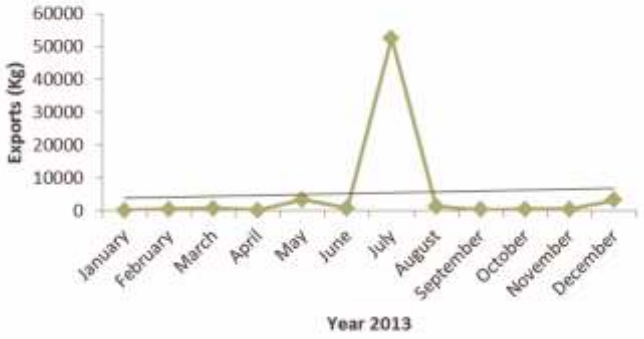

Figure 48. South Africa's mussel exports during 2013.

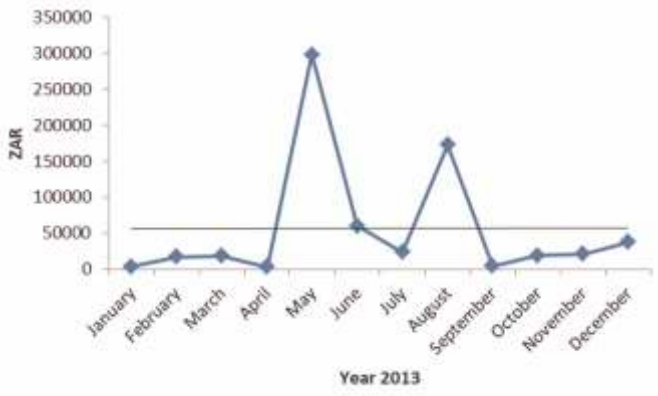

Figure 49. Value of mussel exports during 2013.

6.7.4 Catfish

South Africa exported approximately 33 tons of catfish with a value of R57 718 to Nigeria in 2013 (Figure 50 and Figure 51). The aquaculture sector did not produce catfish for the market in 2013. The catfish exported may have been obtained from fisheries located within South Africa. This may give an indication of the potential for catfish farming in South Africa as the market channels are available to be exploited.

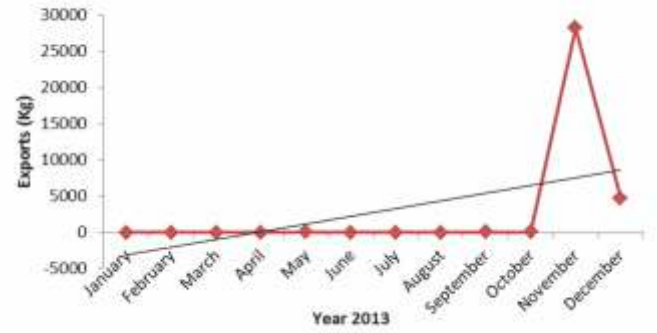

Figure 50. South Africa's catfish exports during 2013.

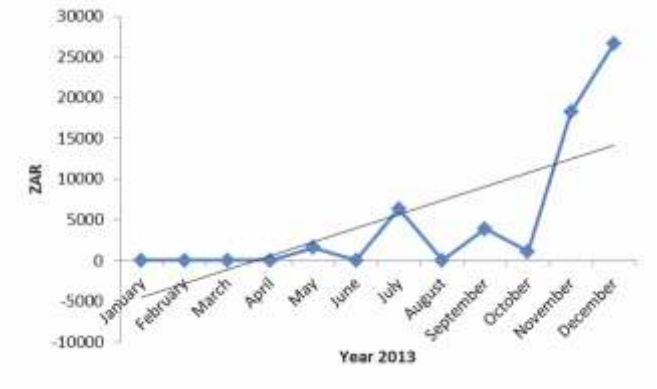

Figure 51. Value of catfish exports during 2013.

6.7.5 Tilapia

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. South Africa exported more than 86 tons of fish valued approximately at R1.4 million during 2013. The top three export destinations for tilapia were United Arab Emirates, United States of America (USA) followed by Zimbabwe. This is illustrated in Figure 52 and 53 below, representing the exported quantity volume and value of tilapia during 2013.

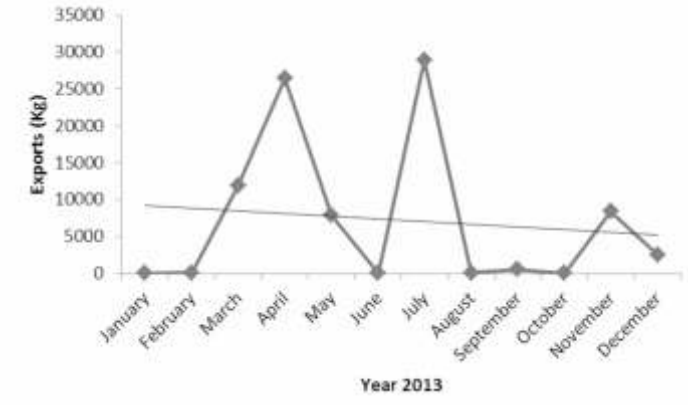

Figure 52. Value of tilapia exports during 2013.

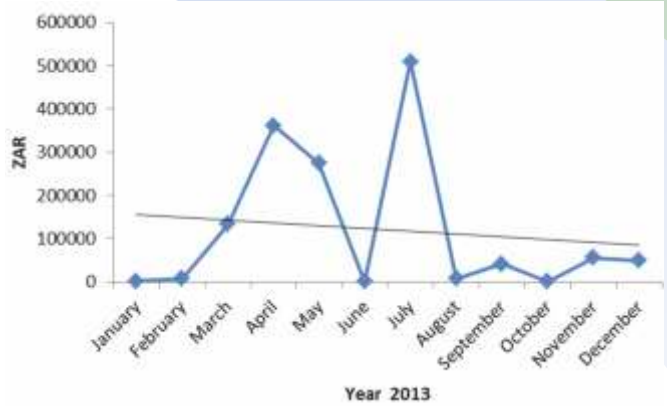

Figure 53. South Africa's tilapia exports during 2013

6.7.6 Trout

South Africa did not export large volumes of trout in 2013 as 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 purposes; 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. A total of 5.9 tons with a value of R98 470 was exported to a number of different countries during 2013 (Figure 54 and Figure 55). Mozambique was the leading importer for trout followed by Japan.

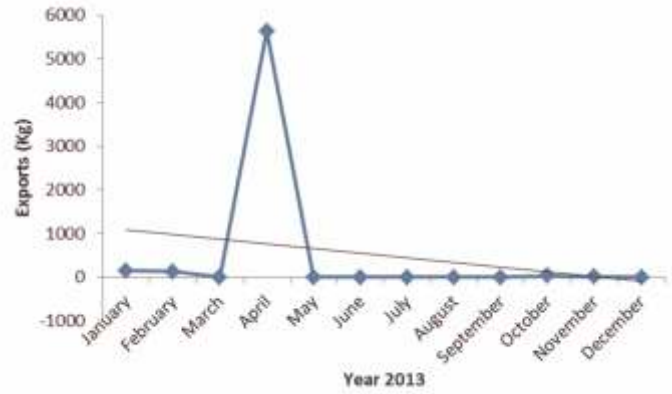

Figure 54. South Africa's trout exports during 2013.

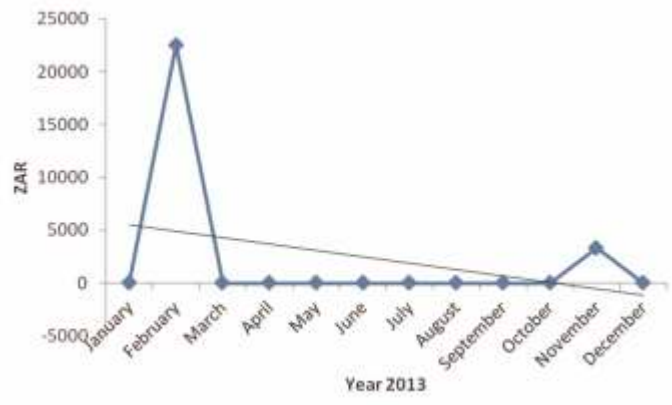

Figure 55. Value of trout exports during 2013.

6.7.7 Salmon

During 2013, 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 39 tons of salmon valued at R2.3 million was exported. The USA was the main exports destination followed by Zimbabwe, importing approximately 5 tons. Figure 56 and 57 illustrates South Africa's export of salmon and the value thereof.

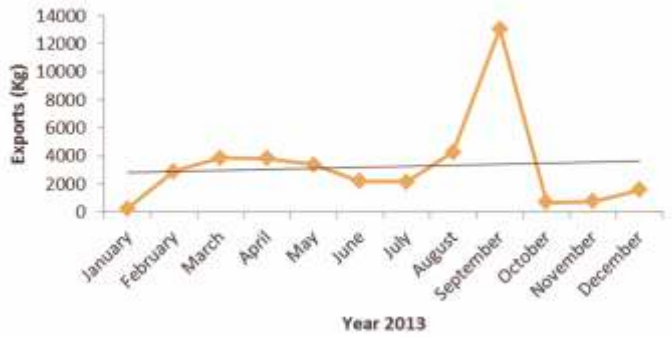

Figure 56. South Africa's salmon exports during 2013.

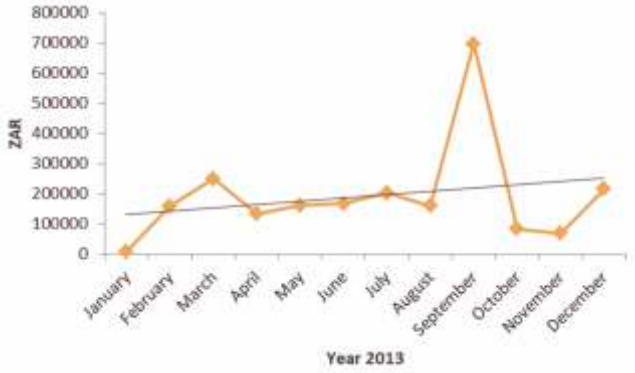

Figure 57. Value of salmon exports during 2013.

6.7.8 Carp

South Africa exported a total of 0.16 tons of carp during the year 2013 valued at R 549 076.00. The carp export destination was mainly Mozambique. There were no reported exports of carp during the year 2012.

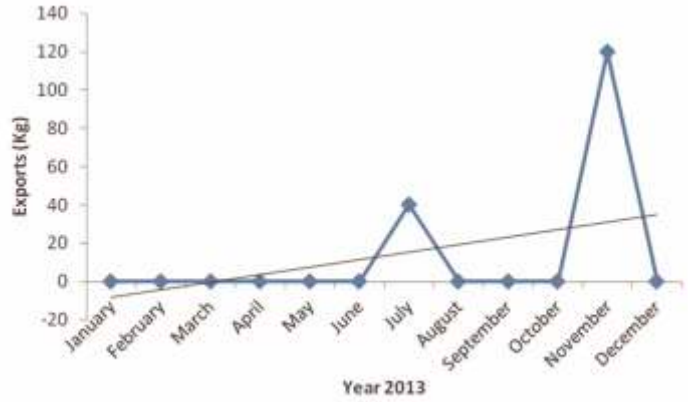

Figure 58. South Africa's carp exports during 2013.

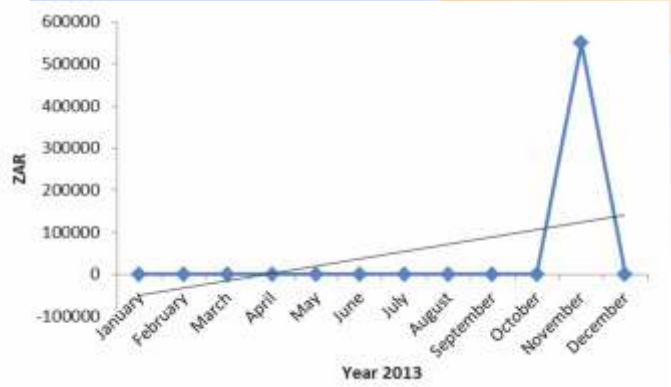

Figure 59. Value of carp exports during 2013.

6.8 Import Market

6.8.1 Catfish

South Africa imported a total of 20 tons from Viet nam in the year 2013 (Figure 60). This represents an 86% decrease in the quantity imported during the year 2013 compared to the year 2012. The fall in the quantity of imports can be attributed to increase in local production of Catfish by farmers who recognised the market potential of the Catfish sub-sector. The estimated value of imported catfish was R488 247.00 in the year 2013 (Figure 61).

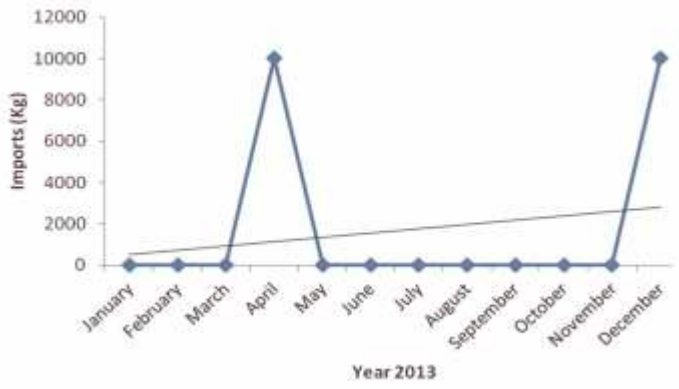

Figure 60. South Africa's imports during the year 2013.

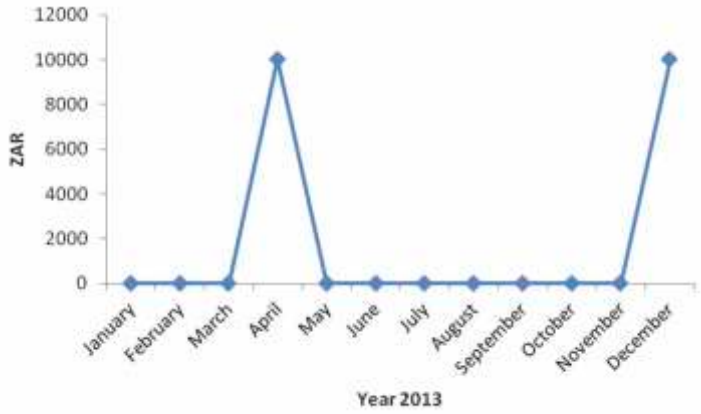

Figure 61. Value of South Africa's Imports during the year 2013.

6.8.2 Tilapia

A total of 117 tons was imported by South Africa during the year 2013 with 85% of the imports coming from China and the rest are from Namibia, Mozambique and Uruguay (Figure 62). During the year 2013 the quantity of Tilapia imports decreased by 84%. The fall in the quantity of imports can be attributed to increased local production by farmers who have identified market potential of the sub-sector. The value of Tilapia imports for the year 2013 is R1 4 million (Figure 63).

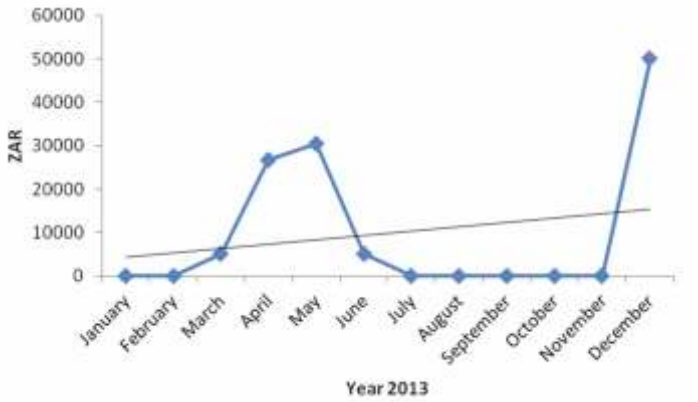

Figure 62. South Africa's Tilapia imports during the year 2013.

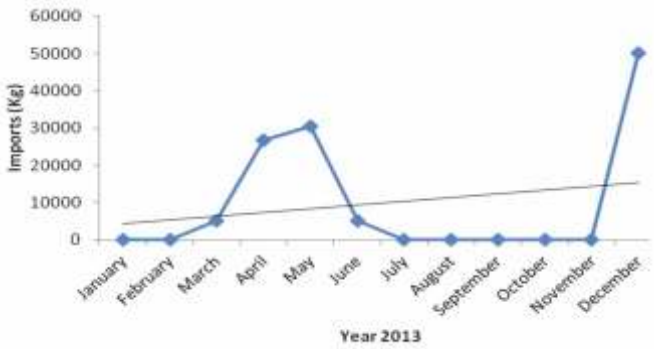

Figure 63. Value of South Africa's Tilapia imports during the year 2013.

6.8.3 Trout

South Africa imported a total of 26 tons of Trout during the year 2013 (Figure 64). The quantity of imports decreased by 95% compared to the year 2012. South Africa imported 87% of the Trout from Chile, with 13% coming from Taiwan and the rest comes from Norway. The value of the Trout imports during the year 2013 is R 383 804.00 (Figure 64).

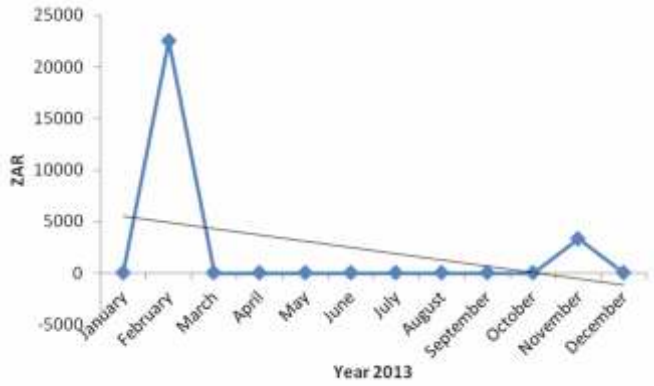

Figure 64. South Africa's Trout imports during the year 2013.

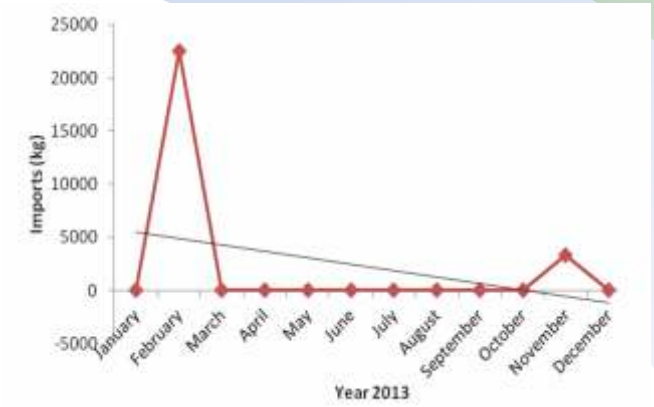

Figure 65. Value of South Africa's Trout imports during the year 2013.

6.8.4 Pacific Salmon

South Africa imported a total of 176 tons valued at R10 804 792.00 of Pacific Salmon during the year 2013 (Figure 66 and Figure 67). During the year 2013, Atlantic salmon imported was at 92 tonnes. This represents a preference of Pacific Salmon to Atlantic salmon by the South African market during the year 2013 which can be attributed to price increases thereby a decrease in the demand for Atlantic salmon. 40% of the imports come from Norway, 35% from China and the rest comes from the United States of America.

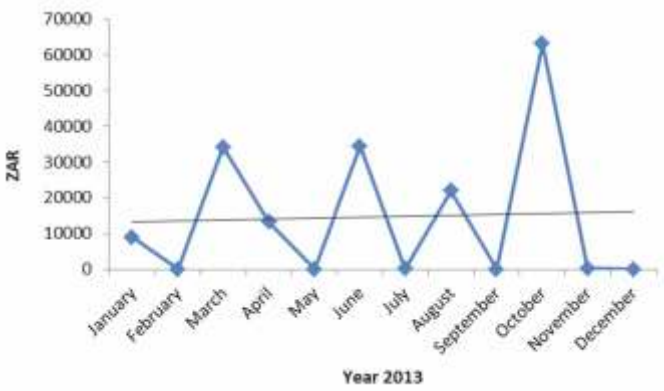

Figure 66. South Africa's Pacific Salmon imports during the year 2013.

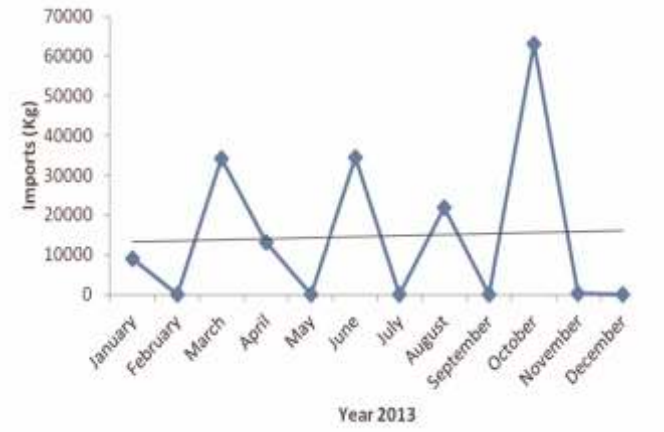

Figure 67. Value of South Africa's Pacific Salmon imports during the year 2013.

6.8.5 Oyster

During the year 2013, South Africa imported a total of 106 tons of oysters valued at R5 063 928.00 (Figure 68 and Figure 69). Oysters are imported live, fresh or chilled. During the year 2013, 98% of the quantity of imported oysters came from Namibia and the rest came from Chile and the United States of America. The quantity of oyster imports shot up by more than 200% in the year 2013 compared to the year 2012. This indicates a high demand for oysters in the local market and also an opportunity for local famers to venture in oyster production.

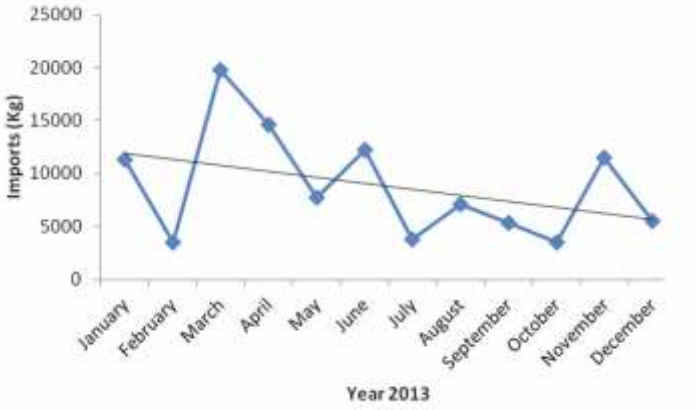

Figure 68. South Africa's Oyster imports during the year 2013

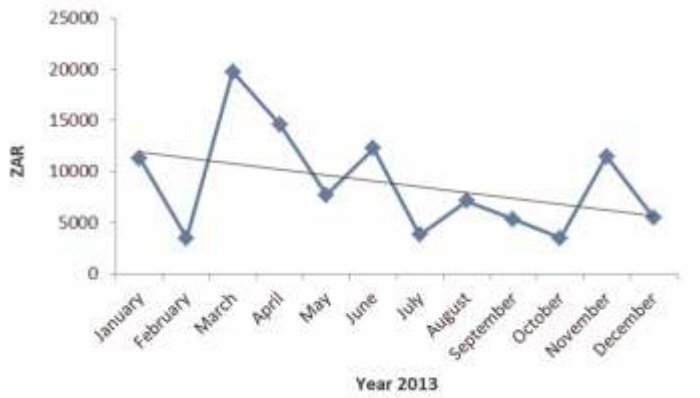

Figure 69. Value of South Africa's Oyster imports during the year 2013

6.8.6 Ornamental

South Africa imported a total of 274 tons of ornamentals valued at R24 331 472.00 during the year 2013 (Figure 70 and Figure 71). Ornamentals are sourced from a number of different countries. 20% of ornamentals came from Indonesia, 17% from Singapore, 16% from Israel, 10% from Sri Lanka, 7% from Thailand, 5% from Kenya and Malaysia, and the rest from, Taiwan, Sudan, Philippines, Nigeria, Mauritius, Madagascar, Malaysia, Japan, India, Colombia and Australia. The quantity of imports increased by 30% compared to the year 2013. The value of imported ornamentals dropped drastically by approximately 67% and this can be attributed to the increased supply and number of competitors of ornamentals.

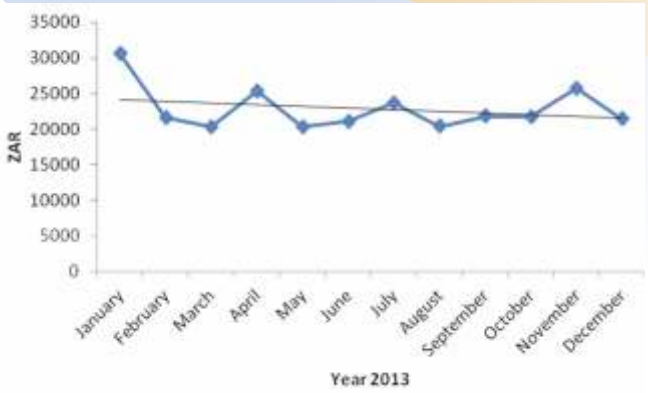

Figure 70. South Africa's Ornamental fish imports during the year 2013

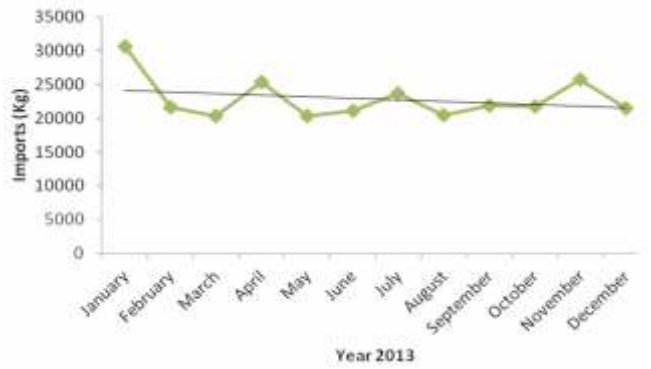

Figure 71. Value of South Africa's Ornamental fish imports during the year 2013

6.8.7 Fish Products

During the year 2013, South Africa imported a total of 288 tons of fillets valued at R7 503 994.00 million (Figure 72 and Figure 73). Frozen fillets of catfish imported from Viet nam constituted 94% of total fillet imports whilst frozen tilapia fillets from China and Zimbabwe constituted 5% and 1% respectively. There were no fillets imported to South Africa during the year 2013.

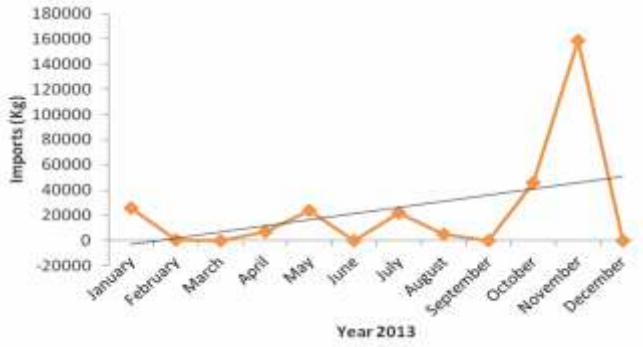

Figure 72: South Africa's fish fillet imports during the year 2013

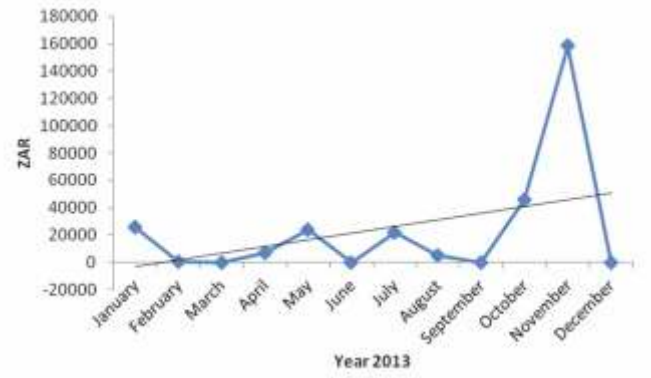

Figure 73: Value of South Africa's fish fillet imports during the year 2013

6.9 Trade Balance

During the year 2013, South Africa achieved a trade surplus of 89 tons in terms of quantity (Figure 74. The quantity of both exports and imports decreased by 363 tons and 3140 tons respectively when compared to the year 2012 (Table 11). In terms of value, South Africa has maintained a trade surplus of R210 592 908.00 during the year 2013 (Table 12). The major export destinations are China, Taiwan, Hong Kong, Singapore and Australia whilst the major sources of imports are China, Viet nam and Norway.

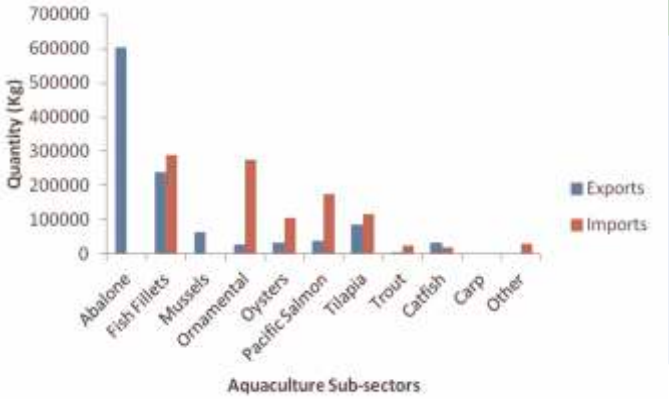

Figure 74. Graph illustrating South Africa's Exports vs Imports in 2013.

Table 11. South Africa's Exports vs Imports during the year 2013

Trade Quantity (kg)	Abalone	Fish Fillets	Mussels	Ornamentals	Oysters	Pacific Salmon	Tilapia	Trout	Catfish	Carp	Other
Exports	602718	237465	63010	26085	32968	39003	86813	5948	33052	160	0
Imports	0	288101	0	274430	105631	176089	117270	25822	20013	0	30454

Table 12. South Africa's value of Exports vs Imports during the year 2013

Trade Quantity (kg)	Abalone	Fish Fillets	Mussels	Ornamentals	Oysters	Pacific Salmon	Tilapia	Trout	Catfish	Carp	Other
Exports Values	237544687	14448485	677125	563066	3751418	2303104	1440485	98470	57718	549076	0
Imports Values	0	7503994	0	24331472	5063928	10804792	1411683	383804	488247	0	852806

7. AQUACULTURE RESEARCH AND DEVELOPMENT

7.1 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:

7.1.1 Finfish Reproduction at the DAFF

Three finfish species were respectively selected for research on reproduction, hatchery methods and grow out performance at the Marine Research Aquarium (MRA) in order to test economic production viability for commercial use. Dusky kob (Argyrosomus japonicus) is a species already farmed but refinement of production methods is the focus point to improve the commercial production efficiency and profitability of kob farming.

7.1.1.1 Objectives Achieved

- Dusky kob broodstock can now be repetitively conditioned to pre-spawning status with a compressed photothermal program as short as 2.5 months – compared to the natural cycle of 12 months. This achievement will enable industry to reduce the quantity of breeders, facility space, capital costs and additional running expenses without compromising on expected "seed" outputs or "rest" periods for used breeders.

- Dusky kob can be induced to spawn according to present programs. Hormone implants (short term release) maximizes spawning output (eggs) in females when compared to hormone injections (Figure 75). Dusky kob breeders are group synchronized single batch spawners. The optimum spawning temperature was found to be 22 C° and fertilization rates (>80%) were not less than for eggs of females only spawned every 3-4 months in older photothermal programs.

Figure 75. Transfer of anesthetized dusky kob breeder after hormone treatment

- The Cape White Stumpnose *(Rhabdosargus globiceps)* was efficiently conditioned for commencement of their spawning cycle by exposing breeders to a uniquely developed photothermal program that ran for two months (Figure 76). The conditioning efficiency was confirmed by the continuous spawning of breeders following the implantation of long term slow hormone release pellets within the pectoral peritoneum. As far as we know this is the first time that continuous spawning was demonstrated for this species .A three week slow release pellet implant induced breeders (asynchronized multi-batch spawners) to spawn on a daily basis (2 spawning sessions noted) for approximately the period that the hormones were released. A similar tendency was observed for fish exposed to a 6 week slow release pellet implant. Commercial stumpnose hatcheries should find this method very useful to ensure consistent availability of fertilized eggs.

Figure 76. Cape White Stumpnose broodsrock conditioned for spawning cycle.

- The spotted grunter (Pomadysis commersonni) was successfully conditioned to pre-spawning status in captivity following a compressed photothermal cycle (3 months) which was constructed from annual photothermal data obtained from the Swartkops River (Port Elizabeth) (Figure 77). It appears that this species is a single batch spawner since once-off spawns were only recorded. For the first time to our knowledge this species was induced to spawn in captivity and a single hormone injection was sufficient enough to induce spawning (Figure 78). High fertilization rates (>90%) were obtained from spawners and the larvae of these species were found to be fast growing and more resilient than those observed for Dusky Kob or Cape White Stumpnose (Figure 79).

Figure 77. Spotted grunter breeder with identification tag and in bath with anesthetics.

Figure 78. Spawning induction hormone implant in spotted grunter.

Figure 79. Spotted grunter eggs (magnified).

7.1.2. A comparative growth performance test (3 months) between captivity bred f1 and wild juvenile cape white stumpnose *(Rhabdosargus globiceps)* by also using the green macro-algae ulva lactuca as a 5% dietary constituent.

In its natural habitat the adult white-stumpnose are mostly found in rocky areas and over sandy bottom from shore to 120 m offshore. The juvenile stage is commonly found in estuaries and in surf zones off sandy beaches (Whitfield, 1998). Juveniles are omnivorous and at about 2 cm standard length (SL) they feed mainly on zooplankton. At 3 cm SL the juveniles thrive mainly on filamentous algae, amphipods and isopods. From about 4cm their molars are beginning to develop and they are able to handle a variety of shelled mollusks, crabs, shrimp, as well as polychaete worms. Adults feed on polychaetes, amphipods, barnacles and crabs (Whitfield, 1998).

It is not known what the growth rate of white-stumpnose is under captive conditions. In its natural habitat this species reach about 15cm fork-length within 15 months. They are also relatively fast growing until sexual maturation which commences at a fork-length of approximately 23-24cm. Hereafter they are growing slower probably due to reproduction activities (Griffiths et al. 2002). This fish is considered as a cold-water species and its optimum growth temperature may correspond to the optimum hatching temperature of about 20 °C (Andrew Russell – personal communication). The growth rate of this species to marketable size (500g) should be tested under captive conditions. The study determined the following objectives:

1. A three month growth rate comparison between captive bred (stunted) and wild caught stumpnose fingerlings fed with formulated food.

2. A three month growth rate comparison between captive bred (stunted) and wild caught stumpnose fingerlings fed with wet and flaked Ulva supplemented formulated food (Figure 80, Figure 81 and Figure 82).

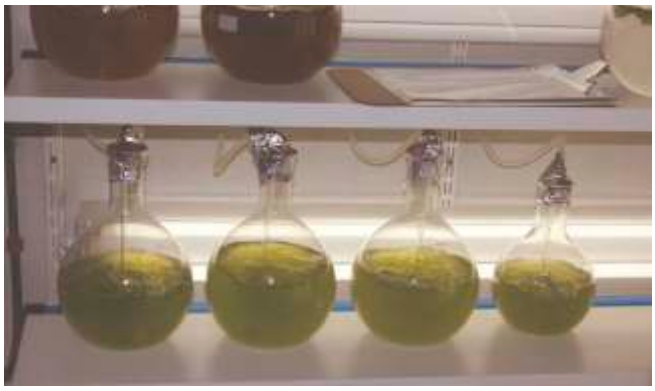

Figure 80. Primary algae cultures for mass propagation as feed for zooplankton (rotifers) which will be fed to fry of finfish.

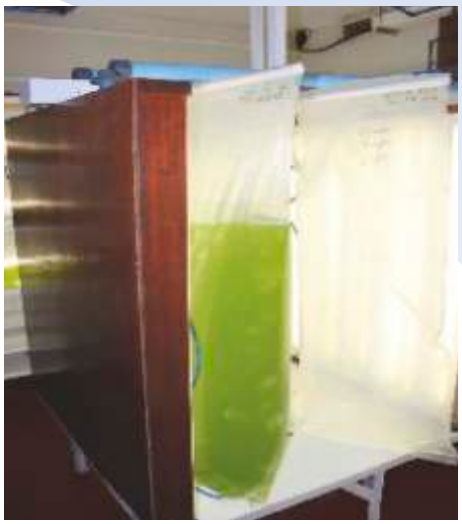

Figure 81. Mass algae culture vessel or "carboy" in algae lab.

Figure 82. DAFF scientists developing the wet and flaked Ulva supplemented formulated feed.

7.1.2.1 Results highlights and discussion

The wild caught and non-stunted juvenile white stumpnose grew significantly better than the captive bred fish (stunted) on both the experimental feed types. The best growth performance of non-stunted wild caught fingerlings is indicative that white stumpnose could be a suitable aquaculture species in South Africa under commercial pond or cage culture conditions (low cost). The best growth figure for wild caught juvenile stumpnose was 36g over a period of 12 weeks. It is about 40% less growth than measured for kob which was grown from a similar juvenile stage (~5g) in only 10 weeks. However, a sub-optimum keeping temperature of 25 °C was used to comparatively define and compare lowered growth rates between experimental fish groups than should be the case at an optimum temperature of approximately 20°C. As for the hatchery bred fish, the significantly reduced average growth performance of approximately 42% (measured against growth of wild caught fish) could be attributed to insufficient feeding (twice a week) after the larval stage which evidently resulted in what is termed stunted growth.

7.1.2.2 Conclusion

The 5% Ulva inclusion in the diets of both wild caught and hatchery raised fingerlings did not significantly influence the growth rate when compared to the control diet. Further tests are required to measure grow rates of white stumpnose at higher than 5% inclusions of Ulva in formulated diets. A 10% Ulva inclusion in the diet will be tested and the Ulva will be prepared as a dehydrated powder prior to its final use.

7.1.3 Identification of the marine diatom Pseudo-nitzschia multiseries as a source of the toxin domoic acid in Algoa Bay

Pseudo-nitzschia is a globally distributed diatom genus, including species that produce the neurotoxin domoic acid (DA), the cause of Amnesic Shellfish Poisoning (ASP). Among 37 described Pseudo-nitzschia species 14 have been shown to contain toxigenic members, although toxin production within a species tends to be inconsistent. Species of this genus are particularly common members of the coastal phytoplankton communities of eastern boundary upwelling systems, with some efficient DA producers exhibiting a wide distribution. In 2012 we undertook identification of a Pseudo-nitzschia species in Algoa Bay. Our study further reported on the cell toxin content of this taxon and the consequent threat it poses to shellfish culture in the region (Pitcher et al. submitted).

A unialgal culture of the Pseudo-nitzschia species dominant in the plankton of Algoa Bay in the spring of 2012 was established by isolation of clonal chains of cells. Identification of the species as Pseudo-nitzschia multiseries was based on observations of frustule morphometrics provided by light and scanning electron microscopy (Figure 90), and confirmed by phylogenetic analysis of the LSU rDNA gene. The Algoa Bay isolate was shown to form a monophyletic group together with P. multiseries isolates from Japan, Australia and the USA. Cultures were shown to produce domoic acid (DA) as measured by a quantitative enzyme-linked immunosorbent assay (ELISA) and by liquid chromatography coupled with tandem mass spectrometry (LC/MS-MS). Particulate DA concentrations in these cultures ranged from 3.61 – 4.76 µg L-1 and resulting cellular levels of DA were ~0.1 pg cell-1. Although recognised as a cosmopolitan species these observations provided the first account of this toxic diatom in the coastal waters of South Africa.

Compared to the west coast, the risk posed by harmful algae is significantly reduced on the south-east coast of South Africa with past reports of toxin-producing algae confined to a single account of Diarrhetic Shellfish Poisoning (DSP). However, the dominance of P. multiseries in Algoa Bay during the spring of 2012 suggests that it may be an important component of the phytoplankton of this region and could therefore pose a significant threat. P. multiseries has been shown, as an example, to be especially problematic in the California Current system where the impacts of DA are realized almost annually through direct toxicity of shellfish and through the effects on the health of marine life. The presence of P. multiseries in the bay in October, when winds are typically strongest and temperatures moderately low fits the ecological profile of Pseudo-nitzschia occurring during periods of mixing.

Assessment of the risk posed by Pseudo-nitzschia is complicated by variability in cellular toxicity. The cell toxin quotas derived from the cultures of P. multiseries isolated from Algoa Bay fall within the range reported for coastal assemblages in other parts of the world. Although particulate DA levels in these cultures were considered sufficiently high to trigger trophic transfer, the relatively low concentrations of Pseudo-nitzschia observed in Algoa Bay are unlikely to contribute to particulate DA concentrations that would cause bivalve toxicity to exceed regulatory levels. However, owing to the potential impacts of DA on marine organisms and humans, further studies are required to better describe Pseudo-nitzschia community composition, population dynamics and toxigenicity on the coast of South Africa. Further to these studies the uptake of DA by locally harvested or cultured shellfish needs to be investigated to better assess the potential impact on these operations.

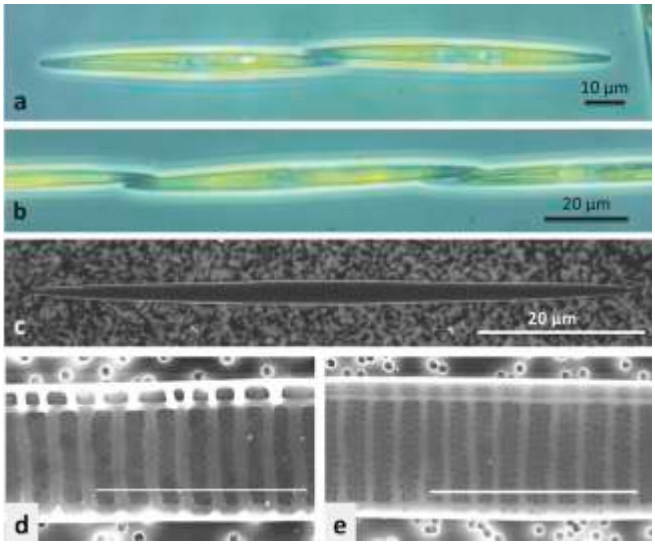

Figure 83: (a,b) Light micrographs providing girdle view of a P. multiseries chain in culture showing cells attached by their overlapping apices; (c) scanning electron micrographs of whole valve; (d, e) and the central regions of valves showing the poroid striae and fibulae, scale bars = 5 µm.

8. AQUACULTURE ENVIRONMENTAL INTEGRITY

8.1 Aquaculture Environmental Impact Assessments

The constructions 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 (107 of 1998) through the Environmental Impact Assessment (EIA) Regulations (2010). The level of environmental assessment required is dependent upon the nature, production capacity and type of activity. The EIA process as it relates to aquaculture is described further in the Environmental Management Guideline for Aquaculture in South Africa (DEA, 2011). The Directorate: Sustainable Aquaculture Management (SAM), Sub-Directorate: Aquaculture Animal Health and Environmental Interactions render technical advice regarding EIAs. The Sub-Directorate also provides review and comment on EIAs for aquaculture operations and any developments that may have an adverse impact on existing aquaculture farms.

8.2 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 2011, 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 environmental authorisation contained a number of conditions which are required to be in place prior to the construction of basic infrastructure. The Department has met these conditions and will commence with the construction phase of the project. The Department has been granted an extension on the Environmental Authorisation as it lapses in September 2014.

The EIA process for the establishment of a Sea-based ADZ in the Eastern Cape was initiated in 2011 and conducted by an independent, qualified Environmental Assessment Practitioner (EAP). The availability of suitable sea-space for the establishment of sea-based aquaculture operations was refined through conducting a Strategic Environmental Assessment (SEA) in 2012. 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 on request from the Department. Two sites located in Algoa Bay were further investigated in the full scoping and Environmental Impact Report and the risks and benefits were investigated in various specialist studies. The DAFF received a positive Environmental Authorisation on the 13th August 2014, however the project has entered the appeals process and the outcome is still pending.

The Department is currently in the process of appointing an independent, qualified EAP to conduct an EIA for another ADZ in Amatikulu located in KwaZulu Natal approximately 120km north of Durban. The site has an area of approximately 80.9 Ha and is situated next to the Amatikulu estuary. The site was a thriving prawn farm in the 1990's, however the only remnants of the prawn farm are the unused earthen dams, water inlet channel (which are extensively covered by vegetation) and demolished pump house situated at the mouth of the Amatikulu estuary. The farming of indigenous and temperate water species with a production output of 20 000 – 30 000 tons is envisaged. The Department will establish infrastructure for the ADZ such as access roads, electricity, sea water pipelines, pump station, reservoir, and fencing.

8.3 Standards for Abalone and Trout aquaculture

DAFF, through the Directorate: Sustainable Aquaculture Management (SAM), Sub-Directorate: Aquaculture Animal Health and Environmental Interactions together with the Department of Environmental Affairs and Development Planning as well as national Department of Environmental Affairs have been working with industry to set standards for the Abalone and Trout aquaculture sectors. The project is a national initiative to develop standards as a proactive environmental management tool to achieve efficiency and effectiveness in environmental impact management by reducing the time and cost of following an EIA process, whilst ensuring that the environmental management is adequately addressed. Chapter 5 of the National Environmental Management Act 107 of 1998 (NEMA) provides for the development or adoption of norms or standards for listed activities, or more specifically, that adherence to the norms or standards will negate the need to apply for an environmental authorisation (and by implication also negating the need for an EIA). The project was initiated in 2011 and a draft document will be released for public comment shortly.

8.4 Alien and Invasive Species Regulations

The Department has been communicating with the aquaculture industry and the Department of Environmental Affairs (DEA) with regards to the finalisation of the AIS Regulations. An initial workshop was held in October 2013 to bring the two parties around the table and discuss the AIS Regulations and the potential implications for the aquaculture industry. Subsequently, the revised regulations were published for comment in February 2014 and there have been various robust debates around the details. There still remains some debate regarding the impact the regulations would have on the sector, specifically the trout sector as it includes an active fly fishing component. In the interim, trout has thus been removed from the lists, and will be governed provincially, until the details are ironed out. The final AIS regulations were published on the 1st August 2014 and will come into effect from the 1st of October 2014.

8.5 National Environmental Management: Integrated Coastal Management Act (24 of 2008) Effluent Discharge permits

The DEA has requested that industry provide effluent monitoring data as a part of their application for a Coastal waters discharge permit. The Department have assisted industry by compiling a technical report which speaks to the ad hoc monitoring the Department undertakes on the abalone farms on an annual basis. This technical report has been used by the abalone farms as an appendix to their application for an Effluent discharge permit. This technical report has saved the industry the time and money of having to complete a separate monitoring report to be submitted to the DEA. DEA has reported that most of the applications for permits have been from the aquaculture industry indicating that the industry is acting in a proactive and responsible manner.

8.6 Gariep Biodiversity Risk and Benefit Assessment

The Department commissioned a Risk and Benefit Assessment for the introduction of Nile tilapia *(Oreochriomis niloticus)*, the Mozambique tilapia *(Oreochromis mossambicus)* and the common carp *(Cyprinus carpio)* into the Free State, South Africa in 2013. The purpose of the assessment was to determine the biodiversity risk and benefits associated with the introduction of the Nile tilapia, the Mozambique tilapia and the common carp for use at the China – South Africa Agricultural Technology Development Centre at the Gariep Dam and six satellite farms in the Free State. A positive authorisation was issued in March 2013.

9. STAKEHOLDER ENGAGEMENT

9.1 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, which 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.

9.1.1 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.

9.1.2 Freshwater Aquaculture Industry Liaison

The Freshwater Aquaculture Industry Liaison (FAIL) is a forum which will be established, hopefully 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.

9.1 3 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 department 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).

There were four AIF meeting conducted during the year 2013 and the participants included DAFF; the dti, DST; the DEA and the DWS (used to be called 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 review of all domestic legislation governing aquaculture, finalization of ADEP, the co-hosting of the Aquaculture Conference, the continuation of the Aquaculture Guidelines project, the continuation of the Aquaculture Development Zones Programme, the finalization of IPAP interventions.

9.1.4 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.

There was only one meeting that was held in 2013. 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 update on the implementation of the Aquaculture Development and Enhancement Programme, the Aquaculture Legal Review project and the finalization of the PAIF Terms of Reference. 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.

A major achievement that was recommended in the PAIF Forum in 2012 that was implemented by the DAFF in 2013 was the meetings that were held between DAFF and the Heads of the Departments responsible for Agriculture in the various provinces. These meetings were important to discuss aquaculture related matters in the different provinces and to discuss areas of collaboration between DAFF and the relevant provinces.

9.1.5 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 2013 the AVCRT met on three occasions. The Forum engaged on issues affecting the aquaculture value chain. Some of the major issues that were discussed include the, ADEP, the need for an Aquaculture Export Council, the Legal Review Audit Project and Project and the Aquaculture Conference held at the Stellenbosch University, the Terms of Reference and workplan for the Marketing and Trade Working Group. The Labour Working Group was established to assist with dealing with labour related matters in the aquaculture sector. The Forum also played a critical role in debating the Alien and Invasive Species Regulations and making recommendations that were implemented by the relevant stakeholders.

9.1.6 Aquaculture Association of Southern Africa Conference

The conference of the Aquaculture Association of Southern Africa is the leading forum for addressing emerging issues and new developments relating to aquaculture in Southern Africa. This Conference and associated workshops provides the opportunity to interact with government, industry and other researchers and to present aquaculture research within Department of Agriculture, Forestry and Fisheries (DAFF) to the broader aquaculture community of southern Africa.

The AASA conference is held bi-annually under the umbrella of the Aquaculture Association of Southern Africa. The 2013 conference was held from 27 September until 03 October in Stellenbosch, Cape Town. Being the foremost meeting on southern African aquaculture research, the conference provides a forum for scientists, researchers, students, engineers, manufacturers, contractors, technologists, industry, economists, policy makers, and resource managers to present their latest research results. Furthermore, it offers DAFF researchers an opportunity to collaborate with leading scientists and specialists in the field of aquaculture.

10. AQUACULTURE PROJECTS

10.1 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 National Aquaculture Strategic Framework and recently approved National Aquaculture Policy Framework (NAPF) 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.

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

The 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 84). Infrastructure development for kob pilot project has been completed (Figure 85) and the EIA report submitted for final comments and inputs from the competent authority.

Figure 84. Recirculation Aquaculture System for dusky kob pilot farm in Hamburg, Eastern Cape.

Figure 85. Dusky kob juveniles in the Hamburg pilot farm.

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

Camdeboo Satellite Aquaculture Project (CSAP) is situated in Camdeboo (Figure 93), Eastern Cape, which is approximately 5km from Graaf-Reinett town. The project is implemented by Camdeboo Local Municipality which entered into an agreement with the Department of Agriculture, Forestry and Fisheries (DAFF). CSAP is currently culturing catfish which is targeted at bulk catering markets such as school feeding schemes, hospitals and prisons. The final product will be minced in tomato sauce and packaged into 2kg pouches which will have a shelf life that is comparable to other canned fish products.

Figure 86: Aquaculture production tunnel funded by DAFF

CSAP is an initiative that aims to establish viable aquaculture clusters through the development of an aquaculture central farm (Figure 86) that would supply satellite farms with catfish juveniles for grow out. Satellite farms, will therefore, sell the market sized fish to the central farm for marketing. The grown out fish will be packaged into 2kg retort pouches and sold into bulk catering markets. 37 satellite farms have been targeted for this project which will result in 13 000 direct jobs. Upon completion, the central farm will have the following key structures:

- Administration Centre
- Training Facility – theory
- Training Facility – practical
- 13 x Aquaculture Production Tunnels
- 1 x Hatchery

Figure 87: Training tunnel and production tunnel at the project site

The primary objective of the project is to contribute towards rural development, food security and job creation through skills based employment and community empowerment. This will be done through intensive training and mentorship provided to rural women and youth in the Camdeboo area. The project currently employs 12 permanent staff members and has trained 168 recruits in ABET studies, life skills and technical aquaculture procedures.

A marketing plan for the project has been developed for the minced catfish in tomato sauce which is packaged in 2kg retort pouches .The marketing plan addresses aspects such as marketing acceptance, branding, competition and by- product. To date no fish products have been sold as no markets have been secured.

An independent consultant has been appointed to secure off take agreements with potential buyers and develop a database of potential customers for 2015 and beyond, as the project scales up. Sondelani Trust, which consist of 109 people, are the beneficiaries of the project and have benefited through training mentioned above. The production tunnel funded by DAFF will be owned and operated by the beneficiaries.

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

The aim is to establish an aquaculture demonstration centre in Free State Province. To date the construction phase is completed and the administration process for the operation phase is underway. A number of research initiative have already commenced in 2013, one of them being the cage culture of catfish (Figure 87).

Figure 87. Catfish cage farming piloting at the China-South Africa Agricultural Technology Demonstration Centre at the Gariep Dam, Free State.

11. TRAINING AND CAPACITY BUILDING IN 2013

11.1 Training and capacity building overview

This section outlines training and capacity building programmes and initiatives undertaken in 2013.

11.1.1 Training Course on Sustainable Aquaculture offered in Iceland

11.1.1.1 Course Overview and Background

This course was attended in Iceland and it was offered by the United Nations University Fisheries Training Programme from 28 September 2013 to the 28 March 2014. Only one official from Aquaculture Research and Development Directorate was offered a scholarship to attend the course on sustainable aquaculture and related issues on fisheries (Figure 88).

The training consisted of lectures, company visits, guest lecture, assignments and individual research work. The topics of lectures attended included both aquaculture and fisheries aspects as follows:

- Sustainability of fisheries
- Development of world aquaculture World oceanography and fisheries
- Biology, physiology, and environment of aquaculture organisms
- Production planning and fish farm economics Aquaculture System, operation, and production planning
- Fish nutrition and feeding
- Policies, governance and regulation of aquaculture operations
- Project design and proposal writing
- Environmental impact of aquaculture production
- Legal framework and monitoring of aquaculture operations
- International policy on marine affairs
- Environmental impact assessment and coastal zone
- Effect of fishing gear on the environment
- Fisheries policy, strategic management and planning

An individual research project was the final part of the training course and a period of three months was given for the designing, conducting experiments, writing and presenting the final project report. Each participant was assigned a supervisor were to assist in the design a project including a proposal, literature review, methodology section, results, and discussion of findings. The produced report offers the culture of rotifers and brine shrimp protocols, which is titled:

11.1.1.2 Project summary and discussion

Figure 88. Final report presentation by DAFF official on the Effects of disinfection on the Survival and Feed Quality of Rotifers *(Branchionus plicatilis)* and brine shrimp *(Artemia salina)*.

Figure 89. Image of disinfected Artemia salina as seen under a microscope.

Despite the improved technology in the batch culture of rotifers (Dhert et al. 2001 and Yoshimura et al. 2003), poor performance is still a common problem in aquaculture hatcheries. Many factors have been linked to rotifer growth performance, such as nutrition and different microorganisms. The bacterial communities associated with rotifers might be one of the most important factors affecting the culture of rotifers. The study has successfully tested the disinfection protocols that were highly effective with regards to survival and feed quality of rotifers and brine shrimp. It is both easy and essential to disinfect live feed to eliminate any pathogens which could have undesirable effects on the culture of marine fish larvae. The results from this study may prove very useful in improving marine larvae culture in South Africa as it has been suspected that the mortalities observed during the larval state of dusky kob *(Argyrosomus japonicus)* might be the result of high microbial loads in live feed cultures.

12. 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.

12.1 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.

12.2 Directorate Aquaculture Technical Services

Aquaculture technical and advisory services have been lacking due to the limited skills in the country. In order to address this aspect, 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 some infrastructures 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:** An enabling environment is being created for the sector. The D: ATS has been tasked with addressing zonation and facilitation of seed supply.

12.3 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 South African Molluscan Shellfish Monitoring & Control Programme (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 National Regulator for Compulsory Specifications (NRCS) and Council for Scientific and Industrial Research (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 reporting progress on the implementation of the National Aquaculture Strategic Framework, 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 responsible 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.

13. REFERENCES

Dhert, P., Rombaut, G., Suantika, G. and Sorgeloos, P. (2001). Advancement of rotifer culture and manipulation techniques in Europe. Aquaculture, 129–146.

Department of Agriculture, Forestry and Fisheries (2008) – South African Molluscan Shellfish Monitoring and Control Programme.

Department of Agriculture, Forestry and Fisheries (2009) – South Africa's Marine Aquaculture Industry Report 2009.

Department of Agriculture, Forestry and Fisheries (2010) – Marine Aquaculture Annual Farm Operations Report 2010.

Department of Agriculture, Forestry and Fisheries (2011) – Aquaculture Annual Report 2011.

Department of Agriculture, Forestry and Fisheries (2012) – Aquaculture Yearbook 2012.

Department of Agriculture Forestry and Fisheries. 2012. Strategic Environmental Assessment: Identification of potential marine aquaculture development zones for fin fish cage culture.

Department of Agriculture, Forestry and Fisheries (2013) – Aquaculture Yearbook 2013.

Department of Agriculture, Forestry and Fisheries (2013) – Site visit reports (unpublished).

Department of Agriculture, Forestry and Fisheries (2014) – Status of the South African Marine Fishery Resources 2012.

Department of Environmental Affairs and Tourism Government Gazette (2007) – Publication of Policy for the Development of a Sustainable Marine Aquaculture Sector in South Africa.

Department of Environmental Affairs and Tourism (2008) – An Environmental Management Plan for Marine Aquaculture in South Africa.

Department of Environmental Affairs. 2011. EIA and Environmental Management Guideline for Aquaculture in South Africa, Department of Environmental Affairs, Pretoria.

Food and Agriculture Association of the United Nations (2012) – The State of World Fisheries and Aquaculture 2012.

Food and Agriculture Association of the United Nations (2014) – The State of World Fisheries and Aquaculture 2014.

Pitcher, G.C., Cembella, A.D., Krock, B., Macey, B.M., Mansfield, L., and Probyn, T. (Submitted 2013). Identification of the marine diatom Pseudo-nitzschia multiseries (Bacillariophyceae) as a source of the toxin domoic acid in Algoa Bay, South Africa. African Journal of Marine Science.

Griffiths, M.H., Wilke, C., Penney, A.J., and Melo, A. (2002) Life history of white stumpnose Rhabdosargus globiceps (Pisces: Sparidae) off South African. South African Journal of marine science. 24: 281-300.

Whitfield, A.K. (1998) Biology and Ecology of Fishes in South African Estuaries. Ichthyological monographs of the J.L.B. Smith Institute of Ichthyology. 223 pp.

14. NOTES