

**AN INVESTIGATION OF PUBLIC AWARENESS AND PERCEPTION OF
MARINE AQUACULTURE IN SOUTH AFRICAN COASTAL
COMMUNITIES: A PILOT STUDY IN THE HERMANUS COMMUNITY**

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ABSTRACT

Marine aquaculture is in its infant stage in South Africa and its development is of priority to the government. Involvement of the public in the development of the sector is essential and a holistic approach to its management is crucial. This study looked at public awareness of marine aquaculture and how it is perceived. The public perception in terms of environmental and socio-economic impact was assessed. Hermanus community was used as a pilot site. A survey was conducted, which included a variety of groups that represent different interests. The outcomes of the study indicated that majority of participants are aware of marine aquaculture and they perceive it to have a positive impact. It is perceived that the negative environmental impacts are exceeded by the positive socio-economic impacts. For the full implementation of the study, it is recommended that focus should be placed on sub-sector perception and awareness. Focus of the awareness programmes should be on young people as they demonstrated to be less aware of marine aquaculture. In addition, promotion of the sector should be in areas where there is less marine aquaculture activities.

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CLARIFICATION OF BASIC TERMS AND CONCEPTS

Abbreviations

AISA	Aquaculture Institute of South Africa (former industry organisation).
DAFF	Department of Agriculture, Forestry and Fisheries (This is a lead government agency for the development of aquaculture in South Africa.
DEAT	Department of Environmental Affairs and Tourism (now restructured to form the DAFF and the Department of Environmental Affairs.
EIA	Environmental Impact Assessment.
FAO	Food and Agricultural Organization of the United Nations.
FAO Guidelines	FAO Technical Guidelines for Aquaculture Certification.
FPE's	Fish Processing Establishments
IUU	Illegal, Unregulated and Unreported.
Marine Aquaculture Policy	Policy for the Development of Sustainable Marine Aquaculture Sector in South Africa (2007).
MLRA	Marine Living Resource Act, 1998 (Act No.18 of 1998).
NASF	National Aquaculture Strategic Framework.
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
PUA	Public Understanding of Aquaculture
TAC	Total Allowable Catch.
TAE	Total Allowable Effort.
ZAR	South African Rands (Currency)

Definitions

Aquaculture	The farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants in a selected and or controlled environment (FAO, 2001).
Marine Aquaculture	The artificial culture, management and harvesting of commercially viable marine aquatic organism in a selected coastal environment with application of the husbandry techniques during the rearing process (DEAT, 2007).

1 INTRODUCTION

Food security is a socio-economic issue and a major concern in many countries, especially on the African continent. Rapid global population growth contributes to increased demand of food supply, including the source of protein (FAO 2007, Grigorakis 2010). Fish and fish products have thus far demonstrated to be the most affordable source of animal protein as well as fatty acids and micro-nutrients (FAO 2003). The increased demand for fish and fish products has placed extreme pressure on capture fisheries resulting in many fish stocks being fully exploited or overexploited. In addition to direct extraction of fish stocks for human consumption; deteriorating environmental conditions, climate change and pollution amongst others, are contributing to the decline of fish stocks (Sheppard *et.al.* 2010).

The global situation of declining fish stocks, increased population and competition for resources is also evident in South Africa. The South African population increased from 44.8 million to 50.5 million between 2001 and 2011 (StatsSA 2011). Despite the fisheries management measures established, the fish stocks are declining in South Africa. Illegal and unreported catches contribute to the collapse of fish stocks (Cullis-Suzuku and Pauly 2010, Serge *et.al.* 2009, Raemakers *et.al.* 2011). The decline of fish stocks is demonstrated by the continuous reduction of the Total Allowable Effort (TAE) and Total Allowable Catch (TAC) for most fisheries (Raemakers *et.al.* 2011).

In order to meet the fish and fish product demands, aquaculture is seen globally as an alternative source of fish and fish products. Aquaculture is defined as the farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants in a selected and or controlled environment (FAO 2001). Marine aquaculture is seen to contribute to fish supply and food security (FAO 2007) and is defined by Nash (1995) as the artificial culture, management and harvesting of commercially viable marine aquatic organisms in a selected coastal environment with applicable techniques during rearing process (DEAT 2007).

Aquaculture (both marine and freshwater) has become one of the fastest growing fish food producing sector globally. It is a high-value sector (Mazur and Curtis 2008, FAO 2010) representing 47% of the world's food fish supply in 2006 and 46% reported in 2010 (FAO 2007, FAO 2010). According to United Nations' Food and Agriculture Organisation (FAO 2010), the aquaculture industry has grown at an average annual rate of 6.6% between 1970 and 2008 (FAO 2010).

Even though the sector is growing, its growth rate is decreasing. Between 1970 and 2006, the average annual growth rate was reported at 6.9% (FAO 2009). In areas such as China, North America, European countries, France, Japan and Spain are experiencing a slower growth rate, whilst Latin America, the Caribbean, Near East and Africa are experiencing increased growth rate (FAO 2010). Africa's contribution to the global production is still minimal at 1.8% and Sub-saharan Africa contributing less than 1% (FAO 2010). It has been estimated that South Africa's marine aquaculture contributed 27% of Africa's production in 2006 (DAFF 2010a).

1.1 Significance and objectives of the study

This study focuses on marine aquaculture. It is aimed to pilot a survey that is intended to determine whether coastal communities are aware of marine aquaculture and how they perceive it and its activities. In addition, the pilot study is aimed at providing an insight into whether the Hermanus community, as a pilot site, are aware of marine aquaculture and how they perceive the sector. The elements that are looked into include the views of the community and key stakeholders on socio-economic and environmental impacts of aquaculture, and its effect on other industrial and economic activities.

1.2 Marine Aquaculture in South Africa

In South Africa, the marine aquaculture sector was not formally regulated until the promulgation of the Marine Living Resources Act, 1998 (Act 18 of 1998) (“the MLRA”) (DEAT 1998). The commercial marine aquaculture initiatives started with the cultivation of oysters (*Crassostrea gigas*) in the 1940s, followed by mussels (*Mytilus galloprovincialis* and *Choromytilus meridionalis*) in the 1980s, abalone (*Haliotis*) and prawns (*Litopenaeus vannamei*) in the 1990s and recently in the 2000s finfish farming, which includes dusky kob (*Argyrosomus japonicus*), silver kob (*Argyrosomus inodorus*), and yellowtail (*Seriolalandi*) (DAFF 2010a).

The marine aquaculture farms are based on both land and sea, and are distributed along the coast from Alexandra Bay in the Northern Cape Province to Mtunzini in the KwaZulu Natal Province (DAFF 2010a). In line with the aquaculture industry globally, marine aquaculture in South Africa has demonstrated noticeable growth in the past ten years with production increasing from 1056 tonnes in 2000 to 1860 in 2009 (Figure 1) (DAFF 2010a).

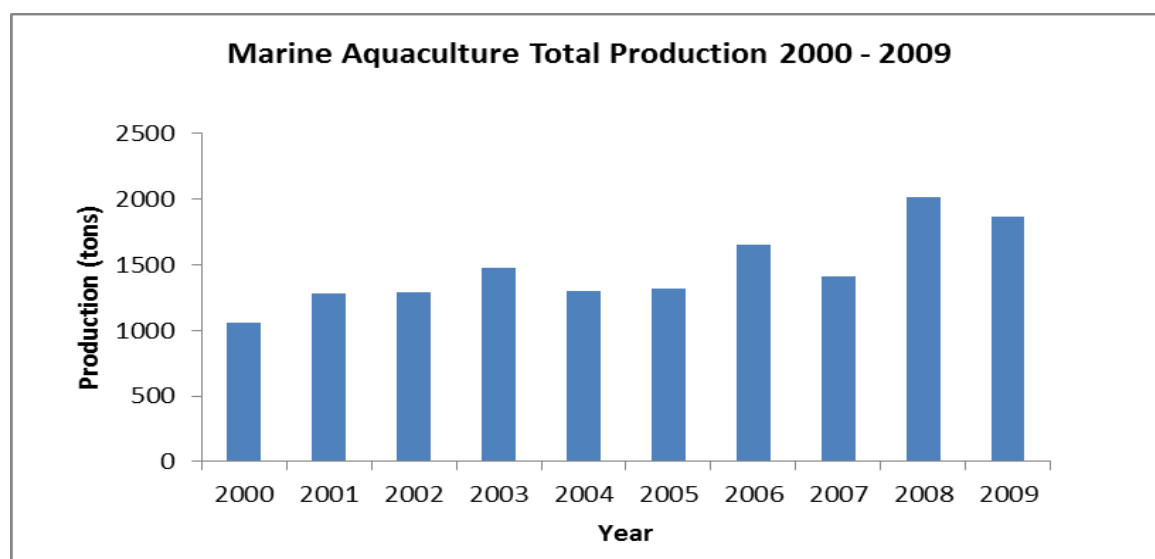


Figure 1: Marine aquaculture productions for a period of 10 years (DAFF 2010a).

It is important to note that fisheries (both capture fisheries and aquaculture) do not only address the challenge of the country’s food security, but also contribute towards job creation and other economic benefits especially for communities residing along the coast (Perez-Sanchez and Muir 2003). Its contribution may not be large at the national

level, but there it has a huge impact at a local level. This case applies to the South African situation.

Similarly to the global trends, South African fish stocks have declined and marine aquaculture is seen as an alternative fish production sector. A clear demonstration is the decreasing Total Allowable Catch (TAC) of wild abalone stocks, which resulted in the closure of the sector in the 2008/2009 season, whilst the cultured abalone production was increasing (Figure 2). During the closure of wild abalone, export to the Asian countries increased. This demand was partially met by the increased production of the cultured abalone (DAFF 2010b). This is also a clear indication that marine aquaculture has presented an opportunity to meet increasing fish demand, whilst reducing the pressure on the wild stocks.

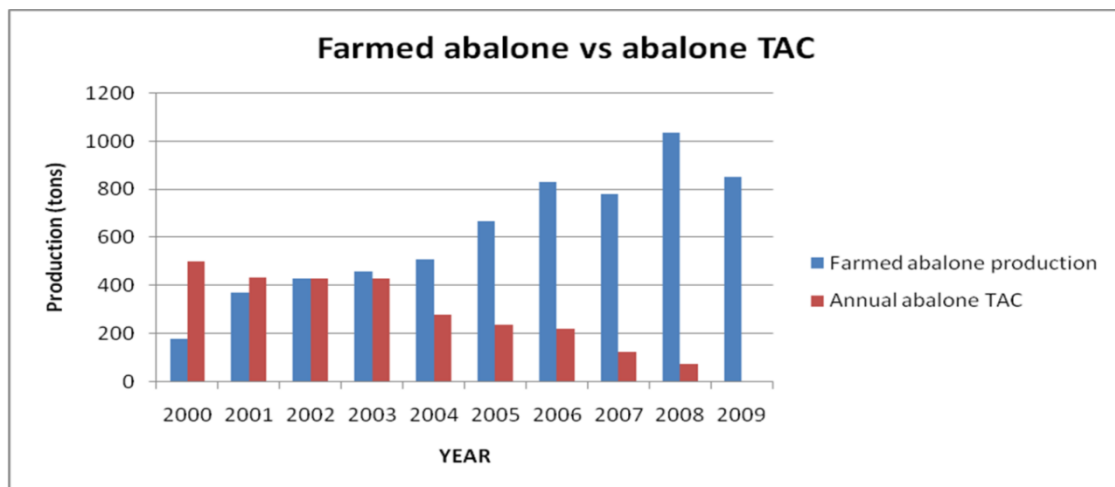


Figure 2: Marine aquaculture abalone productions for a period of 10 years in comparison to the declining Total Allowable Catch of the wild Abalone (DAFF 2010b).

1.3 South African Marine aquaculture legislative framework

The primary legislation regulating marine aquaculture in South Africa is the MLRA. There is additional legislation that this sector has to adhere to. Most of this legislation is environmental conservation oriented, rather than socio-economic and developmental oriented. Some of the legislation are the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA), National Environmental Management: Bio-diversity Act, 2004 (Act 10 of 2004) (NEMBA), National Environmental Management: Integrated Coastal Management Act, 2008 (Act 24 of 2008) and National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003).

A Policy for the Development of Sustainable Marine Aquaculture Sector in South Africa (2007) (“the Marine Aquaculture Policy”) was developed to support the implementation of the MLRA and facilitate sector growth (DEAT 2007). The Marine Aquaculture Policy identified challenges hampering the development of the sector including access to suitable sites. The South African coastline lacks sheltered bays, is of high energy level, and pristine. Therefore in most cases conservation takes the forefront. In addition to the limited number of suitable sites, there is high competition for sites with other sectors such as real estate, tourism and conservation agencies.

The Marine Aquaculture Policy has also made government realize the potential for sector growth and its possibility to play a role in addressing the socio-economic challenges affecting the coastal communities. Even though the Marine Aquaculture Policy has made government notice the potential for marine aquaculture, freshwater aquaculture development is also a government priority. This study focuses specifically on marine aquaculture which accounts for most of aquaculture production in South Africa (DAFF 2011b) and is a high-value industry requiring access to suitable coastal sites and utilization of marine resources for inputs (Mazur and Curtis 2008). The government decision to prioritise aquaculture (both marine and fresh water) could result in policy revision in order to align sector development.

1.4 Sustainable development and marine aquaculture

To ensure sector growth, developmental policies need to take into consideration different aspects of sustainable development. In an article by Gibbs (2009) different sustainable development approaches are briefly discussed. A triple bottom line approach of financial (economic), environmental and social performance is favoured by most authors, but Gibbs (2009) indicated that the approach of production carrying capacity, ecological carrying capacity, economic carrying capacity and social carrying capacity could be a more appropriate approach to address sustainable marine aquaculture development. All these approaches are valid and the current paper favours the triple bottom line approach. It is decided that the production carrying capacity can be categorised under economic issues and the ecological carrying capacity under environmental issues.

Even though not fully implemented, it is important to note that the Marine Aquaculture Policy takes into consideration three essential dimensions of sustainable development, i.e. economic, social and environmental conditions (DEAT 2007) similarly to those discussed by Gibbs (2009). This is a holistic management approach that is also supported by the Food and Agriculture Organization of the United Nations. FAO has demonstrated its support to the holistic management approach that takes into consideration pillars of sustainable development through the development FAO Technical Guidelines for Aquaculture Certification (“the FAO Guideline”), which requires and encourages FAO member states to consider these aspects (i.e. economic, social and environmental conditions) amongst others when dealing with marine aquaculture management and development (FAO 2011). Partial implementation of the Marine Aquaculture Policy has assisted South Africa in implementing environment elements of the FAO Guidelines, but very little has been done to ensure consideration of other aspects such as the socio-economics aspects and animal welfare.

Globally, marine aquaculture receives criticism due to the perceived negative environmental impacts resulting from its activities (Bunting and Shpigel 2009, Yossi *et.al.* 2009, Koldewey and Martin-Smith 2010, Grigorakis and Rigos 2011) and often without taking into consideration its socio-economic impact. This puts marine aquaculture at a disadvantage when compared to competing sectors, especially for resources such as sites, water and financial assistance. The increased criticism could be caused by the influence of organized environmental groups coupled with lack of data on socio-economic impacts of marine aquaculture.

The influence of the organized conservation and environmental agencies reflects itself during processes such as Environmental Impact Assessments (EIA) as required by the NEMA. In these processes, it is perceived that environmental concerns take priority over the social and economic impacts of marine aquaculture activities. Other reasons for the environmental issues to take the forefront could be due to the utilisation of technical data (Garaway *et.al.* 2006), which have been collected over the years on environmental issues, in convincing the public and communities (Mazur and Curtis 2008) about marine aquaculture. On the other hand, most countries, including South Africa has not given sufficient attention to fisheries socio-economic research and its dimensions (Paterson and Peterson 2010), and have minimal technical data to communicate to the public, communities and other crucial stakeholders in the marine aquaculture sector.

Even though marine aquaculture is an alternative source of fish supply, it needs to be practiced with caution as it might have negative impacts on the environment resulting in long-term socio-economic impacts. A study conducted by Whitmarsh and Palmieri (2009) on social acceptability of marine aquaculture showed that presently the social acceptability of the sector might only be linked to the environmental degradation and not its economic and social contribution. This might also be the case in South Africa as the environmental impact of the marine aquaculture activities takes priority in comparison to the social and economic benefits.

At times, the EIA reports highlight detailed environmental impact without demonstrating social and economic benefits that could result from the development or the balance thereof. This has a potential to result in the sector being perceived negatively by financial institutions and marketing agencies which are generally needed to contribute to the development of the sector. The negative perception of the sector could also be perpetuated by the lack of awareness and knowledge resulting in reluctance to avail support services from financial institutions and limited market-related activities.

1.5 Public perception and marine aquaculture

There is no doubt that when dealing with sector development, socio-economic elements cannot be excluded as they are at the core of most developmental initiatives. This is acknowledged by Garaway *et.al.* 2006 in indicating that there is a need to increase interdisciplinary research and include the social sciences when dealing with stock enhancement. There are numerous socio-economic factors that affect marine aquaculture development. Some of the social factors were identified by Bunting (2008) as public acceptability and perception, stakeholder conflict (e.g. user groups or environmental groups), and limited education and information exchange. All these social elements contribute to the basis of the current study.

In their study related to social acceptability of marine aquaculture by Whitmarsh and Palmieri (2009) also concluded that social acceptability is linked to public perception. In addition to public perception, level of knowledge and awareness could contribute to social acceptability of the sector. The study showed that the public acceptability of the aquaculture in Scotland (specifically for salmon farming) was influenced by the environmental impact related to it. In addition the study showed that stakeholder opinions differ widely with the environmental groups and the capture fisheries groups

placing greater importance on environmental impact higher than the socio-economic impact, whilst the aquaculture industry and the economic development agencies indicate the opposite.

Perez-Sanchez and Muir (2003) established that capture fisheries groups in Mexico were noticing aquaculture as an alternative industry to capture fisheries for generating income. The participants perceived aquaculture to have a positive influence on livelihoods in the community. There was no indication as to how the participants perceived the environmental impacts resulting from aquaculture practices.

In Australia, different areas perceive the environmental and socio-economic impacts of aquaculture differently. Based on a study conducted by Mazur and Curtis (2008), majority of participants recognised the positive impacts resulting from aquaculture. In comparison, other industries were perceived to have lower negative environmental impact. The industries that were looked into included tourism and retail, agriculture and services sectors.

The Aquaculture Institute of South Africa (AISA) – Aquaculture benchmarking survey was conducted in 2009 had small elements of consumer perception (Britz *et.al.* 2009). The results of the study indicated that 85% of the participants were not aware of aquaculture. Even though the study was focused on consumers, it gives an indication that the general public might not be aware of aquaculture. The current study is more focused and will assess the general public and other stakeholder's awareness and perception.

The acknowledgement of the aquaculture sector as an economic activity has recently been noticed by government. It is therefore crucial for sector managers and policy developers to understand the public awareness, perception, and social acceptability of the sector in order to obtain buy-in and public support to drive developmental programs that will facilitate growth. Most challenges faced by government in facilitating sector development and growth could be related to social acceptability, awareness and public perception. This is important for decision makers to know and understand as it might be useful for the purposes of the policy development, and sector development through programs such as awareness and knowledge sharing strategies.

Understanding social-economic elements of aquaculture is important for South Africa as the sector is fairly new and the recent introduction of the draft NASF which requires different programmes geared towards sector development. The draft NASF has identified the support services including financial services, and revision of existing policies and legislative framework as high priority to facilitate growth and development of the sector (DAFF 2011a). This brings the importance of policy makers' 'understanding of public and other stakeholder's opinion to the forefront to ensure that programmes emanating from the draft NASF address the concerns and do not create conflict amongst different marine resources and coastal users. It is therefore essential to understand the level of awareness and knowledge that coastal communities and affected and interested stakeholders have with regard to marine aquaculture. Most importantly, an understanding of how coastal communities perceive marine aquaculture is required. This will assist in ensuring that policy and decision makers take into consideration different views of key interested and affected stakeholder, especially

communities, to ensure smooth implementation of policies intended to facilitate the marine aquaculture development.

In order to facilitate sector development; relevant policies and programmes that take into account the three pillars of sustainable development need to be developed and implemented in consultation with affected and interested stakeholders and the general public. In the case of marine aquaculture, key affected stakeholders are coastal and fishing communities, and the interested stakeholders are mainly the environmental groups. Other affected stakeholders include sectors that are competing for resources, which include, but are not limited to property development and tourism industries.

2 METHOD AND MATERIALS

This research was conducted as a pilot for the study to be conducted on public perception and awareness of marine aquaculture in South African coastal towns.

2.1 Site selection for the pilot study and description of the study area

The study focuses on marine aquaculture. During 2010, marine aquaculture farms were distributed along 16 coastal towns with the majority in the Western Cape Province (DAFF 2010b). For the purpose of this pilot study, Hermanus has been selected as the study area where the survey methodology will be tested.

Hermanus is a town situated in the Western Cape of South Africa, approximately 115km southeast of Cape Town (Figure 3). It has a diverse population of approximately 75 000 people representing all Republic of South Africa's (RSA) official race groups i.e. Africans, Whites, Coloureds and Indians/ Asians. Hermanus is a historic fishermen's town and presently hosting marine aquaculture operations that contributes a large share to the South African abalone production. In addition to fisheries (capture fisheries and aquaculture), it is a tourist destination due to its status of having good land-based whale watching facilities. Hermanus attracts the real estate property development industry due to its proximity to Cape Town.

Hermanus is known to be a location for major abalone industry, both culture and capture. In addition to the fisheries, the diversity of the community and the presence of other economic sectors complementing or competing with marine aquaculture made Hermanus a suitable and ideal pilot site for the study. To ensure a fair representation in terms of different racial groups and participants interest, the study area was divided into townships, suburbs, town centre, tourism areas and the fishing harbour.



Figure 3: A map of Hermanus area and its position in South Africa.

2.2 Exploratory Survey

An exploratory survey was conducted to test whether the draft questionnaire was structured in a way that participants would understand, and to determine the duration of the interview. A total of 15 individuals participated in the exploratory survey and comments on the draft questionnaire were obtained and used to revise the questionnaire. The final questionnaire is discussed in the research instrumentation chapter.

2.3 Research Participants

In the current study, similar target groups to those utilised by Whitmarsh and Palmieri (2009) when determining social acceptability of marine aquaculture in Scotland were used. The groups included regulators (fisheries compliance officers and municipality representatives); marine aquaculture industry; environmental organisations; and capture fishing industry. In addition, key users users, i.e. Fish Processing Establishments (FPE's), restaurant owner and consumers were identified as stakeholders. Affected and interested stakeholders are diverse, and they were grouped into larger categories.

The view that most coastal areas have valuable recreational activities (Gibbs 2009) prompted the current study to include the tourism industry. In addition, it is recognised that the property development industry is growing and has become a potential competitor for sites. Therefore, they were also considered in the current study. To ensure fair representation, general public including local residents (with low, medium

and high income) are also part of the participants. Even though environmental organisations are not particularly based in Hermanus, they advocate environmental protection and conservation, therefore they were identified and included in the study as key interested stakeholders.

The intention was to survey 150 participants representing different identified, affected and interest groups, which were later regrouped for analysis into larger categories (Table 1). The survey participants were aggregated by race, age, gender, economic class, interests, and educational level. Classification of race was based on the four official race groups in South Africa. Determination of age groups used was informed by the South Africa's mid-year census report and further re-grouped to make the sub-samples large enough for analysis. Education level groups were randomly done and further re-grouped based on a report by Britz *et.al.* (2009).

2.4 Research Instrumentation

Perez-Sanchez & Muir (2003) used a survey approach with a questionnaire when determining fisherman's perception on resource management and aquaculture development in Mexico. Similarly a questionnaire has been used in the current study to determine the public perception and awareness of marine aquaculture in the Hermanus community in South Africa.

A questionnaire was compiled, consisting of 41 questions grouped into seven sections which focused on the following areas: (a) personal information, (b) awareness and knowledge of fish products, (c) awareness of marine aquaculture, (d) environmental aspects in relation to aquaculture, (e) socio-economic aspects in relation to aquaculture, (f) industry preference, and (g) general comments on perception (Appendix A). A five point Likert scale was used to gain participants perception of marine aquaculture environmental and socio-economic impacts.

2.5 Survey data collection

Data collection was conducted by 7 officials from the DAFF over a period of six days in December 2011 and January 2012. The intention was to collect data over a period of 5 days. During the data screening process, gaps were identified and it was noticed that crucial stakeholder groups inputs were not represented i.e. capture fisheries and property development industries. This led to the decision to extend data collection.

Due to the diversity of the participants, two approaches were taken in collecting data. The first approach was the interview set-up. The survey questions were asked and an opportunity to seek clarity on the questions was provided to the participants. This was to ensure that views of the participants with low literacy level are properly captured. Each interview session took 20-30 minutes. The second approach was electronic mailing of the questionnaire. The group which participated on electronic mail survey were the environmentalists who have high literacy level.

Table 1: Target groups for the pilot study.

Initial target Stakeholder Groups	Revised Stakeholder Groups
Members of the public	General Public
Local residents	
Marine Aquaculture farm owners	Marine Aquaculture Production Industry
Marine Aquaculture farm workers	
Marine Aquaculture Service Providers	
Marine Aquaculture feed manufacturers	
Recreational fishermen	Capture Fisheries Industry Stakeholders
Commercial fisheries Right holders	
Subsistence and Small scale fishermen	
Fishing vessels crew members	
Fishing forum representatives	
Tourism industry	Economic Sectors (Non-fisheries)
Real estate and Property Development Industry	
Agriculture	
Environmentalists (and groups thereof)	Environmentalists
Animal Health interest groups	
Fish Processing Establishments	Fish processing and Retail
Retail business (Restaurants)	
Regulators	Regulators

2.6 Data analysis

Data derived from the questionnaire was captured and analysed statistically using MS Excel and further analysis was done on general comments of the respondents by summarising and categorising their responses.

A profile of participants was compiled based on the 9 questions that addressed personal information. The main variables were stakeholder groups, age, race, gender, education, employment and monthly income of respondents. The categories were perceived environmental and socio-economic impact, followed by the awareness of fisheries and marine aquaculture, and lastly the sector preference. In addition, there was a category that looked into the comments raised by the participants regarding their general perception of marine aquaculture. Analysis of the relevance of questions used to gather information was assessed and recommendations made for the full implementation of the study in other areas.

3 RESULTS

3.1 Participants profile

The intention was to survey a total of 150 participants. Due to the diversity of interest groups, more individuals (n=211) were surveyed of which 8 did not respond resulting in a response rate of 96.2% (n=203). Of the total respondents, 86% (n=171) were residents of Hermanus and 14% (n=29) were non-residents. Non-residents were from other coastal towns such as Cape Town, Gordon's Bay, Hout Bay, and Port Elizabeth visiting Hermanus tourists or for employment.

3.1.1 Race, Gender and Age Composition

South Africa's population is divided into 4 main racial groups, i.e. Africans (79.5%), Whites (9%), Coloureds (9%) and Indians, which includes Asians (2.4%) (StatsSA 2010). The racial composition of the respondents were Africans (n=83; 41%); Coloureds (n=79; 39%); Whites (n=36; 18%); and Indians/Asians (n=2; <1%). Three of the participants (<2%) chose not to disclose their race. Of the total respondents (n=203), 38% (n=78) were females and 62% (n=125) were males. Racial composition with gender ratio is presented in Figure 4.

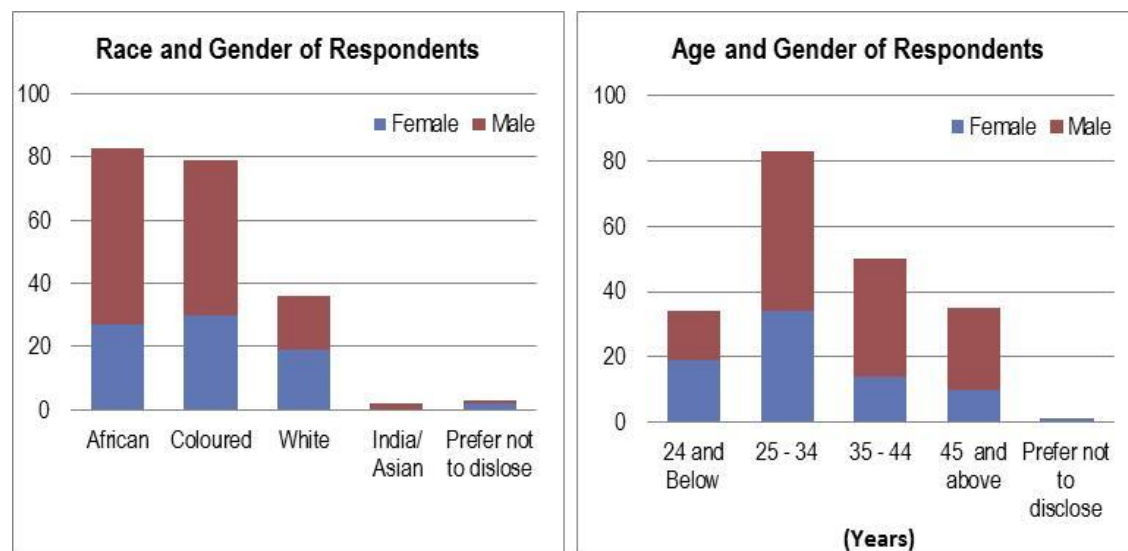


Figure 4: Number of participants per different age and race groups with male and female ratio.

Respondents were divided into four age groups i.e below 25 years (n=34; 17%); between the age of 25–34 years (n=83; 41%); 35–44 years (n=50; 25%) and above 44 years (n=34; 17%). One respondent did not to disclose her age. Gender composition of each age and race category is shown in Figure 4.

3.1.2 Employment, Income and Education

Income and employment are amongst the socio-economic benefits arising from marine aquaculture. The employment rate among all respondednts was 85% (n=173). Employment was divided into full time (n=114; 56%), part-time (n= 28; 14%), seasonal (n=15; 7%) and self-employment (n=16; 8%). High number of participants are employed on a full time basis (Figure 5). Employment rate amongst the Africans and

Whites was 86% (n=71) and 94% (n=34) respectively with Coloureds recording 78% (n=63). Employment rate per gender reflects that 91% (n=71) of females and 82% (n=102) of male are employed.

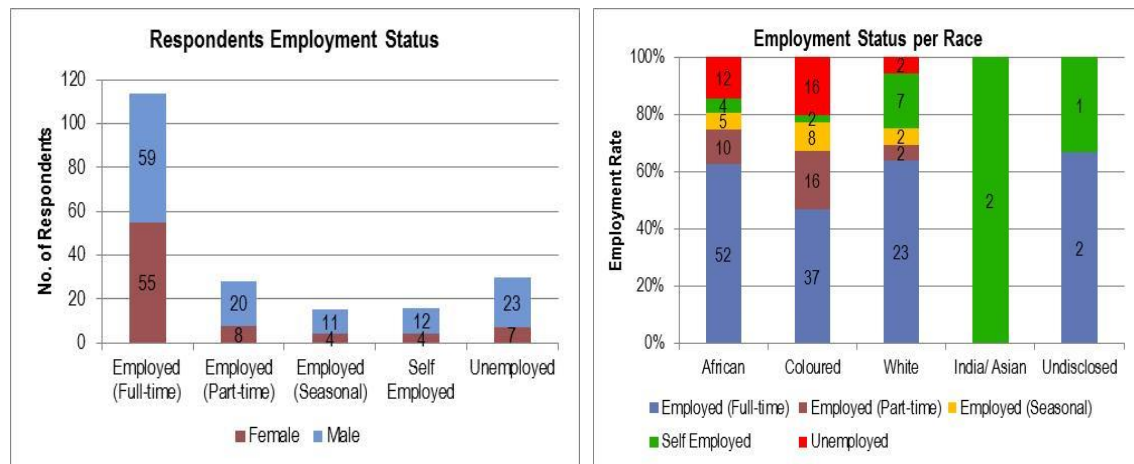


Figure 5: Respondents employment status (left) total number of respondents and ratio of male and female per employment category and (right) rate of employment status per racial group.

Employment status has impact on the income of individuals and their households. On average, respondents had households of 4 individuals. Of the total respondents 35% (n=71) earned a monthly income between ZAR1000 and ZAR5000, 16% (n=32) ZAR5001 to ZAR10000; 12% (n=24) ZAR10001 and above (Figure 6). Other respondents did not disclose their income (n=30; 15%). Ratio of males and females together with the distribution of income groups by race is illustrated in Figure 6.

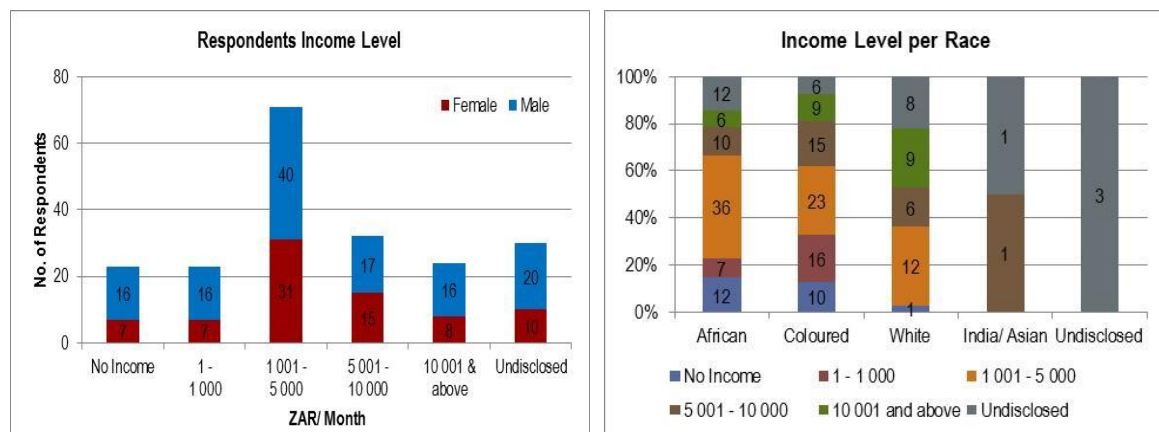


Figure 6: Respondents education level (left) total number of respondents and ratio of employment status per education level (right) rate of education level per racial group.

Employment and income may be linked to the education of individuals. In this study, it is noticed that high number of respondents have matric (n=95; 47%), followed by respondents without matric (n=73; 36%) and post matric education (n=35; 17%). Participants without matric have a high unemployment rate (n=25; 34%) in comparison to those who have matric (n=4; 4.2%) and post matric education (n=1; 3%) (Figure 7). When excluding the Indian and Asian racial group (due to the low number of respondents), Coloureds show the highest percentage of respondents without matric or post matric education and Whites have highest post matric education.

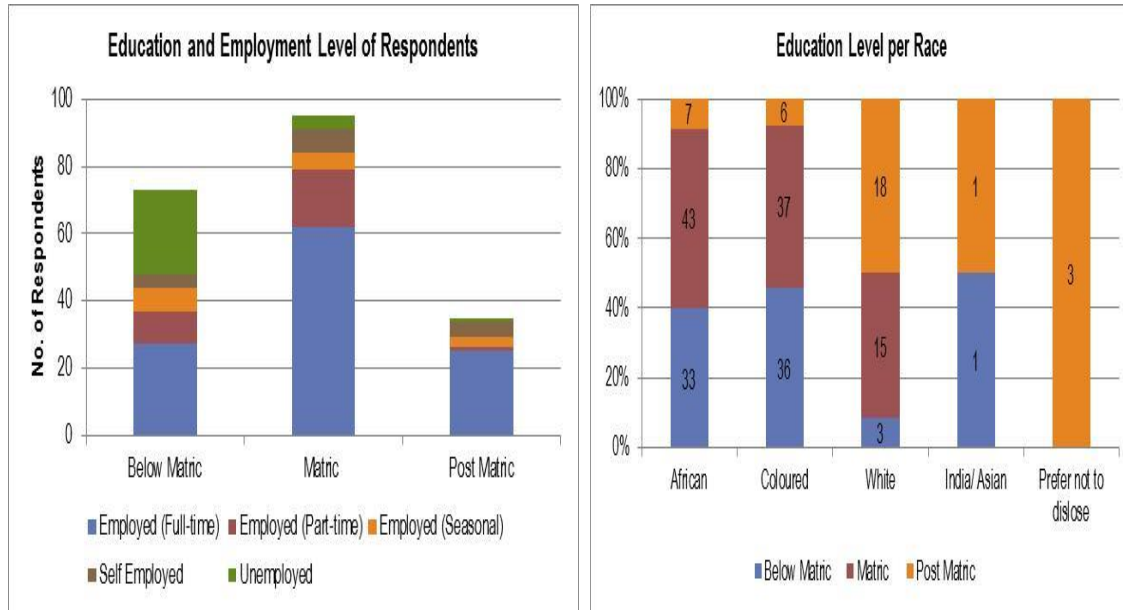


Figure 7: Respondents education status (left) total number of respondents and ratio of male and female per employment category and (right) rate of employment status per racial group.

3.1.3 Stakeholder Categories

Seven main stakeholder categories were identified. Most respondents were classified on general public (n=125; 62%); followed by capture fisheries stakeholders (n=28;14%) and environmentalists (n=15;7%). Other stakeholders were the marine aquaculture industry (n=12; 6%); non-fisheries economic sectors that include agriculture, property development and real estate, and tourism industries (n=8; 4%); fish processing and retail (n=7; 3%), and regulators (n= 7; 3%) (Figure 8). It is important to note that respondents may belong to more than one stakeholder group. For the purpose of this study, they only indicated the category which they were mainly active in.

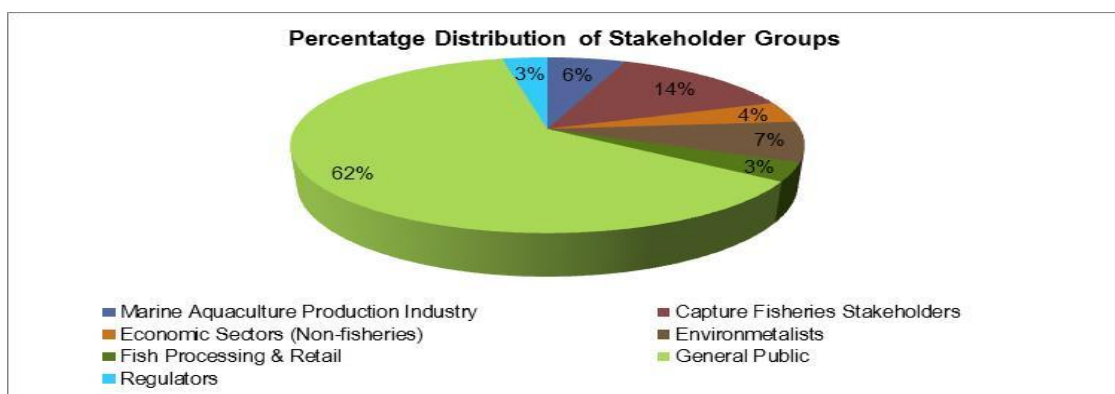


Figure 8: Respondents profile and percentage distribution of interested and affected stakeholders.

3.2 Awareness and preference of fisheries products

Hermanus is a fishing community. Therefore, it is expected that awareness of fisheries and consumption rate of fish should be high. Majority of the respondents were consumers (n=191; 94%) and small portion (n=11; 5%) are non-consumers, whilst one respondent did not disclose. Majority of respondents (n=111; 55%) indicated that they consume fish once per week, with the average consumption rate of 1.5 times per week.

Most of the respondents (n=133; 66%) were aware of the origin of the fish (cultured or captured) consumed in their households at all times, 23% (n=48) were not aware (n=48; 23%) and 10% (n=21) were sometimes aware. Majority of respondents (n=114; 56%) would prefer captured fish to be consumed in their households, whilst 28% (n=56) are not concerned of the origin of the fish, and 16% (n=32) prefer cultured fish (Figure 9). Of the respondents who are aware of the origin of the fish, 70% (n=93) prefer capture fisheries.

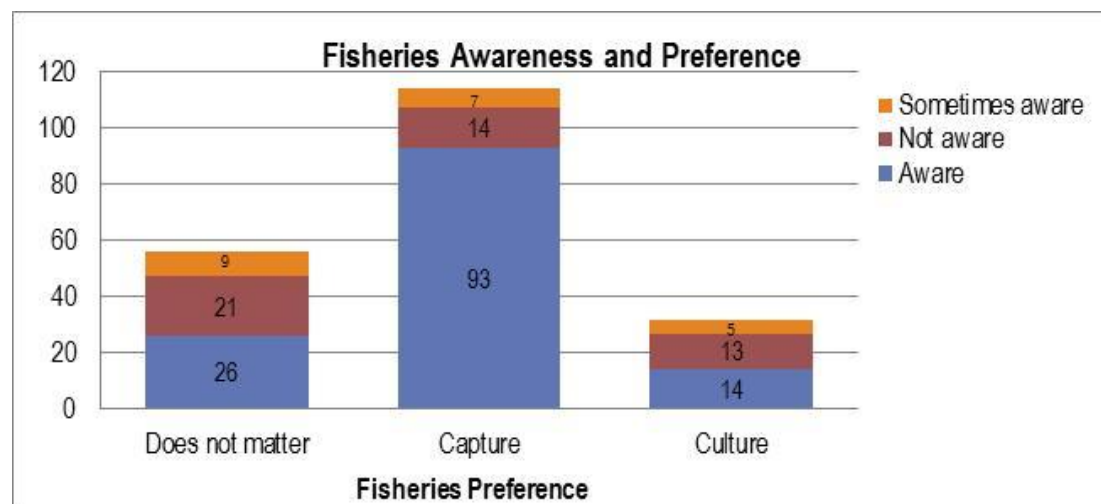


Figure 9: Respondents fisheries awareness and preference (captured or cultured) fish.

3.3 Awareness of marine aquaculture practices and products

Capture fisheries and marine aquaculture are amongst the key economic sectors in Hermanus (Basson 2003). Majority of the respondents have heard of marine aquaculture (n=140; 69%). Of the respondents who have heard of marine aquaculture, majority are also aware of its products (n=121; 86%). Looking at the overall respondents, both those who have and those who have not heard of marine aquaculture, 60% (n=121) are aware of marine aquaculture products and 40% (n=82) are not aware. This is made on the assumption that respondents who have not heard of marine aquaculture are also not aware of its products. Marine aquaculture awareness rate by different stakeholder groups is outlined in Figure 10. A neutral group in the identified stakeholders is the general public as they may not have any investment in the marine aquaculture sector, and they do not represent a competing or complementing sector.

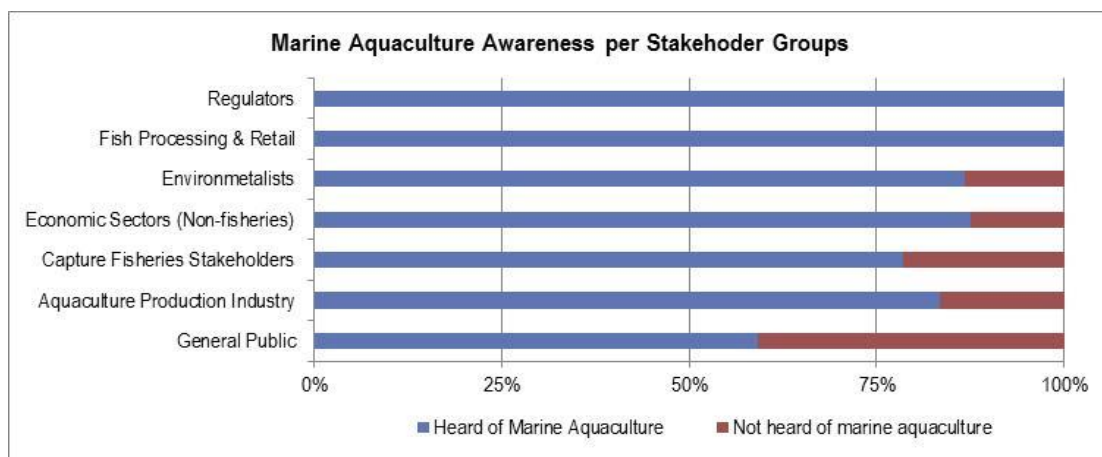


Figure 10: Rate of marine aquaculture awareness by stakeholder groups.

Respondents with an income of less than ZAR1000 and young respondents (24 years and below) appear to be the least aware of marine aquaculture. Both these groups show awareness rate of less than 50%. Other groups have an awareness rate above 50%. Groups that show the greatest awareness with a rate above 90% are the seasonal workers and self employed groups; respondents with post matric education, and the Whites (Figure 11).

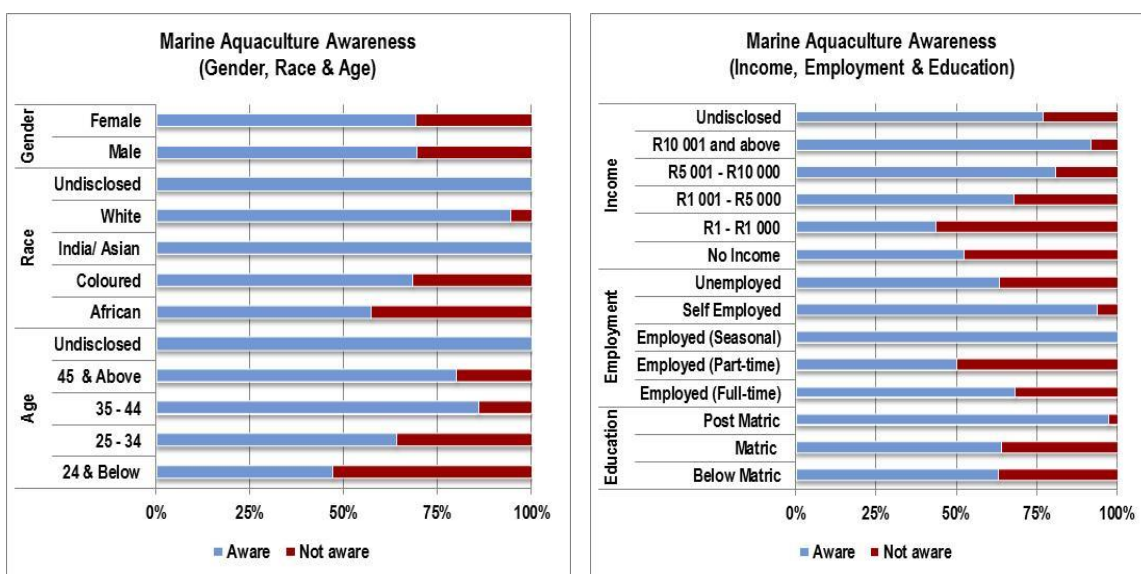


Figure 11: Respondents rate of marine aquaculture awareness by Gender, Race and Age (left); and Income, Employment and Education level (right).

Among all respondents 62% (n=127) are aware of marine aquaculture farms and 38% (n=76) are not aware. Of those who are aware of marine aquaculture (n=140), 85% (n=119) are aware of farms in Hermanus, 6% (n=8) are aware of farms in other parts of the country and 9% (n=13) are not aware of any marine aquaculture farms.

The South African marine aquaculture industry currently consists of six sub-sectors i.e. abalone, mussels, oysters, seaweed, prawns and finfish. Respondents mentioned all indicating that they are aware of these species. Abalone is a main contributor to the marine aquaculture production and was mentioned by respondents 120 times. Marine

aquaculture species that are cultured in other countries and freshwater species were also mentioned. These were categorised as other aquaculture species. Some respondents mentioned species that are not currently cultured for human consumption anywhere in the world, but are kept in aquaria for display purposes. Such species were categorised as ornamental species (Table 2).

Table 2: List derived from the species mentioned by respondents and the number of time each species was mentioned.

Species	Number of times mentioned
Abalone	120
Finfish	23
Oysters	21
Mussels	18
Prawns	15
Seaweed	6
Other (Aquaculture)	22
Ornamental	42

Even though some of the respondents are aware of marine aquaculture (n=140), only 52% (n=73) have interacted with its activities (Table 3). Interaction mainly took place through the marine aquaculture production industry and very little through marketing and the EIA public participation processes.

Table 3: List of mode of interaction with marine aquaculture by respondents and the number of times each mode was mentioned.

Mode of Interaction	Number of times mentions
Marine Aquaculture Production Industry	34
Fish processing	16
Consumer intercation	7
Marketing	4
Regulation	4
EIA Public Participation Process	2

3.4 Marine Aquaculture and Environmental Impacts

Majority of respondents indicated that all six economic sectors identified in this study and existing in Hermanushave have an overall positive impact on the environment. Of the six sectors, marine aquaculture was placed third in terms of positive impact and second in terms of negative impact on the environment (Figure 12). It is important to note that the analysis is based on 98 respondents who indicated one of the four options posed in the question. Other respondents (n=5) indicated that the impact of sectors depends on how they are practiced, therefore their view cannot be expressed based on the options provided, i.e. positive, no impact, negative or unaware.

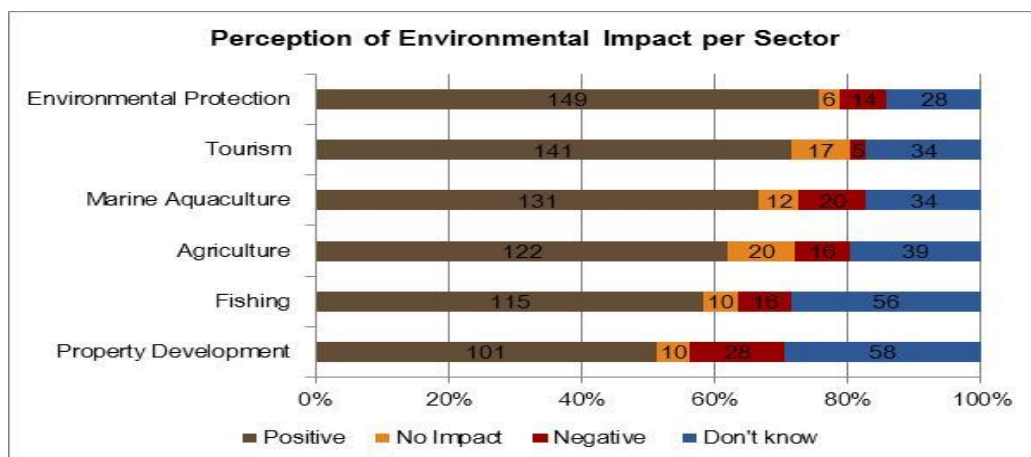


Figure 12: Respondents perception regarding the environmental impacts resulting from the six economic sectors that occur in Hermanus.

Stakeholders view environmental impacts differently and this could be due to their involvement and interest in the sectors identified. The Marine Aquaculture production industry; Capture fisheries stakeholders; Fish processing and retails; and Regulators do not recognise any negative impact marine aquaculture may have on the environment. Majority of all other groups also felt that there are no negative environmental impacts resulting from marine aquaculture. Among the general public, 12% (n=15) indicated that there are negative impacts, while other groups such as environmentalist (n=3; 29%) and economic sectors (non-fisheries) were more critical (n=2; 25%) (Figure 13). Analysis in terms of gender, race, age, income, employment and education was done (Figure 14). The groups that show the least positive perception of marine aquaculture with regards to its environmental impact are participants with low income and the unemployed.

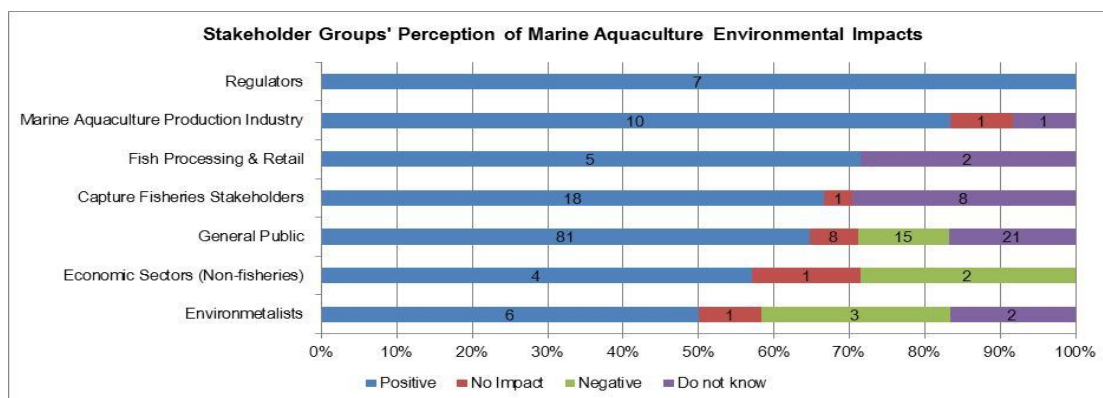


Figure 13: Respondents perception of marine aquaculture’s environmental impacts by stakeholder groups.

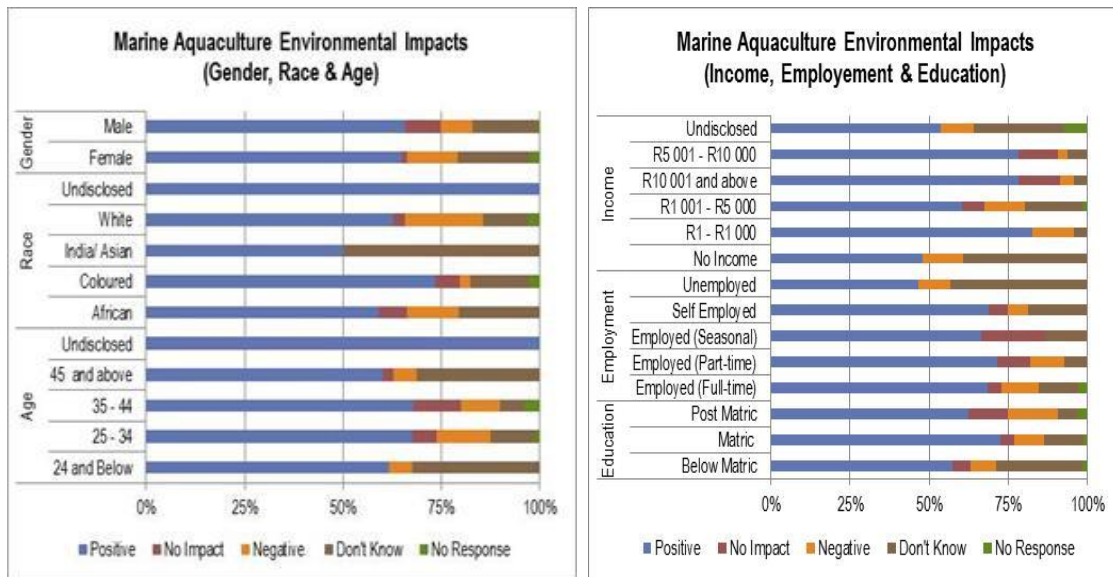


Figure 14: Respondents rate of perception of environmental impacts resulting from marine aquaculture by (left) Gender, Race and Age; and (right) Income, Employment and Education.

There are both positive and negative impacts on the environment resulting from different marine aquaculture practices and production systems. The level of impact may be related to the production method. For the purpose of this study, assessment of perception is focused on the marine aquaculture industry as a whole, not individual production methods. Respondents indicated that the level of positive environmental impacts of marine aquaculture exceeds the negative impacts. Those who have a strong opinion about the impacts, overwhelmingly feel that the impacts are positive (Figure 15).

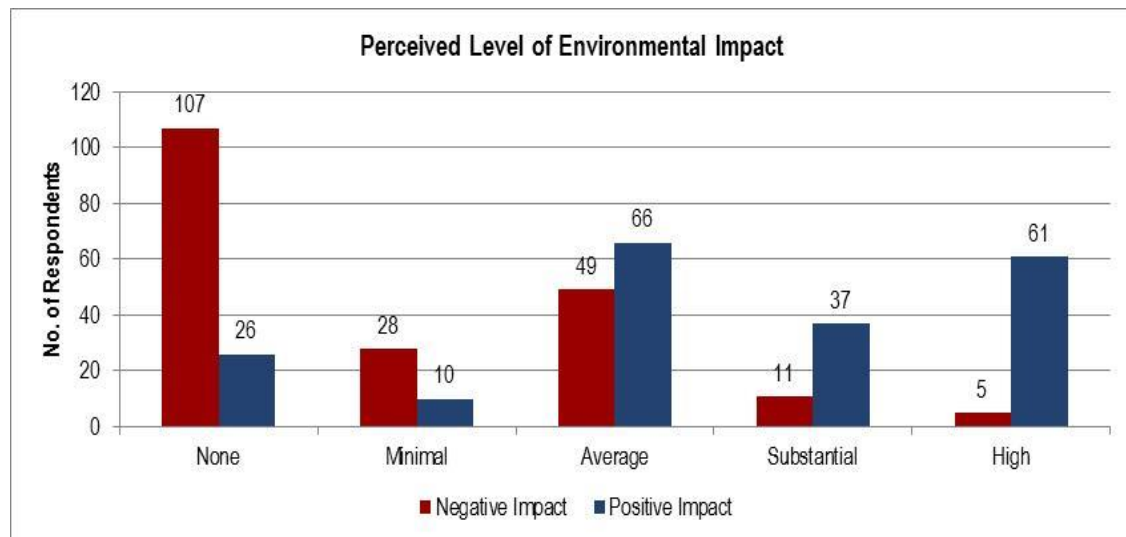


Figure 15: Level of perceived negative and positive environmental impacts resulting from marine aquaculture.

To understand what is perceived as negative and positive environmental impacts, respondents were requested to mention the negative and positive impacts they believe emanate from marine aquaculture. Of the n=203 respondents, 16% (n=33) did not respond to the question, 21% (n=42) were not aware of positive impacts and 7% (n=15)

are of the view that there are no impacts. There were respondents (n=15; 7%) who mentioned socio-economic impact instead of environmental impacts. Five positive impacts were mentioned by participants when asked about what they view as positive impacts. On top of the list was stock enhancement and other positive effects on the wild stocks (Table 4).

Table 4: List of positive environmental impacts perceived by respondents and the number of times mentioned.

Positive Environmental Impacts (Marine Aquaculture)	No. of times mentioned
Production of juveniles for stock enhancement to increase fish availability	41
Reduction of pressure from the wild stocks	30
Provide an opportunity for recovery of overexploited fish stocks	20
Reduces poaching opportunities	4
Improves water quality (filter feeders)	3

In terms of negative environmental impacts resulting from marine aquaculture, 28% (n=56) did not respond, 20% (n=41) were not aware and 19% (n=39) were of the view that there were no negative impacts resulting from marine aquaculture. From respondents comments, a list with eight negative impacts were compiled with pollution mentioned most often (Table 5).

Table 5: List of negative environmental impacts perceived by respondents and the number of times mentioned.

Negative Environmental Impacts (Marine Aquaculture)	No. of times mentioned
Pollution	43
Increased poaching opportunities	10
Extraction of wild stock (broodstock, feed and feed manufacturing)	6
Negative aesthetic impact	3
Coastal land degradation for farm development	2
Genetic dilution of wild stocks	1
Marine habitat degradation	1
Alteration of water movement through structures	1

3.5 Marine Aquaculture and Socio-Economic Impacts

As already indicated, socio-economic needs are at the core of most sector developments. In South Africa, job creation, food security, poverty alleviation and rural development are government priorities. Marine aquaculture is among the sectors identified to contribute to these priorities. In this study, 5 other sectors were identified and respondents believe they all have overall positive socio-economic impacts (Figure 16). Marine aquaculture was ranked second in terms of positive socio-economic impacts and third in terms of negative impact.

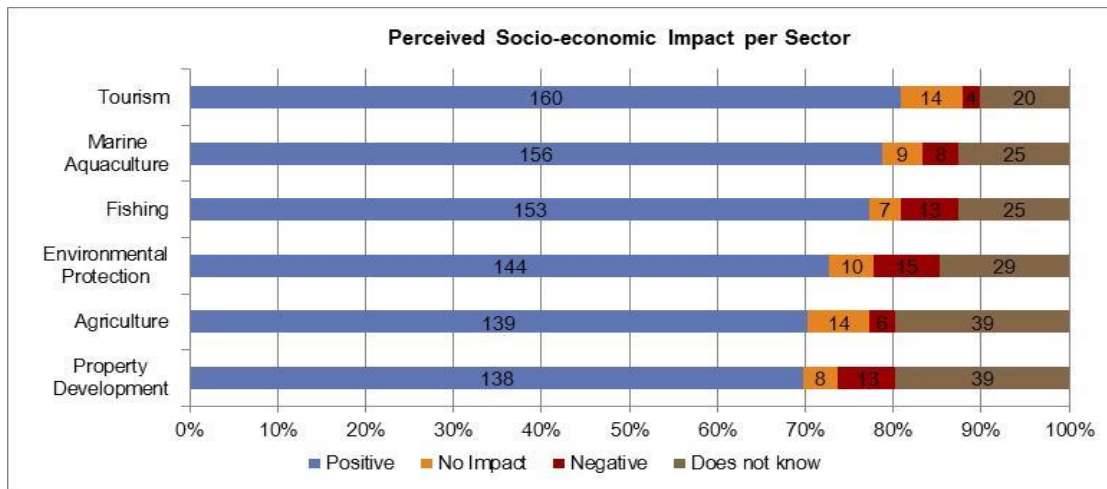


Figure 16: Respondents perception regarding the socio-economic impacts resulting from the six economic sectors which occur in Hermanus.

Analysis of perceived socio-economic impacts by gender, race, age, income, employment and education show that those who are unemployed and have low income perceive the lowest positive impact (Figure 17).

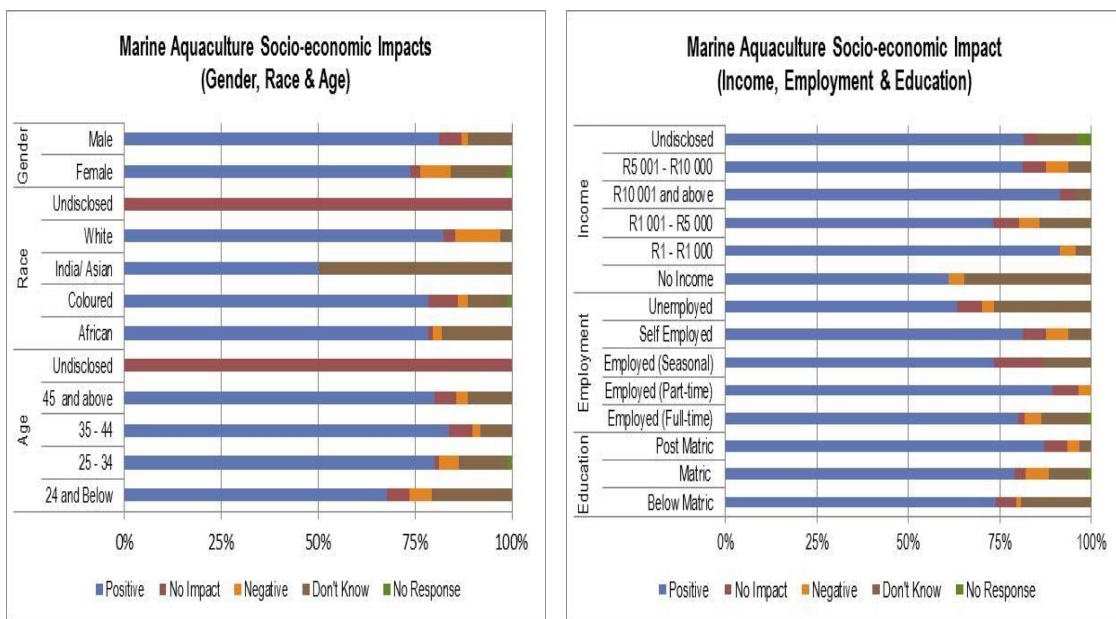


Figure 17: Respondents rate of perception of socio-economic impacts resulting from marine aquaculture by (a) Gender, Race and Age; and (b) Income, Employment and Education.

The Marine Aquaculture production industry and other non-fisheries economic sectors are of the view that marine aquaculture does not have any negative socio-economic impacts. (Figure 18). Using a five-point Likert scale, respondents indicated their view in terms of level of positive and negative socio-economic impacts resulting from marine aquaculture. Respondents perceive marine aquaculture to have higher positive impacts than negative impacts (Figure 19).

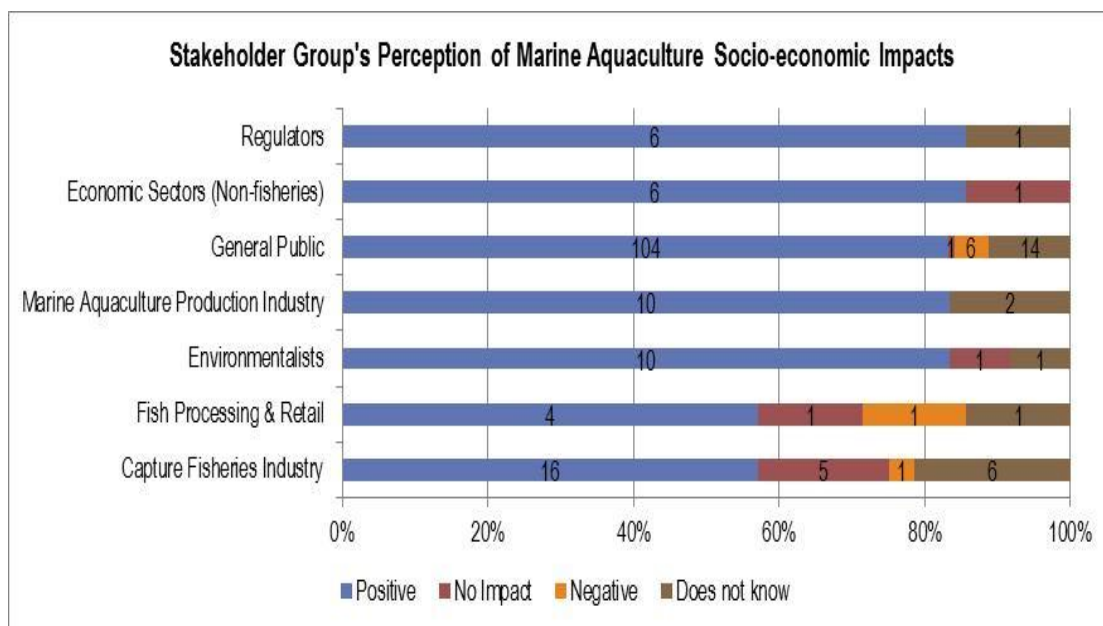


Figure 18: Respondents perception about marine aquaculture’s environmental impacts per stakeholder groups.

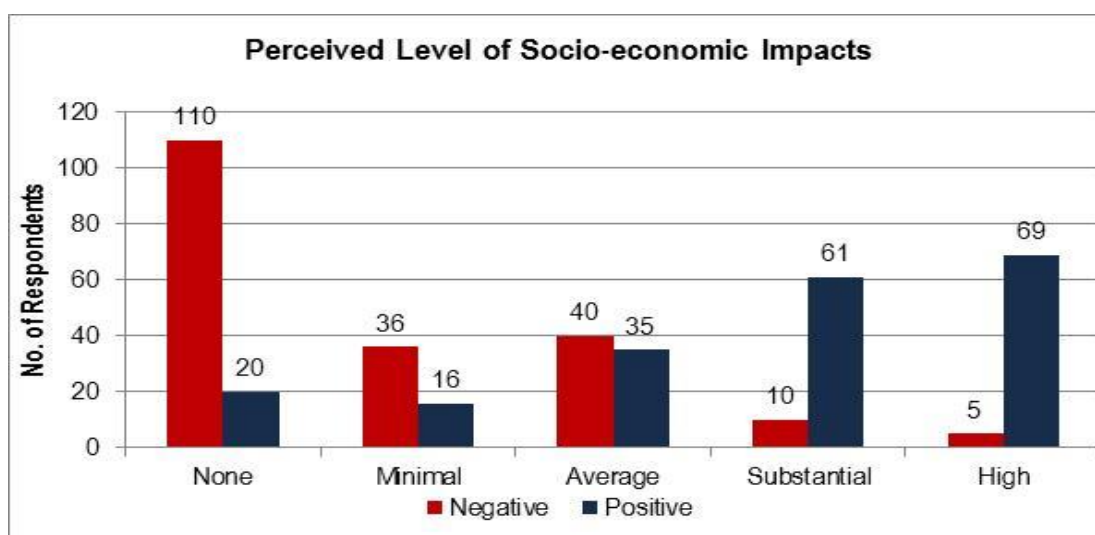


Figure 19: Level of perceived negative and positive environmental impacts resulting from marine aquaculture.

Respondents were requested to name perceived positive and negative socio-economic impacts of marine aquaculture. Ten percent of the respondents (n=20) did not respond to the question, 7% (n=15) were not aware of any positive impacts and 5% (n=10) indicated that there are no positive socio-economic impacts resulting from marine aquaculture. Ten positive socio-economic impacts were mentioned and on top of the list was job creation which was mentioned 150 times (Table 6).

Table 6: List of positive socio-economic impacts perceived by respondents and the number of times mentioned.

Positive Soci-economic Impacts (Marine Aquaculture)	Number of time mentioned
Job creation	150
Food security	13
Skills development	13
Business opportunities	9
Community development (and rural development)	9
Income opportunities	5
Stimulation of tourism industry	5
Economic development	1
Decrease price for fish in the market	1
Poverty reduction	1

The negative socio-economic impacts of marine aquaculture were ranked third amongst the six identified sectors in this study. Of the total participants (n=203), 24% (n=48) did not respond to the question, 21% (n=43) indicated that they did not know and 36% (n=72) indicated that there are no negative socio-economic impacts resulting from marine aquaculture. Nine negative socio-economic impacts were mentioned by respondents. Increased opportunity for poaching as a negative environmental impact was mostly mentioned (Table 7).

Table 7: List of negative socio-economic impacts perceived by respondents and the number of times mentioned.

Negative Socio-economic Impacts (Marine Aquaculture)	No. of time mentioned
Increased poaching opportunities	14
Benefits are directed to individuals, not the entire community	7
Competes with the capture fisheries for markets	7
Increases pollution and affect health of the residents	4
Creates few jobs and reduces jobs whilst reducing jobs in the capture fisheries	3
Reduces aesthetic value of the area	3
Lack of transparency	3
Knock-off effects resulting from environmental impacts	1

3.6 Comparison of Environmental and Socio-economic Impacts of Marine Aquaculture

Respondents are of a view that marine aquaculture has positive environmental and socio-economic impacts. They are of the opinion that the positive socio-economic impacts exceed negative environmental impacts (Figure 20a). The views of the general public are in line with the views of the overall respondents (Figure 20b).

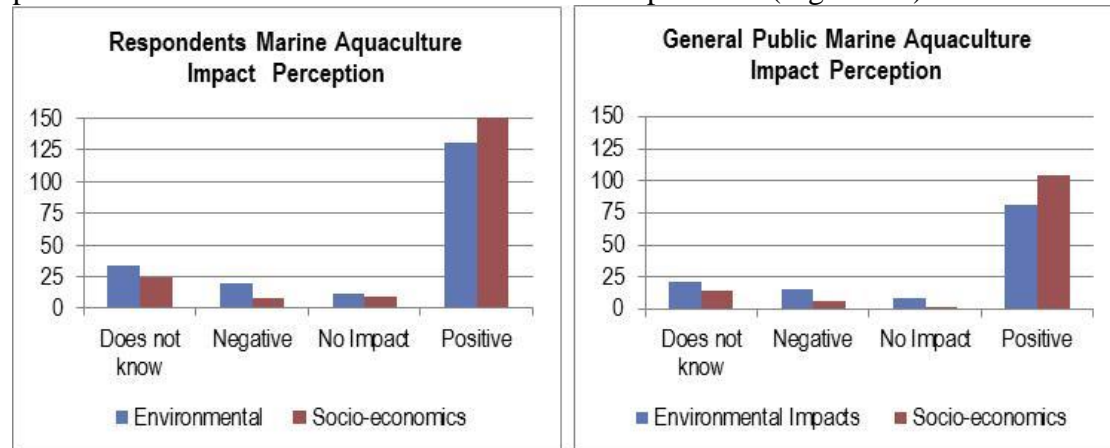


Figure 20: Respondents perception of environmental and socio-economic impacts of resulting from marine aquaculture (left); and General public's perception of environmental and socio-economic impacts resulting from marine aquaculture (right).

3.7 Competing sector preference in comparison to Marine Aquaculture

Marine aquaculture was highly preferred by most participants (n=73; 36%) whilst tourism was ranked second (n=35; 17%). Members of the general public who are assumed not to have stake in any of the identified sectors highly preferred marine aquaculture. A large portion of capture fisheries stakeholders also preferred to have marine aquaculture in Hermanus (Figure 21). This could be due to the increased awareness of declining fish stocks and marine aquaculture as an alternative fish supply.

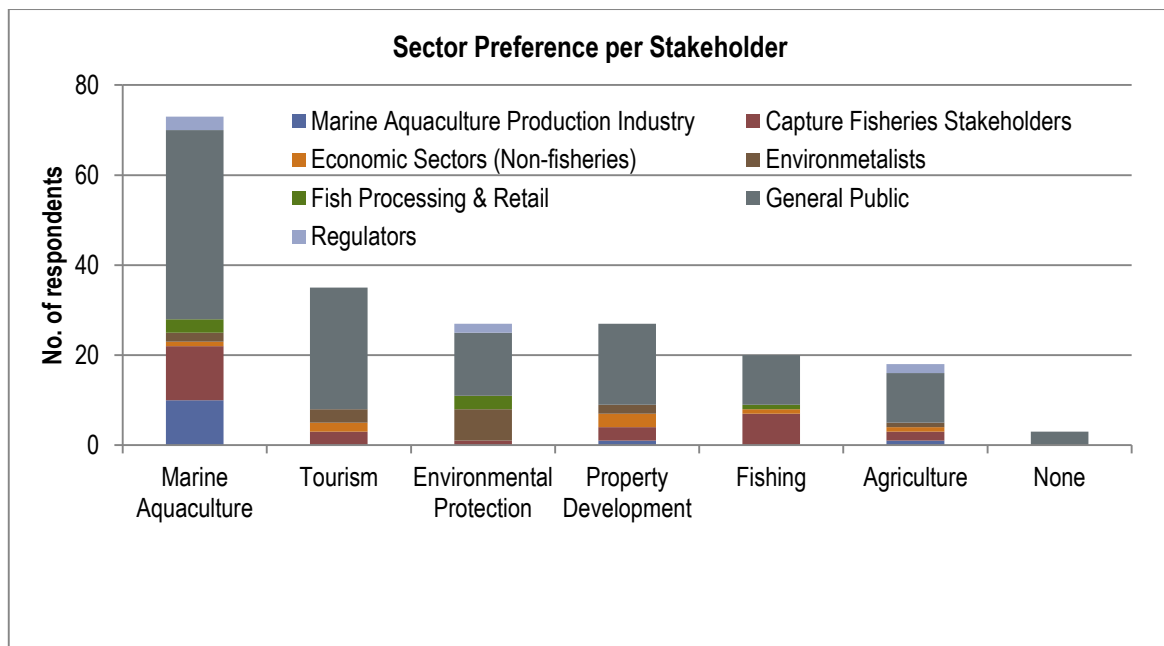


Figure 21: Respondents’ indication of preferred sector in Hermanus.

4 DISCUSSION

This study addresses public awareness and perception of marine aquaculture from the three dimensions of sustainable development, i.e. environmental, social and economic considerations. Special attention is given to the environmental and socio-economic dimensions. Since marine aquaculture is seen as an alternative to marine capture fisheries, the two cannot be separated when dealing with these dimensions. The area for the pilot study (i.e. Hermanus) was strategically identified because it is a host to both sectors and other competing and complementing industries.

It is a legislative requirement for policy makers to ensure public involvement in policy development (RSA, 1996). In 2006, the development of the Marine Aquaculture Policy adhered to this requirement. Its Implementation Plan identified socio-economic gaps that need to be addressed in order to successfully implement programmes geared towards marine aquaculture development (DEAT, 2009). This paper will not only contribute to the Marine Aquaculture Implementation Plan, but will also contribute to the elements of the recent draft NASF that emerged after the alignment of marine and freshwater aquaculture. It is also important to note that the draft NASF drives towards policy revision to address some elements of the fragmented legislative framework. This study provides policy makers with a view on the public perspective of marine aquaculture. In addition, it serves as a pilot for a most comprehensive study on public awareness and perception of marine aquaculture in coastal communities. It should further initiate dialogue on public understanding of aquaculture and provide guidance to the aquaculture awareness programme intended to promote aquaculture in South Africa.

4.1 Survey Participants

Representation of interested and affected stakeholders in this study was fairly covered. The four official racial groups existing in Hermanus are all represented in the results of the study, even though they do not entirely mirror the representation as per national statistics. Nationally and provincially, racial representation also does not give a mirror image of each other. On the national level Africans are a majority, followed by Whites, Coloureds then Indian/ Asians (StatsSA, 2011). In the Western Cape province, the Coloureds have a highest percentage, followed by Africans, Whites and Indians/ Asians (DSD, 2008). In this study, the racial representation in a descending order is Africans, Coloured, Whites and Indians/ Asians. It is clear that racial representation is based on the area, therefore it could be ignored that the representation in this study does not mirror national or provincial representation, but when conducting a full study, this needs to be considered.

4.2 Fisheries Awareness and Preference

Majority of participants are fish consumers with a low consumption rate (1.5 times per week). Awareness of origin of the fish consumed in their households is high. The study site is a historic fishing community and the results on fisheries awareness cannot be argued otherwise. Nevertheless, it is also important to take note of the study conducted by Cawthorn *et.al.* (2011) indicating that fisheries sustainability may be compromised due to incorrect presentation of fisheries information to consumers by retail industry.

The results in terms of fisheries preference are in line with the outcomes of the benchmarking survey by Britz *et.al.* (2009) and shows that participants prefer consumption of captured fish over cultured. The current study did not look into the reason for fisheries preference, whilst the benchmarking survey by Britz *et.al.*(2009) outlined that the reasons were related to the taste, organic preference (noted as “more natural”) and usage of chemicals in the cultured fish products. A further investigation of the reasons for fisheries preference needs to be conducted to provide a better direction for marketing elements of marine aquaculture.

4.3 Awareness of Marine Aquaculture

It is to be expected that the Hermanus community should be aware of marine aquaculture due to their proximity to the activity and the results are similar to what Mazur and Curtis (2008) found in their study conducted in Australia. There is however a discrepancy between the current study and the benchmarking survey by Britz *et.al.*, (2009). This study shows that the Hermanus community is aware of marine aquaculture whilst the study by Britz *et.al.* (2009) shows that majority of South African consumers have never heard about aquaculture (both marine and freshwater). The fact that the Hermanus community is in close proximity to the marine aquaculture farm could contribute to their high awareness level in comparison to the rest of the country. Other possible explanation could be that aquaculture awareness has increased over the years. It is therefore important to have a wider and more representation of different provinces and areas when implementing a full awareness and perception study in South Africa. This will provide an opportunity to do a fair comparison between the studies and credible assessment of awareness progress over the years

Even though majority of participants were aware of marine aquaculture, there are two groups that showed low awareness rate i.e. participants below the age of 25 and participants earning less than ZAR1000 per month. Possible explanation for low awareness levels within the younger participants could be due to the lack of involvement in the fisheries industry. A further investigation needs to be conducted on the possible reasons for low awareness among participants with low income. These groups may not be influential at the moment, but they need to be considered as they may have influence on future policy directives and decision making of developments in their area.

The outcomes of this study and the studies that may emanate from it, need to be taken into consideration when developing the South African Aquaculture awareness programmes. Coastal communities will need to be made aware of marine aquaculture; its farms, species and products thereof. This will assist in obtaining buy-in during public participation processes and contribute towards addressing the issue of competition for site with other sectors. It is therefore important to discuss how the public perceives the impacts marine aquaculture has on the community based on the dimensions of sustainable development.

4.4 Perception of Marine Aquaculture Environmental and Socio-economic Impacts

There are pros and cons in any sector development. The same is experienced with marine aquaculture development. It is how those pros and cons are addressed and trade-offs are dealt with that determines the success of sector development. In this study the participants weigh the positive and negative impact of marine aquaculture and perceive the pros to exceed the cons. Whitmarsh and Palmeri (2009) have argued that the social acceptability may be linked to perception. The results of the current study show that the society perceives marine aquaculture positively, therefore it can be concluded that the sector has gained acceptance. A realisation of declining wild fish stocks and the potential for marine aquaculture to bridge the gap, may be the reason for the social acceptability of the sector. Even though participants seem to be overwhelmingly positive towards the sector, it is important to analyse how they perceive the environmental and socio-economic elements of sustainable development. This will provide decision makers and policy developers information to ensure that all public concerns are addressed.

4.4.1 Environmental Impacts of Marine Aquaculture

Seemingly majority of participants, including Environmentalists perceive marine aquaculture to have positive environmental impacts that exceed negative impacts (Figure 15). Nevertheless, most environmentalists indicated that assessment of impacts should be at the sub-sector level and not on the marine aquaculture as a whole. This is a valid input and should be considered when implementing the full study. The participants' observation of environmental impacts of the marine aquaculture is valid. Previous administration was focusing on environmental protection therefore legislative requirements are conservation driven. This may be the reason marine aquaculture industry has paid attention to potential environmental impacts. This results in the sector getting a much needed positive image. The industry needs to focus on addressing and minimising the negative impacts commented on by participants (Table 5), whilst using the positive impacts to their advantage when promoting the sector (Table 4).

Even though majority of participants perceive marine aquaculture to have positive impacts, there were two groups that demonstrated the least rate of positive perception towards marine aquaculture in relation to the environmental impacts. These groups are participants who are unemployed and those earning less than ZAR1000 per month. A significant number of these participants indicated that they do not know whether marine aquaculture has positive, negative or any impact on the environment. These groups may not afford to obtain access to resources (e.g. internet, newspapers, etc) due to their lack of finance. It can therefore be assumed that their access to knowledge plays a role in sector perception, therefore to promote positive perception of the sector, information needs to be made available to the public.

4.4.2 Socio-economic Impacts of Marine Aquaculture

The main socio-economic impact perceived by the participants is job creation and is mentioned more than any other perceived impact in the study. Some of the participants argue that marine aquaculture does not create enough job opportunities instead it reduces employment in the capture fisheries. Reduction of poaching opportunities

resulting from marine aquaculture was mentioned as a positive environmental impact. The same impact was mentioned as a negative socio-economic impact. Some argue that marine aquaculture increases the market and availability of products from fish species that are declared to be endangered in the wild environment. This also creates a monitoring challenge and affects consumer choice. In addition, there could be a possibility of misrepresentation of product information by the retail industry (Cawthorn *et.al.* 2011). These two reasons may explain why the public links marine aquaculture and poaching. To address this challenge, the marine aquaculture industry needs to invest in product branding and ensure implementation of product traceability. Publicity on product branding and traceability will be required. This can also be linked to ensuring easy access to information for the public. As with the environmental impacts, the group that demonstrated the least rate of positive socio-economic impacts are those with low income. These can also be seen in the unemployment group and among young participants.

5 CONCLUSION

Marine aquaculture awareness is high in the Hermanus community. The participants in this study perceived the sector to have a positive contribution to the community through job creation. The environmental impacts resulting from marine aquaculture are perceived to be minimal. Participants are of the view that negative environmental impacts are exceeded by both positive environmental and socio-economic impacts.

The pilot study has assisted in highlighting elements that need to be addressed in the full implementation. Some of the elements include evaluation of perception at the sub-sector level, assessing the stakeholder groups to be involved; and ensuring the questionnaire covers all relevant elements.

6 RECOMMENDATIONS

It is recommended that:

- A public awareness and perceptions study that focuses on different aquaculture systems and sub-sectors be conducted to get a more informed public view of aquaculture.
- A study on Public Understanding of Aquaculture (PUA) needs to be conducted at least every five years in order to determine progress in terms of social acceptability of freshwater and marine aquaculture over the years. The PUA should be conducted in all areas, not only in traditional fishing communities and communities where aquaculture is practiced. A comparison of awareness levels can also be drawn from that study to ensure that awareness programmes are directed to areas with less awareness. The PUA study should also look into perception of different groups and determine what could influence such perception (both negative and positive).
- Awareness programmes should place more focus on areas that do not have aquaculture activities. In addition, focus should be given to young people when conducting awareness campaigns.

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