Participatory Development of Provincial Aquaculture Programmes for Improved Rural Food Security and Livelihood Alternatives

Qurban Rouhani & Peter J Britz

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PARTICIPATORY DEVELOPMENT OF PROVINCIAL AQUACULTURE PROGRAMMES FOR IMPROVED RURAL FOOD SECURITY AND LIVELIHOOD ALTERNATIVES

Report to the Water Research Commission and Department of Agriculture, Forestry and Fisheries

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EXECUTIVE SUMMARY

The WRC Baseline Study of the Contribution of Aquaculture to Rural Livelihoods in South Africa in 2004 revealed that despite having potential, rural aquaculture was almost non-existent (Rouhani and Britz, 2004). This despite the existence of a number of state owned hatcheries and rural aquaculture projects that had been supported by Government. The project recommended that subsistence level aquaculture would not be viable due to the skills and resource constraints of the rural poor, and that the provincial agriculture departments should focus on promoting aquaculture as a profitable enterprise amongst emerging commercial farmers. Revitalisation of the state hatcheries was identified as a key intervention to create service centres or hubs to support community-public-private partnerships (CPPPs), training, technology transfer, fingerling supply, extension and other services in support of aquaculture development. This rationale formed the basis for the current WRC project entitled: *Participatory development of provincial aquaculture programmes for improved rural food security and livelihood alternatives.*

The project team under the leadership of Rhodes University held a series of consultations with the provincial departments of agriculture (PDAs) to establish the level of interest in establishing provincial aquaculture programmes in partnership with the WRC research management team. All provinces responded positively, although the Western Cape subsequently withdrew as the province already had an established and well resourced aquaculture policy and strategy process underway, led by the Department of Finance and Economic Affairs.

Participatory action research (PAR) was chosen as an appropriate methodology for the project as it focuses on the effects of the researcher's direct actions of practice within a participatory community with the goal of improving the performance quality of the community or addressing an area of concern. The target community was provincial agriculture department staff responsible for aquaculture development within the participating provinces.

The first step in the engagement with the provinces was the drafting of provincial aquaculture strategies. This process was useful for establishing working relationships with the provincial personnel, and to understand the issues they faced in each province. Immediately apparent were the often severe organisational constraints under which the PDAs operated, which would ultimately become the main issue the project team had to contend with in the achievement of the project objectives. Draft provincial aquaculture

strategies were developed in participative workshops for Limpopo, Mpumalanga, KwaZulu-Natal (KZN), Free State, Northern Cape and North West Province. However, only in Limpopo, Free State and Mpumalanga were the strategies formally taken forward and adopted by the PDAs. The Eastern Cape PDA, chose not to develop a provincial aquaculture strategy (PAS), indicating that it first wished to see a successfully implemented aquaculture project. The only provinces that made tangible progress in translating their PASs into projects were Limpopo and Free State. This was largely due to political support and stable and competent leadership within the PDAs. In the other provinces, PAS implementation was effectively halted by personnel changes, alleged financial irregularities, unwieldy procurement processes and a lack of skilled personnel.

Despite the poor progress of certain provinces in adopting a PAS, they remained interested in aquaculture development and the project team played a support role in promoting hatchery revitalisation in Limpopo (Turfloop Hatchery), Mpumalanga (Lydenburg and De Kuilen), KZN (Mkhathini), and Eastern Cape (Amalinda). The Turfloop hatchery was made operational again after many years of being dormant with support of from the Rhodes research team and the Limpopo University Aquaculture Unit. Despite the high potential for a trout production CPPP identified at Lydenburg and Mpumalanga, the Province did not respond to a proposal to revitalise these facilities to support small-scale farmer trout production along the model used in the Western Cape. In KZN, the PDA was slow to respond to the opportunity at Makhathini, however by 2009 a budget and tender had been put out to revitalise the facility. In the Eastern Cape, the project team played a key role in supporting the establishment of a CPPP between the Eastern Cape government and an MK Veterans Trust which was developing the Amalinda provincial hatchery as an ornamental fish farm.

A major project focus was the training of provincial hatchery staff and extension officers. The training of hatchery staff can be deemed a success as their training was linked to hatchery revitalisation. However, the agricultural extension officers proved very difficult to access for regular training as they had many other duties, and did not fall under the direction of the provincial aquaculture managers. Several provinces' managers questioned why they should be trained when there were no aquaculture projects or farmers to serve. Thus, only the Limpopo extension officers received regular training. Mpumalanga sent extension officers on one course and the other provinces were not able to provide extension officers for training. This outcome indicates that provincial aquaculture projects should perhaps be staffed with dedicated aquaculture specialist extension personnel (as is the case in the Western Cape). It was also evident from the outset of the project that the PDA managers responsible for aquaculture required aquaculture training at a more strategic level. Thus, a study tour of commercial aquaculture facilities was carried out, which greatly increased their insight into the sector's potential and their confidence in the province investing in support for of aquaculture.

In order to facilitate linkage between the private sector and government support for aquaculture, and realise the potential of the state hatcheries as development agents, a Public-Private-Partnership (PPP) model was developed which is similar to the operational PPP for Jonkershoek hatchery whereby Stellenbosch University has provided development support for the trout industry in the Western Cape. The first step in the strategy was for the provincial governments to revitalise the hatcheries to engage meaningfully with the private sector. This is a work in progress in Limpopo, Mpumalanga and KZN, however at Amalinda Hatchery in the Eastern Cape an operational PPP was established with support by the province and the project team.

In evaluating the project, it is clear that some of the project goals were not achieved due to organisational constraints within the PDAs. Of particular concern is that farmers were not effectively engaged with or support provided. This raises the question of whether the PDAs are the most appropriate public sector organisation for establishing a new sector such as aquaculture. Certainly, their unwieldy organisational structure, which is slow to respond to needs and frequently beset by dysfunction, is not conducive to meeting the needs of aspirant aquaculture enterprises.

The challenge for South Africa is thus how to provide government support for sector development that addresses the needs of aquaculture enterprise development, both large- and small-scale. Aquaculture cannot be entirely private sector-driven as the transaction costs of pioneer farmers are too high and there are barriers they cannot overcome, such as access to suitably zoned land and water. On the other hand, the experience of South Africa's provincial hatcheries shows that Government, without private sector participation, is a poor driver of sector development. Thus the organisational challenge is to create a structure(s) whereby Government sets the development policy agenda and offers various forms of support and the private sector drives the actual production and market related aspects of project implementation through vehicles such as PPPs, or special purpose vehicles (e.g. the Western Cape Aquaculture Development Initiative (WCADI)) which are market driven and independent of the bureaucratic constraints of the PDAs.

However, even with the commercialisation of aquaculture, there is still a clear need for Government, particularly the PDAs, to play a role in supporting this industry by providing various services e.g. veterinary services, quality fingerlings, technical support, industrial investment incentives and bulk infrastructure services. This requires a more coordinated, cooperative governance approach which is well beyond the mandate of the PDAs. Fortunately, the national departments of Agriculture, Forestry and Fisheries, Science and Technology and Trade and Industry have collaborated to formulate a national aquaculture strategy to be considered by Cabinet. The roll-out of such a strategy would provide much needed guidance and support to the PDAs and a key recommendation is that DAFF continue to fulfil the leading support role to the PDAs initiated in the present project.

The major contribution of the current project can thus be seen as creating awareness and buy-in for supporting aquaculture within the PDAs, and a programme and strategies for provincial aquaculture capacity development. Despite the constraints experienced, the PDAs are committed to aquaculture development and the challenge is to address the sometimes severe organisational constraints within these departments. Linking the PDAs into broader cooperative governance arrangements, whereby they are empowered to deliver the support services within their mandate, will result in them playing a more effective support role.

It is therefore recommended that ongoing organisational and technical support be provided to the PDAs by the Department of Agriculture, Forestry and Fisheries (DAFF) to build on the foundation laid by this project. The interaction between DAFF and the PDAs needs to be formalised into a programme approach to plan the roll-out of the national aquaculture strategy. Specific recommendations are:

- Aquaculture development strategies should be market-driven and appropriate state supported special purpose vehicles such as PPPs or provincial aquaculture project promotion agencies should be established to drive public and private sector investment into projects such as Aquaculture Development Zones (ADZs).
- In terms of hatchery revitalisation, it is recommended that suitable NGO, University or economic development agencies facilitate this process in partnership with the PDAs to create viable, market driven service hubs which address the needs of rural farmers.
- The training of provincial PDA staff in aquaculture needs to continue at all levels.
- It is recommended that the Rhodes University initiative to train state vets in aquaculture in partnership with the OIE, and to establish a fish disease research diagnostic centre, be supported.

- The use of the Nile tilapia (classified as an alien invasive under the NEMBA regulations) within areas of its distribution needs to be agreed on and managed between by DAFF and the Department of Environmental Affairs.
- Aquaculture is a scarce skill in South Africa, and as such both DAFF and the PDA need to invest in tertiary training, including secondment or provision of bursaries.

In terms of the next step, it is therefore recommended that DAFF convene a process with the PDAs to debate the final report recommendations, and agree on organisational structures, processes and support actions going forward.

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ADZ	Aquaculture Development Zone
AEOs	Aquaculture Extension Officers
AISA	Aquaculture Institute of South Africa
ANC	African National Congress
CPPP	Community Public Private Partnership
DAFF	Department of Agriculture, Forestry and Fisheries
DEAT	Department of Environmental Affairs and Tourism
ECDC	Eastern Cape Development Corporation
EIA	Environmental impact assessment
EOs	Extension officers (provincial)
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross Domestic Product
HOD	Head of Department
IGDP	Integrated Growth and Development Plan
KZN	KwaZulu-Natal
MEC	Member of Executive Council
MK	Umkhonto we Sizwe
MPB	Mpumalanga Parks Board
NDA	National Department of Agriculture
NEMBA	National Environmental Management Biodiversity Act
NGO	Non governmental organisation
OIE	World Organisation for Animal Health
PAR	Participatory Action Research
PAS	Provincial Aquaculture Strategy
PDA	Provincial Department of Agriculture
PGWC	Provincial Government of the Western Cape
PPP	Public Private Partnership
RU	Rhodes University
SMEDP	Small Enterprise Development Programme
SMMEs	Small, medium and micro- enterprises
WCADI	Western Cape Aquaculture Development Initiative
WRC	Water Research Commission

Chapter 1
Introduction

INTRODUCTION AND OBJECTIVES

Although South Africa is a water scarce country, aquaculture represents a potential form of agricultural diversification in a context where approximately 1.3 million rural households are active in different forms of supplementary food production, of which 52% experience hunger and 59% are food insecure (Backeberg and Sanewe, 2010). As aquaculture is not an established agricultural production sector in South Africa, interventions to promote its development need to be informed by its production potential, and expected socio-economic contribution. New knowledge is thus required to contextualise and develop appropriate strategies for aquaculture development which are aligned with South Africa's Agricultural Production Strategy (DAFF, 2010a). As the mandate of the Water Research Commission (WRC) is generating water-centred knowledge, it was thus appropriate that the present project entitled: *Participatory development of provincial aquaculture programmes for improved rural food security and livelihood alternatives* was undertaken under WRC's Key Strategic Area: Water Utilisation in Agriculture with co-funding from the Department of Agriculture, Forestry and Fisheries. The project formed part of a suite of WRC funded aquaculture research projects between 2003 and 2010.

In the sections below, the project is contextualized by summarizing the status and contribution of aquaculture globally, in Africa and in South Africa. The imperatives to increase fish supply to meet growing demand, and to create rural livelihoods to reduce food insecurity, are highlighted. The South African policy context and the challenge of defining appropriate public sector interventions to stimulate aquaculture development is then described. This is followed by the project objectives and participatory action research methodology.

Global Aquaculture Perspective

Aquaculture is the fastest growing animal production sector in the world, increasing by 6% per annum and accounting for approximately 46% of global fish production (FAO, 2010). Though aquaculture has been practised for many centuries, there has been accelerated growth in the sector over the last three decades due to the following factors:

1. A ceiling has been reached on catches from wild fisheries, and over- fishing has resulted in much of the world's fish stocks declining.

2. There has been an increase in the demand for fish due to population growth, higher income and awareness of the health benefits of fish.
3. An increase in the real price of fish. With the increase in the price of fish, aquaculture has become more profitable.
4. Fish farming technology has developed rapidly due to research, resulting in a significant increase in the number of new species being farmed.

Figure 1. A tilapia farm in Egypt. Egypt is the largest aquaculture producer in Africa and the world's largest producer of tilapia.

Aquaculture has expanded from its traditional base in Asia to become a global sector, with countries such as Norway, Chile, Vietnam and Egypt establishing themselves as significant producers since the 1980s. Several aquaculture products have become commodities and are now traded globally. For example, aquaculture products are increasingly imported into South Africa from various countries to meet a growing local seafood demand. Typical products include salmon from Chile, catfish from Vietnam, tilapia from China and prawns from India.

Aquaculture development in Africa has lagged behind the rest of the world, although in recent years governments have increasingly taken steps to promote the sector (Brummett *et al.* 2008). Historically, the development of aquaculture in sub-Saharan countries has gone through a series of phases. Between 1950 and 1970 aquaculture was introduced into Africa by the colonial administrations, but production did not become established outside of state hatcheries (Hecht 2006). From 1970 to the mid 1990s, aquaculture was promoted as a rural subsistence farming activity with significant donor support, research and development, and government investment in seed supply and extension to farmers. This period resulted in some commercial success in countries such as Nigeria, Madagascar, Cote d'Ivoire, Zambia and South Africa, but on the whole the promotion of small scale aquaculture was unsuccessful (Hecht 2000). From 1995 onwards, donor support for aquaculture development declined, but commercial aquaculture began to emerge spontaneously in a number of countries due to a rise in fish demand and price which made aquaculture increasingly viable (Hecht, 2006).

Aquaculture production in Sub-Saharan Africa nonetheless remains insignificant in global terms, contributing 0.13% and 13.6% to total World and African aquaculture production respectively (FAO, 2010). The contribution by aquaculture to GDP in the target countries is negligible, ranging from 0.001% to 0.715%. Aquaculture production only contributes 2.03% (72,334 mt) to the total fisheries yield of the target countries (3.6 million mt) (FAO, 2010; Hecht, 2000).

Aquaculture production in Africa is however beginning to grow. It is projected that by 2013 aquaculture production in Sub-Saharan Africa will be between 208,600 and 380,400 mt per annum (FAO, 2010). Total aquaculture production in the 17 target countries between 1998 and 2003 has increased by 61% from 44,962 mt to 72,334 mt (Hecht, 2006).

Per capita fish consumption has decreased significantly in many African countries over the last 30 years, which is a worrying trend for policy makers (Delgado *et al.,* 2003). This is an effect of increased population growth and a decrease in African wild fish catch. High value fish exports from Africa are expected to decrease over the next decade and imports of low value fish will increase (Delgado *et al.,* 2003; Hecht, 2006). The price of fish in Africa is thus destined to rise significantly, whereas the price of traditional sources of protein such as beef, poultry and pork is likely to fall (Delgado *et al.,* 2003). This will favour the development of aquaculture for high value species (Hecht, 2000).

In this global environment, what aquaculture opportunities exist for aquaculture development in South Africa and what interventions are required to facilitate sector development?

Aquaculture – A South African Perspective

The modern aquaculture industry in South Africa was effectively initiated in the 1980s with the establishment of commercial trout, oyster, mussel, ornamental fish and catfish farming (Hecht and Britz, 1990). In parallel to the private sector investment in aquaculture, a number of state-led projects were initiated in the 1980s to stimulate the growth of rural aquaculture, largely with the objective of enhancing food security and income in rural households, situated in areas with traditional communal land tenure systems (Rouhani and Britz, 2004).

The potential for freshwater aquaculture in South Africa is however significantly constrained by the natural environment. The first major constraint is a scarcity of water, and the second is the extreme seasonal temperature fluctuations over much of the interior (Hecht and Britz, 1990). For example, the winters over large areas of the interior are too cold for economically viable production of many warm-water aquaculture species, yet the summers in the same areas are too warm for cold-water fishes such as the salmonids. Thus, salmonid aquaculture is limited to higher altitudes where summer temperatures do not rise too high, and for warm-water species such as ornamental fish, greenhouse tunnel systems that can sustain warm-water aquaculture during winter, are employed. Water is often re-circulated in such systems which partly addresses the problem of water scarcity. Successful aquaculture enterprises are thus likely to employ more capital and skills intensive methods of production to overcome the temperature and water limitations in most areas of the country. This poses a problem for the development of rural aquaculture in South Africa as skilled expertise, capital and efficient extension service are required if programs are to be successfully sustained.

Figure 2. Harvesting trout at a commercial farm in Mpumalanga. Trout production is the largest sector in freshwater aquaculture.

A third constraint, also related to the environment, is the choice of species available for production. With the exception of trout and ornamental fish, which have a high market value, most indigenous and introduced freshwater fish species have historically yielded prices too low to justify the costs of intensive aquaculture production.

A Brief History of Aquaculture in South Africa

The development of aquaculture in South Africa can be divided into three historical periods (Hecht and Britz, 1990). During the colonial era, exotic species were introduced and produced locally, mainly for angling purposes. The apartheid era saw the development of private sector commercial aquaculture (particularly trout and oysters) and government led “homeland” aquaculture initiatives to address food security issues. The post-1994 democratic era has been characterised by the development of commercial aquaculture, particularly abalone, and various projects to develop aquaculture as a small scale rural enterprise. The survey of

Rouhani and Britz (2004) revealed that the legacy of each era is still evident today in the form of various facilities and projects. In order to appraise existing projects, many of which are dysfunctional, and to develop recommendations for the growth of the sector based on existing policy imperatives, it is necessary to understand the original motivation and history behind what we see today.

Exotic Angling Fishes Dominated Aquaculture before the 1950s

Aquaculture in South Africa has its roots in the provincial state hatcheries, which produced exotic species of fish for angling purposes. The successful production of trout was made possible with the establishment of the Jonkershoek Hatchery in Stellenbosch and the Pirie Hatchery near King Williamstown in the 1890s (Hecht and Britz, 1990). It was from these facilities that most of the suitable waters in the Cape Colony were stocked with trout, and this continued for the following hundred years.

Figure 3. Aquaculture in South Africa is over a hundred years old and has its roots in trout flyfishing

It was Government policy at the time to develop inland sport angling. In addition to rainbow and brown trout, fish such as large and small mouth bass and carp were also produced and stocked into inland waters. Other provincial hatcheries were built and exotic fishes were stocked in most of the country's water bodies. This infrastructure and the skills that were created laid the foundation for later attempts to promote food fish farming.

Development of Aquaculture for Food Production and Subsistence during the Apartheid Era

Aquaculture development was promoted in the ethnically based rural "homeland" areas of South Africa as part of a policy to make them economically viable entities (Batchelor, 1988). The then Department of Development Aid, tasked with promoting projects which would enhance the viability of the nascent homeland "states", promoted aquaculture projects in the former Transkei, Venda, Gazankulu and Lebowa, primarily for food security of the impoverished communities subsisting under traditional land tenure systems. Aquaculture programmes at the University of the North (in the former Lebowa homeland), University of

Venda (former Venda homeland), University of Zululand (former KwaZulu homeland) and University of Transkei (former Transkei homeland) were established to support these initiatives. The projects focused largely on the development of integrated, polyculture systems. Species used included common carp, Chinese carps (bighead, silver and grass carps), tilapia and catfish, with ducks or chickens supplying nutrient input into the pond. All these projects however failed to yield the expected outcomes in terms of promoting a new form of rural small-scale food production. Many of the projects have continued to the present day with similar objectives (Rouhani and Britz, 2004).

Attempts were also made to establish the commercial aquaculture of carp, trout and catfish in the 1980s and 1990s. Carp farming was promoted by the former Transvaal Nature Conservation Department as a culture species in the early 1980s at the Marble Hall fish hatchery. Many commercial farmers built ponds and began growing the species, but the boom was shortlived and production crashed from 30.3 metric tons in 1975 to only 1.2 metric tons three years later, mainly due to the low demand and market price for carp (Hecht and Britz, 1990). Trout farming in the Lydenburg area was more successful as commercial farmers developed innovative products and marketing strategies. Government hatcheries that were built specifically to support trout farming and angling included the De Kuilen and Lydenburg hatcheries. In the late 1980s the Foundation for Research Development supported the research into catfish farming at Rhodes University, which led to the establishment of commercial farming of the species in the Lowveld region. Production rapidly grew to 1000 ton per annum but as with carp farming, low market demand and concomitant low prices resulted in production effectively ceasing by 1992.

Figure 4. The remains of an aquaculture project in Clare, Limpopo Province that was initiated in the 1970s

Despite the efforts described above, the objective of successful production of fish as a cheap protein source either from the small scale rural or commercial farming sectors in South Africa did not materialise. Production driven aquaculture technologies were a global phenomenon in the 1980s resulting in many failures. In the nineties there was a trend towards market driven aquaculture, focusing on high value species that could sustain the high running costs typical of intensive aquaculture.

One commercial sector that developed independently of any government support in the early 1990s was ornamental fish farming. Approximately 60% of ornamental fish sold in South Africa are imported. This provided the incentive for local producers to supply the market. The industry began largely as a backyard hobby, but larger scale producers emerged over the last 15 years who produce over 80 different varieties of aquarium fish (Hecht and Britz, 1990; Britz and De Kock, 1994).

During the late 1980s and early 1990s, a change in policy of the provincial nature conservation departments resulted in a cessation of the production and stocking of exotic fish, to one of conserving South Africa's indigenous fish fauna. This constituted an effective withdrawal of Government support for the freshwater aquaculture industry, and resulted in the closure, mothballing or privatisation of many Government aquaculture facilities. The period of political transition in the early 1990s resulted in a lack of policy or funding to support aquaculture research and development, and without government support, the aquaculture industry in South Africa effectively developed at a much slower rate than in other parts of the world.

Development of Small-scale Commercial Aquaculture in the Constitutional Democratic Era

Despite the lack of a national aquaculture policy since 1994, there have been attempts to develop small-scale commercial aquaculture in rural contexts on the back of larger commercial enterprises. These initiatives have been motivated by Government's policy of promoting black economic empowerment and supporting emerging farmers.

A significant initiative was the training and setting up of 48 small-scale "satellite" fish farmers linked to the Amatikulu Hatchery in KwaZulu-Natal (Britz, 1994). Amatikulu Hatchery was a successful commercial enterprise, exporting approximately 1 million ornamental fish per year. The production side of the farm was sold off in units of two fish production tunnels each, to experienced workers from the farm and was financed by loans from the Small Business Development Corporation. Initially production went well while a contracted farm manager was supervising the farmers. However, when the farmers elected to dispense with the cost of the manager's salary, production and profits declined, revealing a lack of basic business and farm management skills. The Amatikulu small-scale satellite farming businesses eventually failed and Amatikulu Hatchery turned its focus to prawn farming. However, despite the fact that the "satellite" farming scheme failed due to poor management capacity, the fundamental concept of linking rural farmers into an existing value chain and market demonstrated that it is a model worth pursuing.

Figure 5. Marble Hall Hatchery in Mpumalanga. This facility built in the 1970s was meant to produce carp for anglers and stocking in dams for food fish. This facility was recently decommissioned and submerged when a nearby dam was extended.

In the Western Cape Province, small scale grow out of trout has been successfully implemented at a number of sites. This initiative is supported by Stellenbosch University, the Department of Science and Technology and the Western Cape Department of Agriculture at Elsenburg. Similarly, successful small scale mussel farmers have been established at Saldanha Bay in partnership with a mussel/seafood processing company.

To summarise, the history of aquaculture in South Africa has shown that the production of low value species as an inexpensive alternative protein source has been unsuccessful due to high input costs and a lack of aquaculture skills among rural farmers. All successful aquaculture enterprises in South Africa are engaged in the production of high value fish or shellfish. Aquaculture as a small scale rural enterprise has only succeeded where the production forms part of an established commercial value chain, and extensive technical support is provided by government and established commercial farmers.

The Current State of Aquaculture in South Africa

A survey of the South African aquaculture sector in 2008, conducted by the Aquaculture Institute of South Africa (AISA), revealed that its annual contribution to national fish production was small, comprising some 3664 tons p.a. (Table 1.1), but that the unit value of the products was comparatively high at R327 million (Table 1.2). Medium size producers interviewed were generally optimistic about market prospects for aquaculture products, but were acutely aware of the dynamic nature of the seafood market, which is increasingly affected by global forces. The products cultured included abalone, trout, mussels, oysters, prawns, seaweed and ornamental fish. Marine fish species such as kob and yellowtail were in a pilot commercial phase. With the exception of trout, the production of freshwater food fish species such as tilapia and catfish had not become established, and most commercial enterprises based on these species had failed.

Table 1.1 Total South African aquaculture production 2005-2008 by species group. Production for the species groups is reported in tons, with the exception of Koi and ornamental fish which are reported as numbers. From Britz *et al.*, 2009.

Species	**Species Tonnage**			
	2005	**2006**	**2007**	**2008**
Abalone	662	756	915	934
African Catfish	180	180	180	180
Dusky Kob	0	0	35	10
Marron	2	1	0	0
Mussels	400	500	500	600
Oysters	166	251	280	289
Prawns	0	0	0	4
Seaweed	665	747	753	608
Tilapia	0	0	0	10
Trout	763	807	658	943
Yellowtail	0	0	0	0
Koi Carp (000s)	472.7	493.0	518.8	514.2
Ornamentals (000s)	545.8	546.6	609.0	601.0
Total*	**2915**	**3321**	**3409**	**3664**

*assuming 50g/koi and 10g/ornamental

Table 1.2 Value of South African aquaculture production (2005-2008) by species group. From Britz *et al.*, 2009.

Species Group	**Value (ZAR millions)**			
	2005	**2006**	**2007**	**2008**
Abalone	100.01	148.24	210.84	268.20
African Catfish	3.60	3.60	3.60	3.60
Dusky Kob	0.00	0.00	1.75	0.51
Koi Carp	1.59	2.12	1.97	1.80
Marron	0.26	0.13	0.00	0.00
Mussels	4.20	4.60	5.00	6.00
Ornamental Species	7.95	8.47	9.21	9.70
Oysters	6.00	9.20	6.90	8.47
Prawns	0.00	0.00	0.00	0.15
Seaweed	0.53	0.67	0.75	0.67
Tilapia	0.01	0.02	0.00	0.30
Trout	19.30	19.06	18.25	27.98
Yellowtail	0.00	0.00	0.00	0.00

Most South African aquaculture enterprises were relatively young businesses, with 50% less than 10 years old, and 31% less than five years old. While most (76%) aquaculture enterprises were small businesses with a turnover of less than R5 million, the bulk of production originated from vertically integrated, medium size enterprises. Of the larger enterprises with turnover above R5 million, the majority (14) were marine and produced abalone. In terms of provincial distribution, most (13) larger commercial enterprises (R5 million turnover) were located in the Western Cape Province, while small scale commercial enterprises (< R5 million turnover) were more evenly distributed amongst the provinces.

A serious concern expressed by the AISA survey participants was the obstacles to establishing new small business aquaculture enterprises. A number of factors including permitting hurdles, lack of finance, lack of an established value chain and high transaction costs combined to make aquaculture as a small enterprise largely non-viable.

The AISA survey concluded that, "the backbone of the South African aquaculture industry is clearly the established medium size enterprises, which have achieved the critical mass to run vertically integrated operations. As such, they are resilient enough to be a market force, self-sufficient in the provision of many elements of the value chain and services, and to comply with an increasing array of legislative and product quality requirements. The medium size enterprises are the foundation from which satellite small producers and a service sector can grow. The medium size aquaculture entrepreneurs are dynamic and innovative and have an appetite for risk. They are the pioneers of the South African aquaculture sector and need to be nurtured and encouraged as their success will breed further success." (Britz *et al.,* 2009)

Indeed, Britz *et al.* (2009) noted that some success has been achieved through schemes to cluster small producers within an established value chain, and provide them with the necessary technical support and services. The two examples cited were:

- A cluster of small mussel farmers in Saldanha Bay which produced mussels for a processing and marketing firm which had formerly owned the production operation.
- A cooperative of small-scale trout producers, established with support from Stellenbosch University and grants from the Department of Trade and Industry, which grow trout seasonally in farm dams and sell them to a local processor.

The main challenges facing these enterprises related to capacity building, particularly developing the business and management skills of the participants.

If the overall status of South African aquaculture is considered, the current production and socio-economic contribution of the sector is less than it could be. Britz *et al.* (2009) concluded that in the short to medium term, imports of fish would increase as the existing aquaculture industry will not have the capacity to supply the growth in demand for fresh, high value fish. The lack of a post-1994 comprehensive aquaculture policy and state led interventions to create an enabling environment for aquaculture development has undoubtedly constrained the establishment of this agricultural sub-sector. Fortunately, concrete steps to develop a national aquaculture policy and strategy have been taken in recent years.

Towards a National Aquaculture Policy and Development Strategy

The political transition to democracy resulted in the phasing out of apartheid era aquaculture research and development projects which had created a foundation for the establishment of trout, catfish, tilapia, mussel, oyster, prawn and ornamental fish farming in South Africa. With the exception of abalone aquaculture which developed spontaneously with industry finance, there was a hiatus in state sponsored aquaculture development through the 1990s, reflecting the lack of policy towards aquaculture development.

However, by 2000 state interest in the potential of aquaculture began to emerge and efforts to develop policy began in various national departments, namely:-

- The Department of Trade and Industry published a “SMEDP Aquaculture Policy” in 2003 which provided a capital subsidy to qualifying small and medium size enterprises investing in aquaculture.
- The Department of Agriculture, with support from the Aquaculture Association of Southern Africa developed a draft “Policy for the Sustainable Development of Aquaculture in South Africa” in 2004.
- The Department of Environmental Affairs and Tourism (DEAT) – Branch Marine and Coastal Management developed a draft marine aquaculture policy in 2004, culminating in the gazetting of “A Policy for the Development of a Sustainable Marine Aquaculture Sector” in 2007.

While it was accepted that the DEAT would be responsible for marine aquaculture and Department of Agriculture for freshwater aquaculture, there was always a stated intention to merge their policies into a single national aquaculture policy.

In parallel with these policy development processes some of the provincial governments (including the Western Cape, Northern Cape and Eastern Cape), began including aquaculture in their economic development initiatives. For example:

- The Northern Cape Province initiated a “Fishing and Mariculture Sector Development Plan” in 2003

- The Eastern Cape Province parastatal, the Eastern Cape Development Corporation, promoted various initiatives including zoning an area for aquaculture development within the Industrial Development Zone in East London.
- The Western Cape Province supported the establishment of the Aquaculture Institute of South Africa (AISA), and the formulation of a provincial aquaculture development policy and strategy. The AISA initiative has subsequently been terminated by the province and a provincial support channelled through a new institution named the “Western Cape Aquaculture Development Initiative – WCADI”.

It was realised that if aquaculture sector development was to proceed in a rational and comprehensive way, coordination of state efforts was required. An aquaculture task team including representatives from the national departments of Agriculture, Environmental Affairs and Tourism, Trade and Industry, Science and Technology and Water Affairs was formed in 2009 with a mandate to develop a cabinet memorandum for a strategy to develop the aquaculture sector. This process was further facilitated by the merging of the marine fisheries and aquaculture mandate into the Department of Agriculture, Forestry and Fisheries in 2009.

Water Research Commission Support for Aquaculture Research and Development

In the light of the growing national interest in aquaculture sector development in the early 2000s, the Water Research Commission (WRC) initiated a series of research projects to support aquaculture development.

The nature of the WRC aquaculture projects was to a large extent informed by an initial WRC “Baseline Study on the Contribution of Aquaculture to Rural Livelihoods”, the primary objectives of which were to determine the actual and potential contribution of aquaculture in rural areas, and to recommend actions to realise this potential (Rouhani and Britz, 2004). The survey, undertaken by Rhodes University’s Rural Fisheries Programme in 2003/4, spanned five provinces, namely the Western Cape, Eastern Cape, KwaZulu-Natal, Mpumalanga and Limpopo Provinces. The project team visited both rural farmers and provincial hatcheries and met with the relevant Provincial Departments of Agriculture (PDA) to understand the situation. The results of the baseline survey indicated that while the contribution of rural small scale aquaculture was negligible, and many projects had failed, there was considerable potential for aquaculture to contribute towards rural livelihoods and economic development provided appropriate strategies were adopted.

Key findings and recommendations were that:

- Rural aquaculture projects were under-performing and the necessary support and services to the farmers were lacking.
- Commercially orientated small scale aquaculture projects, such as the small scale trout farmers in the Western Cape Province, were intrinsically more viable than “food security” type projects.
- The establishment of a rural aquaculture sector would be entirely dependent on a sustained, public sector led intervention.
- Provincial hatcheries should be revitalised to provide technical support, training, extension support and fingerlings.
- Community-public-private partnerships were recommended to promote market linked, small-scale aquaculture.
- The lack of aquaculture policy was highlighted as a key issue in order to provide direction to aquaculture development in the provinces.

In the light of the identified need for public sector led interventions to promote aquaculture development, the WRC launched a consultative process to determine how appropriate support could be provided. Discussions with the then National Department of Agriculture (NDA) resulted in an agreement to co-fund a WRC project to provide support to the provinces to develop aquaculture strategies and capacity. The NDA would be responsible for national policy development, which would inform the provincial strategies. It was proposed that the WRC aquaculture support programme to the provinces take the form of a Participation Action Research (PAR) Project whereby the results of the project were fed back into the provincial aquaculture development processes in an iterative manner (see Section below on the PAR methodology). A consultative process was thus launched with the provinces interested in participating in the proposed “Participatory Development of Provincial Aquaculture Programmes for Improved Rural Food Security and Livelihood Alternatives”.

A rigorous participatory process was essential as the project and PAR process had be based on the respective provinces’ existing circumstances and needs, and required a substantial capacity commitment within the provincial departments of agriculture. Specifically, it was necessary to negotiate the details of potential PAR projects involving provincial staff and facilities in various rural community contexts. The consultative study was thus carried out in two phases with the following objectives:

1. Consultation Phase 1

Objectives

- Determine if the provincial government departments have any existing or impending plans to develop aquaculture
- Determine the specific aquaculture sites / facilities that would be included in the PAR phase
- Determine the aquaculture technical skills available within the provincial government departments

2. Consultation Phase 2

Objectives

- Of the seven provinces consulted, select 2 to 3 provinces suitable for implementing the PAR Phase
- Draft Terms of Reference to implement the PAR phase
- Comment on whether the local communities' preference for other sources of protein over fish could be a factor in developing aquaculture

The responses from the provincial departments of agriculture were overwhelmingly supportive with regards to developing aquaculture within the rural sector; however some were not ready to participate in an aquaculture capacity development process. This led to four provinces (Eastern Cape, Western Cape, Limpopo and Mpumalanga) agreeing to participate in the PAR aquaculture programme. Terms of reference for a five-year programme, co-funded by the National Department of Agriculture, were developed for each province through a further round of consultations. Core activities were to be the revitalisation of provincial hatcheries including public-private partnership models, development of provincial aquaculture strategies, and training of extension staff and farmers. In three other provinces, namely North West, Free State and KwaZulu-Natal, WRC funded assistance was limited to the development of a provincial aquaculture strategy for each.

Figure 6. Turfloop Hatchery in Limpopo Province, in need of revitalisation

The method of implementing this phase of the project was by Participatory Action Research (PAR). PAR is a collaborative process whereby those responsible for action (in this case PDS staff) are involved in the research process which provides feedback to improve their effectiveness in achieving specified goals. Thus rather than developing static plans and methods in implementing the project, there would be space for continuous reflection and planning to ensure that the project team and the Provincial Departments of Agriculture (PDAs) could adequately respond to dynamic situations. During the second round of consultations with the PAR participating provinces (Limpopo, Mpumalanga, Eastern Cape, and Western Cape), priorities for action were defined for each.

Limpopo Province's Department of Agriculture was particularly enthusiastic about the PAR programme committing to:

- Collaborating with the WRC in developing aquaculture within the rural context as food security is the mandate of the Department.
- Formalising its existing aquaculture development activities into a coordinated strategy and plan.
- Revitalising the Turfloop Hatchery in collaboration with the Aquaculture Unit at Limpopo University as a hub from which to support existing rural aquaculture projects.
- Increasing the number of dedicated aquaculture personnel within the Department.
- Working with the Aquaculture Unit at Limpopo University and the Department of Ichthyology and Fisheries Science to collaborate in the WRC PAR Programme and to provide training for agriculture extension officers.

In Mpumalanga Province, the Department of Agriculture had identified aquaculture as a potential activity to increase food security in the rural areas and committed to participating in the WRC PAR project. Focus areas for Mpumalanga included:

- The design of a new aquaculture facility to replace that at Marble Hall fish breeding station which had been flooded by the raising of the Arabie Dam.
- Developing a provincial aquaculture strategy aligned with the emerging national aquaculture policy.
- Technical support by the WRC / Rhodes University collaboration for the design of the facility to replace the Marble Hall facility, and for evaluating the revitalisation of the Lydenburg Trout hatchery.
- Recruiting aquaculture specialist personnel.

In the Western Cape Province, the then MEC for Agriculture, Mr Kobus Dowry was supportive of the PAR aquaculture project and requested his managers to provide it with the necessary support. A need for extension capacity within the Department of Agriculture was identified as a priority to support the small trout farmer projects in the province. The Western Cape PAR programme would include:

- The Department of Agriculture hiring an aquaculture specialist based at Elsenburg Research Institute to provide extension services to emerging fish farmers.
- A steering committee being formed between the Department of Agriculture, Stellenbosch University and the WRC (represented by the implementing agent tasked with the PAR programme) to monitor the progress of the programme.
- A strategic plan for the Department to develop rural aquaculture
- Stellenbosch University assisting in mentoring the aquaculture specialist.

Subsequent to the consultative process, the Western Cape Province did not fully utilise the offer of participation in the WRC PAR project, as the Western Cape Department of Economic Development and Tourism had facilitated the development of an integrated provincial aquaculture policy and strategy. The level of provincial aquaculture development capacity was substantially higher than that of the other provinces, and it was subsequently decided to provide additional WRC PAR technical support in the Eastern Cape Province and KwaZulu-Natal.

In the Eastern Cape Province, consultations revealed that the Eastern Cape Provincial Department of Agriculture had no plans for rural aquaculture development, but it recognised the potential of the sector with regards to food security. The Department of Agriculture was however not prepared to develop an aquaculture strategy and commit resources to development, until a pilot project had demonstrated the potential of aquaculture in a rural development context. It was thus agreed to integrate an extensive aquaculture project into the Fort Hare University “AgriPark” programme which was facilitating the entry of small entrepreneurs from the Alice community into various agricultural value chains. It was agreed that:

- The site selected for the PAR would be the 5 to 6 dams within Fort Hare University and part of the Fort Hare AgriPark Initiative.
- Staff from Rhodes University and Fort Hare University would collaborate to implement a PAR within the context of the Fort Hare AgriPark initiative with an emphasis on skills development.

Following the low demand for WRC PAR project support in the Western Cape, additional technical support was extended to the Eastern Cape Province to facilitate the revitalisation of the Amalinda Provincial Hatchery at East London. The facility had been contracted out to an ANC Veterans group to operate as an ornamental fish farm but they required technical assistance which the WRC project agreed to provide through Rhodes University.

Initial consultations with KwaZulu-Natal Department of Agriculture in September 2004 revealed that the then HOD (Dr Dludla) was supportive of revitalising the Makatini Research Centre hatchery to support rural aquaculture development. Follow-up meetings in April 2005 defined the scope of the WRC PAR programme. The agreed WRC PAR priorities for KwaZulu-Natal were:

- A provincial strategic plan for rural aquaculture to coordinate public sector support for aquaculture activities in the province.
- The Makatini Research Centre was identified as a site that could be developed as a focal point with regards to rural aquaculture development. This site could provide fingerlings and training to potential farmers.
- Training of aquaculture extension service officers to provide support for rural fish farmers, particularly personnel from Makatini Hatchery.

In the provinces which were not ready to fully participate in the PAR process, some forms of technical and planning assistance were nonetheless requested following consultative visits. These included:

- Support to the Free State Department of Agriculture to develop an aquaculture strategy, and define options of using the Gariep Hatchery to support Aquaculture.
- A scoping of the aquaculture potential in the Northern Cape and advice on the development of an aquaculture strategic plan.
- A scoping of the aquaculture potential of the North West Province and consultations with Department of Agriculture officials.

In the light of the positive response by most provinces, the WRC thus initiated a five-year targeted, solicited project entitled "Participatory Development of Provincial Aquaculture Programmes for Improved Rural Food Security and Livelihood Alternatives". The project contract was awarded to Rhodes University to be undertaken in partnership with Limpopo University, Fort Hare University, and Stellenbosch University. Co-funding for the project was provided by the then National Department of Agriculture (now Department of Agriculture, Forestry and Fisheries – DAFF)

3. The Objectives of the WRC PAR Project

The contractually specified objectives of the project were:

General Objective

To improve rural food security and livelihood options by supporting Provincial aquaculture programmes to revitalize state fish hatcheries and build technical capacity of staff.

Specific Objectives

1. Development of strategic plans for Provincial Departments of Agriculture (PDAs) for aquaculture development – in terms of existing provincial and national plans for food security and economic development.
    a. Determine the current and required resources for aquaculture development within each PDA.
    b. Identify projects (and their timeframes) that the PDA could initiate.
    c. Identify key partners and the nature of the partnership that the PDA could engage in to develop aquaculture within the provinces.
    d. Develop an action plan for implementation.

2. Revitalisation of existing state hatcheries to supply fingerlings and technical support to rural farmers as required.
    a. Assess the current status of provincial hatcheries and the degree to which they can support the implementation of the strategic plan, identify constraints (trouble shooting) and then make recommendations and formulate a plan of action for the upgrading and maintenance that may be required.
    b. Assess the current technical skills of the staff at the hatcheries, determine further skills that may be required and then develop training courses to bridge the gap.
    c. Assess the need for additional technical staff.
    d. Develop guidelines for the operation of the hatcheries.
    e. Develop the framework for an exit plan.

3. Provision of farmer support.

   a. Develop a database of fish farms within the province (subsistence and commercial), and then determine the threats and opportunities to each of the facilities.

   b. Develop guidelines for the rural farmers to produce quality fish in a cost effective manner.

   c. Develop guidelines for the rural farmers to enable their operation to penetrate and maintain a market share.

   d. Develop a manual for farmer training that would include technical, financial, and marketing components.

4. Development of a link between state hatcheries and rural farmers for sustainable development.

   a. Develop a Community Public Private Partnership (CPPP) model (province specific) that outlines the roles and interactions between the PDA that operates the state hatcheries, rural farmers and commercial farmers.

   b. Facilitate the implementation of the CPPP model as above.

   c. Provide mentorship for PDA aquaculture extension officers.

   d. Develop the framework for an exit plan.

As circumstances in each province were unique, not all of the Specific Objectives were applicable to all of the provinces. The table below lists the Specific Objectives for each province, together with the state hatcheries / facilities included within the PAR project.

Table 1.3 Specific objectives for each province, together with the state hatcheries/facilities included within the PAR project.

Province	**Specific Objectives**	**Facilities included within the PAR scope**
Western Cape Province	3 & 4	Jonkershoek (and the Stellenbosch University cage culture extension programme)
Eastern Cape Province	3	AgriPark programme at Fort Hare University
Mpumalanga Province	1, 2, 3 & 4	Proposed warm water species hatchery in Maleoskop or the Lydenburg Trout Hatchery.
Limpopo Province	1, 2, 3 & 4	Turfloop Hatchery
North West Province	1	N/A
KwaZulu-Natal Province	1	N/A
Free State Province	1	N/A

4. The Project Participatory Action Research Methodology

Participatory action research (PAR) was chosen as an appropriate methodology for the project as it focuses on the effects of the researcher's direct actions of practice within a participatory community with the goal of improving the performance quality of the community or addressing an area of concern. The target community was the staff with responsibility for developing aquaculture within the participating provincial government departments. Action research involves utilizing a systematic cyclical method of planning, taking action, observing, evaluating and critical reflection prior to planning the next cycle (O'Brien, 2001; McNiff, 2002). The actions have a set goal of addressing an identified problem in the workplace, for example, revitalising a specific government hatchery by means of a Community Public Private Partnership. It is a collaborative method to test new ideas and implement action for change. In the words of PAR pioneer Kurt Lewin: “If you want to know how things are, just try to change them” (Lewin, 1958).

PAR was particularly appropriate in the context of government middle management, as the process is empowering of the participants to be more effective in their roles. Government officials were engaged in the identification of end points or goals. Once the end point was identified, the role of the PAR implementers would be to actively facilitate, record and evaluate the process, so lessons would be learned and that could be replicable elsewhere. The process had several positive outcomes:

- A unique insight into the dynamics and challenges of everyday working life of government officials was obtained, revealing a sometimes disturbing picture of disempowerment and an inability to be effective due to bureaucratic processes beyond their control.
- The participating officials were empowered with knowledge to better understand aquaculture development and to achieve clearly defined strategic goals.
- The evaluation of the process and recording of lessons learned by the researcher facilitated communication and an understanding of the challenges at government senior management and policy-maker level. As such, it promoted better integration of aquaculture related planning, the structuring of aquaculture related management line functions, and the implementation of projects and extension services.
- The PAR project served to elicit buy-in at all levels of government for the implementation of the provincial aquaculture strategic plans which were a new activity in the traditionally livestock and crop orientated provincial agriculture departments.
- The PAR process created an ongoing and trusted linkage between the University-based aquaculture specialist researchers and provincial and national government officials responsible for aquaculture development.

Linkages with DAFF

During the implementation of the project, the project team worked very closely with DAFF aquaculture staff. DAFF aquaculture personnel would be notified prior to most provincial meetings, site visits and training sessions, and would generally attend. The project team would regularly interact with DAFF, and if there were challenges in the implementation of the project, joint consultations would be held to devise a common strategy on the way forward.

Requirements for Food Security and Rural Livelihoods

While South Africa is considered food secure at a national level, chronic food insecurity and poverty is prevalent in many households due to structural inequalities, multiple stressors and vulnerability to shocks – such as rapid increases in the price of food (Hart, 2009). A trend in South Africa is that more households are dependent on food purchases and more households are becoming food insecure (DAFF, 2010a). Food security is now understood in terms of the ability of households to access food, as opposed to food supply (Hart, 2009). A focus on household livelihoods and assets is thus deemed necessary in order to understand the ability of households to access food either through production, purchase or transfers (Hart, 2009). These concepts underlie the strategies outlined in South Africa's Agriculture, Forestry and Fisheries: Integrated Growth and Development Plan 2011-2031 (IGDP), (DAFF, 2010b).

The IGDP seeks to position agriculture as the means of improving national food safety and security, and create agricultural economic output in a profitable and sustainable manner through a qualitative and quantitative improvement of South Africa's agricultural productivity. Agriculture is seen as a means to fuel rural economic growth and development, create rural employment, alleviate the plight of the poor and stimulate off-farm economic development. The dualism in South Africa's agricultural sector is well documented, with some 40,000 mainly white commercial farms producing more than 99% of South Africa's formal marketed output. The challenge is to empower South Africa's 300,000-400,000 smallholder farmers and some 4 million subsistence farming households to participate in the opportunities offered by the sector. South Africa's Agricultural Production Strategy (DAFF, 2010b) refers to the smallholder sector as the "missing middle" and defines a primary strategic goal as increasing the entry of smallholder farmers into commercial agriculture. Challenges to overcome are low household assets, lack of education, access to networks and value chains, entrepreneurial ability, low production efficiency, weak farm management skills and poor support services.

Aquaculture is recognized as an agricultural activity within the mandate of DAFF. As a new agricultural sub-sector, what interventions are required to stimulate its growth and who should be the target groups? Rouhani and Britz presented evidence suggesting that aquaculture is not an appropriate form of agriculture at a rural subsistence level, due to the high level of skills required, as well as capital -a resource to which poor households don't have access. They did however see a role for aquaculture in promoting emerging small scale commercial farmers, but the success would be entirely dependent on a comprehensive public sector intervention to address the challenges outlined above. It was clear that smallholders lacked the means (material, capital, skills and services) to establish aquaculture operations themselves. The need to create a conducive environment for the establishment of small commercial aquaculture farmers was further highlighted by Britz *et al.* (2009) who found that the current regulatory environment was particularly unfriendly to small aquaculture businesses. They suggested that the establishment of aquaculture value chains by larger commercial producers would be a prerequisite to the entry of smaller producers into various value chain niches. This context underpinned the current PAR project strategy of promoting community-public-private partnerships (CPPPs) to revitalize state hatcheries in order to promote the establishment of value chains in target areas, into which smallholder farmers could be linked.

Figure 7. In recent years there has been an increase in rural areas in the acceptability of the eating of fish and consequently an increase in the demand for fish

PROVINCIAL AQUACULTURE STRATEGIES: A STARTING POINT FOR SUPPORTING SECTOR DEVELOPMENT

Introduction

One of the main lessons learnt from the WRC Baseline Study on the contribution of aquaculture to rural livelihoods, was that the aquaculture development activities that were being implemented by the provincial agriculture departments (PDAs), were uncoordinated and not aligned with provincial planning processes (Rouhani and Britz, 2004). Provincial aquaculture facilities, staffing and operations were largely an inheritance from past policies dating back to the colonial and Apartheid eras, and there was no guiding policy framework for how government supported projects should be supported in terms of roll-out to beneficiaries. A number of government hatcheries in the provinces had become non-functional, as their original purpose no longer formed part of a policy objective (e.g. the breeding of alien fish for angling) and they were at risk of being lost unless they were revitalised. Britz and Rouhani (2004) observed that the existing provincial rural aquaculture projects were badly conceived, lacked the necessary organizational support, and were not financially viable. It was evident that unless aquaculture development was planned and coordinated, the difficulties farmers faced would persist and the low success rate of aquaculture projects would be perpetuated. The 2004 WRC aquaculture baseline survey report thus recommended a more integrated approach to aquaculture planning and development, focusing on the revitalisation of government hatcheries and the promotion of small commercial farmers. Subsistence level aquaculture was not recommended due to the technically demanding nature of the technology and the high input costs which resource-poor rural farmers could not afford.

As public sector agricultural support is primarily a provincial competency, it was clear that provincial aquaculture strategies needed to be developed, based on the biophysical conditions, organizational capacities and potential markets in each province. The development of Provincial Aquaculture Strategies was thus the first objective of the current WRC project, with the revitalisation of government hatcheries as a key strategy to create hubs for fingerling production, technology transfer and training.

Figure 8. Catfish being prepared in a restaurant in Nigeria. The high demand for fish has created the space for farmers to grow without needing much support from government. In South Africa, where demand for fish is still growing, government support will be required in the initial years.

The Imperative to Develop Provincial Aquaculture Strategies (PAS)

It was clear that before any interventions could be made to revitalize the state hatcheries, or train the aquaculture extension officers, coordinated provincial aquaculture development plans with clear goals were required. These plans, referred to as the Provincial Aquaculture Strategies (PAS) would provide a "road map" for the provincial Departments of Agriculture (PDAs) to plan and develop aquaculture in the provinces.

The strategy development process was also intended to:

1. Develop a common vision for aquaculture development within the various Directorates of the provincial departments of agriculture. By bringing in the relevant Directorates, such as veterinary services and marketing extension services, amongst others, the process to develop the plan would secure their support as required from the outset.
2. Secure funding to develop aquaculture in the province. In government, funding for sector development requires a strategic plan or some form of policy. Therefore, one of the purposes of the PAS development process was to ensure that the directorates responsible for aquaculture were allocated the requisite funding.
3. Secure the political support for aquaculture. Aquaculture is a new area for investment in South Africa and for this sector to be supported by government, a certain amount of political support would be required for the PDAs. Therefore the process of developing the provincial aquaculture strategies was designed to include participation of PDA senior managers and support by the responsible MEC.
4. Provide action plans to implement the PAS, including timeframes and costs. Action plan were included in the PAS at the request of the PDAs to assist them to implement their PAS.

Figure 9. Rural tilapia farmers such as this group in Limpopo Province need government support for, for example, access to fingerlings and technical support.

The Process of Developing the Provincial Aquaculture Strategies

The process of developing the PAS was designed to be as consultative and inclusive as possible. Following a series of consultations with the provinces to determine which provinces wished to develop a PAS, a series of provincial PAS workshops were held for the following provinces:

1. Limpopo Province
2. North West Province
3. Mpumalanga Province
4. Free State Province
5. Northern Cape Province
6. KwaZulu-Natal Province
7. Western Cape Province

Gauteng, the Eastern Cape and Western Cape Provinces were excluded as:-

- in Gauteng the scope of livelihoods-based aquaculture was deemed to be limited due to the metropolitan nature of the province;
- in the Eastern Cape the senior managers of the PDA requested that they would prefer a viable aquaculture pilot project to be developed before they committed to the development of a PAS;
- in the Western Cape Province a substantive provincial aquaculture planning process was already underway led by the Provincial Department of Economic Development and Tourism with support from the PDA (Western Cape Provincial Development Council, 2009).

Figure 10. A labourer at a rural farm in Limpopo taking a rest from building the walls to a pond

The project team, when engaging the PDA in developing the PAS, was mindful that the process had to be consultative and inclusive, and the PDA had to take ownership of the process.

These three parameters were deemed to be essential for the legitimacy and success of the process. To achieve this, the project team adopted the following approach when engaging the provinces in developing the PAS (though there were some variations in each province due to the specific conditions in each province):

1. In each province, contact was made with the PDA to host a provincial workshop to develop the PAS. Following consultation a date and venue would be selected. The project team would then facilitate the process, working closely with the PDA to organize the logistics of the workshop.
2. Assist the PDA in developing an invitation list. The Project team was mindful not to dictate the invitation list, but advised the PDA so that it included all relevant provincial departments, commercial and emerging farmers, and representatives from the then National Department of Agriculture.
3. The project team ensured that the workshop would be opened by a senior manager (preferably the HOD) of the PDA to ensure that the top level of the PDA was aware of the process. In addition, relevant senior managers in the PDA in directorates such as Farmers Support, Animal Health and Marketing would be invited.
4. The one day PAS workshops were initiated with a presentation by the project team on the project, the potential of aquaculture, and the objectives of the workshop.
5. In the discussion phase of the workshop, the floor would be opened to the participants to voice their ideas, views, discussion points and concerns. Following the general

discussion, the inputs would be t collated into themes in a participatory manner, using cards on a pinboard. The agreed themes were then used to develop the general framework of the PAS.

6. Based on the workshop inputs, the project team compiled a draft PAS for each participating province and submitted it to the relevant PDA for comment.
7. A follow-up meeting (with the same invitee list as the first workshop) was then convened to workshop the draft PAS document, and revise it.
8. After feedback was incorporated, the final document was submitted to the PDA for formal adoption and implementation.

There where some variations to the above process, depending on the conditions and needs of specific provinces. A more detailed description of the background to the PAS development is provided below for each province.

Figure 11. Dzindi Fish Farm in Limpopo Province. This facility is currently unused, with better planning, state facilities could be optimized.

Limpopo Province

From the outset of the Project in 2006, the Limpopo provincial government indicated its strong support for aquaculture development in the province. The Limpopo PAS was developed in year one of the project with the full participation of the provincial agriculture HOD and the senior general manager responsible for aquaculture. At both workshops, the PDA ensured that all of the relevant provincial government departments and directorates within the PDA were represented.

For Limpopo, the initial workshop was spread over a two-day period reflecting the importance attached to it by the provincial department. The workshop was facilitated by an official from the PDA and chaired by the senior manager of the PDA. The discussions generated substantial enthusiasm for aquaculture amongst both officials and aspirant farmers present at the meeting. The PAS draft was work-shopped at a second meeting in the province and the final PAS was submitted to the PDA. The final aquaculture development strategy for Limpopo Province is provided in Appendix 1.

Perhaps one of the most important outcomes of the PAS was the decision by the PDA to revitalise the Turfloop Hatchery, which was envisaged to be a hub from which to roll-out support for aquaculture development in the province.

A further indication that the PDA had taken ownership of the PAS was their decision to elevate the PAS document to being Limpopo's Provincial Aquaculture Policy. The PDA independently workshopped the Provincial Aquaculture Policy with relevant stakeholders in various towns in the Province. The PAS, now the Provincial Aquaculture Policy, was thus effective in mobilizing provincial support and buy-in to an aquaculture development programme for the province.

Figure 12. An ornamental fish farmer in Limpopo Province

North West Province

In North West Province it was clear from the outset that the process of developing a PAS would be challenging due to organizational problems being experienced within the PDA at the time. The initial workshop in 2005 was poorly attended, and by relatively junior officials of the PDA. After concluding the PAS, the project team made a special effort to meet with the senior managers of the PDA to present the draft PAS document, and was invited to present it at the monthly PDA section heads meeting. The outcome of this presentation was that the draft report would need to be interrogated at the special one-day section heads workshop. This meeting was held in the second year of the project (2006) and was well attended by several senior mangers of the PDA. However it was clear that though the province liked the concept of aquaculture development, it was not ready to proceed. At the time, the PDA was facing significant internal organisational challenges and the senior managers were not willing to take responsibility for developing and implementing an aquaculture strategy.

Figure 13. A catfish project in the North West Province that was performing below its potential. With greater support by the PDA, aquaculture could be better planned and managed.

During this period, *Invest Northwest*, a provincial economic development parastatal organisation made contact with the project team to see how they could assist in the process of developing the PAS, as they where exploring the potential of aquaculture in the province. However, following various unsuccessful attempts by *Invest Northwest* to expedite the process, they withdrew their support.

By the conclusion of the WRC project in 2010, the PAS has still not been adopted by the North West Province PDA. Apart from one aquaculture project that was initiated by the PDA, which was poorly designed and implemented and subsequently failed, the provincial government have not lent further support to the aquaculture development process.

Mpumalanga Province

At the onset of the project in 2005, the Mpumalanga PDA was already in the process of mobilizing support for aquaculture development. Specialist staff with aquaculture skills had been appointed, a warm-water hatchery cum training facility was planned at Nelspruit, and possible pilot projects were being considered. Despite this initial commitment, the facilitation process with the Mpumalanga PDA to develop and adopt a PAS was soon constrained by internal staffing changes and organisational issues within the PDA.

The first PAS workshop in 2005 was well attended and chaired by a senior manager of the PAS, and it seemed that the process to adopt the PAS would be relatively straightforward. An aquaculture specialist with an engineering background had recently been appointed to implement aquaculture projects and the HOD indicated her support for the process. The workshop was fruitful and several strategic aquaculture options were discussed for the province. The draft PAS was submitted to the PDA and work-shopped at a follow-up meeting (Appendix 2). However progress then stalled, in spite of regular attempts by the project team to facilitate implementation of the PAS. This stagnation in the process was due to two main reasons:

1. For a number of years personnel turnover retarded project implementation within the PDA. In the period of the WRC project (2005-2010) there were three HOD and three MEC appointments for the Mpumalanga PDA. This movement at the senior management level impacted the PDA's ability to make decisions and implement action, especially when trying to equip the department to develop a new sector such as aquaculture.
2. In terms of implementation, the primary activity focus of the middle managers responsible for aquaculture within the PDA appeared to be the planning of the proposed warm water aquaculture facility in Nelspruit (which to date has not been constructed), and a trout cage culture project. Little progress was made towards implementing the other goals identified in the PAS. As such, the required institutional support for the PAS implementation process was not forthcoming. The suspension and subsequent dismissal of two key aquaculture managers was a final blow to any aquaculture project momentum in 2009.
3. Financial mismanagement. Both the proposed hatchery and cage culture projects were halted by issues relating to tender irregularities. Most funding allocated to the hatchery was withdrawn and the proposed project downscaled.

Figure 14. Lydenburg Hatchery in Mpumalanga Province could be developed as a hub for trout production in the province

As at the time of writing (2011-03-03) the PAS had still not been formally adopted by the Mpumalanga PDA, the warm water hatchery was still in a planning phase, and no other aquaculture projects had been initiated, this despite regular follow-ups and meetings by the project team and contacts with the national department of agriculture.

Free State Province

In the Free State Province, the process to develop a provincial aquaculture strategy was quite straightforward, as the department possessed a stable and skilled management, and there was a strong relationship between the project team and the PDA. Following an initial consultative meeting with the HOD of the PDA in 2005, the first PAS workshop was held which was attended by senior members of the Agriculture and Environmental Affairs Departments respectively. On completion of the draft PAS document, it was work-shopped in a follow-up meeting, accepted by the PDA, and signed off by the HOD / MEC's office in 2006 (Appendix 3).

Aspects of the PAS were implemented by the PDA during the WRC project lifespan, including:

1. Identifying Aquaculture Development Zones (ADZs) in the province.
2. Revitalizing the Gariep Hatchery. The lack of a linkage to farmers and an aquaculture value chain was however a concern raised by the Rhodes team in respect of the Gariep Hatchery.

The PDA also appointed an aquaculture specialist, which is an indication that the province is committed to developing this sector.

Two possible reasons account for the successful implementation of the PAS by the PDA.

1. The individual / contact person responsible for aquaculture in the province is a senior manager in the PDA, and as such is able to make decisions and take action as and when required. In other provinces the contact person is fairly junior.
2. The Free State PDA has a close working relationship with the Department of Agriculture, Forestry and Fisheries (due to joint collaboration with the Chinese government to revitalise Gariep Hatchery). A by-product of this close working relationship between DAFF and the PDA is that aquaculture has been prioritized and supported.

Northern Cape Province

The initial contact between the project team and the Northern Cape Province PDA revealed that senior managers were in principal supportive of developing a PAS. To initiate this process, they requested a provincial “study visit” so that the project team and officials from the PDA could visit the existing aquaculture sites. The three-day study visit consisted of visits to a catfish farm on the Vaalharts irrigation scheme, an ornamental fish farm, and an abalone farm in Port Nolloth. It was a very useful exercise for the participants as it helped contextualize the discussions at the subsequent PAS workshop.

The workshop was represented by various directorates in the PDA and other stakeholders in the province. The draft PAS was submitted to the PDA but the document has yet to be adopted (Appendix 4). Due to the relatively limited technical skills to take aquaculture forward in a meaningful way, the PDA has put this process on the “back burner” until such time as they decide the province is ready to implement support for this potential new sector.

KwaZulu-Natal Province (KZN)

The initial workshop to develop a PAS for KZN in 2005 was well attended and chaired by the HOD, but soon after this event the HOD was replaced and it seemed that freshwater aquaculture was no longer a priority for the PDA. After submitting the draft PAS to the PDA (Appendix 5), there was a time lag in the PDA committing to a date to workshop the draft PAS and define the way forward. After a year of trying to secure a date for the second workshop, a date was set but as only one person arrived for the meeting and it had to be postponed.

Figure 15. Makhathini Hatchery in KZN will be revitalised by the PDA

The third meeting (some months later) was well represented; however, it was not possible for senior officials to attend the meeting and voice support for aquaculture sector development. To raise awareness of aquaculture within the PDA, it was then proposed that the project team organize a study visit for the senior managers of the PDA to aquaculture projects in the country. The study visit was a success, and following this the draft PAS was submitted to the PDA for consideration. However, at the time of writing (15/3/2011) there has been no official confirmation by the PDA that the PAS has been adopted. Nonetheless, the PDA had budgeted for plans to revitalize the Makhathini hatchery.

Aquaculture development within KZN is thus proceeding on a project basis, but its implementation still lacks a provincially endorsed rationale and strategy with appropriate organizational support and allocation of resources.

Despite a positive initial reception by the KZN provincial PDA, the process of securing the support for an aquaculture development has been drawn out, and as at 2011 had not yet reached conclusion. This was largely due to a rapid turnover of senior management staff in the PDA, and general organizational constraints over the project period.

Western Cape Province

When the initial consultation for the WRC provincial project was undertaken, it was intended that the project team facilitate an aquaculture strategy for the Western Cape Province through the PDA. However, the Western Cape Province's Department of Economic Development and Tourism took the lead and facilitated the development of a Provincial Aquaculture Policy in 2007 as part of the province's integrated economic planning process. This was followed by a Provincial Aquaculture Strategy facilitated by the Western Cape Provincial Development Council in 2007. As the only province with a well established commercial aquaculture sector, the process was substantive and well supported by stakeholders. Subsequently, significant support by the province has been invested in organisations and projects in support of aquaculture development including:

- The formulation of an aquaculture policy and five year strategy.
- Funding of the Aquaculture Institute of South Africa (AISA) which provides various forms of service including training, market and production surveys, a fish health support programme, and specialist studies. AISA has subsequently been replaced by the Western Cape Aquaculture Development Initiative (WCADI).
- An aquaculture section within PDA's Elsenburg Research Institute.
- Development of best practice guidelines for aquaculture.
- Facilitation of environmental management issues related to aquaculture by CapeNature authorities.

The main features of the Western Cape policy are that it:

i. Provides a clear statement of the Provincial Government of the Western Cape's (PGWC) intent with regard to the development of an equitable, diverse, viable, competitive and sustainable aquaculture sector;

ii. Enables active engagement with all relevant national and provincial institutions to address regulations and legislation so that a conducive environment for aquaculture development is created;

iii. Rectifies imbalances in implementation of current regulations *vis-à-vis* aquaculture and other farming sectors;

iv. Enables one departure point (WCADI) for all stakeholders for the much needed interventions required by provincial government departments to create an enabling environment for investment and to establish required capacities to develop the sector;

v. Facilitates and guides local authorities in any policy, strategy and implementation formulation processes to create an enabling environment for local aquaculture development initiatives and to integrate and synergise developmental activities between provincial and local government;

vi. Takes due cognizance of and redresses past imbalances in the problems experienced in the transformation policy implemented in terms of the Marine Living Resources Act by ensuring that the PGWC will be able to fulfill its prime responsibility of implementing the development of this relatively new and promising industry on the basis of equitable access to the aquaculture resources; and

vii. Ensures that the development of the aquaculture sector is maximised through the establishment of pragmatic good management practices.

The Western Cape aquaculture policy is given substance through the five-year Western Cape Aquaculture Strategy 2009-2014, which defines objectives which are relevant, attainable, measurable, sustainable and time-bound. Strategic plan actions which had been implemented by 2011 included the formation of WCADI, a grant system for promoting aquaculture enterprises, particularly SMMEs, a market value chain analysis, and CPPP initiatives including a process to build a hatchery for abalone reseeding.

What stands out in the Western Cape in comparison to the other provinces is 1) the integration of aquaculture into the province's economic strategy, 2) the level of integration and coordination of actions between provincial departments, and 3) the relatively higher level of specialist and managerial skills within the respective departments.

Figure 16. The trout production project in the Western Cape Province has shown that emerging farmers can participate in aquaculture

Conclusion

The experience of facilitating the development of aquaculture strategies with the provincial PDAs indicates that two factors primarily determined the level of success in the various provinces:-

1. The organisational constraints and challenges within PDAs, and broadly speaking provincial government departments.
2. The relative novelty of the aquaculture sector (as compared to traditional agricultural sectors such as livestock which are well established organizationally). While aquaculture is appealing as a potentially new agriculture sub-sector at a political level, and attracts initial endorsement, the current WRC PAR research outcomes demonstrate that the establishment of organisational support within the provincial governments is a substantial undertaking.

The project team's key strategy of establishing working relationships with PDA staff, and developing PASs in a collaborative manner was effective in provinces with a stable staff complement, and active support for the aquaculture development process at the HOD and MEC level. Where staff turnover and leadership support for aquaculture development was lacking, progress was constrained. In all provinces, the project team persisted in working with the available PDA personnel, no matter how challenging the organizational constraints within provincial government. This close engagement achieved two outcomes: 1) it ensured that the provinces took ownership of the process and the PAS; and 2) it was a very important learning process for the officials of the PDAs. For most of the responsible PDA officials, it was their first exposure to / experience with aquaculture. For the project team, it provided a firsthand insight into the organizational problems besetting government service delivery to farmers with regard to establishing profitable aquaculture. These have ramifications far beyond the scope of the present project.

While the project team maintained good relations with individual officials, who generally did their best within the limits of their skills and organizational environment, the intended project outcomes were often simply beyond their control. In some PDAs there were prolonged periods (years) of a state of flux within the top management which crippled strategic processes and their implementation. Senior officials were frequently transferred between directorates, under suspension, dismissed, or had resigned. This created an environment where only the most routine decisions could be made, rendering the departments operational only at the most rudimentary level.

While certain provinces readily adopted the PASs, with the exception of the Western Cape, no comprehensive approaches to organizational structure and resources in support of implementation of this non-traditional aquaculture sector were formulated. While in most provinces at least a single middle management official was usually designated responsibility for aquaculture, the lack of a supporting organizational structure and resources constrained their effectiveness. For example, the aquaculture manager of Limpopo Province had no power to direct the generalist extension officers who were deployed at a municipal level with separate management and accountability structures. Thus, while these extension officers were trained in the basics of aquaculture as part of the WRC provincial aquaculture support project, they could effectively not be used as required to support roll-out of aquaculture extension.

Figure 17. Stocking a dam with trout fingerlings in the Western Cape Province, as part of a project to develop emerging farmers.

Interestingly, in the Western and Eastern Cape Provinces where commercial aquaculture is taking off, effective government support has been provided through the Economic Affairs departments driven by clear market opportunities. While aquaculture project support has largely been outsourced in the Western Cape Province through the Aquaculture Institute of South Africa (and subsequently WCADI), universities and consultants, the PDA is now fulfilling a support role in the area of aquaculture research and extension, within the fairly well planned and resourced provincial aquaculture strategy. A dedicated aquaculture division within the Western Cape Department of Economic Development and Tourism is planned. In the Eastern Cape, aquaculture has been facilitated on a project basis by the Eastern Cape Development Corporation parastatal (ECDC) which has played a role in facilitating aquaculture investments including the East London Industrial Development Zone aquaculture park, the Amalinda ornamental fish farm, the Coega prawn farm and an aquaculture site at Qolora in the Transkei. The ECDC recently formulated an aquaculture sector development plan; however, the Eastern Cape PDA has yet to take up any meaningful involvement in aquaculture.

In view of the above experiences, a possible conclusion is that the lead in terms of provincial strategy and attracting investment into aquaculture is perhaps best done through provincial agencies responsible for economic development, and that the required extension and support services should be provided through the PDAs.

The current project illustrates that aquaculture capacity building within the PDAs is a long term process that will require national guidance and coordination. While aquaculture investment may well be best served under the mandate of provincial economic development agencies, the PDAs will have to provide essential support services including health services, extension, training, and research. National support in the form of the National Aquaculture Strategy and Action plan 2011-2015 which is to be led by DAFF is a welcome development which will provide this continuity. With regards to the PASs already developed, it would be advisable for DAFF to provide continued support to the PDAs to assist them to internalize these documents and to implement them particularly in terms of organizational structure and human resource skills.

Priorities for Action

1. Involve provincial economic development agencies in the development of provincial aquaculture development strategies.
2. DAFF to coordinate implementation of the national aquaculture strategy within the provinces.
3. DAFF to facilitate the integration of aquaculture development into provincial PDA organizational structures and management.

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THE REVITALISATION OF PROVINCIAL AQUACULTURE HATCHERIES

Introduction

The revitalisation of selected existing provincial hatcheries was a core strategy intended to provide aquaculture development hubs for emerging farmers, from which to provide services such as advice, training, and fingerlings. The revitalization was also closely linked to the Public Private Partnership (PPP) objectives of this project, and the training of the provincial hatchery and extension staff.

For most of the PDAs the non-functional provincial hatcheries, which were a legacy from the now defunct policies of previous administrations, presented a dilemma. On the one hand, they were expensive to maintain but produced no tangible return. On the other, they could potentially serve as valuable assets to support the growth of aquaculture in their provinces. So the question for the provincial authorities at the time was: did they close these facilities, or invest further resources linked to a new aquaculture development strategy? A further reservation on the part of the PDAs was that aquaculture as a sector had shown very little growth in rural areas despite a legacy of numerous projects from the past.

Figure 18. Provincial hatcheries such as Turfloop in Polokwane could play an important role in aquaculture development, however they were in need of investment to upgrade the facilities

Elements of a Functional Hatchery

A survey of state hatcheries conducted by Rouhani and Britz (2004) revealed that most were at best partially functional and lacked clear goals. All were under-resourced. A functional hatchery requires:

- Management and senior extension staff with trained at tertiary level (degree of diploma), capable of breeding and maintaining fish and managing staff. Semi-skilled technical staff and labour.
- A functional infrastructure with a maintenance budget controlled by the hatchery management.
- An operational plan with clear goals and performance criteria.
- Active projects with a funding base.

The Relevance of Provincial Hatcheries

Through the process of developing the Provincial Aquaculture Strategies (PAS), it was clear that that the revitalisation of the provincial hatcheries entailed more that just renovation of the physical assets, and that an outcome of refitting and operation of these facilities was the provision of services that addressed farmers' needs and promoted aquaculture development.

What was acknowledged in the various provinces was that government services and support for aquaculture were fragmented and lacked clear goals. In such an environment, it was understandable why a number of the state run hatchery appeared to be redundant. The lack of public aquaculture support services also made life difficult for aspirant farmers. Therefore, in the consultation phase of developing the PAS, the concept of a "one stop" service was regularly brought up when defining the overall purpose of the hatcheries. The broader role of the revitalised hatcheries was that they would offer the following services:

1. Quality fingerlings. Fingerlings of appropriate genetic origin with good production traits, and compliant with biodiversity management considerations.
2. A portal for technical advice / support to farmers. Information on husbandry, business planning, and technical support is essential to establishing a new form of animal husbandry such as aquaculture. There are many issues, for example, environmental management decisions, that are beyond the capacity of the individual farmer that require the initiation of processes by state officials.
3. Market and product information. Market information, product processing and marketing strategy is beyond the knowledge of many individual farmers and assistance is required to link farmers into value chains.
4. Facilitate PPP linkages. Experience suggested that the most effective way to establish small-scale farmers was to link them into existing value chains by mean of PPP arrangements. This requires facilitation and negotiation through an independent public sector entity such as an aquaculture service centre with appropriately skilled staff.

5. A physical base and training centre for provincial aquaculture officials. Practical aquaculture training is best done in a local context where officials can continue to gain experience through daily operations following an initial formal training period

Figure 19. A farmer with poor quality tilapia fingerlings. Revitalised provincial hatcheries could be producing quality seed to farmers.

The hatcheries therefore envisaged as playing a key role in developing the sector in the respective provinces. The process of revitalization of the provincial hatcheries during the project is described and discussed in detail below.

The Conceptual Framework for Hatchery Revitalisation

The process to revitalize the provincial hatcheries did not consist of a series isolated interventions to renovate existing facilities, but was integral to the WRC project objective of strengthening the PDA's aquaculture development capacity. The rationale for revitalization of the respective hatcheries was established through the provincial aquaculture strategy development process, and linked to the various activities such as the training of staff, provision of services and PPP arrangements.

The conceptualization of hatchery revitalization began with the provincial aquaculture strategic planning process which, in the absence of a national policy, provided a policy foundation for aquaculture development in each province. It was accepted that in order to attract the private sector to participate in most provincial contexts, the state would have to invest to a certain level in a supporting infrastructure, personnel, training and support services. It was envisaged that this would occur through central hubs in the form of the state hatchery facilities.

The hatcheries would also provide a link to the farmers providing technical services, training and extension support. Most importantly, the skilled hatchery management staff would facilitate entry of farmers into existing commercial value chains though PPP negotiations with private sector partners.

The Process

The general process for the revitalisation of the provincial hatcheries was:

1. *Inclusion of the revitalisation of the hatcheries in the PAS'*. For the PDAs to allocate financial resources to upgrade hatcheries, there had to be strategy and clearly planned objectives. The PAS also represented a commitment by the PDA to invest in and support aquaculture
2. *An operational plan*. For each provincial hatchery within the scope of the project, the project team developed an operational plan with a budget. This plan, developed in consultation with the PDA, included an assessment of the hatcheries, identifying the potential of the hatchery (e.g. which species of fish it should produce), and a costed production plan. The operational plans for the hatcheries in effect became the motivation for the PDA to invest into the revitalisation of the hatcheries.
3. *Implementation*. Once the operational plans were submitted to the PDA, regular meetings between the project team and PDA officials (both formal and formal) were held with them to encourage them to implement the plans. Aquaculture specialist expertise and technical was provided by the WRC project team where required.

The outcomes of this process for each provincial hatchery are described below.

Figure 20. Egyptian farmers sorting all male tilapia fingerlings for sale. By producing quality fingerlings, Egypt has become the largest producer of tilapia.

Turfloop Hatchery, Limpopo Province

Due to the enthusiasm and tangible support for aquaculture development displayed by the Limpopo Department of Agriculture, the revitalization of the Turfloop Hatchery was the focus of special attention.

Situated on the outskirts of Polokwane near to the University of the North, the hatchery was established in 1982 as a catfish production and research facility in the former Lebowa homeland under the Department of Agriculture. In the 1980s and early 90s the facility was closely linked to the Aquaculture Unit of the then University of the North (now renamed Limpopo University), and its operation was supported by significant technical skills (J. Theron, Limpopo University Aquaculture Unit, personal communication, February 2005). However, the relationship with the University weakened, and when the current project was initiated in 2004, the facility possessed only one member of staff (the manager) with limited technical skills and had not produced fish for a number of years.

The status of the Turfloop Hatchery was assessed by the project team in 2006 (Appendix 6). The facility comprised of 20 earthen ponds, a large well-equipped hatchery and had employed six staff until 2005. However, by 2006 an aquaculture technician was the only employee remaining on site. Few ponds contained fish, the rest being empty and overgrown with weeds and most of the plumbing had been destroyed by a veld fire. The rearing systems inside the hatchery building were not operational, however, most of the infrastructure was still in a relatively good condition.

A plan to revitalize the hatchery was agreed and implemented with the Limpopo PDA. In summary, the milestones in the revitalization of the Turfloop hatchery of the project were:

1. The PAS developed in 2005 included the revitalization of Turfloop Hatchery as a key strategy to establish an aquaculture service hub for the province. While catfish breeding was historically the main focus at Turfloop, Tilapia was regarded as a key species, particularly the Nile tilapia (*Oreochromis niloticus*) which was present in the Limpopo River catchment and was being farmed on a pilot scale. The hatchery was also seen as facility which could be used to select for fast growing strains of indigenous tilapia. The facility was also ideally suited for training PDA extension staff and farmers in aquaculture techniques. Being close to the Limpopo University's Aquaculture Unit, technical assistance was readily available. With it substantial infrastructure and central location in the Province, it was also seen as being a potentially attractive PPP site.
2. In 2006, following the assessment of the Turfloop facility (Appendix 6), a revitalisation plan for the facility was developed in consultation with the PDA (Appendix 7), resulting in the release the funds to revitalise the facility.
3. In 2007, the manager of hatchery and agriculture extension officers from the province attended a four-week training course in aquaculture at Tompi Seleka College

presented by an expert employed by the WRC project. This training was a morale boost for the manager and honed his skills in aquaculture.

4. In 2008, the PDA initiated a multimillion rand renovation of the Turfloop facility. A tender was awarded to a private contractor who cleaned the earth ponds, installed new piping and restored the water supply. Technical assistants employed by the project team also worked closely with the manager of the farm, and for the first time in possibly ten years catfish were spawned on site. This was a significant milestone in the journey of Turfloop and its revitalization as it indicated the capability of the staff, and the commitment of the PDA, to rendering the facility operational again.
5. In year five of the project (2009), the focus of Turfloop was to produce all male tilapia with technical assistance from Limpopo University's Aquaculture Unit. The team at the hatchery brought in tilapia broodstock from another government aquaculture facility at Tompi Seleka College, and the fish were bred in the ponds. However, the staff was unable to successfully apply a protocol to feed the fingerlings with a synthetic male hormone to produce an all male population. The hatchery is expected to produce all male tilapia in 2011.

Throughout this process, the project team provided ongoing support and advice to the PDA in both formal and informal meetings. What was important is that the project team enjoyed the trust of the PDA, and as such it was easy to provide advice.

At the time of writing (15/3/2011), there still was a lot of work that to be carried at Turfloop. For example the hatchery unit of the farm was still not operational, despite technical input from the project team regarding design and costing. Cumbersome government procurement procedures were reported to be a major constraint to proposed refurbishments. Nonetheless, a valuable and substantial aquaculture facility was once again in operation.

The main challenge to effective operation remains human resource skills in aquaculture and general management. The Limpopo PDA remained committed to building its human resource capacity in aquaculture, hiring two additional university graduates as dedicated aquaculture staff in 2010 and planning additional in-service training of existing staff.

Figure 21. Limpopo Department of Agriculture invested R2.5 million in upgrading the infrastructure at Turfloop

Lydenburg Hatchery, Mpumalanga Province

Although the Lydenburg and the adjacent De Kuilen Hatcheries were owned by the Mpumalanga Parks Board, and the Mpumalanga PDA had no jurisdiction over them, they were regarded as important strategic assets to the development of aquaculture in Mpumalanga. When the WRC project was initiated, the Mpumalanga Parks Board was not using the facilities for large-scale fingerling production, and only a fraction of the facility being used for fish conservation and environmental education projects. The project was of the opinion that logically the PDA with its development mandate should have access to the facility, which could be used to promote the entry of small farmers into the trout industry in the region. As the De Kuilen hatchery had been mothballed, and the Lydenburg Hatchery was still operational, the latter facility was the focus of project team efforts to revitalize it in order to fulfil the PAS goals.

The Lydenburg Hatchery was commissioned in 1948 to produce trout and bass for stocking into to stock dams and rivers for recreational angling (flyfishing) and to supply trout fingerlings to commercial fish farmers. The facility was managed by the then Department of Nature Conservation, now the Mpumalanga Parks Board (MPB). In the mid 1990s, there was a policy decision by most of the provincial Nature Conservation Departments to halt the breeding and stocking of alien fish as this activity was seen as contradictory to their biodiversity and conservation mandate (Rouhani and Britz, 2004).

The Lydenburg Hatchery is a large facility, comprising of 126 ponds of various sizes, a hatchery, a cold room, storerooms and offices. It was managed by skilled aquaculture management personnel, with a workforce of 15 to 16 semi-skilled employees. When the MPB was constituted and took over the Lydenburg Hatchery, they instituted a policy that no live trout could leave the facility. Fish were bred but could not be sold live. In the years preceding the initiation of the WRC project, the numbers of trout at the facility had significantly been reduced due to budget cuts and the reduced water quota to the farm. A yellowfish breeding project for conservation and restocking was being carried out when the WRC project was initiated but no restocking activity was being carried out.

During the consultation phase of developing the PAS, the potential for revitalising Lydenburg Hatchery as a trout production centre under the PDA was discussed. If the PDA could gain access to the Lydenburg Hatchery, trout could again be bred and used to support aquaculture development in the region. The importance of trout to Mpumalanga is significant, as it is the most important freshwater farmed fish in South Africa and most of the trout production occurs in this province. The economies of the towns of such as Dullstroom and Belfast are heavily dependent on trout.

The revitalisation of Lydenburg Hatchery was seen as a potential springboard to widen trout production to include emerging farmers. In Mpumalanga, trout was only produced by established commercial farmers, but there was potential to open new waters (dams) for emerging farmers. With a well established trout production value chain in the province (fingerling production, grow out, processing, value adding and marketing), the inclusion of emerging farmers into this established sector was seen to be an option worth developing.

Figure 22. A broken pipe at Lydenburg Hatchery. The province will need to invest in infrastructure upgrading at this facility.

Even though there was an established commercial trout production industry in Mpumalanga, the project team was not able to motivate the PDA to engage with MPB to use the Lydenburg facility to further develop trout production. The chronology of the interaction between the project team and the PDA is listed below:

1. In the first year of the project (2005), the PAS developed and included the potential revitalisation of the Lydenburg Hatchery for trout production. The final draft of the PAS

was submitted to the PDA but this document was never formally adopted by senior management of the PDA.

2. In year two of the project (2006), the project team undertook a detailed assessment of the Lydenburg Hatchery and developed a trout production plan for it (Appendix 8). The plan was comprehensive in that it identified the various business options for the hatchery such as producing fingerlings, selling of yearling fish and establishing a "put and take" fishery on the premises. A put and take fishery is a fishery where dams are stocked with large fish that anglers are provided access to on a pay per catch basis. This activity can generate revenue for the hatchery, especially as this facility has sufficient dams to support this activity and its location (in Lydenburg) would make it accessible to tourists / recreational anglers. The production plan also took into account the water restrictions to the Hatchery (imposed due to the growing water demand from the town) and proposed methods on how to maximise production within the water allocation to the farm.
3. The Plan was submitted to the PDA, however there was no apparent interest on the part of the PDA in taking it forward. It appeared that the PDA was solely focused on building a new warm water hatchery for tilapia in Nelspruit. Although the plans for the warm water hatchery were developed in 2006, the hatchery had not been constructed by 2011.
4. The relatively slow action by the PDA in Mpumalanga and ongoing personnel turnover were a concern for the project team, and the issue was consequently discussed with DAFF aquaculture staff. In 2009, two meeting between the project team, the PDA and DAFF were held in Nelspruit to assess the situation and discuss how to expedite the process. It was decided that the PDA would engage with the project team in a more determined way. However, soon afterwards the two managers responsible for aquaculture in the PDA left the PDA and the process again stalled.

In summary, the lack of response by the Mpumalanga PDA in the agreed strategy of revitalizing the Lydenburg Hatchery was due to:

- Internal organizational problems within the PDA. These included personnel turnover and suspensions, tender irregularities, and unspent budgets.
- The aquaculture manager's sole focus on building the proposed warm water hatchery in Nelspruit, and lack of serious interest in acquiring the Lydenburg Hatchery;
- The failure of the PDA to engage with MPB about transferring the facility.

The fundamental concept of a state run trout hatchery in Mpumalanga to support small farmer to grow fish out in state dams remains sound. If the provincial government organizational challenges could be addressed through decisive leadership, the hatchery could serve a valuable role in aquaculture development in the province.

Makhathini Hatchery, KZN

Revitalising Makhathini Hatchery was not in the initial scope of the project but was included in year three of the project in 2007 following the reduced project involvement in the Western Cape Province. Makhathini Research Centre is currently the only operational provincial aquaculture facility in KwaZulu-Natal Province, following the closure of the former-Natal Parks Board hatcheries at Camberg (trout) and Nagel Dam (Carp and Bass). The facility is situated in a communal area approximately 20 km below the Jozini Dam, and forming part of an agriculture research centre that was established in 1985 by the former Department of Development Aid and now run by the PDA.

Figure 23. There is currently a process within the KZN PDA to upgrade Makhathini Hatchery

The facility is small, comprising a hatchery building and four x 40 m^2 ponds. The area is sub-tropical and surrounded by a traditionally fish-eating local population. The aquaculture facilities are presently in good condition due to the recent availability of funding. The Makhathini Research Centre was involved in a joint research program with the University of Stellenbosch in 2004/5, investigating the effects of cage-culture on water quality of irrigation dams and the production of tilapia. This project has since concluded and there are no current projects at the hatchery.

The process to revitalize the hatchery unfolded as follows over the project period:

1. In the first year of the project, the project team in collaboration with the PDA, developed a draft PAS which identified Makhathini Hatchery as a priority for revitalization.
2. In year 3 (2007), when Makhathini Hatchery was included in the scope of the project, and a technical assessment and production plan for the hatchery developed by the

project team in collaboration with the aquaculture manager of Makhathini (Appendix 9). This included a costed plan to produce tilapia fingerlings.

3. The plan was submitted to the PDA which then included the revitalization of the Makhathini Hatchery into the Makhathini Master Plan development process. This plan is essentially for an integrated the irrigation scheme over a large area below the Jozini dam.
4. The project team recommended the PDA revitalisation of the hatchery be carried out independently of the master plan, due to delays the Makhathini Master Plan process.
5. In year four (2008) of the project, the PDA issued a tender to revitalise and manage the Makhathini Hatchery to produce 500,000 tilapia fingerlings in its first year of production. Several private companies responded to the tender, however the process has been put on hold as it seems that the tender specifications of the proposed hatchery may be over ambitious. The tender had still not been awarded at the time of writing (31/3/2011).

Although the PDA had committed to the revitalization of the hatchery, the goals of the facility are not well defined. It seems the PDA intends to use the hatchery to stock the surrounding pans with tilapia fingerlings to enhance stocks. However, there is no scientific evidence that the fishery is recruitment limited, and it is suggested that the PDA evaluate how the hatchery can best be used to promote aquaculture development in the area.

Gariep Hatchery, Free State Province

The Gariep Hatchery is situated below Gariep Dam on the Orange River in the Free State Province. Although this hatchery was not part of the original scope of the WRC project, the project team developed a strong working relationship with both DAFF and the Free State PDA and responded to requests for some technical support in their the process of revitalising it.

The Gariep Dam Hatchery was built as a research and fingerling supply station, and continues with this original purpose. Yellowfish and barbel are bred at the facility for stocking of private waters. Research at Gariep Dam focuses on developing culture protocols for indigenous species. Although it has the capacity to produce in excess of 150,000 fingerlings per year, the loss of skilled aquaculture personnel has reduced the scale of operations at the time the present project was initiated. The facility included 12 hectares of earthen ponds, an indoor hatchery, and various other facilities, all of which are currently in use and are in a good state of repair. The facility employs 10 labourers that are either unskilled or have limited skills, but the positions for a manager and research assistant, both of which require a tertiary education; were vacant during the present projects engagement with the province.

The revitalisation of Gariep Hatchery was a joint collaboration between DAFF, the Free State PDA and the Chinese Government. In 2007, DAFF and the Chinese Government began discussions for the Chinese assistance to develop aquaculture in South Africa. A Chinese delegation visited South Africa and after visiting the Turfloop and Gariep Hatcheries, elected to revitalise Gariep. In the same year, a member of the project team was part of the technical DAFF delegation to visit China to assist in finalising the Terms of Reference for the Chinese assistance to South Africa. During the discussions between DAFF and the Free State PDA with the Chinese, the project team provided some technical input into the process.

Figure 24. The new multi million Rand facility at Gariep Hatchery being built by the Chinese. This project is a collaboration between the South African and Chinese governments.

In 2010, the Chinese began the construction of new building (and upgrading existing infrastructure) at Gariep. This included the building of five new buildings (including a large indoor hatchery). For the first 3-4 years, the facility would be run by the Chinese in collaboration with a South African team and from then on will be run by South Africans. The revitalisation of Gariep Hatchery is now complete. The primary function of the facility will be used a demonstration centre for carp production. However, DAFF and the project team are in discussion on developing a production plan to also use this facility for trout production which is a more viable economic option. The eastern Free State has significant trout potential and this facility can be used to provide fingerlings for this sector.

Amalinda Fish Farm, Eastern Cape

Amalinda Fish Farm, situated on the outskirts of East London, is a provincial facility that was established in 1967 by the then Department of Nature Conservation to conduct research and breed exotic fishes such as bass and carp to stock dams in the Province (Rouhani and Britz, 2004). The provincial Nature Conservation departments subsequently changed their policy regarding the breeding and stocking of exotic fishes, and the facility changed focus and began research into the breeding of indigenous fishes, such as mullet, yellowfish species and

Eastern Cape Rocky *(Sandelia)*. This resulted in the successful stocking of Eastern Cape dams with mullet proving its potential as a food species in fresh waters.

Figure 25. The Premier (centre) of the Eastern Cape Province visiting Amalinda Fish Farm

In the mid 1990s the Amalinda facility was closed due to lack of funds and a lack of policy regarding research and development. Most provincial research took retrenchment packages and left and the facility was mothballed. The hatchery was subsequently revived as a commercial venture by the East Cape Development Corporation, with the aim of producing Koi-carp for the ornamental fish trade (Rouhani and Britz, 2004). In 2005, the facility was leased by the provincial government to trust made up of Mkhonto we Sizwe (MK) veterans and other beneficiaries who intended continuing the koi venture.

Amalinda possesses of extensive facilities including an administration complex, a hatchery, nursery, laboratories and 36 Ponds of varying size.

Figure 26. Aerial view of the Amalinda fish farm.

In 2008, Amalinda fish farm was included within the scope of the WRC project – to implement the revitalisation of the facility. A summary of the project team's involvement in Amalinda is provided below.

In 2008, the project team, representatives from DAFF and the project beneficiaries met at Amalinda for a site visit. The provincial government had appointed a consultant to revitalise this facility, but it was evident from the empty ponds that this was not being achieved (the term of this consultant came to an end in 2008). Most of the 41 ponds were empty and overgrown with weeds and there was almost no sale of fish from the farm. The farm clearly had not bred koi for a number of seasons. Technical and business skills were identified as the main constraints.

After a series of meetings with the managers of Amalinda Fish Farm, a turn around strategy was developed and agreed upon. The key strategy was to secure a commercial partner for Amalinda to assist with marketing, and to hire a qualified aquaculture manager for the farm. In 2009, Amalinda Hatchery hired a graduate from Rhodes University with a specialization in aquaculture as the farm manager. The manager subsequently led the rehabilitation of the farm and began to spawn koi and goldfish.

In 2009, the project team secured a commercial partner for Amalinda who was one of the biggest koi producers in the country. The understanding between the commercial partner and Amalinda was that Amalinda would buy koi fingerlings from them, and after they reached market size the commercial partner would buy them back. It seemed a win-win deal as Amalinda did not have the marketing network and the commercial partner did not have the physical space to expand their production operations. Amalinda bought fingerlings from the commercial partner (worth in excess of R200 000), however when the fish had reached market size Amalinda experienced difficulty in getting the commercial partner to buy back the fish. After a number of months of trying with no avail to get a commitment from the commercial partner it was decided to find another commercial partner.

The project team then contacted the proprietor of *Fish Designs*, a large commercial ornamental fish farm in KwaZulu-Natal linked to the largest fish importer / wholesaler in the country. After a site visit to the facility, it was agreed to assist Amalinda market their fish and bought over 2000 juvenile koi. Following further discussions, *Fish Designs* requested that Amalinda diversify into the production of other ornamental fish (such as goldfish) which they could market. In 2010, Amalinda began producing goldfish for *Fish Designs* with an agreed target of R80 000 worth of goldfish every month. Amalinda is currently gearing up its hatchery to meet this order.

Figure 27. An employee feeding koi at Amalinda Fish Farm

In addition, the project team assisted Amalinda to develop proposals to expand from ornamental fish into food fish production in the region. It was hoped that the capacity base developed at Amalinda would pave the way for further aquaculture developments. These included proposals for:

1. A tilapia production centre
2. A retail shop (for ornamental fish and hardware – such as glass tanks and air pumps) at Amalinda Fish Farm.
3. Revitalising Pirie Hatchery (a dilapidated provincial trout hatchery near King Williams Town) into a trout production centre and as a tourism hub.

The above proposals were developed by the WRC team for Amalinda management, and initial meetings with various provincial government department were held. In principal these concepts had the support of the provincial government, and the managers of Amalinda were in the process of trying to secure the funds for these expansion projects.

In general, Amalinda is an example of how partnerships between government, the community and the private sector can operate, and how existing state facilities can be revitalised and create a provincial aquaculture skills base and development node.

Figure 28. A fish farmer with stunted tilapia in porta pools. There is a need for state hatcheries to produce quality fingerlings

Database of Farms Linked to Hatcheries

A database of commercial and small scale farmers linked to provincial hatcheries was compiled. This revealed that with the exception of the Western Cape's Jonkershoek hatchery which supported small scale trout farmers, there were no or very few aquaculture farms with linkages to the other provincial hatcheries. The focus of the WRC teams support and capacity building efforts was thus on the staff of the facilities themselves.

Discussion

The revitalisation of the provincial hatcheries was an important component in the general development process of making aquaculture relevant to rural development. These facilities, most them built as far back as in the 1970s were generally in a state of disrepair, operating on low budgets and with few skilled staff, were not performing. But perhaps most critical was that the operation of these provincial facilities had no guiding policy and their existence seemed to be dislocated to the needs of the province.

Therefore the revitalisation of the provincial hatcheries needs to be seen from two perspectives:

1. The physical infrastructure repair required.
2. The organisational understanding within the PDA on the role of the provincial hatcheries.

In Limpopo, KZN, Free State and in the Eastern Cape Province, the physical revitalisation of the provincial hatcheries has been undertaken, or is at an advanced stage of implementation.

These are encouraging signs in the development of aquaculture in the provinces and it demonstrates the commitment of the provinces.

Figure 29. A stunted tilapia from a farm in Limpopo. This fish of approximately 20 g is sexually mature and will effectively stop growing. There are techniques to ensure all fingerlings are male and as such continue to grow, increasing production.

However, possibly the more important part of this process and one that is less tangible is the shift in the organisational understanding within the various PDAs on the role of provincial hatcheries in developing the sector. This shift in understanding is an important milestone within the PDAs. Only five years ago, most of the senior managers in the PDA knew very little about their provincial hatcheries and provided little support for them. However, in the process of developing the PAS, and in the general engagement between the project team and the PDAs there is now a greater understanding of the issues. With understanding comes support and resources – something these hatcheries had little of before.

In provinces where little progress was made in revitalisation of their provincial hatcheries, the cause of this was not that the PDA did not recognise the importance of revitalising the provincial hatcheries, but rather that organisational problems within the PDAs made it very difficult to make and implement decisions. Personnel turnover and suspensions were a major problem in some provinces which seemingly paralysed the ability of the PDAs to function in a normal way. The overriding constraint to efficient hatchery function, even in the provinces that did take significant steps to revitalisation, was the lack of aquaculture and general management skills. Lastly, cumbersome government procurement and budgeting processes constrained progress where material commitments were made to hatchery revitalization. These internal and organisational challenges within some PDAs were a significant concern not just for aquaculture development, but for service delivery as a whole.

A possibility to mitigate these circumstances is that DAFF may need to implement a robust engagement with these provinces and to assist them in the process of developing aquaculture. However, the problem of poor service delivery is ultimately a political one requiring appropriate political will to address in a holistic manner.

In view of the extremely limited capacity of the provincial PDAs to carry out effective hatchery revitalization on their own, and given the need to link aquaculture development interventions to established value chains, the rationale for PPPs as a key strategy in provincial aquaculture development is compelling. Private sector partners are incentive driven, possess significant technical skills, and know what the market requires. It is thus understandable that the best outcomes from state hatcheries are evident in the Western Cape (Jonkershoek supporting small trout farmers) and the Eastern Cape (Amalinda Hatchery supplying ornamental fish) where PPP partnerships have been established.

Priorities for Action

1. DAFF to engage with provinces on the strategic purpose of their hatcheries and integrate them into the national aquaculture strategy, particularly the Aquaculture Development Zone concept.
2. PPP arrangements should be facilitated for each hatchery by a development institution such as a University or economic development agency

TRAINING AND MENTORING OF EXTENSION OFFICERS AND TECHNICAL STAFF

Introduction

Aquaculture is a relatively new sector in South Africa with potential for broad based development in rural areas, but technical skills and experience are scarce. The failure of many aquaculture ventures can ultimately be ascribed to a lack of skills and experience. During the WRC baseline survey on the role of aquaculture in rural livelihoods (Rouhani and Britz, 2004), human capacity building was identified as a critical need at various provincial hatcheries and government funded aquaculture projects that were evaluated. Most of these facilities were operating below their potential, and the lack of aquaculture skills was a major contributing factor.

Figure 30. A Limpopo farmer disappointed with his small harvest of fish. Farmers need technical support.

The skills gap identified during the baseline survey was cross cutting, in that it not only applied to the farmers but also to the provincial hatchery staff and technical staff, and the aquaculture extension officers and managers within the PDA. This low skills base was thus constraining the potential to develop aquaculture. Emerging farmers, after putting effort into their farms were not getting the expected results. Yields were low and input costs too high. Farmers could not access technical assistance and felt that they were "alone". While it was encouraging to see the interest in aquaculture and that emerging farmers were investing their own money into aquaculture, it was discouraging to see that the lack of technical assistance resulted in inefficient production systems and limited income for the farmers (Rouhani and

Britz, 2004). This highlighted the need to train the existing provincial hatchery and agriculture extension officers in aquaculture.

Figure 31. A project team member, Mr Johan Theron of University of Limpopo, visiting farmers. In the background of the picture are PDA extension officers.

The need to train the provincial hatchery staff and agriculture extension officers in aquaculture techniques thus formed a key activity of the current WRC provincial aquaculture programme project. Training was included in the Provincial Aquaculture Strategies (PAS) and a schedule of training arranged with the respective provincial PDAs. In addition, the initial contact between the project team and the provincial PDA managers responsible for aquaculture strategy and planning revealed that these officials had little exposure to aquaculture, and thus study tours of commercial aquaculture, as well as ongoing informal advice and mentoring were provided for participating provinces.

The Relevance of Training the Extension Officers and Hatchery Technical Staff

Aquaculture is a non-traditional form of animal husbandry, and its development is thus ultimately dependent upon the proponents and recipients of government led interventions acquiring the necessary knowledge and mastering the technical skills of the discipline. The fish breeding and production processes require high-level technical skills and experience in their application. No two farms are alike and aquaculture development personnel thus require the skill and experience to adapt and respond to the needs of specific problems that may arise in different situations.

The WRC baseline study (Rouhani and Britz, 2004) determined that rural farmers were in desperate need of technical support. It was evident that the basic principles of aquaculture had not been taught to the farmers, and that extension officers and provincial aquaculture staff could not effectively diagnose and recommend remedies for their problems. For example, at a government funded community based aquaculture farm, fish feed worth R 100,000 spoiled when it was stored in a greenhouse due to the excessive heat and humidity. Therefore the training of the extension officers – to provide support to the rural farmers – was seen as an important intervention to increase the viability of the farms and to increase production.

The rationale for the WRC focus on the training of extension officers was to create a nucleus of trained personnel who could reach farmers, as neither the PDA nor DAFF had the resources to hire an aquaculture specialist to visit and support all of the farms in the rural areas. Each province already had an established extension service programme for emerging / rural farmers, and therefore including the aquaculture training and outreach within this established institution was a logical step.

Figure 32. Extension officers from Limpopo PDA visiting a rural fish farmer

The other component of the PAS training focused on the provincial hatchery staff. The new "vision" for the provincial hatcheries, included the playing of an important role in supporting and developing rural aquaculture. The revitalized hatcheries were to provide technical support and fingerlings to the rural / emerging farmers. This essential service had been withdrawn for a number of years and as such it was very difficult for new fish farms to begin or existing ones to continue operation. To be able to respond to this the provincial hatchery staff required training and ongoing mentoring. Therefore the training of the hatchery staff became an important component of the project and a priority of the PDAs.

The General Status of Hatchery and Extension Staff Skills

In the initiation phase of training, an assessment was made of the aquaculture skills of hatchery staff in Limpopo (Appendix 10), Mpumalanga (Appendix 8) and KwaZulu-Natal (Appendix 9). These revealed that the aquaculture skills base of the extension officers was low.

Figure 33. A koi-spawning workshop at Amalinda. The skills of most hatchery staff were rudimentary and outdated.

In Limpopo province, the provincial agriculture extension officers all had diplomas in agriculture extension, and most had attended short courses in specific areas of agriculture (such as beekeeping or animal production). However, they had no previous exposure to aquaculture. While the extension officers were not skilled in aquaculture, they had sufficient general education and aptitude to assimilate new information and to implement it.

The managers of the provincial hatcheries were generally fairly well skilled in aquaculture through their training and experience. Most had been in their positions for years and knew how to run the hatchery and to produce fingerlings. However, since some of these hatcheries were not operational for extended periods of time, the managers needed to update their knowledge on modern techniques of fish production.

The Training Activities

A mix of training methods and media were selected for transferring aquaculture skills. These included:

1. **Formal training courses**: Formal courses were structured to address themes, for example, fish health, production and water quality. The short courses ranged in duration from a three day course to a four week course comprising one-week blocs.
2. **Site Visits**: Site visits by the project team to the sites where PDA officials worked were an effective means of providing advice and mentorship.
3. **Formal Mentoring**: Staff of provincial hatcheries were mentored in their workplaces in everyday procedures by qualified aquaculture specialists.
4. **Study Visits**: Study visits by PDA officials to functioning aquaculture facilities were used to provide exposure to commercial aquaculture.
5. **Informal Mentoring**: This approach included presentations at meetings, discussions, advice and specific inputs from the project team related to the implementation of

aspects of the PASs in order to develop the management capacity of provincial officials.

6. **An Aquaculture Manual and Factsheets:** An Aquaculture Manual and factsheets were produced as a reference resource for the coursework and to assist extension officers and hatchery staff in their everyday work.

The presentation of the training and effectiveness of each of these training methods in the respective provinces is described in detail below for the provinces where they were carried out.

1. Formal Training Courses

Various formal training courses on general aquaculture and health management were presented over the project lifespan to farmers, extension officers, hatchery personnel, and state veterinarians (Appendix 11).

Training Course for Aquaculture Extension Officers and Hatchery Staff

A four-week training module was developed (Appendix 12), based on the materials in the aquaculture training manual, and the course accredited by Rhodes University. The modules were specifically designed to train the agriculture extension officers and hatchery personnel. The course was presented in one-week blocs as the extension officers' other obligations precluded them from attending for longer continuous periods. The initial week of the course consisted of an introduction to aquaculture and its basic principles. The latter weeks then focused on the more technical aspects of aquaculture, such as breeding and production.

The course comprised a mix of theory and practical sessions. In the theory sessions, the subject would be presented in lecture form followed by a discussion led by the trainer. It was important to initiate discussion during the theory component as this encouraged the course participants to engage and participate, and enabled the course presenter to determine the extent to which the participants understood the subject. Each day had a practical session which included fish harvesting techniques, sexing different fish species, spawning, and testing water quality. The practical sessions were an important part of the training and it allowed the trainer to evaluate the extent to which the participants had absorbed the theory.

At the end of the four-week course, the participants wrote a test and were presented with Certificates of Competence, which were issued by Rhodes University. This course was officially accredited by Rhodes University as a short course.

Limpopo Province was the main beneficiary of the formal coursework training as the province was highly receptive to hosting courses. The initial four-week course was first presented in the Limpopo Province in 2007, at the Tompi Seleka Agriculture Training Centre to extension officers, the Turfloop Hatchery production manager and the manager of the Tompi Seleka aquaculture section. A further two-week training course for the extension officers was conducted in 2010 and 2011. The courses were well received by the extension officers. Although the courses were offered at no cost to the PDAs (the PDAs had to arrange the transport and accommodation of the participants), unwieldy bureaucratic procedures within the PDA made it difficult to set dates and make the necessary arrangements for the course.

Another cause of delay in presenting the courses was that while the Provincial aquaculture manager would nominate district extension officers for the course, they were not under his authority and therefore permission to attend had to go through several layers of management.

In Mpumalanga a two week training programme at the Lowveld Agriculture Centre (in Nelspruit) was presented in 2008 (10-20 September) for aquaculture extension officers, which included field trips to the Lydenburg and De Kuilen hatcheries. The course focused on trout production as this province is the largest trout producer in the country. Although the course was well received by both the participants and Mpumalanga PDA management, the project team was unable to get the PDA to send extension officers for the follow up two-week course. Organizational problems within the PDA appeared to be the cause.

The project team made several attempts to continue this course in Mpumalanga Province but it was not possible for the PDA to organize this. There did not seem to be a connection between the PDA Directorate responsible for aquaculture and that for extension officers. This issue was discussed by the project team with the aquaculture officers within the PDA but they were unable to suggest a solution.

During the provincial aquaculture strategic planning phase in the first year of the project, North West Province and Eastern Cape Province indicated that they would send AEOs on the course, but this never materialized. The reason once again appeared to be a lack of coordination with the respective PDAs.

Fish Health Course for State Veterinarians

In the process of developing provincial aquaculture capacity, fish health was identified as one of the main gaps in developing aquaculture. State veterinarians are required to certify the health of aquaculture species and products, but lack any aquaculture training in their primary BVSc degree.

Figure 34. State vet at a fish health course at Rhodes University

This gap is a significant threat for farmers as the lack of fish health services can result in the loss of an entire farm's stock to disease. An example is the spread of Koi Herpes Virus through South African koi farms resulting in culling and a three-year export ban on their products to certain countries during which time the farmer needed to demonstrate that the farm has been disease free. Such health assessment and certification needs to be made by a state assigned veterinary officer. In the absence of state fish health services, the development of the aquaculture sector will be constrained.

Fish health, which includes surveillance, diagnostics, treatment and certification, is a highly specialized field requiring skilled professionals. It was therefore clear that the current provincial state veterinarians required training in fish health management. As this new focus area, which was identified as a training need within the current WRC project, was beyond the scope of the project terms of reference, the DAFF was approached for support. As veterinary services are a shared mandate between DAFF and the PDAs, the DAFF provided funding to offer an introductory course in fish health at Rhodes University to provincial state veterinarians.

Figure 35. Vets at the training course sampling fish from the University fish farm

Two vets from each province, as well as representatives from the DAFF Directorate of Animal Health attended a five-day course at Rhodes University's Department of Ichthyology and Fisheries Science (See Appendix 13 for the course outline). The course was presented by Prof Horst Kaiser, a fish health researcher at the Department, as well as Dr David Huchzermeyer, a private veterinarian who is also the only fish pathologist in the country. The course was very well received and was also accredited by the South African Veterinary Council. The course was also awarded 37 Continued Professional Development Points. Interestingly, the course was presented in the Department of Ichthyology and Fisheries Science building which previously housed the "Cape Bacteriological Institute" where South Africa's first veterinarian, Jotello Soga (see Figure 36) was based at the end of the 19^{th} century.

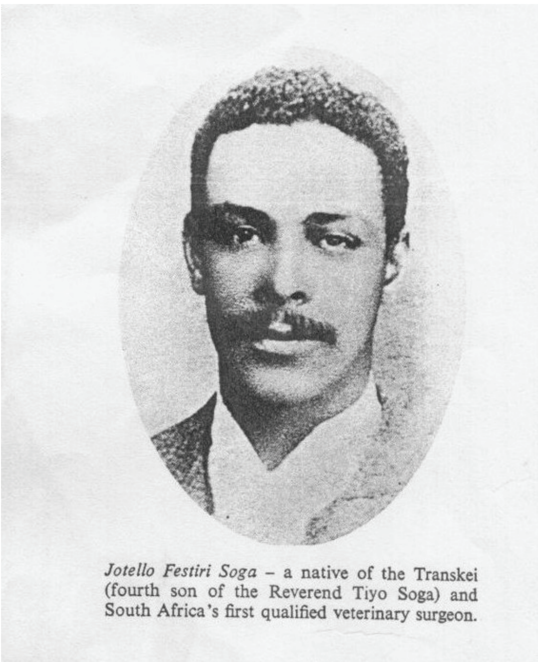


Figure 36. South Africa's first veterinary surgeon, Dr Jotello Soga, was based at the Cape Bacteriological Institute, now home to the Department of Ichthyology and Fisheries Science where the fish health course for state veterinarians was presented.

Further outcomes of this course included:

1. DAFF would like Rhodes to continue offering these courses for state vets.
2. Rhodes University has been approached by the World Animal Health Organisation (OIE) to become a Collaboration Centre for the OIE for fish health in Africa. The first OIE course was scheduled for September 2011.
3. DAFF and Rhodes University have entered into a discussion to develop a joint fish health centre at the current Provincial Veterinary Diagnostic Centre in Grahamstown. It is proposed that this facility be used to train state vets, provide diagnostic services to farmers, conduct surveillance services, and conduct research. If developed, this centre would become the hub of fish health development in the country.

Fish Health Course for Amalinda Fish Farm Staff

A two day fish health management course was presented to Amalinda Fish Farm staff by Prof Horst Kaiser of Rhodes University on 16-17 July 2009. The course included both the theoretical and the practical and was undertaken at the Amalinda farm. A short manual was also prepared for the participants.

2. Site Visits

An integral component of the training was site visits to aquaculture facilities to give substance to the theoretical course content. A brief summary of how the site visits formed part of training and mentoring is provided for the relevant provinces.

Limpopo Province

Site visits undertaken by the project team to Turfloop and the community owned fish farms were always carried out together with the PDA officials, and where possible the extension officers. These site visits proved to be a valuable method for the project team to build relationships with the PDA, and more importantly to assist the PDA to improve its service to the famers.

A typical site visit would include meeting the farmer at his farm, walking around the farm and assessing what his immediate challenges were, and then having a discussion to see how the problem facing the farmer could be remedied. In one instance a farmer was finding it expensive to buy fish feed at the local co-op. After discussions with the extension officers, it was agreed that the extension officer would arrange to buy the fish meal from Johannesburg and include this shipment when he made his order for the local farmers. In another instance the farmer did not have a net to harvest his fish. It was then agreed that a net from Tompi Seleka would be brought to him.

These two examples illustrate how real life "problem solving" is an important element of training extension officers.

Mpumalanga Province

In Mpumalanga Province, the project team made several site visits to the Lydenburg and De Kuilen Hatcheries with Mpumalanga PDA staff. The focus of these site visits was to discuss how these facilities could be revitalized and modified to fit the needs of the province. As such they served to make PDA staff aware of the aquaculture development options for Mpumalanga and how to address them.

KwaZulu-Natal Province

In KwaZulu-Natal, Makhathini Hatchery was the focus of the WRC project. During the first two years of the project, the project team met with the staff of the hatchery on site when developing the revitalization plans of the hatchery. There were also subsequent visits to Makhathini when the project team met with Stellenbosch University to determine if linkages with another WRC project on water quality and aquaculture (implemented by Stellenbosch University) could be created.

Free State Province

In the Free State Province the project team made a number of visits to the Gariep Hatchery to assist in developing plans for the facility. The PDA and DAFF had an agreement with the Chinese Government to revitalize this facility and they required technical input in this process. These site visits have assisted the PDA staff in understanding the various fish breeding options for the hatchery.

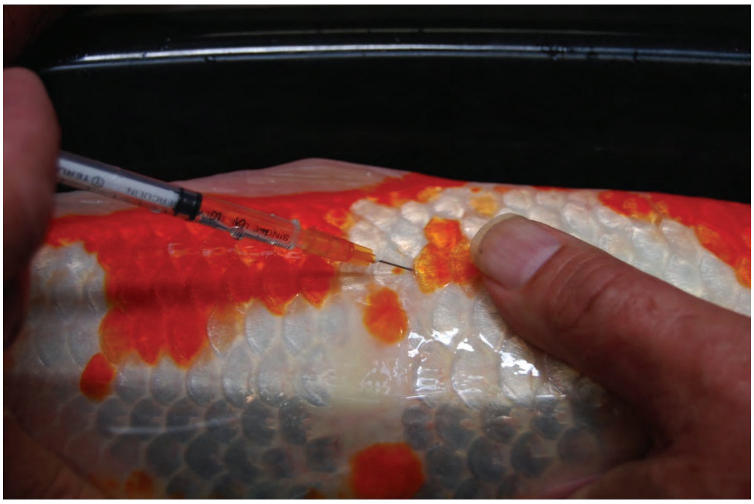


Figure 37. A demonstration in koi breeding at Amalinda Fish Farm

Eastern Cape Province

In the Eastern Cape the project team personnel made regular site visits to the Fort Hare Agripark in 2006-7 and Amalinda Fish Farm in 2008-2010. The WRC project manager met regularly on-site with the Amalinda Fish Farm Board of Directors and Manager to provide them with technical support and mentor them in developing their organizational capacity and business strategy. The site visits increased the confidence of the Amalinda staff and were integral to the revitalization process.

In conclusion, the site visits to the various provincial facilities were found to be a particularly effective means of problem solving and transferring skills to hatchery technical staff. By contrast, communication with hatchery personnel from a distance was difficult due to poor email access and language barriers. Apart from the direct solving of technical problems and skills transfer, the site visits served to build relationships with the hatchery personnel, motivate them and build their confidence in their ability.

3. Formal Mentoring

Of the four provincial hatcheries within the scope of the project (Turfloop, Lydenburg, Makhathini and Amalinda), it was only feasible to carry out formal training / mentoring at the Turfloop (Limpopo) and Amalinda (Eastern Cape) facilities. The reason for the non-participation of the Provincial Departments of Agriculture in Mpumalanga and KwaZulu-Natal was that these provinces had not launched any process to revitalize their hatcheries, and as such it was premature for the project team to engage with the technical staff of the hatcheries.

In Limpopo, it was evident that in addition to the formal courses which the hatchery managers attended, ongoing mentorship would be required for the staff to be able to produce fish at Turfloop Hatchery following eight years of no production. In 2007, the Programme initially appointed Dr Bert Polling, a retired University of the North aquaculture lecturer and researcher with many years of experience, to provide mentorship to the manager at Turfloop. This step was taken in consultation with the Limpopo PDA. Dr Polling provided technical assistance to the manager in preparing the hatchery for the production of catfish fingerlings at Turfloop. Much of his time was spent trying to organize the replacement of missing or defunct equipment, such as pumps and blowers. It was also necessary to procure and condition brood fish. Dr Polling's mentorship was also extended to the fish farmers at the Ipopeng Fish Farm (in Seshego). The farmers developed a production plan for their facility which was done as part of the training curriculum of the AEOs and the farmers of Ipopeng. In 2009, the mentoring of technical staff at Turfloop Hatchery was taken over by Mr Johan Theron of Limpopo University's Aquaculture Unit. Mr Theron also provided support and mentoring to the extension officers when they visited the farmers.

In Mpumalanga, mentorship was provided to the aquaculture manager in respect of the development of a production plan for the Lydenburg Hatchery by Mr Martin Davies of Rhodes University, who was the trout specialist on the WRC project. No mentoring of hatchery staff was possible in Mpumalanga Province as the province has failed to implement its aquaculture strategy and revitalize the state-owned Lydenburg and De Kuilen hatcheries. The key staff responsible for aquaculture within the Mpumalanga Department of Agriculture (PDA) were dismissed in 2009 which meant that no progress was made subsequent to that to promote aquaculture within the province.

In the Eastern Cape Province, Fort Hare Agripark participants were mentored in fish harvesting and slaughter in 2006. The mentoring of personnel at the Amalinda Fish Farm commenced in 2009/10 and was the main focus area for the WRC project's support for the facility's revitalization. The main mentoring activities facilitated by the WRC project at Amalinda included:

- The appointment of a qualified aquaculturist to manage the facility and mentor the farm staff in aquaculture skills.
- The owners of Orient Koi from Pretoria visiting Amalinda Fish Farm for two-day visits approximately once a month (the cost of which was shared by the project and Amalinda Fish Farm) to provide the fish farm workers with training on koi production and selection. They also assisted the farm staff to prepare for the East London Koi Show.
- Advice by a commercial ornamental fish farmer on how to set up their hatchery for the production of goldfish.
- Assistance when approaching provincial government departments on various issues.

4. Study Visits

Study visits to functional aquaculture facilities were also used as a method to train and build capacity of provincial officials. These study visits exposed PDA officials to the development of aquaculture and allowed them to experience another perspective of how the industry works and how it could be developed in their province.

Most PDA officials had either never been exposed to aquaculture, or if they had, their experience was limited to the dysfunctional provincial hatcheries which were a financial drain. This uncertainty on their part made them sceptical on the extent to which provincial resources should be invested into the sector, if at all. The idea for study visits was prompted at a PAS workshop, where a senior government official expressed doubts on whether commercial aquaculture was working in the country and requested the project team to organize a study visit so that they could "see" that there was indeed commercial aquaculture in South Africa.

Figure 38. Officials from KZN PDA on a site visit to a kob cage aquaculture facility in Port Elizabeth

In KwaZulu-Natal, a study visit was organized for provincial PDA managers to visit commercial aquaculture projects in three provinces. The study visit included a commercial ornamental fish farm in Pretoria, a pilot kob (marine fish) farm in Johannesburg, an abalone farm in Hermanus and finally a pilot kob farm in Port Elizabeth. What was important for the PDAs during this visit was to see the diversity of aquaculture and that it is an established sector. Meeting the farmers enabled the PDA officials to determine what their needs were and to define the role of government in developing an "enabling environment" for aquaculture to grow in KZN. At the end of the tour, the KZN PDA managers agreed to invest in a marine aquaculture project development that had earlier been submitted to their department for support. It was clear that the study visit had provided them with the opportunity to experience the commercial aquaculture sector first-hand, and that they had acquired the confidence to support this nascent sector.

Another outcome of the study visit was that the days spent on the road visiting the various commercial fish farms strengthened the working relationship between the PDA and the project team.

In the Northern Cape Province, a study visit for PDA staff was arranged in 2007 which included visits to a small catfish producer on the Hartswater Irrigation Scheme, an ornamental fish farmer in Upington, and the marine aquaculture node in Port Nolloth where abalone were being cultured. This was the first exposure of these personnel to aquaculture and contributed to the province's understanding of the potential of aquaculture and made them more receptive to the development of an aquaculture strategy.

Similarly, staff from the Gauteng PDA and the national Department of Agriculture were conducted in 2008 on a one-day study visit to a commercial koi farm and a re-circulating kob farm. The Gauteng PDA greatly appreciated the exposure to aquaculture and the significant contribution that it could make to the province.

In the Eastern Cape, a group from a community based recreational trout fishing project at Cata, a village near Keiskammahoek, was taken on a study visit to Mpumalanga Province to visit trout fish farms and fly-fishing lodges. This activity was not directly part of the WRC project, but as the area could support a possible trout production centre, exposure to both trout fly-fishing and aquaculture was valuable to the participants.

5. Informal Mentoring

Project team members had regular contact with the aquaculture managers of the PDAs to assist them with the formulation and implementation of the Provincial Aquaculture Strategies. These meetings and discussions were also used to informally mentor the managers and to capacitate them to make and implement decisions.

6. Training Resource Material

6. 1. The Aquaculture Manual

There was a need for training resources that could be used in training the extension officers. Existing training manuals developed in Asia or for other African countries were not completely relevant to South African conditions and environmental diversity. The project therefore responded to the need to develop a training manual for training extension officers. The compilation of the manual was a specific objective of the WRC project and the final report published by the WRC.

The manual had to fulfil the following parameters:

1. Easy to read, though technically strong.
2. Relevant to training of extension officers, used as a reference for the extension officers and also accessible for literate farmers.
3. Relevant to rural development.
4. Include appropriate technology for rural farmers to use.

The development of a multi-purpose training manual was therefore an essential part of the process of training the extension officers. The manual would be used for the training and the participants would be able to use it after training as a reference document. The manual comprehensively covered basic aspects of freshwater aquaculture in South Africa including fish biology, aquaculture species, types of aquaculture systems, water quality, pond management, transporting live fish, size sorting, feeds and feeding, harvesting and preserving fish, health and disease management, fish breeding, cage culture, polyculture and integrated aquaculture, and business and financial planning.

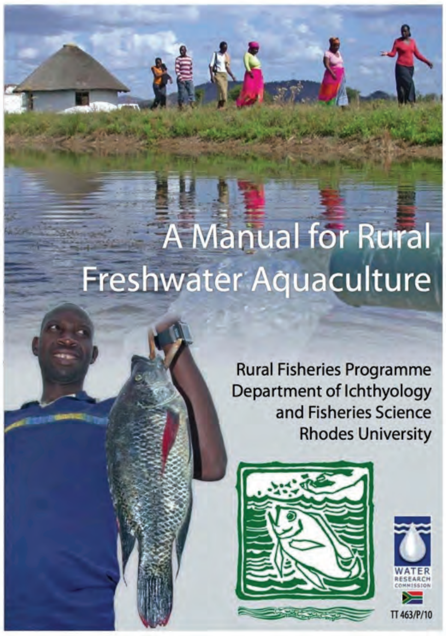


Figure 39. The front cover of the training manual developed by the project team. This resource could become a valuable tool to develop the skills of extension officers and farmers.

The project team adopted a systematic approach to develop and "test" the manual, to ensure that it was technically correct and relevant and that the process had buy-in from the PDAs. The process was as follows:

- The project team developed the framework for the manual content.
- A specialist was appointed to write the text to fill the framework into a draft manual.
- An artist was appointed to draw sketch diagrams to illustrate specific points. Photographs of South African fish farms and provincial hatcheries from the project library were included.
- The manual was then distributed to the PDAs for their comment and input.
- The manual was then "field tested" in the training of extension officers in Mpumalanga and Limpopo.
- The manual was then "re- worked", based on the inputs from the training sessions.

- The final document was submitted and published by the WRC under the title "A MANUAL FOR RURAL FRESHWATER AQUACULTURE", WRC REPORT NO. TT 463/P/10.

6.2. Factsheets

In addition to the training manual, aquaculture factsheets were produced by the project team. The factsheet comprised a single sheet of paper (A4) that contained information on a single topic / issue, for example, water quality or feeding regimes. Ten factsheets were produced on different topics. The concept was that the factsheets would be distributed to the farmers, and over time the farmers would be able to have a collection of factsheets that would be easy to refer to.

The factsheets were not widely used in the training aspect of the project as they were only developed in the fourth year of the project. This resource could be rolled-out in the future. As it is relatively easy to translate a fact-sheet into a local language, they could be an effective resource for training rural farmers.

Figure 40. The training course offered practical as well as theoretical knowledge on aquaculture to the extension officers

The Challenges Faced in Training and Mentoring

A number of challenges were experienced in implementing the training and mentoring aspect of the project, stemming mainly from the organizational problems within provincial government departments.

Overall, the formal courses were poorly attended. It was expected that the PDAs would nominate extension officers for aquaculture training who would then serve specific farms or areas, so that they would be able to impart their skills and knowledge. Despite initial commitments from the KwaZulu-Natal and Eastern Cape PDAs, no extension staff were sent for training. In Mpumalanga Province, although the project team managed to hold one round of training for the extension officers, it was poorly attended, and the PDA was unable to organize a repeat of the exercise despite numerous follow-ups by the project team. As the PDA did not have any existing rural aquaculture projects requiring support, it was difficult for them to secure extension officers to attend the training courses.

For Limpopo and Mpumalanga, extended periods of time (months) and many follow-ups by the project team were required for the PDAs to:

- Select and organize the release of extension officers to attend the course.
- Secure a training venue.
- Provide the funding for the travel of the extension officers to the course and for their accommodation.

This caused significant delays in the dates planned for the training.

The objective of training the provincial agriculture extension officers was that they would be able to provide support to the emerging aquaculture farmers, but after the course they were not linked to farmers requiring aquaculture technical support. This was due to organizational line function issues. In Limpopo Province, aquaculture is managed from the provincial head office, however the extension officers are managed at the municipal level offices of the PDA, and it proved to be difficult for the PDA aquaculture section to coordinate with the various municipal offices to instruct the aquaculture trained extension officers to regularly visit fish farmers in their area. This is an indication that the PAS was not properly integrated into the organizational line functions within the PDA.

The Benefits of Training the Extension Officers and Hatchery Technical Staff

The training of the extension officers and hatchery technical staff had the following benefits:

- Basic aquaculture skills were provided to the PDA extension officers who participated, which increased their knowledge and awareness of the sector. Most of the extension officers indicated to the training course instructor that the course enabled them to identify aquaculture development opportunities as they had been unaware of this agricultural sub-sector.
- Although there were gaps in the process of assigning extension officers to the farmers, an institutional knowledge foundation has been put in place. The PDA managers are aware of the organizational problems and with time should be able to ensure that the extension officers and the farmers are linked.

- The training of the hatchery staff was successful in Limpopo and Eastern Cape Province, highlighting the effectiveness of formal training combined with ongoing mentoring. After the training and with technical mentoring from the project team, the staff were able to make Turfloop Hatchery operational once more, and catfish were successfully spawned. This was a significant achievement as many years have elapsed since the last time fish were spawned at the hatchery. Similarly, at Amalinda hatchery the WRC project training interventions resulted in the first fish sales from the facility. Therefore the training of the staff directly contributed to the revitalization of both hatcheries.

Figure 41. A state vet at the Rhodes training course

Discussion

Though training and capacity building were identified in the initial contacts and PAS development with the PDAs as a key component of developing aquaculture, the various PDAs did not take full advantage of the formal training services provided by the project. This juxtaposition between what the provinces indicated that they needed in the PAS planning, and what actually was taken advantage of when provided, is an indication of the organizational challenges within the rigidly structured PDA management and human resource allocation framework. The lesson is that to effectively implement the PASs and associated training and extension, a process of organizational re-structuring and allocation of dedicated manpower and resource is required. Very often the managers responsible for aquaculture did not have the power (and perhaps the ability) to implement the PAS training goals within the rigid PDA organizational structure.

Although in the original project concept aquaculture training was focused on hatchery staff and extension officers, it was clear from the first contacts with PDA managers that this level of official required higher level training in aquaculture to empower the provinces to effectively implement their aquaculture strategies. The interventions by the project team to informally mentor and advise these staff, and to provide a study tour, were successful, but each province ideally requires a qualified aquaculturist to drive the PAS implementation.

The intervention to provide a structure for training provincial veterinarians in aquaculture health management can be deemed highly successful, as it attracted support from the DAFF and enthusiastic buy-in from the vets. This has laid an essential foundation for providing aquatic veterinary health services in each province.

It is clear that training and mentoring of extension officers and hatchery technical personnel needs to be an ongoing activity if they are to be effective in contributing to the development of rural aquaculture and making it a contributor to rural livelihoods.

A more systematic approach to integrating aquaculture into the organisation of line functions within the PDAs is required in order to link trained extension officers with farmers. With greater support and input from DAFF to assist PDAs to reach their goals and objectives, some of the bureaucratic challenges discussed above can be addressed.

It is also evident that a diffuse farmer-extension officer driven development approach will probably not result in the establishment and growth of provincial aquaculture due to their limited skills and experience in aquaculture. The success in establishing operations at Turfloop and Amalinda indicates that a much more intensive, integrated approach to establishing projects is required which addresses all issues required to link small farmers into aquaculture value chains. As the Amalinda example illustrates, a private sector linkage and partnership supported by high-level mentorship and management skills is essential to penetrate commercial markets. This approach is supported by the experience of developing small-scale trout farmers in the Western Cape Province (Britz *et al.,* 2009)

Priorities for Action

1. At least one aquaculture specialist extension officer with a higher degree in aquaculture needs to be appointed in provinces with an aquaculture strategy.
2. DAFF needs to engage with provinces to facilitate ongoing training of aquaculture personnel as part of the national aquaculture strategy.
3. Mentorship arrangements for hatchery staff should be arranged through Universities or specialist service providers.
4. The training needs of farmers linked to proposed PPP small farmer projects need to be addressed.

DEVELOPING PUBLIC PRIVATE PARTNERSHIP FRAMEWORKS FOR PROVINCIAL AQUACULTURE HATCHERIES

Introduction

During the evaluation of the status of the state hatcheries with the aim of developing models for their revitalisation, it was important to understand their history and original purpose. South Africa's state hatcheries represent a legacy from different historical periods, during which fish were cultured for various purposes. For example, colonial era hatcheries such as Jonkershoek were used to introduce exotic species for angling purposes, while during the apartheid era, "homeland" development policies gave rise to aquaculture initiatives to address food security which resulted in the building of hatcheries such as Turfloop and Makhathini. With a change in conservation policy away from stocking alien fish in the 1980s, and the demise of apartheid era policies in the early '90s, many of the state hatcheries lacked a clear purpose and fell into disuse or dysfunction. A challenge facing the provinces was what role, if any, should the old hatcheries play in aquaculture development in post-millennium democratic South Africa?

Figure 42. Trout from a commercial farm in Mpumalanga Province being processed. With government support, there are opportunities for emerging fish farmers to develop equitable partnerships with the private sector.

While the provinces recognised that their hatcheries were an obvious asset to consider using in implementing their provincial aquaculture strategies, there was caution in investing in them due to the following factors:

- They were expensive facilities to maintain that had not delivered any clear benefit for many years.

- The model of state hatcheries providing fingerlings to resource poor, small farmers to produce cheap protein did not appear to have worked throughout Africa.
- The state run facilities lacked a market orientation and were not linked to commercial aquaculture value chains.

Figure 43. Lydenburg Hatchery could be revitalised with the support of the private sector

In the aquaculture strategic planning process, the provinces articulated that a development model was required that would serve to integrate farmers into aquaculture value chains, while not overly burdening the Departments financially. Therefore a PPP (public-private-partnership) model was proposed as a basis for revitalizing the provincial hatcheries in the provincial aquaculture strategies.

Figure 44. Provincial hatcheries could supply seed to emerging farmers and the private sector

The Model

In developing possible PPP models for each province, it was clear that there could be no "one size fits all approach" to the revitalization of state hatcheries. Each hatchery has its unique circumstances and environment that dictated what was possible. Each PDA was also at a different point in building capacity to develop aquaculture in the province. Therefore, the project team had to ensure that solutions proposed to the PDA reflected the needs and circumstances in that province.

The participating PDAs had various options with regards to the management and operation of the state hatcheries. These included:

1. *Fully controlled and operated by the PDA*. Historically, all state hatcheries were operated in this way. In this arrangement, farmers were simply customers purchasing fingerlings. With the move away from breeding exotic fish (mainly trout and bass) by the provincial conservation departments this management arrangement failed, as income dropped and the facilities were too large and expensive to maintain. All fully controlled state hatcheries had fallen into dysfunction by the time the WRC project was initiated in 2005.
2. *Ownership by the PDA, but operated by a University*. An innovative arrangement was reached between Stellenbosch University and CapeNature whereby the Jonkershoek facility continued to operate as a trout hatchery operated by the university for the purpose of promoting trout aquaculture in the Western Cape Province. The province retained ownership of the facility but all operating costs were covered by the University.
3. *Ownership by the PDA but operated by private enterprise under a lease agreement*. Some state hatcheries have been leased to the private sector with mixed results. These include De Kuilen Hatchery in Limpopo before its closure, and Nagel Dam in KZN. De Kuilen operated as a highly successful trout ova export facility before it was bought out and closed down by an overseas competitor. Nagel Dam hatchery was leased to a private entity who wished to farm catfish, but the venture failed due to low demand for catfish. Both facilities have subsequently been stripped of their assets.
4. *Ownership by the PDA but operated by a Non-Government Organization (NGO) or parastatal supporting rural community aquaculture development*. In this model, ownership is retained by the province but the hatchery is operated by a not-for-profit NGO or parastatal with a development mandate that uses grant funding to promote its mission. An example of this model was the transfer of the Amalinda Hatchery from East Cape Nature Conservation to the East Cape Development Corporation (ECDC) in the mid-nineties. ECDC converted the facility into an ornamental fish farm for emerging farmers. It was taken over from ECDC by an *Mkhonto we Sizwe* (MK) Veterans trust to be operated as a commercial entity.

5. *Sale of the facility to private enterprise, with no onward PDA control over operations or production.* While this is an option where the state no longer has any purpose in retaining ownership of a facility, there are no known examples of it being implemented in South Africa. The state tends to retain ownership of its land, even where the building and infrastructure fall into disrepair.
6. *A Public Private Partnership,* whereby the facility remains under Provincial Government ownership, but operates in partnership with a private enterprise with certain conditions pertaining to production, development and training (Figure 46). Under this arrangement, the hatchery still serves a developmental role for the province and its operating costs are partially funded by the state in expectation of the social good it will generate. However, the participation of a private sector partner is negotiated to help achieve the aquaculture development mission of the province. The private sector partner will make a profit out of its access to the facility through the production and sale of fish, and/or the rendering of services to the province such as aquaculture training and extension. For the province the potential benefits are:
   - High level commercial aquaculture skills are harnessed into the aquaculture development process.
   - Access to established aquaculture value chains is created for emerging farmers. What has worked particularly well in the Western Cape is the private sector partner providing production, processing and marketing channels for emerging trout and mussel farmers.
   - Production strategy and performance is market driven.
   - Provincial aquaculture staff are mentored by commercial farmers.
   - The facility still operates on close to full-scale and does not fall into decay. As such it can still fulfil an aquaculture development role. The substantial variable running costs of production are paid for by the private sector partner.
   - The facility serves as a viable demonstration facility.

Figure 45. There is a demand for quality fingerlings in South Africa. Provincial state hatcheries, in collaboration with the private sector, can fill this need.

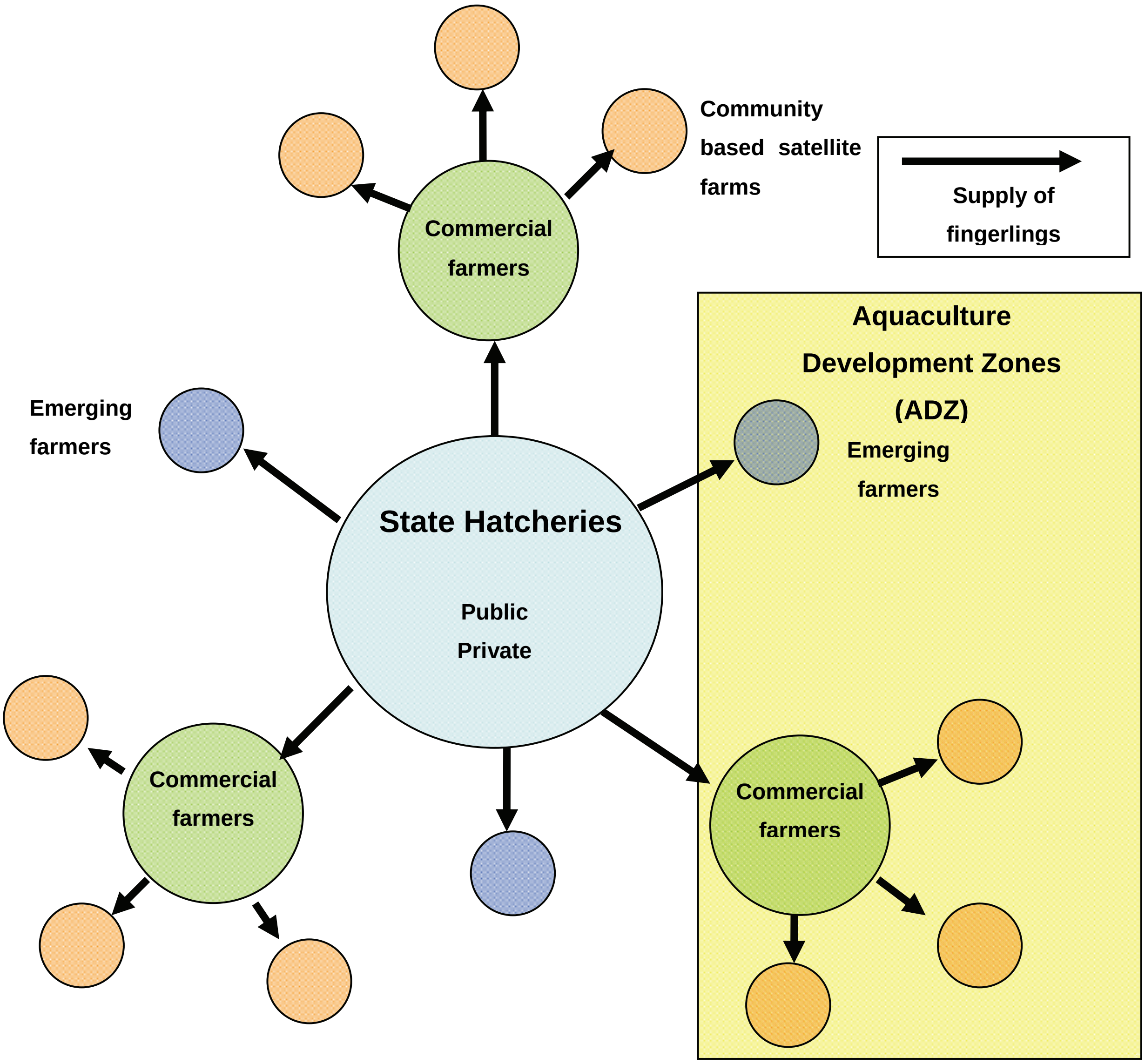


Figure 46. Schematic diagram, indicating the central role of the revitalized State Hatcheries in supplying fingerlings to both commercial farms, within and outside the Aquaculture Development Zones and directly to emerging farmers. The State Hatcheries would be operated as a PPP. Such a scheme is currently successfully operated to support the trout industry in the Western Cape Province.

After considering the various alternatives for state hatchery utilization, the PPP model (option 6), was deemed the most suitable development model. Under this option the hatchery can be leased at a nominal fee to a private enterprise/ university/ NGO on condition that it serves the province's aquaculture development objectives.

A good existing example of a successful hatchery PPP is *CapeNature's* Jonkershoek trout hatchery which has been leased to Stellenbosch University to conduct research, provide training and supply fingerlings to a small-farmer grow out scheme. This facility has played a key role in establishing the trout industry value chain in the Western Cape even though its original purpose was to stock rivers with trout for angling.

Figure 47. A pond at Amalinda Fish Farm with Koi. Production at this facility has increased due to the partnership with a commercial farmer.

In the other provinces where non-functional state run hatcheries existed, the project team recommended that to make the facilities attractive to a private company or organization interested in a Public Private Partnership, the Provincial Government should undertake to renovate the hatchery, and then offer the facility which is in working condition in exchange for the undertaking by the operator to produce and make available fingerlings, as well as to provide training and technical support to rural aquaculture developments.

The funding of fixed and variable costs would have to be negotiated in each case depending on the objectives of the public and private sector partners. In principle, the private sector partner would have to pay for the variable costs associated with the production of fish for sale for profit, while the state would cover property maintenance and the salaries and costs of development related activities. The private sector partner could also sell additional services required, such as training, extension, marketing and processing of satellite farmers' fish; or provide certain in-kind services as a *quid pro quo* for the opportunity of using the state facility.

The Link between the Hatchery and the Farmers

In the consultation phase of the WRC project, the provinces recognized that the future and viability of state hatcheries was directly related to the development potential for aquaculture in the province, and the demand for support services. Therefore, if the emerging fish farmers were not performing well, then regardless of how much fish the hatchery was producing, there would be no market for the fish. Thus, the PDAs recognized that revitalizing the hatcheries was contingent upon an overall strategic approach to sector development, including attracting private sector investment.

The revitalization of state hatcheries also links to the national strategy of creating Aquaculture Development Zones (ADZ). This is based on the industrial park concept whereby the state zones and develops land, clustered infrastructure and services ready for investment. Permitting and environmental legislation is a major hurdle to investment into aquaculture, and thus with the State undertaking the required environmental impact assessments, facilitating permits for access to water, and providing technical support, such as veterinary, research and extension services, investment by the private sector is made much more attractive. Ex-state hatcheries could form the nucleus of ADZs or provide services located elsewhere (Figure 46). Thus the revitalized state hatcheries would function within an overall aquaculture development plan context. PPPs were seen as key strategy to attract private sector commitment and boost provincial government confidence in aquaculture as a sector.

Through the process of provincial hatchery revitalization, PPP options were explored and developed for the respective facilities based on the conditions and opportunities in each province. These are summarized below:

Turfloop – Limpopo Province

In the first two years of the project, the primary focus of the project was to create a foundation for developing a PPP for Turfloop Hatchery. Following consultations with the provincial aquaculture managers of the Limpopo Department of Agriculture the following was achieved:

- The revitalization of Turfloop was included in the Provincial Aquaculture Strategy with the goal of creating a provincial aquaculture service hub
- Development of a production / operational plan for Turfloop
- Development of a budget to re-commission Turfloop
- Training the hatchery manager
- Discussion on the role Turfloop and linkages to rural farmers.
- Site visits to discuss the operational requirements of Turfloop
- An in-principle decision to seek private sector partners for a Turfloop PPP

It was necessary to initially carry out the above actions as it was agreed that the existing poor condition of the Turfloop hatchery would not encourage the private sector to take up joint operation or management of the facility. In 2007-8, the PDA initiated a R2.5 million project to re-commission the external ponds at Turfloop Hatchery. A further R 600 000 was allocated to upgrade the systems within the hatchery building. This financial commitment by the PDA is an indication that the province was committed to aquaculture development and a future PPP.

Figure 48. With the physical revitalisation of Turfloop Hatchery complete, there is now opportunity for the PDA to engage with the private sector to form a partnership

The production of fingerlings from Turfloop Hatchery in 2009 in effect set the stage for the PDA to engage with the private sector to develop a PPP in the operation and management of the Turfloop. The proposed model for the PPP as agreed with Limpopo PDA aquaculture managers would be that the private partner would operate and manage Turfloop and breed and sell what ever species they wished (as long as it adhered to environmental legislation) as long as it could supply the PDA with a set number of tilapia and catfish fingerlings for emerging farmers. The number and price of the fingerlings would then need to be negotiated between the PDA and the private operator.

In this model, the PDA would be relieved of the day to day operation and cost of running Turfloop, yet it would still be guaranteed a fixed number of fingerlings at a set price to support emerging farmers. The benefit for the private partner would be that it would take over a fully refurbished fish farm (at a minimum but negotiated cost per month) and have the freedom to operate it as desired, and it would also have a guaranteed market to sell fingerlings to the PDA each year.

To date, the PDA has not formally engaged the private sector to initiate a process to develop a PPP, though to a large extent the foundation has been laid. The revitalized facility has attracted informal enquiries from the private sector to assess the opportunity. For example, the PDA was approached by a De Beers sponsored company investigating the feasibility of aquaculture as an enterprise for communities within its Venetia Mine labour pool area. The services of the project team has been made available to the PDA to assist with this process, however it seems that a decision to formally initiate PPP negotiations has not yet been made at the senior management level of the PDA.

Makhathini – KwaZulu-Natal Province

In the initial scope of the project, the WRC project involvement was limited to the PAS. However after year two of the project (2006), it was decided to increase the role of the project team in the province to include support to the PDA and the revitalization of Makhathini Hatchery with a view to a possible future PPP. As with Turfloop, the Makhathini Hatchery was not in a state that would interest the private sector, therefore it was necessary for the province to initiate the process to renovate it before promoting a joint venture with the private sector. Furthermore, as the Provincial Aquaculture Strategy was still not formally adopted by the PDA it would have been premature for the PDA to engage with the private sector with regards to Makhathini.

The absence of clear developmental goals for the facility, and senior management changes within the PDA, constrained the development of a well articulated PPP. In 2009, the PDA issued a tender to revitalize the facility under a "joint venture" arrangement whereby a private sector service provider would renovate the facility and produce 500,000 tilapia fingerlings during the initial year of production. The tender was not awarded as it seems some of the specifications in the tender may have been unrealistic.

Figure 49. A pond at Makhathini Hatchery

Even though the process in KZN has taken years, and the awarding of the tender to physical revitalise Makhathini may only happen in 2011, the PDA still requires continued support to define clear objectives for the facility and make it attractive to investors. The major constraint to the process has been the constant flux of senior personnel in the KZN PDA.

Lydenburg Hatchery – Mpumalanga Province

In Mpumalanga Province, the objectives of the project were to assist the PDA to revitalise either Lydenburg or De Kuilen Hatchery. These adjacent facilities presented an ideal opportunity to implement a PPP similar to the Stellenbosch Jonkershoek Hatchery described above. The relevance of these two hatcheries was recognized and accepted by the Mpumalanga MEC for Agriculture when the project team met with her during the consultative phase of the project (2005). Both of these state facilities situated in Lydenburg were at one time successful trout hatcheries, with De Kuilen being the biggest trout ova productions centre in the country. Bearing in mind that Mpumalanga produces the largest provincial volume of trout, and that trout is the largest sector in freshwater aquaculture, the relevance of revitalizing these two facilities was clear.

A primary obstacle to revitalizing Lydenburg and De Kuilen was that both facilities were managed by Mpumalanga Parks Board (MPB) whose conservation mandate resulted in a policy of no live fish leaving the facilities. Therefore, the recommendation of the project team to the PDA was to make a submission to MPB to take over the running of the Lydenburg and De Kuilen hatcheries for aquaculture development purposes.

To initiate this process, in 2006 the project team in consultation with the Mpumalanga PDA manager developed a document that outlined the potential of Lydenburg Hatchery with an accompanying production strategy. This document was to be used by the PDA to assist them to make the decision to request MPB for permission to take over the running of Lydenburg Hatchery. There was however no subsequent progress on this issue on the part of the Mpumalanga PDA. The PDA aquaculture staff subsequently indicated to the project team that their priority was building a warm water (tilapia) hatchery in Nelspruit. However, by 2011 this task has not yet been accomplished.

There were also a number of direct requests to the PDA from a private company, which was open to negotiating a PPP, to take over De Kuilen Hatchery. However no response from the PDA was forthcoming. This company even sought the intervention of DAFF to facilitate matters with the PDA, but did not stimulate interest from the Mpumalanga PDA in participating in the proposal.

The lack of progress for the project team in assisting the PDA to revitalise either Lydenburg or De Kuilen needs to be seen in the following context. Firstly, there were significant organizational problems within the PDA, and as such aquaculture did not always receive the required support at the senior management level. During the six year life of the WRC project, three HODs and three MECs governed the department which hampered decision-making within the department. Secondly, the provincial aquaculture manager did not seem to support the concept of revitalizing either Lydenburg or De Kuilen Hatchery and instead prioritized the building of a warm water hatchery in Nelspruit.

Figure 50. There is considerable infrastructure at Lydenburg Trout Hatchery

This slow pace of development in Mpumalanga Province was brought to the attention of DAFF and in 2009, in a final attempt by the project team to determine what should be done next, two meetings were held in Nelspruit between the project team, DAFF and the PDA to discuss the way forward. It was agreed that the PDA would work more closely with the project team, however soon thereafter the aquaculture manager and a manager responsible for aquaculture left the service of the PDA. This caused even further delays in the process, and at the time of writing (15/3/2011) the warm water hatchery has not been built, nor are there any plans to revitalise either Lydenburg or De Kuilen hatchery.

The rationale for a PPP for both De Kuilen and Lydenburg remains valid however. If the bureaucratic obstacles can be overcome, the facilities could serve to promote small scale trout farming in an area where a thriving trout industry exists. Clearly some leadership from a political level will be required to address the organizational issues with the Mpumalanga PDA.

Gariep Hatchery – Free State Province

The scope of the project with regards to the Free State Province was to develop the Provincial Aquaculture Strategy; however due to the strong links forged with the PDA, the project team became involved in providing advice and technical support for the revitalization of Gariep Hatchery, which had potential to support a PPP. However, the role of the project team in what became a politically driven process was ultimately quite small, after the Chinese government sponsored the building of a new facility.

In 2005, DAFF and the Chinese Government entered discussions to revitalise Gariep Hatchery into a breeding and demonstration centre. The project team was involved in assisting DAFF with technical input into these discussions, and travelled to China to finalize the agreement between DAFF and the Chinese Ministry of Agriculture. In 2010 the Chinese Government completed the revitalisation of Gariep Hatchery which included an administration building, an accommodation building, a large indoor hatchery and grow out facility, a stores building and a boiler room.

Figure 51. South African and Chinese government officials engaged in a discussion at Gariep Hatchery

The project team also developed an Aquaculture Development Zone (ADZ) plan for the PDA, where the role of Gariep Hatchery was identified within the scope of developing aquaculture in the province. One of the recommendations made to the PDA was to breed trout at Gariep, ideally under a PPP off-take arrangement. There is significant potential to develop trout in the eastern Free State and Gariep could then play a pivotal role in supplying the seed.

At the end of 2010, the project team was requested by DAFF to assist in developing a business plan for Gariep Hatchery. It was understood that PPP principles defined through the WRC provincial aquaculture support project would be applied during this process.

Amalinda Fish Farm – Eastern Cape Province

A PPP project facilitated by the project team for the Amalinda provincial hatchery in East London made good progress. Formerly a Nature Conservation research and breeding facility, it was leased under a PPP arrangement to a black empowerment company, mainly comprising former MK veterans, to establish an aquaculture development node. Although leased to a commercial entity aiming to grow ornamental fish, considerable grant support has been provided to revitalize the facility and develop the necessary aquaculture skills. From this base, plans are being made to extend into other aquaculture projects which will benefit rural livelihoods in the province, for example, a tilapia production facility and the rebuilding of the Pirie trout hatchery.

In 2008, the project team included the Amalinda Fish Farm as part of its scope in the Eastern Cape and has played an active role in supporting implementation of the PPP. The Amalinda Hatchery has significant production potential, but due to the limited technical skills of the beneficiaries there had been little progress prior to the WRC project team support. The project team consulted with the beneficiaries of Amalinda Fish Farm, and proposed that a PPP would be a viable option for the development of the farm.

Figure 52. Staff from Amalinda Fish Farm exhibiting and selling their fish at a koi show in East London. Amalinda won a number of prizes at this show.

Due to the Amalinda beneficiaries' lack of aquaculture and business skills, the project team facilitated additional private sector linkages to strengthen the PPP. This has resulted in a marketing agreement with a commercial ornamental fish farmer from KZN. In order to bolster the on-farm technical capacity, part of the Eastern Cape Government grant to the farm was used to employ a recent graduate from the Department of Ichthyology and Fisheries Science of Rhodes University.

There are still many challenges that face Amalinda Fish Farm, mainly related to aquaculture and management skills of the participants. The internal structures within Amalinda Fish Farm still need to be strengthened, as they are still dependent on government grants. However, the facility does have the production potential and market access to be a viable production unit. The skills, networks and infrastructure developed could serve to see aquaculture expanded by emerging entrepreneurs in the province.

Discussion

Experience demonstrates that where no aquaculture sector exists, 1) that the barriers of entry are too high for prospective small-scale aquaculture farmers, and 2) that Government managed hatcheries tend to operate in a vacuum without addressing the entrepreneurial aspirations of farmers. Public Private Partnerships (PPP) are thus a key strategy for linking the state and emerging farmers to develop the aquaculture sector. The key success factors are that the development agenda is set by the province, while the operational and market agenda is devolved to the private sector partner. In order to reduce the initially high capital and transaction costs of the pioneer farmers, government provides support in the form of the hatchery facility and other recurrent costs.

The examples above illustrate that there is however no "one size fits all" approach in developing PPPs in the various provinces. What works in one province may not necessarily work in other provinces. While the basic principles of the model remain the same, there are various PPP permutations that will be unique for each province.

To date, only the Jonkershoek and Amalinda facilities have adopted a PPP arrangement to manage and operate the former state-run facilities. The other facilities, such as Turfloop, Lydenburg and Makhathini, have PPP potential, but the respective PDAs require assistance to facilitate the process within the context of implementing their PAS. The limitation in these instances has not been the nature of the hatchery facility, but rather the organizational constraints within the PDAs.

Aquaculture development needs to be seen as a long-term process. Projects need to be nested in a holistic national programme that provides continuous support to the PDAs. It needs to be recognized that working with government is a long-term process. Fortunately, during the course of the WRC provincial aquaculture support project, national government developed a more comprehensive approach to aquaculture sector support, culminating in a draft national aquaculture strategy with DAFF as the lead government department. This boost from a national level should greatly strengthen efforts in the provinces to build viable PPPs.

The experience of the WRC project highlights where interventions and leadership will be required to overcome the serious organizational problems which hamper the effectiveness of many PDAs.

Priorities for Action

1. PPPs based on market driven opportunities for aquaculture development need to be negotiated for the Turfloop, Makhathini, Lydenburg, De Kuilen and Gariep hatcheries.
2. A process needs to be facilitated in Mpumalanga to address the strategic importance of De Kuilen and Lydenburg hatcheries in respect of aquaculture development, and the access to the facilities by the PDA.

PROJECT EVALUATION AND LESSONS LEARNED

Introduction

The current WRC project was based on a Participatory Action Research (PAR) methodology, whereby the results and data gathered during the research process were fed back into a participative process with the PDA to facilitate the goal of developing and implementing provincial aquaculture programmes for improved rural livelihoods and food security. The project was a novel experience for the project team which was exposed to the daily realities of the life of civil servants at various levels. While the project objectives were directly related to aquaculture development, the research revealed original insights into the organisation of government which hold lessons for aquaculture development strategy.

From the outset, the team learned that the project could only proceed at a pace determined by the organisational processes of the PDAs, and the leadership ability and manpower skills within the organisation. In provinces where aquaculture was supported from a political level, and stable and sound senior management existed within the PDAs, progress was good. On the other hand the PDAs in certain provinces were rendered effectively dysfunctional by constant leadership changes, investigations into financial irregularities, and organisational arrangements that were not conducive to providing support for a newly-identified agri-sector such as aquaculture.

Figure 53. Frozen fish from a community project in Limpopo Province ready for sale

In all provinces, the project team maintained excellent collegial relations with PDA colleagues building up relationships of trust and non-judgement. This facilitated deeper insights into the personal experience of PDA officials and the often frustrating circumstances under which they carried out their duties. While individual officials without exception displayed goodwill and did their best to develop the provincial aquaculture programmes, the rigid provincial bureaucracy and procurement processes were all too often disempowering.

The WRC participatory provincial aquaculture project was in retrospect a brave and pioneering initiative in that it sought to build capacity in the provinces to support aquaculture development – at a time when there was no national aquaculture policy or strategy. As such, it was up to the provincial Agriculture MECs and HODs to determine the level of priority and support accorded to aquaculture. Some provinces provided resources in support of the aquaculture PASs, others adopted PASs without addressing organisational implications and resources, and some placed aquaculture on the backburner due to internal organisational problems. The project team had little leverage at a provincial political level to change the organisational arrangements, and was thus obliged to work with the circumstances that prevailed in the respective PDAs.

Figure 54. A rural fish farmer overseeing her pond

The WRC project sought to use the existing PDA hatcheries combined with the provincial extension service to create capacity to promote aquaculture development and provide support services to farmers. This approach yielded limited results as the low aquaculture skills base of the PDA staff, combined with organisational problems within the PDAs, resulted in project efforts focussing largely on training and mentoring of PDA staff. Under these conditions it was simply not realistic to expect the roll-out of strategies to attract new farmers and investment into aquaculture in most of the provinces.

In situations where the services of a properly qualified aquaculturist were secured, for example at Elsenburg College in the Western Cape and Amalinda Hatchery in the Eastern Cape, tangible and rapid progress was made. This emphasises the primacy of recruiting appropriately qualified and skilled PDA aquaculture staff. While the project team did its best to train and mentor existing PDA staff in aquaculture, it realised that many were simply not sufficiently educated to take on strategic development processes which required independent initiative and problem solving skills.

Given the pervasive slow and often inefficient bureaucratic processes within most of the provincial PDAs, and the routine nature of most activities, it is questionable whether the PDAs are the best vehicle for establishing a new economic sector such as aquaculture. It is interesting to note that government interventions have worked best to establish aquaculture projects, where it has been through economic development mandated departments (e.g. the Western Cape Department of Economic Development and Tourism, Northern Cape Department of Economic Affairs, Department of Science and Technology), and parastatals (the East Cape Development Corporation, Industrial Development Corporation) that have partnered with the private sector in specific aquaculture projects.

Thus the “extension” development model seems to be the most appropriate to support existing farmers, whereas the initiation of new projects, such as market driven PPPs seems to be best promoted by the economic development agencies of state or universities.

Project Evaluation

The evaluation of the project with regards to its various objectives is presented below.

Table 6.1 The Revitalisation of Hatcheries

Hatchery	**Evaluation**
Turfloop	The PDA invested significant funds in the upgrading of the physical infrastructure of the facility. However though the physical upgrading has been completed, the fish breeding skills of the staff need improvement.
Makhathini	There has been no physical revitalisation of this hatchery though a tender to do so has been advertised.
Lydenburg and De Kuilen	This facility is still under the management of the Mpumalanga Parks Board and the warm water system that the PDA is proposing be built, is still at the planning stage.
Gariep	The PDA (in collaboration with DAFF and the Chinese government) have invested millions of Rands into this facility and undertaken a major upgrade. This was completed in December 2010 and it is expected to start producing fish soon. A market linked PPP is required.
Amalinda	Amalinda Fish Farm is producing and selling fish on a regular basis through a PPP arrangement with support from Rhodes University.

Table 6.2 Training and Mentoring

Province	Evaluation
Limpopo	A number of training courses were held, however there were many delays in organising these courses as it was not always possible for the PDA to secure the relevant permissions and logistics to attend the courses. There was a disconnect between the training of the extension officers and them being mandated to support the farmers.
KwaZulu-Natal	No extension officers were trained as the PDA was not in a position to nominate participants. The Makhathini Hatchery manager did attend a training course, however the PDA needs to operationalise an aquaculture strategy before systematic training can commence.
Mpumalanga	Extension officers were trained, however the PDA was not in a position to make effective use of the training opportunities due to internal organisational problems.
Eastern Cape	There was regular training and mentoring of Amalinda fish farm staff.

Table 6.3 Developing Public Private Partnerships (PPPs)

Hatchery	Evaluation
Turfloop	A PPP model has been proposed which has not yet been implemented by the PDA.
Makhathini	This facility does not have a PPP. The objectives of the facility need better definition before a PPP can be proposed.
Lydenburg and De Kuilen	These hatcheries have attracted strong private sector interest to form PPPs, but both the MPB and PDA have not responded to proposals to revitalise the facilities.
Gariep	This revitalised facility will be managed by the PDA and DAFF. The possibility of a PPP linked to trout production has been suggested.
Amalinda	This facility operates as a PPP between Eastern Cape Government, an MK Veterans Trust and a marketing partner.

Impact on Aquaculture Production

The initial rationale for this project was that through the establishment of provincial aquaculture programmes, rural farmers would be provided with the necessary support to increase production and make an increasing contribution to rural livelihoods; this in a context where 40% of rural households are food insecure. With the exception of the increase in fish production at Amalinda fish farm, which occurred independently from the PDA, there was no increase in the production by rural farmers in the other provinces where the project team was active. This fact reflects the continuing lack of cooperation between most PDAs and farmers, as well as the difficulty in establishing any new programme within provincial organisational structures. The project's experience demonstrates that while it is relatively easy to write about aquaculture strategy, it is extremely difficult to integrate it into government departmental structures in terms of operational functions, manpower skills and resources.

Figure 55. A successful ornamental fish farmer in KZN

Organisational Impediments

An overriding concern was the organisational impediments within the PDAs, particularly the length of time it took for PDAs to make strategic decisions or change organisational arrangements. An example of the above is that extension officers in Limpopo Province, who were trained in aquaculture in 2006, had by the completion of the WRC project in 2011 still not been directed to serve aquaculture farmers as they did not fall under the authority of the PDA aquaculture manager.

A second concern is the lack of an economically driven vision for aquaculture with holistically planned interventions, for example, the establishment of aquaculture development zones to provide farmers with the necessary services and infrastructure to realise a particular opportunity. This approach speaks to the need for a dedicated provincial unit or special purpose vehicle to drive aquaculture. PDA managers and extension officers, while useful in serving the needs of established farmers, are not properly skilled to facilitate an increase in aquaculture production through attracting new investment and the establishment of new farmers.

Towards a Unified National Approach to Aquaculture Development

One of the outcomes of this project was the significant government support for aquaculture development, both at national and provincial level. It is thus important not to interpret the organisational problems observed within the PDAs as a lack of support for the concept of aquaculture development. Towards the end of the project, significant organisational support was beginning to emerge from national government through the Departments of Agriculture Forestry and Fisheries, Science and Technology, and Trade and Industry who collaborated in the formulation of a National Aquaculture Strategy. This was submitted to and approved by Cabinet. The combining of both marine and freshwater aquaculture within a single ministry (DAFF) was also a progressive move, facilitating a unified national approach to aquaculture.

These developments at national level bode well for aquaculture development in the provinces. The national strategy outlines a comprehensive approach to support for aquaculture development including aquaculture development zones, veterinary services, marketing support, research and training. Thus, while the present project developed provincial aquaculture support programmes largely independently of national government, the foundation laid by the project in the provinces will facilitate an informed national government plan to roll-out services in support of aquaculture development. Extension support from the PDAs will need to form a vital element of such services.

Figure 56. An ornamental fish farmer in KZN sorting her fish

Lessons Learnt

This project was to a large extent a pioneer in the process of strategic and technical support to the provincial agriculture departments to use aquaculture as a means to contribute to achieving food security and improved rural livelihoods. The project, involving management support and funding from both the WRC and DAFF, and implemented by Rhodes University across five provinces, was a first for South Africa. There were new experiences, not only for the various PDAs but also the project team. Lessons learnt included:

Figure 57. A technician at Gariep Hatchery. There is a need to improve the skills of the present staff at provincial hatcheries.

- ***High turnover of PDA staff.*** The high turnover of PDA staff was a severe limiting factor. New staff, or staff acting in a position, are often reluctant to make decisions. Therefore it would be advisable that a working group made up of senior members of the PDA be set up in each province. In this way if a member of the committee leaves his post, decisions can still be made by the remaining members of the committee.
- ***Accountability.*** The inordinate delays in implementing agreed actions, unspent budgets, political in-fighting, and generally poor performance by many PDA officials, is indicative of a low level of personal and organisational accountability. While unwieldy organisational structures and weak management within the PDAs were partly to blame, a culture of non-accountability to stakeholders outside the PDAs was a disturbing feature which severely constrained the effectiveness of most PDAs in carrying out their missions.

Towards an Integrated Provincial Model

The project revealed the limitations of working with provincial PDAs to establish a new agricultural sub-sector. It can be argued that a more coordinated cooperative governance approach should be adopted within the provinces, informed by a holistic economic vision and plan for implementation. In reality, the PDAs only addressed specific aspects of support to establish a new sector and did not put in place concrete steps to grow the sector, particularly in respect of investment and market orientated interventions.

Taking a step back, although the WRC project interactions with the Western Cape PDA were limited to meetings with the HOD, this province in many ways provides a model for how provincial governments should provide support in an integrated way for aquaculture development. The project team found the Western Cape provincial government departments to be practising real cooperative governance in order to roll out the provincial economic development strategies. Interestingly, aquaculture policy and strategy was led by the Department of Finance and Economic Affairs, with the Department of Agriculture playing a support role. In the other provinces, the project team's sole contact was with the PDAs, which seemed to be operating within a narrower mandate. Linking provincial economic strategy and aquaculture development is something that should receive greater attention in future when strategic planning processes are undertaken. Aquaculture as a new agri-sector requires dedicated resources, new projects and an integrated development strategy. It was in retrospect perhaps unrealistic to expect the PDAs to be the sole drivers of aquaculture development within existing resources and organisational structures. New money, new high-level manpower qualified in aquaculture, and new structures are realistically required to effectively establish aquaculture. Once again, the example of the Western Cape is illustrative where aquaculture was strategically supported through the creation of a "special purpose vehicle" in the form of the Aquaculture Institute of South Africa. This has subsequently been replaced by the Western Cape Aquaculture Development Institute (WCADI) which forms a bridge between government and the aquaculture sector. Importantly, these structures while serving Government's developmental goals are driven by the needs of aquaculture farmers – both big and small.

The Need for Freshwater Aquaculture Policy

There is a need for a national policy with regards to freshwater aquaculture. In 2008 there was discussion between DAFF and the then Marine and Coastal Management (MCM) of the Department of Environment and Tourism to develop a joint aquaculture policy, but this did not materialise. MCM published their policy, but there is still no freshwater aquaculture policy from DAFF. To a large extent, the PDAs take guidance from DAFF, and in the absence of a national policy the provinces are uncertain as to the extent to which they should support aquaculture, and what the nature of this support should be. The De Kuilen and Lydenburg hatcheries are perhaps a good illustration of this point. If a national strategy and policy identified Lydenburg as an ideal "aquaculture development zone", an imperative would be created to utilise these facilities for the benefit of aquaculture development. If required, a political decision to transfer the facilities from the Mpumalanga Parks Board to the PDA could be taken.

Figure 58. An emerging farmer with fish from a dam in the Eastern Cape

Similarly, while the Eastern Cape Province PDA chose not to support aquaculture strategy, the Eastern Cape Development Agency, a parastatal facilitating private sector development and investment, successfully facilitated the Amalinda Hatchery PPP.

The overall lesson appears to be that while PDAs are necessary to provide essential support services for aquaculture development, economic strategy and facilitation of private sector partnerships in aquaculture (including emerging farmer support to penetrate aquaculture value chains) is perhaps best achieved through other institutions with a purpose designed mandate. The various defunct provincial hatcheries and slow progress made by many PDAs to take the lead in implementing the PASs bear testimony to the mandate mismatch.

An Exit Strategy: **Strengthen the Relationship between DAFF and the PDAs**

While the five-year WRC project has ended, it is important to build on the capacity foundation that has been created and integrate the lessons learned into future planning.

The capacitation of DAFF with high level aquaculture skills, combined with its mandate to facilitate the implementation of a Cabinet-endorsed national aquaculture strategy, creates the necessary vehicle to continue supporting the PDAs in the development of aquaculture strategy and capacity. With an emerging national aquaculture strategy, and by implication policy, the provinces will receive more strategic guidance which will hopefully result in aquaculture development programmes and projects.

PDA staff require ongoing technical support and advice. The good working relationships created by the project team with both DAFF and PDA personnel have resulted in some individuals continuing to play an advisory role at both levels. While there is a strong relationship between DAFF and the PDAs, the interface was at middle management level during the WRC project lifespan. The experience of the project team was that the provincial aquaculture managers had limited influence over the decision-making of senior managers, and as such issues that needed urgent attention sometimes remained unresolved for lengthy periods of time. For aquaculture to develop (at the province level), there needs to be regular engagement between DAFF and the PDA at the Director to Director level, with recommended bi-annual meetings between the respective HODs.

Conclusions

In the evaluation of this project it is important to realise the context of aquaculture development in South Africa. Aquaculture is a relatively new agricultural sub-sector and to a large extent “unproven”, compared to the cattle or poultry industries, which employ thousands of people and contribute significantly to the economy of the country. Most PDAs seem to be under significant pressure, with overstretched human resource capacity, to deliver, and as such their ability to capacitate services for new sectors such as aquaculture is limited. Clearly new money to resource the implementation of the national aquaculture strategy is required if meaningful capacity is to be put in place.

Critical Evaluation of the Achievement of the WRC Project Objectives

Since most of the objectives of the WRC project were either directly or indirectly linked to a response, or some form of support, from the PDAs, the success of this project was dependent on the capacity and organisational efficiency of the PDAs. While PDAs determined the extent to which project objectives could be achieved, it was only by engaging the PDAs through the PAR research process that the gaps / weaknesses in the “system” were revealed. The extent to which the objectives of the project were achieved is critically evaluated below.

The general objective of the project as stated in the terms of reference was:
“To improve rural food security and livelihood options by supporting Provincial aquaculture programmes to revitalize state fish hatcheries and build technical capacity of staff”. The achievement of this overall goal was given substance through activities which addressed specific objectives.

1. Strategic Plans for Provincial Agriculture Departments

The first specific objective was to develop strategic plans for Provincial Departments of Agriculture (PDAs) for aquaculture development. The project team was highly effective in making initial contacts with the provincial departments of agriculture and conducting a consultation process which resulted in the development of strategic plans for aquaculture in

Limpopo, Mpumalanga, KwaZulu-Natal, and Free State Provinces. Draft strategic plans were prepared for the Northern Cape and North West Provinces. The dialogue with the Eastern Cape Province resulted in the PDA choosing not to develop an aquaculture strategic plan until an aquaculture pilot project demonstrated the potential of the sub-sector. In the Western Cape, initial consultations revealed that the Province had launched its own strategic planning process which was well resourced and no further assistance was required from the WRC project.

During the consultation phase the project team was effective in:

a. Determining the current and required resources for aquaculture development within each PDA.
b. Identifying projects with timeframes that the PDA could initiate.
c. Identifying key partners and the nature of the partnership that the PDA could engage in, to develop aquaculture within the provinces.
d. Developing an action plan for implementation.

In general, most provinces readily embraced the concept of aquaculture development and participated actively in strategic planning processes. This interaction made the PDAs aware of the potential of aquaculture, and created buy-in to build departmental aquaculture capacity. The process also laid a foundation for the good working relationships the project team enjoyed for the rest of the project's lifespan. While it was relatively easy to work with the respective PDAs to develop aquaculture strategic plans, the integration of these plans into the PDA management arrangements and budget processes was very uneven. As a result, the plans were at best partially resourced and implemented, and in some provinces they remained documents of good intent. This result in itself is a useful outcome in that it indicates where the challenges are in developing capacity within the PDAs. Going forward, the challenge will be for DAFF to work from a national level with the provinces to coordinate and maintain their aquaculture strategic plans as active management guidelines with the national aquaculture strategy. A process will be required to ensure that the provincial aquaculture strategic plans are appropriately resourced within specified timeframes. Most importantly, some form of performance monitoring and feedback will be required as all too often the project team observed that the PDAs would persist in implementing interventions that did not yield the planned outcomes. A good example of this was the retaining of staff at dysfunctional hatcheries that had not produced fish for many years. In conclusion, the development of aquaculture strategic plans for the target provinces was successful, but organisational arrangements and human resource issues within the PDAs proved to be a major constraint to their implementation.

2. Revitalisation of State Hatcheries

The second specific objective was the revitalisation of existing state hatcheries to supply fingerlings and technical support to rural farmers. For the target hatcheries (Turfloop in Limpopo, Lydenburg in Mpumalanga, Makhathini in KZN, Amalinda in Eastern Cape and Gariep in Free State), the project team:

a. Assessed the status of provincial hatcheries, and the degree to which they could support the implementation of the strategic plans. Constraints were identified and recommendations and plans of action drafted for the required upgrading and maintenance.
b. Assessed the technical skills of the staff at the hatcheries, and developed training courses to bridge the skills gaps.
c. Assessed the need for additional technical staff.
d. Developed guidelines for the operation of the hatcheries.
e. Developed a framework for an exit plan.

The extent of the actual project team support for the hatchery revitalisation process was determined by the provincial partners. While the initial assessments of the hatcheries' status and recommendations for revitalisation was a relatively straightforward process, the implementation of hatchery revitalisation only proceeded substantially at Turfloop Hatchery in Limpopo and Amalinda Hatchery in the Eastern Cape Province. In the Free State Province, the project team was only requested to provide strategic and technical advice as the partnership with China implemented the actual hatchery revitalisation. In Mpumalanga and KwaZulu-Natal, organisational and human resource problems within the PDAs halted any meaningful progress towards hatchery revitalisation. Although Jonkershoek hatchery in the Western Cape was part of the original terms of reference, no technical assistance was required at this still functional facility.

The substantial involvement of the project team in the implementation of the revitalisation of the Turfloop and Amalinda hatcheries yielded some rewarding outcomes. Both Limpopo and Eastern Cape Province committed significant funding for the renovation and running costs of these facilities and the project team facilitated training and technical assistance to the hatchery staff. As a result both facilities bred fish for the first time in many years, and staff morale was vastly improved. At both facilities the low aquaculture and management skills of the staff remained a constraint. The training and mentoring process was clearly an ongoing one requiring high level aquaculture skills on-site. The project team recommended that at least one qualified aquaculturist should be employed per province. This was implemented at Amalinda where a Rhodes University graduate was employed as a production manager and made a huge impact on the revitalisation process. In conclusion, once provinces commit resources to hatchery revitalisation, on-site human resource skills become the key factor determining the success of the process.

3. Provision of farmer support

While the project was successful in achieving its objectives of developing resources for farmer support, the lack of meaningful linkages between the PDAs and rural farmers constrained the implementation of actual on-farm technical assistance.

The most important output from the project was an aquaculture manual, designed for South African conditions, to be used as a guide and reference by both farmers and PDA hatchery and extension personnel. The guide has been published by the WRC (WRC Report TT 463/P/10) and is readily available. The manual incorporated earlier project outputs including guidelines for the rural farmers to produce quality fish cost effectively and to penetrate and obtain a market share. A small farm aquaculture financial plan model was included as a spreadsheet on a CD with the manual.

Farm visits were incorporated into the formal training courses of the extension officers to encourage linkage of PDA staff with the farmers.

It was intended to develop a database of rural small scale and commercial farmers. While a database of commercial farmers was compiled, there were very few rural aquaculture farmers in the target provinces. The only province with a significant number of active small-scale aquaculture farmers was the Western Cape where integrated development projects have promoted the establishment of over 30 small farmer projects through the *Hands On Cooperative* (trout) and the *Masiza Mussel* project. The lesson is that it is not possible for resource-poor small farmers to master aquaculture production techniques and penetrate value chains without technical assistance. Therefore, the establishment of aquaculture support hubs at the revitalised hatcheries will be essential to promote small farmer aquaculture projects where opportunities for some form of production exist.

4. Developing a link between state hatcheries and rural farmers for sustainable development

While the fourth objective was to link state hatcheries to rural farmers, the poor state of the hatcheries and low skills level of PDA staff dictated that project efforts were focussed on supporting the capacitation and efficient functioning of the state hatcheries. It would have been irresponsible to raise farmer expectations if the PDAs were not able to service their needs.

As a market orientated approach is required to linking rural farmers into value chains, a key step was to define the aquaculture opportunities and develop Community Public Private Partnership (CPPP) models as a basis for operating the refurbished hatcheries. The PDA management in most provinces (Limpopo, Mpumalanga, KZN and Free State) accepted in principle that some form of private sector partnership was required to link rural farmers into value chains; however it was only in the Eastern Cape at the Amalinda Hatchery where a CPPP was actually implemented during the project lifespan. In Limpopo, the strategy was to first operationalise the hatchery before engaging with possible private sector partners. Although a clear CPPP opportunity and private sector interest existed to promote small farmer trout production in Mpumalanga, organisational inertia in the PDA resulted in this being a lost opportunity. In KZN, human resource turnover resulted in ongoing delays and the lack of a clear plan for the Makhathini facility. In Free State Province, the Gariep hatchery was refurbished during the project's existence, but no clear market opportunities or private sector partners were identified. If we take a step back, no PDA has been able to successfully develop a CPPP arrangement. The only two successful CPPP models implemented are for Jonkershoek Hatchery and Amalinda Hatchery, and in these cases the hatchery operations were contracted out and the CPPP arrangements developed by Stellenbosch and Rhodes Universities respectively. The lesson appears to be that the PDAs do not possess meaningful capacity to promote market orientated development projects, and that the government departments and parastatals mandated with economic development seem better equipped to promote CPPP projects through partners such as universities and NGOs.

The WRC project was effective in providing training and mentorship for PDA aquaculture extension officers who form the interface with farmers. Unfortunately, despite a well organised and resourced training programme, it was only the Limpopo PDA that made full use of the opportunity. The training resources and capacity created will however have a life beyond the WRC project's lifespan, which will provide the other provinces with a facility to train their extension officers as they begin to implement their aquaculture strategies.

The final objective was a framework for an exit plan. Through the life of the WRC project, the project team engaged with DAFF on an ongoing basis to link the national department to the provinces. This resulted in the capacitation of DAFF to support aquaculture development in the provinces on an ongoing basis. Such support will be informed by the Cabinet-approved national aquaculture strategy developed in 2009/10. The national aquaculture strategy is comprehensive in that it seeks to create a holistic and effective support for service delivery including research and development, veterinary services, aquaculture development zones and capacitation of provincial PDAs. Furthermore, the knowledge and experience of the university based members of the WRC project will still be available to serve the provinces' aquaculture development needs. Significant training resources and capacity were developed which will be maintained provided a demand exists. Thus, the WRC project has laid the foundation for a lasting legacy of institutionalised support for aquaculture development in South Africa.

In conclusion, the project team is confident that the process to develop aquaculture capacity within the PDAs, although slow, is making progress. Most importantly, the PDAs have taken ownership of the process. Even in provinces where there was little progress, the PDAs have recognised their limitations, and are seeking measures to address them. This foundation in the provinces bodes well for the roll out of the proposed national aquaculture strategy.

CONCLUSIONS AND RECOMMENDATIONS

The lesson from previous experience in South Africa is that establishing a new small farming sector such as aquaculture requires the Government to play a significant role in creating an enabling environment for the sector to become established. In some countries, farmers receive direct subsidies for production, in others, the government funds research and development, veterinary services or other services needed to support the industry, especially in its early years of development. The latter approach is preferable as it promotes sustainability. This however requires clear goals and holistic and effective support for service delivery.

Figure 59. The demand for fish in South Africa has increased, creating the space for aquaculture to grow

The challenge in South Africa is thus how to provide government support for sector development that addresses the needs of aquaculture enterprise development, both large and small. Aquaculture cannot be entirely private sector driven as the transaction costs of pioneer farmers are too high and there are barriers they cannot overcome, such as access to suitably zoned land and water. On the other hand, the experience of South Africa's provincial hatcheries shows that Government, without private sector participation, is a poor driver of sector development. Thus the institutional challenge is to create a structure(s) whereby Government sets the development policy agenda and offers various forms of support, and the private sector drives the actual production-related project implementation through vehicles such as PPPs, or special purpose vehicles (e.g. WCADI) which are market driven and independent of the bureaucratic constraints of the PDAs.

Figure 60. Sharing a freshly harvested fish from an Eastern Cape Dam

However, there is still a clear need for Government, particularly the PDAs, to play a role in supporting this industry by means of various services. Emerging farmers cannot afford veterinary services and this cost needs to be covered by the state. Other services such as access to quality fingerlings, technical support and bulk infrastructure services (such as electricity and water) require inputs from the state.

Therefore, the main objectives of this project were to assist the provincial governments to develop capacity to provide the services that rural emerging fish farmers require, particularly access to value chains through CPPP arrangements linked to hatcheries, advice from trained extension officers and access to quality fingerlings.

Realising the Potential of South African Aquaculture – Within the Scope of Rural Development

Environmental and market conditions suggest that aquaculture can play a role with regards to rural development and contribute towards rural food security in South Africa. There is growing demand for fish in rural areas, freshwater fish is being increasingly consumed in the urban areas by the West African expatriate community, and the health benefits thereof are also being recognised. As commercial aquaculture is often a viable form of development in rural areas where suitable environmental conditions exist, the services required contribute to the creation of jobs, thereby ensuring food security.

Figure 61. Guidelines for the use and management of exotic species for aquaculture need to be developed

The question though is how South Africa realises the potential of aquaculture. Keys areas in the objectives of this project that Government needs to address include:

Table 7.1 How South Africa realises the potential of aquaculture

Key intervention required by Government	**WRC project response**
National policy and strategy	The project team contributed to policy and strategy workshops, and made submissions to national officials on, for example, the concept of aquaculture development zones (ADZs), which have subsequently become part of national aquaculture development strategy. The team created awareness among national planners of issues in the provinces and suggested strategies for the appropriate response.
Provincial planning	The project team facilitated development of Provincial Aquaculture Strategies in six provinces.
Farmer support	Provincial extension officers and hatchery staff were trained and mentored. An aquaculture manual was developed.
Access to quality fingerlings	The process of revitalising provincial hatcheries was facilitated.
Developing skills base	Training of hatchery staff and the mentoring of PDA officials
Commercialisation	Developed Public Private Partnership (PPP) model for the provincial hatcheries
Developing training resources	Developing the aquaculture training manual

Perhaps the most important success of this project has been that it put aquaculture on the provincial agenda and that the PDAs are now committed to supporting this sector. Furthermore this project has also to a large extent galvanised national support for this sector and assisted DAFF to ensure its commitment and support for their provinces.

A major cross-cutting concern that emerged was the pervasive organisational dysfunction in many provincial PDAs which constrains service delivery. This was perhaps more acutely felt in terms of the project's aquaculture development initiatives which required new plans, staffing and resources.

Recommendations

Based on the experiences of the project team, the following recommendations are made:

1. **Support to the PDAs.** Ongoing organisational and technical support to the PDAs will be required, to build on the foundations laid by this project. It is recommended that DAFF take on this role as part of its roll-out of the national aquaculture strategy.
2. **Special Purpose Vehicles.** While the PDAs are vital in providing support services, their mandate is too wide, and the organisational structures too unwieldy, to respond timeously to aquaculture development opportunities. It is therefore recommended that state supported special purpose vehicles such as PPPs or provincial aquaculture project promotion agencies be established to drive public and private sector investment into projects such as Aquaculture Development Zones (ADZs).
3. **Building Skills and Training.** The training of provincial PDA staff in aquaculture needs to continue at all levels. The extension officers were still not technically strong enough to operate independently and required further training. At least one qualified and experienced (5-10 years) aquaculture specialist should be employed in each province. Organisationally, aquaculture extension personnel should be freed from general duties and directed by PDA aquaculture management. Clear career paths in aquaculture for officials at various levels, with goals for advancement, should be defined within the PDAs.
4. **Support for the Revitalisation of the Provincial Hatcheries.** This is a critical area in which the provinces require strategic support linked to the national aquaculture strategy and market orientated CPPP projects. It is recommended that suitable NGO, University or economic development agencies facilitate this process in partnership with the PDAs to create viable, market driven service hubs which address the needs of rural farmers.

5. **Formalising the Interaction between DAFF and the PDAs.** The interaction between DAFF and the PDAs needs to be formalised into a programme approach to plan the roll out of the national aquaculture strategy. A standing committee and/ or working groups which facilitate regular meetings between the national and provincial departments is required, to ensure that projects stay on track through feedback, accountability and adaptive management.
6. **Fish Health Capacity.** The project revealed clearly that aquaculture, as a new animal production sub-sector, requires state veterinary services. It is recommended that the Rhodes University initiative to train state vets in aquaculture in partnership with the OIE, and to establish a fish disease research diagnostic centre, be supported.
7. **Guidelines for the Use of Exotic Species.** The species which farmers may use needs to be clearly defined and managed. At present rural farmers are farming with either catfish or the Mozambique tilapia. These are generally low value species and do not always have the best growth rates. The use of the Nile tilapia (classified as an alien invasive under the NEMBA regulations) within areas of its distribution needs to be agreed and managed between DAFF and the Department of Environmental Affairs. With regards to the Nile tilapia, if its use is approved, under strict and managed situations, it could have significant improvements on the production of farmers.
8. **DAFF and the PDAs Investing in Tertiary Bursaries.** Aquaculture is a scarce skill in South Africa, and as such both DAFF and the PDA need to invest in tertiary bursaries. With tertiary trained aquaculture specialists, the sector will grow.

The Next Step

The experience of this WRC project generated unique insights into the situation of the PDAs in respect of their organisational capacity to promote aquaculture development. In terms of service delivery, the project's outcomes are relevant not only in respect of aquaculture, but for agriculture as a whole.

It is therefore recommended that DAFF convene a process with the PDAs to debate the final report recommendations, agree on organisational structures and processes, and commit to the support of actions going forward.

REFERENCE LIST

BATCHELOR A. 1988 *The Department of Development Aid and Fisheries Development*. Invited paper presented at the 20th regular meeting of the SARCCUS Standing Committee for Animal Production. Gaborone, Botswana. 9p

BACKEBERG GR, AND SANEWE, AJ (2010) Towards productive water use and household food security in South Africa. Proceedings of the 6th Asian Regional Conference of ICID, Yogyakarta, Indonesia, 10-16 October 2010.

BRITZ PJ (1994) Small fish: Big Business. *SA Commercial Marine, June-August 1994 Pp 8-9.*

BRITZ PJ AND DE KOCK S (1994), The South African Ornamental Fish Trade. *Proceedings of the Aquaculture Association of Southern Africa 3.* 53p.

BRITZ PJ, BOTES L, AND LEE B. (2009) AISA 2009 Aquaculture Benchmarking Survey of Primary Production and Markets. A report for the Aquaculture Institute of South Africa and SwissContact, produced by Enviro-Fish Africa (Pty.) Ltd. 130p.

BRUMMETT R, LAZARD J, MOEHL, J, (2008) African aquaculture: realizing the potential. *Food Policy* 33: 371-385.

DELGADO CL, WADA N, ROSEGRANT MW, MEIJER S. & AHMED M (2003) Outlook for Fish to 2020: Meeting Global Demand. A 2020 Vision for Food, Agriculture, and the Environment Initiative International Food Policy Research Institute & WorldFish Center. 28p.

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM 2007. Policy for the development of a sustainable marine aquaculture sector in South Africa. Government Gazette No 30263, General Notice 1109.

DAFF (2010a). South African Agrcultural Production Strategy Concept Document. Department of Agriculture, Forestry and Fisheries, Republic of South Africa.

DAFF (2010b). Agriculture, Forestry and Fisheries: Integrated Growth and Development Plan 2011-2031. Department of Agriculture, Forestry and Fisheries, Republic of South Africa.

FAO (2010). The State of World Fisheries and Aquaculture Report 2010. Fisheries and

Aquaculture Department. Food and Agriculture Organisation of the United Nations, Rome, 2010. 180p.

HART, T (2009) Exploring definitions of food insecurity and vulnerability: time to refocus assessments. *Agrekon* 48(4): 362-383.

HECHT T (2000). Considerations on African aquaculture. World Aquaculture Vol 31(1): 12 – 19.

HECHT T (2006). FAO Regional review on aquaculture development. 4. Sub-Saharan Africa. Fisheries Circular. No. 1017/5. Rome, FAO. 97 p.

HECHT T AND BRITZ PJ (1990). Aquaculture in South Africa: Production, Progress and Constraints. Aquaculture Association of South Africa. 54pp

LEWIN, K (1958). *Resolving Social Conflicts*. Harper, New York.

MC NIFF, J (2002). *Action Research for Professional Development: Concise Advice for New Action Researchers.* Third edition Published by Jean McNiff. Accessed at http://www.jeanmcniff.com/ar-booklet.asp (Accessed 17/08/2011).

MOEHL J (1999) Aquaculture in Africa. Perspectives from the regional office for Africa. FAO Aquaculture Newsletter (22): 21 – 22.

O'BRIEN R (2001) An Overview of the Methodological Approach of Action Research. In: Roberto Richardson (Ed.), *Teoria e Prática da Pesquisa Ação [Theory and Practice of Action Research].* João Pessoa, Brazil: Universidade Federal da Paraíba. (English version) Available: http://www.web.ca/~robrien/papers/arfinal.html (Accessed 17/08/2011)

ROUHANI QA AND BRITZ PJ (2004) Contribution of Aquaculture to Rural Livelihoods in South Africa: A Baseline Study. Water Research Commission Report No: TT235/04.105pp.

RURAL FISHERIES PROGRAMME (2010) A Manual for Rural Freshwater Aquaculture. WRC Report TT 463/P/10 (2010). 93p.

SKELTON PH (2000) Flagships and fragments — perspectives on the conservation of freshwater fishes in southern Africa. *African Journal of Aquatic Science* 25: 37-42.

WESTERN CAPE PROVINCIAL DEVELOPMENT COUNCIL, (2009). The Western Cape Aquaculture Strategy: The First Five Year Plan (2009-2014). Provincial Government of the Western Cape. 38p.

APPENDIX 1:
Limpopo Province Aquaculture Strategic Plan

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF AGRICULTURE

PARTICIPATORY DEVELOPMENT OF PROVINCIAL AQUACULTURE PROGRAMMES FOR IMPROVED RURAL FOOD SECURITY AND LIVELIHOOD ALTERNATIVES

STRATEGIC PLAN FOR AQUACULTURE DEVELOPMENT IN THE LIMPOPO PROVINCE

2007 / 2008

CO-WORKERS:

TABLE OF CONTENTS

ACRONYMS

AGRIBEE	Agricultural Black Economic Empowerment
ARDC	Agriculture and Rural Development Corporation
ASWG	Aquaculture Sector Working Group
CASP	Comprehensive Agricultural Support Programme
CPPP	Community Public Private Partnership
DBSA	Development Bank of Southern Africa
DEAET	Department of Economic Affairs, Environment and Tourism.
DoA	Department of Agriculture
DWAF	Department of Water Affairs and Forestry
FAO	Food and Agricultural Organisation of United Nations
GIFT	Genetically Improved Farming Tilapia
GITO	Government Information Technology Office
ICT	Information and Communication Technologies
IFSNP	Integrated Food Security and Nutrition Programme
LAWG	Limpopo Aquaculture Working Group
LDA	Limpopo Department of Agriculture
MAFISA	Micro Agricultural Finance Institution of South Africa
NAWG	Northern Aquaculture Working Group
RESIS	Revitalization of Smallholder Irrigation Schemes
SAWG	Southern Aquaculture Working Group
WRC	Water Research Commission

PREAMBLE

This working draft presents the first version of the Strategic Plan for Aquaculture Development in the Limpopo Province. The development of this strategic plan is being driven by the Department of Agriculture in the Limpopo Province as assisted by Rhodes University who are implementing an initiative by the Water Research Commission and the National Department of Agriculture to achieve participatory development of provincial aquaculture programmes for improved rural food security and livelihood alternatives.

Primary inputs towards the formulation of a Strategic Plan for Aquaculture Development in the Limpopo Province were gathered from farmers, service providers, policy makers and other stakeholders at a workshop in Polokwane from 12-13 January 2006. In this workshop it was identified and agreed upon that aquaculture producers require recognition and that service providers (Department of Agriculture and others) are ready and willing to provide the necessary support to the aquaculture sector.

This Strategic Plan is an essential tool for planning and resource allocation. The aim of the Plan is to strategically mobilise, distribute and utilize those resources equitably and efficiently to achieve the four Government objectives namely:

- Growing the economy
- Job creation
- Economic empowerment and
- Poverty Alleviation

The Strategic Plan will provide essential information that will enable effective benchmarking that will result in the monitoring and evaluation of the Department's performance in achieving the planned objectives and outcomes.

The new philosophy of the strategic support to agricultural sector by the Department is participatory and demand led/driven. This philosophy is supported by four key services delivery approaches, namely:

- Municipally focused
- Commodity based
- Value chain analysis and
- Project based

The strategic planning is a cyclical process informed by the above philosophy, followed by programme implementation, monitoring and performance evaluation.

FOREWORD

The Aquaculture Strategic Plan outlines strategies and quantifiable objectives for 2007/08 targeted at realizing the key strategic programmes of the Departmental Strategic Plan.

In line with the theme" Towards a sustainable aquaculture sector that contribute to economic growth, entrepreneurship and food security in a participatory manner", the department has adopted a turnkey approach to the various programmes such as the Revitalisation of Smallholder Irrigation, Sustainable Resource Management, Farmer Support and Development, Veterinary Services, Technical Research Services, Agricultural Economic Development Planning and Agribusiness and Structured Agricultural Training to align aquaculture strategic objectives with these programmes in order to achieve departmental objectives.

The Department hereby calls on all farmers to realize that" Lehumo le tswa tshemong" and "Alle boere moet `n plan maak vir die jaar".

We continue to value partnership with stakeholders and look forward to maximum co-operation as we implement plans in the 2007/08 financial year.

Mr K.C.M. MANNYA

GENERAL MANAGER: FARMER SUPPORT AND DEVELOPMENT

1 OVERVIEW OF AQUACULTURE

Aquaculture is defined as the propagation, improvement, trade or rearing of aquatic organisms (plant and animal) in controlled or selected aquatic environments (fresh, sea or brackish waters) for any commercial, subsistence, recreational or other public or private purpose.

1.1 AQUACULTURE GLOBALLY

On a global scale, aquaculture is growing more rapidly than any other food-producing sector. World aquaculture production totaled 45.7 million tons in 2000 and was valued at US$56.5 billion (FAO, 2002). In 1997, farmed fish, crustaceans and molluscs contributed 3.9% of total world fish supplies, and this figure had increased to 27.3% by 2000 (FAO, 2002).

Globally market forces, the diversification of the economic base, the sustainable utilization of resources and a quest for food security drive the development of aquaculture. In this regard, aquaculture has developed into a diverse industry, with over 64 countries participating in the production of more than 300 species of fish, shellfish, crustaceans and aquatic plants.

On average, global aquaculture has experienced a compounded growth rate of 9.2% per year since 1970 (FAO, 2002). This is considerably greater than that of capture fisheries and the terrestrial agriculture sector, which experienced an average compounded growth of only 1.4% and 2.8%, respectively for the same period (FAO, 2002). This trend is set to continue as world fishery production has effectively leveled off, the demand for fish is increasing due to population growth, and the shortfall in supply will have to come from aquaculture if per capita consumption is to be maintained.

The per capita supply of food fish from aquaculture globally (excluding China) has increased four-fold in the past three decades, from 0.6 kg in 1970 to 2.3 kg in 2000 (FAO, 2002). This suggests that the contribution made by aquaculture to global protein security has continued to increase per capita, in spite of global human population growth.

1.2 AQUACULTURE IN AFRICA

In spite of its vast natural and human resources, the participation of Africa in the global aquaculture sector is lacking and aquatic species indigenous to Africa have developed into aquaculture species of international importance. Developing countries from Southeast Asia and South America have secured significant participation in these sectors, but African countries have been unable to secure any meaningful economic benefits thus far.

Africa's contribution to global aquaculture production is extremely low relative to the contributions made by other continents. Africa contributed only 0.4% of global production in 1995, compared to 87.7% from Asia and Oceania, 6.7% from Europe, 1.6% from South America, and 0.7% from the former USSR during the same year (Hecht and De Moor, 1997). However, in line with global trends, the aquaculture industry in Africa has also experienced considerable growth over the past few decades. For example, African aquaculture production, including finfish, shellfish, molluscs and aquatic plants, increased from 11,800 to 82,014 tons between 1985 and 1995; that is an eight-fold increase in only 10 years (FAO, 1997; Hecht and De Moor, 1997). The production of fish and shellfish from the African continent totaled approximately 79,500 metric tons in 1998; 57% of this was produced by three countries bordering the Mediterranean, with Egypt producing most (i.e. 43,000 tons) (Hecht, 2001). Thirty-tree sub-Saharan countries produced the remaining 34,000 metric tons, of which 93% can be attributed to 6 countries, viz. Nigeria (16700 tons), South Africa (4500 tons), Zambia (4100 tons), Zimbabwe (3800 tons), Namibia (1300 metric tons) and Kenya (1100 tons) (Hecht, 2001). The other 27 countries for which statistics are available produced a total of only 2500 tons (Hecht, 2001). Most of the product in the six major producing countries originated from relatively large and capital intensive private operations or joint ventures between the private and the public sector, whereas by contrast, the farms in the 27 minor producer countries are small-scale or subsistence operations (Hecht, 2001). Hecht (2001) concluded from this summary that national aquaculture development programs for rural areas in most sub Saharan countries have not been sustainable, despite substantial international donor funding and despite a highly suitable environment.

1.3 AQUACULTURE IN SOUTH AFRICA

The further growth of aquaculture in Southern Africa depends on the successful integration, use and development of natural resources (water, land, climate, energy and biodiversity), human resources (labor, skills and technology) and economic resources (capital, infrastructure and market access).

The modern aquaculture industry in South Africa was effectively initiated in the 1980s with the establishment of trout, oyster, mussel, ornamental fish and catfish farming (Hecht and Britz, 1990). In 1988, the sectors produced a total of 3094 tons, valued at R45.8 million (Hecht and Britz, 1990). Ten years later, in 1998, this figure had increased to 5208 tons (FAO, 1998). This translates to an average increase per annum of 6.8% between 1988 and 1998. During this period a number of state led projects were initiated to stimulate the growth of rural aquaculture, largely with the objective of enhancing food security and income in rural households.

The potential for fresh water aquaculture in South Africa is constrained by the natural environment. The first major constraint is a scarcity of water and the second the extreme seasonal temperature fluctuations over much of the interior (Britz and Hecht, 1990). A third constraint is the choice of species available for production. With the exception of trout and ornamental fish, which have a high market value, most indigenous and introduced fresh water fish species have historically yielded prices too low to justify the costs of intensive aquaculture production.

The development of aquaculture in South Africa can be divided into several epochs or categories. Firstly, the colonial era during which exotic species were introduced and produced, mainly for angling purposes. The apartheid era saw the development of private sector commercial aquaculture (particularly trout and oysters) and government led “homeland” aquaculture initiatives to address food security issues. Thirdly, the post-1994 democratic era, which has witnessed the development of a large-scale commercial aquaculture (in particular abalone) and a trend towards more entrepreneurial rural aquaculture.

During the late 1980s and early 1990s the provincial nature conservation departments changed their policy and stopped promoting the production and stocking of exotic fishes into indigenous waters. This constituted an effective withdrawal of Government support for the freshwater aquaculture industry, and resulted in the closure, mothballing or privatization of many Government aquaculture facilities. The period of political transition in the early 1990s resulted in a lack of policy or funding to support aquaculture research and development, and without government support, the aquaculture industry in South Africa effectively developed at a much slower rate than in other parts of the world.

Despite the lack of a national aquaculture policy since 1994, there have been attempts to develop small-scale commercial aquaculture in rural contexts on the back of larger commercial enterprises. These initiatives have been motivated by Governments policy of promoting black economic empowerment and supporting emerging farmers.

Various factors are currently stimulating the development of aquaculture in Southern Africa, including:

- The availability of resources in certain areas: water, land, labor, energy, etc.;
- The non-consumptive and integrated manner in which aquaculture uses water;
- The diminishing natural fisheries resources;
- Good national and international market interest;

- Good agricultural and other essential infrastructure;
- The need for diversification and optimization of resources;
- The good access to national and international technologies;
- International partnerships and collaboration around the sector; and
- The socio-economic needs towards redress and food security;

Factors that are currently inhibiting the development of the aquaculture sector in Southern Africa include:

- Fragmented policies and protocols from various Government Departments;
- The lack of marketing structures to access the market interest;
- The limited access to finance and developmental capital; and
- The limited human resources in capacity, skills and aquaculture expertise.

Aquaculture development is a vehicle for participation, skills enhancement, empowerment, food security and socio-economic upliftment.

2 VISION IN THE STRATEGIC PLAN

The overall vision of the Limpopo Department of Agriculture in terms of aquaculture is:
Towards a sustainable aquaculture sector that contributes to economic growth, entrepreneurship and food security in a participative manner.

The vision of the Limpopo Department of Agriculture in terms of aquaculture is reflected in this greater vision.

3 MISSION IN THE STRATEGIC PLAN

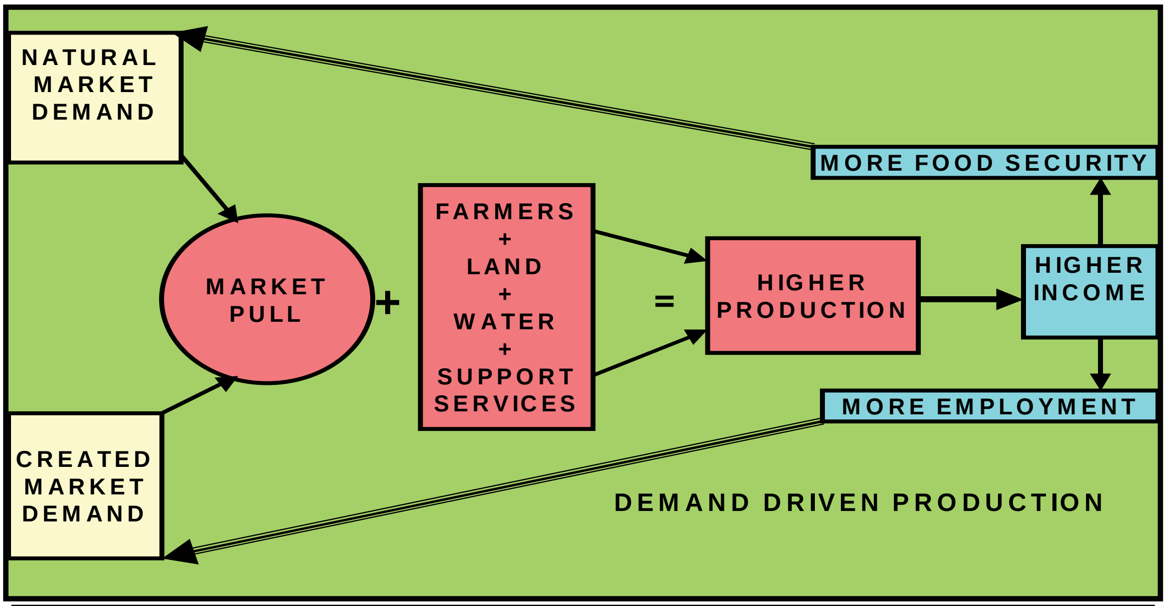
The overall mission of the Limpopo Department of Agriculture is:
To contribute to the economic growth of the Province through a sustainable agricultural sector and food security programmes for a better life for all.

The mission of the Limpopo Department of Agriculture in terms of aquaculture development is in the provision of support to the sector in such a manner that it becomes a vibrant contributor the livelihood creation and commercial enterprise.

4 OBJECTIVES (GOALS) IN THE STRATEGIC PLAN

The core objectives of the Limpopo Department of Agriculture in terms of aquaculture is to achieve the following outcomes (goals):

- The **revitalisation of exciting State aquaculture facilities** so that these may serve as centres for fingerling supply, training and technical services. These facilities include Turfloop Hatchery, Tompi Seleka and the Dzindi Fish Project.
- The isolation of **key support needs** towards the building of a stronger aquaculture sector and to achieve greater entrepreneurship.
- **Capacity building** at the State owned facilities and within the Department of Agriculture so as to serve the needs of the growing aquaculture sector and to enable the creation of **training programmes** at all levels from management (within the Department) to extension officers and farmers.
- The **increase in aquaculture production** by eliminating production obstacles and assisting with the provision of effective and practically implementable aquaculture information, fingerlings and dedicated extension services.
- The identification of **key policy and legislative issues** impacting on the performance of the aquaculture sector and to address these by cooperative relationships with other Government Departments.
- The **penetration of new and existing markets** for aquaculture products by market development and familiarisation with aquaculture products.
- The creation of Community Public Private Partnerships (CPPP) by encouragement of all stakeholders and illustrating the mutual benefits of such business relationships.
- The development of practical and accessible aquaculture **information sources and training manuals**.
- The development of the necessary **hatchery operation protocols**.



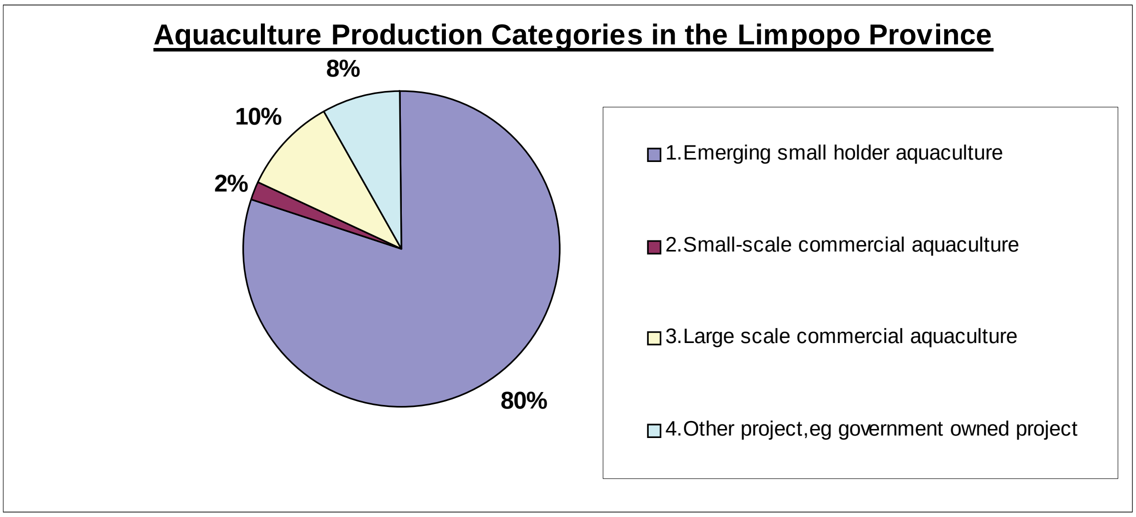
The Demand Driven Production Model employed by the Department of Agriculture

In order to achieve the goals above the Department will make use, among others, of the Demand Driven Production model

5 AQUACULTURE SITUATION ANALYSIS

The Limpopo Province is divided into six districts in which the occurrence of aquaculture development varies from significant to less prominent and almost absent. Aquaculture activities are most prominent in the Vhembe district in which a combination of established and new emerging aquaculture farmers are found together with a commercial aquaculture sector. Aquaculture activities are also found in the Bohlabela, Capricorn and Mopani districts, but lacking in the Sekhukhune and Waterberg districts, mainly due to a scarcity of water resources.

Aquaculture in the Limpopo province can be divided into the following categories:



In terms of production the emerging smallholder farmers are focussed mainly on supply for household consumption, while the small-scale commercial farmers produce for local retail and hawkers / traders. The large-scale commercial producers are focussed on supply to national chain stores and food services and the export market.

The primary production species in the Limpopo province are:

- Mozambique Tilapia (*Oreochromis mossambicus*)
- Nile Tilapia (*Oreochromis niloticus*)
- African Sharptooth Catfish (*Clarius gariepinus*)
- Common Carp (*Cyprinus carpio*)
- Nile Crocodile (*Crocodylus niloticus*)
- Other ornamental fish species

Apart from various commercial aquaculture ventures such as Aurelian Aquaculture, Metzi-Metzi Aquaculture, Lowveld Catfish Farm (Hoedspruit) and Bosveld Catfish Farm (Warmbad), the WRC Report K5/1446/4: "*Contribution of Aquaculture to Rural Livelihoods in South Africa: A Baseline Study* (Britz and Rouhani, 2004) identified the following rural aquaculture projects in the Limpopo Province:

A. DZINDI FISH PROJECT

The Dzindi Fish Project was built in the 1960s by the Transvaal Provincial Administration (Nature

INFRASTRUCTURE
8 ponds (50 x 20 m)
Officers and storerooms
Water supply channel

Conservation Division). Its primary purpose was to breed tilapia and carp for stocking local dams. In 1994, it was handed over to the provincial Nature Conservation Department. With the change in policy by Nature Conservation regarding the production of exotic species the facility fell under the Directorate of Economic Affairs. Subsequently, the facility has stopped producing fish. However, negotiations are currently underway that will see the facility fall within the domain of the Department of Agriculture.

B. TOMPI SELEKA COLLEGE OF AGRICULTURE

INFRASTRUCTURE
7 earthen
Small storage building

The facility began operating in the early 1960s, with the purpose of training students in fisheries and aquaculture. Aquaculture no longer forms part of the curriculum, the primary reasons being that graduates could not find placement after Nature Conservation reduced its activity in local aquaculture.

C. TURFLOOP BREEDING STATION

INFRASTRUCTURE
20 earthen ponds
Hatchery
Storage and office space

This facility was motivated for by the University of the North and built for the former Lebowa government by the Department of Agriculture in 1982. The intention was to breed catfish and carp to stock local dams. The University of the North had close ties with this facility. However, production has declined over the years, and in 2003 no fish were produced.

D. BATLHABINE ITIRELENG FISH PROJECT

INFRASTRUCTURE
6 earthen ponds (75 X 50m)
Processing area
Storerooms and offices
Water supply channel

The project was initiated in 1992. However, soon after the ponds were stocked with fingerlings, the project was brought to a halt. This was due to conflict between two local chiefs over land that was not related to the project in any way. The Lebowa government initially financed the project. The motivation for the project was food security for the farmers and to generate revenue through the sale of fish to the local community. Neither a feasibility study nor a business plan was conducted prior to commencement of the project. The conflict between the local chiefs has recently been resolved, and a new group has approached the Department of Agriculture for funding and assistance to restart the project. Members of the new group have received training in aquaculture at Tompi Seleka Agriculture College, and the Department of Agriculture is willing to provide ongoing technical support. A request for financial assistance to restart the project has been made to government. However, a marketing study has still not been undertaken to determine if there is sufficient local demand for the fish.

E. DAKARI HOLIDAY RESORT AND FISH VENTURE

In 2001, members of the local community approached The Department of Agriculture for assistance in starting this aquaculture project. They subsequently received funding from various donors, which totalled approximately R150000. Their first greenhouse tunnel was built in 2002, and was designed to produce ornamental fish for the aquarium fish trade. The group produced a business plan before the project began, and the University of Venda provided technical assistance. The project is still operational and appears to be successful.

INFRASTRUCTURE
One greenhouse tunnel
60 indoor concrete tanks
40 outdoor concrete tanks
Borehole water
Eskom power

F. IPOPENG FISHERY PROJECT

This Ipopeng Fishery Project was first initiated in 1997, and included 28 farmers. The initial phase proved to be unsuccessful (it was not possible to determine the reasons). The project was restarted in 2003 and currently supports a group of 13 farmers. The second phase was funded by the Department of Agriculture, with the primary motivation being food security for the farmers and the generation of revenue from fish sales to the local community.

INFRASTRUCTURE
6 earthen ponds (90 x 54 m)
1 greenhouse tunnel
Fish processing facility
Storerooms and office
(Access to more ponds)

G. ITERELENG FISHERY PROJECT

The Itereleng Fishery Project was initiated by the Department of Agriculture in 2001, and was funded by the Department of Health and Welfare. The motivation behind the project was to generate revenue by selling fish locally. The ponds were only stocked once before the project collapsed due to limited training and skills.

INFRASTRUCTURE
9 earthen ponds (90 x 40 m)
Fish processing facility
Storerooms and office

H. MR. DAVID PHOLOSI COMMERCIAL FARM

Mr. David Pholosi is an emerging commercial vegetable farmer who has an interest in aquaculture. After stocking his water reservoir with tilapia, he independently built an earthen pond to start producing fish, at an approximate cost of R16000.

INFRASTRUCTURE
1 reservoir (15 m in diameter)
1 earthen pond (30 x 10m)

I. BOREADI-A-NGOAKETSI

Mr. Fannie Masha, a farmer and businessman, built a cement pond in his back yard in 1992. His intention was to grow and sell fish locally. Mr. Masha undertook this project independently and still has fish in his tank.

INFRASTRUCTURE 1 cement tank (7 x 7m)

J. UNCLE JAMES' PROJECT

Uncle James, a local businessman and farmer, built a water reservoir at a personal cost of R30000. The reservoir was built in 2002 for the purpose of holding borehole water intended for citrus orchard irrigation and to enable him to produce fish to be sold at his butchery.

INFRASTRUCTURE 1 cement reservoir (70 x 10m)

K. MR. DEENA GOVENDER CROCODILE FARM

Mr. Deena Govender operated a private tilapia and carp production unit between 1994 and 1997. He subsequently changed the operation and is currently producing crocodiles. The crocodile operation is also a private concern.

INFRASTRUCTURE 24 earthen ponds (40 X 60m)

L. CLARE VILLAGE PROJECT

The Clare Village Project was initiated by the Gazankulu government for the local tribal authority in 1976. It was primarily built for food security and to generate revenue through the sale of fish to the local community. The project collapsed in 1994, and details of the project are scant since the people involved are no longer available.

INFRASTRUCTURE 6 earthen ponds (40 X 70m) Office and storeroom

6 ALIGNMENT WITH THE DEPARTMENTAL STRATEGIC OBJECTIVES

6.1 GENERAL ALIGNMENT

In order to achieve success in the mobilisation of aquaculture in the Limpopo Province it is important that the Strategic Plan for Aquaculture be aligned with the strategic objectives of the greater Department of Agriculture. In this regard the annual performance plan for the Department lists the following strategic outcomes:

- Revitalisation of smallholder irrigation schemes (RESIS)
- Preparation of integrated agricultural plans
- Preparation of an appropriate mechanisation support policy
- Management of agricultural related risks
- Establishment of appropriate marketing and statistics
- Improved food security and income generation
- Farmer support services are accessible to clients
- Funding support is mobilised and co-ordinated
- Animal health managed
- Land accessibility
- Tenure security for farmers on Communal land

Although all of the strategic outcomes (goals) for agriculture above are relevant to aquaculture, the highlighted points have been identified as core focal areas in terms of integrating aquaculture development with the strategic approach of the Department of Agriculture.

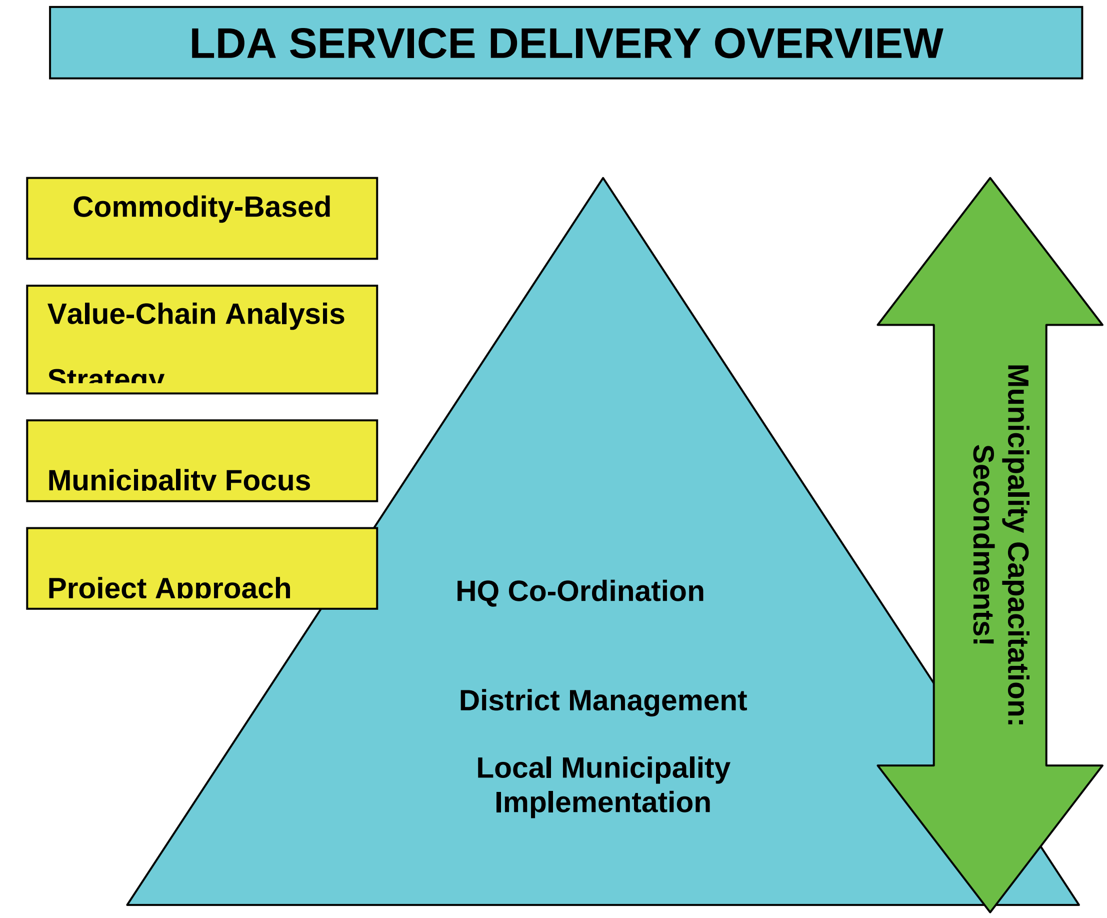
Aquaculture development in the Limpopo Province can also be aligned with the Provincial Growth and Development Strategy in that a number of the core objectives of this strategy have direct relevance to the aquaculture sector. These include:

- The improvement of the quality of life.
- Growing the province’s economy
- Fostering sustainability
- Creating employment
- Stimulating competitiveness

Furthermore aquaculture development would be relevant to two of the identified development clusters identified in terms of the Provincial Growth and Development Strategy; these being:

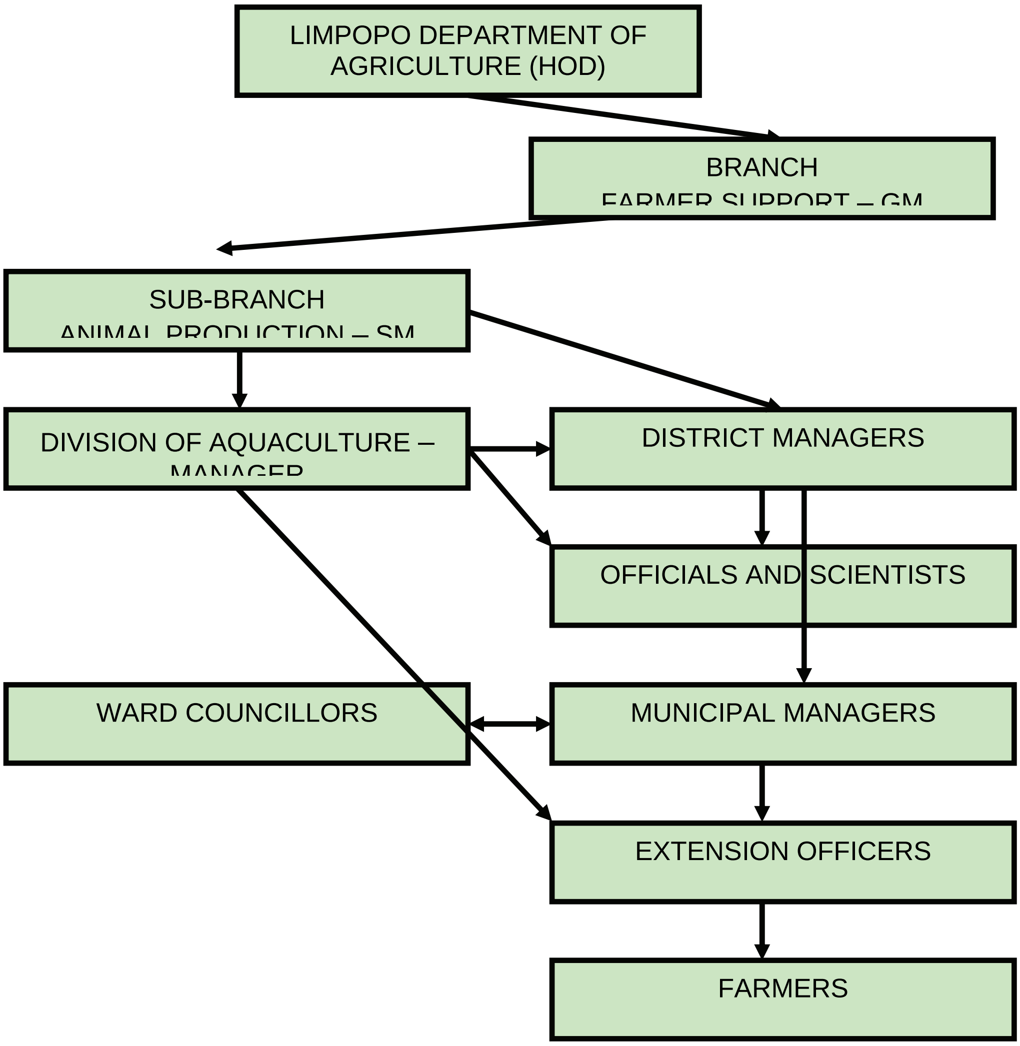
- The red – and white meat cluster
- The tourism cluster

The general service delivery approach of the Department of Agriculture is relevant to the service delivery that is required for the building out of aquaculture in the province. This model proposes coordination by the Department of Agriculture and wide reaching implementation at municipal level by the provision of capacity. The underlying focal areas within this municipality approach are a commodity-based approach, a value chain analysis strategy and a project approach:



The service delivery approach of the Department of Agriculture

From the perspective of aquaculture development the following diagram illustrates the flow of



information, contact and interaction from the Department of Agriculture via the municipal structures to the farmer.

6.2 SPECIFIC DEPARTMENTAL ALIGNMENT

For aquaculture to succeed in the Limpopo province specific alignment with the overall strategic plan for the Department of Agriculture is important. The following section highlights the programmes in the Strategic Plan for the Department of Agriculture (2005 / 2006) and indicates how these programmes will be adopted into aquaculture development. The relevant aspects / programmes from the Department's Strategic Plan have been displayed (*blocked*) and the alignment in terms of aquaculture development discussed shortly after each programme[1].

[1] Note that although the objectives and mechanisms have been taken from the Department's Strategic Plan (2005/2006), only the items that have relevance to aquaculture have been retained. By no means does this imply that the objectives and mechanisms that have been left out are of less importance but rather that these objectives are more prominent to the overall strategic planning in the Department.

Channels of communication between the Department of Agriculture to the fish farmer via the municipal structures.

6.2.1 SUSTAINABLE RESOURCE MANAGEMENT

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 2: Sustainable Resource Management

Objectives as relevant to aquaculture:
An integrated revitalization of Irrigation Schemes program has been initiated in the Department. In this programme, which is farmers led and departmentally facilitated, services such as bulk water supply, training, institutional arrangements and more are rendered to the existing irrigation schemes and their areas of influence within the neighbouring communities.

In terms of aquaculture development the Department of Agriculture must integrate an awareness of aquaculture development and aquaculture opportunities into the revitalisation of smallholder irrigation schemes (RESIS) programme. This can be done by:

Improving exposure to aquaculture by including the concept into all RESIS initiatives through illustration of aquaculture's potential in multi-facetted and diversified water resource utilisation and its socio-economic advantages.

Wherever irrigation water is developed the potential for aquaculture must be evaluated.

Whenever irritation training takes place an aquaculture component must be included.

All Water Users Association and or similar institutional structures must be informed of the potential of aquaculture.

Engineers in the Department must be sensitise to the identification of aquaculture opportunities and to the design issues that could improve the secondary use of irrigation schemes for aquaculture.

Water resource conservation must be coupled to the diversification of resource use (i.e. get more from your resource in a responsible manner) though aquaculture.

6.2.2 FARMER SUPPORT AND DEVELOPMENT

6.2.2.1 FARMER SETTLEMENT

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 3: Farmer Support and Development:

Sub-programme 3.1: Farmer Settlement:

Objectives as relevant to aquaculture:

- *To contribute to the redistribution of 30% of commercial agricultural land in an effort to bring equity in land ownership.*
- *Support land restitution and redistribution through pre and post farmer settlement support.*
- *Commercialisation of small-scale farmers.*
- *Facilitate and support and develop sustainable commercial enterprises.*
- *Contribute to food security for the marginalized poor in the Province.*
- *Develop a funding strategy for projects through CASP.*

In terms of aquaculture development the Department of Agriculture must take the following steps towards integrating aquaculture development with farmer settlement:

Aquaculture must be promoted in an equitable manner.

Where aquaculture can be integrated into restitution and redistribution, this should be done with pre and post farmer settlement support towards achieving a project management approach.

Settlement should not only be land focussed, but should be resource focussed in a manner which will provide opportunities for historical disadvantage communities to gain access to water resources for the development of aquaculture enterprises.

Small scale subsistence aquaculture farmers should be commercialised.

Aquaculture should be promoted and implemented as a mechanism to achieve greater food security for the marginalized poor.

The Department must actively seek funding for new aquaculture initiatives through CASP.

6.2.2.2 DISTRICT SERVICES AND EXTENSION ADVISORY SERVICES

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 3: Farmer Support and Development:

Sub-programme3.2: District Services

Sub-programme3.3: Extension Advisory Services

An ideal extension advisory service must have a quest for new knowledge, a desire to perform, an ability to interpret and adapt and the capacity to make relevant and timely decisions. The value of such a service is in the better utilization of assets, the adoption of improved technologies and in the generation of a cohort of successful farmers and commodity entrepreneurs.

Priorities of the District Services *include the establishment of District Development Plans, agricultural support systems, succession plans, to facilitate implementation of MAFISA, CASP, LAND CARE, RESIS and related services and to implement AgriBEE.*

Priorities of the Extension Advisory Services *include the establishment of appropriate development systems, provision of participatory extension services (especially to emerging farmers), technology transfer and to promote innovation towards solving development issues.*

Together the services above also seek to develop and strengthen institutional capacity of farmer organizations, to develop models for management of farmer organizations and to develop a farmer register.

In terms of aquaculture development the Department of Agriculture must adopt all of the directives provided above for district services and extension advisory services. Furthermore it is important that:

The Department integrate an understanding and exposure to aquaculture with the greater strategic plan (i.e. it is important that CASP be used in service delivery to aquaculture farmers).

The Department should established one aquaculture specific extension officer in each of the 4 active districts in which aquaculture is practised – Vhembe, Bohlabela, Capricorn and Mopani.

6.2.2.3 FOOD SECURITY AND RURAL DEVELOPMENT

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 3: Farmer Support and Development:

Sub-programme 3.4: Food Security and Rural Development

Policy, Priorities and Strategic Objectives as relevant aquaculture:
Pro-poor mitigation measures and strategies will be developed and provided within the framework of the Integrated Food Security and Nutrition Program (IFSNP). Access support measures to food production and income generation will be provided at the entry level of the program.

Strategic Objectives as relevant to aquaculture:
- *To develop strategies, technologies and capacity that will enable households and the vulnerable to increase their access to food.*
- *To create adequate awareness and education on food insecurity issues.*
- *To develop appropriate entry-level support measures and strategies.*
- *To develop institutional mechanisms at municipal level.*

In terms of aquaculture development the Department of Agriculture must take the following steps towards integrating aquaculture development with food security and rural development:
Aquaculture must be promoted and supported by district services, extension services and at municipal level to rural communities as a means of attaining food and nutritional security.
The Department must developed appropriate entry level (“starter-pack”) aquaculture support programmes which can provide technologically proven equipment and technologies to rural communities to enable them to commence with some aquaculture activities.

6.2.2.4 CROP PRODUCTION AND ANIMAL PRODUCTION

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 3: Farmer Support and Development:

Sub-programme 3.5: Crop Production

Sub-programme 3.6: Animal Production

Policy, Priorities and Strategic Objectives as relevant to aquaculture:
The strategic objectives include the provision of information, technology options and advice to farmers and community groups on:

- *Natural resource use and management – (soil, water and vegetation).*
- *Animal breeding and production.*
- *Post harvest management and processing.*

To achieve this the Department must:

- *Develop strategies for livestock (fish) improvement.*
- *Development of guidelines and production manuals for specific commodities.*
- *Support to farmer training.*
- *Strengthening of commodity associations on technical production and marketing issues.*

In terms of aquaculture development the Department of Agriculture must take the following steps towards integrating aquaculture development with animal production objectives and strategies:

Specific aquaculture information packages and advice must be attained or generated and used by extension officers who are dedicated to aquaculture.

Use of the available international guidelines on resource (water) use, aquaculture husbandry and post harvest procedures. This will also be attained by adopting the training manuals developed by the Rhodes University / WRC in their aquaculture development programme.

The Department must provide support to the Tompi Seleka Training Centre so that it may revitalize its aquaculture training programme. Likewise the revitalization of Turfloop Hatchery must be done in a manner which allows it to become a training hub assisted by the Limpopo University.

The Department must support the creation and effective functions of an aquaculture producers association in the Limpopo province.

6.2.3 VETERINARY SERVICES

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 4: Veterinary Services

The policy, priorities and objectives of the veterinary programme include the control and surveillance of diseases and the expansion of the scope of service delivery.

In terms of aquaculture development the Department of Agriculture must take the following steps towards integrating aquaculture development with the required veterinary services:

The Department must identify at least one veterinary specialist in the Province that could be trained further in basic fish diseased diagnostics and treatment.

Extension offices that are dedicated to aquaculture should be trained in basic fish health management.

As veterinary services for aquaculture is limited in South Africa the Department must establish strong linkages to recognised institutions that deal with fish aquaculture diseases in other parts of the country.

The Department must cooperate with the University of Limpopo towards the incorporation if an aquaculture disease research facet into the Aquaculture Research Unit.

6.2.4 TECHNICAL RESEARCH SERVICES

6.2.4.1 RESEARCH

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 5: Technical Research Services

Sub-programme 5.1: Research

Policy, Priorities and Strategic Objectives as relevant to aquaculture:

- *To facilitate the quality and quantity of food production.*
- *The introduction of high value crops with local and export market potential.*
- *Provision and adoption of appropriate technology responding to the broad socio-economic and environmental challenges.*
- *Strengthening research and training capacity of agricultural beneficiaries.*

In terms of aquaculture development the Department of Agriculture must take the following steps towards integrating aquaculture development with the required research needs:

The Department must provide support to the Tompi Seleka Training Centre so that it may play a role in aquaculture research.

The Department must provide specific research support to the Aquaculture Research Unit of the University of Limpopo and the University of Venda.

Turfloop Hatchery should be positioned not only as a center for fingerling supplies and training, but also as a research facility.

The department must initiate an exercise for the identification of specific aquaculture research needs in the province.

6.2.4.2 INFORMATION AND COMMUNICATIONS TECHNOLOGY SERVICES

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 5: Technical Research Services

Sub-programme 5.2: Information and Communications Technology Services

The Government Information Technology Office (GITO) seeks to provide an effective management function with regards to Information and Communication Technologies (ICT). The core function is to assist and give information and communication technology guidelines to the Department, to streamline ICT towards international standards, to manage IT service provision by SITA and to ensure that the network architecture adequate for connectivity to the district offices, agricultural colleges, research stations and head office.

In terms of aquaculture development the Department of Agriculture must adopt all of the directives provided above for the improvement of communications and technology services. Of core importance will be to ensure that the applicable aquaculture information is directed towards the entry points of these information networks and to ensure that the aquaculture related information remains valid and up to date. The responsibility for this function must lie with central Division of Aquaculture within the Department.

6.2.5 AGRICULTURAL ECONOMIC DEVELOPMENT PLANNING AND AGRIBUSINESS DEVELOPMENT

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 6: Agricultural Economic Development Planning and Agribusiness Development.

Policy, Priorities and Strategic Objectives as relevant to aquaculture:

- *To render value chain analysis in farm economics and marketing.*
- *To facilitate and provide marketing support to agribusiness.*
- *To provide agricultural risk management.*
- *To facilitate the transformation of projects into sustainable agribusiness.*
- *To provide MAFISA credit support products to farmers.*

In terms of aquaculture development the Department of Agriculture must take the following steps towards integrating aquaculture development with the Department's strategic objectives for economic development and planning and agribusiness development:

- The Division of Aquaculture in the Department must develop standard business plan formats for aquaculture, which includes a basic financial feasibility component. Aquaculture training at all levels (within the Department, for district and extension advisory services, for municipalities, communities and farmers) must incorporate the relevant level of financial understanding towards the development of economically sound aquaculture practises.
- An aquaculture market survey is required which must provide accurate information of the size of the informal and formal markets, constraints to these markets and suggested procedures for market development.
- The existing government supported projects must be revitalised to the extent that they become functional agribusinesses.
- The two existing Centres of Development should incorporate dedicated training and exposure programmes for aquaculture.
- The Aquaculture Division of the Department must make contact with the relevant administrators of the MAFISA credit support products so that a system of using MAFISA for aquaculture can be developed.
- The Aquaculture Division of the Department must compile and maintain accurate statistical information on the Limpopo aquaculture sector.

6.2.6 STRUCTURED AGRICULTURAL TRAINING

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 7: Structured Agricultural Training

Policy, Priorities and Strategic Objectives as relevant to aquaculture:
- *Strengthening research and training capacity of agricultural centres.*
- *To provide training programmes in appropriate fields to prospective and practising farmers, extension officials and advisors.*

In terms of aquaculture development the Department of Agriculture must be guided by all of the above directives towards integrating aquaculture development with the Department's strategic objectives for structured agricultural training. Furthermore the Department must:

- Revitalised the aquaculture training programmes that were presented at Tompi Seleka in the past and gear Turfloop Hatchery up (with assistance from the University of Limpopo's Aquaculture Research Unit) to become an aquaculture training centre.
- As stated previously the existing Development Centres must be equipped to incorporate exposure programmes to aquaculture.
- Adopt the training manuals developed by the Rhodes University / WRC in their aquaculture development programme.

6.2.7 OUTSOURCING PLANS AND RESTRUCTURING OF STATE OWNED ASSETS – AGRICULTURE RURAL DEVELOPMENT CORPORATION (ARDC)

Relevant aspects captured from the Department of Agriculture Strategic Plan

Programme 8: Outsourcing and Restructuring of State Owned Assets – Agriculture Rural Development Corporation (ARDC)

Policy, Priorities and Strategic Objectives as relevant to aquaculture:
- *Restructure projects in line with the Community Public Private Partnership (CPPP) principles in order to ensure the efficient utilization of available resources and further economic growth.*
- *Establish an effective institutional framework to attract investment.*
- *To establish business models.*
- *To engage financial institution such as Land bank and DBSA.*

In terms of aquaculture development the Department of Agriculture must be guided by all of the above directives towards integrating aquaculture development with the Department's strategic position on the activities of the ARDC. Furthermore the Department must strongly encourage the formation of CPPP aquaculture projects by using a cross cutting approach to link commercial aquaculture ventures with public assets to the collective advantage and ownership within communities.

6.3 ASPECTS ASSOCIATED TO STRATEGY ALIGNMENT

The Univen Agriculture Industry Study recommends that all efforts in agriculture (thus by default aquaculture) must be consolidated and integrated, while there must be a focus on the development of human and institutional capacity underpinned by effective policy and strategy development.

The Rhodes University / WRC Baseline Survey identified the status of aquaculture in the Limpopo Province and gave direction by highlighting the constraints and potential around the existing aquaculture facilities. A core recommendation from the survey included the revitalisation of key facilities towards the development of aquaculture in the province.

7 CORE PROCESS IN ARRIVING AT AQUACULTURE STRATEGIES

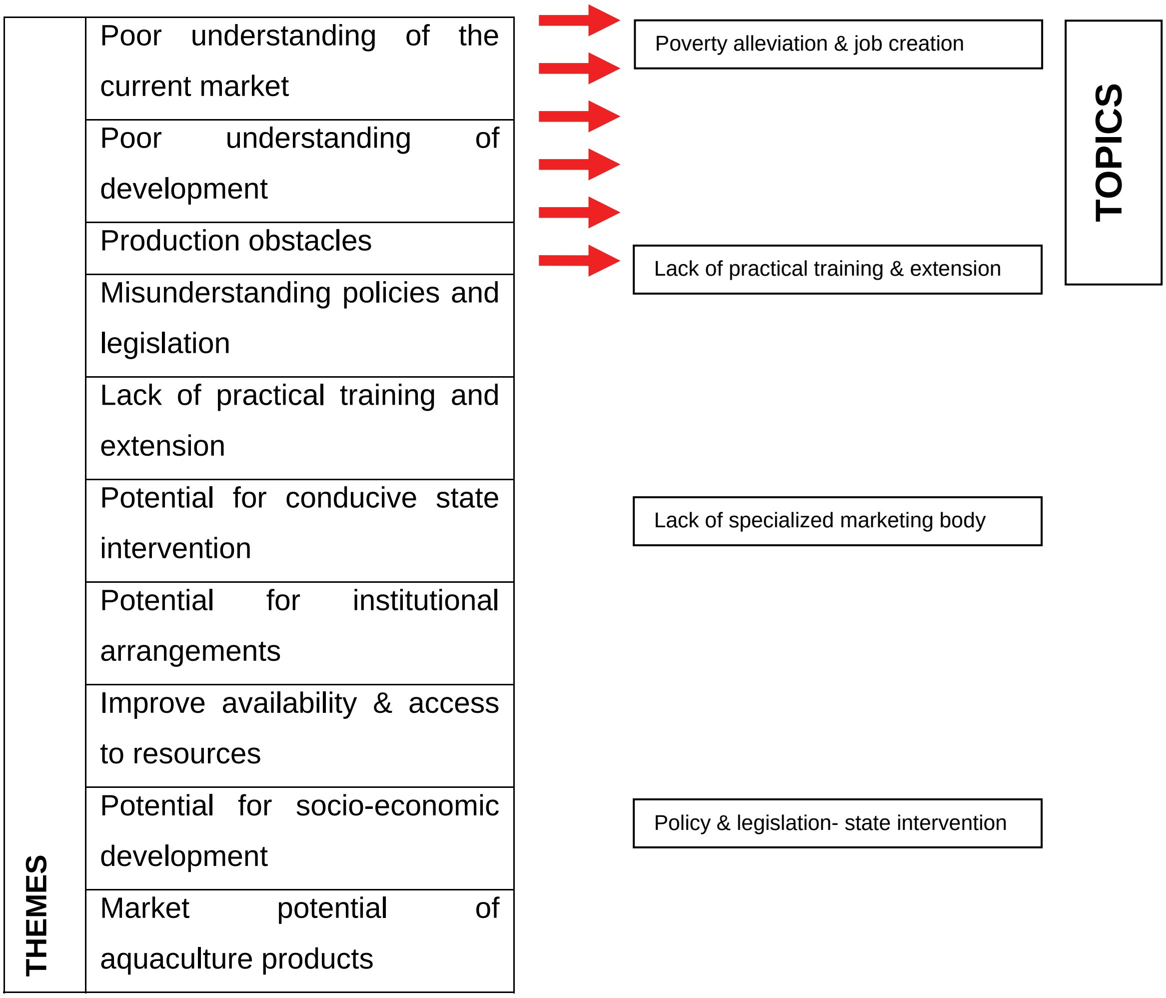
In a consultative workshop attended by various stakeholders in the Limpopo aquaculture sector (January 2006) the core hindrances (issues) and core potentials in moving forward with the development of aquaculture were identified towards the establishment of strategic approaches for the most prominent of these. The hindrances (issues) were grouped into five themes as follows:

- Misunderstanding of people on policies and legislation.
- Lack of practical training and extension.
- Production obstacles.
- Poor understanding of the total current market.
- Poor understanding of aquaculture development.

The main areas of potential associated with the aquaculture sector were also grouped into five main themes as follows:

- Potential for conducive state intervention.
- Potential for better institutional arrangements.
- Potential to improve availability and access to resources.
- Potential for aquaculture to contribute to socio-economic development.
- Market potential of aquaculture products.

For each of the themes above, the major underlying issues / challenges and potentials / opportunities were identified and sorted into the following topics.



These selected topics were analysed in terms of the actions that could be taken to resolve the issues or achieve the potentials, together with the identification of a lead agent, partners or co-workers, the required resources and the timeframes within which the actions could be taken. The results hereof are displayed in tables that have been added as an annex to this document (Annexure 1). This information has enabled the development of the core strategies, actions and projects in the next chapter.

8 AQUACULTURE SPECIFIC STRATEGIES FOR THE PROVINCE

In spite of the importance of specific strategic alignment to the Department of Agriculture, the aquaculture sector has unique development and service needs. These unique needs are addressed in the following section by consideration of the strategies, actions and projects to which the Department should react to ensure the growth and development of a sustainable aquaculture sector in the province. This section on specific strategies on aquaculture should be considered in conjunction with the previous section on strategic alignment to ensure synergy in effort and resource allocation in the Department.

Each of the strategies below is presented in tabular form in which the broad strategy is depicted and associated with the Departmental actions and projects. The projects are accompanied by an indication of urgency (as a measure of how soon it should be implemented in order to move forward with sector development) and a budget. In terms of the urgency index the following numbering system has been used:

- A project with an urgency index of 1 indicates the need for immediate attention (e.g. current financial year)
- A project with an urgency index of 2 indicates the need for attention in the near future (e.g. following financial year)
- A project with an urgency index of 3 indicates the need for future attention (e.g. as a future need)

8.1 ECONOMIC STRATEGY

Much economic uncertainty surrounds aquaculture, as locally applicable feasibility modelling is rare. For this reason an economic strategy, which addressed and recognises commercialisation and subsistence farming is required. This includes clarifications on business modelling and the realisation of the value of aquaculture and aquaculture products.

ECONOMIC STRATEGY				
STRATEGIC INTERVENTION	**GENERAL ACTIONS**	**IDENTIFIED PROJECTS**	**BUDGET AND URGENCY**	
Increase aquaculture production through commercialisation	Develop urban market access	Develop an economic business model for farmers to maximise profit	R60 000,00	1
	Develop generic business models			
	Access to credit for emerging and other farmers			
	Establish aquaculture development zones / nodes			
Promote food security through aquaculture	Establish viable aquaculture starter packs	Form Private Public Partnerships (PPP) around aquaculture	R60 000,00	2
	Enhance natural fisheries			
		TOTAL	R120 000,00	

8.2 MARKET STRATEGY

Market demand is the single largest force that can ensure the growth of a sustainable aquaculture sector in the Limpopo Province. For this reason aspects such as the development of markets and the creation of consumer awareness is of such importance that the Department of Agriculture should take a leading role in its establishment.

MARKET STRATEGY				
STRATEGIC INTERVENTION	**GENERAL ACTIONS**	**IDENTIFIED PROJECTS**	**BUDGET AND URGENCY**	
Quantify market potential for aquaculture products	Conduct a market survey	Undertake commercialisation by a survey of market opportunities	R100 000,00	1
Facilitate market access for aquaculture products	Improve understanding of health certifications, transport requirements, packaging and value adding	Undertake a market education campaign	R200 000,00	2
	Disseminate market information and skills to the sector	Dissemination of market information to aquaculture emerging farmers	R60 000,00	2
	Establish commodity associations	Undertake a fish value awareness campaign	R80 000,00	3
	Acquire assistance from marketing agencies (e.g. NAMC, DTI, etc.).	Establish a fresh fish sale point	R500 000,00	3
Awareness and promotion of aquaculture products	Launch a “Eat fish” promotion			
		TOTAL	R940 000,00	

8.3 CAPACITATION STRATEGY

Capacity for the development of aquaculture (especially in terms of aquaculture skills) is limited in South Africa. Nevertheless the information and institutions to assist with the building of capacity is available. In this regard it is important that the Limpopo Department of Agriculture first creates the internal capacity to be able to render an effective service to the growing aquaculture sector. It is important that the Department move towards a position in which specialised services can be offered in aquaculture.

CAPACITATION STRATEGY				
STRATEGIC INTERVENTION	**GENERAL ACTIONS**	**IDENTIFIED PROJECTS**	**BUDGET AND URGENCY**	
Develop aquaculture by internal capacitation of LDA	Train extension officers in aquaculture	Capacitation and training of officials and farmers	R300 000,00	1
	Appoint managers to averse the establishment of an Aquaculture Division			
	Provide in-service training			
	Define a outcome based extension programme	Development of aquaculture production manuals and producer manuals	R50 000,00	1
Develop aquaculture by capacitation of farmers	Provide general and specialised extension support to farmers			
	Promote farmer commodity organisations	Formation of commodity associations	R50 000,00	2
	Develop and provide farmer manuals and reference materials			
Develop aquaculture by capacitation of research and training institutions	Define research projects which are aligned with the aquaculture strategy			
	Provide bursaries and research funds			
		TOTAL	R400 000,00	

8.4 SPECIES MANAGEMENT STRATEGY

The choice of commercially viable species for aquaculture development is important both from an economic performance perspective and also from the perspective of biodiversity and conservation when considering the potential impact of exotic species on locally indigenous stocks. In this regard the Limpopo Department of Agriculture must ensure that it has a clear and legally aligned strategy on aquaculture species.

SPECIES MANAGEMENT STRATEGY				
STRATEGIC INTERVENTION	**GENERAL ACTIONS**	**IDENTIFIED PROJECTS**	**BUDGET AND URGENCY**	
Facilitate access to suitable species for aquaculture	Facilitate compliance with the National Environmental Management: Biodiversity Act	Develop a common environmental management framework for aquaculture species	R80 000,00	1
	Define management protocols to farm with alien aquaculture species	Develop a written protocol for alien aquaculture species	R80 000,00	2
	Screen and develop indigenous species for suitability to aquaculture	Establishment of a conducive regulatory environment with adequate monitoring	R80 000,00	3
	Address the issue of farming with the exotic Nile Tilapia			
		TOTAL	R240 000,00	

8.5 INSTITUTIONAL COORDINATION

The Department of Agriculture does not operate in isolation insofar as aquaculture development, facilitation and regulation is concerned. Many other government Departments have a role to play in this regard and this role should be well understood and defined between Departments and other stakeholders by forging strong communication networks.

INSTITUTIONAL COORDINATION STRATEGY				
STRATEGIC INTERVENTION	**GENERAL ACTIONS**	**IDENTIFIED PROJECTS**	**BUDGET AND URGENCY**	
Create institutional coordination in support of provincial aquaculture strategies	Place aquaculture on the agenda of the economic cluster			
	Establish an interdepartmental (with national government assistance) task team on Nile Tilapia	Develop organisational linkage structure	R40 000,00	1
	Establish an interdepartmental working group on aquaculture	Form working groups	R40 000,00	1
	LDA to facilitate involvement of NEPAD, development – and finance institutions, etc.			
		TOTAL	R80 000,00	

8.6 RESEARCH STRATEGY

Aquaculture is scientifically advanced and although the sector is accessible to rural communities, the future development of the sector will be supported by a strong local research component. For this reason aquaculture must be placed on the Department's research agenda. Such research must however be demand driven and have practical and applicable value to the growth of the sector.

RESEARCH STRATEGY				
STRATEGIC INTERVENTION	**GENERAL ACTIONS**	**IDENTIFIED PROJECTS**	**BUDGET AND URGENCY**	
Promote demand driver research	Conduct survey of aquaculture potential in the Limpopo Province	LDA and DWAF to conduct a comprehensive reserve determination project	R200 000,00	2
	Improve current strains of fish and identify new candidate species for aquaculture	Undertake a breeding program for suitable species	R400 000,00	2
	Identify research needs from the sector	Formation of a working group to set a research agenda and programme	R40 000,00	2
Promote research into new species and technologies	Conduct research into culture based fisheries	Research on impacts / potential of aquaculture starter packs on beneficiaries	R40 000,00	1
	Conduct research into suitability of cage aquaculture			
Develop provincial research capacity	Support research institutions			
	Develop provincial research programme			
Research potential risk and impact on biodiversity and environment		Identify potential impacts of aquaculture species on local biodiversity	R150 000,00	1
Research socio-economic impact of aquaculture development interventions		Survey of the socio-economic impact of aquaculture	R80 000,00	1
		TOTAL	R910 000,00	

8.7 INFRASTRUCTURE STRATEGY

The Limpopo province and in specific the Department of Agriculture already has some infrastructure in Turfloop and other hatcheries or aquaculture stations. This infrastructure however needs urgent revitalisation coupled with human resources and skills for them to become centres for the production of fingerlings, training centres and information hubs. In addition to this the province has a significant irrigation infrastructure into which aquaculture can be incorporated.

INFRASTRUCTURE STRATEGY				
STRATEGIC INTERVENTION	**GENERAL ACTIONS**	**IDENTIFIED PROJECTS**	**BUDGET AND URGENCY**	
Revitalize state aquaculture facilities	Define how state facilities can fulfil provincial strategic needs	Revitalisation of Turfloop Hatchery	R500 000,00	1
	Allocate roles and functions to current aquaculture facilities	Revitalisation of Dzindi Fish Farm	R250 000,00	1
	Determine requirements for the revitalisation and repair process	Revitalisation of Tompi Seleka aquaculture facilities	R500 000,00	2
Integrate aquaculture into provincial irrigation schemes	Evaluate potential for aquaculture in irrigation schemes			
	Make contact with Irrigation Boards			
Promote aquaculture development zones / nodes	Identify areas for high potential aquaculture development nodes	Establishment of an aquaculture development zone	R500 000,00	2
	Develop support packages to address infrastructure and service needs	Provision of infrastructure for emerging farmers in various districts across the value chain	R400 000,00	2
		TOTAL	R2150 000,00	

8.8 EMERGING FARMER DEVELOPMENT

Although large scale commercial fish farmers may need support from time to time the Department must focus its attention on the development of emerging farmers to the level at which they may enter into the mainstream economy and become competitive. In addition to this small scale fish farmers should be encouraged so that this may contribute to food security.

EMERGING FARMER DEVELOPMENT STRATEGY				
STRATEGIC INTERVENTION	**GENERAL ACTIONS**	**IDENTIFIED PROJECTS**	**BUDGET AND URGENCY**	
Promote the entry of emerging farmers into aquaculture	Provide financial assistance	Devise a structured farmer development programme	R150 000,00	1
	Provide training	Establish emerging farmer integration into existing irrigation schemes	R200 000,00	2
	Illustrate the benefits of aquaculture in the creation of economic opportunities, food security, etc.	Devise mechanisms to link communities to existing provincial aquaculture infrastructure by use of a CPPP model	R80 000,00	2
	Provide outcome based extension support	Provide support to the Ipopeng Fisheries Project	R100 000,00	1
		Provide support to the Itereleng Fisheries Project	R200 000,00	1
	Conduct a value chain analysis to determine the economic hindrances		R100 000,00	1
		TOTAL	R830 000,00	

8.9 STRATEGY ON POLICY FRAMEWORKS

The approach by the Department of Agriculture to aquaculture will be bedded in its internal policies and the policies and mandates of other government Departments. In this regard it is important that policy frameworks are clear and applied to all levels of aquaculture extension and development. Taking a lead from national policy frameworks will also assist the province in contributing to the respective national goals.

POLICY FRAMEWORK STRATEGY				
STRATEGIC INTERVENTION	**GENERAL ACTIONS**	**IDENTIFIED PROJECTS**	**BUDGET AND URGENCY**	
Align provincial aquaculture strategies with relevant policies	Contribute to the national aquaculture policy process	Liaise with the National Department of Agriculture	R20 000,00	1
	Take direction from national aquaculture policies and protocol			
	Communicate with the Department of	Incorporate the Biodiversity Act into	R60 000,00	1

	Environmental Affairs and Tourism on the implementation of the Biodiversity Act	Departmental policies and develop a protocol for aquaculture in terms of the Act		
	Communicate with the Department of Water Affairs and Forestry in terms of the National Water Act			
	Provide an implementation model for NEPAD and take direction from the NEPAD action plan of aquaculture			
		TOTAL	R80 000,00	

9 DETAILS PERTAINING TO PROGRAMMES OF ACTION

The following section provides father details based on the aquaculture specific strategies, actions and projects that have been developed in the previous chapter. The intention of the programmes in this chapter is to provide support and guidance to the projects identified in Chapter 8 by providing key insight into the respective situations. This will enable the Limpopo Department of Agriculture to approach the specific projects with a better understanding of the scenario.

9.1 PROGRAMME: CAPACITATION

Guidance for the Limpopo Department of Agriculture to create additional capacity and extension services:

- Build out the Division of Aquaculture within the Department by appointing at least 4 additional aquaculture specific extension officers. This may only be achievable by identifying potential candidates from higher education institutions or by dedicated training of existing extension generalists that have a keen interest in aquaculture.
- Consult with Mpumalanga and North West Province (via the Northern Aquaculture Workgroup) for the identification of a suitable person / organization that can be supported towards the establishment of improved disease diagnostic and treatment services in the aquaculture sector.
- Design and provide aquaculture generalist training / exposure to all extension services (from provincial to municipal level).

- Support and build out the existing service centers so that these may disseminate aquaculture related information to farmers.
- Obtain training materials fro aquaculture training at all levels (from middle management to farmers).
- Support the Universities of Limpopo (Aquaculture Research Units) and Venda in training more aquaculturists and providing inputs into training initiatives by the Department.
- Design practical training programs for ongoing training of farmers.

9.2 PROGRAMME: DZINDI, TOMPI SELEKA AND TURFLOOP

A. DZINDI FISH PROJECT

Guidance in terms of the Dzindi Fish Project:

- A detailed study is required to determine the facility's role in the greater framework of aquaculture in the Province (especially in terms of serving as a training or service center).
- The facility needs to be assessed in terms of the requirements towards repair and revitalization of the infrastructure.
- The facility needs to be assessed in terms of the human resources that are required to ensure the successful running of it.

B. TOMPI SELEKA COLLEGE OF AGRICULTURE

Guidance in terms of the Tompi Seleka College:

- A detailed study is required to determine the facility's role in the greater framework of aquaculture in the Province (especially in terms of serving as a training or service center).
- The facility needs to be assessed in terms of the requirements towards repair and revitalization of the infrastructure.
- The facility needs to be assessed in terms of the human resources that are required to ensure the successful running of it.
- The curricula of the remainder of Tompi Seleka must be reviewed towards the re-inclusion of an aquaculture training programme.

C. TURFLOOP BREEDING STATION

Guidance in terms of the Turfloop Hatchery:

- The Department must investigate and invite private sector participation in Turfloop so as to achieve a PPP model.

- As assessment must be made of the fingerling needs of the Limpopo and other surrounding provinces so that the revitalization of Turfloop can react to this fingerling need. This should form the basis of a feasibility exercise to ensure that the Hatchery can be operated on an economically sound basis.
- Links between Turfloop and the University must be strengthened so that training programmes can be designed around the facility and so that the Aquaculture Research Unit of the University could provide technical support.
- Agreement must be reached with relevant authorities on the availability, use and amount of water for Turfloop Hatchery throughout the year.
- Training must be provided to hatchery managers and staff so that this may lead to the creation of extension to and training of farmers. The training programmes should include:
- Species selection
- Fish keeping and grow-out
- Economic and financial considerations
- Concepts of water quality relevant to aquaculture
- Pond design and construction
- Nutrition of culture species
- Diseases and treatment
- Harvesting and marketing
- The current facilities must be repaired and the necessary brood stock sourced.
- Logistical planning must be done around the transport of fingerlings into all areas of the Province.

9.3 PROGRAMME: THE WAY FORWARD FOR FARMERS

In January 2006 the fish farmers of the Limpopo Province were consulted to determine their underlying concerns and to establish their views on how these issues could be practically resolved. With the issues identified the required actions, identification of a lead agents, partners or co-workers, the required resources and the timeframes within which the actions could be taken were tabled as follows:

Table 5 – Guidance in terms of the farming fraternity

Underlying Issue	What to be done	Who leads	Resources	When
Lack of training and development for the industry	Develop specific strategies for training. This must include farmers, extension officers, institutional organizations, tertiary education and training organizations	Department of Agriculture, with help from: NGOs Tertiary institutions SETA	State funds NGOs. Development partners	12 months
Capacity building	Training courses, learnerships, farmers sharing experiences	LDA Private sector International orgs- World Fish, FAO NGOs Tertiary institutions	State funds NGOs. Development partners	12 months
Lack of champions	• Incentives for farmers to become champions • Intervention by state to promising farmers.	LDA Private sector International orgs- World Fish, FAO NGOs Tertiary institutions	State funds NGOs. Development partners	24 months
Institutional arrangements for capacity building (revitalization of state facilities and determination of the role of the facilities for training, providing fingerlings, information, etc.)	• Incentives for farmers to become champions • Intervention by state to promising farmers.	• LDA • Tertiary institutions	• State funding • Private sector	2 years
Potential for a strong producers association (market)	Create platform or enabling environment for the sector	• LDA • Farmers	• Facilitators • State support	Within 6 months
Application of a action research strategy (to link up with capacity building)	Create a functional research committee	• LDA • Farmers • NGOs • World Fish / FAO • Tertiary institutions	• State fund • Technical Partners	Within 12 months

9.4 PROGRAMME: THE WAY FORWARD FOR SUPPORT AGENCIES

All service providers to the aquaculture sector used the consultative workshop in January 2006 to determine how best they can react to the needs of the aquaculture sector in order for it to develop sustainably. It was recommended that the best macro approach in this regard was the establishment of a Limpopo Aquaculture Working Group (LAWG), convened by the Department of Agriculture and upon which the following organisations would have representation:

Government Departments (LDA, DoA, etc.)

- NGOs such as Novafrica
- Universities of Limpopo, Venda and Rhodes
- Provincial producer and farmer's associations

This workgroups must be established immediately and meet at least once a quarter. The following draft terms of reference would serve to guide the workgroup initially and until such a time as the workgroup is able to revise and improved upon these:

- To finalise and implement effective policy and strategies towards the building out of a sustainable aquaculture sector
- To coordinate all stakeholders in the aquaculture sector
- To provide advice on research, training and other development issues

To monitor the outcomes of the aquaculture strategy development and effect of these strategies on the sector

Message from aquaculture service providers to the aquaculture sector

The service sector appreciates the participation of producers and recognises them as pioneers of the new industry. The service sector is committed to the finalisation of and implementation of effective aquaculture development strategies.

9.5 PROGRAMME: APPROACH TO NILE TILAPIA

The use of the exotic Nile Tilapia (*Oreochromis niloticus*) for aquaculture has become a contentious issue within the Limpopo – and other provinces. These fish have a superior production performance to the indigenous Mozambique Tilapia (*Oreochromis moss*ambicus), but out compete and hybridise with this indigenous species to the extent that the indigenous stains are lost. It is recommended that the following steps be taken with regard to the use of Nile Tilapia in the Limpopo Province:

- An assessment is required to determine the exact distribution of Nile Tilapia towards the establishment of zones in which these fish may be farmed.
- Tertiary institutions must be encouraged to develop improved strains of Mozambique tilapia following the procedures of the GIFT programme for the Nile tilapia so that these stains can be used in those areas where Nile tilapia farming is not allowed.
- Suitable local genetic material must be found for the establishment of hatcheries for Mozambique Tilapia which can be supplied locally.
- Conservation measures must be developed for natural Mozambique tilapia stocks which must include the conservation of genetic pools and protection of rivers or tributaries that can be effectively isolated.
- A certification system must be designed for tilapia hatcheries to ensure distribution of genetically pure material.
- A awareness programme is required to sensitize farmers, anglers and the public about the effects that Nile Tilapia could have in the environment.
- Farmers must be well informed of their obligations towards compliance with the relevant national legislation such as the National Environmental Management: Biodiversity Act.

9.6 PROGRAMME: IDENTIFICATION OF NEW OPPORTUNITIES

Guidance for the Limpopo Department of Agriculture in terms of the identification of new aquaculture opportunities:

As assessment of the water resources in terms of their aquaculture potential must be conducted for the entire province. The identification of development nodes would consolidate the application of resources and ensure focussed development.

- Candidate aquaculture species must be identified and decisions taken as to how the necessary stock can be sourced and supplied.
- Active partnerships between communities and commercial farmers should be established to accelerate development.
- The Department should consider legislative matters that influence aquaculture and address these insofar as possible on behalf of new aquaculture development nodes.
- The Department must establish the necessary extension services and development centres in order to react to new aquaculture opportunities identified by the public.

10 PARTNERS IN AQUACULTURE DEVELOPMENT IN LIMPOPO

In this section a short analysis is provided of the core stakeholders that are involved in aquaculture development in the Limpopo Province (outside of the lead agent in the Department of Agriculture). The understanding

10.1 NEPAD AND THE WORLD FISH CENTRE

The role and access to NEPAD and the World Fish Centre to be defined.

10.2 NATIONAL DEPARTMENT OF AGRICULTURE

The National Department of Agriculture has developed an aquaculture section to address national policy and development issues in aquaculture in order to promote the establishment of a commercially viable and beneficial sector or industry. In this regard the National Department has co-funded the provincial strategic plan development initiative (with the Water Research Commission). The Limpopo Department of Agriculture will benefit for the initiatives taken by the National department and must ensure that it is ready and willing to receive such support.

The National Department has identified the lack of policy and developmental frameworks, together with an uncoordinated and often inconsistent approach from governmental and regulating authorities as a major constraint to the development of the sector. This has driven the National Department to compiling a single National Policy on Aquaculture to promote and support a sustainable aquaculture sector in South Africa. As part of the process they have established a central aquaculture sector working group (ASWG) to promote more effective producer, processor, and interdepartmental cooperation in the interests of a united and prosperous aquaculture sector.

To facilitate the development of a united and prosperous aquaculture sector the Department will, by means of policy:

- Address the capacity to unify and simplify aquaculture legislation, regulation and to facilitate the sustainable use of aquatic resources.
- Incorporate and align legislation, regulation, production and marketing inputs and sustainable resource use into a team effort by using interdepartmental and public private partnerships.

Furthermore the National Aquaculture Policy will deliver guidance on:

- Norms and Standards for sustainable aquaculture
- Aquaculture Database

- Promoting aquaculture for food security
- Government aquaculture centers
- Centers of excellence/Service centers
- Advisory services
- National Aquaculture Institute
- Intellectual property rights
- Human resource development
- Regulatory implications

Apart from developing the National Aquaculture Policy the Department is also active in hosting the Aquaculture Sector Working Group, guiding the Regional (Northern – and Southern) Aquaculture Working Groups, participating in the Aquaculture Association of Southern Africa, working with the WRC in developing provincial strategic plan for aquaculture, developing norms and standards for the sector and keeping an active sector related information database.

Future initiates of the National Department in aquaculture include the training of aquaculture field officers, the establishment of community inland fisheries programmes to enhance food security, fostering further interdepartmental relationships and participation in provincial aquaculture development initiatives.

10.3 DEPARTMENT OF WATER AFFAIRS AND FORESTRY (DWAF)

The overall mandate of DWAF over the water resources that are required for the development of aquaculture is:

- The protection, use, development, conservation, management and control of water resources in a manner, which takes the following factors into account:

  Promoting equitable access to water.

  Redressing the results of past racial and gender discrimination.

  Promoting the efficient, sustainable and beneficial use of water in the public interest.

  Facilitating social and economic development.

  Providing for the growing demand for water use.

  Protecting aquatic and associated ecosystems and their biological diversity.

  Reducing and preventing pollution and degradation of water resources.

DWAF is in the process of completing a process of policy and protocol development around the use of water resources fro aquaculture purposes. This protocol will define the approvals process to gain access both the water resources on private land and to gain access to State controlled water resources. In terms of this process some water uses for aquaculture (mainly small scale and low impact initiatives) will be generally authorised or will be authorised by default through Schedule 1 of the National Water Act. Larger aquaculture initiative or those with a likely impact on the water resources will be subject to a licence application in accordance with the Schedule 21 (National Water Act).

10.4 DEPT OF ECONOMIC AFFAIRS, ENVIRONMENT AND TOURISM

The Department of Economic Affairs, Environment and Tourism are mandated within Limpopo by the National Department of Environmental Affairs and Tourism to oversee the implementation of the Environment Conservation Act, the National Environmental Management Act and the National Environmental Management: Biodiversity Act.

Certain sections of the Environment Conservation Act stipulate that environmental assessments must be completed for listed activities as published by the Government. For aquaculture ventures the main (not exclusive) activity is:

> *The concentration of livestock, aquatic organisms, poultry and game in a confined structure for the purpose of commercial production,*

10.5 OTHER GOVERNMENT DEPARTMENTS / ORGANISATIONS

The National Department of Science and Technology actively promotes small-scale aquaculture enterprise development and are active in seeking opportunities to develop small-scale aquaculture initiatives within the Limpopo Province.

The Department of Trade and Industry actively seek the creation of export opportunities for aquaculture ventures.

The Water Research Commission is co-funding the development of provincial strategic plans for aquaculture together with the National Department of Agriculture and has fulfilled a key role in addressing research needs in aquaculture development.

10.6 REGIONAL AND INTER-PROVINCIAL LINKAGES

The Limpopo Province is bordered primarily by Mpumalanga and North West Province in terms of aquaculture development. In this regard a regional aquaculture development focus should be established so that the sector can be developed in a mutually beneficial manner.

The following steps are recommended towards establishment of an inter-provincial and regional aquaculture sector:

- Representatives from the Aquaculture Division within the Limpopo Department of Agriculture must make contact with their counterparts within Mpumalanga and the North West Province and use the forum created by the Northern Aquaculture Working Group for further interaction.
- The Limpopo Province should inform the applicable sister provinces of its capabilities in aquaculture development, especially in terms of training capabilities and the potential to supply seed material or fingerlings. In this manner synergies will be established in which the provinces may find it useful to make use of these respective capabilities to move forward in a regional manner.
- The provinces must seek cooperation on matters such as the diagnosis and treatment of fish diseases, marketing and technical advances.

10.7 FARMERS AND OTHER ASSOCIATIONS

The Northern Aquaculture Working Group serves as a common platform for all stakeholders in aquaculture in the northern provinces of South Africa. This group functions as a regional leg of the Aquaculture Association of Southern Africa and serves the aquaculture sector by means of establishing the required networking between all role players on a common platform.

Within Limpopo a Tilapia Framers Association has been established and more recently a Limpopo Fish Farmers Association. The Department of Agriculture should support these associations and use them as a collective forum for communication to farmers, promotion of the sector and starting points for support to farmers.

10.8 HIGHER EDUCATION INSTITUTIONS

Three main higher education institutions are involved in aquaculture development in the Limpopo Province, these being:

- The Aquaculture Research Unit of the University of Limpopo is a leading aquaculture research and training centre in Southern Africa, which has much to offer in terms of assisting both the Department of Agriculture and the Limpopo Province to more forwards with the creation of an economically important aquaculture sector. This unit is also conveniently situated to provide support to the Turfloop Hatchery both in terms of technical support and the provision of training programmes.
- The University of Venda can play an important role in regional aquaculture development and are able to provide expertise in aquaculture resource characterisation, community

development around aquaculture and the design of management procedures for Nile Tilapia.

- The Eastern Cape based Department of Fisheries Science at Rhodes University are the implementing agents from a five year aquaculture revival program funded and supported by the National Department of Agriculture and the Water Research Commission. In this regard they will play an important role in assisting the Limpopo Department of Agriculture with the necessary strategic planning, training and building out of the sector.

11 INDICATIVE PROGRESS AND REVISION

The strategic plan will be supported by an interdependent implementation plan, which will highlight specific actions and related timeframes. In spite of this implementation plan the revision and update of both the strategic plan and the implementation plan is of critical importance in ensuring the successful role out of aquaculture in the Limpopo province. In addition to this mechanisms must be put in place to monitor the effects of interventions proposed in the strategic plan. The following steps are recommended in the revision, update and monitoring process:

- The strategic plan must be work-shopped once a year towards ongoing improvement and revision of strategic objectives. The entire document must be revised in accordance and distributed to the relevant stakeholders.
- Once a year an strategic implementation audit should be conducted to measure the success of the strategic interventions. This must be done by crystallising core interventions from the strategic plan and comparing the progress over the one year implementation period to the status before the intervention. These result must be quantifiable into jobs, created, project implements, training achieved, production increases, etc. The results of such an audit must be used to further guide the updates of further strategic interventions.

APPENDIX 2:
Mpumalanga Province Draft Aquaculture Strategic Plan

MPUMALANGA

DEPARTMENT OF AGRICULTURE AND LAND ADMINISTRATION

PARTICIPATORY DEVELOPMENT OF PROVINCIAL AQUACULTURE PROGRAMMES FOR IMPROVED RURAL FOOD SECURITY AND LIVELIHOOD ALTERNATIVES

STRATEGIC PLAN
FOR AQUACULTURE DEVELOPMENT IN THE MPUMALANGA PROVINCE

FEBRUARY 2006

CO-WORKERS:

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PREAMBLE TO THE MPUMALANGA STRATEGIC PLAN FOR AQUACULTURE

This working draft presents the first version of the Strategic Plan for Aquaculture Development in the Mpumalanga Province. The development of this strategic plan is being driven by the Department of Agriculture and Land Administration (DALA) in the Mpumalanga Province as assisted by Rhodes University who are implementing an initiative by the Water Research Commission and the National Department of Agriculture to achieve participatory development of provincial aquaculture programmes for improved rural food security and livelihood alternatives.

Primary inputs towards the formulation of a Strategic Plan for Aquaculture Development in the Mpumalanga Province was gathered from farmers, service providers, policy makers and other stakeholders at a workshop in Nelspruit on 9 February 2006. In this workshop it was identified and agreed upon that aquaculture producers require recognition and that service providers (DALA and others) are ready and willing to provide the necessary support to the aquaculture sector.

This Strategic Plan is an essential tool for planning and resource allocation. The aim of the Plan is to strategically mobilise, distribute and utilizes those resources equitably and efficiently to achieve the following objectives:

- Growing the economy
- Job creation
- Economic empowerment and
- Poverty alleviation

The Strategic Plan is informed by the National Government's priorities that include:

- Reducing poverty
- Creating employment opportunities
- Food security
- Growing the economy
- Rural development/urban renewal
- Sustainable development and
- NEPAD

The Strategic Plan will provide essential information that will enable effective benchmarking that will result in the monitoring and evaluation of the Department's performance in achieving the planned objectives and outcomes.

The philosophy of strategic support to the agricultural sector in this Strategic Plan is participatory and demand led/driven. The strategic planning is a cyclical process informed by this philosophy, followed by programme implementation, monitoring and performance evaluation.

FOREWORD

To be written by a senior official (e.g. MEC)

1 OVERVIEW OF AQUACULTURE

Aquaculture is defined as the propagation, improvement, trade or rearing of aquatic organisms (plant and animal) in controlled or selected aquatic environments (fresh, sea or brackish waters) for any commercial, subsistence, recreational or other public or private purpose.

1.1 AQUACULTURE GLOBALLY

On a global scale, aquaculture is growing more rapidly than any other food-producing sector. World aquaculture production totaled 45.7 million tons in 2000 and was valued at US$56.5 billion (FAO, 2002). In 1997, farmed fish, crustaceans and molluscs contributed 3.9% of total world fish supplies, and this figure had increased to 27.3% by 2000 (FAO, 2002).

Globally market forces, the diversification of the economic base, the sustainable utilization of resources and a quest for food security drive the development of aquaculture. In this regard, aquaculture has developed into a diverse industry, with over 64 countries participating in the production of more than 300 species of fish, shellfish, crustaceans and aquatic plants.

On average, global aquaculture has experienced a compounded growth rate of 9.2% per year since 1970 (FAO, 2002). This is considerably greater than that of capture fisheries and the terrestrial agriculture sector, which experienced an average compounded growth of only 1.4% and 2.8%, respectively for the same period (FAO, 2002). This trend is set to continue as world fishery production has effectively leveled off, the demand for fish is increasing due to population growth, and the shortfall in supply will have to come from aquaculture if per capita consumption is to be maintained.

The per capita supply of food fish from aquaculture globally (excluding China) has increased four-fold in the past three decades, from 0.6 kg in 1970 to 2.3 kg in 2000 (FAO, 2002). This suggests that the contribution made by aquaculture to global protein security has continued to increase per capita, in spite of global human population growth.

1.2 AQUACULTURE IN AFRICA

In spite of its vast natural and human resources, the participation of Africa in the global aquaculture sector is lacking and aquatic species indigenous to Africa have developed into aquaculture species of international importance. Developing countries from Southeast Asia and South America have secured significant participation in these sectors, but African countries have been unable to secure any meaningful economic benefits thus far.

Africa's contribution to global aquaculture production is extremely low relative to the contributions made by other continents. Africa contributed only 0.4% of global production in 1995, compared to 87.7% from Asia and Oceania, 6.7% from Europe, 1.6% from South America, and 0.7% from the former USSR during the same year (Hecht and De Moor, 1997). However, in line with global trends, the aquaculture industry in Africa has also experienced considerable growth over the past few decades. For example, African aquaculture production, including finfish, shellfish, molluscs and aquatic plants, increased from 11,800 to 82,014 tons between 1985 and 1995; that is an eight-fold increase in only 10 years (FAO, 1997; Hecht and De Moor, 1997). The production of fish and shellfish from the African continent totaled approximately 79,500 metric tons in 1998; 57% of this was produced by three countries bordering the Mediterranean, with Egypt producing most (i.e. 43,000 tons) (Hecht, 2001). Thirty-tree sub-Saharan countries produced the remaining 34,000 metric tons, of which 93% can be attributed to 6 countries, viz. Nigeria (16700 tons), South Africa (4500 tons), Zambia (4100 tons), Zimbabwe (3800 tons), Namibia (1300 metric tons) and Kenya (1100 tons) (Hecht, 2001). The other 27 countries for which statistics are available produced a total of only 2500 tons (Hecht, 2001). Most of the product in the six major producing countries originated from relatively large and capital intensive private operations or joint ventures between the private and the public sector, whereas by contrast, the farms in the 27 minor producer countries are small-scale or subsistence operations (Hecht, 2001). Hecht (2001) concluded from this summary that national aquaculture development programs for rural areas in most sub Saharan countries have not been sustainable, despite substantial international donor funding and despite a highly suitable environment.

1.3 AQUACULTURE IN SOUTH AFRICA

The further growth of aquaculture in Southern Africa depends on the successful integration, use and development of natural resources (water, land, climate, energy and biodiversity), human resources (labor, skills and technology) and economic resources (capital, infrastructure and market access).

The modern aquaculture industry in South Africa was effectively initiated in the 1980s with the establishment of trout, oyster, mussel, ornamental fish and catfish farming (Hecht and Britz, 1990). In 1988, the sectors produced a total of 3094 tons, valued at R45.8 million (Hecht and Britz, 1990). Ten years later, in 1998, this figure had increased to 5208 tons (FAO, 1998). This translates to an average increase per annum of 6.8% between 1988 and 1998. During this period a number of state led projects were initiated to stimulate the growth of rural aquaculture, largely with the objective of enhancing food security and income in rural households.

The potential for fresh water aquaculture in South Africa is constrained by the natural environment. The first major constraint is a scarcity of water and the second the extreme seasonal temperature fluctuations over much of the interior (Britz and Hecht, 1990). A third constraint is the choice of species available for production. With the exception of trout and ornamental fish, which have a high market value, most indigenous and introduced fresh water fish species have historically yielded prices too low to justify the costs of intensive aquaculture production.

The development of aquaculture in South Africa can be divided into several epochs or categories. Firstly, the colonial era during which exotic species were introduced and produced, mainly for angling purposes. The apartheid era saw the development of private sector commercial aquaculture (particularly trout and oysters) and government led “homeland” aquaculture initiatives to address food security issues. Thirdly, the post-1994 democratic era, which has witnessed the development of a large-scale commercial aquaculture (in particular abalone) and a trend towards more entrepreneurial rural aquaculture.

During the late 1980s and early 1990s the provincial nature conservation departments changed their policy and stopped promoting the production and stocking of exotic fishes into indigenous waters. This constituted an effective withdrawal of Government support for the freshwater aquaculture industry, and resulted in the closure, mothballing or privatization of many Government aquaculture facilities. The period of political transition in the early 1990s resulted in a lack of policy or funding to support aquaculture research and development, and without government support, the aquaculture industry in South Africa effectively developed at a much slower rate than in other parts of the world.

Despite the lack of a national aquaculture policy since 1994, there have been attempts to develop small-scale commercial aquaculture in rural contexts on the back of larger commercial enterprises. These initiatives have been motivated by Governments policy of promoting black economic empowerment and supporting emerging farmers.

Various factors are currently stimulating the development of aquaculture in Southern Africa, including:

- The availability of resources in certain areas: water, land, labor, energy, etc.;
- The non-consumptive and integrated manner in which aquaculture uses water;
- The diminishing natural fisheries resources;
- Good national and international market interest;

- Good agricultural and other essential infrastructure;
- The need for diversification and optimization of resources;
- The good access to national and international technologies;
- International partnerships and collaboration around the sector; and
- The socio-economic needs towards redress and food security;

Factors that are currently inhibiting the development of the aquaculture sector in Southern Africa include:

- Fragmented policies and protocols from various Government Departments;
- The lack of marketing structures to access the market interest;
- The limited access to finance and developmental capital; and
- The limited human resources in capacity, skills and aquaculture expertise.

Aquaculture development is a vehicle for participation, skills enhancement, empowerment, food security and socio-economic upliftment.

2 VISION IN THE STRATEGIC PLAN

The overall vision of the Mpumalanga Department of Agriculture and Land Administration (DALA) is:

A united and prosperous agricultural sector, a well-conserved biosphere and ecosystem, and a healthy and sustainable environment.

The vision of DALA in terms of aquaculture is reflected in this greater vision.

3 MISSION IN THE STRATEGIC PLAN

The overall mission of DALA is:

To contribute to poverty reduction and a better life for the people of the Province by:

- Building an efficient, internationally competitive, profitable and sustainable agricultural sector,
- Protecting, conserving and enhancing the quality of the environment for the present and future generation,
- Conserving the Province's bio-diversity and ecosystems,
- Sustainable land development.

The mission of DALA, and specifically its newly established Division of Aquaculture, in terms of aquaculture development, is in the provision of support to the sector in such a manner that it becomes a vibrant contributor the livelihood creation and commercial enterprise.

4 VALUES IN THE STRATEGIC PLAN

The overall values of DALA are in its commitment to render services that are:

- Development orientated, fair, just and accessible to all,
- Value adding, effective and efficient,
- Guided by the principals of openness, transparency, equity and respect for human dignity,
- Particularly sensitive to the needs of all segments of the community, especially the poor, women, youth and the disabled.

These values of DALA are carried into the aquaculture sector by the Division of Aquaculture within this department.

5 OBJECTIVES (GOALS) IN THE STRATEGIC PLAN

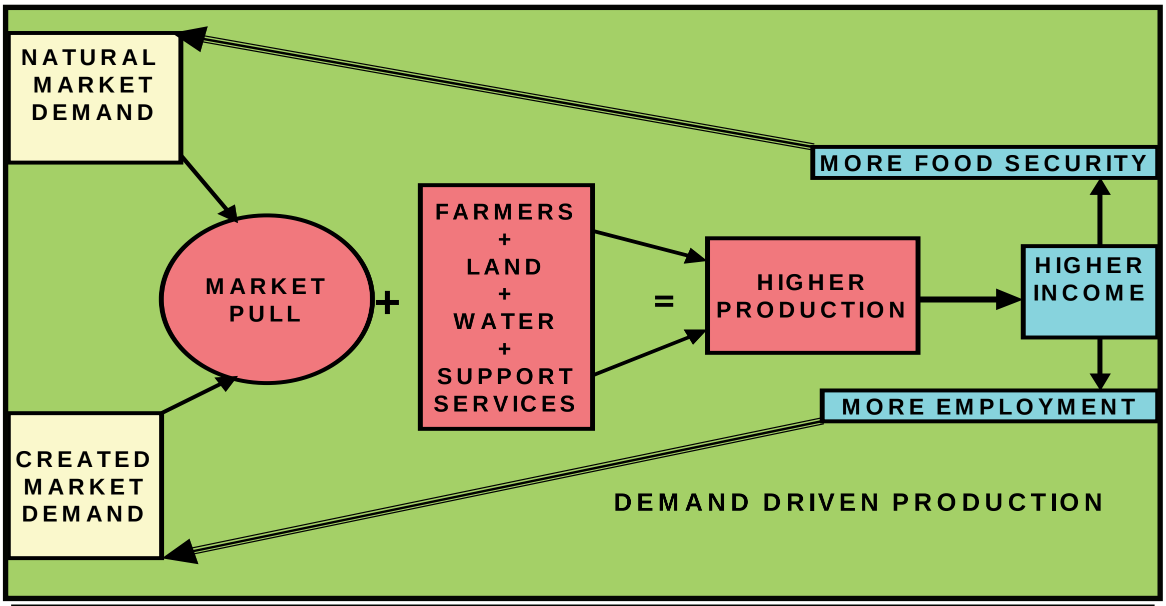
The core objectives of DALA are:

- To manage and administer for improved quality service,
- To facilitate access to agricultural resources by Previously Disadvantaged Individuals (PDIs),
- To improve the performance of the agricultural sector,
- To enhance the quality and safety of the environment,
- To promote and manage conservation as well as sustainable use of bio-diversity and natural resources,
- To develop and promote competitive and appropriate technologies.

Using these greater objectives of the Department the sub-objectives of the Division of Aquaculture within the Department and in terms of aquaculture development is to achieve the following outcomes:

- The **vitalisation of exciting and new State aquaculture facilities** so that these may serve as centres for fingerling supply, training and technical services. These facilities include the existing Lydenburg Hatchery and the newly planned Lowveld College Hatchery in Nelspruit.
- The isolation of **key support needs** towards the building of a stronger aquaculture sector and to achieve greater entrepreneurship.
- **Capacity building** within DALA so as to serve in the needs of the growing aquaculture sector and to enable the creation of **training programmes** at all levels from management (within the Department) to extension officers and farmers.
- The **increase in aquaculture production** by eliminating production obstacles and assisting with the provision of effective and practically implementable aquaculture information, fingerlings and dedicated extension services.
- The identification of **key policy and legislative issues** impacting on the performance of the aquaculture sector and to address these by cooperative relationships with other Government Departments.
- The **penetration of new and existing markets** for aquaculture products by market development and familiarisation with aquaculture products.
- The creation of **Community Public Private Partnerships (CPPP)** by encouragement of all stakeholders and illustrating the mutual benefits of such business relationships.
- The development of practical and accessible aquaculture **information sources and training manuals**.

In order the achieve the abovementioned objectives the following Demand Driven Production Model must be used by the Division of Aquaculture in its development strategy of the aquaculture sector.



The Demand Driven Production Model for achievement of the strategic objectives.

6 LEGISLATIVE AND OTHER MANDATES

The Division of Aquaculture is subject to all of the agricultural, veterinary, conservation, environmental and land administration mandates of DALA. The following is the primary legislation of concern to aquaculture development, but does not include the full list of legislatively backed mandates of DALA:

A. AGRICULTURAL AND VETERINARY MANDATES

- Agricultural Product Standards Act 1990 (Act 119 of 1990), which sets standards for all agricultural products.
- Animal Diseases Act 1984 (Act 35 of 1984), which obliges the country and empowers veterinary services to act against animal diseases.
- Conservation of Agricultural Resources Act 1983 (Act 43 of 1983), which provides a framework for the protection of all natural resources such as water, soil and vegetation.
- Fertilisers, Farm Feeds, Agricultural Remedies and Stock remedies Act 1947 (Act 36 of 1947), requires that all chemicals, remedies and fertilisers used in agriculture should not have any secondary effects on humans.
- Mpumalanga Agricultural Development Corporation Act, 2000 (Act 5 of 2000), empowers the Mpumalanga Agricultural Development Corporation to facilitate the development of farmers from previously disadvantaged backgrounds through the provision of support in the form of knowledge, exposure and access to finance.

B. ENVIRONMENTAL AND CONSERVATION MANDATES

- The Constitution of South Africa (Act 108 of 1996).

- National Environmental Management Act 1998 (Act 107 of 1998), which sets out procedures for co-operative governance with regards to environmental management.
- National Environmental Management: Biodiversity Act 1998 (Act 10 of 2004), which strives to the holistic protection of biodiversity.
- Environment Conservation Act 1989 (Act 73 of 1989), which will be repealed by the National Environmental Management Act shortly and currently governs the process of environmental impact assessment.
- National Water Act 1996 (Act 36 of 1998) which sets out all aspects related to the management and use of water resources.
- Mpumalanga Conservation Act 1998 (Act 10 of 1998), that seeks to regulate nature conservation activities within the Province.

7 AQUACULTURE SITUATION ANALYSIS

The Mpumalanga Province is divided into three management districts (i.e. Ehlanzeni -, Gert Sibande – and Enkangala Districts) and active aquaculture activities can be found in each of these. With the extreme variance of climatic zones within the province 9and within the management districts), from tropical lowlands to highveld grasslands, the aquaculture types are diverse. In the higher laying cold areas trout farming is common, while warm water species such as crocodiles, ornamental fish, tilapia and catfish are farmed in the warmer regions.

The primary production species in the Mpumalanga province are:

- Mozambique Tilapia (*Oreochromis mossambicus*)
- African Sharptooth Catfish (*Clarius gariepinus*)
- Common Carp (*Cyprinus carpio*)
- Nile Crocodile (*Crocodylus niloticus*)
- Rainbow Trout (*Oncorhynchus mykiss*)
- To a lesser extent species such as the Bushveld Smallscale Yellowfish (*Labeobarbus polylepis*) for conservation purposes, Eels species (*Anguilla spp.*) and the Mosquito Fish (*Aplocheilicthys katangae*)
- Other ornamental fish species

Apart from various commercial aquaculture ventures such as Machado Trout Farm, Lunsklip Fisheries and others, the WRC Report K5/1446/4: "*Contribution of Aquaculture to Rural Livelihoods in South Africa: A Baseline Study* (Britz and Rouhani, 2004) identified the Lydenburg – and De Kuilen Hatcheries as government supported aquaculture facilities within Mpumalanga. A report titled "*Status of the Lydenburg Hatchery*" has been compiled at the same time as this strategic plan and provides details regarding the current status of Lydenburg facilities and the actions that would be required in the revitalisation of these facilities. Apart from the Lydenburg – and De Kuilen Hatcheries, the WRC Report K5/1446/4 could not detect any rural aquaculture development during 2003 and 2004. This situation is currently being addressed by the establishment of various small-scale farmer initiatives by the newly formed Division of Aquaculture.

The following summary of the Lydenburg – and De Kuilen Hatcheries provides more clarity of their current status.

A. LYDENBURG HATCHERY

The Lydenburg hatchery was commissioned in 1948 and falls under the custodianship of the Mpumalanga Parks Board. The hatchery was previously active in the production of trout, but currently this production is limited together with the production of small numbers of Bushveld Smallscale Yellowfish (*Labeobarbus polylepis*) and Mosquito Fish (*Aplocheilicthys katangae*). The infrastructure is generally in a poor state of repair and the hatchery is handicapped by water shortages. Nevertheless the Lydenburg Hatchery has potential for revitalisation into a centre for training, the production of indigenous fish, research, etc.

<u>INFRASTRUCTURE</u>
Trout hatchery building
Circular concrete tanks (25)
Concrete daphnia ponds (18)
Earthen ponds (80)
Officers and storerooms
Various houses and living quarters
Laboratory
Water Focus Centre (Aquarium)

B. DE KUILEN HATCHERY

The De Kuilen Hatchery was commissioned in 1975 by the Mpumalanga Parks Board for the production of trout and to secure a better water supply for the Lydenburg Hatchery. With the change in mandate of the Mpumalanga Parks Board with regards to the production of alien species, the facilities were leased to a private operator who produced 25 to 30 million trout ova per annum for export for many years. The private operator was bought out (2003) by a large international producer of ova and the operation subsequently stopped. The facility is now in a poor state of repair and no longer functional.

8 ALIGNMENT WITH THE DEPARTMENTAL STRATEGIC OBJECTIVES

8.1 BACKGROUND TO DEPARTMENTAL ALIGNMENT

In general DALA prioritises the provision of food security and farmer support (especially to emerging farmers and land reform beneficiaries), while noting the requirements for capacity building and skills development in achieving this. The Division of Aquaculture echoes these priorities in the development of aquaculture, as the achievement of success in the mobilisation of the aquaculture sector is underpinned by strategic alignment within DALA. The strategic objectives of DALA are included in section 5 above and will form the foundation from which aquaculture is developed. This strategic alignment will also ensure that aquaculture can be better catered for in the Medium Term Expenditure Framework (MTEF) for the period 2005/2006 to 2008/2009.

There are three key sectors serviced by DALA, which are agriculture, environment and conservation. In terms of agriculture (and aquaculture) DALA has identified the improvement of irrigation (building of dams, etc.), the reopening of the Maputo harbour and the new Kruger-Mpumalanga International Airport as key factors in development. In terms of the environmental and conservation sectors DALA seeks to improve its regulatory, co-ordinating and advisory services through the internal appointment of expertise and skills development.

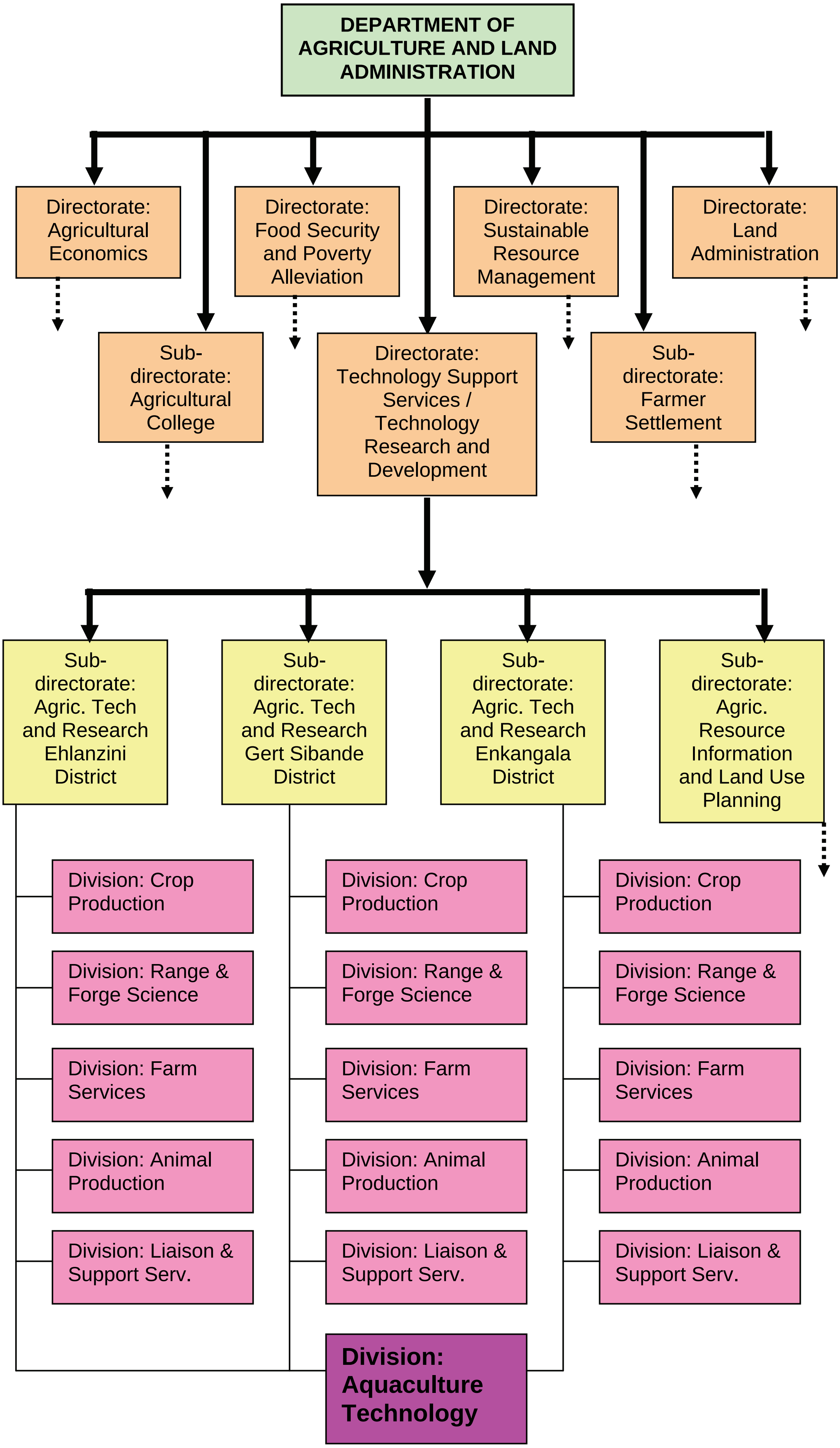
It is important that the Division of Agriculture also aligns itself with its mother Department its terms of the following strategic areas:

- The role of DALA in agricultural based wealth creation, poverty reduction and conservation.
- The initiatives of DALA and other parastatals in the provision of farming loans for identified agricultural potentials (i.e. such as specific aquaculture projects).
- The provision of agricultural (and aquaculture) infrastructure through the Comprehensive Agriculture Support Programme (CASP).

- The support given to small-scale farmers in terms of basic operational infrastructure establishment.
- The rural service programmes through the rural service points.
- Linking in with environmental centres, especially in providing awareness of environmental legislation and environmental education (as this effect aquaculture).

The following diagram (next page) illustrates the alignment of the Division of Aquaculture within DALA and the service and cross-disciplinary networking in the Department. Within the more comprehensive version of this diagram used in the greater strategic plan of DALA the Division of Aquaculture's core purpose is given as being the development and transfer of commercial aquaculture technology while the core functions are:

- The development of appropriate and adaptable fish production technologies.
- To conduct research on fish production.
- To compile reports on research.
- To monitor the implementations of research recommendations



SPECIFIC ALIGNMENT

For aquaculture to succeed in the Mpumalanga Province specific alignment with the programmes of the greater DALA strategic plan is important. The following section highlights these programmes and indicates how these programmes will be adopted into aquaculture development. The relevant aspects / programmes from the Department's Strategic Plan have been displayed (*blocked*) and the alignment in terms of aquaculture development discussed shortly after each programme[1]. In most instances the captions from the greater Departmental Strategic Plan have been summarised and only aspects of relevance shown.

8.1.1 PROGRAMME 1: ADMINISTRATION

Relevant aspects captured from the DALA Strategic Plan
Programme 1: Administration

Strategic goal

- *To manage and administer for improved service delivery*

Strategic objectives

- *To provide administration and general governance services*
- *To provide strategic leadership / management and strategy / policy implementation*
- *To provide financial and corporate support services*
- *To provide effective departmental co-ordination*

Although the above strategies of DALA are more relevant to the greater administration of the Department, these administrative objectives must be used as guidance towards a comprehensive administrative approach for the Division of Aquaculture in its goal towards effective service delivery. In this regard it is also recommended that this strategic plan be lodged with the relevant administrative sections of the Department to ensure administrative due diligence.

[1] Note that although the objectives and mechanisms have been taken from the Department's Strategic Plan, only the items that have relevance to aquaculture have been retained in summary. By no means does this imply that the objectives and mechanisms that have been left out are of less importance but rather that these objectives and programmes are more prominent to the overall strategic planning in the Department and not necessarily at the level of aquaculture development.

8.1.2 PROGRAMME 2: SUSTAINABLE RESOURCE MANAGEMENT

Relevant aspects captured from the DALA Strategic Plan
Programme 2: Sustainable Resource Management

Strategic goal

- *To develop and implement policy for sustainable utilisation of natural resources.*

Strategic objectives

- *Support the development and sustainability of agricultural infrastructure.*

The programme consists of two sub programmes:

Subprogram 2.1: Engineering Services
Most of the functions in this programme focus on traditional activities such as road building, construction of dams and soil conservation. Nevertheless the goal is to promote sustainable utilisation of resources through supporting the sustainability of agricultural infrastructure and improving the efficiency and effectiveness of water use in agriculture, amongst others.

Subprogram 2.2: Land Care
Land Care works holistically to protect and conserve natural resources. This includes promoting sustainable utilisation of natural resources though the survey, design and construction of conservation works and the planning of catchment areas.

Although all the aspects of programme 2 are of importance to aquaculture development, the following specific alignment is essential:

- The Division of Aquaculture must ensure that it remains informed of the infrastructure works that are related to the use of water resources (as per the responsibilities of the Engineering Services) as these should be evaluated for their aquaculture potential and the possibilities of integrated aquaculture with other core water supply activities.
- The Engineering Services should be used to provide technical inputs into the design of aquaculture infrastructure wherever it is required in project development.
- Due to the extensive knowledge of water resource planning, the Land Care section should be used as partners in the identification of aquaculture opportunities and the planning for sustainable management of aquaculture production.

8.1.3 PROGRAMME 3: FARMER SUPPORT SERVICES

Relevant aspects captured from the DALA Strategic Plan
Programme 3: Farmer Support Services

Extension officers and extension services are challenged by rapid development in agricultural technology, market liberalisation, land redistribution, land settlement support, globalisation and the changing economic environment.

Sub-programme 3.1: Farmer Settlement
Strategic goal

- *To render agricultural support services*

Strategic objective

- *To render pre-settlement and post settlement support in land reform*
- *To manage and administer agricultural state land*
- *To advise on the subdivision of agricultural land and change of land use*

Sub-programme 3.2: Farmer Support
Strategic goal

- *To render agricultural extension services*

Strategic objective

- *To expand the extension services*
- *To continually improve the effectiveness of the extension services*
- *To increase the number of needs based farmer training opportunities*

Sub-programme 3.3: Food Security
Strategic goal

- *Enhancing household food security and income generation*

Strategic Objective

- *To capacitate communities to respond to agriculture opportunities*
- *To improve the sustainability of food security and poverty alleviation projects.*

The alignment of aquaculture development with the extension programmes of DALA follows the sub-programmes hereafter.

8.1.3.1 SUB-PROGRAMME 3.1, 3.2 and 3.3: FARMER SUPPORT SERVICES IN THE DISTRICTS

Relevant aspects captured from the DALA Strategic Plan
Sub-programme 3.1, 3.2 and 3.3: Farmer Support Services in the Districts

The Mpumalanga Province is divided into 3 management districts, these being:
- *The Ehlanzeni District*
- *The Gert Sibande District*
- *The Nkangala District*

Collective service delivery priorities
- *To address the capacitation of the rural poor towards independent entrepreneurship and self-sufficiency*
- *To ensure food security by capacitation under the philosophy of helping people to help themselves. Advances are planned in food security by promoting new technologies such as aquaculture*
- *To strengthen the capacity of households to respond to agricultural opportunities as a safety net*
- *Render support to restitution beneficiaries*
- *To ensure good governance by applying transparency and co-responsibility*
- *To promote infrastructure development by advancing local markets, conveying conservation practices, supporting indigenous know-how and participating in inter-sectoral relationships with other role-players such as the private sector.*
- *To enhance socio-economic development by participating in municipal IDP structures and interacting with other departments and banking institutions.*
- *To promote human resource development by capacitating officials through formal and in-service training*
- *To ensure effective communication by having meetings, holding public information days and maintaining an open door policy*
- *Implement the comprehensive Agricultural Support Programme (CASP)*
- *To identify and support the implementation of the Agri-business programme*
- *To increase the number of farmers reached by the technicians and to improve and evaluate the effectiveness of the extension service*

Although all the aspects of programme 3 are of importance to aquaculture development, the following specific alignment is essential:

- As aquaculture is a new area of technology and development the Division of Aquaculture must sensitise and expose the existing farmer support and extension services to this field. This must be done by means of dedicated programmes to inform the farmer support and extension services of aquaculture to the level at which they (at a minimum) are able to refer aquaculture opportunities and inquiries to the Division of Aquaculture.
- The Division of Aquaculture must strive for the establishment of at least one dedicated extension officer by the appointment and training of a suitable candidate with experience in aquaculture development.
- The Division of Aquaculture must form a linkage with the Farm Settlement sub-programme to assist with the identification of aquaculture opportunities that may arise from the resettlement process. This would include the provision of post-settlement support to aquaculture farmers.
- The Division of Aquaculture must form linkages with the Food Security sub-programme to ensure that aquaculture becomes know as a means to achieving food security, poverty

alleviation and entrepreneur development. Communities must be sensitised to aquaculture so that they are able to develop aquaculture opportunities in partnership with DALA.

- Aquaculture has been identified as a specific area of potential technology introduction into the management districts and the Division of Aquaculture must thus be prepared to disseminate such technologies into these areas.
- To achieve success in aquaculture development the Division of Aquaculture must ensure the formation of strong communications between all potential stakeholders. Furthermore the Division must promote the recognition of aquaculture opportunities in the IDP processes of the respective municipalities.
- The Division of Aquaculture must hold regular public days to enhance the awareness of aquaculture as a tool for poverty reduction, food security and business development.
- Aquaculture must be linked into the CASP programme (and the Agribusiness programme) to ensure that the opportunities that are created by the programme can be exploited for the development of aquaculture.

8.1.4 PROGRAMME 4: VETERINARY SERVICES

Relevant aspects captured from the DALA Strategic Plan
Programme 4: Veterinary Services

The programme (consisting of 5 sub programmes) renders a veterinary service in all aspects pertaining to animal health, public health and diagnostics. Imperatives include the establishment of veterinary clinics and the recruitment of professionals

Strategic objectives

- *To ensure the health of provincial livestock, poultry and game*
- *To ensure that food derived from animals is safe and wholesome*
- *Disease surveillance, compliance, quarantine, vaccination and quality control*
- *Oversight of food safety, abattoir hygiene, imports and exports.*
- *Continuing education and training, diagnostic support and animal welfare.*
- *Notifiable disease control and disease emergency response.*
- *To promote animal health and disease control according to OIE guidelines.*
- *To supply a veterinary laboratory diagnostic services.*
- *To render a veterinary epidemiological service, including contingency planning.*
- *To provide primary animal health care and clinical services.*
- *To monitor imports and certify exports of animals and agricultural products.*
- *To facilitate Veterinary extension and training.*
- *Risk assessment and early warning analysis.*
- *Improving meat safety assessments by the hygiene assessment system (HAS).*

The alignment of aquaculture development with the veterinary programmes of DALA follows the sub-programmes hereafter.

8.1.4.1 SUB-PROGRAMME 4.1: ANIMAL HEALTH

Relevant aspects captured from the DALA Strategic Plan
Sub-programme 4.1: Animal Health

Strategic goal
To monitor animal disease, prevent the spread of diseases, control outbreaks and evaluate epidemiological data.

Strategic objectives
- *Compilation of contingency plans and standard operational plans*
- *Implementation of risk assessment and early warning system analysis*
- *Provision of epidemiological services*
- *Liaison with neighbouring provinces and other stakeholders*

8.1.4.2 SUB-PROGRAMME 4.2: VETERINARY PUBLIC HEALTH AND FOOD SAFETY

Relevant aspects captured from the DALA Strategic Plan
Sub-programme 4.2: Veterinary Public Health and Food Safety

Strategic objectives
- *To provide leadership in food safety by inspections at abattoirs and through hygiene assessments*
- *Linkage and co-operation between international and national agencies*
- *Effective participation in setting standards*
- *Risk assessment, surveillance and capacity building to reduce food-borne disease.*
- *Development of an information system on food-borne disease*

8.1.4.3 SUB-PROGRAMME 4.3: VETERINARY LABORATORY DIAGNOSTICS

Relevant aspects captured from the DALA Strategic Plan
Sub-programme 4.3: Veterinary Laboratory Diagnostics

Strategic objectives
- *To render a provincial laboratory diagnostic service.*
- *Implement a laboratory quality – and information management system.*
- *Aim to achieve ISO 17025 accreditation.*

8.1.4.4 SUB-PROGRAMME 4.4: IMPORT AND EXPORT

Relevant aspects captured from the DALA Strategic Plan
Sub-programme 4.4: Import and Export

<u>Strategic objectives</u>
- *These are governed by the FAO, WTO and OIE codes and regulations. In addition, every importing country sets its own requirements and regulations*
- *The upkeep of a credible provincial veterinary service, accredited laboratories and uniform national norms and standards.*

8.1.4.5 SUB-PROGRAMME 4.5: CLINICAL SERVICES

Relevant aspects captured from the DALA Strategic Plan
Sub-programme 4.5: Clinical Services

<u>Strategic objectives</u>
- *These are governed mainly by the Veterinary and Para-veterinary Professions Act and The Animal Protection Act.*
- *To render extension, advice and clinical services to all operating projects.*
- *Rendering a service to indigent communities not served by private practitioners and to augment animal health, public health and diagnostic services.*

Although all the aspects of programme 4 are of importance to aquaculture development, the following specific alignment is essential:

- Veterinary services to the aquaculture sector in the entire Southern African region are lacking. There is a dire shortage of specialisation into aquaculture-based veterinary and the management of aquaculture diseases. In this regard the Division of Aquaculture must motivate for specialised training of at least one Departmental veterinarian in basic diagnostics, treatment, breakout response, import and export controls and consumption safety in the aquaculture sector.
- A standardised (preferably regular) monitoring programme for the health status of aquaculture in the province must be designed and implemented. In this regard the Mpumalanga trout industry has done similar work and this should be supported, adopted and expanded upon by the Division of Aquaculture.
- The Division of Aquaculture must form beneficial linkages with the private company Aqua Vet that is based in Mpumalanga. This company provides various veterinary services to the greater aquaculture sector in South Africa. Furthermore linkages must be formed with other national institutions that provide services in aquaculture disease management (i.e. the University of the Free State and Onderstepoort).

8.1.5 PROGRAMME 5: TECHNICAL RESEARCH AND DEVELOPMENT SERVICES

8.1.5.1 SUB-PROGRAMME 5.1: RESEARCH

Relevant aspects captured from the DALA Strategic Plan
Sub-programme 5.1: Research

Strategic goal
- *To develop and transfer appropriate agricultural technology.*

Strategic objectives:
- *To conduct adaptive, demand driven and participatory research to improve agricultural productivity*
- *To establish and strengthen research partnerships*
- *To support the development of aquaculture and game farming*

8.1.5.2 SUB-PROGRAMME 5.2: INFORMATION SERVICES

Relevant aspects captured from the DALA Strategic Plan
Sub-programme 5.2: Information Services

Strategic goal
- *Develop and update agricultural databases for improved decision-making*

Strategic objectives
- *To market /disseminate available information*
- *To enhance access to information on the Agricultural Geo-Information System and other data bases.*

8.1.5.3 SUB-PROGRAMME 5.3: INFRASTRUCTURE SUPPORT

Relevant aspects captured from the DALA Strategic Plan
Sub-programme 5.3: Infrastructure Support

The main function is to provide and maintain farm services and infrastructure facilities to the research divisions

Although all the aspects of programme 5 are of importance to aquaculture development, the following specific alignment is essential:

- Although aquaculture technology is widely available the introduction of this new field to DALA poses a challenge in terms of researching the available information for its applicability to local conditions. Aquaculture is however a core research area together with game farming as these provide alternative agribusiness opportunities. In this regard a partnership must be formed with the Research sub-programme to establish an adaptive, demand driven and participatory research drive for aquaculture, together with the dissemination of this information.
- For effective aquaculture development in the Mpumalanga province the Division of Aquaculture must prioritise the compilation and maintenance of a database of current

aquaculture activities as well as areas that possess a potential for aquaculture. This should be done in partnership with the sub-programme for Information Services.

8.1.6 PROGRAMME 6: AGRICULTURAL ECONOMICS AND MARKETING

Relevant aspects captured from the DALA Strategic Plan
Programme 6: Agricultural Economics and Marketing

This programme consists of various sub-programmes:

- *Sub-programme 6.1: Market Services which is primarily responsible for the provision of market information and with further sub-programmes:*
  - *Sub-programme 6.1.1: Agribusiness Development Support (Financial Liaison) which focuses on establishing cooperatives and agribusinesses and value adding*
  - *Sub-programme 6.1.2: Production Economics: which renders production economic advisory services (feasibilities and planning)*
  - *Sub-programme 6.1.3: Agricultural Risk and Disaster Management which develops early warning systems and administers disaster relief*
- *Sub-programme 6.2: Micro Economics which renders statistical and analytical services*

Overall Strategic objectives

- *To promote economic and sustainable production and development in all agricultural sectors*
- *To promote economic growth, job creation and socio-economic development*
- *To improve the facilitation of access to domestic and export markets*
- *To improve the establishment of agricultural businesses*
- *To improve agricultural production and economic advisory services in viability analysis, market access, business development, statistics and risk management*
- *To facilitate access to finance*
- *To collate, analyse and publish agricultural statistics*

Although all the aspects of programme 6 are of importance to aquaculture development, the following specific alignment is essential:

- The marketing and marketability of locally produced aquaculture products is a national challenge and caused primarily by poor awareness of aquaculture products and competition with traditional fisheries products. For this reason the Division of Aquaculture must initiate an active aquaculture product marketing and awareness drive. Due to the early initiation of aquaculture it is however suggested that such a drive initially focus on the existing products produced by the Mpumalanga trout sector. This drive can be extended to other products as the sector develops.
- As the aquaculture sector develops the Division of Aquaculture must form links with the departmental marketing structures to investigate export opportunities, local markets, product value addition, financing opportunities for new projects, packaging, distribution, etc.
- The Division of Aquaculture must ensure that each new aquaculture project is scrutinised by means of a feasibility exercise to determine the sustainability. Assistance can be provided in this regard by the sub-programme for Production Economics, who are also able to provide extension services with regard to feasibility determination.
- Statistical analysis of the aquaculture sector development (in terms of products, socio-economic impact, distribution, etc.) can be provided to the Division of Aquaculture by the Micro Economic sub-programme.

8.1.7 PROGRAMME 7: STRUCTURED AGRICULTURAL TRAINING

Relevant aspects captured from the DALA Strategic Plan
Programme 7: Structured Agricultural Training

This programme consists of two sub-programmes:

Sub-programme 7.1: Agricultural Training
Strategic goal
- *To improve the performance of the agricultural sector*

Strategic objectives
- *To provide formal agricultural training*
- *To maintain and develop the college farm (Lowveld Agricultural College)*

Sub-programme 7.2: Further Education Training
Strategic goal
- *To provide skills development to prospective and practising farmers*

Although all the aspects of programme 7 are of importance to aquaculture development, the following specific alignment is essential:

- The Division of Aquaculture is in the process of building a new hatchery / research facility on the premises of the Lowveld Agricultural College. This should be used as the stepping stone towards the establishment of a formal training course / programme for students of the college.
- A partnership should be established with the Further Education Training programme to disseminate aquaculture information by means of a skills development programme that could be presented in the form of popular press, information brochures, field days and integration with other agricultural training programmes in the respective districts.

8.1.8 PROGRAMME 8: ENVIRONMENT AND CONSERVATION SERVICES

Relevant aspects captured from the DALA Strategic Plan
Programme 8: Environment and Conservation Services

National Treasury has gazetted 9 programmes and sub-programmes for Provincial Environmental Affairs departments, of which 6 are applicable to the province and two still require institutionalisation. The Chief Directorate Environmental Services currently consists of the following four programmes:

- ***Programme 8** – Planning, Impact, Pollution and Waste Management (Directorate: Environmental Impact Management Services and Directorate: Pollution & Waste Management Services).*
- ***Programme 9** – Ecosystems, Biodiversity and Natural Heritage Management (Sub-Directorate: Biodiversity & Conservation Management Services).*
- ***Programme 10** – Environmental Management and Sustainable Development, Empowerment and Capacity Building (Directorate: Environmental Awareness & Education).*
- ***Sub-Programme 10.1** – Environmental Management and Sustainable Development Policy, Legislation, co-ordination and Monitoring (Sub-Directorate: Strategic Environmental Management).*

The directorates as listed above have the following primary responsibilities:

Directorate: Pollution & Waste Management Services
Responsible for planning and compliance in waste management, air quality management and pollution abatement.

Directorate: Environmental Impact Management Services
Responsible for authorizing, monitoring and compliance of listed activities, which could have potentially detrimental impact on the environment.

Sub-Directorate: Biodiversity & Conservation Management Services
Responsible for planning, regulating, monitoring for integrated eco-system and bio diversity management and sustainable utilisation of natural resources.

Directorate: Environmental Awareness & Education
Responsible for promotion, encouragement, development and implementation of environmental awareness and education.

Sub-Directorate Strategic Environmental Management
Responsible for development of environmental standards, norms and guidelines, environmental information management, environmental policy analysis, environmental capacity building, integrated land use, development planning, facilitation of sustainable development and greener governance.

Relevant aspects captured from the DALA Strategic Plan
Programme 8: Environment and Conservation Services

All of the sub programmes of this programme deal with the following core environmental issues:

<u>Waste management</u>
Waste must be managed to avoid environmental degradation, conserve resources and protect people and the environment. An integrated approach to waste management includes minimisation, reduction, re-use, treatment and disposal.

<u>Land</u>
Industries depend on sustainable land resources. This is also a source of food, fuel, construction material and more. Land degradation (erosion, loss of vegetation, chemical imbalances) leads to a reduction in productive capacity.

<u>Water</u>
Water needs to be managed carefully for economic development and ecological integrity. Four Water Management Areas (WMAs) are located in the province, while close cooperation with partners (e.g. DWAF) is required to ensure adherence to water quality guidelines in the EIA process

<u>Sustainable development</u>
As stipulated in the World Summit's Johannesburg Plan of Implementation, sustainable development initiatives need to be implemented across all three tiers of government.

Although all the aspects of programme 8 are of importance to aquaculture development, the following specific alignment is essential:

- Due to aquaculture being a new field of expertise and the lack of experience of officials to understand and deal effectively with the application of the respective environmental legislation to aquaculture, the Directorate of Environmental Services can delay the rapid development of responsible and sustainable aquaculture practises. For this reason the Division of Aquaculture must forge close ties with this Directorate in order the capacitate its officials, increase the awareness of aquaculture and jointly develop mechanisms for dealing with aquaculture within the existing legislative framework.
- The Division of Aquaculture must take the lead in the development of best management practises and environmental management plans for aquaculture that would be acceptable to the Directorate of Environmental Services and which would lead to the sustainability of aquaculture practises.
- The Division of Aquaculture must take the lead in the formulation of policies (guided by the relevant legislative frameworks) around the use of exotic species in aquaculture development. In this regard the Division must form close ties with the Directorate of Environmental Services and the Mpumalanga Parks Board.
- In the environmental awareness programmes that are implemented by the Directorate of Environmental Awareness and Education, aquaculture must be promoted as a means to relief the harvesting pressure on marine fisheries stocks and promoting socio-economic and environmentally responsible development.
- The Division of Aquaculture should form a partnership with the Sub-Directorate of Strategic Environmental Management and the provincial branch of the Department of Water Affairs and Forestry in establishing norms and standards for water quality discharge from aquaculture. In this regard the Department of Water Affairs and Forestry have already developed policy and protocol for aquaculture development.

8.1.9 PROGRAMME 9: LAND ADMINISTRATION

Relevant aspects captured from the DALA Strategic Plan
Programme 9: Land Administration

Strategic Objectives:

- *Facilitate the implementation of land reform*
- *Ensure an integrated land management process and services*
- *Provide formalised sites to be allocated to the landless beneficiaries and to increase title deeds to beneficiaries.*
- *Provide participatory development planning at local municipal level though the development of Integrated Development Plans (IDPs)*
- *Formalisation of existing rural settlements under tribal jurisdiction.*

The Land Administration Directorate consists of three sub programmes:

Sub-programme 9.1: Planning and Surveying Services

- *To implement tenure upgrading programs and town-planning projects*
- *To provide surveying services and land master planning*
- *To establish and maintain as strategic land database*
- *To administer state land release*
- *To assist with Integrated Development Plans*

Sub-programme 9.2: Land Development

- *To administer the functions of the Mpumalanga Townships Board, Mpumalanga Development Tribunal and the Mpumalanga Development Appeal Tribunal*
- *To administer certain delegated sections of the Communal Land Rights Act.*
- *To implement a land use management system to administer zoning*

Sub-programme 9.3: Land Reform

- *To obtain community resolutions for development on state land.*

Although all the aspects of programme 9 are of importance to aquaculture development, the following specific alignment is essential:

- The Division of Aquaculture must ensure that aquaculture becomes an alternative production option in cases where water resources are allocated through the land reform process to previously landless beneficiaries. Aquaculture should also be promoted as a production option in existing rural areas and on communal land.
- The Division of Aquaculture must promote the recognition of aquaculture opportunities in the IDP processes of the respective municipalities and ensure that new aquaculture opportunities are recognised in the zoning possesses of the Land Administration programme

8.1.10 PROGRAMME 10: FOOD SECURITY AND POVERTY REDUCTION

> ***Relevant aspects captured from the DALA Strategic Plan***
> ***Programme 10: Food Security and Poverty Reduction***
>
> *Strategic goal*
> - *Reduce poverty and ensure food security*
>
> *Strategic objectives*
> - *Implementation of the Integrated Food Security & Nutrition program.*
> - *Implement programs for income generation and poverty alleviation.*
> - *Implement the Integrated Sustainable Rural Development Program (ISRDP)*
> - *Promote food safety, education and use of food production resources.*
> - *Co-ordinate the development of partnership to mobilise the resources of departments, the private sector, the civic and development groups towards poverty reduction.*
> - *Strengthening of the capacity of the rural poor and their organisations*

Although all the aspects of programme 10 are of importance to aquaculture development, the following specific alignment is essential:

- The Division of Aquaculture must ensure that the necessary information is passed onto the programme for Food Security and Poverty Reduction as this sector has a great potential in contributing to these ideals. The Division must remain active in promoting aquaculture as an alternative form of agriculture, which has significant food security and poverty reduction potential.

9 PARTNERS IN AQUACULTURE DEVELOPMENT IN MPUMALANGA

In this section a short analysis is provided of the core stakeholders that are involved in aquaculture development in the Mpumalanga Province (outside of the lead agent in the DALA).

9.1 NEPAD AND THE WORLD FISH CENTRE

The role and access to NEPAD and the World Fish Centre to be defined.

9.2 NATIONAL DEPARTMENT OF AGRICULTURE

The National DALA has developed an aquaculture section to address national policy and development issues in aquaculture in order to promote the establishment of a commercially viable and beneficial sector or industry. In this regard the National Department has co-funded the provincial strategic plan development initiative (with the Water Research Commission). The Mpumalanga DALA will benefit from the initiatives taken by the National department and must ensure that it is ready and willing to receive such support.

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The National Department has identified the lack of policy and developmental frameworks, together with an uncoordinated and often inconsistent approach from governmental and regulating authorities as a major constraint to the development of the sector. This has driven the National Department to compiling a single National Policy on Aquaculture to promote and support a sustainable aquaculture sector in South Africa. As part of the process they have established a central aquaculture sector working group (ASWG) to promote more effective producer, processor, and interdepartmental cooperation in the interests of a united and prosperous aquaculture sector.

To facilitate the development of a united and prosperous aquaculture sector the Department will, by means of policy:

- Address the capacity to unify and simplify aquaculture legislation, regulation and to facilitate the sustainable use of aquatic resources.
- Incorporate and align legislation, regulation, production and marketing inputs and sustainable resource use into a team effort by using interdepartmental and public private partnerships.

Furthermore the National Aquaculture Policy will deliver guidance on:

- Norms and standards for sustainable aquaculture
- An aquaculture database
- Promoting aquaculture for food security
- Government aquaculture centers
- Centers of excellence and service centers
- Advisory services
- The proposed National Aquaculture Institute
- Intellectual property rights
- Human resource development
- Regulatory implications

Apart from developing the National Aquaculture Policy the Department is also active in hosting the Aquaculture Sector Working Group, guiding the Regional (Northern – and Southern) Aquaculture Working Groups, participating in the Aquaculture Association of Southern Africa, working with the WRC in developing provincial strategic plans for aquaculture, developing norms and standards for the sector and keeping an active sector related information database. Future initiatives of the National Department in aquaculture include the training of aquaculture field officers, the establishment of community inland fisheries programmes to enhance food security, fostering further interdepartmental relationships and participation in provincial aquaculture development initiatives.

9.3 DEPARTMENT OF WATER AFFAIRS AND FORESTRY (DWAF)

The overall mandate of DWAF over the water resources that are required for the development of aquaculture is:

Contact Details:
Mr.
Tel:
Fax:
E-mail:

- The protection, use, development, conservation, management and control of water resources in a manner, which takes the following factors into account:
  - Promoting equitable access to water.
  - Redressing the results of past racial and gender discrimination.
  - Promoting the efficient, sustainable and beneficial use of water in the public interest.
  - Facilitating social and economic development.
  - Providing for the growing demand for water use.
  - Protecting aquatic and associated ecosystems and their biological diversity.
  - Reducing and preventing pollution and degradation of water resources.

DWAF is in the process of completing a process of policy and protocol development around the use of water resources for aquaculture purposes. This protocol will define the approvals process to gain access both to water resources on private land and to gain access to State controlled water resources. In terms of this process some water uses for aquaculture (mainly small scale and low impact initiatives) will be generally authorised or will be authorised by default through Schedule 1 of the National Water Act. Larger aquaculture initiative or those with a likely impact on the water resources will be subject to a licence application in accordance with the Schedule 21 (National Water Act).

9.4 OTHER GOVERNMENT DEPARTMENTS / ORGANISATIONS

The National Department of Science and Technology actively promotes small-scale aquaculture enterprise development and are active in seeking opportunities to develop small-scale aquaculture initiatives within the Mpumalanga Province.

The Department of Trade and Industry actively seeks the creation of export opportunities for aquaculture ventures.

The Water Research Commission is co-funding the development of provincial strategic plans for aquaculture together with the National Department of Agriculture and has fulfilled a key role in addressing research needs in aquaculture development.

9.5 REGIONAL AND INTER-PROVINCIAL LINKAGES

In South Africa the Mpumalanga Province is bordered primarily by Limpopo, KwaZulu Natal in terms of aquaculture development. In this regard a regional aquaculture development focus should be established so that the sector can be developed in a mutually beneficial manner. The following steps are recommended towards the establishment of an inter-provincial and regional aquaculture sector:

- Representatives from the Aquaculture Division within the Mpumalanga DALA must make contact with their counterparts in Limpopo and KwaZulu Natal and use the forum created by the Northern Aquaculture Working Group for further interaction.
- The Mpumalanga Province should inform the applicable sister provinces of its capabilities in aquaculture development. In this manner synergies will be established in which the provinces may find it useful to make use of these respective capabilities to move forward in a regional manner.
- The provinces must seek cooperation on matters such as the diagnosis and treatment of fish diseases, marketing and technical advances.

9.6 FARMERS AND OTHER ASSOCIATIONS

The Northern Aquaculture Working Group serves as a common platform for all stakeholders in aquaculture in the northern provinces of South Africa. This group functions as a regional leg of the Aquaculture Association of Southern Africa and serves the aquaculture sector by means of establishing the required networking between all role players on a common platform.

Within Mpumalanga the Mpumalanga Trout Forum is an active platform for the trout farmers of the region. DALA should support this association and use them as a collective forum for communication to the trout farmers, promotion of the sector and as a starting point for support to these farmers.

9.7 EDUCATIONAL INSTITUTIONS

The main educational institution involved in aquaculture development in the Mpumalanga Province is the Lowveld Agricultural College, which falls under DALA. Although the College is not currently active in the teaching of aquaculture as a subject the building of a new training hatchery on the grounds of the college will lead the way for more formalised training programmes.

Nationally, the Universities of Rhodes -, Limpopo and Stellenbosch present educational programmes in aquaculture. The Department of Ichthyology Rhodes University is the implementing agents for a five year aquaculture revival program funded and supported by the National Department of Agriculture and the Water Research Commission. In this regard they will play an important role in assisting the Mpumalanga DALA with the necessary strategic planning, training and building out of the sector.

10 CORE ISSUES AND POTENTIALS

In a consultative workshop attended by various stakeholders in the Mpumalanga aquaculture sector (9 February 2006) the core hindrances (issues) and core potentials in moving forward with the development of aquaculture were identified towards the establishment of strategic approaches for the most prominent of these. The hindrances (issues) were grouped into five themes as follows:

- Misunderstanding of people on policies and legislation.
- Lack of practical training and extension.
- Production obstacles.
- Poor understanding of the total current market.
- Poor understanding of aquaculture development.

The main areas of potential associated with the aquaculture sector were also grouped into five main themes as follows:

- Potential for conducive state intervention.
- Potential for better institutional arrangements.
- Potential to improve availability and access to resources.
- Potential for aquaculture to contribute to socio-economic development.
- Market potential of aquaculture products.

11 STRATEGY ON THE DEALING WITH ISSUES AND POTENTIALS

For each of the themes in the previous chapter (issues and potentials) the major underlying issues / challenges and potentials / opportunities were identified and prioritised into selected topics. These topics were analysed in terms of the actions that could be taken to resolve the issues or achieve the potentials, together with the identification of a lead agent, partners or co-workers, and the timeframes within which the actions could be taken. The results hereof are displayed in the tables that follow.

Table 1 – Addressing the topic of policy, legislation and state intervention

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers	Timeframe
Lack of understanding in policy and legislation	A lack of communication and information related to legislation and policies	• Link to AASA chat rooms and aquaculture workgroups. • Link with all stakeholders (gov. departments, etc.). • Take hand with new projects	• DALA-LRU-A • Part of aquaculture workgroup system • Aquaculture advisory panel	Within 3 months
	Legislative management protocols in terms of local conditions	• Establish aquaculture service centre	• DALA-LRU-A • With Environmental Directorate, other stakeholders (e.g. DWAF) and producer organisations	18 to 24 months
	Legalising currently un-permitted aquaculture activities	• Awareness under farmers of un-permitted situations • Compile guidelines to aquaculture legalisation	• DALA-LRU-A with partners such as Environmental Directorate, DWAF, parks Board and National Dept. Agric. • Current WRC project	Awareness and aquaculture guidelines in 12 months
	Licensing of water use for aquaculture	• Awareness under farmers of un-permitted situations • Compile guidelines to aquaculture legalisation • Work closely with DWAF	• DALA-LRU-A with DWAF.	Awareness and Aquaculture guidelines in 12 months
	Representation on catchments management agencies (CMA)	• Write a letter to CMAs to reserve representation by aquaculture	• DALA-LRU-A	In 1 month

Table 2 – Addressing the topic of lack of practical training and extension

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers	Timeframe
Lack of practical training and extension	Lack of training strategy	• Develop specific strategy for training to include farmers, extension officers, institutional organization and tertiary / training organizations	• DALA-LRU-A • Private sector • Institutional orgs. • Tertiary institutions • SETA	12 months
	Lack of capacity and expertise with regard to aquaculture training	• Fill allocated posts in DALA-LRU-A with suitably trained people and motivate for learnerships / bursaries	• DALA-LRU-A with assistance from National Dept. Agric, Universities and AASA	In 2006/2007 financial year
	Lack of aquaculture specialists in the various regions for farmer support	• Fill allocated posts in DALA-LRU-A with suitably trained people • Skills training for existing extension officers • Letter to veterinary services for support to aquaculture	• DALA-LRU-A with assistance from National Dept. Agric, Universities and AASA • Universities, DST, National Dept. Agric and WRC approach for training the trainers • DALA-LRU-A	In 2006/2007 financial year Over 5 years + ongoing Immediate
	Incentives for personnel and trainers	• Use existing DALA incentive scheme	• To be mobilised by DALA-LRU-A	As soon as possible
	Develop new training facilities (Lowveld College) and revitalization of state facilities (Lydenburg Hatchery) for capacity building.	• Allocate strategies and budgets. • Establish negotiation forum with Mpumalanga Parks Board	• DALA-LRU-A • With Mpumalanga Parks Board	In 2006/2007 financial year

Table 3 – Addressing production obstacles and access to resources

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers	Timeframe
Addressing production obstacles and access to resources	Uncertainty regarding current and required production infrastructure	• Establish data base of current production infrastructure • Undertake assessment of aquaculture potential • Undertake needs assessment in terms of infrastructure	• DALA-LRU-A with possible assistance from National. Dept. Agric., WRC, DST and other stakeholders	Starting immediately and to be completed in 2 years
	Lack of in-depth economic feasibility studies and detailed project information	• Develop production models and benchmarks • Develop standard format for aquaculture business plans	• DALA-LRU-A to request assistance from National Dept. Agric, DTI, DST and banking institutions	To initiate with 6 months
	Identification of aquaculture entrepreneurs	• Establish aquaculture entrepreneur identification programme	• DALA-LRU-A	Within a year and ongoing
	Funds required for project development	• To liaise with DST, WRC, MADC, DTI and other sources	• DALA-LRU-A with specific project proponents	Ongoing
	Ensure disease surveillance and diagnostics	• To check capacity with veterinary services in terms of aquaculture • Motivate for appointment / training for an aquaculture veterinarian • Training to farmers on aquaculture disease	• DALA-LRU-A to liaise closely with veterinary services, farmers and National Government	Action to initiate within 12 months

Table 4 – Addressing the topic of poverty alleviation, job creation and other socio-economic matters

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers	Timeframe
Poverty alleviation and job creation	Support for emerging and small-farmers	• Establish aquaculture service centre • Target emerging and small-scale projects to provide support to • Train existing extension officers in basic aquaculture	• DALA-LRU-A with assistance from WRC and DST projects	Completed in 18 to 24 months
	Awareness of aquaculture in poverty alleviation	• Train existing extension officers in basic aquaculture • Use existing departmental communication frameworks	• DALA-LRU-A	To commence as soon as possible
	To achieve correct project for correct situation with correct technologies and species	• Implement Participation Rural Appraisal (PRA) in aquaculture and with specialist inputs	• DALA-LRU-A with relevant implementing agents and specialist	With each new project
	Lack of information for aquaculture in communities	• Establish aquaculture service centre	• DALA-LRU-A	18 to 24 months

Table 5 – Addressing the topic of marketing

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers	Timeframe
Lack of specialized marketing body	Change perception to aquaculture and its products	• Use indigenous knowledge base about fish • Develop market development strategy	• DALA-LRU-A • With assistance from DTI, National. Dept Agric. And farmers (where applicable)	Commence With 6 months
	Lack of market information and need for improved market access	• Undertake market survey, including access to international market surveys (i.e. FAO).	• DALA-LRU-A to outsource with assistance from DTI, MADC and National Dept. Agric. • Consult with similar national projects (i.e. SEDA)	Commence With 6 months
	Ensuring consistent product quality and quantity	• Develop protocol on minimum quality standards • Conduct research on quality problems. • Pool production to address quantity constraints	• DALA-LRU-A with assistance from SABS. • Information from farmers and end users. • DALA-LRU-A in cooperation with farmers	Over a period of 5 years

APPENDIX 3:
Free State Province Draft Aquaculture Strategic Plan

FREE STATE PROVINCE
DEPARTMENT OF AGRICULTURE

PARTICIPATORY DEVELOPMENT OF PROVINCIAL AQUACULTURE PROGRAMMES FOR IMPROVED RURAL FOOD SECURITY AND LIVELIHOOD ALTERNATIVES

WORKING DRAFT

STRATEGIC PLAN
FOR AQUACULTURE DEVELOPMENT IN THE FREE STATE PROVINCE

FEBRUARY 2006

CO-WORKERS:

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PREAMBLE TO THE FREE STATE STRATEGIC PLAN FOR AQUACULTURE

This working draft presents the first version of the Strategic Plan for Aquaculture Development in the Free State Province. The development of this strategic plan is being driven by the Department of Agriculture in the Free State Province as assisted by Rhodes University who are implementing an initiative by the Water Research Commission and the National Department of Agriculture to achieve participatory development of provincial aquaculture programmes for improved rural food security and livelihood alternatives.

Primary inputs towards the formulation of a Strategic Plan for Aquaculture Development in the Free State Province was gathered from farmers, service providers, policy makers and other stakeholders at a workshop in Bloemfontein on 26 January 2006. In this workshop it was identified and agreed upon that aquaculture producers require recognition and that service providers (Department of Agriculture and others) are ready and willing to provide the necessary support to the aquaculture sector.

This Strategic Plan is an essential tool for planning and resource allocation. The aim of the Plan is to strategically mobilise, distribute and utilizes those resources equitably and efficiently to achieve the following objectives:

- Growing the economy
- Job creation
- Economic empowerment and
- Poverty alleviation

The Strategic Plan is informed by the National Government's priorities that include:

- Reducing poverty
- Creating employment opportunities
- Food security
- Growing the economy
- Rural development/urban renewal
- Sustainable development and
- NEPAD

The Strategic Plan will provide essential information that will enable effective benchmarking that will result in the monitoring and evaluation of the Department's performance in achieving the planned objectives and outcomes.

The philosophy of strategic support to the agricultural sector in this Strategic Plan is participatory and demand led/driven. The strategic planning is a cyclical process informed by this philosophy, followed by programme implementation, monitoring and performance evaluation.

FOREWORD

To be written by a senior official (e.g. MEC)

1 OVERVIEW OF AQUACULTURE

Aquaculture is defined as the propagation, improvement, trade or rearing of aquatic organisms (plant and animal) in controlled or selected aquatic environments (fresh, sea or brackish waters) for any commercial, subsistence, recreational or other public or private purpose.

1.1 AQUACULTURE GLOBALLY

On a global scale, aquaculture is growing more rapidly than any other food-producing sector. World aquaculture production totaled 45.7 million tons in 2000 and was valued at US$56.5 billion (FAO, 2002). In 1997, farmed fish, crustaceans and molluscs contributed 3.9% of total world fish supplies, and this figure had increased to 27.3% by 2000 (FAO, 2002).

Globally market forces, the diversification of the economic base, the sustainable utilization of resources and a quest for food security drive the development of aquaculture. In this regard, aquaculture has developed into a diverse industry, with over 64 countries participating in the production of more than 300 species of fish, shellfish, crustaceans and aquatic plants.

On average, global aquaculture has experienced a compounded growth rate of 9.2% per year since 1970 (FAO, 2002). This is considerably greater than that of capture fisheries and the terrestrial agriculture sector, which experienced an average compounded growth of only 1.4% and 2.8%, respectively for the same period (FAO, 2002). This trend is set to continue as world fishery production has effectively leveled off, the demand for fish is increasing due to population growth, and the shortfall in supply will have to come from aquaculture if per capita consumption is to be maintained.

The per capita supply of food fish from aquaculture globally (excluding China) has increased four-fold in the past three decades, from 0.6 kg in 1970 to 2.3 kg in 2000 (FAO, 2002). This suggests that the contribution made by aquaculture to global protein security has continued to increase per capita, in spite of global human population growth.

1.2 AQUACULTURE IN AFRICA

In spite of its vast natural and human resources, the participation of Africa in the global aquaculture sector is lacking and aquatic species indigenous to Africa have developed into aquaculture species of international importance. Developing countries from Southeast Asia and South America have secured significant participation in these sectors, but African countries have been unable to secure any meaningful economic benefits thus far.

Africa’s contribution to global aquaculture production is extremely low relative to the contributions made by other continents. Africa contributed only 0.4% of global production in 1995, compared to 87.7% from Asia and Oceania, 6.7% from Europe, 1.6% from South America, and 0.7% from the former USSR during the same year (Hecht and De Moor, 1997). However, in line with global trends, the aquaculture industry in Africa has also experienced considerable growth over the past few decades. For example, African aquaculture production, including finfish, shellfish, molluscs and aquatic plants, increased from 11,800 to 82,014 tons between 1985 and 1995; that is an eight-fold increase in only 10 years (FAO, 1997; Hecht and De Moor, 1997). The production of fish and shellfish from the African continent totaled approximately 79,500 metric tons in 1998; 57% of this was produced by three countries bordering the Mediterranean, with Egypt producing most (i.e. 43,000 tons) (Hecht, 2001). Thirty-tree sub-Saharan countries produced the remaining 34,000 metric tons, of which 93% can be attributed to 6 countries, viz. Nigeria (16700 tons), South Africa (4500 tons), Zambia (4100 tons), Zimbabwe (3800 tons), Namibia (1300 metric tons) and Kenya (1100 tons) (Hecht, 2001). The other 27 countries for which statistics are available produced a total of only 2500 tons (Hecht, 2001). Most of the product in the six major producing countries originated from relatively large and capital intensive private operations or joint ventures between the private and the public sector, whereas by contrast, the farms in the 27 minor producer countries are small-scale or subsistence operations (Hecht, 2001). Hecht (2001) concluded from this summary that national aquaculture development programs for rural areas in most sub Saharan countries have not been sustainable, despite substantial international donor funding and despite a highly suitable environment.

1.3 AQUACULTURE IN SOUTH AFRICA

The further growth of aquaculture in Southern Africa depends on the successful integration, use and development of natural resources (water, land, climate, energy and biodiversity), human resources (labor, skills and technology) and economic resources (capital, infrastructure and market access).

The modern aquaculture industry in South Africa was effectively initiated in the 1980s with the establishment of trout, oyster, mussel, ornamental fish and catfish farming (Hecht and Britz, 1990). In 1988, the sectors produced a total of 3094 tons, valued at R45.8 million (Hecht and Britz, 1990). Ten years later, in 1998, this figure had increased to 5208 tons (FAO, 1998). This translates to an average increase per annum of 6.8% between 1988 and 1998. During this period a number of state led projects were initiated to stimulate the growth of rural aquaculture, largely with the objective of enhancing food security and income in rural households.

The potential for fresh water aquaculture in South Africa is constrained by the natural environment. The first major constraint is a scarcity of water and the second the extreme seasonal temperature fluctuations over much of the interior (Britz and Hecht, 1990). A third constraint is the choice of species available for production. With the exception of trout and ornamental fish, which have a high market value, most indigenous and introduced fresh water fish species have historically yielded prices too low to justify the costs of intensive aquaculture production.

The development of aquaculture in South Africa can be divided into several epochs or categories. Firstly, the colonial era during which exotic species were introduced and produced, mainly for angling purposes. The apartheid era saw the development of private sector commercial aquaculture (particularly trout and oysters) and government led “homeland” aquaculture initiatives to address food security issues. Thirdly, the post-1994 democratic era, which has witnessed the development of a large-scale commercial aquaculture (in particular abalone) and a trend towards more entrepreneurial rural aquaculture.

During the late 1980s and early 1990s the provincial nature conservation departments changed their policy and stopped promoting the production and stocking of exotic fishes into indigenous waters. This constituted an effective withdrawal of Government support for the freshwater aquaculture industry, and resulted in the closure, mothballing or privatization of many Government aquaculture facilities. The period of political transition in the early 1990s resulted in a lack of policy or funding to support aquaculture research and development, and without government support, the aquaculture industry in South Africa effectively developed at a much slower rate than in other parts of the world.

Despite the lack of a national aquaculture policy since 1994, there have been attempts to develop small-scale commercial aquaculture in rural contexts on the back of larger commercial enterprises. These initiatives have been motivated by Governments policy of promoting black economic empowerment and supporting emerging farmers.

Various factors are currently stimulating the development of aquaculture in Southern Africa, including:

- The availability of resources in certain areas: water, land, labor, energy, etc.;
- The non-consumptive and integrated manner in which aquaculture uses water;
- The diminishing natural fisheries resources;
- Good national and international market interest;

- Good agricultural and other essential infrastructure;
- The need for diversification and optimization of resources;
- The good access to national and international technologies;
- International partnerships and collaboration around the sector; and
- The socio-economic needs towards redress and food security;

Factors that are currently inhibiting the development of the aquaculture sector in Southern Africa include:

- Fragmented policies and protocols from various Government Departments;
- The lack of marketing structures to access the market interest;
- The limited access to finance and developmental capital; and
- The limited human resources in capacity, skills and aquaculture expertise.

Aquaculture development is a vehicle for participation, skills enhancement, empowerment, food security and socio-economic upliftment.

2 VISION IN THE STRATEGIC PLAN

The overall vision of the Free State Department of Agriculture is:

To be the leading Agricultural Department in South Africa which promotes social and economic development of Free State communities by rendering agricultural services.

The vision of the Free State Department of Agriculture in terms of aquaculture is reflected in this greater vision.

3 MISSION IN THE STRATEGIC PLAN

The overall mission of the Free State Department of Agriculture is:

To facilitate and render agricultural development and support services to the people of the Free State through

- Committed and professional staff
- Co-operative teamwork and
- Research based agricultural technology

The mission of the Free State Department of Agriculture in terms of aquaculture development is in the provision of support to the sector in such a manner that it becomes a vibrant contributor the livelihood creation and commercial enterprise.

4 VALUES IN THE STRATEGIC PLAN

The overall values of the Free State Department of Agriculture are in its commitment to render services that are:

- Effective, efficient, equitable, accessible and of satisfactory quality
- In line with the Batho Pele policy of taking the services to the people

The core values of the Department are informed by the basic values and principals governing public administration as provided for in Section 195 of the Constitution (Act 108 of 1996). More specifically the following values have been identified:

- Effective and efficient utilisation of resources;
- Batho Pele;
- Co-operation;
- Accountability;
- Good Governance;
- Loyalty;
- Dedication and responsibility;
- Integrity.

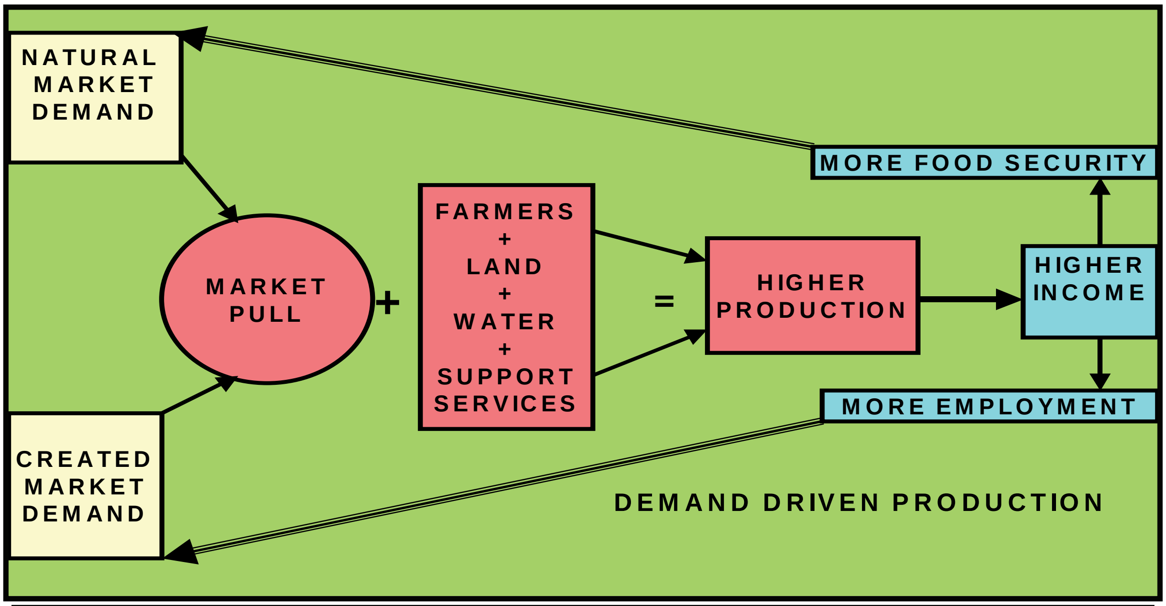
These values of the Department of Agriculture are relevant to the development of aquaculture also.

5 OBJECTIVES (GOALS) IN THE STRATEGIC PLAN

The core objectives of the Free State Department of Agriculture in terms of aquaculture are to achieve the following outcomes (goals):

- The **revitalisation of exciting State aquaculture facilities** so that these may serve as centres for fingerling supply, training and technical services. These facilities include primarily the Gariep Dam Hatchery.
- The isolation of **key support needs** towards the building of a stronger aquaculture sector and to achieve greater entrepreneurship.
- **Capacity building** at the State owned facilities and within the Department of Agriculture so as to serve the needs of the growing aquaculture sector and to enable the creation of **training programmes** at all levels from management (within the Department) to extension officers and farmers.
- The **increase in aquaculture production** by eliminating production obstacles and assisting with the provision of effective and practically implementable aquaculture information, fingerlings and dedicated extension services.
- The identification of **key policy and legislative issues** impacting on the performance of the aquaculture sector and to address these by cooperative relationships with other Government Departments.
- The **penetration of new and existing markets** for aquaculture products by market development and familiarisation with aquaculture products.
- The creation of **Community Public Private Partnerships (CPPP)** by encouragement of all stakeholders and illustrating the mutual benefits of such business relationships.
- The development of practical and accessible aquaculture **information sources and training manuals**.

The following Demand Driven Production Model must be used by the Free State Department of Agriculture to achieve the objectives above:



The Demand Driven Production Model for achievement of the strategic objectives.

6 LEGISLATIVE AND OTHER MANDATES

The development of aquaculture is subject to all of the legislative mandates of the Free State Department of Agriculture. The following are the primary statutes of concern to aquaculture development, but does not include the full list of legislatively backed mandates of the Department:

A. VETERINARY AND ANIMAL HEALTH MANDATES

- Animal Diseases Act, 1984 (Act 35 of 1984)
- Meat Safety Act, 2000 (Act of 2000)
- Animal Improvement Act, 1998 (Act 62 of 1998)

B. PLANT AND LIVESTOCK MANDATES

- Fertilizers, Farm Feeds and Agricultural Remedies Act, 1947 (Act 36 of 1947)
- Generally Modified Organisms Act, 1997 (Act 15 of 1997)

C. LAND AND LAND REFORM MANDATES

- Subdivision of Agricultural Land Act, 1970 (Act 70 of 1970)
- Provision of Land and Assistance Act, 1993 (Act 126 of 1993)

7 AQUACULTURE SITUATION ANALYSIS

Little aquaculture currently takes place in the Free State and this is limited to a few small subsistence (extensive) farms, some ornamental fish production and a little recreational trout aquaculture in the cooler eastern areas of the province. Apart from this, aquaculture is practiced at the state owned Gariep Fish Hatchery.

The primary production species in the Free State province are:

- Mozambique Tilapia (*Oreochromis mossambicus*)
- African Sharptooth Catfish (*Clarius gariepinus*)
- Common Carp (*Cyprinus carpio*)
- Rainbow Trout (*Oncorhynchus mykiss*)
- Other ornamental fish species

The WRC Report K5/1446/4: "*Contribution of Aquaculture to Rural Livelihoods in South Africa: A Baseline Study* (Britz and Rouhani, 2004) identified only the Gariep Fish Hatchery as a facility active in aquaculture in the province:

D. GARIEP FISH HATCHERY

The Gariep Fish Hatchery was built as a research and fingerling supply station. The hatchery consists of approximately 12 Ha. of earthen ponds, an indoor hatchery building and various other offices and storerooms, all of which is in a good state of repair.
Although the facility was originally intended as a Catfish production and fingerling supply centre it has also done much work in the last decade on the production of indigenous species (primarily Yellowfish) for restocking. Nevertheless aquaculture activities have declined significantly due to an absence of a dedicated aquaculturist, a sufficient operational budget and an altered approach to the potential genetic impact of artificially spawning and stocking Yellowfish species.

8 ALIGNMENT WITH THE DEPARTMENTAL STRATEGIC OBJECTIVES

8.1 GENERAL ALIGNMENT

In order to achieve success in the mobilisation of aquaculture in the Free State Province it is important that the Strategic Plan for Aquaculture be aligned with the strategic objectives of the greater Department of Agriculture. In this regard the department has identified the following ten strategic goals:

- **Agro processing and production, job creation and poverty alleviation**
- **Agricultural economic and market development**
- Optimisation of plant and livestock health, production and product safety
- **Improved stakeholder relations**
- Natural resources and infrastructure utilisation and management
- **Research and experimental facilities**
- Information management, including Information Technology and related technology utilization
- **Formal and non-formal training**
- Intra departmental excellence
- Effective financial management in full compliance with relevant acts and regulations

Although all of the strategic outcomes (goals) for agriculture above are relevant to aquaculture, the highlighted points have been identified as core focal areas in terms of integrating aquaculture development with the strategic approach of the Department of Agriculture.

8.2 SPECIFIC ALIGNMENT

For aquaculture to succeed in the Free State province specific alignment with the overall strategic plan for the Department of Agriculture is important. The following section provides general guidance in terms of the strategies that can be employed by the Department in the mobilisation of aquaculture.

8.2.1 PROGRAMME 1: ADMINISTRATIVE ALIGNMENT

Strategic objectives for the Department of Agriculture

- To manage and administer for improved service delivery in the field of aquaculture.
- To provide strategic leadership / management and strategy / policy implementation as this relates to aquaculture.
- To provide effective interdepartmental co-ordination in taking aquaculture development forward.
- To ensure good governance by applying transparency and co-responsibility

8.2.2 PROGRAMME 2: SUSTAINABLE RESOURCE MANAGEMENT

Strategic objectives for the Department of Agriculture

- To develop and implement mechanisms for sustainable utilisation of natural resources for aquaculture development.
- To enhance aquaculture as a sector which could provide alternative and integrated resource utilisation.
- In terms of aquaculture development the Department of Agriculture must integrate an awareness of aquaculture development and aquaculture opportunities into resource revitalisation programmes.
- Wherever water resources are utilised for irrigation the development potential of integrated aquaculture must be evaluated.

8.2.3 PROGRAMME 3: SUPPORT SERVICES AND EXTENSION

Extension officers and extension services are challenged by rapid development in agricultural technology, market liberalisation, land redistribution, land settlement, globalisation and the changing economic environment. It this regard the ideal extension advisory service is largely grounded on four pillars:

- The quest for new knowledge.
- The desire to perform above average.
- The ability to interpret and adapt to a new environment.
- The capacity to make relevant and timely decisions.

It is a service whose real value is embedded in myriad outcomes, of which the most significant are:

- Better utilization of productive assets.
- Adoption of improved technologies at farm level.
- Growing contribution of the aquaculture sector
- Generation of a visible cohort of successful farmers and commodity entrepreneurs.

Strategic objectives for the Department of Agriculture

- To establish a demand driven aquaculture extension component which is well equipped and capacitated (by formal and in-service training) to render effective and efficient aquaculture extension and support services.
- To sensitise existing farmer support and extension services in other agricultural fields to aquaculture as a new area of technology. This must be done by means of dedicated programmes to inform the farmer support and extension services of aquaculture to the level at which they (at a minimum) are able to refer aquaculture opportunities and inquiries to the relevant people who may advance such opportunities to feasibility studies and further development.
- To render pre-settlement and post settlement support by means of information on aquaculture as an alternative production method as well as a means to food security and poverty alleviation.
- To create awareness and enhance the implementation of AgriBEE in the field of aquaculture.

- To develop, communicate and implement development plans with all major stakeholders (municipalities, farmers, communities, traditional leaders, etc.).
- To address the capacitation of the rural poor towards independent entrepreneurship and self-sufficiency through aquaculture where the potential therefore exists.
- To commercialise small-scale subsistence aquaculture farmers where the potential for this exists.
- To develop a database of aquaculture farmers in the province.
- To strengthen liaison with organised aquaculture in the country.
- To promote innovation towards solving development issues in aquaculture.
- To promote infrastructure development, advance local markets, convey conservation practices, support indigenous know-how and participate in inter-sectoral relationships and communication with other role-players in aquaculture.
- To increase the number of needs based farmer training opportunities and public information days in aquaculture.
- To enhance socio-economic development by participating in municipal IDP structures.
- To strengthen linkages between research and extension as this relates to aquaculture.
- To implement a holistic capacity and secession building program for field agents (bursaries, seminars, quarterly workshops, assertiveness campaigns, etc.).
- To integrate aquaculture with the Comprehensive Agricultural Support Programmes (CASP).

8.2.4 PROGRAMME 4: VETERINARY SERVICES

Veterinary services to the aquaculture sector in the entire Southern African region are lacking. There is a dire shortage of specialisation into aquaculture-based veterinary and the management of aquaculture diseases. Nevertheless aquaculture development is dependant upon veterinary services and this area should thus receive the required attention.

Strategic objectives for the Department of Agriculture

- To motivate for and establish basic aquaculture veterinary services by specialised training of at least one veterinarian in basic diagnostics, treatment, breakout response and import and export controls in the aquaculture sector.
- To establish and implement as standardised monitoring programme for the health status of aquaculture and the spread of disease.
- To implement disease surveillance, compliance, quarantine, vaccination and quality control as applicable.
- To oversee the control of notifiable diseases and design disease emergency response mechanisms.
- To promote aquaculture health and disease control according to OIE guidelines for aquaculture disease.
- To facilitate veterinary extension, advice, clinical services and training in the field of aquaculture.
- To form beneficial linkages with private sector veterinary services in the field of aquaculture and to link with institutions that provide services in aquaculture disease management (i.e. the University of the Free State and Onderstepoort).

8.2.5 PROGRAMME 5: RESEARCH AND INFORMATION SERVICES

Although aquaculture technology is widely available the introduction of this new field poses a challenge in terms of researching the available information for its applicability to local conditions.

Strategic objectives for the Department of Agriculture

- To source, develop and transfer (disseminate) appropriate aquaculture technology.
- To conduct adaptive, demand driven and participatory research to improve aquaculture development and productivity
- To establish and strengthen research partnerships around aquaculture.

- To develop guidelines, information packages and production manuals, which can be used by the extension services. This will also be attained by adopting the training manuals developed by the Rhodes University / WRC in their current aquaculture development programme.
- To compile and maintain a database of current aquaculture activities and current aquaculture research, as well as areas that possess a potential for aquaculture development
- To improve communication and technology services as these relate to aquaculture development in the province

8.2.6 PROGRAMME 6: ECONOMICS AND MARKETING

The marketing and marketability of locally produced aquaculture products is a national challenge and caused primarily by poor awareness of aquaculture products and competition with traditional fisheries products.

Strategic objectives for the Department of Agriculture

- To promote economic and sustainable aquaculture production and development.
- To promote economic growth, job creation and socio-economic development through the development of aquaculture.
- To design and implement an aquaculture product marketing and awareness drive based on the results of an aquaculture market survey
- To improve the facilitation of access to domestic and export markets for aquaculture products.
- To improve economic advisory services in the viability / feasibility analysis, market access, business development, statistics and risk management of aquaculture ventures.
- To facilitate access to finance.
- To investigate the potential economic effects of improved product value addition, improved distribution, improved traceability and other value chain dynamics.
- To assist with the transformation of small scale subsistence projects into agribusinesses.
- To assist with extension as this relates to financial record keeping, budgeting and forecasting at farm level.
- To develop standard business plan formats for aquaculture.
- To compile and maintain accurate statistical information on the provincial aquaculture sector.

8.2.7 PROGRAMME 7: STRUCTURED AQUACULTURE TRAINING

Strategic objectives for the Department of Agriculture

- To disseminate aquaculture information by means of a skills development programme that could be presented in the form of popular press, information brochures, field days and integration with other agricultural training programmes.
- To ensure accessibility of aquaculture training programmes to potential farmers.
- To adopt the training manuals developed by the Rhodes University / WRC in their current aquaculture development programme.

8.2.8 PROGRAMME 8: ENVIRONMENT AND CONSERVATION

- Due to aquaculture being a new field of expertise and the lack of experience of officials to understand and deal effectively with the application of the respective environmental legislation to aquaculture, delays can be experienced in the development of responsible and sustainable aquaculture practises.

Strategic objectives for the Department of Agriculture

- To forge close ties with the Department of Tourism, Environmental and Economic Affairs in order the capacitate its officials, increase the awareness of aquaculture and jointly develop mechanisms for dealing with aquaculture within the existing legislative framework.
- To take the lead in the development of best management practises and environmental management plans for aquaculture, which would also lead to the sustainability of the aquaculture sector.

- To take the lead in the formulation of policies (guided by the relevant legislative frameworks) around the use of exotic species in aquaculture development.
- To promote aquaculture as a means to relief the harvesting pressure on marine fisheries stocks and achieving advantageous socio-economic and environmentally responsible development.
- To assist the Department of Water Affairs and Forestry in meeting the norms and standards for water quality discharge from aquaculture.

8.2.9 PROGRAMME 9: LAND ADMINISTRATION

Strategic objectives for the Department of Agriculture

- To ensure that aquaculture is promoted as an alternative production method, which could be practised in an integrated manner with other resource utilisations.
- To create an awareness of aquaculture with land reform beneficiaries.
- To promote aquaculture development in rural communities and on communal land.
- To participate in the development of Integrated Development Plans (IDPs) so that aquaculture can be included as a potential land or resource use alternative.
- To ensure that aquaculture developments are correctly zoned.

8.2.10 PROGRAMME 10: FOOD SECURITY AND POVERTY

Strategic objectives for the Department of Agriculture

- To enhance household food and nutritional security and income generation on a suitable basis trough aquaculture.
- To capacitate communities to respond to aquaculture opportunities.
- To co-ordinate the development of partnerships to mobilise the resources of departments, the private sector, the civic and development groups towards poverty reduction trough aquaculture.
- To create awareness and education on food insecurity issues.
- To develop appropriate entry level ("starter-pack") aquaculture support programmes which can provide technologically proven equipment and technologies to rural communities.

9 PARTNERS IN AQUACULTURE DEVELOPMENT IN FREE STATE

In this section a short analysis is provided of the core stakeholders that are involved in aquaculture development in the Free State Province (outside of the lead agent in the Department of Agriculture).

9.1 NEPAD AND THE WORLD FISH CENTRE

The role and access to NEPAD and the World Fish Centre to be defined.

9.2 NATIONAL DEPARTMENT OF AGRICULTURE

The National Department of Agriculture has developed an aquaculture section to address national policy and development issues in aquaculture in order to promote the establishment of a commercially viable and beneficial sector or industry. In this regard the National Department has co-funded the provincial strategic plan development initiative (with the Water Research Commission). The Free State Department of Agriculture will benefit from the initiatives taken by the National department and must ensure that it is ready and willing to receive such support.

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The National Department has identified the lack of policy and developmental frameworks, together with an uncoordinated and often inconsistent approach from governmental and regulating authorities as a major constraint to the development of the sector. This has driven the National Department to compiling a single National Policy on Aquaculture to promote and support a sustainable aquaculture sector in South Africa. As part of the process they have established a central aquaculture sector working group (ASWG) to promote more effective producer, processor, and interdepartmental cooperation in the interests of a united and prosperous aquaculture sector.

To facilitate the development of a united and prosperous aquaculture sector the Department will, by means of policy:

- Address the capacity to unify and simplify aquaculture legislation, regulation and to facilitate the sustainable use of aquatic resources.
- Incorporate and align legislation, regulation, production and marketing inputs and sustainable resource use into a team effort by using interdepartmental and public private partnerships.

Furthermore the National Aquaculture Policy will deliver guidance on:

- Norms and standards for sustainable aquaculture
- An aquaculture database
- Promoting aquaculture for food security
- Government aquaculture centers
- Centers of excellence and service centers
- Advisory services
- The proposed National Aquaculture Institute
- Intellectual property rights
- Human resource development
- Regulatory implications

Apart from developing the National Aquaculture Policy the Department is also active in hosting the Aquaculture Sector Working Group, guiding the Regional (Northern – and Southern) Aquaculture Working Groups, participating in the Aquaculture Association of Southern Africa, working with the WRC in developing provincial strategic plans for aquaculture, developing norms and standards for the sector and keeping an active sector related information database. Future initiatives of the National Department in aquaculture include the training of aquaculture field officers, the establishment of community inland fisheries programmes to enhance food security, fostering further interdepartmental relationships and participation in provincial aquaculture development initiatives.

9.3 DEPARTMENT OF WATER AFFAIRS AND FORESTRY (DWAF)

The overall mandate of DWAF over the water resources that are required for the development of aquaculture is:

- The protection, use, development, conservation, management and control of water resources in a manner, which takes the following factors into account:
  - Promoting equitable access to water.
  - Redressing the results of past racial and gender discrimination.
  - Promoting the efficient, sustainable and beneficial use of water in the public interest.
  - Facilitating social and economic development.
  - Providing for the growing demand for water use.
  - Protecting aquatic and associated ecosystems and their biological diversity.
  - Reducing and preventing pollution and degradation of water resources.

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DWAF is in the process of completing a process of policy and protocol development around the use of water resources for aquaculture purposes. This protocol will define the approvals process to gain access both to water resources on private land and to gain access to State controlled water resources. In terms of this process some water uses for aquaculture (mainly small scale and low impact initiatives) will be generally authorised or will be authorised by default through Schedule 1 of the National Water Act. Larger aquaculture initiative or those with a likely impact on the water resources will be subject to a licence application in accordance with the Schedule 21 (National Water Act).

9.4 DEPARTMENT OF TOURISM, ENVIRONMENTAL AND ECONOMIC AFFAIRS

The Department of tourism, Environmental and Economic Affairs are mandated within Free State by the National Department of Environmental Affairs and Tourism to oversee the implementation of the Environment Conservation Act, the National Environmental Management Act and the National Environmental Management: Biodiversity Act.

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Certain sections of the Environment Conservation Act stipulate that environmental assessments must be completed for listed activities as published by the Government. For aquaculture ventures the main (not exclusive) activity is:

> *The concentration of livestock, aquatic organisms, poultry and game in a confined structure for the purpose of commercial production, including aquaculture and mariculture.*

9.5 OTHER GOVERNMENT DEPARTMENTS / ORGANISATIONS

The National Department of Science and Technology actively promotes small-scale aquaculture enterprise development and are active in seeking opportunities to develop small-scale aquaculture initiatives within the Free State Province.

The Department of Trade and Industry actively seek the creation of export opportunities for aquaculture ventures.

The Water Research Commission is co-funding the development of provincial strategic plans for aquaculture together with the National Department of Agriculture and has fulfilled a key role in addressing research needs in aquaculture development.

9.6 REGIONAL AND INTER-PROVINCIAL LINKAGES

The Free State Province is centrally located in South Africa and could thus play a pivotal role in the regional cooperation between aquaculture efforts in the country. The province is bordered primarily by the Northern Cape, Eastern Cape, KwaZulu Natal, Mpumalanga and North West Provinces in terms of aquaculture development. A regional aquaculture development focus should be established so that the sector can be developed in a mutually beneficial manner. The following steps are recommended towards establishment of an inter-provincial and regional aquaculture sector:

- Representatives from the Free State Department of Agriculture must make contact with their counterparts within the neighbouring provinces and use the forum created by the Northern Aquaculture Working Group for further interaction.
- The Free State Province should inform the applicable sister provinces of its capabilities in aquaculture development. In this manner synergies will be established in which the provinces may find it useful to make use of these respective capabilities to move forward in a regional manner.
- The provinces must seek cooperation on matters such as the diagnosis and treatment of fish diseases, marketing and technical advances.

9.7 FARMERS AND OTHER ASSOCIATIONS

The Northern Aquaculture Working Group serves as a common platform for all stakeholders in aquaculture in the northern provinces of South Africa. This group functions as a regional leg of the Aquaculture Association of Southern Africa and serves the aquaculture sector by means of establishing the required networking between all role players on a common platform.

9.8 HIGHER EDUCATION INSTITUTIONS

The main educational institution involved in aquaculture in any manner is the University of the Orange Free State. This involvement is mainly in aquatic parasite research.

Nationally, the Universities of Rhodes -, Limpopo and Stellenbosch present educational programmes in aquaculture. The Department of Ichthyology Rhodes University is the implementing agents for a five-year aquaculture revival program funded and supported by the National Department of Agriculture and the Water Research Commission. In this regard they will play an important role in assisting the Free State Department of Agriculture with the necessary strategic planning, training and building out of the sector.

10 CORE ISSUES AND POTENTIALS

In a consultative workshop attended by various stakeholders in the Free State aquaculture sector (26 January 2006) the core hindrances (issues) and core potentials in moving forward with the development of aquaculture were identified towards the establishment of strategic approaches for the most prominent of these. The hindrances (issues) were grouped into five themes as follows:

- Misunderstanding of people on policies and legislation.
- Lack of practical training and extension.
- Production obstacles.
- Poor understanding of the total current market.
- Poor understanding of aquaculture development.

The main areas of potential associated with the aquaculture sector were also grouped into five main themes as follows:

- Potential for conducive state intervention.
- Potential for better institutional arrangements.
- Potential to improve availability and access to resources.
- Potential for aquaculture to contribute to socio-economic development.
- Market potential of aquaculture products.
-

11 STRATEGY ON THE DEALING WITH ISSUES AND POTENTIALS

For each of the themes in the previous chapter (issues and potentials) the major underlying issues / challenges and potentials / opportunities were identified and prioritised into three selected topics. These three topics were analysed in terms of the actions that could be taken to resolve the issues or achieve the potentials, together with the identification of a lead agent, partners or co-workers, and the timeframes within which the actions could be taken. The results hereof are displayed in the tables that follow.

Table 1 – Addressing the topic of policy, legislation and state intervention

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers	Resources	Timeframe
Lack of understanding in policy and legislation	Authorisation process and the management thereof in order to achieve a trade-off between development and conservation	Compile policy and aquaculture authorisation process for the Free State Province	Dept Agriculture Dept Tourism, Environmental & Economic Affairs Other aquaculture stakeholders District municipalities	Department budget Human resources	By end of 2006/2007 financial year
	Institutional capacity and institutional arrangements to deal with aquaculture development	Establish an interdepartmental aquaculture forum for cooperation and capacitation between departments	Dept Agriculture Dept Tourism, Environmental & Economic Affairs Other aquaculture stakeholders	Interdepartmental budget and human resource contributions	In the 2006/2007 financial year and following the Strategic Plan
	Procedures for the development of aquaculture for previously disadvantaged beneficiaries	Compilation of an aquaculture development guideline	Dept Agriculture Dept Tourism, Environmental & Economic Affairs Other aquaculture stakeholders	Interdepartmental budget and human resource contributions Also possible municipal funding	By end of 2006/2007 financial year

Table 2 – Addressing the topic of lack of practical training and extension

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers		Timeframe
Lack of practical training and extension	Need for specialised aquaculture training and “training the trainers”	Development of training material and training programmes Identification of suitable people to receive training	Dept Agriculture Dept Tourism, Environmental & Economic Affairs WRC Aquaculture Programme of the University of Rhodes National Department of Agriculture	Department budget Human resources	By mid 2006
	Training of beneficiaries and stakeholders	Commence with “training the trainers” Development of training material and training programmes	Joint venture between all provincial government departments involved in aquaculture WRC Aquaculture Programme of the University of Rhodes National Department of Agriculture	Department budget Human resources	Second half of 2006
	Lack of introduction programmes to aquaculture and identification of training beneficiaries	Develop basic introductory training in aquaculture and a dedicated beneficiary identification programme	Dept Agriculture Joint venture between all provincial government departments involved in aquaculture WRC Aquaculture Programme of the University of Rhodes National Department of Agriculture	Department budget Human resources Also possible national assistance	In the 2006/2007 financial year

Table 3 – Addressing production obstacles and access to resources

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers		Timeframe
Addressing production obstacles and access to resources	Aquaculture potential in the Free State unknown	Survey of potential required	Dept of Agriculture with core partners such as the Dept. of Water Affairs and aquaculture experts	Department budget Human resources	Within six months of the Strategic Plan
	Best species for use in aquaculture in the Free State unknown	Survey of best species required	Dept of Agriculture with aquaculture experts	Department budget Human resources	Within six months of the Strategic Plan
	Guidance required in approach to production and methods	Compile generic aquaculture manual for selected species	Dept Agriculture Joint venture with WRC Aquaculture Programme of the University of Rhodes National Department of Agriculture	Department budget Human resources Assistance from WRC project and National Dept. of Agriculture	Within six months of the Strategic Plan

Table 4 – Addressing the topic of poverty alleviation, job creation and other socio-economic matters

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers		Timeframe
Poverty alleviation and job creation	Aquaculture awareness and access to information	Develop basic introductory training in aquaculture with the required training materials. Develop awareness brochures Capacitate municipal structures to enhance aquaculture awareness	Dept Agriculture Dept Tourism, Environmental & Economic Affairs Joint venture with WRC Aquaculture Programme of the University of Rhodes National Department of Agriculture Municipalities	Department budget Human resources Assistance from WRC project, National Dept. of Agriculture and municipalities	Commence in the 2006/2007 financial year
	Implementation (action) plan for aquaculture development	Complete the Strategic Plan and associated action plan	WRC Aquaculture Programme of the University of Rhodes with inputs from the Dept. of Agriculture	WRC Programme	By mid 2006
	Achieving tangible socio-economic benefits	Determine the beneficiation potential of aquaculture in the province by a survey of this nature and compilation of an internal guideline that contains the survey results	Dept Agriculture Dept Tourism, Environmental & Economic Affairs Aquaculture experts	Department budget Human resources Also possible municipal funding	By the end of 2006/2007 financial year

Table 5 – Addressing the topic of marketing

Topic	Core issues/ opportunities	Action to be taken	Lead agent and co-workers		Timeframe
Lack of specialized marketing body	Lack of understanding of aquaculture markets	Conduct and compile a market survey with research into value addition and processing	Joint venture between the Dept. of Agriculture, tertiary aquaculture institutions, National Dept. of Agriculture and Dept. of Trade and Industry	Department budget Human resources Assistance from National Dept. of Agriculture, Dept of Trade and Industry and municipalities	By the end of 2006/2007 financial year
	Better access to markets	Include into aquaculture training programmes Collective market promotion	Joint venture between the Dept. of Agriculture, SMME programs and commercial producers. The Dept. of Trade and Industry and National Dept. of Agriculture	Department budget Human resources Assistance from National Dept. of Agriculture, Dept of Trade and Industry and municipalities	To develop as projects come on streams and training programmes are initiated
	Requirement for market development	Collective market promotion Integration with food security programmes	Joint venture between the Dept. of Agriculture, SMME, food security programmes and commercial producers. The Dept. of Trade and Industry and National Dept. of Agriculture	Department budget Human resources Assistance from National Dept. of Agriculture, Dept of Trade and Industry and municipalities	Immediate integration with food security programs and as new projects come onto stream

APPENDIX 4:
Northern Cape Draft Aquaculture Strategic Plan

Department of Agriculture & Land Reform

Provincial Aquaculture Strategy 2007-2010

Department of Agriculture and Land Reform

Provincial Aquaculture Strategy 2007-2010

Introduction

The world wide annual growth rate of aquaculture is estimated by the FAO as being at 8.8%, making it the fastest growing animal production sector. With the increase in the demand for fish and the diminishing catches of fisheries, aquaculture is set for continued growth and it is estimated that approximately 43% of all fish consumed is now farmed.

Over the past few decades, Asia has enjoyed exceptional growth in aquaculture, however, there are signs that the Asian industry is beginning to level off as competition for land and water increases. The future growth of aquaculture is envisaged as coming from Africa. Although the continent has significant potential in aquaculture, presently it only accounts for 2% of world production. However, there are a number of processes in motion to advance Africa aquaculture growth.

NEPAD, through its Fishery and Aquaculture Action Plan has mobilised Pan African processes to develop the aquaculture sector. Strategies and specific action plans are currently being put in place to capitalise programmes to develop the sector. These programmes include, research and development, capacity building and infrastructure development. Also nationally, the Department of Agriculture has also prioritised aquaculture as a sector of growth and embarked on a number of national programmes to develop and support this sector.

In light of the above, the Northern Cape Province is seen to be well situated to develop its aquaculture potential, a potential which extends to both the marine and the freshwater environments. The existing mariculture nucleus in Port Nolloth (and other coastal towns) could be further developed. With the decline in mining activities, developing feasible economic opportunities for these towns is critical. This has sparked an initiative called the Namakwa Mariculture Park, which would still require further support and interventions to realise its potential.

With regards to freshwater aquaculture, cost effective strategies such as the diversification of aquaculture within the irrigation schemes could be implemented. An added advantage of aquaculture is that the product lends itself to processing and value adding. This creates further jobs and increases profit margins. Also depending on the needs of the communities or the markets, various species of fish can be cultivated. Therefore, various species of fish can be grown to meet the needs for food production, local or international markets.

Relevance of aquaculture to the Northern Cape Province

The Provincial Growth and Development Strategy (PGDS) for the Northern Cape Province highlighted the need for the province to achieve greater diversification of its agriculture sector. The rationale is to spread risk and promote agriculture products that have the potential for processing.

Aquaculture is essentially an agriculture activity, and the development of this sector is essentially a diversification of agriculture in the Northern Cape Province. Aquaculture products have high potential for processing, for example, fish can be processed in a variety of different ways, such as smoking, canning, filleting, salting.

Furthermore, aquaculture would be developed in a manner that supports the polices and priorities of the Department of Agriculture and Land Reform, and as part of the Land Reform process, emerging farmers could be trained in aquaculture. A specific programme would be developed for the training and mentoring of small scale / emerging farmers involved in aquaculture. The Research and Development initiatives of the Department would also extend to aquaculture; this would be done in collaboration with tertiary institutions. For the Northern Cape to remain competitive, both at the local and international markets, there would be the need to constantly develop new products.

The rehabilitation of the Vaalharts Irrigation scheme is a focus for the Department. Therefore, aquaculture could become a viable economic activity to revitalise the scheme.

Achieving the potential in aquaculture

To develop and promote the growth of aquaculture in the province, six main goals have been outlined, and for each goal, strategies have been identified.

Goal 1. Skills development

Issue: At present there is a lack of a skills base in the province to meet the technical requirements required to develop the aquaculture sector. Short term and long term interventions would be necessary to ensure that the growth of the sector is sustainable.

Strategy:

1. Make provisions to assist in the training of new aquaculture farmers.
2. Train selected Agriculture Extension Officers in aquaculture. The role of the Extension Officers would be to provide technical support to farmers.
3. Provide specialised short courses in aquaculture for managers in the Department of Agriculture. These short courses would assist officials in managing and developing the sector at a provincial level.
4. Provision of bursaries for black students to study aquaculture at tertiary institutions. On completion of their studies graduates would be absorbed by the Department.
5. Increase the research capacity in aquaculture at the Vaalharts Research Centre.
6. Provide specialised training to state veterinarians on fish health.

Goal 2. Developing a research programme

Issue: There is significant potential to develop the aquaculture sector in the Northern Cape Province, however, there has been little primary research undertaken to suitably inform the direction or scale of the industry in the province. For example, essential surveys on markets needs, suitable species of fish, identification of potential sites and access to water, land and other infrastructure have not been undertaken. This type of information is essential in planning and mapping the future of the aquaculture in the province.

Strategy:

1. Appointment an Aquaculture Research Advisory Group. The purpose of this advisory group would be to provide technical support to the province in determining the research needs of the province, evaluating the research outputs as well as providing other advisory services to the Department of Agriculture.
2. Make provision to implement research projects as identified by the Aquaculture Research Advisory Group.
3. Form partnerships with tertiary institutions and other research organisations to assist in undertaking the research.

Goal 3. Market development

Issue: The Northern Cape Province has significant aquaculture potential, however, the market for freshwater aquaculture products has not been tested. To ensure that aquaculture in the province is promoted in a sustainable manner, aquaculture growth must match market needs. This lack of information on market needs includes preferred species, preferred products (e.g. smoked or fresh) and pricing structures. Therefore, for this industry to grow, the gap between aquaculture promotion / production and market needs will have to be closed.

Strategy:

1. Undertake a detailed market survey to determine market needs. This survey must take into account both the formal and informal markets, on local, national and international markets. Issues such as processing needs and pricing structures also need to be investigated.
2. Make provisions to implement the recommendations of the market survey.

Goal 4. Infrastructure development

Issue: Commercial aquaculture requires significant infrastructure; this includes ponds or tanks to grow the fish in, farm hardware, electricity, processing facilities, freezers and roads. These facilities are costly, therefore it would be essential to determine what is available in the province, and then develop what is needed. There is also the potential of integrating aquaculture into irrigation schemes to share infrastructure and costs.

Strategy:

1. A survey to determine what infrastructure is available (for example the irrigation schemes) and what needs to be developed .

Goal 5. Social development and equity

Issue: There is a need to promote, develop and support small scale and emerging fish farmers. These farmers need the necessary resources and support to define their role within the agriculture sector; this support includes interventions to assist the farmers to acquire suitable aquaculture sites, obtain access to water and other services such as technical support and veterinary services. There is also a need to ensure the representivity of women in the sector.

Strategy:

1. Develop a programme to identify and support emerging farmers who are interested in aquaculture.
2. Facilitate the entry of women into aquaculture.
3. Develop Public Private Partnerships (PPPs) between commercial and emerging aquaculture farmers. Schemes such as satellite farms have proved to be successful models.

Goal 6. Aquaculture Development Zones (ADZs)

Issue: The development of infrastructure for aquaculture and providing support services, such as veterinary services, needs to be undertaken efficiently and effectively. As such, suitable Aquaculture Development Zones (ADZs) will be identified. The zoning of aquaculture will mean that resources for aquaculture will be made available for areas of high aquaculture potential. Issues such as access to water, land, and EIAs for potential fish farmers will be addressed within the ADZs. The ADZs will also create an enabling environment for the commercial aquaculture ventures to invest in.

Strategy :

1. Conduct a survey to identify suitable ADZs. This survey needs to develop suitable strategies to implement the ADZs. In this process, the roles of the various stakeholders (e.g. local municipalities and government departments) would be identified.
2. Make resources available to develop the ADZs. This development would be undertaken in a phased approach.

APPENDIX 5:
KwaZulu-Natal Draft Aquaculture Strategic Plan

Department of Agriculture & Environmental Affairs

Provincial Aquaculture Strategy 2008 – 2011
Abridged Version

Department of Agriculture and Environmental Affairs Provincial Aquaculture Strategy 2008-2011

The vision:
To develop an environmentally responsible aquaculture sector in KwaZulu-Natal that is adaptive, sustainable, competitive and equitable.

Introduction

The world wide annual growth rate of aquaculture is estimated by the FAO as being at 8.8%, making it the fastest growing animal production sector. With the increase in the demand for fish and the diminishing catches of fisheries, aquaculture is set for continued growth and it is estimated that approximately 43% of all fish consumed is now farmed.

Over the past few decades, Asia has enjoyed exceptional growth in aquaculture, however, there are signs that the Asian industry is beginning to level off as competition for land and water increases. The future growth of aquaculture is envisaged as coming from Africa. Although the continent has significant potential in aquaculture, presently it only accounts for 2% of world production. However, there are a number of processes in motion to advance Africa aquaculture growth.

NEPAD, through its Fishery and Aquaculture Action Plan has mobilised Pan African processes to develop the aquaculture sector. Strategies and specific action plans are currently being put in place to capitalise programmes to develop the sector. These programmes include, research and development, capacity building and infrastructure development. Also nationally, the Department of Agriculture has also prioritised aquaculture as a sector of growth and embarked on a number of national programmes to develop and support this sector.

In light of the above, the KwaZulu Natal Province is seen to be well situated to develop its aquaculture potential, a potential which extends to both the marine and the freshwater environments.
The Province holds a significant potential for subsistence, small-scale commercial and large-scale industrial aquaculture development from warm-water to cold-water species and for the marine and/or freshwater sub sectors of the industry. In this regard the Province has a suitable climate in certain areas, good water supplies, a long coastline and good agricultural infrastructure. There is however a shortage of aquaculture expertise, limited market development, little extension services and a lack of good seed stock.

In terms of production the current emerging smallholder farmers are focussed mainly on supply for household consumption, while the small-scale commercial farmers produce for local retail and hawkers / traders. The large-scale commercial producers are focussed mainly on the export market.

The primary production species in the KwaZulu Natal province are:
- Mozambique Tilapia (*Oreochromis mossambicus*)
- African Sharptooth Catfish (*Clarius gariepinus*)
- Common Carp (*Cyprinus carpio*)
- Rainbow Trout (*Oncorhynchus mykiss*)
- Prawns (Fenneropenaeus indicus)

- Ornamental fish species

There has also been a recent resurgence and interest in mariculture in the province, such as the pilot commercial project in Mtunzini to grow the dusky kob (*Argyrosomus japonicus*) in ponds. It is envisaged that mariculture (principally a commercial sector) commercial will become a significant sector in the province and would therefore require equal support from the Department of Agriculture and Environment.

Relevance of aquaculture to KwaZulu Natal Province

Developing the aquaculture sector in the province is relevant to the broader strategic objectives of the DAEA. Listed below are the DAEA strategic goals:

1. Globally competitive agricultural production;
2. Accessible, quality and available food;
3. Farmer succession (emergent to commercial);
4. Sustainable job creation (BEE);
5. New markets developed (agricultural and value added);
6. New and diverse products developed;
7. Safe, healthy and sustainable environments;
8. Sustainable natural resource utilisation and community participation;
9. Improved national and international trade access and competitiveness; and
10. A transferred Department, geared for service excellence and compliance with its legislative mandate.

All of these strategic outcomes (goals) above are relevant to aquaculture and need to be used as guiding principals for the aquaculture sector.

Achieving the potential in aquaculture

To develop and promote the growth of aquaculture in the province, seven goals have been outlined, and for each goal, strategies have been identified.

Goal 1. Skills development & capacity building

Issue: At present there is a lack of a skills base in the province to meet the technical requirements to develop the aquaculture sector. Short term and long term interventions would be necessary to ensure that the growth of the sector is sustainable.

No	Actions	Champion	Timeframes
1.	Establish an Aquaculture Unit within DAEA. The unit's functions would include the coordination of aquaculture development within the province, providing a "one stop shop" facility for farmers for information and permits.	CBO	2008/2009
2.	Establish a Provincial Reference Working Group composed of relevant government departments, private sector, municipalities, academic institutions and other stakeholders to provide support to the Aquaculture Unit	IPC & CBO	2008/2009
3.	Establish a "hot line" between DAEA and fish farmers. This "hot line" or forum would serve as a direct line of communication to assist in solving some of the challenges that farmers may face.	GM: SSS	2008/2009
4.	Train DAEA officials (such as extension officers, hatchery staff, aquaculture scientists, state veterinarians and managers) and farmers.	COO & CBO	2008/2009

5.	Provisions for bursaries for students (priority to PDIs) to study aquaculture at tertiary institutions. On completion of their studies graduates could be absorbed by DAEA.	GM: SSS	2008/2009
6.	Develop training materials to train farmers and DAEA officials in aquaculture (in the appropriate languages).	Training & reference group	2008/9

Goal 2. Revitalising existing state facilities

Issue: There are a number of existing state hatcheries and fish farms in KZN that is underutilised in the province. These facilities still have potential and could be used to play an important role in supporting and developing aquaculture in the province. Furthermore, the development of infrastructure for aquaculture and providing support services, such as veterinary services, needs to be undertaken efficiently and effectively. As such, suitable Aquaculture Development Zones (ADZs) will be identified. The zoning of aquaculture will mean that resources for aquaculture (marine and fresh water) will be made available for areas of high aquaculture potential. Issues such as access to water, land, and EIAs for potential fish farmers will be addressed within the ADZs. The ADZs will also create an enabling environment for the commercial aquaculture ventures to invest in

Action plan and timeframes

No.	Actions	Champion	Timeframes
1	Assess provincial aquaculture facilities, and for those that remain to be relevant to the DAEA, develop action plans to revitalise them. Prioritise Makhathini (warm water) and possibly a cold water hatchery.	SSS & Reference group DoA	2008/9
3	Indentify and develop ADZs within KZN. The survey would take into cogenesis the role of the revitalised provincial hatcheries within the ADZs to provide fingerlings and as a facility to train emerging fish farmers.	SSS & Reference group DoA COO Gm: OPS Municipalities	2008 / 2011

Goal 3. Developing a research and information dissemination programme

Issue: There is significant potential to develop the aquaculture sector in KZN, however, however there has been little primary research undertaken to suitably inform the direction or scale of the industry in the province. For example, research to determine suitable species of fish, identification of potential sites and access to water, land and other infrastructure have not been undertaken. This type of information is essential in planning and mapping the future of the aquaculture in the province. There is also a need to develop capacity within the province, to disseminate the above information.

Action plan and timeframes

No.	Actions	Champion	Timeframes
1	Mandate the Aquaculture Unit within DAEA to fund research in the province that would promote the growth of the sector. An Aquaculture Research Advisory Group would guide the unit on this mandate.	RG & SSS	2008/9
2	Ring fence funding to implement research programmes.	RG & SSS	ongoing
3	Develop a platform from which results of aquaculture research programmes can be easily available to farmers and industry.	DoA, DST	2008/9
4	Form partnerships with tertiary institutions, the commercial sector and international organisations to assist in research.	RG & SSS	ongoing

Goal 4. Market development

Issue: KZN Province has significant aquaculture potential, however, the market for aquaculture products has not been tested. To ensure that aquaculture in the province is promoted in a sustainable manner, aquaculture growth must match market needs. This lack of information on market needs includes preferred species, preferred products (e.g. smoked or fresh) and pricing structures. Therefore, for this industry to grow, the gap between aquaculture promotion / production and market needs will have to be closed.

Action plan and timeframes

No.	Actions	Champion	Timeframes
1	Undertake a detailed socio- economic and market survey to qualify and quantify the formal, informal, local and international sectors. The survey would also investigate the issues such as pricing structures and value chain analysis.	NAMC COO /ADSS IPC	2008/2009
2	Determine the marketing infrastructure required to develop an ADZ (e.g. processing centres).	IPC	
3	Develop a database for market information that is readily accessible to farmers and stakeholders.		
4	Develop a programme to promote fish consumption.	Communica tion CBO/ Youth & women	2008/2009

Goal 5. Social development and equity

Issue: There is a need to promote, develop and support small scale and emerging fish farmers. These farmers need the necessary resources and support to define their role within the agriculture sector; this support includes interventions to assist the farmers to acquire suitable aquaculture sites, obtain access to water and other services such as technical support and veterinary services. There is also a need to ensure the representivity of women in the sector.

Action plan and timeframes

No.	Actions	Champion	Timeframes
1	Develop programme to support farmers who are interested in aquaculture.	CBO / SSS	2008/2009
2	Fast track the entry of women, youth and physically challenged into aquaculture.	COO & SSS Women & youth	ongoing
3	Develop Public Private Partnerships (PPPs) between commercial and emerging farmers. Ongoing or proposed projects with PPP components would be considered for DAEA support.	CBO & IPC	ongoing

Goal 6. Promotion of the commercial sector

Issue: It is generally agreed that the private sector will drive the emergence of the aquaculture sector in the province / country and as such there is a role for government to facilitate their entry and participation into the sector. As such lengthy bureaucratic process that farmers face will need to be streamlined. There is also a lack of emerging farmers making the transition to the commercial sector.

Action plan and timeframes

No.	Actions	Champion	Timeframes
1	To promote the growth of the commercial sector, DAEA would develop incentives for BEE / PPP initiatives.	CBO COO IPC and private sector	2008/9
2	DAEA to engage with current and proposed commercial projects to determine if DAEA could play a role in fast tracking these projects. DAEA could also develop links with international funders / partners to assist in the growth of the commercial sector.	CBO COO IPC and private sector	2008/9
3	Identify and support aquaculture facilities that are of strategic importance to the province (e.g. hatcheries, farms and sites).	CBO COO IPC and private sector	2008/9

APPENDIX 6:
Turfloop Hatchery Assessment

Limpopo

DEPARTMENT OF AGRICULTURE

PARTICIPATORY DEVELOPMENT OF PROVINCIAL AQUACULTURE PROGRAMMES FOR IMPROVED RURAL FOOD SECURITY AND LIVELIHOOD ALTERNATIVES

<u>STATUS OF THE TURFLOOP HATCHERY</u>

FEBRUARY 2006

CO-WORKERS:

agriculture

Department: Agriculture

REPUBLIC OF SOUTH AFRICA

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1 Introduction

This document reports on the assessment of the current status of the Turfloop Hatchery, while making recommendations of the actions that are required for its revitalisation. This revitalisation is core to the project titled, "*Participatory Development of Provincial Aquaculture Programmes for Improved Rural Food Security and Livelihood Alternatives*", which is being implemented by the Rhodes University as an initiative by the Water Research Commission and the National Department of Agriculture.

The Turfloop Hatchery is situated north of Polokwane in the Limpopo Province and was previously active in the production of warm water aquaculture species under guidance of the University of Limpopo and the Limpopo Department of Agriculture. It has subsequently fallen into disuse.

A Strategic – and Action Plan for the development of Aquaculture in the Limpopo Province precede this hatchery and assessment report for the Turfloop Hatchery. In this regard the guidance provided by these plans for the aquaculture sector in the Province has been considered in this assessment and especially in the recommendations towards the revitalisation of the hatchery. The following objective (goal) is quoted form the Strategic Plan for Aquaculture Development in the Limpopo Province:

The ***revitalisation of exciting State aquaculture facilities*** *so that these may serve as centres for fingerling supply, training and technical services. These facilities include Turfloop Hatchery, Tompi Seleka and the Dzindi Fish Project.*

2 Purpose of the Status Report

As seen from the introduction above the primary purpose of the assessment and status report is to provide some direction towards the revitalisation of the facilities. However the purpose of the exercise can be broken down into the following aspects:

- To document the current position of the facilities in terms of infrastructure, facilities, water supply, human resources, etc.
- To identify and current products that may be produced by the hatchery.
- To identify the major constraints that have led to the current status of sub optimal use and which could be preventing revitalisation.
- To consider the potential of the facilities given the nature, extent and potential of aquaculture in the Limpopo Province.
- To provide a platform from which recommendations can be made as to the way forward (action plan) for the revitalisation process.
- To provide some benchmarking from which the progress in the revitalisation process can be monitored.

3 Methodology of Assessment

The following methodology was followed in the assessment of the Turfloop facilities:

- Some benchmark information about Turfloop Hatchery was gathered from previous work by Rhodes University in the WRC project titled "*Contribution of Aquaculture to Rural Livelihoods in South Africa: A Baseline Survey*" (2003).
- Three members of the current Rhodes University project team visited the Turfloop Hatchery site twice towards the end of 2005 to assess the facilities in detail.
- Interviews were conducted with on site personnel (primarily Mr. M. Maja), with associated people from the nearby University of Limpopo and with Mr. J. Phosa who coordinates

aquaculture in the Limpopo Province though managing the Division of Aquaculture within the Department of Agriculture.

- The information collected from the site interviews and assessment of the facilities was subsequently analysed and documented by the project team (assisted by Dr. N. Vine who acted as technical specialist in hatchery design and methodology).

4 Current Status of the Hatchery

The Turfloop Hatchery was originally motivated for by the University of the North (now the University of Limpopo) and built for the former Lebowa government by the Department of Agriculture in 1982. The intention was to breed catfish and carp to stock local dams towards the creation of sustainable fisheries and small aquaculture projects. Initially the University was intimately involved with the operation of the facilities, but a steady disregard to the running of the operation has seen the production of all fish species declining to the point where no fish were produced in 2003. Inn the following section the results of the current assessment have been categorized to provide a clear picture of the situation.

4.1 Essential Infrastructure

The essential infrastructure for the operation of a hatchery is still intact and largely in a working order. This essential infrastructure includes:

- The site is services with a gravel road joining it to a main arterial route, which leads to Polokwane and other major centres. The gravel road is not in a very good condition and some minor repairs may be required at the hatchery site. Nevertheless the road infrastructure is not a hindrance to revitalisation of the facilities.
- The site is supplied with electricity via the national electricity grid.
- The hatchery site has access to water supplies – refer to point 4.3 below.
- The site is services with telecommunication lines.

4.2 Aquaculture Facilities, Design and Condition

The aquaculture facilities at the Turfloop Hatchery are in a good state of repair and consist of the following main elements:

- A well equipped re-circulatory indoor hatchery (approximately 1600 square meters) with numerous fibreglass tanks and associated equipment.
- Ample indoor office space, laboratory space and storage space is available. The offices are only equipped with basic furniture, while no laboratory equipment is present.
- Twenty-seven outdoor earthen ponds (of which a few have been lined with concrete). Some of the earthen ponds have been exposed to erosion damage, which can be repaired at low cost.

The design and layout of the facilities is practical for the purpose of producing fingerlings of warm water aquaculture species. The indoor hatchery facilities are very useful in creating controlled environments for spawning, eggs and larvae, while the outdoor facilities are well positioned to cope with fingerling production from the juvenile stock produced in the indoor facilities. The outdoor ponds lack bird netting (although the poles and supporting wires for such netting are in a good state of repair) and the remaining predator controls (i.e. fencing against otters and other predators) requires some repair.

The indoor facilities at Turfloop Hatchery are in a good state of repair and well suited to large-scale fingerling production.

The outdoor ponds at Turfloop are in a good state of repair. Note the support system for bird netting is still intact.

4.3 Water Supplies

In spite of the dry climate of the Limpopo Province the Turfloop Hatchery has a good water supply that is provided by a dedicated dam which was constructed directly upstream of the hatchery facilities. All water supplies are thus gravity fed from the nearby supply. Although the hatchery my be prone to times of lower water supply, the relatively low volumes of water that are required for the operation (i.e. the re-circulatory indoor facilities re-uses water internally and the water in earthen ponds in which the fingerlings of warm water species are produced does not require the replacement of large water volumes) this is not seen as a limiting factor to the revitalisation of the facilities. Nevertheless some points that require consideration are:

- Water quality monitoring is an essential part of hatchery operation, especially given that the water resource (the upstream dam) will provide water of a fluctuating quality. Under the high pressure the piped water from the dam may also cause nitrogen super saturation, which could be lethal for larval and young fish.
- An operational plan for the facilities must address the question of water supply prioritisation so that certain of the large ponds that are not essential to the core functions of the facilities could be drained or left with minimal water supplies in seasons of water shortage.
- The Department of Agriculture must ensure that the use of the water is authorised or licensed with the Department of Water Affairs and Forestry who have embarked on a national exercise to ensure that aquaculture can be accommodated within the statutory obligations of the National Water Act. Likewise the provincial Department of Economic Affairs, Environment and Tourism must approve the facilities.

4.4 Personnel and Human Resources

With the steady decrease in production and the shortage of aquaculture expertise in the Department of Agriculture the Turfloop facilities have been ground to a halt by the absence of trained, motivated, equipped personnel that have an outcome based operation procedure for the facilities. Having recently (2005) had five general assistants at the facilities it now has only one aquaculture technician with no active outcome based programmes running. The human resource assessment, skill requirements and actions to be taken have been detailed in a separate report titled “*Skills Report for the Turfloop Hatchery*”.

4.5 Current Products and Output

The outdoor ponds of the hatchery facilities have some catfish fingerlings that are maintained on an ad hoc basis for uncoordinated supply to small-scale farmers. Nevertheless the effective tangible output of the facilities is nil. No intangible outputs / products (i.e. support services and training) could be identified.

5 Major Constraints

The foremost constrain to the revitalisation of the Turfloop Hatchery is trained human resources and an outcome based operation plan. This lack in human resources has been reported in a separate document ("*Skills Report for the Turfloop Hatchery*") Nevertheless the following summary of secondary constraints is relevant to the operation of the facilities:

- The facilities do not enjoy significant budgetary support within the Department of Agriculture.
- As stated above, there is no outcome based operation plan.
- Little reliable information is available on the needs within the aquaculture sector in terms of fingerling supplies (species, size, frequency and quantity).
- There is a shortage of good quality brood stock.
- The potential of the facilities to serve as a fingerling supplier, training and technical centre is not know in the sector or within the Department of Agriculture.
- The facilities have been technically isolated.

6 Future Potential

The hatchery has the potential to produce large quantities of juvenile fish for stocking into local dams and for provision to the aquaculture sector. Some of the larger ponds could also be used for grow-out of the juveniles, thereby providing prospective clients with a range of available fish sizes for stocking.

The infrastructure inside the hatchery building is capable of being adapted to catfish, tilapia or carp production or a combination of these. Initially it would better focus on a maximum of two species as the culture of additional species creates logistical challenges in management and operational optimisation.

The Turfloop facilities have the potential to serve as a training facility and a centre of technical expertise that could be fed into the extension services and extension programmes of the Limpopo Department of Agriculture.

7 Recommendations and Plan of Action

Based on the status of the facilities, its potential and the needs of the Limpopo aquaculture sector the following points of action can be taken in the revitalisation of the Turfloop Hatchery:

7.1 Budgets and the Operational Plan

Although the running budget of the Turfloop facilities will depend on the financial interventions that are required in all the action points that follow, a detailed operational budget for the repair, maintenance and running of the facilities must be drawn up for acceptance into the budgetary planning of the Department of Agriculture. This must be accompanied by a financial viability / feasibility analysis and logical, outcome based Operational Plan (also based on the action points below and other data such as the assessment of the needs in the aquaculture sector). It is recommended that the Operational Plan be the first step in the revitalisation exercise and that it should contain details as to the steps in this revitalisation exercise.

7.2 Initial Repair Phase

Following this report a detailed bill of quantities and repair schedule for the facilities must be drawn up, budgeter and executed. As the facilities are in a good state of repair it is expected that these repairs could be completed at a relatively low costs and within one to two months of an applicable budget approval in the Department of Agriculture.

7.3 Water Supplies

Agreement must be reached with Department of Water Affairs and Forrest and the Local Authority (if applicable) on the use and availability of water supplies. Once this has been completed the water infrastructure (pipe and supply lines) must be checked and repaired as required.

7.4 Human Resources

As stated earlier the main constrain in the revitalisation process is the appointment of personnel who are able (i.e. trained) in the running of a fish hatchery according to an Operational Plan. This process must commence with an assessment of the required human resources (refer to associated report titled "*Skills Report for the Turfloop Hatchery*"), the identification of the right people, their appointment and equipping them with the tools, support and ongoing training required for them to succeed at running the operation.

7.5 Species Selection and Needs Assessment

The needs of the local and inter-provincial aquaculture sectors in terms of specie requirements, size, acceptable costing, supply frequency and quantity must be determined. This assessment must be done with consideration of the statutory obligations around the supply of certain species and the permitting implication for the transport of fish (especially between provinces). In addition to this the transport and distribution logistics of fish must receive specific attention as part of the Operational Plan.

7.6 Brood Stock

Depending upon the selected production species, good quality brood stock must be collected. The University of Limpopo and, the Northern Aquaculture Working Group, the commercial farmers in Limpopo, the Aquaculture Association of Southern Africa and other reliable information or brood stock sources should be consulted in this process. Furthermore the brood stock husbandry must be researched carefully as brood stock conditioning is central to successful juvenile production.

7.7 Training and Extension

Once established the Turfloop facilities must strive actively towards becoming training centre a technical hub for aquaculture information. In this regard outcome based training programmes must be developed for the training of extension officers, new aquaculture entrepreneurs, existing farmers and resource managers, etc.

The aquaculture division at Limpopo University has had strong links in the past with the Turfloop hatchery. This University has the expertise to assist both with the mentoring of personnel at Turfloop and with the establishment of the training programmes for extension services and farmers. Training and technical support could also be sourced from other national aquaculture institutions (Rhodes University and Stellenbosch University).

Some aspects, which would be included in the respective training programmes, at different levels of intensity depending on the target audience, would include:

Species selection and specie specific husbandry

- Economic and financial considerations in aquaculture
- Concepts of water quality relevant to aquaculture
- Pond design and construction and basic aquaculture engineering
- Nutrition of culture species

- Diseases and treatment
- Harvesting and marketing

7.8 Familiarisation and Partnerships

The managers of the facilities and the greater Department of Agriculture must embark upon a sector familiarization exercise to ensure that all stakeholders in the aquaculture sector are aware of the products that are available for the Turfloop Hatchery. Entrepreneurs, small, scale farmers, commercial farmers, resource managers, etc. must be informed of the available of fingerlings, technical support, extension services and general aquaculture assistance as provided by the Turfloop facilities. This familiarization must be done by means of announcement at every opportunity (i.e. aquaculture workgroups and meeting), publication (i.e. newsletters of the aquaculture fraternity), informing key stakeholders (i.e. other government departments, universities and colleges, municipalities, etc.) and directed media coverage (i.e. newspaper and magazine articles, etc.)

As part of the familiarization process the Department of Agriculture must investigate and invite private sector participation in the Turfloop Hatchery so as to achieve a PPP model.

8 Monitoring Progress in Revitalisation

The implementation of the actions recommended above requires monitoring to ensure the success of the revitalisation effort for the Turfloop Hatchery. In this regard this assessment and report should be used as the initial benchmark for such a monitoring programme. The following steps are recommended for the monitoring process:

- The recommendations of this report must be internally work-shopped within the Limpopo Department of Agriculture and its Division of Aquaculture for acceptance and initiation of the process.
- The key interventions (i.e. an Operational Plan and the associated appointment of personnel) must enjoy high priority.
- As soon as the Operational Plan is complete it should be externally reviewed by appropriate aquaculture specialists before implementation.
- Six months after implementation of the Operational Plan the Turfloop facilities should be scrutinised in terms of the recommended actions and content of the Operational Plan. This audit should inform any revisions and identify areas of non-performance so that these may be prioritised. This process should be repeated at 12 -, 18 and 24 months and annually thereafter. As these audits progress new priority actions to those in section 7 above should be added according to the needs and progress of the time.

9 Conclusion

In this report the two primary areas have been coupled to success of the revitalisation of the Turfloop Hatchery. These two areas are the appointment of trained personnel and the compilation of an outcome based Operational Plan (with its associated budgets, etc.). The Department of Agriculture must prioritise these aspects first in order to establish a logical initiation towards bringing the Turfloop facilities up to a level at which it can fulfil its potential, serve the needs of the growing aquaculture sector and become a successful nucleus for provincial aquaculture development.

APPENDIX 7:
Turfloop Hatchery Operational Plan

Project Title: Participatory development of provincial aquaculture programmers for improved rural food security and livelihoods alternatives

Guidelines for operations of hatcheries

Turfloop hatchery

November 2006

CO-WORKERS:

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October 2006

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Turfloop Fish Hatchery, Polokwane District, Limpopo Province: Status, Prospects & Modus Operandi

Background

Turfloop Fish Hatchery was visited by various officials of the Department of Agriculture, Limpopo Provincial Government, and the Rhodes University Rural Fisheries Programme during late 2005 to assess its current status. Following on from their findings (Dept. Agric, Limpopo Prov internal report, February 2006) that the hatchery is in good physical repair although currently unproductive, the author of this present report (NPE James) was then asked to investigate the hatchery during October 2006 with a view to drawing up proposals for the following aspects pertaining to the hatchery:

- Potential uses of the hatchery, and potential candidate species suitable for hatchery production.
- Material requirements to revitalize the hatchery.
- Skills requirements.
- An operational manual for mono-sex tilapia production at Turfloop.
- Suggestions as to the possibility of Private: Public partnerships and Community involvement in running the hatchery.

This document is the result of these investigations.

(1) Potential Uses of Turfloop Fish Hatchery

History

Turfloop Hatchery was built in 1982 under the motivation of the then University of the North (now University of Limpopo) as a warm water fish hatchery to supply predominantly *Clarias gariepinus* fingerlings to fish farmers in the northern regions of South Africa. A secondary production goal was the breeding of tilapia and carp fingerlings for the stocking of dams and community fish projects.

Clarias gariepinus production

During the 1980s and 90s there was considerable interest countrywide in the commercial production of *Clarias gariepinus* for food, and as a result of this widespread interest the hatchery was constructed to fulfill the expected very heavy future demand for *Clarias* fingerlings. This was instigated by the recent success of the North American channel catfish industry, and the local availability of what appeared to be an ideal aquaculture candidate species in our local *Clarias* species. The interest was technology-driven with little attention paid to the aspects of marketing and customer acceptance of the final product. Research conducted at both the University of the North and Rhodes University soon produced tried-and tested methods of *Clarias* propagation in large numbers, larval rearing, artificial diets, intensive stocking protocols, and harvest yields. During the late 1990s several farms were already in production. The Catfish Growers Association of Southern Africa had 82 members in 1991 and the production for that year went from almost nothing to a very high 1150 tons of catfish. Within two years, not a single one of the original members was still farming this species. Several community-based projects were started over the past 10 years with the intention of creating wealth through the farming of catfish, these too have failed. The bottom line is that all disregarded the essential factor of market acceptance of the product before undertaking investment

By 1993 the catfish farming industry was in crisis and the continued use of the Turfloop Hatchery went into decline. Up to this stage the hatchery was run by staff from the University of the North Aquaculture Research Unit (Sakkie van der Walt from the then Lebowa Dept of Agriculture and , Johan Theron and Bert Polling from the university under the direction of Dr Koos Prinsloo). In the years since then there have been various proposals as to its use, including *Tilapia* production (Bert Polling, pers comm.), but nothing has come to fruition, and the entire facility is currently empty of water and unused.

Turfloop Hatchery was designed primarily as a *Clarias* seed production unit. As such, it has an indoor hatchery where intensive production of small fish under carefully controlled environmental conditions can be carried out. There are ample outdoor ponds for both larval and fingerling grow-out as well as for plankton production for feed. The production of <u>any</u> large scale fish fingerlings requires similar facilities, thus the hatchery is suited to a wide range of potential candidate species other than *Clarias,* with few major infrastructural changes being required.

Until such time as *Clarias* becomes seriously acceptable in the market place, it would be wise not to place too mush emphasis on their potential at Turfloop Hatchery. This species has in the last few years become a good aquaculture candidate species in countries such as Nigeria, and is being actively farmed there, but does not there meet the same level of market resistance that led to the failure of the catfish farming industry in South Africa.

Trout and other cool water species
Clearly, with the high summer temperatures experienced in the region , production of cool water species such as trout is not viable, as they require temperatures below 20ºC.

The conservation regulations currently being implemented in South Africa under the new NEMBA Act also make undesirable the importation of alien candidate species such as the North American channel catfish (*Ictalurus* spp) . These same regulations may also severely curtail the potential of other alien species currently in the country such as carp, which despite active promotion as an aquaculture species in South Africa for over 30 years, has not been a success, again largely due to poor market acceptance.

Ornamental fish species
Theoretically, the hatchery could be used for ornamental fish production. This is a highly specialized and skilled form of aquaculture whereby a wide variety of species are produced for both ponds and indoor aquaria and marketed through the pet trade worldwide. Ornamental fish aquaculture is usually divided into two sectors:

- those non-tropical species requiring ponds to grow out, i.e. goldfish and koi,
- those species that are truly tropical and which cannot survive temperatures below 18ºC, and which are either raised outdoors in warm tropical or equatorial countries such as Singapore, Malaysia or Thailand, or in countries such as Taiwan, China, Japan and Florida in the US where tunnels are used to raise the species intensively.

Turfloop Hatchery would not be suitable for intensive rearing of tropical ornamental fish without considerable and expensive infrastructural modifications. Intensive production of these species also demands a high degree of skills of the hatchery staff. However, Turfloop Hatchery as it stands, would make an ideal goldfish or koi production unit, capable of supplying a wide range of goldfish varieties to the pet trade or possibly for export. As with the tropical ornamental fish species, this is not an activity that can be pursued efficiently by unskilled staff, and the operation would have to be run as a private profit-earning venture employing staff skilled in the specifics of this form of aquaculture. If the Department of Agriculture was to consider the long-term leasing of the facility they may well attract a private investor of this type. This is further expanded in the section on Private: Public partnerships.

Tilapia
The one species, indigenous to this country, which has high proven market potential, and which is eminently suitable to a wide range of aquacultural techniques is tilapia (specifically the indigenous species *Oreochromis mossambicus*, but also including *Tilapia rendalli*, and the

North African species *Oreochromis niloticus* which has recently been introduced to the Limpopo river system via Zimbabwe) . This fish species (tilapia in general) has been shown to be acceptable in the market, both formal and informal, has good quality white meat (a failing of *Clarias*, which has yellowish/red flesh, and no scales) and is easy to produce as fingerlings in quantity.

Advantages of tilapia can be summarized as follows (2006, Aquaculture in Africa, L. Ter Morshuizen):

"Tilapia – the `new' white fish
From humble roots the lowly African tilapia has shot to being the 8th most cultured species in the world, and this in only a few years! Within much of Africa tilapia are a staple diet harvested from local lakes and rivers by subsistence fishermen. Although the tilapia was already being farmed in the time of the ancient Egyptians around 2500 BC, the species was always regarded as being `poor man's food'. In the 1990s tilapia became established in the US seafood market as a desirable fish that is healthy to eat, thaws well, has few bones and a mid flavour. The cherry on top for this fish is the white flesh colour which makes it an ideal replacement for the diminishing marine fish stocks, and this suit of desirable traits has rocketed tilapia to an international celebrity.

Within Southern Africa there are two distinct markets for tilapia. The formal market in South Africa has been slow to accept tilapia as the fine cuisine that it is, preferring marine fish above freshwater fish. In contrast, the formal sector in the other Southern African countries relishes this species as a food fish. The informal market is the large opportunity that is very under-supplied at present. Several tilapia farmers and fishermen are already selling these fish into the informal market and are finding that there are numerous advantages to this sector, including

The fish can be sold whole, unprocessed
The price obtained is often higher than the formal market
Smaller fish can be sold, shortening the growing time
This market sector pays cash for the product

From the aquaculture perspective tilapia are wonderful fish to work with, they grow at reasonable densities, are highly tolerant of handling, they are resistant to diseases and tolerate poor and fluctuating water quality."

It is fast growing, tolerant to a wide variety of water conditions, resistant to disease and handling stress, feeds low on the food-chain, and can be grown intensively. Why then, has this clearly highly suitable candidate species not become widespread in aquaculture in Southern Africa? Whilst tilapia farming has been successful elsewhere in the world, one marketing and two biological factors have been shown to hinder successful tilapia production to date in South Africa.:

- the existing prejudice in the formal market against freshwater fish on the basis that they taste 'muddy'.
- the poor growth of Tilapia below 20ºC, and its intolerance of water temperatures below 13ºC.
- its precocious breeding in grow-out ponds that results in mixed harvests of few large and numerous small fish.

The first aspect (market acceptance), is largely a result of possibly wrong marketing aims by potential investors in the tilapia industry to date, whereby marketing has focused on the well-supplied and high quality (although expensive) sea-food sector which comprises mainly the supermarket chains which supply the formal sector. Here tilapia has been projected as a potential baseline white fish to compete with hake and even maasbanker. The latter is still available countrywide as a ‘cheap fish’ of often dubious quality. Other investors have proposed tilapia as a high quality product sold in filleted format to compete with other well established products such as kingklip and red roman, but have not succeeded in achieving economical production to compete with such high-value products and have encountered customer prejudice and resistance.

Tilapia is, however widely consumed throughout tropical Africa, but largely as a catch from an artisanal fishery, whereby family groups and individuals catch tilapia of all sizes informally (rod and line, traps and nets) and either eat them themselves or sell them locally. The bottom line is that there is a tradition and culture of eating tilapia, that makes potential marketing so much easier in that taboos, conservatism and simple plain ignorance do not have to be overcome in selling the product. This is half the battle in identifying a successful candidate species.

South Africa, especially the more northern parts of the country, is suitable for tilapia production, especially in the form of small scale rural community-run projects. Once quality fingerlings are made available, a high degree of skills is not required for onward growing and harvesting. However these projects, like the one run at Ipopeng at the Seshego Water Purification Works near Polokwane, suffer the debilitating effects of mass *Tilapia* spawning within the ponds (resulting in poor overall growth and irregular fish harvest size), lack of quality seed availability and no technical support. A hatchery like Turfloop could supply quality mono-sex (all male) seed and the technical back-up to make these projects a success. Both hatchery and its potential markets (the rural fish projects) would be interdependent to a great extent.

Other potential positive aspects that make the focus on tilapia attractive are:

- the use of red tilapia forms of *Oreochromis mossambicus* currently available in South Africa to improve market acceptability and price. Red tilapia are xanthic colour mutations of the ordinary wild grey form of tilapia that are generally orange or yellow in colour and have no black lining to the body cavity. As such they superficially resemble some marine food fish such as red roman, or smoked haddock and it is well known that red-coloured fish obtain a premium price in the market place. As these fish are still essentially pure indigenous species there are no complications with conservation regulations pertaining to their use in aquaculture, provided that they can be shown to be the pure species and not imported hybrid red tilapia.

- The possibility of using *Oreochromis niloticus*, the Nile Tilapia, in aquaculture under controlled conditions. Growth rates of this species have been shown to be much higher than any other tilapiine species and it is widely used as the species of choice in tilapia farms in Israel, the USA, Asia and the Philippines. Nile tilapia have been introduced to non-native waters of Zimbabwe during the last ten years. Whilst this is regrettable in conservation terms in that genetic pollution has taken place of indigenous species, it is a fact that *O. niloticus* is now present in the Limpopo River catchment, albeit in probably hybrid form with the indigenous *O. mossambicus*, but their presence there is now a fact. It is only a matter of time before requests are made to use this species commercially.

- In the Eastern Cape, at the climatic extremity of their natural range, naturally cold tolerant strains of Tilapia (*O. mossambicus*) occur that can tolerate water temperatures as low as 9.5ºC during winter, and which show good growth patterns at lower temperatures than their more northerly cousins. These would make ideal founder stock for tilapia aquaculture.

- Tilapi*a* can be manipulated during their early life-history stages to become mono-sex, or all male fish. This is a specialized procedure (explained in more detail later in this report) during which larval fish are fed with feed containing methyl-testosterone to fix the sex of the embryonic fish as male only. No females are produced (the success of sex-reversal is usually found to be 95-100% male) and therefore fingerlings can be distributed to grow-out ponds which will then not suffer the problems of precocious breeding resulting in over-population that has bedeviled so many tilapia farming projects. Whilst the in-hatchery methods of producing the all-male fingerlings require skilled handing, the subsequent grow-out does not, and the product is therefore highly suitable for rural aquaculture projects.

Note: in the USA the process of obtaining authority from the Food and Drug Administration (FDA) to use methyl-testosterone (MT) in livestock production intended for Human consumption is not yet complete, although permission has been granted by the FDA for registered hatcheries to carry out trials and to sell their product. The long process involved is partly due to the fact that MT is an anabolic steroid that has been abused by some athletes, and therefore controls over its use are necessary. Tests are currently underway to assess any residues of MT in the fish harvested for Human consumption (Phelps, pers. Comm.). There is a wealth of information supporting the safe use of MT in sex-reversal of juvenile fish for Human consumption, and approval by the FDA is anticipated. It is not known, at this stage, what the South African regulations are concerning use of MT in livestock feed for fish., and this would need to be clarified before undertaking commercial production

Other species
One other potential food-fish candidate species that would be well worth considering is the catfish *Schilbe intermedius* (formerly *S. mystus* and *Eutropius depressirostris*) the butter-barbel or makriel. This fine-eating and largely boneless species has considerable aquaculture potential as a food-fish if fingerlings could be supplied from a central hatchery such as Turfloop. They occur often in great densities in the wild (Limpopo and Pongolo river catchments and northwards throughout tropical Africa) and are exploited and appreciated by subsistence fisheries. Butter barbel have been successfully spawned under controlled hatchery conditions and are easily reared under pond type conditions. *S. intermedius* may have a role in the control of unwanted tilapia juveniles in mixed-sex aquaculture populations. Considerable research has been carried out using the cichlid *Hemichromis fasciatus* and the catfish *Clarias gariepinus* for predator control of tilapia offspring in ponds.

The demand for bass (*Micropterus salmoides*, and the sub-species *M. salmoides floridianus*, the Florida bass, for the stocking of sport-fishing dams is still high, now that the hatcheries operated by Dept Environment Affairs and Tourism no longer propagate this species. The ponds at Turfloop Hatchery would be ideal for the mass cultivation of bass fingerlings for sale to the public, if the necessary stocking permits could be obtained for stocking dams with bass in catchments that already contain this species. Production of bass fingerlings in ponds is not a labour-intensive operation and the fish will wild-spawn each September once the water temperatures rise to 20ºC. The fingerlings can be harvested from the breeding dams by draining them once they have reached 40 mm length and then sold.

(2) <u>Material requirements to revitalise the hatchery</u>

The interplay of infrastructure and skills
Whilst the Turfloop Hatchery has fallen into a state of inactivity during the last five years, the infrastructure is still largely complete. Put into perspective with the very considerable costs that would be incurred in building a similar facility today 'from *scratch*', i.e. many millions of Rand, the material requirements to revitalize the hatchery are relatively minor. The facility is a well-designed one with little expense spared in its original design and construction. The size and scope of its infrastructure, and the sophistication of its component parts demands that it be used wisely and intelligently by skilled staff to achieve its considerable potential. It must be emphasized here that a hatchery is a technically complicated and biologically sophisticated

facility that can not be simply "turned on" and filled with water by unskilled staff, and expected to produce fish, any more so than can a factory produce manufactured goods, without the skills to do so.

Fish, being fragile living organisms grown at unnaturally high densities under hatchery conditions, are highly perishable, and once dead, have zero value. They are very easily killed by apparently minor actions, such as pumps not switching on, resulting in de-oxygenation of tanks, poisoning by toxic substances such as dish-washing liquids and detergents, .over heating of their water, or being transferred to water of a different temperature etc. Thus, apparently minor mistakes in the operation of the facility can have catastrophic consequences such as loss of the entire stock, which can result in total failure not only of the hatchery operations, but also far-reaching downstream effects on those projects dependant on it for their supply of fingerling stock.

The demands of fragile livestock that are dependant on the continuous operation of such equipment as pumps, blowers, filters and other essential life-support infrastructure to stay alive mean that such equipment must be in good serviceable condition. Also, a regular system of equipment servicing and maintenance is essential for successful hatchery operations. A failure to plan for, and budget for equipment maintenance and replacement will inevitably result in disasters that have the end result in hatchery failure.

Turfloop Hatchery has five integral physical components:

- the dam and water supply
- the indoor hatchery, offices, store-rooms and laboratory
- the outdoor pond system
- other fixed or movable infrastructure such as accommodation and vehicles.
- the livestock

Turfloop Dam and water supply to the hatchery: responsibility for dam maintenance
Turfloop Dam was purpose built to supply the hatchery in 1982. There are no other authorized water-users from the dam, although cattle were seen grazing along its upper shoreline margins, so presumably it services local rural livestock watering requirements.. The hatchery also is reputed to have a borehole supply, although no knowledge of this was made available to us on our visit during early October 2006. During that visit we encountered officials of the Department of Water Affairs (dam safety section, headed by Mr Peter Nightingale of Pretoria office) who were inspecting the dam for safety aspects. This official indicated that there appears to be some confusion as to who is responsible for the actual ownership, maintenance and operation of the dam since the demise of the former Lebowa Government, under whose jurisdiction it fell prior to 1994. This responsibility aspect needs to be settled timeously by the respective Departments of Agriculture and that of Water Affairs & Forestry, prior to any decision being made on transfer of responsibility for the hatchery operations to any third party

.**Figure 1**. Turfloop Dam, October 2006. The dam is being burnt by nearby community farmers for cattle grazing, and is badly eroded on it flanks as a result.
The dam has a high safety threat in that it is a very large structure, with an 18 m high earth wall, and a spillway that requires regular maintenance. Downstream, and threatened by the dam should any failure occur, is a densely populated Human rural population. Since the whole area encompassed by the dam and hatchery is now in a 'Reserve', in that it is fenced and access is controlled, the ownership and responsibility for safety may also fall partially under the jurisdiction of the Department of Environment Affairs and Tourism. Mr Nightingale indicated that the spillway is now considered to be inadequate in times of severe flooding, and needs clearing of vegetation and reshaping, and that the wall needs clearing of trees and re-grassing as erosion is taking place. The Turfloop Hatchery is immediately downstream of the wall (200 m) and failure of the Turfloop Dam wall could have catastrophic consequences to staff and structures at the hatchery.

Water supply to the hatchery
As the dam supplies water to only the hatchery, the amount of water available must be considered by any reasonable yardstick to be highly adequate. The dam water was originally said to be 18 m deep at the spillway in 1982 (Bert Polling, pers comm..).

Even bearing in mind a considerable degree of silting up since that date, the lake formed by the dam is estimated to have covered over 30 ha at the time of our visit (October 2006, and the end of the dry season) despite the water level being a good 5-7 m down from full retention level. Thus, even at an estimated capacity of only 20-30%, the dam still holds back sufficient water for normal hatchery operations.

Figure 2. Turfloop Hatchery from the wall of the dam. The main water-supply pump is to the right of the group of thorn trees just below the dam-wall. The entire hatchery area has been recently burnt by grass fires (October 2006).

A fundamental design flaw is that water for Turfloop Hatchery needs to be pumped, despite the fact that the hatchery lies below the dam water level, and downstream of the intake. Presumably this was designed like this to allow for a degree of filtration (through a system of circular concrete reservoirs filled with sand) prior to the water being reticulated to the various tanks and ponds. However this is a poor feature of the original design that would be expensive to rectify.

The main pump is situated at the base of the wall about 200 m from the hatchery. Whilst the electric pump is still there, the drive belts and electrical switch-gear are missing, the pump is exposed to the elements and the whole unit needs a thorough technical inspection and servicing. A protective building needs to be erected over the pump unit and security need to be stepped up as this is the lifeblood source for the whole hatchery. The pipeline to the hatchery from the pump is buried and of unknown condition. The water is pumped to a system of four large concrete reservoirs, situated near the approach road to the hatchery, that act as sand filters, before flowing by gravity to another larger concrete reservoir that then acts as the storage tank for the hatchery. All these tanks appeared to be in good condition externally with no visible cracks or leaks, although it was not possible to view inside the four reservoirs. All the tanks appeared to be empty of water. From this final reservoir, a system of concrete canals leads water to the ponds and water is piped to the main hatchery filter system. Most of the canals are in good repair with only minor repair work needing to be carried out in places. Some screens, shutters and filters need replacing at the outlets to the ponds.

Figure 3. Turfloop Hatchery water supply header tank (foreground) and sand filter tanks (white, in background).

The Indoor Hatchery

1. Filter room

Inside the main indoor hatchery is a room which currently house three large concrete filters. The method by which the filters operate is as follows: water is re-circulated by pumps through the numerous fibre-glass and asbestos tanks within the indoor hatchery. Each fish-tank has an overflow and polluted water is then drained via a central manifold (for each of the three filter systems) into a settling tank, which currently contain some gravel. These tanks then overflow into large rectangular reservoirs, after which the pumps then re-circulate the water. The current design of the filters is poor, in that the effluent which comes directly from the fish tanks is piped firstly into the gravel based biological filters, before being then piped into the main holding tanks. This is the incorrect way round for efficient filtration and will result in clogging of the biological filter medium (which is largely missing anyway, and needs to be replaced). Details of the proposed re-design of this filter system are given below.

Figure 4.The indoor hatchery filter room. The large white pipe directs effluent water from the fish-tanks into the primary filter chamber which then overflows to the large secondary tanks to the left of the picture. The pumps, which draw water from these, are situated at the base of the blue pipes. The third pump is missing.

One pump of the three is missing from the filter room, and the other two need inspection for serviceability of windings and bearings, and electrical connections. A reserve pump should be purchased.

The filter room is generally well and substantially built, and can be easily re-modelled. The numerous electrical connections, conductors and switchboards appear to be in a good state of repair. The many (18-20 in number) 3-4KW electrical heaters (geyser type elements) that are mounted in the filter tanks would not be economical to run, and would be inefficient anyway and need to be removed. If supplementary heating is required a heat pump (compressor type) would be far more energy efficient than multiple geyser elements.

2. Re-design of filters

The current filter design is poor and the primary tanks which must have contained the filter medium, (most of the gravel used has been removed), would be prone to blocking with suspended sediments when under a high biological load. The secondary tanks are un-necessarily large in volume, and the flow-system basically needs to be ‘turned around’ in design in order to operate efficiently.

 

Figure 5. Insufficient gravel remains in the primary filter chambers to be effective, but should be better situated in the secondary chambers, leaving the primary chambers as settling tanks. The secondary chambers currently house numerous high wattage geyser-type heating elements which should be removed, and replaced with a heat-pump for additional heating if required.

The existing primary filter tanks, that at present contain some gravel, need to be cleaned out and left without any form of filter medium except mats of filter 'floss' to catch suspended sediments, placed under the inflows. These tanks will then serve as primary settling tanks for the heavier particles to settle out in the form of sludge, which can be drained or siphoned off from time-to-time. The 110 mm PVC plastic drains from these tanks then direct water to the three large rectangular concrete tanks, that were formerly used as secondary clarifiers. These large tanks need to be divided into four equal sections each, by construction of three dividing walls built of brick or cement-plastered block across them. The inflowing water flows into the first compartment (25% of the total area) and under the first wall which should have spaces left at its base, where alternate bricks are left out, (to allow passage of water), and its height should be equal to the height of the main tank walls. From the second compartment the water should then flow over the top of the second dividing wall, which has no spaces at its base, but of which the height is only 80% of the height of the main tank wall. Water in the third compartment again flows under the third dividing wall (similar to the first), and into the fourth and final compartment . Thus, each rectangular tank is divided into four separate, but connected compartments. The first three of these compartments are then filled with suitable filter medium such as plastic (PVC) shavings, glass wool, bio-balls etc. The final compartment which comprises 25% of the volume of the original tank, remains empty of all except purified water, and serves as the reservoir tank from which the pump draws its supply. This final compartment should be fitted with an inflow pipe connected to a high-volume float valve to automatically keep the system full at all times and to compensate for evaporation or other water losses from the system.

3. Main tank room
The main tank room consists of approximately 46 octagonal fibre-glass tanks mounted on steel frames, and 66 rectangular asbestos tanks of which 18 are approx 1.2 x1.2 x 0.5 m (720 litre) and 48 half-sized ones. Apparently some of these asbestos tanks have given problems with the joints failing, and were being replaced by the octagonal fibre-glass ones of which there are 23 spare ones in the upstairs roof-store.

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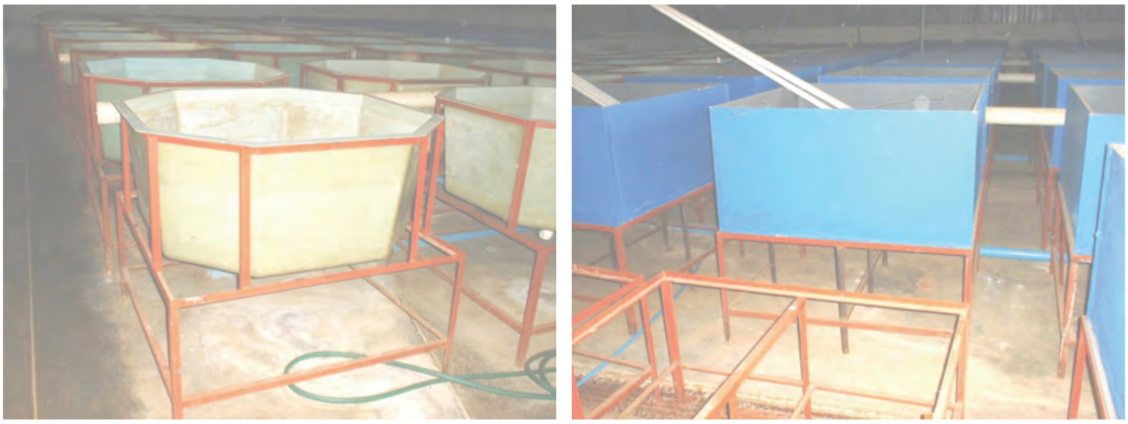

Figure 6. New fibre-glass octagonal tanks hang from their steel frames. Older rectangular asbestos tanks of various sizes are packed densely in rows in the hatchery leaving little working space.

The general impression of the main indoor hatchery is that far too many tanks have been squeezed into too small a space and that no room has been left for working with nets, or the carrying of essential hatchery items like buckets. It is suggested that at least 30% of the tanks be removed into storage to allow working access. Most of the tanks have not been connected to their exit plumbing anyway, so considerable re-arrangement and plumbing work needs to be carried out, although most of the fittings do seem to be available on-site, or in store.

The inlet plumbing from the filter system seems to be largely intact and in good order. One problem is that all the fittings have been solvent welded and any modifications will require that the joints be broken.

The roof is well insulated making working conditions bearable in hot weather, and the neon strip lighting appears to working well. The metal angle-iron tank stands have little to no rust and are in good order. One point of concern is the new octagonal fibre-glass tanks that may have not yet been tested for strength: they appear to be designed to hang from their lip around the circumference of the tanks, and since each must hold approximately 400-500 litres or more, the weight on these thin fibre-glass lips may be excessive. They need testing.

The main tank room needs a central blower (installed in the filter room) such that all tanks can receive a flow of compressed air. There was apparently no standby generator such that in times of power failure all systems will stop, which can cause considerable losses in both fish stocks where held at high densities, and the biological integrity of the filters if the power-cut is prolonged. One other aspect of power failure with re-circulating systems with no standby system is the ‘drain-down effect’ that results in many tanks draining down after the power has been cut to such an extent that the filters overflow, then have insufficient capacity to refill the tanks once power is restored. The filters may then run dry with resulting damage to the pumps, or are rapidly refilled with colder water from outdoors (during winter) that can cause stock losses with the fish due to temperature shock. A standby generator is essential for pump and blower operation at least. This unit does not need to be a large fixed industrial-type unit, but depending on the budget available should at least be of the simple manually-started portable petrol or diesel powered type with a rating of around 5-7kw, depending on the total draw demand of the equipment connected to it. The best units are, however, 3-phase industrial type units with switchgear fitted with a 10 second automatic electrical starting-delay period after power failure, before they automatically self-start, and battery-charging capability. Second-hand units of 20-30KW are obtainable for R30 000.00 to R40 000.00.

4. The 'mini hatchery'

Off to one side of the main hatchery is a small room currently partially fitted out with several tanks of non-uniform size or shape. This room would be ideal for treating the fish with various chemical substances (i.e. for sex reversal, medication etc) and needs to be properly fitted out with tanks, water reticulation and lighting (see Manual of Hatchery Operation for further details).

5. Office, store-rooms and laboratory

There are two large and one small store-rooms that currently house a range of nets and other equipment including grass mowers and oxygen bottles. The one lockable store-room could be converted into a bulk feed store, and the small store room a chemical and medical supply store room.

The laboratory/office is adequate in size and would need installation of typical office equipment such as computer, fax, scanner, printer and stationery. The lab has two mechanical scale balances, and would require a dissecting microscope and other lab and water testing equipment as listed in the proposed budget (ph, oxygen, temperature testers etc). The laboratory needs a large chest type freezer and fridge for food and drug storage.

Figure 7. The main office and laboratory at Turfloop Hatchery. There is little office equipment apart from two mechanical scales and some furniture.

6. The upstairs roof store

In the loft of the building there are numerous tanks and other plumbing equipment, most of it in a good state of repair.

The outdoor pond system

The pond system is well constructed and extensive in terms of number of ponds. There are 6 concrete sided but mud-bottomed ponds of approximately 22 x 15 m x 1.5 m deep. These are in a good state of repair and ready for use. Some of the out side up-stand pipes (200 mm PVC) have been burnt by a bush-fire and need replacing. There are also 6 earth-walled ponds of similar size. All these ponds re enclosed in *vibra-crete* walling to keep out platanna frogs and other predators, and a security mesh fence. A small amount of repair work and sealing of these walls needs to be carried out, particularly where the inflow canals enter the pond system. Although the bird-netting support structure frame is in place, the netting is missing and needs re-installing.

Figure 8. Concrete-lined ponds behind walls and mesh fences to exclude predators. All the ponds are either partially or completely empty (October 2006).

Apart from the 12 ponds described above there are also 12 other earth ponds, of which six have concrete monk type exits, and of which six are also enclosed in predator proof walling. There are also three large mud bottomed ponds of approximately 30 m x 60 m. All the earth ponds need a small degree of wall maintenance where the banks have collapsed to a minor extent. In places the canal system needs new screens on the inflows and replacement of burnt exit up-stand pipes on the outlets. The canal system needs minor cement work to seal a few leaks.

Figure 9. Large rough earthen ponds with no predator-proofing. Each pond is fitted with a monk-type drain. Such ponds would need bird netting, platanna-proof walling and fencing to be of much value.

Figure 10. Pond outlet pipes are positioned outside the ponds as up-stand-pipes that are 'turned down' into the drainage canal for draining the pond. Some of these PVC pipes have been burnt and require replacement.

A drawback with the pond system is the poor vehicle access to the proximity of the ponds. This would make bulk harvesting difficult, and labour intensive. For harvesting of fish, the pond system would need a number of *portapool*-type tanks to be set-up nearby with a strong flow of clean water through them for holding the harvested stock, as mud-bottomed ponds are notorious for becoming de-oxygenated and turbid when drawn down for harvest. If fish cannot be transferred rapidly to clean water, much of the stock can be lost.. These tanks could also serve as purging and packing-preparation tanks prior to packing and transport of the fingerlings harvested from the ponds.

Road access and signage
The turn-off on the main Polokwane/Tzaneen tar road needs a sign board to indicate the way to the hatchery. Inside the security gate of the reserve the road access needs some upgrading and gravelling to allow unfettered access in all weather. The track is currently soft sand and rough.

Other fixed or movable structures or assets
Currently the hatchery has no vehicle of any type. A 1-tonne bakkie would be the minimum requirement to run the hatchery and to deliver stock. For fingerling deliveries, however, far better would be a specialist trailer that can be fitted with tanks and oxygen for fingerling bulk delivery. This would free up the bakkie for general work around the hatchery and for making minor deliveries and the obtaining of stores etc.

There is no accommodation for hatchery staff on-site. Due to the complex nature of the facility in terms of number of tanks, pumps and systems and the fragility of the fish therein, it would be essential for the hatchery manager to live on-site, such that he/she can have ready and quick access to the hatchery in time of urgent need. There is ample space for a hatchery manager's house near the approach road to the hatchery. Water supply, electricity and telephone are already on site. A simple face-brick two bed-roomed house with kitchen, lounge, bathroom and office would be adequate. Nearby are two staff houses that currently house the guards at the security gate to the reserve entrance. Further accommodation could be provided here for hatchery staff.

Livestock
There is currently no livestock at the hatchery and all the tanks and ponds are empty of water. This is a good thing, as it is always tempting to 'make do' with pre-existing stock irrespective of its origin and quality, and these animals invariably get mixed up with other better-quality stock later introduced to the hatchery.

Brood-stock would have to be obtained from various sources depending on the species selected for use. Selection of brood-stock should not be based on what is locally readily available i.e. in the Turfloop Dam. The origin of the fish in the dam is unknown and their suitability for aquaculture indeterminate. If tilapia fingerlings are to be produced, the selection of suitable brood-stock needs careful investigation under the following criteria:

- Is the strain of proven purity of species?
- Are there any written records of growth rates, fecundity, longevity etc?
- Is the source population sufficiently large enough not to be in-bred?
- Has the strain selected been used before for aquaculture and with what results?
- What is the temperature regime of the geographic origin of the strain selected?
- Does the population have any (recorded) evidence of desirable aquaculture traits such as superior growth rates, cold tolerance, deep body morphology, late maturity etc, or a combination of these?
- Is the strain obtainable, i.e. are sufficient numbers of adult fish available and accessible, for transport to Turfloop Hatchery in good condition?

Consultation with experts at the relevant ichthyology or zoology departments Rhodes, Stellenbosch and Limpopo Universities should be undertaken to identify the best possible sources of brood-stock.

Numbers of brood-stock adult males and females required depends on the scale of the fingerling production planned. More females than males are invariably needed at a ratio of 3:1. A rough estimate of initial brood-stock numbers required to produce a quarter to half a million fingerlings per summer breeding season would be 150 females and 50 male adult *Oreochromis mossambicus*. In theory, each female can produce 300-1000 larvae every 6 weeks throughout the warmer summer months (depending on adult size).

Budget
A budget covering the (physical) material revitalization of the hatchery is attached as annexure "A".

(3) <u>Skills requirements</u>

As recently as 2005 the Turfloop Hatchery had five general assistants based at the hatchery. None of these are currently present, and there are no skilled or un-skilled staff present. One watchman, who has the keys to the buildings, was present when we visited in October 2006, and it is apparent that he lives nearby.

A hatchery manager with sufficient relevant skills is central to the success of the facility's operations. As the job entails considerable constructional and technical work often under unpleasantly hot summer conditions and entailing considerable physical effort, it is recommended that the hatchery manager be male. His skills requirements can be summarized as follows:

- A biological background in the life sciences, preferably ichthyology, with a minimum qualification of a BSc Honours degree in either zoology or ichthyology.
- Some practical fish farming experience in an administrative or managerial role. This is not a position suitable for staff who have merely graduated with a diploma, or who have worked as semi-skilled labourers or general hatchery assistants. The manager will be required to conduct both training and extension work with others in the aquaculture field who may interact with the hatchery, such as rural community aquaculture staff and workers. Thus he should have the ability to communicate well and to speak with authority on all aspects of hatchery operations, and on the wider aspects of aquaculture that may affect grow-out facilities serviced by the hatchery.
- Considerable technical expertise is essential. No hatchery facility can successfully operate whereby specific technical experts need to be called in whenever minor faults or problems occur with essential services such as plumbing, water reticulation, electrical installations (such as pumps and blowers) and of course fish husbandry. If the hatchery manager cannot solve most of the day-to-day problems such as pumps tripping, filters not working efficiently, inadequate feed supply or unsuitable storage, fish disease management, harvesting and fingerling transport etc, then he is not suitable for the job, and the hatchery will fail, virtually overnight.
- The hatchery manager must have sufficient administrative skills to organize all supplies for the hatchery, and to be able to keep a set of accounting books reflecting all purchases, sales, employee salaries and other expenses. He should also be able to compile and write explicit reports describing the activities of the hatchery, and to be able to identify specific shortcomings both short-term and long-term in nature as to the hatchery's activities.
- He should be able to manage and lead a team of semi-skilled staff by example, such that after a season's operations they become familiar with all sides of the hatchery's day-to day needs and requirements for successful production of fingerlings, without the need for continual supervision.

It cannot be emphasized enough that the success or failure of the Turfloop Hatchery depends on obtaining the appropriate suitably qualified individual to run it. Any compromise on this will guarantee failure. It would be unrealistic and irresponsible to consider that an un-skilled person could learn the hatchery manager's job on-site. He must have prior and suitable experience, otherwise the hatchery will fail.

Other staff: for efficient hatchery production one semi-skilled manager's assistant, with some aquacultural experience, and at least two general labourers would be required. The manager's assistant should have a minimum of a diploma in livestock management, with preferably some fish husbandry experience. The two general workers would also be far better suited for their jobs if they had worked on an aquaculture facility before and had some 'feel' for fish husbandry. Some experience in electrical or plumbing maintenance, and general building experience would be invaluable.

Of core importance to the successful operation of the hatchery is the manager's ability to tap into and benefit from sources of information and experience elsewhere. The nearby University of Limpopo's Aquaculture Research Unit facilities are near to hand, and he would be expected to be in regular contact with the Ichthyology and Fisheries Science department of Rhodes University, the aquaculture unit at Stellenbosch University, the Water Research Commission and other relevant sources of information.

It is strongly recommended that the job application interview board for the manager's post include representatives of these institutions, who can then assess his suitability for the position. The post of hatchery manager at the Turfloop Hatchery is akin to that of a manager at a complex manufacturing factory, whereby a single mistake can effectively negate all the efforts taken up to that point to 'produce the goods'. Thus a combination of scientific and technical expertise, combined with a sense of responsibility to the livestock under his care is essential.

Turfloop Hatchery: operations manual

Rationale
This manual is based on the premise that the Turfloop Hatchery is operated under the following conditions:

- the hatchery is run as a business to produce fingerlings of mono-sex *Tilapia* for sale at a profit
- the hatchery is in control of its own finances, has a budget for capital equipment, running costs and staff salaries
- the hatchery is committed as part of its operational responsibility to making available fingerlings of high quality destined to feed into and support community-based aquaculture ventures
- the hatchery is staffed by one skilled manager, supported by a team of one semi-skilled assistant and two to three general labourers or hatchery assistants
- the modifications suggested to revitalize the hatchery in this report, have been carried out, specifically: the general plumbing, building and electrical repairs; alterations to the indoor hatchery filter system design; predator proofing of the outdoor ponds; construction of the outdoor-pond harvesting tanks, and construction of the manager's house

This manual is not meant to define the only activities to be carried out at Turfloop Hatchery. Clearly, any manager 'worth his salt', will have his own ideas as to the sequences of goals and work planned to achieve these goals throughout the yearly calendar. The manual is merely to define some of the more important of the routine operations that will require attention throughout the year. It is for the hatchery manager to define tasks for himself and his staff, on a daily basis. However these tasks can be based on the broad outlines as described below for efficient operation of the hatchery.

(1) <u>'Starting up' the hatchery</u>

After years of virtual neglect, the start-up phase of the hatchery operations will be crucial for getting to know:

- What is in-operative, and needs repairs
- What equipment needs replacing with new materials
- What works, but needs modifying to specific needs

(a) Water supply
The first phase of any hatchery operation will be to ensure that adequate water of good quality is reliably available at all times to the hatchery. The first essential is to ensure that the pump and associated equipment below the dam wall is in good working condition. No work can precede this in terms of importance.

(i) The 'Revitalisation of the hatchery' report recommended that the main supply pump receive a full servicing and the electrical installation be overhauled. It is also essential that the pump installation be protected from the elements by some form of secure building.

(ii) Once the pump is proven to be in good order the next phase would be to test all major water mains. As these appear to be buried, their routing will only become apparent once leaks are noted at the surface, and repairs can then be carried out. It is logical that the main water flow for the indoor hatchery is routed directly to the four large circular concrete tanks which serve as sand filters, near the approach road entrance. A close inspection of these tanks to open any gate-valves before starting the pump may ensure that buried pipes are not burst on initial start-up. The actual system of how these tanks fill and whether they overflow or are automatically kept full by some means of float switches will only become apparent by trial and error.

(iii) Once the sand-filters are filled, the flow should then be directed to the single large concrete reservoir. Again this will be a trial and error process as they may well be no-one with adequate experience locally to advise on how the system worked. Dr Bert Polling , who lives near Polokwane (phone 015-2636076) , and Dr Johan Theron at the University of Limpopo should be contacted for assistance if required.

(2) Commissioning and using the indoor hatchery

(a) Commissioning of filters

(i) If the sand-filter and reservoir tanks that constitute the main hatchery water supply are successfully filled, the next phase is to let water into the indoor hatchery system and fill the filters indoors. If the recommended modifications have been carried out, these will consist of three separate filter systems each with a settling tank adjacent to the main hatchery interior wall, which in turns drains into a large concrete rectangular reservoir, fitted with baffle-walls which divide each filter into separate compartments each filled with some form of filter medium (gravel, plastic shaving, PVC pieces, bio-balls, glass wool etc), and ending up with a small empty tank section from where the pump draws. It is strongly recommended that the filter medium be of some light-weight substance (not gravel but rather PVC discards or shavings or similar) contained in mesh bags that can be manually removed when required for cleaning of sludge. Although gravel forms a good filter medium, the digging out of gravel is an arduous task, and due to this, tends to be neglected with the nett result that filters then receive no maintenance for years and block up, thus becoming largely unserviceable.

(ii) Filters of this 'up-and-over-and-under ' type act largely as biological filters and need to be kept running at all times to retain their load of beneficial bacteria. If switched off for more than a few hours, the bacteria starve for oxygen as the system becomes anaerobic and the bacteria die off, and may become toxic to fish once re-started. It is important that staff are made aware of this, and that such filters are not shut off, when the demand on them is apparently low, or temporarily nil. If filters are ever inactive for more than a few hours it is imperative that for the first half hour of operation the pumped water is directed <u>away</u> from any tanks containing live fish, to remove hydrogen sulphide (rotten egg smell) and other toxic substances that may have accumulated.

(iii) The filters should be left recirculating back to themselves for at least two days prior to directing the water flow to any tanks, to ascertain if any leaks or plumbing problems are present, and after this the water should be dumped entirely and the entire filter system re-filled with fresh water, before any water is directed to fill any of the fish tanks. This is to ensure that the very high pH that results form leaching of new concrete works (often over pH 10, which is lethal to most fish) does not poison any livestock. Once the filters are re-filled the water should be tested for pH. If the pH rises to over 10, the water should again be dumped after a period of recirculation through the system, and then re-filled.

(iv) It must be remembered that for their first 4-6 weeks of operation the biological filters have only a mechanical cleaning ability which will remove suspended matter only. Dissolved toxins in the form of ammonia from fish metabolism will not be neutralised until the filter medium ‘matures’ by becoming coated with bacteria capable of breaking down these toxins into less toxic forms. To do this the filters need a biological loading in the form of some fish in the tanks and a light feeding regime that will encourage the beneficial bacteria to colonise the filter medium. It is suggested that approximately 20 tanks inside the hatchery are stocked with any fish that are to hand, and that these are fed lightly to ‘load’ and therefore mature the filter system for 4-6 weeks on start-up. Continuous water quality monitoring during this process is essential, and records must be kept of pH, temperature, oxygen and nitrate/nitrite levels both at the inflow and outlet to each filter to ascertain its ability to convert toxic ammonia to less toxic nitrite.

(b) The indoor fish tanks

(i) The various fish containments within the main hatchery can gradually be plumbed in and filled, and fitted with screens and covers as required for use. The greater the volume of water contained in the total system the better the buffering capacity against water quality fluctuations, which will reduce stress levels of the fish using the system, so even tanks not destined to contain fish immediately should be filled and added to the re-circulating system.

(ii) The entire system should be left running to check for plumbing faults and leaks and the numerous inevitable gremlins that always occur in a complicated plumbing system such as this. The power should be shut off for short periods and then re-connected to ensure that the pumps do not run dry (or suffer air-locks) once all tanks are refilled after power-cuts. Any stand-by electrical system should also be tested at this stage before (valuable) fish are stocked into the system. Overflow screens and outlet pipes in the fish-tanks should be checked for adequacy to cope with the intended water flow rates. Tanks should be filled and drained to ensure that staff are familiar with these procedures and the time required to do both, and the filter’s capacity to refill with adequate new water to cope with filling new tanks not previously connected to the system. All staff should be made familiar with all aspects of the water reticulation system, such that the inevitable glitches such as tanks overflowing, or outlets blocking, can be adequately dealt with without loss of stock.

Summary of essential factors concerning re-circulating filer systems:

- Filters need to run at all times, otherwise beneficial bacteria die off, resulting in the water becoming toxic to fish
- If filters are ever stopped for more than two hours, the water should not be immediately directed to fish-tanks on start-up.
- New filters take 4-6 weeks to mature and become efficient at removing ammonia
- Filter plumbing can be complicated and staff need to become familiar with its operation . Water quality monitoring must be carried out at regular intervals

(**c) Preparation for stocking of indoor tanks**
Before any indoor tanks are used for live fish, it is essential to ensure the following:

- That all outlets are screened against fish escape. Netting mesh size to be in proportion to the size of fish contained,
- that all tanks can be covered to prevent fish jumping out, especially at night, and to prevent any mesh used for this purpose 'gill-netting' the fish in the tanks
- that the water temperature in the indoor hatchery system is not markedly lower or higher than that which the stocked fish are used to, i.e. within 2ºC.
- that suitable feed is available in adequate quantity
- that adequate hand-nets are available to service the tanks
- that water quality records exist of the indoor conditions
- that adequate tanks are prepared for the rearing of the desired numbers of fish without excessive crowding, which would lead to stress and disease losses
- that records are kept of the species, origin, size of fish and date of stocking etc

(d) Re-organisation of the 'mini hatchery' room for specialized work
It is envisaged that the small hatchery room, known as the mini-hatchery be utilized for specialized work such as the incubation of fish eggs and first larval rearing of fry. If mono-sex *Tilapia* are to be produced, then this room should have the following equipment:

- ➢ egg-hatching jars fitted with flowing fresh water
- ➢ tanks with re-circulating water to house swim-up fry
- ➢ prepared methyl-testosterone-laced feed for initial feeding treatments
- ➢ numbered tanks, labels and indelible pens to keep accurate records of relevant dates for commencement and duration of feeding treatments
- ➢ a selection of fine aquarium type nets, and suitable small buckets for handling stock

(e) Store-rooms and equipment storage

(i) Hatcheries are notoriously warm and humid places, quite unsuitable for the storage of dry goods and feeds and fragile laboratory or electronic equipment such as computers. All store-rooms containing dry feeds, nets and other perishable equipment should be kept isolated from the humidity of the main fish room, otherwise nets will rot, metal equipment will rust and feed will rapidly deteriorate and may become toxic. It is recommended that the main hatchery doors are fitted with spring-closing mechanisms.

(ii) Chemicals and medicines should be kept in separate rooms from feed. Fuel supplies, oils, lawn-mowers and other potentially toxic substances to fish should not be kept in the same stores as nets, buckets and other fish-handling equipment, to prevent contamination. Potentially lethal substances such as weed-killers and insecticides should have no place within the hatchery building at all, and should be kept in a separate outside lockable store, with the keys in responsible hands only. It is recommended that the use of such substances be kept to an *absolute minimum*, as accidents and abuse can, and do, happen. Access to substances that can cause mass-mortality of the fish stock should they be introduced to the recycling system or ponds, should be limited to senior management only.

(iii) Hatcheries require a wide range of tools for plumbing and other maintenance work done on a continual basis. Tools need to be accounted for, as they are easily lost or stolen, and a secure lockable store with an inventory of all tools should be available and used 'religiously', otherwise losses of expensive tools can be crippling, and highly inconvenient when urgently required, and found to be missing.

(3) The outdoor pond system: 'starting up', filling and use of the system

(a) Start-up, repairs and filling

Modus operandi

Some of the Turfloop Hatchery ponds have been dry for several years and will require checking of walls for animal burrows and other holes that could cause failure on filling with water. In contrast to the indoor tank system, it is recommended that only those outdoor ponds that are to be used immediately are filled with water. The ponds operate on a general 'stagnant basis' in that, unlike trout ponds, which have a constant strong flow of water passing through them, these only require water to compensate for evaporation. All the ponds are mud-bottomed, and the floors and walls (where not concreted) should be raked smooth before filling. Where ponds are to be used for growing plankton, fertilizers can be incorporated in the bottom sediments prior to filling with water.

Predator protection

The suggestions made for revitalizing the hatchery emphasized the need for bird-netting over the fingerling ponds: without this predator loss of stock will be high. Likewise, the platanna-proof (frog) walling must be kept in good repair to prevent the ingress of these and other fish and fry-eating pests during wet weather. Platanna frogs and leguaans can be extremely difficult to eradicate once they gain access to large ponds, and can cause heavy stock losses.

Inlets and outlets

The inflowing cement canals must be screened to prevent unwanted fish or frog access to the ponds, and to prevent fish from one pond migrating to an adjacent one. A regular system of checking and servicing these screens and canal-shutters, and maintenance of the canals, needs to be implemented for efficient management of stock, and this can be one of the many routine duties of the junior staff.

Leaks and drainage

It is not always easy to see whether ponds have serious leaks without filling them. It is suggested that each pond is filled and left standing with water at full retention level for two days to check for leaks, prior to the unit being used for fish. The higher bank of ponds can be checked first and the water then drained off, or piped into the lower bank of ponds, to save on water wastage, if the pond is not to be used immediately. Once the ponds have been checked for leakage they can be either left full, if use is imminent or drained completely. Ponds should not be left with small volumes of water in them as this encourages insects to breed therein, which can then become pests to both fish fry and workers alike. If ponds will not drain completely the bottoms should be re-shaped such that they do so, and a sump excavated around the exit pipe which will then collect and hold sludge.

(b) Pond management

Ponds need to be managed on an efficient basis: ponds are far more than just holding tanks for fish, they are there for a purpose, be they either for brood-stock conditioning, fish breeding, fry-rearing of fingerling on-growth. As such, each pond has a specific use and must be managed accordingly.

(i) **Brood-stock holding ponds**. These ponds will contain brood-stock obtained by the hatchery from elsewhere, for later use. These ponds should preferably be the smaller ones whereby specific brood-stock can be kept separately according to geographic origin or even sex. Regular checks need to be made to establish the well-being of these new stocks and to check for any outbreaks of diseases or parasites, and to remove dead or sick fish that may contaminate the others. Each pond should have a number- plate, and a sign-board detailing the fish species, origin, size, stocking date etc therein, such that stocks cannot become mixed or confused. Brood-stock tilapia in these holding ponds can be fed commercially available tilapia pellets.

(ii) **Breeding ponds**. If mono-sex tilapia are to be bred, this is best carried out en-masse in shallow ponds of not more than 1 m depth. For sex-reversal to be successful the ova or newly-hatched fry need to be collected on a weekly basis from the breeding females' mouths, so the ponds need to be easily drained such that mouth-brooding females can be caught without undue stress, and the hatching eggs carefully removed from their buccal cavities with the fish spitting them into them mud. This will require the use of the six smaller concrete-lined ponds, where turbidity can be kept to a minimum on draining.

(iii) **Holding tanks**: adjacent to the breeding tanks, on the flat ground immediately to the side of these ponds, should be set-up a small system of portable plastic tanks and containers with inflowing fresh water for holding the mouth-brooding females prior to and post-stripping of eggs or hatching fry. Several small tanks will be required to hold fry or un-hatched eggs at different stages of development prior to taking them to the 'mini hatchery' indoors for incubation and later androgen-feed treatment. Other larger tanks will be required for holding un-stripped and stripped female parent fish, before returning them to the refilled pond, once the entire stock has been checked for mouth-brooders. This procedure may be a lengthy one and may take an entire day, so the small-tank system should be shade-netted with 80% shade-cloth to prevent excessive heating up of the small sized tanks, which would rapidly kill the fish and fry. It is <u>essential</u> that the stripped eggs, or fry, once removed from the mother's mouth, are contained in high-quality well-oxygenated water of the same or slightly cooler temperature as the ponds (1-2ºC cooler) , and removed to the incubators in the indoor 'mini hatchery' as soon as possible. Thus, the small-tank system should also have a sorting table adjacent to the tank holding mouth-brooding females for efficient and stress-free removal of the fish from the holding tanks, stripping of eggs, and transfer to the other large tanks for stripped females.

Note: A supply of compressed air to this system from the central hatchery blower will greatly reduce fish stress, as air-stones can be placed in each tank and container to elevate oxygen levels, and consideration should be made for the use of sedatives for use in the tank holding the mouth-brooding fish awaiting stripping of eggs.

(iv) **Feeding:** Feeding of the livestock in the ponds is relatively simple and straightforward, as no growth-trials are envisaged, and the fingerlings must be sold when still small (preferably 40-60 mm in length) to allow for ease of transport and high survival en-route to their market destination. Brood-stock tilapia can be kept in good condition on a diet of commercial tilapia pellets, supplemented by chemical or animal-manure fertilization of the ponds to promote phytoplankton and zooplankton blooms on which the fish feed. The larvae, once they have been weaned off the methyl-testosterone supplemented dry diet, at approximately four weeks of age, will be stocked into ponds for onward growth and it is recommended that ponds be pre-filled and immediately fertilized one week prior to stocking with 1-month old fry to encourage planktonic growth (ponds should not be filled earlier than this to prevent the growth of predatory insect larvae that would prey on the fish fry). Fingerlings awaiting sale can be adequately maintained on a diet of crushed tilapia pellets and do not need expensive high-protein diets for maintenance over what would be relatively short time-periods in the ponds, whilst awaiting transport to market (a few weeks at most).

(v) **Fry and fingerling rearing ponds**. These ponds will house fry (juvenile fish of 15-30 mm length) and subsequently fingerlings (30-80 m length) for grow-out and holding prior to dispatch to the customer. As the fish will be small and fragile when harvested, the catching technique must be efficient to prevent undue stress to the fish and subsequent losses during transport. The ponds should have smooth bottoms and carefully shaped sides such that small seine nets can be utilized for harvesting. Fine screens should be in place over the outlet pipes to prevent escape of stock. The water in these fry-rearing ponds will most probably be enriched to enhance plankton production, and as such, the intestines of the harvested fish will be full of semi-digested ingested matter on harvesting. Fish never transport well when the gut is full and this results in excessive fouling of the transport water with subsequent de-oxygenation and losses of the stock whilst en route, so the fingerlings will need to be purged before transport.

(vi) **Harvested-fingerling holding tanks**. A system of small, shaded tanks, sufficient to hold the fish intended for transport will be required, with a through-flow of running water, and compressed air, such that the harvested fish can held without food and be purged of their gut contents prior to packing for transport. These pools should preferably be made of brick or plastered concrete block and be rectangular, as fish are much easier to catch in rectangular tanks than round ones. They must be drainable, and covered such that fish do not jump out. The entire system should be predator proof and lockable. Fingerlings harvested from the grow-out ponds should be transferred in manageable numbers from the catching net to large buckets (20l) and then rapidly transferred to the purging tanks. No food is given to the fingerlings in these tanks for 24 hours (or more, depending on the distance they have to travel, and at what density) and packing for transport from these tanks should best take place in the cool hours of the early morning for transport and delivery that same day.

(4) A protocol for the production of mono-sex tilapia fingerlings for the stocking of community-based rural fish projects

General
There is a wealth of technical information on the breeding and rearing of mono-sex Tilapia in the literature, and the reader is encouraged to refer to these papers for detailed information . An excellent summary of the protocols to be followed is attached as Annexure B (Phelps & Popma, 2000).

Candidate species in South Africa
The only tilapia species currently authorised by the Department of Environment Affairs and Tourism and the Department of Agriculture for aquacultural use in this country at present are the indigenous species *Oroechromis mossambicus* and *Tilapia rendalli*. Although the Nile Tilapia, *O. niloticus* is now found within the Limpopo system as an alien introduced species its use is at present illegal. The Mocambique Tilapia, *O. mossambicus,* is a species widely cultivated throughout the tropical world but suffers the inherent disadvantage of precocious reproduction and resulting harvest of numerous small and few uniform-sized large individuals. The red-breast Tilapia, *T. rendalli*, is largely phytophagous (herbivorous) and prospers where abundant macrophytes (natural or introduced) are available. Mono-sex production of only the mouth-brooding *O. mossambicus* has been attempted, although technically mono-sex production of *T. rendalli* should pose few problems if fertilized eggs or hatching juveniles can be obtained at the right stage of development.

Modus operandi of fingerling production
A basic outline as to the protocol used is given as follows:

- Adult fish are introduced to shallow outdoor ponds in the sex ration of 1M:3F
- During the summer months when water temperatures exceed 20ºC the males will come into breeding condition, establish territories and spawn with ripe females.
- Mouth-brooding females will be carefully netted from the ponds on a 7-10 day cycle, such that the incubation period prior to the first release of the juveniles is interrupted

(usually takes place from 14-20 days post spawning) and eyed-ova or hatched fry with yolk-sacs are harvested from the females' mouths.

- Larvae are introduced to incubation tanks in the indoor 'mini hatchery' and monitored for first exogenous feeding, i.e. after complete absorption of the yolk sac.
- Larvae are then fed a dry-food diet mixed with methyl-testosterone fro 3-4 weeks to fix the sex as male only.
- During this carefully-controlled feeding period fry are transferred to the larger fibre-glass or asbestos tanks in the main indoor hatchery.
- Once the initial feeding period of 3-4 weeks is complete, sex reversal has been achieved and the fry can then be stocked outdoors in the larger ponds for onward growth to fingerling size (40-60 mm).
- Fingerlings are supplementary-fed with commercial *Tilapia* pelleted feeds in the ponds, which should be fertilized to encourage plankton growth which will from the bulk of their dietary requirements.
- Fingerlings are harvested at a size as required by the customer, and after purging in the harvesting tanks, transported to their market destination or collected by the customer.

Flow chart of activities to produce mono-sex tilapia fingerlings:

Breeding ponds containing Mixed sex adults at a ratio of 1M:3F

→

Weekly harvest of hatchlings and fry, from mouth-brooding females, transferred to indoor hatchery

→

9-14 mm juveniles fed hormone diet for 4 weeks, then transferred to larger tanks

↓

30 mm fry transferred to outdoor fertilised ponds for grow-out to fingerling stage

↓

Fingerlings harvested and transferred to purging tanks prior to transporting to customer

(5) Community Public Private Partnerships

Options

The decision as to the type of ownership or management of the Turfloop Hatchery has several options. Originally the hatchery was built with public funding through the Former Government of Lebowa, under the auspices of the Department of Agriculture and the former University of the North (now Limpopo). The hatchery was custom-designed to produce *Clarias gariepinus* fingerlings and carp and tilapia as sideline. Over its several years of operation various projects mainly using University research funding or NGO=sponsored funding have been carried out at the hatchery, until its fall into disuse since 2003.

Options that are available include:

- Fully controlled and operated by the Provincial Government of the Province of Limpopo
- Ownership by the Provincial Government, but operated by the University of the North
- Ownership by the Provincial Government but operated by Private Enterprise under a lease agreement
- Ownership by the Provincial Government but operated by a Non-Government Organisation (NGO) for supporting Rural Community Aquaculture development
- Sale of the facility to Private Enterprise, with no onward Provincial control over operations or production
- A Public Private Partnership whereby the facility remains under Provincial Government ownership, but operates as a private enterprise with certain conditions pertaining to production.

Pros and cons

Each of the above have numerous advantages and disadvantages. However the option of total control by the Provincial Government is not an attractive one as it is under this scenario that the hatchery has basically ceased operations over the last three years. Similarly the use of the hatchery by University research groups is a very ad hoc arrangement whereby for some periods the hatchery would be well-utilised and at other times virtually abandoned, depending on research project focus and available funding. Turfloop Hatchery is a well-designed facility of considerable value, both as a production unit as well as a venue affording considerable training potential for aquacultural development.

The last option, that of a Public Private Partnership, is the most attractive. Under this option the hatchery can be leased at a nominal fee to private enterprise on condition that a considerable portion (negotiated according to the lease-agreement terms) of the hatchery's output is devoted to the production of quality mono-sex tilapia fingerlings for the supply to rural aquaculture developments in the Limpopo Province. The balance of the facility can be used for production of other species (for example, ornamental fish such as goldfish or koi) to be sold for profit. There are ample structures and facilities at Turfloop to accommodate both production goals, and no hindrances should be placed in the agreement drawn up on possible future increasing the future size of the facility in terms of constructing new ponds or erecting buildings or other structures required to increase output.

Figure 11. The community aquaculture project at Ipopeng at the Seshego Water Purification Works near Polokwane. The ponds contain some *Clarias gariepinus* and mixed-size population of *O. mossambicus*. Overpopulation with undersized fish and lack of technical advice are serious hindrances to success.

To make the offer attractive to a private company or organization interested in a Public: Private Partnership, the Provincial Government should undertake to revitalise the hatchery as detailed in the attached budget (Annexure A), and to then offer the hatchery as a facility in full working condition in exchange for the undertaking by the operator to produce and make available fingerlings, training and technical support to rural aquaculture developments. Funding for input and running costs, and output fingerling prices should be negotiated, and a sliding scale of reducing staff salaries can be offered by Government as the hatchery becomes profitable and can take charge of its own finances and salaries., possibly over a period of three years. It is suggested that Government supports 100% running and salary expenses in the first year, reducing this to 50% in the second and 25% in the third.

Caution

Note: a final word of warning that needs to be emphasized, is that Turfloop Hatchery, as a complex highly sophisticated aquaculture unit, will <u>not</u> succeed if placed under the management of unskilled personnel of limited technical and managerial expertise. Many NGO's may claim to have the expertise to take over the running of the hatchery in the belief that they can quickly rear large quantities of fish therein and make a profit. These organizations need to be investigated carefully by both the Department of Agriculture and professional aquaculture experts alike, to ascertain the genuine level of aquacultural and managerial expertise offered by their personnel, before 'handing over' the hatchery to those who may have few real appropriate skills to make it a success.

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Annexure 'A'

Provisional Draft Estimate of Refurbishment Costs for Turfloop Fish Hatchery, Limpopo Province

Section A. Material & Equipment refurbishment costs

(1)Essential services

(a) Road access, needs minor grading and gravelling at hatchery end, and signposting at tar road end……………………………………………………………………………….40 000.00

(b) Electricity: checking of circuits and switchboards……………………...............10 000.00

(c) Water supply: main dam-supply pump requires servicing, replacement of belts and construction of weatherproof building……………………………...80 000.00

(d) Telephone: currently still connected…………………………………………..….nil

R130 000.00

(2) Indoor hatchery

(a) Recirculating filter system modifications……………………………………..…70 000.00

(b) Indoor plumbing and re-spacing of tanks………………………………………50 000.00

(c) Laboratory water quality control instruments…………………..............……40 000.00

(d) Minor electrical alterations…………………………………………….…………25 000.00

(e) Office equipment, computer, fax etc………………………………….……...….40 000.00

(f) Installation of air-blowers (2) with plumbing……………………………………..40 000.00

R265 000.00

(3) Outdoor water reticulation and pond systems

(a) Repairs and extensions to canal network and underground plumbing……………………………………………………………......................80 000.00

(b) Minor repairs to pond walls, installation of platanna-proof walling and security fencing around balance of pond system ……………………………...90 000.00

(c) Replacement of predator-proof bird netting over ponds………………………….60 000.00

R230 000.00

(4) Other essentials and operational requirements

(a) Brood-stock, locally and nationally sourced………….…………………………...80 000.00

(b) Feeds, including specialized feeds and medical supplies……………………….50 000.00

(c) Fingerling packaging and transport equipment……………………………..……25 000.00

(d) Oxygen and other consumables……………………………………………..……15 000.00

(e) System failure alarm system………………………………………………….……40 000.00

(f) Specialised trailer with tanks and oxygen for stocking……………………….……80 000.00

(g) Hatchery transport vehicle (1-tonne bakkie)………………………………………. ..150 000.00

R440 000.00

Total material and equipment refurbishment costs R1 065 000.00

Section B: Staff salaries and housing costs

(1) Capital items: once-off costs

(a) Manager's house on-site (essential)……………………………..…………………..500 000.00

(2) Salaries: recurring costs (annual)

(a) Skilled manager………………………………………………..………………..…..200 000.00

(b) Semi-skilled sub manager………………………………………………..…………. 96 000.00

(c) 3 labourers……………………………………………………………………………..54 000.00

R350 000.00

Total staff capital and recurring costs…………………………………………… R850 000.00

Grand total refurbishment costs………………………………………………..R1 915 000.00

APPENDIX 8:
Lydenburg Hatchery Assessment

Project Title: Participatory development of provincial aquaculture programmes for improved rural food security and livelihoods alternatives

Guidelines for operations of hatcheries

Lydenburg Hatchery

November 2007

CO-WORKERS:

This document was prepared by Mr Martin Davies, Etienne Hinrichsen and Qurban Rouhani.

Operational Plan for Lydenburg Hatchery

Introduction

The Lydenburg Hatchery, situated south east of the town Lydenburg in the Mpumalanga Province, falls under the Mpumalanga Parks Board and was commissioned in 1948 to produce trout and bass, mainly for research, stocking out to angling waters and to supply to the trout production sector for growing on to table fish. Trout is an important activity in Mpumalanga (for fly fishing and aquaculture) and as a result Lydenburg played an important role in the promotion of these two sectors. However, in view of the current environmental legislation, The Mpumalanga Parks Board has subsequently instituted a policy to phase out trout production from Lydenburg, and focus on indigenous species. However funding and support to this facility has gradually been withdrawn, as a result the facility is run down and seems to lack any direction or purpose.

Large ponds at Lydenburg Hatchery. This facility, though in need of repair, still has significant potential to support aquaculture in the province.

There is an urgent need to transfer this facility to Mpumalanga Department of Agriculture. By doing so, Lydenburg can be re-commissioned and serve a vital role in aquaculture production in the province. It is also important to ensure that the revitalization of Lydenburg Hatchery is market driven. Therefore, the species and quantity of fish produced (and cost of production) should be based on expected sales.

Lydenburg Hatchery can take advantage of the well established fly fishing (for trout) and farming sector in the province.

This document outlines the status and potential of Lydenburg Hatchery and argues that this facility should be transferred to Mpumalanga Department of Agriculture as a trout hatchery. There is significant potential to increase trout production in the province and a state hatchery such as Lydenburg could play an important role.

Infrastructure status of Lydenburg

Lydenburg Hatchery consists of 126 ponds of various sizes and descriptions, but much of this has fallen in disrepair. Currently the facilities consist of the following main elements:

- A trout egg hatching facility, which contains approximately 18 hatching troughs. The use of the hatching house is limited to the winter hatching period for trout and can hold in excess of 50 000 ova. Nevertheless this capacity is severely limited by the availability of water. A re-circulation system (with chillers) will need to be built to ensure that egg production is independent of outside conditions.
- Approximately 25 circular concrete tanks with an approximate capacity of 18,4 cubic meters each. These tanks have various applications from the housing of juvenile fish to the conditioning of brood stock and more. These tanks are however in a poor state of repair (many are leaking) and their use is limited by the available water.
- Approximately 18 raceway type daphnia ponds with am approximate capacity of 7,6 cubic meters each. These tanks were used in the past in daphnia production as feed for other fish. These tanks are however in a poor state of repair (many are leaking) and are not currently used.
- The hatchery has approximately 80 earthen dams of which at least 15 are not used in any manner. Many of the remaining dams suffer from severe seepage to the extent that some would require reconstruction for any further use.
- Approximately 7 km of old concrete channels and galvanised piping make up the water reticulation system of the hatchery. This infrastructure is in a poor state of repair and causes significant loss of the available water.

One of the many broken pipes at Lydenburg Hatchery.

Other related infrastructure at Lydenburg Hatchery:

- There are 13 houses on site of which 1 are in a state of complete disrepair and a further 4 are used as offices by various sub-divisions of the Mpumalanga Parks Board. These houses are old and require ongoing maintenance to keep them in a functional sate.
- There are singles quarters for approximately 20 people, which are used by personnel of various sub-divisions of the Mpumalanga Parks Board.
- The main building on site houses various offices, one laboratory, a central administrative hub for the various subdivisions of the Mpumalanga Parks Board and an educational aquarium referred to as a Water Focus Centre. This building is in fair state of repair and well utilised by various components.

- The greater property has approximately 7 closed storerooms with a further 2 open or semi-open storage areas, 1 fuel store and a workshop.

Many of the ponds wall are also cracked and in need of repair.

As seen from the descriptions above the facilities are old and will require major repairs and upgrading in order for the hatchery to become fully functional in aquaculture type production of fish. Nevertheless much potential exists for conservation-based fisheries, the creation of recreational fisheries, research and training etc.

Table 1 SWOT analysis of Lydenburg Hatchery

Strengths	Weaknesses	Opportunities	Threats
Significant infrastructure with high potential to develop (for trout and other species of fish)	Empty staff posts at the hatchery, and the staff may need re-training and motivation.	Aquaculture has been prioritised by both Provincial and National Government, therefore Lydenburg could play an important role in the revitalisation of aquaculture in the province and for the country.	The growth of industry and housing in the area is placing severe pressure on the water available to Lydenburg.
The hatchery is accessible (situated within the town of Lydenburg)	Certain infrastructural decay (e.g. leaking channels and pond walls)	Lydenburg could benefit from resources made available from national of provincial government to re-commission this facility..	The hatchery is administered by Mpumalanga Parks Board. This authority does not support aquaculture nor trout production.
Lydenburg can capitalise on its history of trout production (developing a brand)	Over the years Lydenburg Hatchery has isolated itself from the regional aquaculture industry	Trout production in South Africa is set to increase and as such there will be a greater need for, quality eggs and seed fish as well as selected broodstock	There is a lack of vision at the provincial level regarding the role and potential of Lydenburg.
Lydenburg is located within a well established trout producing area.	Facility is underutilised	Lydenburg is located centrally within the trout production zone of Mpumalanga, and as such would be able to provide live and table fish to the market. Furthermore its close proximity to Johannesburg would enable it to export eggs / seed to international markets	Lack of capacity at the hatchery to operate the facility

There is a high demand for trout eggs, fingerlings and for table trout.	Lack of funding	Ideal facility to provide training to farmers, mentoring and to conduct R & D	Environmental legislation could have serious impact not only on Lydenburg, but trout aquaculture as a whole
Supply and services available (e.g. electricity, fish food, veterinary services)	There is a wide range in water temperature between the summer and winter months and flow in some months may require that the water is recirculated	Water supply and temperature range is ideal for the culture of a wide range of species (e.g. trout and koi) in association with partial recirculation technology	Potential contamination of water supply due to the increase in mining and housing development within the area
The infrastructure is flexible enough to permit a facility with multi purposes, such as training, put and take fishery, seed and broodstock production (for various species).		Rapid expansion of Lydenburg and surrounding areas provides market for aquaculture products	There may not be a reliable supply of electricity to operate the pumps (and the anticipated rise in electricity costs)
Adequate supply of cool quality water for commercial aquaculture		Potential to develop a tourism activity at Lydenburg Hatchery, such as a put and take fishery	Opposition by local trout producers to the possibility of products fem Lydenburg competing with local farmers
			Lack of resources for maintenance

The function of Lydenburg Hatchery

Lydenburg Hatchery could be used for the following purposes (listed in table 2 is a production model for Lydenburg with proposed production values) ha:

- Production of trout to stock the provincial cage culture programme
- Production of trout eggs for its own use and to the public
- Fingerlings to stock ponds at Lydenburg for the put and take fishery and to sell to the public. The put and take fishery is a tourism activity that would provide income to the Hatchery.
- Production of table fish
- Ornamental fish production

Other activities that could also be supported at Lydenburg include:

- A training facility for farmers
- A fish processing facility, cold and hot smokers to add value to the trout produced at the Hatchery
- A research facility to develop new and improved strains of trout

The dam from which Lydenburg Hatchery receives its water. The hatchery will have to re-circulate water as there may not be enough to flow through the ponds all year round.

Support Municipal Infrastructure

The essential infrastructure for the operation of a hatchery is intact and largely in a working order. This essential infrastructure includes:

- The site is serviced with a gravel road, becoming tarred before leading into the town of Lydenburg. This road infrastructure is in an acceptable condition.
- The site is supplied with electricity via the national electricity grid.
- Although water supplies have become a major constraint, the hatchery has access to water supplies.
- The site is serviced with telecommunication lines.

Water supply

As the Lydenburg Hatchery is primarily a cold-water facility, requiring relatively large volumes of water, the reduction of sufficient water supplies has handicapped its operation. In this regard various factors have exacerbated this situation since the commissioning of the facilities in 1948. These factors can be summarised as follows:

Earthworks for a large housing project adjacent to Lydenburg Hatchery. These new developments will increase pressure on the availability of water for Lydenburg Hatchery.

- Water is supplied to the Lydenburg Hatchery from the Lydenburg Town Dam, which in turn is fed by the Sterkspruit River. The water from this dam is managed by the local municipally, who do not treat the water supplies to the hatchery as a primary concern.
- The water reticulation infrastructure on the hatchery site (open concrete channels and galvanised piping), the ponds and the dams originate from the original commissioning of the facilities and has become old and largely beyond reasonable repair. Much water is lost to leakage and seepage from these facilities, including the final sedimentation dam into which water is led prior to its return into the municipal water supply system.
- The development of 3 500 new homes is taking place in the residential expansion of Lydenburg and this is impacting heavily on the quantity of water that is available for the hatchery activities as opposed to domestic supplies.
- The De Kuilen trout breeding facilities were established in 1975 in the upstream catchments that could both supply good quality water to the Lydenburg Hatchery and serve as a trout breeding station. Subsequently 5 businesses (including trout farming operations) have been established in the area between De Kuilen and the Lydenburg Hatchery and this has severely decreased the water volumes and has impacted heavily on the quality of water that could potentially be supplied from this area. Even the water supplies at De Kuilen itself have been impacted upon by upstream activities.

De Kuilen is another facility that could be used by the Department of Agriculture for ova production. This facility was recently vandalized and many of the trays in the picture removed.

Personnel and Human Resources
The steady decrease in fisheries production, the failing infrastructure and the revision of the mandate and policies within the Mpumalanga Parks Board regarding the production and stocking of fish, has led to the absence of a dedicated aquaculturist at the Lydenburg Hatchery. Currently 9 unskilled labourers operate under the management of Mr. T. De Beer and this team is not exclusively responsible for the hatchery and fisheries / aquaculture operations. This team is responsible for the overall management and maintenance of the entire property, which is used by various sub-divisions of the Mpumalanga Parks Board and which is used for various conservation related aspects.

Staff at Lydenburg may need further training to be able to meet the production demands of the Hatchery.

There is a need for a dedicated aquaculturist with the necessary qualifications and experience in aquaculture and fisheries at the hatchery. The tasks and responsibilities, as well as the supporting human resources to such an appointment, must be clearly defined.

As people of this calibre are in short supply in South Africa an active programme will need to be undertaken in identifying potential candidates towards a successful appointment. In this regard it is recommended that a candidate identification process include close contact with the Universities of Rhodes, Stellenbosch and Limpopo (these universities all having active aquaculture programmes). The appointment must be made with the necessary support systems (in terms of infrastructure, budgets, other human resources, ongoing training etc.) for this person to operate successfully in the realisation of the potential at the Lydenburg Hatchery.

Current Products and Output

The outputs of the Lydenburg Hatchery in terms of aquaculture products is limited by the poor state of repair of the fisheries infrastructure, the absence of a dedicated aquaculturist, the limited supplies of water and the mandates and policies of the Mpumalanga Parks Board not to be active in aquaculture production or the propagation and sale of exotic species such as trout. In summary the current products and outputs can however be summarised as follows:

- Trout eggs that are either stripped from brood fish on site or sourced externally are hatched and grown on at the hatchery. These fish are slaughtered and sold as table fish to the surrounding communities on an informal basis and the total production in this regard is unknown but limited.

These large circular ponds would be well suited for the grow out of trout fingerlings

- A programme is operated at the hatchery for the production of Bushveld Smallscale Yellowfish (*Labeobarbus polylepis*) for conservation purposes. This programme is however limited and has only reintroduced approximately 40 fish to the wild.
- A core population of Mosquito Fish (*Aplocheilicthys katangae*) is kept at the hatchery and four subpopulations have sub been established at other locations in the province. Apart from the control of mosquito larvae these fish are widely used in research, especially in aquatic toxicology research.
- Small numbers of Mozambique Tilapia (*Oreochromis mossambicus*) and Banded Tilapia (*Tilapia sparrmanii*) are distributed infrequently from the Lydenburg facilities.

The hatchery is large however some adjustments would be need to be made to it, such as a re circulating system. This would enable the hatchery to keep eggs when external water conditions are not ideal.

- The display and education aquarium at the Lydenburg Hatchery (refereed to as a Water Focus Centre) provides a very successful output in terms of attracting many visitors, especially school groups who gain from its educational value.
- As an output some research and information on conservation and fisheries is generated by the primary fisheries / aquaculture facilities. This relates mainly to the husbandry of indigenous fish such as the Bushveld Smallscale Yellowfish (*Labeobarbus polylepis*).

<u>Proposed production of Lydenburg Hatchery</u>

In spite of the poor state of repair and the shortages of water, the facilities have the potential to be upgraded and to serve in the development of aquaculture and fisheries in the province and further a field. The Provincial Department of Aquaculture is planning to develop cage culture of trout in dams and a result will require large numbers of fingerlings. Furthermore, section of the hatchery can be used for recreational fishery (put and take). Dams are stocked with trout and paying fly fishers can fish them out. In view of the large numbers of houses that will be built around the hatchery it is envisaged that this could become a popular activity and as such earn revenue for the hatchery. A production plan (table 2) has been prepared. There are some assumptions in the plan, such as the number of tons of trout that would be required to initiate the cage culture programme of the province. These figures in the table should be viewed as a starting point and as such further interactions will be required with the provincial department of Agriculture.

Lydenburg facility could be developed to provide seed for the proposed cage culture of trout in Mpumalanga Province

Trout fingerlings at Lydenburg Hatchery. It is imperative that this facility is transferred to the Department of Agriculture so as to enable this facility to function to its full potential

Table 2. Potential production of trout at Lydenburg Hatchery

Category	**Eggs**	**Fry**	**Fingerlings**	**Yearlings**	**Growers**	**Adult**
Stocking of cages*: (200t) @ 1.25kg (50t) @ 350g	400 000	267 168	222 640	193 600	176 000	160 000
Eggs	500 000	222 000	185 000	154 000	140 000	X
Trout for “put & take” fishery at Lydenburg	13 000	8 000	6 400	5 120	4 608	X
Trout for “put & take” fishery to be sold externally	13 000	8 000	6 400	5120	4 608	X
Table fish (for Lydenburg)	**	X	X	X	X	X
Fry (for sale)	80 000	80 000	X	X	X	X
Fingerlings (for sale)	25 000	20 000	16 000	X	X	X
Total	**1 031 000**	**605 168**	**436 440**	**357840**	**325 216**	**160 000**

*This refers to the trout cage culture that the province plans to develop
**The number of eggs required to produce table fish for sale at Lydenburg has been included into the overall needs to produce eggs to stock the cages.

Below is a list of the proposed of roles for Lydenburg Hatchery:

- Production of trout fingerlings to support the proposed trout cage culture project of the province.
- Production of ovas, fingerlings and live trout for sale to commercial farms.
- Open some of the dams for a put and take fishery.
- Apart from the spawning of Bushveld Smallscale Yellowfish (*Labeobarbus polylepis*) the facilities have the potential of producing a range of other indigenous and conservation worthy species. This is, however, only possible if a dedicated aquaculturist were appointed and an outcomes-based Operational Plan implemented.
- Lydenburg Hatchery is large enough to also produce ornamental species (such as Koi) and also tilapa during the warm months. The koi could be sold to ornamental fish retailers while the tilapia could be used to stock ponds of rural farmers.
- The Lydenburg Hatchery has a significant potential in serving as a coldwater aquaculture and fisheries training facility and centre of technical expertise. This could compliment the proposed Lowveld Aquaculture Training College. Furthermore such a training centre could serve a core purpose in the coldwater aquaculture training of extension officers within the Department of Agriculture and Land Administration.
- A research centre to develop new and improved strains of trout that is suited to the environmental conditions of South Africa.

Empty and over grown raceways – with some repair they could be used to grow out trout fingerlings

Conclusion

Lydenburg, though currently in a state of disrepair has significant potential to supply the necessary fingerlings (and eggs and yearlings) to support aquaculture in the province. For this to happening the facility would need to be transferred to the Department of Agriculture (provincial), as this department is mandated to promote this sector.

Apart from producing trout to stock the cages, this facility could provide training to farmers and aquaculture extension officers. Further, the research tradition of Lydenburg Hatchery could be continued by using some of the resources of this facility to develop improved strains of trout for South African conditions. This could be done in conjunction with a tertiary institution.

Lydenburg could also be used as a centre to train farmers

APPENDIX 9:
Makhathini Hatchery Assessment and guidelines for operations

Project Title: Participatory development of provincial aquaculture programmes for improved rural food security and livelihoods alternatives

Guidelines for operations of hatcheries

Makhathini hatchery

November 2006

CO-WORKERS:

This document was prepared with the assistance of Chiles Churchill of AQUAZUL

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Introduction and History

The Makhathini Research Station is located on the Pongola Flood Plain approximately 15 km northeast of the town of Jozini. The station was developed in the late 1970s as an extension and research facility to aid farmers in Northern KwaZulu-Natal in particular crop and livestock farmers with the majority of the research stations focus been directed to crops such as cotton, maize, sugarcane, cattle and goats. In the mid 1980s the first explorations into aquaculture by this institute was undertaken with funding from the Dept of Development Aid under the guidance of Mr Andy Coetzee who was working at the station at the time. He however left the station relatively shortly after the project commenced and by 1989 the aquaculture drive at this research institute had died out through lack of funding and technical know-how.

After fisheries studies conducted on the Pongola River system and seasonal pans by Rhodes University in the early 1990s it became apparent that the fish stocks within the system were been overexploited by the local communities and it was suggested that aquaculture be re-visited as a possible solution to the problem. These findings together with pressure from government to develop the rural communities once again saw the Makhathini Research Station become involved in aquaculture. By 1994 the research station had constructed four external earthen ponds and a small hatchery unit consisting of 7 concrete circular tanks and one small indoor re-circulating system which were used for fingerling production.

At the time Mr Steven Goetze who was working at the station as an animal scientist was appointed part time to run the aquaculture facilities. Although familiar with livestock his knowledge of aquaculture was rudimentary. Over time though, through visits to Israel and Taiwan, Mr Goetze gained a substantial background and knowledge base of extensive aquaculture systems which would be used in the surrounding rural communities. By 1999 the aquaculture unit at the research station had evolved to the stage that they were now supplying fingerlings to the surrounding communities undertaking aquaculture projects. The Mboza village project was the first project of any standing involved in aquaculture and the research station supplied approx 6000 catfish fingerlings. Although quoted in the 1999 Annual Report of the Department of Agriculture and Environmental Affairs KZN as being “operational and generating income” with “extension services continuing to be delivered to the project, ensuring continuity and sustainability” the project soon collapsed.

Aquaculture at the research station did however continue with the first full time technician been appointed to help Mr Goetze in 1997. Since then the research station has continued to produce small amounts of fingerlings to local communities and aid in various Research and Development (R&D) projects on the Makhathini flats and surrounding areas. The research station has also been involved with various University run projects dealing with aspects such as the effects of aquaculture on water quality (Stellenbosch University) and cage culture trials with catfish (*Clarius garipinus*) and tilapia (*Oreochromis mossambicus*) in the irrigation scheme staging dams (Agricultural Research Counsel, Department of Science and Technology, Stellenbosch University)

Current status

Staff

Staff presently working at the Makhathini research station includes Mr Mbongeni Ngwane who has held the post of aquaculture technician for the past 5 years and has now taken over as the aquaculture manager with the departure of Mr Steven Goetze. He holds an aquaculture diploma from Stellenbosch University and is presently in the process of registering for the Honours program at the Ichthyology department at Rhodes University Three other staff members help him in the running of the facility and culture of fish.

Facilities

The facilities on the research station have changed little over the last twenty years due to budget constraints. At present of the original four earthen ponds constructed only three are operational and hold water (Figure 1). The hatchery facilities at the site are still made up of the original 7 outdoor concrete tanks (Figure 2) and a small hatchery unit housed indoors. There are however, three plastic high density polyethylene (HDP) porter pools which are lying un-utilized on site (Figure 3). Efforts have also been made by Mr Ngwane to extend the fingerling production system by building a system outdoors from breeze blocks and concrete. This system is however incomplete due to a lack of funding and has remained partially built for the last three years (Figure 4)

Figure 1: One of Three Earthen Ponds at Makhathini Research station

Figure 2: The original 7 concrete tanks constructed at the Research Station in the 1980s

Figure 3: HDP porter pools lying un-utilized at the Research Station

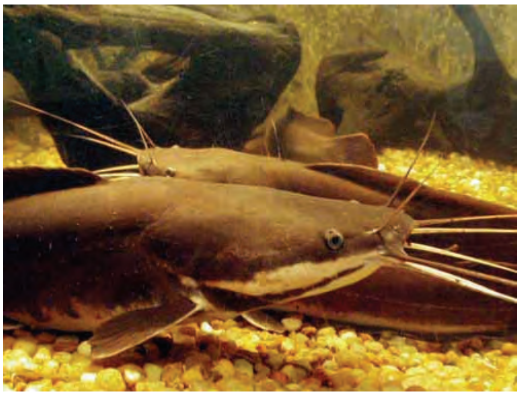
Figure 4: Incomplete fingerling system which has remained so for the last three years

Species

At present three species of fish are found in the systems at the Makhathini Research Station and include the following:

Mozambique Tilapia (*O. mossambicus*)

Red breasted Tilapia (*T. Rendalli*)



African Sharp Toothed Catfish (*C. gariepinus*)

Earthen ponds

Pond culture is the most popular method of growing tilapia in developing countries where capital is a limiting factor. One benefit of pond culture is that tilapia feed on a large variety of natural food organisms found in fertilized ponds reducing the amount of supplemental feed required for their growth. Feed is often 60% or more of total production cost and feed cost reductions can substantially increase the profitability of a culture system. Tilapia ponds range from extensive systems (Figure 5) using only organic or inorganic fertilizers, to intensive systems, using high-protein feed, aeration and regular water exchanges. The major drawback of tilapia pond culture is the high level of uncontrolled reproduction that may occur in growout ponds (Figure 6).

Figure 5: Earthen pond at the Makhathini Research Station. This pond can be classified as an extensive system as it has no provision for aeration which is a necessity for increasing stocking densities

Figure 6: An example of uncontrolled reproduction from an earthen pond stocked with similar sized fingerlings after manual sexing to get all male fish

In severe cases the production of fry and fingerlings, may be so great that offspring compete for food with the adults. In these cases the original stock becomes stunted, yielding only a small percentage of marketable fish weighing 500g or more. Technologies do exist however to circumvent this problem in both extensive and intensive pond culture systems (Figure 7) and are listed below:

1) **Periodic harvesting of tilapia fry and fingerlings to reduce competition for food.**
   - Effective in small ponds
   - Labour intensive
   - Requires little skill

2) **Separation of sexes after an initial growth period**
   - Mistakes are made during sexing (90% efficient)
   - Requires trained labour
   - Difficult to do in large ponds

3) **Stocking hybrid "all – male" species.**
   - Requires pure strains of broodstock
   - Fingerlings are expensive to produce
   - Requires special hatchery facilities and skilled labour.

4) **Stocking predacious fish in the tilapia ponds**
   - controls excessive reproduction
   - produce two types of fish
   - large tilapia must be stocked initially or they will be eaten

5) **Feed tilapia fry male hormones to produce "all – male" fingerlings**
   - hormones are difficult to obtain
   - hatchery facilities and skilled labour required

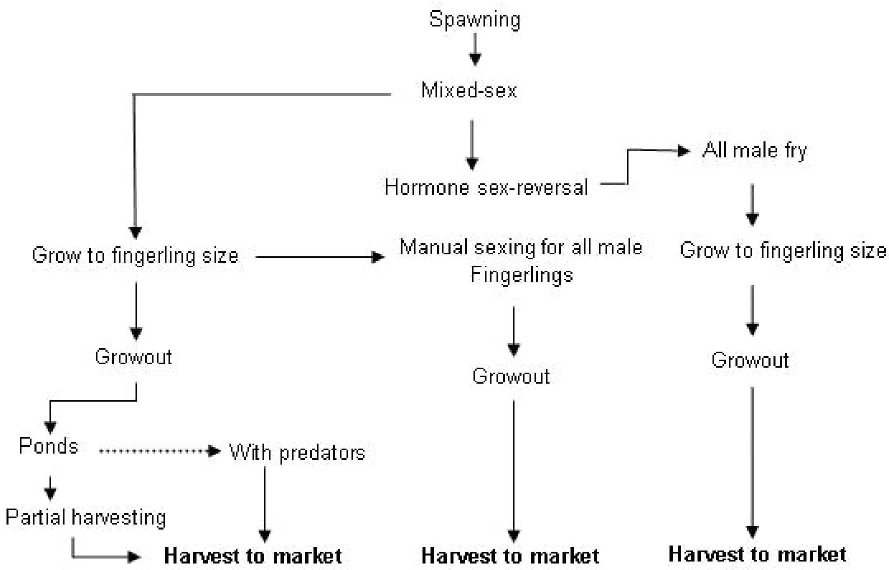


Figure 7: Flow diagram of the various processes used to regulate and prevent recruitment of juveniles within culture ponds when farming tilapia. All male fry can be obtained through cross breeding of species such as *O. niloticus* and *O. mossambicus*. This method is however not available here in South Africa due to biodiversity concerns.

At present the earthen ponds at the research station are stocked with a variety of different sized fish including catfish and tilapia. Due to limited demand the ponds have not been used to their optimum as fingerling demands from surrounding communities and various research projects is intermittent and numbers vary greatly. If there were a set number of fingerlings required each month the research station could be managed in such a way to ensure the required fish numbers. Due to limited facilities however the Makhathini research station does not have the capacity to grow out and hold fingerlings if demand drops off. Present production levels in these ponds are poor and little or no management is invested in increasing outputs due to lack of demand for fingerlings. In late 2006 approximately 2000 tilapia fingerlings were supplied to the Department of Science and Technology cage culture project on the Makhathini flats (Figure 8 & 9). At present tilapia fingerlings (10-25 g) are selling for R1-R1.50 each depending on size.

Figure 8: Harvesting of ponds at Makhathini Research Station for Tilapia fingerlings. Helping during the operation were the beneficiaries of the DST cage culture project

Figure 9: Pulling of seine nets through the ponds at the Makhathini Research Station

Training
Although not fully utilized at present, the Makhathini Research Station offers everything needed by small scale emergent aquaculture farmers in terms of training. Over the past 20 years numerous community members have undergone informal training at this facility in terms of fish identification, sexing of tilapia, feeding regimes and basic water quality principles. This site does however have the potential to provide the relevant aquaculture training to Department of Agriculture extension officers who are involved with aquaculture projects throughout the province. It is recommended that this training be conducted during a formalised aquaculture familiarization and training course. The National Department of Agriculture (DoA) and the Water Research Commission (WRC), have developed specialised training courses for extension officers and farmers. The courses (implemented by the Department of Ichthyology and Fisheries Science) have already been implemented in Limpopo Province and are therefore ready to be rolled out to KZN. Local community members who have also been granted funding to start aquaculture ventures in the province should also attend this training exercise to familiarize themselves with the species they will be farming and the general principles associated with fish farming.

Hatchery
Hatchery operations at the research station are at present highly rudimentary with fry been collected from the earthen ponds and from within the cement tank system. Production numbers are as such highly variable and dependant on natural recruitment within the ponds. This method has proved to be sufficient in the past due to limited fingerling demand, however if aquaculture within the region is to be established a more reliable and manageable hatchery operation will have to be implemented.

With limited capital inputs two types of fingerling production methods can be successfully implemented at the research station. The first type of fingerling production system is known as the "Hapa system" and involves the stocking of broodstock fish into Hapa nets within an earthen pond (Figure 10 & 11) and is widely used in developing countries. This type of fingerling production method involves the stocking of broodstock (generally 10 females and 3 males) in Hapa nets and regular collection of fry from within the nets (once every two weeks). From the Hapa nets fry are transferred to new nets where they are grown-out to fingerling size before been sold or stocked into grow-out ponds. With increased management inputs this system can be further refined and rather than harvesting fry from the broodstock hapas eggs are collected from the females prior to hatching and incubated in a separate hatchery.


Figure 10: Hapa system for fry rearing before release into the ponds. This method is widely used in developing countries as seen here in the Sudan


Figure 11: Broodstock hapas in an earthen pond as seen here in the Sudan

The second hatchery technique which is commonly used in the culture of tilapia involves the harvesting of eggs from broodstock which are kept in re-circulating systems where water quality parameters such as temperature, pH, ammonia and nitrite levels are regulated. This type of hatchery operation is the preferred option in large scale hatcheries where regular high quality fingerlings are required. By regulating water temperatures year round spawning of broodstock can be achieved thus increasing the output of small hatchery units exponentially. At the Makhathini research station for example the spawning season of tilapia in the external ponds is limited to the warmer months from November to April where water temperatures rise above 24^{o}C.

This type of hatchery operation has been recently setup at the Riverview hatchery in Mtubatuba with outstanding results. Riverview had been operational for the last 5 years with broodstock been stocked into Hapa nets in external ponds from which eggs were collected and incubated indoors (Figure 12-15). On average the hatchery produced 20 000 fingerlings per season as spawning was limited to the warmer summer months as in the case of the Makhathini Research Station. With minor capital investment (approximately R100 000) this system has been modified to an indoor re-circulating system where broodstock are conditioned, paired and harvested for eggs. Production levels at this unit are now in the region of 40-50 000 eggs per week.

Figure 12: Harvesting of eggs from broodstock female at Riverview Hatchery

Figure 13: Incubation system used at Riverview Hatchery

Figure 14: Broodstock holding tanks and fry rearing systems at Riverview Hatchery

Figure 15: ± 6 week old fingerlings from the Riverview Hatchery

Production potential from the current infrastructure with minor improvements

Production Plan

At present three core components namely the 3 earthen ponds, the 7 cement tanks and a small indoor hatchery unit comprise the aquaculture facilities at the Makhathini research station. With minimal alterations the cement tanks and indoor hatchery unit can be transformed into broodstock holding and egg incubation facilities at the station. A structure could also be provided to enclose the cement tanks with heating provided (Air conditioners) which would help in regulating the water temperatures during the cooler months of the year. If five of the cement tanks were used as broodstock ponds the research station could comfortably keep approximately 180 broodstock females (an average weight of 300 g would be ideal) and 20 males. The remaining two tanks will be used as resting tanks for females and males.

Stocking of the tanks would take place every two weeks with 30 rested females and 5 males been introduced into each tank. These fish would them remain in the tanks for 4 weeks with females from four tanks been harvested for eggs every week. It is expected that if temperatures can be maintained at approximately 28-30^{o}C approximately 2 eggs per gram broodstock can be achieved from this system. This equates to approximately 18 000 eggs per week.

Once harvested the eggs would need to be incubated and the fry stocked into separate indoor tanks for growout to fingerling size ± 10g. At present these facilities do not exist at the research station although there are three large porter pools (13 m^3) lying disused on site. If these porter pools were linked to a re-circulating temperature controlled system with appropriate filtration 18 000 fry could be stocked into each porter pool. Fry would then remain in the porter pool for a period of 21 days before been released into the earthen ponds where they will be grown out to the required fingerling size. In essence this system could supply up to 54 000 fingerlings per month if operated throughout the year.

The fatal flaw however, in this production system, is the stocking of fry out into the earthen ponds for further growout. Temperatures for the majority of the year are not conducive to stocking or moving fish into these external ponds due to low temperatures and the negative impacts it will have on the fry. During winter months excessive mortalities can be expected as has been recorded at the Makhathini research station during past attempts to move fish over this period.

Production potential from the current infrastructure with provision of two tunnel systems housing broodstock, egg incubation and fingerling systems

To overcome the problems water temperature play at this site and provide year-round production the provision of two tunnel structures (30 m X 10 m) could be provided which will house the broodstock, incubation and fingerling production systems. These facilities in conjunction with the existing infrastructure at the research station have the potential to up fingerling outputs at the site to approximately 50 000 eggs per week and provision for the production of approximately 100 000 fingerlings per month in the fingerling rearing system. With time extra tunnels can be provided for increasing fingerling growout capacity if the need arises as this is the bottleneck in the production cycle in the proposed system. The research station will however have to sell these fingerlings when they reach the desired size ± 10-15 g as growout facilities are limited.

Production plan

The production plan for the system described above will include the construction of a broodstock system consisting of twelve broodstock tanks each with a volume of 3 m^3 and will be stocked with 20 broodstock females (approx 300-500 g) and 4 broodstock males (300-500 g). These tanks will be connected to a biological filter which will provide filtration to the system. The present cement tanks at the research station will be used as resting tanks for broodstock to regain condition between spawning cycles.

Once in the broodstock system females from 9 tanks will be harvested for eggs every week with three tanks been allowed to rest until the following week. This harvesting method will follow a cycle allowing three tanks a two week spawning period every three weeks. Once harvested the eggs will be taken to the incubation system where they will be incubated for up to three days until they hatch. This system will also be connected to a biological filter and mechanical filter to ensure high water quality which is a necessity during egg incubation.

Once incubation of the eggs is complete the newly hatched fry will be stocked into the fingerling rearing system. This system will consist of twenty four 2 m diameter porter pools with a depth of 1.2 m (Figure 16) which at all linked to a biological and mechanical filter for water filtration. System design may vary significantly depending on the availability of capital but the simplest and most cost effective design would involve the provision of one large biological filter to handle the entire system. This does however have its draw backs in the sense that if the biological filter fails (all algae and bacteria in the filter die) there is a possibility that the entire fingerling stock will be lost. Fingerlings will remain in this system until they reach a size of approximately 10-15 g at which time they are large enough to sell or supply to various community projects. In total this system should be able to produce approximately 80-100 000 fingerlings per month if all runs smoothly. In monetary terms this equates to approximately R100 000-R150 000 per month if the market is large enough to accept the fish.

Figure 16: Example of the fingerling growout containers to be used in the tunnel system. Temperature regulation within this system will allow for year round production of fingerlings

Approximate costing

An approximate costing for the system described above is given below. Please note that the prices listed may vary by about 20%:

General Costs

General items	**Number required**	**Cost**	**Total cost**
Blower	2	8 000	16 000
Generator 10 Kva	1	20 000	20 000
20 000L backup water tank	2	19 000	38 000
Earth works 1 TLB for two days work (R375/h)	16	375	6 000
Transport of TLB to and from site	1	4 000	4 000
Plastic greenhouse tunnel	2	30 000	60 000
Connection to water mains on site	1	4 000	4 000
		Total	**148 000**

Broodstock system

Items	Number required	Cost	Total cost
PVC canvas tank liner	14	3 000	42 000
Biological filter construction	1	10 000	10 000
biological filter media 1.5cubes	13	245	3 185
Mechanical filter	1	1 500	1 500
Pump 1.5 Kw spec pump	1	1 750	1 750
rod heaters 3 Kw	2	3 000	6 000
PVC fittings and pipes			12 000
Airline valves and piping	14	30	420
PVC airline pipe 110 mm	30	12	360
Saddles for airlines 110 mm	14	30	420
		Total	**77 635**

Fry to fingerling growout system

Items	Number required	Cost	Total cost
2 m diameter hdpe tanks	24	2 000	48 000
Biological filter construction	1	15 000	15 000
Biological filter media 2 cubes	18	220	3 960
Mechanical filter	1	1 500	1 500
pump 1.5 Kw spec pump	2	1 750	3 500
PVC fittings and pipes			12 000
Air line for tanks 45 m	45	6	270
Stand pipe in tanks 24 m PVC 75 mm	24	12	288
Floating biological airlift filter in tanks	24	200	4 800
in tank biological filter media (shredded plastic)	24	50	1 200
Rod heaters 3 Kw	2	3 000	6 000
		Total	**96 518**

The estimated total cost to establish this fingerling production facility at the Makhathini Research station is expected to cost in the region of R330 000.

Conclusion

Makhathini Research Centre has the potential to become the “hub” for aquaculture development for the Northern Region of KZN. By implementing the interventions suggested in the Draft Provincial Aquaculture Strategy, this facility could play a pivotal role in fingerling production and as a demonstration and training facility. The Provincial Department of Agriculture could make use of the services and technical capacity afforded by the National Aquaculture Provincial Revitalisation Programme of the DoA / WRC that is being implemented by Rhodes University.

APPENDIX 10:
Skills assessment of staff at Turfloop Hatchery

Limpopo
DEPARTMENT OF AGRICULTURE

PARTICIPATORY DEVELOPMENT OF PROVINCIAL AQUACULTURE PROGRAMMES FOR IMPROVED RURAL FOOD SECURITY AND LIVELIHOOD ALTERNATIVES

<u>SKILLS REPORT FOR THE TURFLOOP HATCHERY</u>

FEBRUARY 2006

CO-WORKERS:

agriculture
Department: Agriculture
REPUBLIC OF SOUTH AFRICA

TABLE OF CONTENTS

1 Introduction

This document reports on the assessment of the current technical skills of the staff at the Turfloop Hatchery, while making recommendations of the further skills that will be required in the revitalisation of the facilities. This skills assessment is part of the greater project titled, "*Participatory Development of Provincial Aquaculture Programmes for Improved Rural Food Security and Livelihood Alternatives*", which is being implemented by the Rhodes University as an initiative by the Water Research Commission and the National Department of Agriculture.

The Turfloop Hatchery is situated north of Polokwane in the Limpopo Province and was previously active in the production of warm water aquaculture species under guidance of the University of Limpopo and the Limpopo Department of Agriculture. It has subsequently fallen into disuse.

A Strategic – and Action Plan for the development of Aquaculture in the Limpopo Province precedes this skills assessment for the Turfloop Hatchery. Furthermore an associated report ("*Status of the Turfloop Hatchery*") should be considered as background information to this report. The Strategic – and Action Plans also provide guidance towards the revitalisation of the Turfloop facilities, which is greatly dependant on the establishment of the correct skills base on the site.

2 Purpose of the Skills Report

The primary purpose of the skills assessment is to benchmark the way forward with regard to establishing the correct skills base for the revitalisation of the Turfloop Hatchery. Furthermore secondary purposes can be summarised as follows:

- To document the current skills at the facilities so that stakeholders may use this information as a starting point.
- To identify the skills that would be required in the operation of the Turfloop Hatchery.
- To provide some benchmarking from which the progress of skills development and personnel appointment can be monitored.

3 Methodology of Skills Assessment

As virtually no skilled personnel are currently active on the Turfloop Hatchery the assessment was limited. Nevertheless the following methodology was followed:

- Some background information about Turfloop Hatchery was gathered from previous work by Rhodes University in the WRC project titled "*Contribution of Aquaculture to Rural Livelihoods in South Africa: A Baseline Survey*" (2003). The report: "*Status of the Turfloop Hatchery*" was also consulted to provide some guidance as to the causes of the current virtual absence of skills.
- Three members of the current Rhodes University project team visited the Turfloop Hatchery site twice towards the end of 2005 to conduct the skills assessment with the general assessment of the status of the facilities.
- Interviews were conducted with on site personnel (primarily Mr. M. Maja as he is the only fulltime employer on the site) and with Mr. J. Phosa who coordinates aquaculture in the Limpopo Province though managing the Division of Aquaculture within the Department of Agriculture.
- The information collected from the site interviews and assessment was subsequently documented.

4 Current Skills at the Hatchery

With the steady decrease in production and the shortage of aquaculture expertise in the Department of Agriculture the Turfloop facilities have been ground to a halt by the absence of trained, motivated, equipped personnel that have an outcome based operational procedure for the facilities. In the assessment the current skills at the hatchery were found the be the following:

- Five general assistants were active at the Turfloop Hatchery during 2005, but due to the lack of specific programmes in aquaculture or at the Turfloop station that have subsequently been moved from Turfloop to the district / municipal officers of the Department of Agriculture. These people did not have any aquaculture training and their qualifications range from Grade 12 to diploma level.
- One permanent aquaculture technician (Mr. M. Maja) is currently based at Turfloop. He has an agriculturally based diploma and has received some aquaculture training in basic aquaculture husbandry. Nevertheless there are no active outcome based programmes running which make use of these limited skills.
- The Division of Aquaculture within the Department of Aquaculture is managed by Mr. J. Phosa who has a diploma in Fisheries Management (Tompi Seleka) and has extensive experience in aquaculture (especially rural aquaculture development). Nevertheless the burden of a growing aquaculture sector on his time allows for virtually none of his skills to be employed at Turfloop.
- Limited unskilled labour is active on the Turfloop station an ad hoc basis. This labour is from the personnel of the nature reserve associated to the facilities and only conducts basic maintenance work on a limited scale.
- Occasionally university students from the Aquaculture Research Unit of the University of Limpopo visit the facilities, but this is limited in extent and does not currently contribute to the skills base at Turfloop.

5 Human Resources and Skills Required

In the report "*Status of the Turfloop Hatchery*" the absence of skilled personnel was identified as one of two primary constraints in the revitalisation of the Turfloop Hatchery (together with an outcome based Operational Plan). In this regard this assessment has found that the following human resources and associated skills would be the minimum requirement for the revitalisation of the facilities to a point at which it can fulfil its potential and become a core supplier and service provider to the aquaculture sector:

- One hatchery manager with minimum qualification a diploma, but preferably a degree in natural sciences with exposure to aquaculture and management subjects.
- Two aquaculture technicians with a minimum qualification of a diploma. It is recommended that one of these be technically orientated (i.e. exposed to the field of engineering, hydrology etc.) and that the other be biologically orientated (i.e. fisheries management, biology, ecology etc.)
- One secretarial position to administer the facilities from the office.
- At least two employees with Grade 12 and who can be trained in-house in aquaculture husbandry so that they may eventually obtain diplomas and be used in training and extension.
- At least four unskilled labourers to assist with the everyday operation of the facilities.

A list of some of the basic skills that will be required by a personnel team at the Turfloop Hatchery will include:

- Management, financial and administrative skills.
- Detailed knowledge of warm water aquaculture husbandry.
- Specialised knowledge of hatchery and spawning techniques.
- Water quality management.

- Basic aquaculture engineering.
- Rural aquaculture development.
- Extension and training techniques.

The human resources described above are regarded as the minimum requirement for the initial revitalisation of the facilities and have been based on the production of juvenile fish and the provision of basic aquaculture support to the sector as it currently stands in the Limpopo Province. These human resources will require re-assessment as the facilities become better established and as the aquaculture sectors expands further.

6 Action Plan for HR Establishment

Based on skills information above the following points of action can be taken in the establishment of the recommended skills base at the Turfloop Hatchery:

6.1 Complete Skills Identification Process

This assessment and report is the start of the process in which skills and human resources can be established at the Turfloop facilities. Nevertheless this process is ongoing and must continue with the development of the Operational Plan for the facilities as described in the report "*Status of the Turfloop Hatchery*". The Operational Plan will provide more accurate information on the tasks at hand and the programmes that will be undertaken by the hatchery and thus this can be used in better skills and human resource allocation exercises.

6.2 Departmental Budgets

As part of the Operational Plan for Turfloop a detailed operational budget will be required which must include a dedicated section on the human resource and skills budgets. These budgets will require acceptance into the budgetary planning of the Department of Agriculture before potential candidates can be sources and appointed.

6.3 Seek and Identify Competent Candidates

With the rapid expansion of aquaculture in South Africa there is a shortage of appropriately trained aquaculture personal. For this reason it is recommended that human resources with the correct skills be actively sourced to meet the needs of a hatchery manager and the aquaculture technicians recommended in section 5 above. In this regard the following steps could be taken:

- All South African Universities and tertiary institutions that run aquaculture based degrees, programmes, certificates etc. should be contacted and informed of the need for personnel that have been trained or at least exposed to aquaculture. These institutions would include the Universities of Rhodes, Cape Town, Stellenbosch, Limpopo, Venda and others.
- The posts should be advertised nationally.
- The posts should be bough to the attention of the various aquaculture workgroups, the Aquaculture Association of Southern Africa and Aquaculture Division of the National Department of Aquaculture.
- Although South African candidates are preferred over foreigners the posts should also be made know to the World Fish Centre and though the channels of NEPAD in instances where they are involved in aquaculture programmes.

Apart from the hatchery management and aquaculture technicians the other personnel recommended in section 5 should be sourced from the Limpopo province (i.e. promising grade 12 pupils and unskilled labour)

6.4 Appoint Personnel

Once the posts have advertised the appointment of the necessary skilled personnel will be dealt with via the Human resources section of the Limpopo Department of Agriculture. In this regard interviews will be arranged, candidates will be selected, appointment offers will be made and appointment contracts will be finalised.

6.5 Training and Further Skills Development

Of core importance to creating a successful skills base, the appointed personnel at the Turfloop Hatchery must be exposed to further training and skills development. In this regard training and mentorship must be attained from close links with the nearby Aquaculture Research Unit of the University of Limpopo, but also with other universities, tertiary institution and organisations such at the Water Research Commission, Government departments, the World Fish Centre and others. Aspects that would make out such further training and skills development must include:

- Financial, economic and people management (especially focussed at the managerial and administrative posts).
- Ongoing technical training in aquaculture through exposure to international techniques, international aquaculture conferences and support organisations (especially focussed at the managerial and technical levels).
- The development of opportunities for in-house personnel to attain further diplomas or degrees in aquaculture related fields.
- Training in the provision of extension services and information dissemination, especially in the rural aquaculture development sector.
- Ongoing training in hatchery techniques.

7 Monitoring Progress in Skills Establishment

The implementation of the actions recommended above requires monitoring to ensure the success of the skills development at the Turfloop Hatchery. In this regard this assessment and report should be used as the initial benchmark for such a monitoring programme. The following steps are recommended for the monitoring process:

- The recommendations for skills development in this report must be internally work-shopped within the Limpopo Department of Agriculture and its Division of Aquaculture for acceptance and initiation of the process.
- The recommended personnel must be approved in terms of Departmental budgets and human resource strategies, while being aligned with the Strategic Plan for Aquaculture Development in the Limpopo Province and the Operational Plan for the Turfloop Hatchery.
- The Turfloop Hatchery must be subjected external to a follow-on skills and human resources assessment six months after the recommended personnel have been appointed. This audit should inform any modifications to the skill requirements and identify skill shortages so that these may be addressed. This process should be repeated at 12 -, 18 and 24 months and annually thereafter.

8 Conclusion

In this skills report it has been shown that the revitalisation of the Turfloop Hatchery depends greatly on the establishment of the correct skills base. Together with the compilation of an Operational Plan the Department of Agriculture must prioritise the establishment of this skills base first in order to channel the Turfloop facilities towards the realisation of its full potential to serve in the needs of the growing aquaculture sector and to become a successful nucleus for provincial aquaculture development.

Appendix 11:

List of formal training courses conducted by the project team

Course	Location	Date
Training of Limpopo PDA extension officers and manager of Turfloop Hatchery: Session 1	Tompi Seleka College	26 Feb-2 Mar 2007
Training of Limpopo PDA extension officers and manager of Turfloop Hatchery: Session 2	Tompi Seleka College	16-20 Apr 2007
Training of Limpopo PDA extension officers and manager of Turfloop Hatchery: Session 3	Tompi Seleka College + community owned fish farms	13-19 Aug 2007
Training of Limpopo PDA extension officers and manager of Turfloop Hatchery: Session 4	Tompi Seleka College + community owned fish farms	15-19 Oct 2007
Training of Mpumalanga PDA extension officers	Lowveld Agriculture College	10-20 Sep 2007
Training of state veterinarians on fish health management	Rhodes University	15-19 Oct 2007
Training of DAFF airport officials responsible of importation of live fish on fish health management	Rhodes University	14-5 May 2008
Training of Amalinda Fish Farm staff in Koi spawning and fish health management: session 1	Amalinda, East London	15-16 Jan 2009
Training of Amalinda Fish Farm staff in Koi spawning and fish health management: session 2	Amalinda, East London	2-3 Feb 2009
Training of hatchery staff of Amalinda Fish Farm in production and fish health. Participants included aquaculture officers from Mpumalanga PDA and the manager	Amalinda, East London	9-12 Aug 2010
Refresher course for extension officers and hatchery staff (Limpopo Province): Session 1	Turfloop + community owned fish farms	11-15 Oct 2010
Refresher course for extension officers and hatchery staff (Limpopo Province): Session 2	Turfloop + community owned fish farms	28 Feb-4 Mar 2011

APPENDIX 12:
Training course outline for Aquaculture Extension Officers and Hatchery Staff

Module 1 (Week 1): Introduction to aquaculture principals

Day 1

- Opening and welcome
- Overview of aquaculture in South Africa
- Basic requirements of Aquaculture
- Tour of hosting institution aquaculture facilities
- Species selection
- Preparation for field visit to nearby aquaculture facility

Day 2

- Visit to nearby aquaculture project
- Introductory talk on its history, motivation, success and challenges
- Discussion with those involved in the project including existing and past challenges
- Netting of fish or other physical activity to demonstrate the use of equipment and typical activity done by those involved in the project.
- Tour around the facilities.
- Fish dissection in laboratory.
- Fish to be dissected to illustrate gross morphological differences internally and externally, gonad appearance and state of maturation, and edible yield from the different species.

Day 3

- Feed-back discussion on visit to local aquaculture project.
- Pond and facility design.
- Water quality
- Pond management and feeding: written assignment session by trainees.
- Preparation for visit to Government or private hatchery next day.

Day 4

- Visit to hatchery.
- Introductory talk.
- Tour of facilities.
- Discussion session on site.
- Open session: general discussion including input from local officials involved in aquaculture.

Day 5

- Harvesting and transport
- Disease prevention and increasing productivity
- Practical demonstration of packing of live fish
- Closure and setting of field assignments for trainees.

Module 2 (Week 2). Follow-up and practical course

Day 1

- Report back on assignments by Extension Officers or other trainees.

Day 2

- Discussion on specific issues that arose out of the report- back identification and ranking of issues identified in above point.
- These included the following aspects: Motivation for the aquaculture venture, Ownership and hierarchy of management, Technical input, Funding, Market, Division of profits, Specific technical and biological problems, Business aspects

Day 3

- Technical and practical training: practical demonstration with group participation: Netting of fish for brood-stock (visit to local dam/ponds to seine net or otherwise capture and transport suitable brood-stock to the holding/breeding facility).
- Preparation for packaging, and transport to holding/breeding facility.

Day 4

- Technical and practical training: fish husbandry: • Holding facilities: tank types and filtration systems • Handling of live fish • Feeding of live fish in restricted facilities •Breeding of fish (Tilapia / catfish / trout) and fry maintenance • Water quality testing and recording

Day 5

- Practical demonstration of hatchery techniques
- Storage and use of feeds
- Care and storage of equipment
- Fish sexing methods
- Fish breeding methods in hatcheries
- Setting of practical assignments to trainees
- Closure

Module 3 & 4 (Week three and four): In-field training for specific aspects

The focus of this section was to prepare the extension officers to interact with the farmers and to enable tem to identify problems and to suggest possible solutions. The on site training (at the fish farms of the emerging farmers included)

- How to evaluate a project and determine if it is successful or is failing to meets its objectives
- Identification of the major strengths and weaknesses of the project
- On-site inspection and discussion
- Possible solutions on how to solve the problems of the farmer
- Re-cap of Rural Aquaculture: its prospects and challenges
- Other opportunities: ornamental fish farming, hatcheries and high-tech aquaculture ventures: description and discussion
- Meet commercial farmers and discuss with them how they operate their farms
- Visit state hatcheries and determine how they could be improved
- Test evaluating knowledge acquired.

APPENDIX 13:
Fish Health Course for State Veterinarians

An introductory course to fish health and management for veterinary practitioners and managers

Department of Ichthyology & Fisheries Science
Rhodes University

RURAL FISHERIES PROGRAMME

Department of Ichthyology & Fisheries Science
Rhodes University

An introductory course to fish health and management for veterinary practitioners and managers

Introduction

With the increase in the demand for fish, and the decline of fisheries (due to over fishing), the role of aquaculture (fish farming) is set to increase. Already, the FAO estimates the aquaculture as the fastest growing animal production sector (8.8%). Worldwide, approximately half of all fish consumed originates from aquaculture, and this percentage is set to increase. While traditionally Asian countries have been at the fore front of aquaculture growth, production in that region is plateauing, partly due to shortages of resources and the quality of water. The new growth of aquaculture will have to come from Africa. The continent has significant natural resources and has a large internal market for fish (and well positioned to meet European markets) yet it only produces 2% of world production.

South Africa, like the rest of Africa, has significant natural resources to develop its aquaculture base. There is a strong base in technology development and nationally aquaculture is being prioritised as a sector of potential growth. However, a key support service to sustain and promote the growth of the commercial sector in South Africa is veterinary service to fish farmers. At present, this service is largely not available to the farmers.

Therefore, the aim of this course is to provide an introductory knowledge to state veterinarians with regards to fish health and management. The areas covered include disease diagnostics, pharmacology, water quality and fish stress management. The course would also include a workshop to develop possible strategies to establish an effective veterinary support programme for fish farmers.

Course presenters:

Prof. Horst Kaiser (PhD in agricultural sciences)

Horst Kaiser is at the Department of Ichthyology and Fisheries Science (DIFS). He has over 23 years experience in lecturing and research in aquaculture research with an interest in fish health management. He studied at the University of Bonn in Germany, acted as an industry consultant for a German intensive system manufacturer, conducted four years of University research in the United States (Idaho) and has been at the DIFS since 1992. He likes research and hates to see sick fish.

Dr David Huchzermeyer (BVSc, MSc in Aquatic Veterinary Studies)

Dr David Huchzermeyer is a private practitioner based in Lydenburg. His practice serves both large and small animals as well as fish. He is a graduate from the Veterinary Faculty at Onderstepoort, University of Pretoria and he graduated from Stirling University with a MSc in Aquatic Veterinary Studies. He has more than 20 years of experience in fish health management and has been consulted on aquatic problems throughout South Africa. He is closely involved with the disease free certification of rainbow trout eggs and koi for the export market. His field of interest covers all fish species, both indigenous and cultured as well as crocodiles. Over the years he has presented a number of fish disease courses for veterinarians, aquaculturists and hobbyists.

Details

The course will be presented at the Department of Ichthyology and Fisheries Science of Rhodes University. The course will include both practical and theoretical sessions. On the last day of the course there will be a workshop session to discuss strategies to improve aquaculture veterinary services for aquaculturists. The discussion panel will include officials from the National Department of Agriculture and Rhodes University. Representatives from Marine and Coastal Management will also be invited.

Cost, number of course participants and date of course

It is proposed that two state vets from each province and the National Department of Agriculture attend this course (total 18 participants). The proposed date for the course is **17-21 September 2007**. The cost of for each participant is R 5 500. Each participant will receive a copy of "*A complete Guide to the Freshwater Fishes of Southern Africa*" (by Prof Paul Skelton), dissecting kits and handouts. The course fees include an excursion to a fish farm, and lunches. Attendants will need to make their own accommodation and travel arrangements to Rhodes University. A list of accommodation facilities is available on the following web site: www.grahamstown.co.za

Course outline

The course is aimed at providing an overview of all aquatic animal health management aspects related to aquaculture. It is tailored for veterinarians wanting to update their knowledge on fish health. Lectures related to systems and aquaculture husbandry are designed to address aspects of fish health management.

There will be lectures and practical sessions in the afternoon.

The course will be five days long with to end by lunchtime on Friday to allow delegates to catch flights.

Outcome

1) An understanding of the interactions between fish and their environment under aquaculture conditions
2) An overview of fish health management
3) An overview of basic aquaculture and husbandry procedures as they relate to fish health management
4) The application of knowledge on fish health for farm management and consulting of farmers

Description of course modules

1. Introduction
   We will introduce the topic of the workshop and provide an overview of aquaculture with attention to the development of aquaculture in the southern African region.
2. Fish in their environment
   This module will provide an overview of the physiology of the stress response in fish. Based on an understanding of the interactions between fish and their environment, we will discuss important water quality variables and their effect on fish health. Typical examples of such variables are the gases in the water, particularly oxygen, nitrogenous compounds such as ammonia, nitrite, and nitrate, gaseous nitrogen, pH, and others. Wherever appropriate there will be a discussion of applications, i.e., how the knowledge can be applied under aquaculture conditions by farmers or consultants.
3. Intensity of aquaculture
   In the lectures about intensities of aquaculture we will compare the three main levels of aquaculture, i.e., extensive, semi-intensive and intensive aquaculture systems. We will pay attention to the importance of management of different systems for fish health. There will also be an overview of bacteriology with regard to biological water filtration in intensive aquaculture systems. This knowledge is important for fish health management.
4. Parasitology
   This section will describe life cycles, biology and treatment methods for various fish parasites. For this, we select the parasites of particular importance for our conditions. Not all parasites infecting fish can be covered, but those of relevance to aquaculture will be described. This includes protozoans, metazoans, trematodes, small crustaceans as well as fungal infections. We will show how knowledge of the life history of a parasite determines the choice of treatment method. This section will also include some nutritional pathology.

5. Chemical methods for water treatment
   Particularly under intensive aquaculture conditions, water may need to be treated using various chemical and physical methods. This module will explain how the treatment methods differ from each other and what they can achieve with regard to the improvement of water quality and ultimately fish health.
6. Fish anaesthesia
   Different anaesthestics are available for fish, i.e., commercially available compounds as well easily available anaesthetics such as clove oil. We compare the different compounds and methods and explain their effects on fish during both handling and transport.
7. Treatment methods
   Treatment methods for parasites and fungal diseases include bath treatment methods, injection of drugs, and topical application. Commonly used methods will be discussed and compared. This section includes an exercise to calculate dosages of drugs for different applications.
8. Aquaculture species and candidates and their environmental requirements
   We present a brief overview of the biology of the most important aquaculture species, mostly fish and what to consider with regard to species-specific health management.
9. Husbandry
   A brief overview of methods used in the early rearing of aquaculture species will be linked to fish health management.
10. Introduction to fish endocrinology with reference to health management
   This section will provide an overview of applied reproduction in aquaculture by describing the endocrinology of reproduction and ways to manipulate hormone levels in fish in order to control spawning.

Practical sessions:

1. Fish dissection
   We will conduct a necropsy on different fish species, diagnose fish parasites, and highlight diagnostic features in fish. This practical is a basic introduction for veterinarians. It is assumed that the delegates are familiar with the basic techniques of examination. Thus, we will focus on aspects relevant for fish.
2. Field trip
   We plan a trip to various farms and discuss fish and abalone health management with farm managers.
3. Water quality analysis methods
   This practical will describe basic methods of water quality analysis, the instruments involved, and the interpretation of results.

Contact details and bookings:

For further information or confirmations please contact

Qurban Rouhani	Tell: 046 636 2230
Programme Manager	Fax: 046 622 4827
Rural Fisheries Programme	Cell: 082 44 55 700
Department of Ichthyology and Fisheries Science	Email: Q.Rouhani@ru.ac.za
Rhodes University	

Payment needs to be arranged prior to the course. Please fax the deposit slip to 046 622 4827 and indicate on it **"Fish health course".** Payment can be made to the following account:
Rhodes University
Standard Bank
A/c no.: 08200 2592
Branch code: 050917