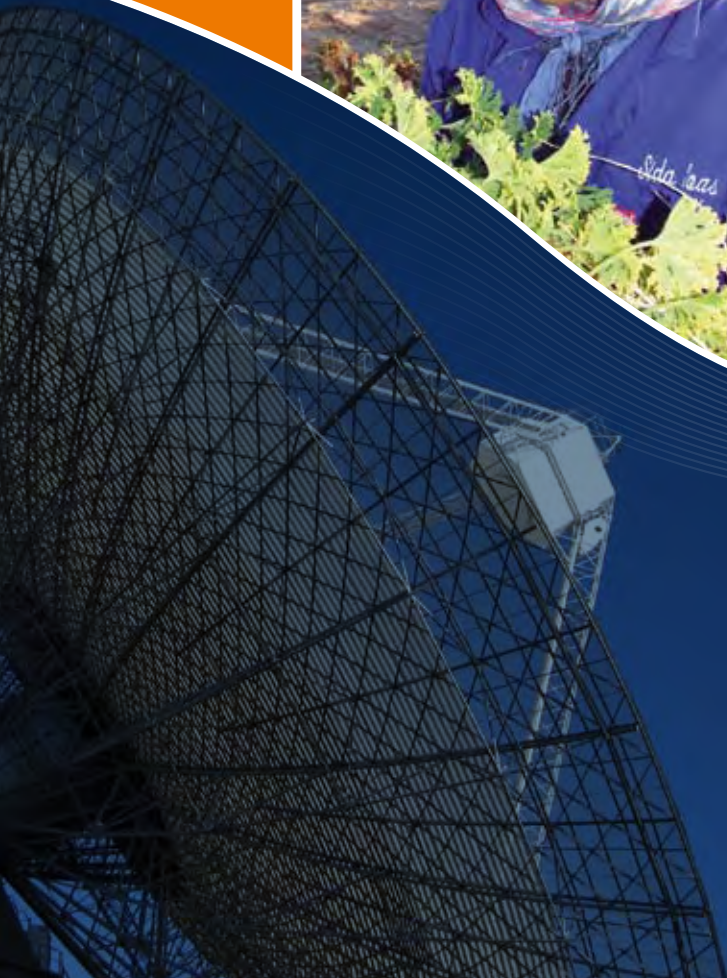


TECHNOLOGY

for **SUSTAINABLE LIVELIHOODS**



science
& technology

Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA



TECHNOLOGY for **SUSTAINABLE LIVELIHOODS**

introduction

The White Paper on Science & Technology (1996) has a broad vision, which focuses on maintaining cutting edge global competitiveness and improving the quality of life. Similarly, the National Research and Development (R&D) Strategy committed to “establish a mission technology for poverty reduction, to address one of the scourges of our age”. In both policy positions, broad interrelated themes fundamental to the expression of a sound S&T policy viz promoting competitiveness and employment creation; enhancing quality of life; developing human resources, and working towards environmental sustainability are clearly pronounced.

brief history

The Sustainable Livelihoods Programme forms part of the Department of Science & Technology’s (DST) focus on Technologies with a Social Impact. It commenced in 2000/01 as part of the “Special Poverty Relief” programme funded by National Treasury to directly and indirectly create jobs and improve the quality of life for the poor, and it grew as part of the Department’s Technology Missions.

In line with the President’s decision to set up a separate Ministry for Science and Technology in 2004, the government’s commitment to growing gross expenditure on R&D to 1% of GDP by 2008, and the new governance model for the DST, the DST Poverty Reduction programme was restructured to meet the expanded mandate. The newly created DST Programmes included one designed as Socio-Economic Partnerships, into which the Poverty Reduction Programmes were absorbed under a broader ‘Social Impacts’ banner, and restructured into the Technology for Social Impact Sub-Programme, with Sustainable Livelihoods, and Sustainable Human Settlement as key programmes focusing on the urgent needs of our citizens who are less able to assert themselves in the market.

programme objectives

The objective is to introduce and demonstrate innovative technology solutions for the beneficiation of local natural resources to support the creation of sustainable job and wealth opportunities in areas of deprivation. Its focus is on sustainability, and the development of downstream beneficiation SMME’s. Sustainable Livelihoods focuses on technology solutions and systems that are mature but do not have widespread application, but have the potential to achieve government’s broad objectives. It does this

by sourcing from the National System of Innovation (NSI) mature technology solutions for the beneficiation (value-addition) of local natural resources and transfers these to communities and community groups with a view of establishing sustainable Small, Medium, and Micro Enterprises (SMME’s). In this way wealth and job opportunities are created in the areas where technology and skills transfer has occurred. It does not focus on R&D but on adaptation of technology solutions on the ground to contribute to the establishment of new industries (wealth creation) and Black Economic Empowerment (BEE) opportunities.

In line with the country’s anti-poverty strategy, the Micro-Economic Reform Strategy (MERS), and other government Departments (e.g. Trade & Industry, Agriculture, Water Affairs and Forestry, and Environmental Affairs & Tourism), the DST has developed a focus on Agro-processing in support of the Accelerated Shared Growth Initiative (ASGISA), which aims to “promote opportunities for participation of marginalised communities in economic activity, and improve the quality of livelihoods of the poor”.

Agro-processing is one of the key sectors identified by government as sectors “that demonstrate strong potential for growth, employment creation and value addition”. Within this portfolio the DST is focusing on post-harvest production of finished value-added products in areas where the remote location does not present a logistical or financial disadvantage, and to establish sustainable (post-funding) SMME’s. The products tend to be high-value goods in a defined growing (or import substitution) market where the natural resources of the area are afforded a competitive advantage.

Supported agro-processing technologies focus on establishing larger demonstration interventions in Aquaculture and bio-prospecting in Essential Oils, and Indigenous Medicinal Plants with scientifically-proven medicinal properties. These are not the only focus technologies, but new focus areas are cottage industries and light manufacturing, to support Provincial Growth and Development Strategies. These are technology areas with strong markets but which require technology-based processes and solutions to improve quality and consistency of the products.

conclusion

In support of the DST 10 year innovation plan, the programme is looking at growing its activities in support of the Farmer to Pharma Strategy which focuses at developing the bio-industry and indigenous knowledge to beneficiate indigenous bio-diversity and develop a leading pharmaceutical industry in South Africa.



AQUACULTURE

Aquaculture is the **controlled** cultivation (farming/production) of a variety of fish, crustaceans, molluscs, and aquatic plants in **marine and freshwater** mainly for human consumption, industrial use and recreational purposes. In South Africa it consists mainly of freshwater species such as crocodiles, trout, catfish, tilapia and ornamental fish as well as marine species such as abalone, prawns, oysters and mussels.

introduction

In Africa, fish already makes a vital contribution to food and nutritional security for 200 million Africans, and provides income for over 10 million people – mostly small-scale fisheries, farmers, and entrepreneurs engaged in fish production, processing and trade. Fish has become the leading export commodity for Africa. However, many African countries are heavily reliant on unsustainable capture fisheries, accounting for 90% of the fish the continent produces. Already the per capita fish supply in Africa has dropped from 8.8kg/capita in 1990 to 6.7kg/capita in 2005 and for a continent where food security is so precarious, the trend is worrying.

In Sub-Saharan Africa about 2% of fish comes from aquaculture, whereas the global supply stands at more than 40%, and increasing. To illustrate, global aquaculture production has increased from 3.5 million tonnes in 1972 to more than 50 million tonnes in 2000, and the United Nations' Food and Agriculture Organisation (FAO) estimates the world aquaculture production could amount to 118 million tonnes by 2030, which is a tripling of the year 2000 production, or an average of 4% growth annually. Despite this phenomenal global growth, Africa's contribution to the world's aquaculture production has remained disconcertingly low, accounting for less than 1% of global production, while South Africa in turn contributes only about 1% of Africa's production. However, in Egypt, aquaculture production has grown ten-fold over 15 years, from 55 000 tonnes to over 750 000 tonnes in 2006.

In many parts of Africa, aquaculture offers strategic entry points for short and long-term investment opportunities to contribute to food security, improve health, women's economic empowerment, and local enterprise development for the poor. In South Africa aquaculture is providing an opportunity for the socio-economic development and beneficiation by rural communities through the sustainable non-consumptive utilisation of water in State and privately-owned irrigation water-works and storage reservoirs and schemes, without the transfer of land ownership being a prerequisite. Aquaculture is best positioned to contribute to food security, wealth and job creation. It also contributes to the reduction of protein deficiency in the diets of many rural communities.

DST aquaculture activities are pilot demonstrations of grow-out technologies, and are undertaken in partnership with the Departments responsible for the uptake, support and roll-out with a focus on establishing scale-critical interventions to ensure long term industry sustainability. DST initiatives promote affordable low-tech cage-culture technology targeting indigenous fresh water and marine species approved by DEAT. Cage culture system provides the most competitive and lowest risk of production methods for the recommended candidate species, and significantly lowers access barrier costs. To this DST is standardising on High-Density Polyethylene (HDPE) cages, as production units owing to their life-cycle cost and environmental benefits.

There is a need for technology interventions in aquaculture, ranging from Research and Development of new candidate species for commercialisation, policies, and the development of artificial spawning, breeding and management technologies which would lead to the development of hatchery technologies for new species. This in turn will increase aquaculture production, as most commercially viable species are commercially produced from small-scale commercial to large-scale industries, and increased market share. There are suitable unutilised fresh water bodies throughout the country in the form of State-



owned irrigation Waterworks, private on-farm dams and coastal zones that could be used to expand aquaculture, and this extends throughout SADC. This indicates a huge potential for growth of aquaculture, primarily for food security, wealth and job creation, as well as for import substitution in the local market.

The New Partnership for Africa's Development (NEPAD) has responded to the challenge by adopting the "Action Plan for Fisheries and Aquaculture in Africa" in recognition of the role aquaculture plays in food security, poverty reduction, regional economic development, and to the achievement of the Millennium Development Goals, one of which is *eradicating extreme poverty and hunger by 2015*. At the NEPAD Fish Summit in 2005, Africa's Heads of State, adopted the Abuja Declaration on Sustainable Fisheries and Aquaculture in Africa, which aims to develop aquaculture in the region and foster regional technology development and transfer.

fresh water aquaculture

The DST is supporting two key initiatives geared for fresh-water aquaculture. These are the Small-Scale Fish Farming Project in the Western Cape, and the Provincial grow-out pilots conducted in partnership with the Departments of Agriculture and Water Affairs and Forestry. **The Small-Scale Fish farming project** aims to establish 35 small-scale (6 – 8tons annually) trout producers on the wine estate irrigation dams in the Southern Western Cape region (Stellenbosch, Worcester, Ceres and Tulbagh).

Rainbow Trout was introduced for sport fishery in the 1890's and is now the country's most commercially grown freshwater species since the 1960's. Trout has to a large extent pioneered fresh water aquaculture in South Africa, and enjoys a farm-gate price of R25/kg. Already 35 Small-Scale producers have been established and trained in managing a fish farming operation. These farmers are now members of the farming Cooperative, named **Hands-On Small-Scale Fish Farmer's Co-op**, established to represent the farmers. This initiative is being strengthened to be exited. Currently "Hands-On" has a 250tons per annual supply agreement, for 5yrs to supply Grade A trout to Three Streams Smokehouse in Franschoek.

The Provincial Grow-Out pilots are undertaken to establish commercial factors of indigenous fish (tilapia, catfish [trout and carp]) using HDPE cages in State-owned irrigation waterworks. This is to ascertain the **technical, economic, and environmental viability** for commercial grow-out of the species. The pilots are to be set up in seven Provinces (excluding Gauteng and Western Cape) as a 50ton production facilities managed over 2 production seasons. These are planned to benefit from the re-vitalisation of State-owned hatcheries by the Department of Agriculture. The hatcheries will provide fingerlings for the commercial grow-out stage, post pilot. In KZN Pongolapoort dam, already the cages have been constructed, inserted in the water, and moored and are awaiting sign-off to introduce fingerlings, and begin the grow-out. The plan is to establish a Public-Private Partnership

(PPP), in line with the Treasury's PPP programme where a successful pilot has been completed, and the DoA will play a leading role in the roll-out of the grow-out model, once the pilot work has been completed.

Marketable sizes for fish range from plate-sized (230g- 450g) upwards. However, the biggest market segment is for smoked trout (400-600g), whole fish and sliced fillets (600-950g), and smoked sliced fillets (\pm 1kg and above) which cover approximately 80% of the processed product.

mariculture

DST is supporting a number of grow-out trials on marine species. These are to ascertain the technical, **economic, and environmental viability** of marine species grow-outs and to establish economic models for roll-out. The pilots are on abalone, yellowtail, silver and dusky kob finfish. The completed **Abalone Grow-Out Pilot** was conducted in Hondeklip Bay in the Northern Cape in partnership with HIK-Abalone, the industry partner, and Stellenbosch University. The trial has proven a success, and to this a commercial business plan, to leverage the DST investment into a commercial activity has been completed, requiring R40million investment over 3yrs. The province and stakeholders are expected to uptake this opportunity.

In the Eastern Cape, DST in partnership with Irvin & Johnson (I&J) Ltd, is conducting a **Marine Finfish Grow-Out Pilot** in ocean-based HDPE cages to ascertain the technical, commercial, and environmental feasibility of commercial grow-out of Yellowtail, Silver and Dusky Kob. The pilot is based on the waters of Nelson Mandela Bay Harbour. It utilises four HDPE-cages placed 1km into the ocean. The third initiative is that of **Yellowtail "ranching"**. It targets beach-seine (treknet) yellowtail quota earners in the Western Cape and provides technology to retain or improve the value of their catch post-capture. The project aim to pilot cage technologies for small-scale fisher(wo)men to capture, hold, and then harvest yellowtail to supply the market on demand. This contrasts with current scenario where due to lack of cold-chain support, small-scale fisher(wo)men loose the value of their catch due to quality deterioration.

conclusion

The DST's role in aquaculture is supportive and provides demonstration of the technology solutions and build a case for roll out. To effect roll-out DST relies on uptake from Departments tasked with the mandate, in this case the Department of Agriculture supports animal production (farming) and they are beginning to roll-out fresh water aquaculture in partnership with provinces. The same applies to mariculture, where DEAT has the mandate. The DST is strengthening partnerships with DEAT, and DoA through inter-departmental **Science & Technology Innovation Activities Agreements** to drive collaboration on areas of interest to better serve the public.





SMALL SCALE FISH FARMER PROJECT (RAINBOW TROUT)

introduction

Rainbow Trout was introduced for sport fishery in the 1890's and has since the 1960's graduated to be the country's most commercially grown freshwater species. It enjoys the accolade of having pioneered fresh water aquaculture in South Africa, and a farm-gate price of R25/kg, and in 2005 a total of 1650tons of Rainbow trout were produced with a market value of R48.5 million. The DST-supported Small-Scale trout farming project has established 35 small-scale (6 – 8tons) trout producers within the private irrigation dams on the wine estate of the Southern Western Cape region (Stellenbosch, Tulbagh, and Worcester).

objective

The DST in partnership with the University of Stellenbosch and other partners, has been providing support, training, and technology for the establishment of emerging trout farmers. Following a successful five-site grow-out pilot, the objective is to establish 35 small-scale trout farmers each producing 6 - 8tons of trout annually, with a retail value of R6.5million. These are registered as members of **Hands-On Small-Scale Fish Farmer Co-Op**, which was secured a 200tons per annum of Grade-A trout supply agreement with Three Streams Smokehouse, whose products retail at Woolworths and Pick n Pay.

technology

Trout farming and wine production share a fantastic mutual symbiotic relationship. Work on the wine farm and the harvesting periods of the two activities are wonderfully compatible. In summer, during grape season irrigation depletes the dams, and this is also the period unsuitable for trout production due to its warm water temperatures. The Western Cape is a winter rainfall region, the dams fill up, and trout thrives during the cold rainy winters, while the vines lie dormant.

The DST initiative supports the adoption of affordable cage-culture technology based on international standards for the development of the aquaculture industry. Each producer uses a cage that consists of a floating platform with two polyethylene cage nets, of 10x10x5m each, and a capital value of R90 000 and R25 000 for other equipment. A grant of R25 000 towards the cage, and other equipment. The balance is paid off in a rent-to-buy scheme with the co-operative. Economic benefits to the small farmers include a minimum wage and sharing in the business profits from the sale of fish. For most, the fish farming income is a secondary income to a primary income as farm laborers.

"Hands-On" assist its members with a wide range of services from the initial site selection and evaluation, the development of cage infrastructure, bulk purchase of fingerling and feeds, monitoring of

fish health and water quality, production planning and managerial assistance, as well as harvesting and marketing services. The basic premise is that producers that are part of a structured organisation with the necessary managerial and administrative support, extension services, technical protocols and guidelines, market and financial access, will have a much higher success potential compared to when each project is a stand alone entity.

achievements

Starting from a successful 5-sites pilot grow-out in 2004/5, the initiative was expanded to 13 projects harvesting 51.4 tonnes. In 2006/7 23 projects harvested 131 tonnes, with the top producer and first winner of the floating Hands-On trophy, Folbekkies Forel Boerdery, producing 6.094tonnes of trout with a retail value of R140774, and the Nietvoorby project, at the ARC in Stellenbosch producing 5.917tonnes with a retail value of R124 107.

In 2007, Goeiemoed Fisheries CC achieved 6.08tonnes and the coveted floating trophy. All are members of Hands-on Fish Farmers Co-operative (Reg. no 2420). In 2007/8 an additional cohort of 12 new projects was established increasing tally to 35 producers, capable of producing a third of the Western Cape Trout production. In 2008/9 Hands-On is being incubated as a business and will be exited, with 35 members, a 250ton production capacity, and a slaughter facility to enable primary beneficiation and product development on site, as well as the ability to process its produce and develop its own brand.

Each project is supported for 2years. The support includes training and support in managing a small-scale production facility, and advanced business training and support accredited by the University. In total almost 300 people are benefiting from the project directly and a lot more indirectly. The annual net-profit of the small-scale farming units are currently up to three times the average annual wages of farm labourers in these regions. Approximately 250 have attended the 4 Level 1 and 4 Level 2 training courses, enabling them to be accredited fish farmers.

conclusion

The Programme has proven its ability to make a meaningful contribution to the per capita income and nutritional status of these communities, whilst it also provides a means for the development of human resources. The Western Cape Model, as demonstrated here is not applicable in other areas where dams are not in close proximity to each other and to support infrastructure as in the Western Cape. The DST, DoA, and DWAF are piloting a model for aquaculture development in inland provinces. This pilot is being conducted in seven Provinces viz, KZN, Mpumalanga, Limpopo, North West, Free State, Eastern Cape and Northern Cape to ascertain technical, environmental and economic viability of indigenous fish production.





PROVINCIAL GROW-OUT PILOTS (7 PROVINCES)

introduction

The successes in the Small-Scale Trout Grow-Out project in the Western Cape demonstrated that small-scale commercial aquaculture can be successful; however, this model works because of the close proximity of wine estates amongst each other; the good winter rains and cold temperatures. The readily available support and value-addition services for trout and an established market in which demand exceeds supply, all serves as crucial success factors. In contrast all other provinces have irrigation dams that are far apart and large, thus the Small-Scale grow-out model cannot function. Secondly, fish production is mainly about temperatures, and inland water systems, other than in certain parts of Mpumalanga, and the escarpment of the Drakensberg, where rainbow trout can be grown, represent warm-water environments. In 2005/6 DST commissioned desktop feasibility studies for 5 provinces (N. West, N. Cape, Mpumalanga, E. Cape and Limpopo) to explore the feasibility of aquaculture in the provinces.

Arising out of the intelligence gained from the Provincial feasibility studies, which indicated a potential for indigenous warm water species, the DST-DoA, and DWAF agreed to collaborate in implementing Provincial Grow-Out Pilots to ascertain the commercial, technical and environmental feasibility of indigenous species. These will provide crucial data on production of tilapia, catfish [carp and trout] as well as biological and technical data, necessary for the development of commercialisation of suitable species in each province.

objective

The DST-DoA-DWAF provincial grow-out pilots are to establish ONE provincial grow-out pilots per province to ascertain the technical, environmental, and commercial factors of the production of indigenous fresh-water species (tilapia, catfish (barbell), trout and carp) using High-Density Poly-Ethylene (HDPE) cage-net technology in State-owned irrigation waterworks. The target provinces are E. Cape, KZN, Limpopo, Mpumalanga, N. West, Northern Cape and Free State. These provinces have fledgling aquaculture industry, and potential for growth, however require technology support and capacity development to do so.

technology

Cage culture provides means to utilise open water systems (large dams, lakes, and ocean) for controlled production of aquaculture species. Globally cage culture constitutes a significant component of over 20% of aquaculture production, and forms the backbone of major commercial species such as salmon, trout, and continues to be implemented with growing success. However, South Africa lags well behind in the development of farming of important indigenous food fishes, in both commercial and small-scale systems. The pilots promote affordable circular cage-culture, based on the international design using HDPE, and targets indigenous food fish, mainly tilapia and catfish.

The benefits of using HDPE in cage construction include ease of production and maintenance, lower operational costs, incredible strength and flexibility to withstand nature's forces and its cages are corrosion-free. For aquaculture it provides improved efficiency of production, better tolerance to fatigue and increased lifespan. The cages reduce the potential for environmental pollution and are highly resistant to bio-fouling from algae.

Tilapia is an indigenous fish found in warmer waters throughout Africa. In Africa tilapia are a staple diet harvested from local lakes and rivers by subsistence fisher(wo)men. It was already being farmed in ancient Egyptians circa 2500 BC and has always been regarded as 'poor man's food'. In the 1990's tilapia became established in the US seafood market as a desirable fish that is healthy to eat, thaws well, has few bones and has a mild taste. They grow at reasonable densities, and are highly tolerant of handling. They are also resistant to diseases and fluctuating water quality common in open systems.

market

In South Africa, the formal market has been slow to accept tilapia as fine cuisine, preferring marine fin-fish above freshwater fish. In contrast, the formal sector in other Southern African countries relishes this species as food fish. The informal market is the large opportunity that is very under-supplied at present, and already several tilapia farmers and fishermen sell tilapia into the informal market. These farmers are enjoying numerous advantages to this sector, including selling the fish whole, unprocessed; obtaining higher prices than in the formal market, and most of all the informal market pays cash for the product.

The advantages of tilapia and **catfish** is their relative ease of reproduction, fast growth rates, adaptability to various feedstuffs & culture systems, and their good marketability. The best selling point for tilapia is the white flesh colour which makes it an ideal replacement for the diminishing marine fish stocks, and these desirable traits have fuelled the increased popularity of the fish. The Department of Agriculture is focusing on the revitalisation of State-owned hatcheries, which will support the provision of suitable fingerlings at the expansion and roll-out of the grow-out systems.

The commitment to actively grow the aquaculture industry cannot be at the expense of catchments and river ecosystems. It is for this reason of biodiversity protection that the DST, DoA and DWAF support primarily the commercial cultivation of indigenous species, or species approved by DEAT as 'naturalised' in the country's water systems, like **trout** and **carp**.

achievements

The projects are progressing slower than expected owing to unforeseen legislative requirements regarding water resources, permits, stakeholder consultation and basic Environmental Impact Assessment (EIA) requirements, however these are almost finished. The basic EIA's are almost complete, and awaits 'records of decision' from DEAT, after which on-the-ground work may begin.

Assessment of suitable water bodies in each province has been completed, in which temperature and depth data from 40 dams was obtained, and evaluated against support infrastructure, necessary to support grow-out and on-site primary-processing. Data indicates that KZN, Free State and Mpumalanga are ready for pilot-demonstration, and that additional assessments are required for E. Cape, Limpopo, and North West. No suitable dam could be found in the N. Cape.

In KZN, HDPE cages have already been installed in the Pongolapoort Dam, and fingerlings are being produced in local hatcheries, using brood stock captured from the dam – done to ensure that no new genetic material is introduced to the resident tilapia population. The project will start in KZN, the Free State and Mpumalanga first, and is being fast-tracked.

Each pilot will be equipped with a facility to primary process its harvest (gutting, and filleting) and will supply its local market. This will provide high quality fish products (whole, gutted and fillets) to the local market, as well as to the retail and restaurant sectors.

In 2008/9 the DST, DoA and DWAF are to fast-track implementation of the pilot projects by involving a number of other players and the private sector that could benefit the implementation, to ensure that almost all pilots are up and running by end of the financial year.

social impact

Each grow-out pilot will create job opportunities for local communities, as well as provide a source of affordable protein during harvest time. The projects will provide local entrepreneurs with economic opportunities to become satellite growers, and benefit from the large-scale operation in terms of support and technology.

conclusion

The provincial pilots involve provincial partners and stakeholders with a view of creating a massive uptake and roll-out of the technology post-pilot. DoA and DWAF are working in creating an enabling environment for the roll-out and access of State-owned waterworks for the advancement of inland fresh water aquaculture.





ABALONE GROW-OUT PILOT (HONDEKLIP BAY)

introduction

Abalone aquaculture is the most important and valuable aquaculture sector in South Africa and is growing. "Abalone" is internationally recognised as describing all species of the genus *Haliotis*. In South Africa, 6 abalone species occur naturally, three of which are extremely rare, and the other two, are tiny species. However, the name abalone is commonly associated with one species: *Haliotis midae*, (commonly known by its Afrikaans name, "perlemoen"). Over-exploitation and rampant poaching have all but decimated South Africa's wild abalone stocks, such that the species is on the verge of total collapse and future abalone production will be entirely dependent on aquaculture.

the industry

The South African abalone aquaculture sector started in the early 1990's with the first 10 tonnes of cultured abalone produced in 1997, and expanded rapidly such that in 2001 it had become the most important and valuable single aquaculture sector in SA and the largest abalone producer outside Asia.

The "perlemoen" industry is composed of 13 established producers, viz., 10 land-based tank farming systems in the Western Cape, 2 in the Eastern Cape and one ranching operation in the Northern Cape. However it is alarming that the sector is becoming increasingly consolidated with a fewer larger companies producing a large share of the country's production.

market

The World market for cultured abalone is primarily for live individuals of 50 – 100mm. In South Africa abalone is harvested after a 3 – 4 year production cycle. It is sold live, frozen, dried or canned primarily to Hong Kong, Japan and Singapore, where South African abalone enjoys high acceptability and demand because of its excellent quality (taste, colour and texture), such that market expansion is limited by output. Entry barriers to the sector includes high capital requirements, access to land, technology, and trained personnel. In 2007 South Africa produced 915 tonnes of farmed abalone, with a farm-gate value of approximately R240 million and a unit value of about R200/kg. Production is expected to reach more than 1000 tonnes in 2008.

technology

South Africa is a market leader in abalone aquaculture technology, and systems development. Current production systems includes growing abalone in land-based flow-through cage systems in abalone farms, where sea water is pumped through a filter system to the abalone tanks, and effluent water flows back to the ocean. Current R&D is focused on improved efficiency, consistency, quality, and product development. Specific long-term R&D programmes includes genetic improvement (funded by the Innovation Fund) health management, feed development and processing technologies. However, the production technologies are generally matured and proven, and

there is a need for technology transfer to include new emerging producers, and to support economic activities in dying small coastal town, previously dependent on capture fisheries. One such town is Hondeklip Bay.

hondeklip bay

The town of Hondeklip Bay possesses arguably the best conditions for shore-based aquaculture, favourable biological conditions including nutrient-rich unpolluted sea water, and infrastructure in buildings and power supply. It is situated some 160km south of Port Nolloth on the Namaqualand West Coast. With the recent closure of the Trans Hex group's diamond mining activity, Premier's John Ovenstone fish factory and the Oceana lobster processing facilities in Hondeklip Bay and with virtually no other significant source of employment in the area, the population of Hondeklip Bay is experiencing severe economic distress. Unemployment is estimate to be in the range of 80%.

the DST pilot

The pilot was initiated to ascertain the environmental, technical, and economic viability of abalone grow-out on the West Coat, against temperatures and water quality, with the intention to create an economic model for abalone grow-out (production) and stimulate commercial abalone aquaculture development in the Northern Cape.

The Hondeklip Bay pilot consisted of 16 grow-out cages, stocked with 20 000 animals. The pilot is housed in the disused Oceana Lobster Processing plant. The buildings were renovated to accommodate the pilot infrastructure. The cages are based on exactly the same production technology used by commercial farmers in the Western Cape. HIK Abalone, the technology partner to the project, one of the largest abalone producers, worked in partnership with the University of Stellenbosch in implementing the grow-out pilot in which growth-rates were monitored in Hondeklip Bay and at HIK Farm (as control) over 2-years.

The project design allowed the assessment of growth rates across 3 different animal size ranges, i.e. Small (12 months, 0.7g), Medium (29 months, 25.2g) and Large (42 months, 85.2g), on a quarterly basis. The outcomes of the pilot indicated that the growth rate, survival, feed conversion and condition of the animals compared favourably with industry norms and that the water quality and temperature range is suitable to sustain commercial abalone culture. However, the lower seawater temperatures are a concern in terms of possible slower growth rates and reduced profitability. The risk factor associated with harmful algal blooms at Hondeklip Bay and the related northern regions of the Namaqualand West Coast was found to be low in terms of the frequency of occurrence.

expansion of the pilot

The DST in partnership with the Fishing and Mariculture Development Agency (FAMDA) and HIK Abalone teamed up in 2007 to expand the project, and to establish abalone-basket manufacturing SMME, pipe fitting workshop, component storage, and project office, in anticipation of possible commercial expansion of the pilot. The project is being expanded from the current 16 tanks to 92 with a capacity to accommodate 100 000 animals. Already 20 additional production tanks have been installed, and 15 permanent jobs and 80 part-time job opportunities have been established, all benefiting local people. The FAMDA Aquaculture Certificate Programme and an intensive aquaculture training programme accredited by Stellenbosch University are being provided to the beneficiaries. A community small-scale West Coast rock-lobster operation is also being assisted by providing live-lobster holding facility and technology support.

conclusion

The project is now serving as a catalyst for economic development to a 120 tonnes commercial abalone farm, with the financial model indicating an internal rate of return of about 21%. This is dependent largely on private and local government investment of R40million over 3years, in which the investment in the pilot would accrue as community equity benefits. The Northern Cape government and DEAT have been appraised on the project and it is hoped that current and on-going work between the provincial partners would drive the roll-out of the technology solutions and model to include a number of other small coastal towns and emerging abalone producers.

“Aquaculture, not the Internet, represents the most promising investment opportunity of the 21st Century.” - Peter Drucker, Economist





MARINE FINFISH GROW-OUT PILOT (YELLOWTAIL, SILVER AND DUSKY KOB)

introduction

Mariculture is a fast developing and growing sector, with a focus on mussels, oysters, abalone, seaweeds and prawns. There is little fin fish culture operations owing to technology challenges, and the supply of finfish by capture fisheries. Three indigenous and endangered South African line-fish species, namely dusky kob (*Argyrosomus japonicus*), silver kob (*A. inodorus*) and yellowtail (*Seriola lalandi*) are good candidates for cage aquaculture because they are widely distributed, highly productive, tolerate a wide range of temperatures and share an excellent domestic and international market profile.

objective

The use of sea-based cages for all three species is the internationally preferred culture method as used in Australia and Europe. However the technical, environmental and financial feasibility of sea cage and culture of South Africa's indigenous marine finfish are unknown. The DST in partnership with Irvin and Johnson Ltd (I&J) are conducting a pilot project aimed at ascertaining over two years, the commercial, technical, and environmental viability of sea-based cages for growing the 3 species to 1 kg, and sell to the market uptake agreement with I&J. From the insight gained from the pilot, a commercialisation model that

would be open to the public and BEE opportunities will be established. The HDPE cages are deployed on a site in the northern lee of the Nelson Mandela Bay harbor in the Eastern Cape, and one kilometre into the ocean.

Wild juvenile kob grows rapidly with fish two years old averaging 46 cm in length and 1.5 kg in weight. However, the level of wild stocks has been reduced to an estimated 2% of pristine stock levels and the commercial fishery is currently in a state of collapse and near closure. Australia produces approximately 500 tonnes of farmed dusky kob and one million fingerlings annually, attaining a market weight of 600g (plate size) in 6 months and 1.5kg (fillet size) in 12 to 15 months. Processed kob has a good fillet of excellent quality and high fat content.

The South African yellowtail is of major significance to small-scale commercial fishers in the South Western Cape. It is also the principal species in the commercial line-fishery in the Cape Agulhas region, where it contributes up to 90% of catches in the summer months. According to Marine & Coastal Management National Marine Linefish System data, the reported commercial catches have been averaging at about 1200 tonnes since 1988, and the "treknet" (beach-seine) catches fluctuated between 2 and 170 tonnes between 1972 and 2004.

technology

Through R&D in the past 5 years I&J Limited has successfully developed the technology to spawn all three species from wild-caught brood stock and proceeded to establish a commercial finfish hatchery at Danger Point (Gansbaai) commercially producing fingerlings from the 3 species, for aquaculture. This hatchery was opened by the Minister of Environmental Affairs and Tourism, the Honorable Mr Marthinus van Schalkwyk, on 10 April 2007. Two other South African companies breed dusky kob.

The pilot has received legislative approval for the implementation (authorization register number: 12/20/12/868) in accordance with the terms of the Environmental Management Act, 1998 (Act No 107 of 1998). The Environmental Impact Assessment was granted by the Department of Environmental Affairs and Tourism, Branch Marine and Coastal Management (MCM) on the 2nd of May 2007, and Nelson Mandela Metropolitan University (NMMU) has been contracted to undertake the environmental monitoring throughout the life-cycle of the project. The University of Stellenbosch performs project management, and is joint-technology partner with I&J.

achievements

Four HDPE Cages were constructed and successfully introduced in the water in November 2007. The cages incorporate a Scottish design, built using locally supplied materials, and the mooring system was designed by an Australian company that has deployed these systems in various parts of the world. In December 2007, 40 000 dusky kob fingerlings with an average mass of 8grams were introduced in sea cage number four. The successful introduction of kob was followed up by the introduction, at the end of January 2008 of 18 000 yellowtail fingerlings, with an average weight of 5grams, in sea cage number two. Both cages are equipped with locally-produced predator nets of 160mm and with an inside net presently of 10mm. All nets have been weighted with approximately 500kg of chain to maintain the cage structure of the nets in the water. In addition the nets from China came fitted with a 150kg lead line, which is proving to be very effective.

The fish are fed twice a day weather permitting, and they appear to be performing above expectations. Fish sampling at the close of the third production month, determined the average weight of kob to be 74.73g and yellowtail at 17.57g compared to the expected target weight 53.32g and 15g.

The project is constrained by weather occurrences, and accurate wind and swell predictions are required to plan necessary work procedures. In the first three production months a total of 16 days were lost due to bad weather, and as a result, a weather station has been installed which will ensure more accurate weather information. Fouling on the nets and cages is a major challenge and it creates extra strain on cages, slippery working surfaces and even chafes holes in the fishnet. This aspect has to be controlled by regular maintenance on the cages.

social impact

It is too early to gauge the social impact of the project. The project has generated interest from the local aquaculture industry. The project aims at creating employment and human capital development opportunities, at the implementation through the University of Stellenbosch and Nelson Mandela Metropolitan University. The resultant BEE opportunities will also undoubtedly create wealth and job opportunities.

conclusion

It is hoped that this grow out pilot will develop a model for the roll-out of sea-based HDPE cages for commercial producing indigenous marine finfish as well as a model for roll-out. Already DEAT has been appraised and DEAT Marine and Coastal Management (MCM) officials have visited the project. The plan is to get DEAT more involved, and to incorporate the project learning and outcomes in its roll-out plans for mariculture development and roll-out. I&J is also exploring large-scale BEE investment opportunities in the Western Cape.





YELLOWTAIL RANCHING (WESTERN CAPE)

introduction

The South African Yellowtail (*Seriola lalandi*) is of major significance to “trek-net” (beach-seine), traditional artisanal fisher(wo)men, quota earners, and small-scale commercial fishers in the South Western Cape. It is also the principal species in the commercial line-fishery in the Cape Agulhas region, where it contributes up to 90% of catches in the summer months. Although the beach-seine fishery is the oldest commercial fishery in South Africa, at current levels it has poor financial viability and is characterised by inconsistent catches, sensitive market conditions and low profit margins.

Beach-seine fishing was introduced to SA in the 1600s and has essentially remained unchanged. Beach-seines are mobile fishing gears that are rowed out under the directions of a spotter to encircle a shoal of fish. A crew of between 14 and 20 persons, depending on the size of the net and the length of the haul, then haul the net to the shore. As the net approaches the shore, the ends of the net are brought together, and the trapped fish are driven into a bag (cod-end) in the middle of the net.

These fisher(wo)men face three primary constraints viz., production is variable, uncertain, and cannot be increased. In season, daily catches range between 300 and 40 000 kg, with R25/kg and R5/kg as high and low prices respectively. Owing to poor or non-existent cold-chain support, most trek-net fisher(wo)men lose the value of their catch, as captured fish die en masse through suffocation and languishing on the beach for hours before making it to the packing plant. In this way the risk of histamine fish poisoning caused by the consumption of bacterially contaminated fish is increased, particularly when fish are not kept chilled or frozen.

objectives

The project aims at developing and demonstrating technology whereby beach-seine encircled yellowtail is transferred to a towing cage, towed back to a selected holding site and then transferred into moored holding cages. Here the fish would be held, conditioned and marketed, thus enabling the fisher(wo)men to retain quality of their catch, and develop a profitable and sustainable yellowtail ranching

venture, priding itself on product quality, environmental awareness, and technical innovation. Ranching has largely developed the tuna industry in the 1990's in Australian, Spain, and Mexico into a world leader today.

technology

The project will utilise HDPE gravity-type fish grow-out cages, as used internationally in ranching operations (eg. tuna ranching). These cages are used in some of the harshest marine environments e.g. west coasts of Scotland and Ireland, Mediterranean, the Canary Islands, and Australia.

achievements

The project is at the early stage of mobilisation and implementation. The project site is planned to be around the Simonstown Bay area.

social impact

The project will improve the quality of capture and financial viability of the traditional yellowtail trek-net fishery by improving the competitiveness of the fishery on domestic and export markets through increased product quality with a real time market response, as they would harvest and supply a high quality product on demand. It will contribute to socio-economic development and empowerment of poor communities through job creation, transfer of skills, income generation and value-chain development. The creation of new leveraged downstream industries will create additional job and business opportunities for disadvantaged coastal communities.

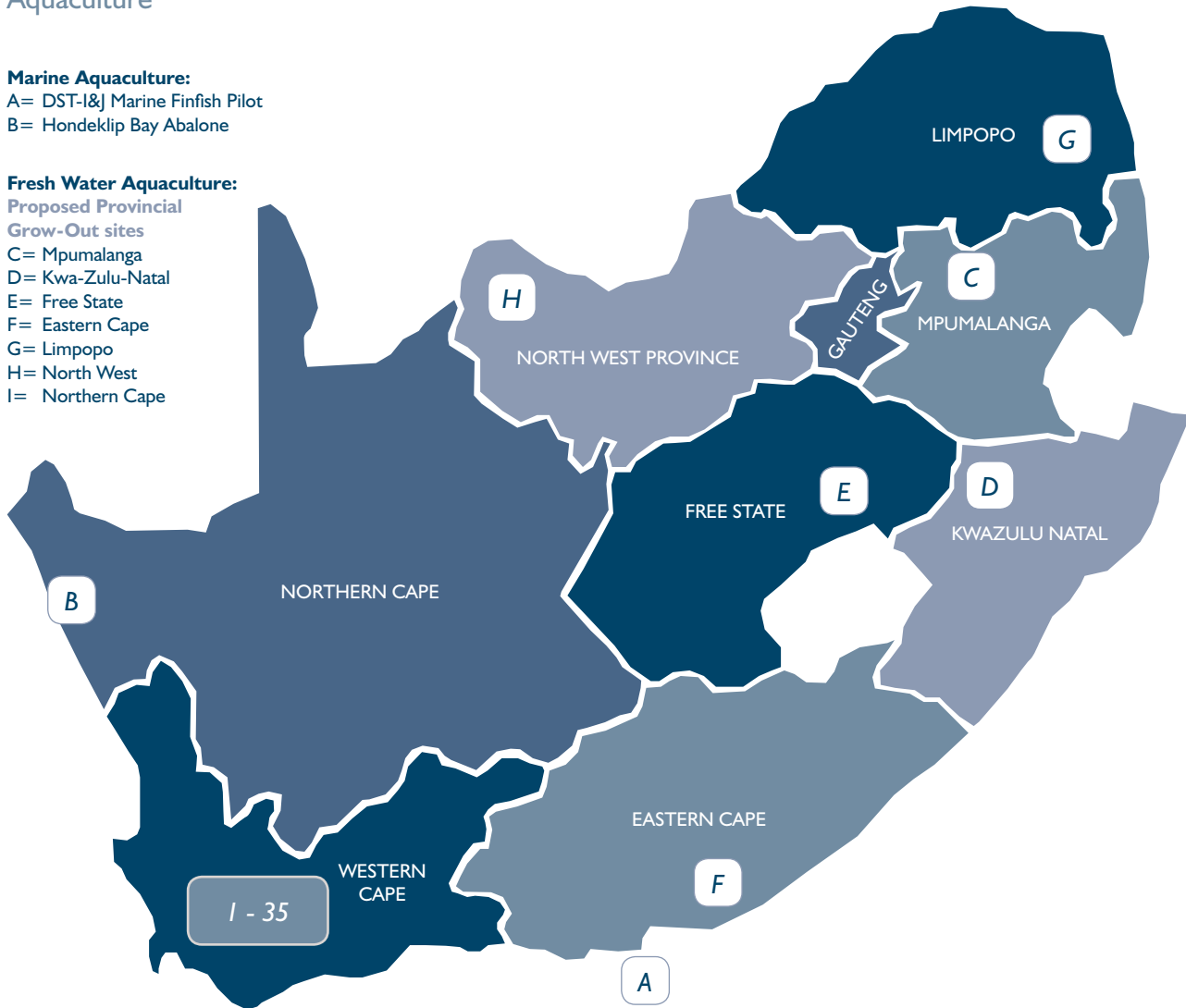
conclusion

The introduction of technology to the artisanal beach-seine capture fishery boasts well for the emerging fisher(wo)men, most of whom cannot afford boats, as well as to declining small town economies. DEAT MCM has been appraised and is expected to be a partner to the implementation, and roll-out of the project post pilot.

MAP indicating DST-funded initiatives:
Aquaculture

Marine Aquaculture:
A= DST-I&J Marine Finfish Pilot
B= Hondeklip Bay Abalone

Fresh Water Aquaculture:
Proposed Provincial Grow-Out sites
C= Mpumalanga
D= Kwa-Zulu-Natal
E= Free State
F= Eastern Cape
G= Limpopo
H= North West
I= Northern Cape



Fresh Water Aquaculture:

W. Cape Small-Scale Trout

- 1= Rustenberg
- 2= Nietvoorbij
- 3= Graham Beck 1
- 4= Graham Beck 2
- 5= Plaiser de Merle
- 6= Cape Olive 1
- 7= Cape Olive 2
- 8= Worcester Trout CC

- 9= Wyzerdrift
- 10= Kleinmôrewag
- 11= Eselfontein
- 12= Rocklands 1
- 13= Rocklands 2
- 14= Rocklands 3
- 15= Dennegeur 1
- 16= Dennegeur 2
- 17= Dennegeur 3
- 18= Eikenhofdam 1

- 19= Eikenhofdam 2
- 20= Eikenhofdam 3
- 21= Nuwejaarsrivier
- 22= Jonkershoek
- 23= Soetfontein 1
- 24= Soetfontein 2
- 25= Barton
- 26= Goedgeloof 1
- 27= Goedgeloof 2
- 28= Boomerang

- 29= Voorhoede 1
- 30= Voorhoede 2
- 31= Hexron
- 32= Slangboskloof
- 33= Theewaterskloof
- 34= Helpmekaar 1
- 35= Helpmekaar 2



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