

National Aquaculture Master Plan for Namibia
Part 2: Freshwater Aquaculture
Section 1: The Master Plan for Freshwater Aquaculture
(2013 - 2023)



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Forward by the President

Forward by Minister

Acknowledgement

Abbreviations and Acronyms

ABN	Agricultural Bank of Namibia
AfDB	African Development Bank
BEE	Black Economic Empowerment
DBN	Development Bank of Namibia
DOA	Department of Agriculture
DWA	Department of Water Affairs
EIA	Environmental Impact Assessment
FAC	Freshwater Aquaculture Council
FAO	Food and Agriculture Organization of the United Nations
GMP	Good Management Practice
GRN	Government of the Republic of Namibia
HACCP	Hazard Analysis and Critical Control Points
IAC	Inland Aquaculture Centres
KIFI	Kamutjonga Inland Fisheries Institute
LRF	Legislation and Regulatory Framework
MET	Ministry of Environment and Tourism
MFMR	Ministry of Fisheries and Marine Resources
MTI	Ministry of Trade and Industry
NAMP	National Aquaculture Master Plan
NAMP-FW	National Aquaculture Master Plan for Freshwater Aquaculture
NASP	Namibia's Aquaculture Strategic Plan
NDP	National Development Plan
NEPAD	New Partnership for Africa's Development
NPC	National Planning Commission
OIE	World Organisation for Animal Health
PPP	Public-Private Partnership
RAS	Recirculating Aquaculture Systems
SMME	Small, Medium and Micro Enterprise
SSC	South-South Cooperation
SWOT	Strengths, Weakness, Opportunities and Threats
TAS	Turnaround Strategy
TNA	Training Needs Assessment
UN	United Nations

National Aquaculture Master Plan for Namibia

Part 2: Freshwater Aquaculture

EXECUTIVE SUMMARY

Preamble

1. The Government of the Republic of Namibia (GRN) has embarked on an objective programme of post-independence reconstruction to address the legacy of apartheid which resulted in the country having the world's highest inequalities in household wealth distribution. In 2007 the Gini index for Namibia was 74%, 0% being total equality.
2. The nation has initiated a series of initiatives to reverse such inequality through creating a platform for a more diverse economy with the primary objective of increasing economic activity.
3. Freshwater aquaculture is perceived as one such economic activity to address this national objective through a pro-poor programme for inland aquaculture development.
4. The Government of the Republic of Namibia acknowledges the importance of aquaculture in their National Development Plans (NDP 2 and 3) and recommended that freshwater and marine aquaculture be afforded high development priority, a position also acknowledged in VISION 2030 (Namibia, Office of the President, 2004).
5. To give effect to this vision the Ministry of Fisheries and Marine Resources (MFMR) was tasked by the National Planning Commission (NPC) in 2006 to develop a National Aquaculture Master Plan (NAMP).
6. AquaStel (Pty) Ltd of Stellenbosch University, South Africa, was commissioned to develop the NAMP with the task divided into two: (i) mariculture and (ii) freshwater aquaculture. This Master Plan deals with the potential for freshwater aquaculture in 12 Namibian regions. Field assessments were undertaken by consultants referred to in this document as the freshwater team.

Approach to Developing the National Aquaculture Master Plan for Freshwater Aquaculture (NAMP-FW)

7. The NAMP-FW was developed through an iterative bottom-up stakeholder consultative participatory process with government and private sector which resulted in a national SWOT (strengths, weakness, opportunities and threats) analysis. The issues arising were clustered under natural resources, human capacities, aquaculture inputs, government/public sector involvements and general challenges. Additionally, extensive field visits were conducted to assess potential sites and government and private initiatives.
8. The issues arising were then captured into the NAMP-FW.
9. A series of relevant assessments, ranging from situation analysis, market assessment, human resource and training needs, key production systems, species identification and technical requirements for potential freshwater species and potential fish yields were generated to support the implementation of the NAMP-FW and presented in Part 2, Section 2.

Outcomes: (i) The National Aquaculture Master Plan for Freshwater Aquaculture

10. Vision:

Freshwater aquaculture sector meaningfully contributing to poverty alleviation and food and nutritional security through transformation, job and wealth creation and economic and rural development.

11. Mission:

Creating a diverse freshwater sector for maximizing socio-economic opportunities and benefits for all its people.

12. Goals

The principal goal of the National Aquaculture Master Plan for Freshwater Aquaculture is to ensure that by 2023, freshwater aquaculture production reaches 4 000 tonnes. This can be best achieved by securing resources and investment to initiate, facilitate and coordinate interventions that will create an enabling regulatory and operational environment to **kick-start** and **accelerate** freshwater aquaculture production in order to fulfill all stakeholder expectations. The NAMP-FW aims to:

- i) Establish a flexible and **pragmatic approach** to respond to current shortcomings for aquaculture uptake within one year.
- ii) Identify, develop and **promote transferable technology** in the short-medium term to enable producers to diversify and be profitable within 5 years.
- iii) Prioritize **employment and wealth creation** opportunities through creating social and private capital and investment.
- iv) Ensure **transformation** and increase social cohesion with emphasis on women and youth where appropriate.
- v) **Accelerate production** to enhance **food and nutritional security** and **food sovereignty**.

The NAMP-FW raises 14 issues for action. For each issue the salient plan of action is prioritized from 1-3, with 1 being the top priority. For brevity only the top priorities are stated here.

On Policy: key issue followed by main recommendations

13. **Key issue:** The aquaculture policy places emphasis on the marine sector and perhaps some undue environmental protection while missing some opportunity to develop aspects of freshwater aquaculture with a pro-poor focus.
14. Develop a harmonized definition for aquaculture as a farming activity and communicate this definition to relevant stakeholders and include in governing principle Acts and Regulations.
15. Recognize aquaculture as a legitimate activity and user of required natural resources, compile an inventory of water resources and secure and ensure access to resources essential for aquaculture development.
16. Supply seed for on-growing in the short to medium term through support from government institutions, transferring this activity to the private sector whilst consolidating the government's role to maintain, develop and supply quality broodstock to private hatcheries in the long term.
17. Recognize the limited pool of suitable indigenous candidate species required to diversify and increase freshwater production and identify and prioritize aquaculture

candidates with established mass production technologies for seed and market size fish.

18. Recognize aquaculture as the lowest consumptive water user for food production compared with traditional agricultural crops, whilst increasing overall water productivity.
19. Encourage and provide incentives to rural communities to create water harvesting structures which can also be used for integrated fish farming.
20. Investigate and promote aquaculture activities in irrigation water canals and reservoirs as a means of increasing water productivity and fish production, whilst acknowledging any limitations.

On Legislation and Regulatory Framework (LRF): key issue followed by main recommendations

21. **Key issue:** For Namibian conditions, the current LRF does not create an adequate enabling environment for advancing the government's objective for promoting pro-poor uptake of freshwater aquaculture. In particular, no known threshold triggers are in place for environmental impact assessments (EIA).
22. Conduct a comprehensive review of relevant legislation and any ensuing regulations to identify and amend/remove where appropriate, constraints to diversify sustainable aquaculture development and promote uptake.
23. Revise EIA regulation to create threshold of 250 tonnes for an EIA requirement.
24. Revise as required the use of exotic species and develop pragmatic guidelines for the utilization of non-indigenous and exotic species to diversify freshwater aquaculture.
25. Ensure activities external to aquaculture do not compromise resources required by aquaculture.
26. Promote voluntary codes of practice and self-regulation using iterative and participatory approaches involving public and private stakeholders.

On Financial Services and Incentives: key issue followed by main recommendations

27. **Key issue:** Access to financial services for small-scale producers and for development is limited and collateral requirements disadvantage government target groups.
28. Revise existing financial assistance programmes to include freshwater aquaculture and create new financial assistance programmes to support the following: (i) appropriate low-cost aquaculture production technologies for well-established species; (ii) innovative, appropriate and needs-driven research and development; (iii) job creation; (iv) investment promotion; (v) capacity building and training; (vi) developing GMPs (good management practice) and (vii) BEE (black economic empowerment) developments.
29. Ensure aquaculture is included into agricultural programmes for fiscal incentives and development.

On Access to Land and Water: key issue followed by main recommendations

30. **Key issue:** Water is scarce and competition for water and land resources is high and requires government intervention to secure equitable access.
31. Develop an inventory of suitable resources and increase and secure access to available public and private land and water bodies for utilization for freshwater aquaculture purposes.
32. Identify and work with affected communities to secure access to appropriate land and water including groundwater.

33. Ensure spatial planning and provincial government planning, including municipal planning, schemes include necessary provisions freshwater aquaculture.
34. Regional Councils/municipalities to identify and avail land to potential community investors.

On Access to Feed: key issue followed by main recommendations

35. **Key issue:** Given feed volumes, the private sector is unlikely to produce aquafeeds in the short to medium term. The government will be expected to take a lead role in securing and improving aquafeeds.
36. Specifically support R&D to develop cost-effective aquaculture feeds to reduce aquaculture production costs, especially for small to medium-scale producers.
37. Evaluate government fish feed plants to improve ingredient quality and pellet stability.
38. Develop guidelines on better practice in feed production and storage.
39. Explore synergies with other institutions and organizations (e.g. Agris) to develop regional storage centres for aquafeeds.

On Access to Seed: key issue followed by main recommendations

40. **Key issue:** The choice of species for freshwater farming is limited. The government should consider using their hatcheries to make seed more accessible to increase and diversify opportunities for freshwater aquaculture and should gradually shift to broodstock supply and development.
41. Identify potential species (including non-indigenous species) for culture in the different regions and areas. In particular, initiate a programme for developing freshwater prawn culture.
42. Prioritize freshwater species with established technologies for mass production aquaculture to meet short to medium-term objectives.
43. Consider decentralizing seed production regionally.
44. Provide technical and financial support to potential farmers, in particular women, and other entrepreneurs to enter into fish nursery operations.

On Research and Technology Development: key issue followed by main recommendations

45. **Key issue:** Despite significant investment in infrastructure, R&D on freshwater aquaculture at government institutions lacks direction and focus. The government should focus on needs driven research for freshwater aquaculture targeting increasing and diversifying production and improving production efficiency.
46. Develop a national research agenda and establish, budget and coordinate national short to medium-term applied freshwater aquaculture research. Specifically, to (i) conduct innovative marketing research initiatives to establish local, national and regional fish demand; (ii) develop appropriate lower cost production systems with widest socio-economic impacts; and (iii) improve production efficiency and reduce production costs for species with well-established technologies.
47. Promote research programmes that will (i) support sector diversification; (ii) develop appropriate and effective farming systems; (iii) cater for domestic and regional markets; and (iv) address sector competitiveness.

On Technology Transfer and Demonstrations: key issue followed by main recommendations

48. **Key issue:** Given its infancy, human capacity and knowledge in freshwater aquaculture and technology is limited. The government should consider an awareness agenda and develop and disseminate appropriate technologies to promote uptake of aquaculture. The designs of current systems are inadequate with minimal functionality for purpose.
49. Undertake a skills audit or training needs assessment (TNA) at about 4-5 year intervals for the freshwater aquaculture sector.
50. Upgrade the Aquaculture Extension Training Programme within MFMR.
51. Develop a timely strategy for dissemination of technology and innovation.
52. Develop a dedicated technology transfer and demonstration programme for hatcheries and on-growing that will support emerging and small-scale entrepreneurs. Specifically, upgrade and use functional community or government farms as demonstration centres.

On Training, Education and Extension Services: key issue followed by main recommendations

53. **Key issue:** As aquaculture is a new activity in Namibia, relevant knowledge is not currently integrated into training/teaching programmes at all tiers of education.
54. For strengthening capacity building of the MFMR officials including researchers and extension officers, a comprehensive "National Extension Strategy" should be developed. One key action of such a strategy should be to undertake a TNA study, leading to the development of field tested extension materials for the inland fisheries, aquaculture and cross-sectorial institutions in Namibia.
55. Undertake an audit of education institutions at 5 year intervals for appropriate action.
56. Familiarize government officials involved in decision making with issues related to aquaculture development and planning.
57. Allocate funds to train researchers on pre-identified priority research issues.

On Aquatic Organism Health Management: key issue followed by main recommendations

58. **Key issue:** Whilst it is acknowledged that freshwater aquaculture activities are currently limited, measures should be put in place at the appropriate time to manage fish health. Currently, production does not warrant such interventions for freshwater aquaculture.
59. Develop and maintain an on-farm pathogen early warning system and a management and response protocol and monitoring programme to support reporting to the OIE (World Organisation for Animal Health).

On Product Quality and Safety: key issue followed by main recommendations

60. **Key issue:** As production volumes increase to meet urban and especially international markets, product quality and safety will dictate sustainability of farms. This may need attention once export volumes become significant. Currently the focus should be centred on food and personal hygiene.
61. Train farmers on the implementation of simple biosecurity measures and good husbandry practices.

On Marketing and Trade: key issue followed by main recommendations

62. **Key issue:** Currently Namibia should focus to meet domestic consumption and promote consumption, whilst considering the regional markets as volumes increase.

63. Specifically conduct detailed innovative market studies, including a survey and evaluation of local informal and formal markets with a focus on volume.
64. Develop production plans for prioritized freshwater aquaculture products.
65. Develop plans to increase domestic consumption of freshwater aquaculture products, including consolidating and expanding the role of the Fish Promotion Trust to promote freshwater fish consumption.
66. Facilitate access to finance, particularly for SMMEs (small, medium and micro enterprise), and develop an incentive package to attract investment into the freshwater subsector.

On Transformation: key issue followed by main recommendations

67. **Key issue:** Entry into aquaculture can be cost prohibitive and is demographically non-representative. Government initiatives should encourage a wider participation in aquaculture.
68. Prioritize creating a platform for lower risk capital infrastructure, appropriate technology and appropriate species packages for uptake.
69. Identify and organize committed, disenfranchised and disadvantaged groups across the country and individuals for retraining and orientation to take up aquaculture for food and ornamental purposes as an economic activity.
70. Consolidate and maintain the low interest loan scheme for developing and funding appropriate technologies.
71. Identify and train trade persons for building and maintenance of lower cost production systems.

On Information Management and Dissemination: key issue and followed by main recommendations

72. **Key issue:** The current level and structure of monitoring does not serve to monitor progress.
73. Develop monitoring and evaluation capabilities within the subsector. Specifically, develop a functional data collection system for government farms and facilities.

Outcomes: (ii) Situation Analysis - Key conclusions followed by recommendations

74. **On Regulations:** There are inconsistencies in some regulations which compromise freshwater aquaculture uptake and in some cases are premature in that government facilities are not in place for compliance.
75. Remove aquaculture from Schedule 1 to make transparent and comparable with other forms of livestock farming or gazette an EIA trigger of 250 tonnes/year allowing small-scale farmers to enter the subsector.
76. Specifically, allow species already introduced, such as *Oreochromis niloticus* and red claw (*Cherax quadricarinatus*) to be made more accessible for farming and promote other species advocated.
77. **On Namibia's Aquaculture Strategic Plan (NASP):** Overall, NASP has a clear mariculture focus due to its current economic significance. For freshwater aquaculture, its implementation appears limited and impact unclear.
78. The MFMR should review their management structure and conduct an analysis of the activities to identify how it can better achieve its targets.

79. The Fish Promotion Trust together with competent authorities and organizations should conduct a well-planned proactive marketing campaign to increase freshwater fish consumption.
80. There is a clear lack of human capacity to promote and develop freshwater aquaculture. We advocate MFMR conduct a training needs assessment study, which to our knowledge has not been done.
81. No structured research in freshwater aquaculture was apparent. We propose that MFMR develop a needs-driven freshwater aquaculture research strategy.
82. **On the Aquaculture Turnaround Strategy:** The MFMR inherited six community freshwater fish farms built by the Ministry of Trade and Industry (MTI) in 2001 for local communities. These farms were deemed woefully unproductive. The MTI therefore commissioned a Turnaround Strategy (TAS) in 2006 to revive these ailing co-operative freshwater fish farms. To date there appears to be no successful resolution.
83. The draft TAS provides a comprehensive analysis/audit of all six farms, four of which (i.e. Mpungu, Likunganelo, Kalimbeza and Kalavo) were visited by the freshwater team. It is our understanding that the remaining two farms are now decommissioned.
84. The freshwater team largely concurs with the observations and constraints contained in the TAS, encapsulated in the SWOT analysis.
85. The ownership of the co-operatives MUST be resolved ASAP. We concur with the GRN, and propose a government (51%): cooperative (49%) Public-Private Partnership (PPP), provided good governance measures are in place.
86. A time-bound exit strategy (community buyout) should be put in place.
87. An integrated agri-aqua approach is advocated for all farms but more effective fish and plant farming practices are required.
88. A committed and adequately trained workforce must be put in place.
89. **On Private Farm Visits:** All initiatives showed signs of infancy of fish farming displaying limited knowledge and could have detrimental outcomes. Expectations from aquaculture are unrealistic.
90. Conduct farm-specific technical audits and guide and train farmers in improving facilities and production.
91. **On Government Inland Fisheries and Aquaculture Centres:** The GRN should be complemented on tremendous political goodwill through capital investment infrastructure development.
92. The line functions of these facilities are unclear. The MFMR should consider the strengths and delineate responsibilities in aquaculture and capture fisheries.
93. The GRN should make efforts to strengthen leadership at KIFI (Kamutjonga Inland Fisheries Institute) and other inland aquaculture centres.
94. Conduct a detailed audit of facilities and invoke remedial measures to optimize its facilities, especially at KIFI.
95. At Hardap, import new strains of *O. niloticus*, a species that already exist in Namibia.
96. **On Assisted 'Cooperative' Fish Farms:** Four of the six farms were visited. The flooding problems are known and some management practices can be put in place to ameliorate flooding on some farms. Until and unless the ownership of these operations is finalized, no meaningful progress can be made to improve these farms.
97. The farms, individually or together, should be rented or leased to committed locally established PPP companies who should operate the farm with technical support of the MFMR and Ministry of Agriculture
98. Technical capacities of key staff on farms need to be upgraded urgently.
99. **On Evaluation of Potential Aquaculture Sites:** Rapid assessments were made on 17 sites and the way forward for each described. These sites were ranked.

100. The highest ranked site locations were at Kaoko Otavi, Oruvandjei, Warmquelle and Bernafay.
101. **On the Regional Stakeholder Consultations:** In total six regional workshops were conducted and the national SWOT (strengths, weaknesses, opportunities and threats) analysis was used to inform the NAMP-FW. The regional and collated national SWOT analysis are presented.
102. **On Assessment of Market Demand for Namibian Farmed Freshwater Fish:** An assessment was made based on secondary literature, household surveys and on demographics.
103. At national level around 75% of purchase transactions are conducted in cash, suggesting that there should be money in the economy to pay for fish, which is cheaper than red meat and poultry.
104. The current practice of the MFMR producing and selling fish at N\$15/kg is untenable and comprises market development and opportunities for freshwater aquaculture uptake and should be re-examined immediately.
105. The national domestic demand for Namibian-grown freshwater fish is estimated at between 1 100 to 14 000 tonnes depending on the per capita consumption of freshwater fish. Gate sales revenue from this demand is estimated at N\$ 23 to 275 million/year at N\$ 20/kg.
106. A regional demand for freshwater farmed fish exists in neighbouring countries but the capacity to compete in this market will need to be assessed carefully.
107. The MFMR should conduct a detailed field study on the domestic market using innovative approaches to understand household consumption patterns of fish by regions.
108. The GRN should develop a national strategy and regional implementation plan for increasing the per capita consumption of freshwater fish.
109. **On Human Resource Development Requirements and Needs Profile:** There is a clear shortage of appropriately trained staff at all tiers of operation and across the whole value chain, including allied sectors in Namibia. Types of skills required for aquafarms were assessed.
110. There is a disjunction between infrastructure investment and human capacity development required to operationalize freshwater aquaculture development objectives.
111. Failure to address such shortages will compromise the GRN's infrastructure investment further.
112. Conduct an in depth TNA and use to design a suitable Namibian training programme that will enable the MFMR and other local training institutions to provide appropriate training to the right people at the right place and at the right time using the right approach.
113. Collaborate with tertiary and vocational institutions in neighbouring countries to upgrade training capacity in Namibia.
114. Review all existing training curricula for the freshwater aquaculture sector and upgrade where necessary to include innovations and trends for freshwater aquaculture in Namibia.
115. **On Fish Feeds and Related Challenges in Namibia:** The MFMR together with assistance from the Spanish Government built a fish feed plant at Onavivi in 2009. The GRN should be complemented on this achievement. The plant has a capacity of 1 200 tonne/yr and can support around 600 tonnes of fish production/year.
116. The key issues with aquafeeds relate to pellet stability, consequent high dust levels and fast sinking rate of pellets.
117. MFMR should investigate if the feed plant can be upgraded to improve pellet stability and produce extruded feeds.

118. **On Potential Aquaculture Systems:** Six environment types in Namibia were considered suitable for development. These ranged from flood plains to groundwater. Additionally, a range of aquaculture production systems, from ponds in floodplains to recirculatory aquaculture systems, are suitable for Namibia.
119. Potential sites visits where such systems could be developed were identified.
120. Land in flood-prone and non-flood zones in the northern regions should be surveyed to identify suitable sites to create suitably sized dug-out ponds for freshwater aquaculture. A key consideration should be to ensure earliest possible receding of floodwaters to maximize the growing period.
121. Discuss with relevant authorities the possibility of using canals for direct stocking with fish and prawns for local communities.
122. Identify suitable reservoirs for cage culture using large juveniles (80g).
123. **On Estimates of Fish Farm Yields:** The yield under varying stocking models was assessed. Of the key factors determining fish yield in Namibia, initial size of fingerlings stocked, use of sex-reversed fingerlings, water temperature and mortality are most crucial.
124. Growth rates and therefore yields in all outdoor systems will be lower than indoor systems where water temperature can be raised. The only exception could be where large volumes of geothermal water are available.
125. Mortality significantly effects economic viability. Financial losses from fish mortalities are estimated to be over 60% from lost sales followed by 27-28% due to their feed costs and 8-12% due to fingerling costs.
126. It is imperative that MFMR immediately source annual water temperature data for the water bodies and initiate, implement and enforce simple protocols to routinely monitor water temperature in their facilities.
127. Immediately increase the size of fingerlings stocked in all on-growing rearing facilities and implement a programme for well-planned production of larger sex-reversed fingerlings, ideally *O. niloticus* and *O. andersonii*.
128. Conduct well-designed pilot trials (2/system) at predetermined sites for a selected number of on-growing systems and species described above to optimize fish farm yields for local conditions.
129. **On Assessment of Potential Candidate Species for Freshwater Aquaculture in Namibia:** Internationally acknowledged criteria, attributes and success factors were applied to identify potential farming candidates for freshwater aquaculture under Namibian conditions.
130. The tilapias had the highest aggregate score of 87 and offered the best chance for development followed by catfish (75), freshwater prawns (67), red claw (62) and carps (52).
131. The choice of tilapia species allowed for aquaculture is a matter of government decision. Currently, *O. andersonii* is farmed but other species such as *O. niloticus*, also available in Namibia, which may offer better growth performance should be seriously considered.
132. *Macrobrachium vollenhovenii* found in the Kunene region should be given high priority for development. This species offers an opportunity to develop a high value freshwater species for culture.
133. **On the Background and Potential to Culture Selected Freshwater Species:** Technical and cultural requirements for the four freshwater species identified for promotion is provided.

1 INTRODUCTION

1.1 The Context and Justification for Developing a National Aquaculture Master Plan for Freshwater Aquaculture

The Government of the Republic of Namibia (GRN) has embarked on a programme of post-independence reconstruction to address the legacy of apartheid which resulted in the country having the world's highest inequalities in the distribution of family income in the world. Consequently, such initiatives have many synergies with post-independence South Africa. The key indicator of such a legacy is amply indicated in the Gini index. Namibia has the highest (most inequitable family income distribution) of 71% followed by South Africa with the second highest in the world of 65% (CIA, 2011). This paradox should also be seen in the light of Namibia being described as a middle income country with a GDP per capita of US\$5330 in 2010 (<http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/NAMIBI/AEXTN/0,,menuPK:382319~pagePK:141132~piPK:141109~theSitePK:382293,00.htm>). Given this inheritance, the nation has initiated a series of initiatives to reverse such inequality through creating a platform for a more diverse economic base with the primary objective of increasing the economic activity, particularly in the rural areas where unemployment can exceed 50%. Freshwater aquaculture (and inland capture fisheries) is perceived as one such economic activity to address this national objective through a pro-poor programme for inland aquaculture development.

Accordingly the GRN has acknowledged the importance of aquaculture in their National Development Plans (NDP 2 and 3) and recommended that freshwater and marine aquaculture be afforded high development priority, a position also acknowledged in VISION 2030 (Namibia, Office of the President, 2004). In particular, the government anticipates freshwater aquaculture to enhance food and nutritional security, generate income and improve rural livelihoods through a pro-poor policy with production targeted primarily to ensure food and nutritional security in local communities, as well as for local, regional and international markets.

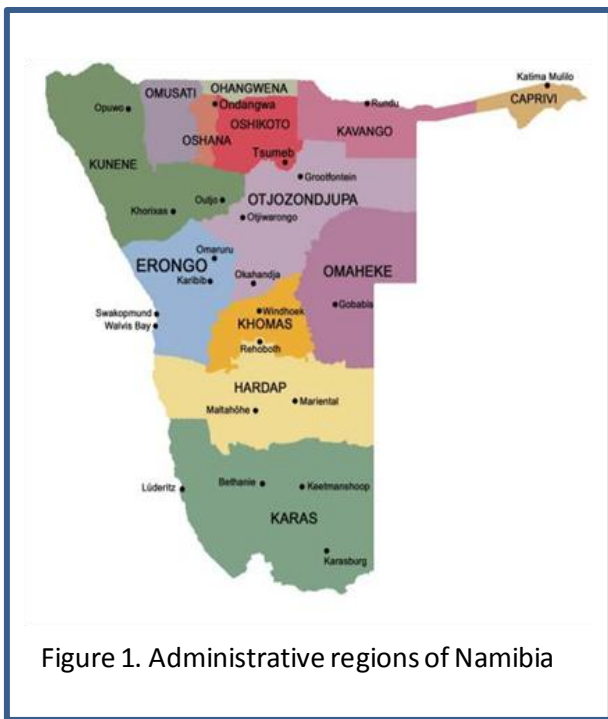


Figure 1. Administrative regions of Namibia

To realize this ambition the Ministry of Fisheries and Marine Resources (MFMR) was tasked by the National Planning Commission (NPC) in 2006 to develop a National Aquaculture Master Plan (NAMP).

Against this backdrop, the MFMR has undertaken to develop a National Aquaculture Master Plan for freshwater and marine aquaculture in Namibia.

Although a small and promising commercial mariculture sector exists in Namibia producing 525 tonnes of shellfish in 2011 worth N\$36 million, freshwater production is non-existent and therefore this Master Plan address challenges for developing, establishing and expanding a diverse freshwater aquaculture sector across the regions of Namibia (Figure 1).

The GRN will create clear and succinct objectives and take due recognition of similarities and differences between itself and other countries engaged in successful freshwater aquaculture, in particular, with reference to (i) phase of freshwater aquaculture development, (ii) socio-economic environment, (iii) climate, (iv) water and land availability and access, (v) nature and topography of the land and (vi) market dynamics.

In developing the Master Plan due cognizance will be taken of the current position of Namibia in relation to global aquaculture production, in order to contextualize the challenges the government faces in creating and ensuring a pragmatic enabling regulatory environment conducive for optimizing opportunities and which actively contributes to national food sovereignty, national wealth and job creation and to regional and world fish supply. A brief synthesis of global aquaculture trends is therefore presented below together with a brief status of aquaculture in Namibia.

1.2 Towards Development of a National Aquaculture Master Plan for Freshwater Aquaculture and Structure of the Document

The National Aquaculture Master Plan for Freshwater Aquaculture (NAMP-FW) is an outcome of situation analysis, field assessments and six iterative participatory stakeholder workshops. The issues arising from these consultations and assessments were extracted and presented here as the National Aquaculture Master Plan for Freshwater Aquaculture in Subsection 4. Detailed outcomes to support the implementation of NAMP-FW are presented in a separate supporting document (NAMP Part 2, Section 2) but are cross-referenced in this document.

To place Namibian aquaculture in context, a summary of global and regional perspectives of aquaculture development and production is presented. A situation analysis was then conducted, initially through literature review to present the freshwater aquaculture status and developments in Namibia to date. Additionally, information on potential geo-physical areas where aquaculture may be feasible was

assessed. This was followed by extensive field visits to assess (i) current private aquaculture initiatives, (ii) government aquaculture centres and community fish farms and (iii) potential sites for future aquaculture development. The above assessments were contextualized through a series of six regional stakeholder workshops representing 12 regions where freshwater aquaculture exists or is being considered. These workshops generated regional SWOT (strengths, weakness, opportunities and threats) analyses which were used to construct a national SWOT table. This SWOT analysis was principally used to formulate the NAMP-FW.

Details of the above assessments and a series of relevant supporting documents based on freshwater aquaculture in Namibia, ranging from market assessments, training needs, species identification and production system technical requirements, were generated as a synthesis for potential freshwater species to support the Master Plan implementation process. These studies, which are cross-referenced in this document, are presented in NAMP-FW Part 2, Section 2. The key conclusions and specific recommendations are included in the Executive Summary of the present document. Each of these supporting documents is concluded with a set of specific recommendations for charting the way forward.

For ease of implementation, the 14 issues and their action plans are presented in tabular form in 5.4.

2 OVERVIEW OF THE GLOBAL AQUACULTURE SECTOR

2.1 Definition and Classification of Aquaculture

Aquaculture is often not clearly defined leading to missed opportunities for preferential rates for services and confusion in legislation and regulations. Therefore, the internationally accepted Food and Agriculture Organization (FAO) definition is recommended for adoption in Namibia.

“Aquaculture is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. Aquatic organisms which are harvested by an individual or corporate body who has owned them throughout their rearing period contribute to aquaculture while aquatic organisms which are exploitable by the public as a common property resource, with or without appropriate licenses, are the harvest of fisheries.” (Rana,1997).

Furthermore, it should be noted that all economic activities are internationally agreed and harmonized by the United Nations (UN) Statistical Division under “International Standard Industrial Classification of All Economic Activities” to which Namibia is a signatory. Aquaculture is classified under Section A: Agriculture, Forestry and Fishing and not under Section B: Manufacturing (<http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27&Lg=1>). As such, aquaculture is classed as farming, rather than an industrial, activity. This harmonized classification is also used by Customs and Excise Authorities.

2.2 Global Overview: Scale, Diversity and Recent Profile of Aquaculture

While the global demand for aquatic products is increasing, wild harvest fisheries are under considerable pressure and their growth is either stagnant or declining. It is now internationally accepted that the increased supply of fish products to meet this demand will be sourced through aquaculture. Nations around the world have taken up this challenge and have developed a suite of technologies to farm a range of globally available aquatic organisms to meet their local and international demand.

Consequently, aquaculture has been the fastest growing food production sector in the world for the last two decades, outstripping livestock 3-4 fold. In 2009, global aquaculture production reached 73 million tonnes growing at an annual rate of 8-10% since 1998, while increasing its proportional contribution to total fisheries

around threefold in two decades. In 1988, aquaculture contributed only 15% of total global fisheries production and by 2009 reached 45% of total fisheries production and was worth US\$110 billion. This contribution, however, is largely an Asian phenomenon, as Asia accounted for 67 million tonnes or 91% of total world aquaculture production in 2009 worth US\$89 billion, while the Americas, Africa and Europe, contributed only 4%, 3% and 2%, respectively. The Asian and world contribution, however, is significantly skewed by China; when China is excluded, the contribution of Asian aquaculture output to total world aquaculture drops dramatically from 91% to 28% in terms of quantity and 31% in terms of value.

Although over 200 species/species clusters are farmed the majority of production stems from a relatively few species and species clusters. In Europe, salmon and trout account for 52% of production, in Asia, the carps and now tilapia account for 34% of production. The tilapias (largely *O. niloticus*), mullets and catfishes account for 75% of African production.

A significant proportion of farmed aquatic products are reared with minimum impact on the environment when compared with other food production sectors such as agriculture and livestock, whilst maximizing benefits to society. In 2008, freshwater fishes low in the food chain accounted for 46% of global production whilst the remaining 54% was of marine and brackish origin. Of this 54%, around 70% are aquatic plants and molluscs which are not dependent on artificial feed and as such, actually remove nutrients from the natural waters, thus aiding coastal de-eutrophication and ameliorating negative impacts of other anthropogenic activities.

To date the farming of exotic species contributes around 25% of world finfish and shellfish production. Rainbow trout was introduced for food or sport to at least 45 countries outside its natural range producing over half a million tonnes. Although indigenous to Africa, tilapias are now widespread in all countries of the subtropical and tropical region. In 2009 these countries produced around 3 million tonnes of relatively low-cost tilapia protein valued at \$4.7 billion, mainly for domestic consumption. Similarly, the salmonids introduced in Chile support a thriving multibillion dollar aquaculture sector that is responsible for approximately 20% of the world's farmed salmon and directly employs approximately 30 000 people. The cupped oyster, native to Japan, was introduced to around 30 countries (including the UK, France, USA, Canada, Korea, China and New Zealand) where around 3.4 million tonnes were produced in 2008.

In addition to aquaculture, introduced species such as tilapias support significant culture-based fisheries in countries such as Brazil, Mexico, Sri Lanka, Philippines, China and Indonesia providing low-cost protein and vital income for rural, in particular asset poor, communities.

National achievements in aquaculture development (as production), vary notably across the continents. This uneven historic pattern is a function of several cumulative and synergistic primary factors between enabling regulatory environments, enforcement and sector driven **voluntary codes**, and (i) tradition of fish cultivation and eating habits, (ii) favourable climate, (iii) availability and access to suitable water and land resources and sites, (iv) easily accessible markets and (v) socio-economic environment. These are discussed further in Part 2 Section 2.

2.3 Aquaculture in Africa

In spite of its vast natural and human resources, Africa's contribution to global aquaculture production is extremely low, whilst aquatic species indigenous to Africa (e.g. tilapias and catfishes) have developed into aquaculture commodities of international significance outside Africa.

The African continent contributed only 2% of global aquaculture production for 2009 and much of this production originated from Egypt (705 000 tonnes of 1.1 million tonnes). However, in line with global trends, the aquaculture sector in Africa, although small, has also experienced considerable growth, albeit from a small base. For example, during the period 1997 to 2007 aquaculture production in sub-Saharan Africa increased from 55 000 tonnes to 193 000 tonnes. Fish supply cannot currently meet the regional demand of the increasing population.

Throughout Africa, per capita consumption of fish has decreased by an average of 2.1 kg/person/year over the last two decades and marine fish imports have increased by 177% during this period. The increasing price of fish has clearly been influenced by this supply deficit which has driven the development of commercial aquaculture (FAO, 2006).

Subsistence aquaculture farming in sub-Saharan countries plays an important role in contributing towards household food and nutritional security, improved nutrition and rural employment. Cash income from aquaculture production contributes to general household costs and living expenses. Such aquaculture production, however, is unlikely to make significant contributions to fish and food supply on a national basis in an environment of accelerating urbanization. However, most countries in sub-Saharan Africa consider aquaculture to have a positive effect on sustainable and improved livelihoods, opportunities for employment and income and poverty alleviation at a family level in disadvantaged rural areas (FAO, 2006).

Aquaculture production in sub-Saharan Africa contributes less than 2% of the total fish supply. Based on 1997 levels, aquaculture production would have to increase by 267% by 2020 to maintain the current consumption level in Africa. Since wild

fisheries cannot meet the demand for fish, aquaculture will have to play a pivotal role in supplying fish to meet national and regional demand (FAO, 2006).

2.4 Recent Initiatives in Regional Aquaculture Development

Attempts by donor and other agencies to have a positive impact on African aquaculture production were evidently limited. The African Development Bank (AfDB) is a major driver for developing capture fisheries and aquaculture in the region. By 2005 it supported 21 projects to the value of around USD 383 million but with a focus on capture fisheries. Only 8 of these projects, totaling around USD 4 million, were on aquaculture. Overall the projects are reported as having limited success (<http://www.afdb.org/fileadmin/uploads/afdb/Documents/Evaluation-Reports/Review%20of%20the%20Performance%20of%20the%20Current%20Fisheries%20and%20Aquaculture%20Portfolio%20of%20the%20African%20Development%20Bank%20EN.pdf>).

Following a recent review of constraints faced in aquaculture development in the region, NEPAD (New Partnership for Africa's Development) launched "The NEPAD Action Plan for the Development of African Fisheries and Aquaculture" in 2005 (http://siteresources.worldbank.org/INTARD/Resources/ACTION_PLAN_endorsed.pdf), which reinforced known constraints and challenges for developing regional aquaculture and promotes improved productivity through expansion and intensification of aquaculture, promoting environmental sustainability, and market development and trade and ensuring food and nutritional security.

The objective of the GRN is to promote freshwater aquaculture production primarily to ensure food and nutritional security in local communities, as well as for local, regional and international markets whilst creating opportunities for income generation and improved rural livelihoods through a pro-poor policy. The GRN will draw on relevant aspects of The NEPAD Action Plan for the Development of African Fisheries and Aquaculture to meet these objectives and priorities.

2.5 Status of Freshwater Aquaculture Development in Namibia

Modern freshwater aquaculture has only been promoted, in earnest, this millennium and the first decade primarily focused on establishing the required infrastructure. Post-independence studies by aquaculture experts from a number of countries indicated that Namibia's fledgling aquaculture sector has a place in the socio-economic development of the country. Initial promotion of freshwater aquaculture by GRN was mainly to enhance food and nutritional security by facilitating the provision of fingerling production to farmers and rural communities for fish farming but this

approach is shifting towards encouraging freshwater aquafarming as a profitable economic activity.

To realize this potential the government has undertaken a series of coordinated freshwater initiatives to maximize the potential of aquaculture with a pro-poor focus. With an established stable political and business climate, the GRN in 2000 was advised by the FAO to establish an **Aquaculture Policy and legal framework** to promote **rights based** aquaculture. The principle instruments promulgated included Namibia's Aquaculture Policy (2001), The Aquaculture Act (2002) and its ensuing regulations for licenses and imports and EIA procedures and Namibia's Aquaculture Strategic Plan (2004). These and other relevant documents are reviewed in NAMP Part 2, Section 2, Subsection 3 to establish their capacity to create an enabling environment to meet the GRN's objective of creating a pro-poor aquaculture development agenda and provide recommendations on the way forward.

The GRN has demonstrated significant political will and commitment to develop the freshwater aquaculture subsector. To obtain a national perspective on the potential and scope, and direct development, the GRN commissioned a series of feasibility, marketing and value addition studies. To support technical development, the government established a series of Inland Aquaculture Centres (IACs) and farms in the Omusati, Oshana, Kavango, Otjozondjupa and Caprivi regions in the north and

fish feed plant with an annual capacity of 1 200 tonnes was established with the assistance of the Spanish Government in Omahenene. A hatchery has been recently constructed at the Inland Aquaculture Centre at Onavivi in the Omusati region to supply small-scale farmers with fingerlings. Four community based pilot fish farming projects remain, two in the Kavango and two in the Caprivi regions. Additionally, four new initiatives are in progress: the Fonteintjie Fish Farming Project in Keetmanshoop, Karas Region; Leonardville Fish Farm, Omaheke Region; Noordoewer Fish Farm, Karas Region; and Divundu Fish Farm, Kavango Region. Between 2003 and 2009 the GRN invested N\$126 million in freshwater aquaculture development. The first decade of this millennium therefore focused on ensuring key infrastructure was in place and laying the firm foundation for consolidation and future expansion. During this initial phase aquaculture production was therefore low, with estimates of around only 50-100 tonnes/year, from the above interventions.



The Master Plan for freshwater aquaculture will therefore consolidate these notable gains from the initial phase and focus on the second phase of development, namely the identification of constraints and interventions required to mobilize required resources and actions for building on and accelerating and diversifying production of freshwater fish whilst stimulating rural economy through addressing rural employment and food and nutritional security.



3 SITUATION ANALYSIS

3.1 Landscape and Natural Resources for Freshwater Aquaculture Production

Although Namibia is classed as semi arid to arid, parts of the country are endowed with water suitable for inland aquaculture; indeed many regions in the north has abundant water with areas that are prone to annual flooding. Namibia's Aquaculture Strategic Plan (MFLR, 2004) suggests that excellent freshwater culture development potential exists along rivers such as the Okavango, Kunene, Orange and Zambezi. Sources of water available for aquaculture include flood plains, rain, rivers, water canals, reservoirs and groundwater which can be geothermal and freshwater or brackish.

The nature, scope and potential geographic locations for freshwater aquaculture development in Namibia, however, will be determined primarily by the landscape and climate, in particular, availability, type of and access to water as well as ambient water temperature. Ambient water temperature is a major factor which would dictate which species can be targeted for freshwater aquaculture and farming yields. In Namibia, most of the inland areas suitable for freshwater aquaculture lie at an elevation above 1000 m. At elevation the water temperature will be lower and, in particular, the diurnal water temperature range larger. Therefore seasonal calendars require careful management to optimize production. Nevertheless, Namibia has a significant North-South fault line which yields geothermal groundwater, which can be readily utilized, for inland aquaculture production if in sufficient quantities.

Namibia has 16 national reservoirs viz. Bondels, Daan Viljoen, Dreihuk, Friedenau, Hardap, Naute, Oanab, Olushandja, Omdel, Omatako, Omatjenne, Otjivero main, Otjivero silt, Von Bach, Swakoppoort and Tilda Viljoen which can be explored for cage culture. A key challenge in farming using cages, however, will be the suboptimal water temperature for warmwater species such as tilapias and catfish and therefore the shorter growing season will need to be carefully managed to successfully farm fish.

Surface water is also available. The northern and southern border regions are endowed with abundant freshwater and are characterised by the only perennial



rivers in the country. Additionally, floodwaters in areas within the northern regions can be harvested and, with careful site selection, used for aquaculture. The varying possibilities of inland aquaculture in geographic regions of Namibia are expanded in NAMP Part 2, Section 2, Subsection 4.

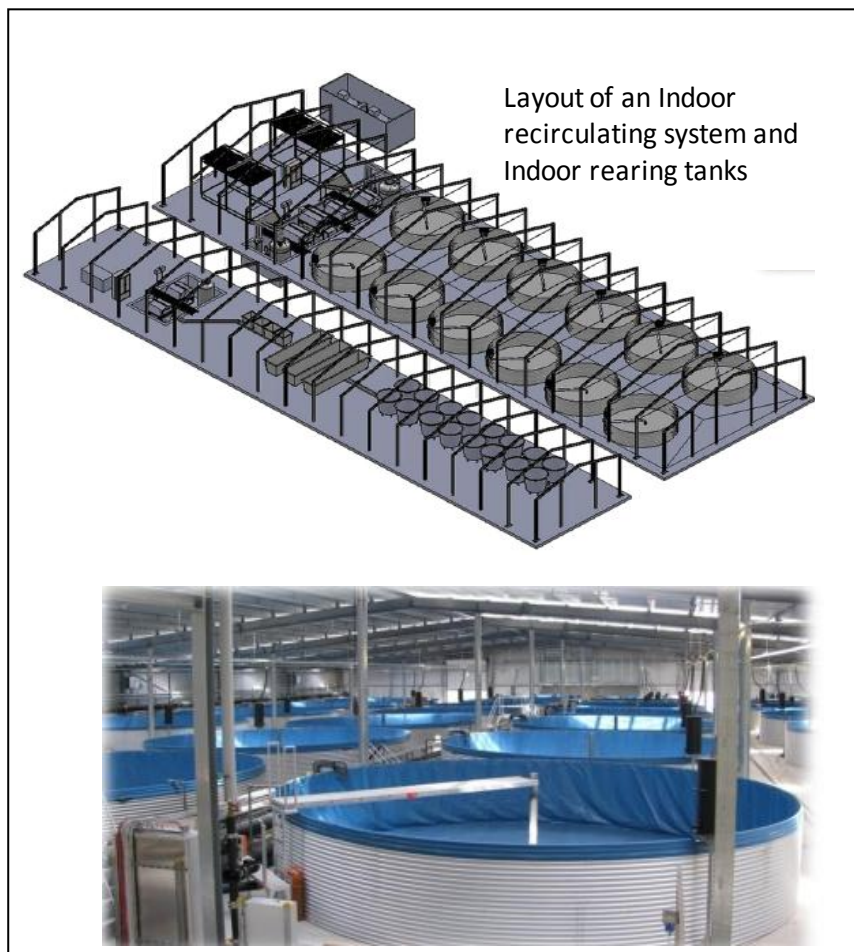
3.2 Key Environmental Types and Production Systems

The opportunities for freshwater aquaculture is not uniform across the country and therefore the scope will be dictated by purpose and scale of culture, management, candidate species, technologies adopted and economic viability. The available water sources in Namibia could be used for four major types of freshwater aquaculture culture systems.

- i. **Still water culture system:** This is usually practised in stagnant water in ponds but tanks are also used. The organism mostly involved in culture is fish, and in Africa, tilapia and catfish. The northern regions of Kavango, Caprivi, Ohangwena, Oshikoto, Oshana and Omusati experience annual floods during the rainy season. These waters can be harvested and used for aqua-agrifarming and provide a relatively low-cost option for farming.
- ii. **Running water or flow-through culture system:** This is usually practised in tanks and raceways made of various materials such as wood, fibreglass, plastic and cement, with fish as the main organism cultured. If abundant water is available earthen ponds are also used. Such systems can be applied in any regions where water is abundant but the scale of operation will depend on the quantity of water available, its temperature and power. However, some potential aquaculture sites assessed where the source of water is springs, with water flow under 'reasonable' pressure and firm surroundings for above-ground structures, showed that they lend themselves to running water systems.
- iii. **Water recycling or recirculating aquaculture systems (RAS):** In this system the flowing water, used for culture is recycled and 'reconditioned' (i.e. filtered of dirt, biologically cleaned and re-oxygenated). Non-earthen structures such as tanks and raceways made of various materials such as wood, fibreglass, plastic and cement are used. These systems, however, are capital intensive and require high working capital and competent management and workforce.

At present RASs are not used commercially in Namibia but are appropriate where water is not abundant and water temperature needs to be raised and controlled. In parts of Namibia, especially in the north and north-west, including areas surrounding Opuwo, Fransfontein, Sesfontein, Warmquelle, and Grootfontein and in the south of the country, in locations such as

Stampriet and Keetmanshoop, water available for aquaculture is groundwater which may be limited but adequate for small flow-through or recirculating aquaculture systems.



- iv. **Cage culture system:** Fish are widely reared in cages or hapas. Cage culture may also be considered as a kind of flow-through system because water in the fish rearing cage units is always being exchanged with water from outside the cage. Cages, of varying sizes, are typically sited in reservoirs and large ponds.

The potential options for inland aquaculture in the different regions of Namibia are given in Table 1 and detailed in Part 2, Section 2, Subsection 14.

Table 1. Opportunities for different types of inland aquaculture across the regions of Namibia based on environment types and system

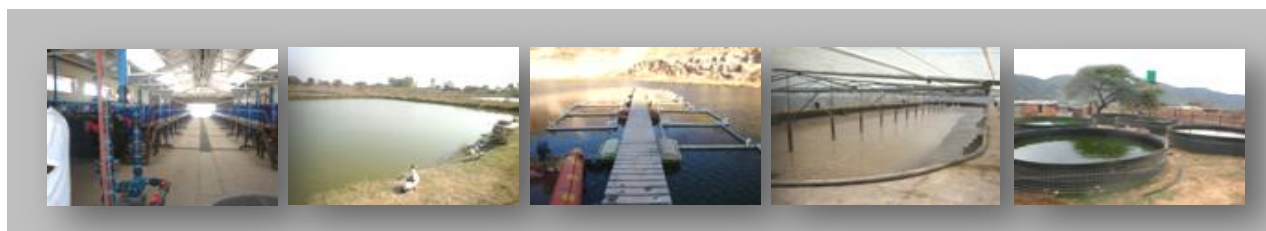
Environment type	Flood plains ^{1,2}		Irrigation canals and rivers		Reservoirs/ mine pits	Groundwater - natural springs/aquifers and boreholes ³		
	Rainwater harvest ponds/ still water	Flowing water	Still ² water	Cage	Ponds/ tanks/ still water ²	RAS ⁴	Flowing water	
Region								
Caprivi	X	X	X			X	X	
Erongo							X	
Hardap		X	X	X		X	X	
Karas		X	X	X		X	X	X
Khomas						X	X	
Kunene				X		X	X	X
Ohangwena	X	X	X			X	X	
Kavango	X	X	X				X	
Omaheke							X	
Omusati	X	X	X	X			X	
Oshana	X	X	X			X	X	
Oshikoto	X	X	X			X	X	
Otjozondjupa		X	X	X		X	X	

¹ Careful site selection to locate elevated areas to optimize growing season.

² Water exchanged on a regular basis based on management. Sites in other regions likely if explored.

³ Details of sites can be found in *Groundwater in Namibia* (Christelis and Struckmeier, 2001).

⁴ Recirculating aquaculture systems (RAS) possible in all regions subject to water availability and viability.



3.3 Species Available for Culture

Three species currently dominate freshwater culture initiatives in Namibia; the tilapias, *Oreochromis andersonii* and *O. mossambicus*, and catfish, *Clarias gariepinus*, are currently produced, mainly at government-run hatcheries at Onavivi



Three spot tilapia, *Oreochromis andersonii* widely reared in the northern regions



African Catfish, *Clarias gariepinus* produced at Onavivi



Rainbow trout, *Oncorhynchus mykiss*



O. niloticus and hybrids currently farmed at Hardap



African river prawn, *Macrobrachium vollenhoveni*, identified for development



Red claw, *Cherax quadricarinatus*, identified for development

Inland Aquaculture Centre in the Omusati region for small-scale farmers, government fish farms and restocking. These species are well adapted to local conditions especially the low winter temperatures.

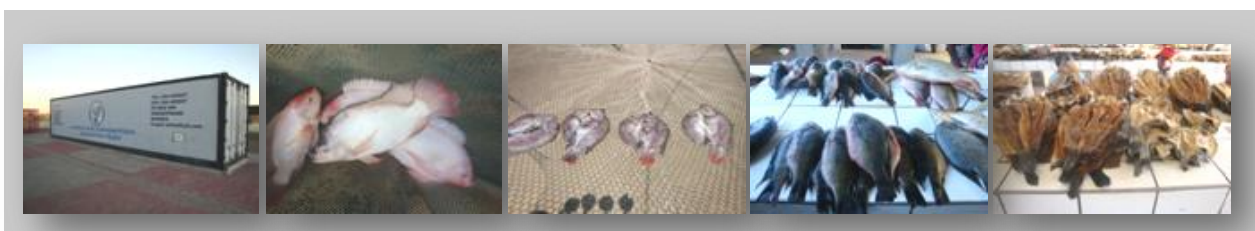
Additionally, *O. mossambicus* and *O. niloticus* and their hybrids are reared in the south at Hardap IAC for on-growing by small-scale farmers, and stocking local reservoirs. At present, widespread use of exotics such as *O. mossambicus* and *O. niloticus* across Namibia is prohibited but is currently under review, especially since species such as *O. niloticus* are now farmed in bordering countries such as Angola, Zambia and Zimbabwe and known to exist in South Africa. At higher altitude, provided water temperatures do not exceed 20 °C, rainbow trout could be farmed in cages using 150 g fingerlings.

To diversify freshwater aquaculture, two species new to Namibian aquaculture have been identified for development, the freshwater prawn from the Kunene region, *Macrobrachium vollehovenii*, and red claw, *Cherax quadricarinatus*, offer the opportunity to farm higher value freshwater species.

3.4 Trade and Market Demand for Namibian Farmed Freshwater Fish

Although the general international market for freshwater fish is highly competitive, significant market opportunities exist in the African region and in the domestic market.

Namibians are principally and traditionally red meat eaters and currently fish does not have a high priority in households and consequently current fish consumption in Namibia is low. Nevertheless, FAO estimates per capita consumption in Namibia at 10 kg/capita/year. There are three major consumer segments in the Namibian market place based on purchasing power: (i) a large group of low- and no-income consumers, both in the cities and rural areas; (ii) a relatively small high-income group of Europeans and Namibians; and (iii) tourist and recreational trade i.e. restaurants, hotels and resorts. Local variations do, however, exist and rural communities, especially in the northern regions along the perennial river systems, are traditional fish eaters creating a high demand for freshwater fish in these regions. These regions account for over 60% of the Namibian population, thus creating a significant market. The current gate price of freshwater fish ranges between N\$15-25/kg and the Fish Promotion Trust, established by the MFMR, is actively engaged in promoting fish consumption and raising awareness of the benefits of fresh fish. If 75% of the 10 kg/capita/yr originates from freshwater fish farming a demand for 14 000 tonnes of freshwater fish will be created, worth up to N\$275 million/year.



Assuming a more conservative estimate of just 5 kg fish/capita per year of which 50% originates from freshwater fish farming, production of 4 000 tonnes of freshwater fish needing 6 000 tonnes of feed (at FCR of 1.5) will be required. Keeping operations small, at 100 tonnes/farm units distributed regionally based on potential local consumption, 40 farms could be created nationwide with the gate value of N\$92 million at N\$20/kg. This could potentially create 560 direct jobs nationally and around 200 jobs related to local construction and maintenance of facilities. Assuming an 80% spend, the wages of staff will generate further trade within the local, mainly rural, economy to the value of N\$9 million annually.

Further details on market analysis, demographics, purchasing power, regional distribution of farm units and proposed systems, are given in Part 2, Section 2, Subsection 10.

3.5 Financial Services and Incentives

There are two main Namibian financial institutions supporting investment in aquaculture for Namibian citizens: the Agricultural Bank of Namibia (ABN) and the Development Bank of Namibia (DBN). Finance can be secured for new start-up facilities, expansion of facilities and marketing. Three main types of loans can be obtained; short (1-3 years), medium (3-5 years) and long (5-10 years) term.

In order to apply for a loan the applicant should be a Namibian citizen and meet the basic requirements as set by MFMR as well as the bank. These requirements may vary between the banks but include detailed feasibility, environmental impact study, business plan, secured access to required water and land, commercially viable species, appropriately trained and competent staff and access to existing markets. Specific details and loan types, exclusions and conditions can be gleaned from the banks' web sites; for the ABN: <http://www.agribank.com.na/> and DBN: <http://www.dbn.com.na/>.

These institutions, however, operate in the formal business sector and the process for tapping these resources is complex and often beyond the reach of small-scale producers. Consequently, access to finance for small-scale producers is limited and collateral requirements disadvantage these GRN target groups. In acknowledgement, the MFMR in collaboration with ABN, have developed guidelines for evaluating and financing aquaculture businesses in Namibia. These guidelines will go some way in helping applicants increase the probability of acquiring finance at a subsidised annual interest rate of 5%. In addition, a Memorandum of Understanding on financing aquaculture ventures with limited or no co-lateral was signed between MFMR and ABN in March 2010 to disburse N\$32 million over four years.

4 DEVELOPING THE NATIONAL AQUACULTURE MASTER PLAN FOR FRESHWATER AQUACULTURE

4.1 Key Challenges and Constraints

To realize the potential of freshwater aquaculture secondary literature was reviewed and a strategic assessment of the national SWOT analysis was undertaken and collated from six stakeholder workshops in geographical locations representing all Namibian regions except Omaheke. The outcomes of the national SWOT analysis were used to inform the development of the Master Plan and are presented in Table 2 below and expanded in Part 2, Section 2, Subsection 9.

Table 2. National SWOT analysis for freshwater aquaculture development

Strengths	
1.	Strong political will to promote freshwater aquaculture
2.	Grants and soft loans from financial institutions with no collateral
3.	Availability of water, including surface and groundwater
4.	Presence of South-South Cooperation (SSC) partner development and support personnel
5.	Availability and willingness of communities to participate
6.	Infrastructure (roads, electrical power and communication)
7.	Availability of government-sponsored seed and feed
8.	Government support in provision of fish seed and feed at subsidized prices
9.	Availability of local and regional markets
10.	Support from Namibian Fish Promotion Trust for market development
Weaknesses or Constraints/Challenges	
1.	<i>Non-conducive regulatory environment</i>
2.	Non-uniform distribution of water for aquaculture across Namibia
3.	<i>Suboptimal water temperatures and growing season, and cold winters</i>
4.	<i>Limited management skills in freshwater aquaculture</i>
5.	Limited access to finance/investment, especially for smaller players
6.	Generally low human capacities, in number and quality, in educational and government institutions
7.	Communication barriers with SSC partners
8.	<i>Limited technical capacity and hands-on practical experience in freshwater aquaculture</i>
9.	Inadequate on-farm infrastructure and limited monitoring capabilities on government-sponsored fish farms
10.	Limited information on freshwater aquaculture

11. Limited choice of species/strains for freshwater farming
12. Uncertain seed quality and use of small and mixed-sex fingerlings for on-growing
13. Predation by birds
14. Limited governance
15. Limited capacity of extension and support services
16. Lack of an aquaculture success story as wealth creator
Opportunities
1. Growing local and regional markets
2. Increased water productivity through integration with agriculture
3. Enhancement of food and nutritional security and general poverty reduction
4. Capacity building opportunities in various vocations
5. Government support for increasing fish eating habit in regions
6. Jobs and wealth creation and creating career opportunities
7. Decentralization of seed production
8. Capacity building
Threats
1. Status quo on current disabling regulations
2. Climate change impacts and variability
3. Floods and droughts
4. Limited skilled labour
5. Limited technical capacity for proposed systems
6. Theft and poaching
7. Maintenance of current cooperative model
8. Rising cost of inputs
9. Poor serviceability of sophisticated production systems
10. Government bureaucracy
11. Current abundance of capture fisheries which can be cheaper than cultured products
12. Biosecurity

The challenges, as weaknesses and opportunities and threats considered critical for development are highlighted in italics in Table 2 and prioritized for action in the Master Plan and in specific recommendations in relevant sections in Part 2, Section 2.

Further, the conduciveness and prognosis of Namibian macro economy for freshwater aquaculture development using PEST (political, economic, social, and technological) analysis is good. The countries democratically elected government is stable. The population is highly literate and the country has well-developed infrastructure, with good transport, logistics and communication networks. The government provides good financial and tax incentives to attract inward investment. This together with free trading zone within SADC creates an attractive combination to penetrate regional markets.

4.2 Guiding Principles

The development of the freshwater aquaculture subsector is a priority of the GRN. The government is committed to creating appropriate and timely platforms for access to and optimal utilization of available resources and existing infrastructure to facilitate new economic activity to create opportunities for job and wealth creation to reduce poverty, especially for rural communities, whilst ensuring food and nutritional security, skills transfer and increased fish production. The government will create a climate in which freshwater aquaculture will have the opportunity to flourish and acknowledges that:

- freshwater aquaculture development in Namibia is in its infancy and therefore requires appropriate and special attention to kick-start the sector and accelerate production;
- freshwater aquaculture can make a meaningful contribution to food and nutritional security and rural economic development;
- aquaculture will be recognized as a **farming activity** and its meaning harmonized across all documents and should benefit equally from all government support and incentives;
- freshwater aquaculture is a legitimate user of land and water resources, consequently, the sector deserves equitable **access** to these resources;
- freshwater aquaculture can be effectively integrated with crop and livestock farming to enhance natural resource productivity and will be promoted, where relevant;
- government investment in appropriate **needs-driven** aquaculture research and development, technology transfer, extension, education and training programmes are prerequisites for accelerating freshwater aquaculture sector development;
- an appropriately skilled and trained workforce is essential for freshwater aquaculture development;

- species with proven technologies that provide benefit in the short to medium term will be prioritized and actioned;
- the government has a responsibility to facilitate a diversity of entrants from subsistence to small and large-scale producers;
- the private sector should bear the main responsibility for export orientated aquaculture development in collaboration with government in line with government policies to promote products;
- the international aquatic market is highly competitive and Namibia will focus initially on national and regional markets;
- development of a sustainable and competitive aquaculture sector should incorporate appropriate but pragmatic economic, environmental and societal principals;
- aquaculture products must be safe and competitively priced for consumers; and
- freshwater aquaculture production will stimulate secondary industries, including feed manufacturing, fish processing, supplies and equipment, and other agricultural trades.

4.3 Essential Critical Success Factors

The development of a sustainable freshwater aquaculture sector requires several critical factors to be in place and these are addressed in the NAMP-FW. The GRN will focus growth in those areas of freshwater aquaculture that will yield results in the short to medium term and support development of targeted aquaculture species which can kick-start and expand the sector in the next 5-10 years.

To maximize the probability of success the government will:

- Take due cognisance of limited capacity within MFMR and outsource leadership of the implementation of the freshwater aquaculture plan
- be instrumental in developing a pragmatic and measured regulatory framework within a supportive operational environment which is appropriate to the developmental needs of Namibia,
- ensure effective coordination among government departments and its agencies to optimize efficiency, development and delivery of collaborative programmes;
- identify and invest in and drive priority aquaculture research, development and technology transfer programmes that can deliver in the short (3-5 years) to medium term (5-10 years);

- pilot innovations and systems to accelerate uptake of freshwater aquaculture;
- upgrade selected facilities into demonstration centres;
- create fiscal incentives and expand access to investment and operating capital as well as key inputs such as fingerlings, feeds and equipment;
- develop and coordinate the implementation of human capacity building programmes including extension, education, training and public awareness programmes;
- coordinate development of effective stakeholder partnerships such as community-government, industry-government, industry-institute and government-institute;
- coordinate effective national and regional promotional, marketing and trade efforts; and
- develop timely and effective biosecurity programmes and good management guidelines.

5 THE NATIONAL FRESHWATER AQUACULTURE MASTER ACTION PLAN

5.1 Vision

Freshwater aquaculture sector **meaningfully** contributing to poverty alleviation and food and nutritional security through transformation, job creation and economic and rural development.

5.2 Mission

Creating a diverse freshwater sector for maximizing socio-economic opportunities and benefits for all its people.

5.3 Goal

The principal goal of the Master Plan is to ensure that by 2023, freshwater aquaculture production reaches 4 000 tonnes. This can be best achieved by securing resources and investment to initiate, facilitate and coordinate interventions that will create an enabling regulatory and operational environment to **kick-start** and **accelerate** freshwater aquaculture production in order to fulfill all stakeholder expectations. The Master Plan aims to:

- i) Establish a flexible and **pragmatic approach** to respond to current shortcomings for aquaculture uptake within one year.
- ii) Identify, develop and **promote transferable technology** in the short-medium term to enable producers to diversify and be profitable within 5 years.
- iii) Prioritize **employment and wealth creation** opportunities through creating social and private capital and investment.
- iv) Ensure **transformation** and increase social cohesion with emphasis on women and youth where appropriate.
- v) **Accelerate production** to enhance **food** and nutritional **security** and **food sovereignty**.

5.4 Issues, Strategy and Action Plan

The NAMP-FW raises 14 issues and associated strategic elements and action plan. For each issue the salient plan of action is prioritized from 1-3, with 1 being the top priority. Priority 1 level plans should be actioned within 1-3 years, priority 2 level plans within 3-5 years and priority 3 level plans within 5-10 years.

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
1	<p>Policy:</p> <p><i>The current Aquaculture Policy (2001) places emphasis on the marine sector and perhaps some undue environmental protection while missing some opportunity to develop aspects of freshwater aquaculture with a pro-poor focus.</i></p>	a. Recognize and prioritize freshwater aquaculture as a legitimate user of required natural resources	i. Utilise the Aquaculture Council (AC) to redress balance between marine and freshwater aquaculture within current instruments. Such a council should co-opt external members with in-depth expertise in aquaculture issues at stake. The policy as well as other instruments such as NASP should be revised to support the implementation of the Fresh Water Master Plan	1	3 4 6 8 10 16
			ii. Revisit and amend the aquaculture policy to raise importance of freshwater fishes and reduce unjustified emphasis on environment based on Namibian conditions: It should <i>inter alia</i> : <ul style="list-style-type: none"> • Develop a harmonized definition for aquaculture as a farming activity in policy and integrate into relevant governing principle Acts and Regulations • Be a key driver to promote and facilitate freshwater aquaculture uptake • Balance policy strategies to address bottlenecks in freshwater aquaculture uptake • Rebalance and promote use of exotic species to be comparable with mariculture • Reflect real biodiversity risks, if any, following good due diligence • Facilitate greater collaboration between the marine and 	1	

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
			freshwater aquaculture subsectors		
			iii. Establish/ engage with provincial structures to ensure the implementation of the Master Plan	2	
		b. Supply quality seed for on-growing in the short to medium term and shift to maintain and supply mainly quality broodstock in the long term	i. Identify and prioritize aquaculture candidates with established mass production technologies for seed and table-size fish	1	
			ii. Select, upgrade and maintain state-owned hatcheries strategically located to supply quality seed and farmer support services.	1	
			iii. Identify and prioritize species for development and management of quality broodstock to include provisions for live gene banks for prioritized species	1	
			iv. Supply quality broodstock to the freshwater aquaculture subsector	2	
			v. Provide support to farmers and entrepreneurs as seed providers to decentralize and privatize seed supply	2	
			vi. Facilitate the establishment of networks and associations of aquaculture operators between hatcheries in order that they may learn from each other, share experiences and develop procedures that can be based on continuous improvement	3	
		c. Recognize aquaculture as the	i. Identify suitable sites, encourage and provide incentives to rural communities to create water harvesting structures which can also be used for integrated fish farming in green projects	1	

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
		lowest consumptive water user for food production whilst increasing water productivity and water harvesting	ii. Investigate and promote aquaculture activities in irrigation water bodies and reservoirs as a means of increasing water productivity and fish production, whilst acknowledging any limitations	1-2	
		d. Promote better management practices in aquaculture	i. Initiate training programmes and initiatives for extension officers and farmers that will improve on-farm management practices and productivity	1	
			ii. Facilitate the development of better water resource management practice	1-2	
		e. Produce and regularly update strategy and plans to ensure that sector development is on track with agreed objectives	i. Conduct and collate biannual reports on projects and programmes to inform biennial reviews	1-3	
			ii. Conduct periodic reviews of the Action Plan to ensure on-target delivery	1-3	
2	Legislation and Regulatory Framework (LRF): <i>For Namibian conditions, the current LRF does not create an adequate enabling environment for</i>	a. Undertake a review of legislations and any ensuing regulations to identify and amend, where appropriate, constraints to diversify while	i. Undertake an audit of existing legislation and regulations to identify constraints to the development of freshwater aquaculture and to act on recommendations	1	3 8 18
			ii. Amend, remove and/or develop new regulations aimed at creating an enabling environment for the uptake of freshwater aquaculture as an alternative economic activity	1	
			iii. Revise as required the use of exotic species and develop	1	

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
	<p><i>advancing the government's objective of promoting pro-poor uptake and stimulating freshwater aquaculture.</i></p>	<p>promoting sustainable freshwater aquaculture development</p>	<p>pragmatic guidelines for the utilization of non-indigenous and exotic species to diversify and increase freshwater aquaculture</p>		
<p>iv. Streamline authorization procedures to a maximum of 90 days for freshwater aquaculture activities in keeping with scale of aquaculture production</p>			<p>1</p>		
<p>v. Revise EIA regulation to create threshold trigger of 250 tonnes for an EIA requirement</p>			<p>1</p>		
<p>vi. Raise awareness among all stakeholders of regulations and guidelines relevant to freshwater aquaculture development and related activities</p>			<p>1-3</p>		
<p>vii. Encourage self-regulation mechanisms through an incentive scheme for implementation of pragmatic good management practice (GMP)</p>			<p>2</p>		
<p>b. Ensure that other activities external to aquaculture do not compromise resources required by aquaculture</p>		<p>i. Work with other line ministries on cross cutting issues such as water to ensure water and land resources are made available for freshwater aquaculture and conflicts resolved between inland capture fisheries and freshwater aquaculture</p>	<p>1-2</p>		
<p>c. Promote voluntary codes of practice and self regulation using iterative and</p>		<p>i. Raise awareness among all stakeholders of regulations and guidelines relevant to aquaculture development and related activities</p>	<p>2</p>		

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
		participatory approaches involving public and private stakeholders	ii. Encourage self-regulation mechanisms through an incentive scheme for implementation of pragmatic GMP	1	
		d. Ensure commercial feed manufacturers, processors and hatcheries operate according to agreed standards to ensure quality feed and seed supply	i. Develop better management standards for manufacturing feed processors and hatchery operators	3	
			ii. Develop and implement a programme to certify feed manufacturing premises and processing factories and set standards for dust levels in feeds	2-3	
3	Financial Services and Incentives: <i>Access to finance for strategic research and financial services for small scale producers are limited and collateral requirements disadvantages governments target groups.</i>	a. Ensure sustainable financial assistance to develop freshwater aquaculture and for small-scale operators and developments	i. Revise existing financial assistance programmes to include freshwater aquaculture and create new financial assistance programmes to support the following: <ul style="list-style-type: none"> • Appropriate low-cost aquaculture production technologies for well-established species • Innovation, appropriate research and development • Job creation • Investment promotion • Capacity building and training • GMPs • BEE • Diversification of rural economic activities 	1	6 8 11 12

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
		b. Create a dedicated socio-economic funding programme (social capital) for aquaculture prioritizing actions for short to medium-term goals	i. Regularly hold seminars, study tours, distribute printed materials and arrange public viewing of video productions to focus on economic benefits of aquaculture and include aquaculture in national agriculture and other road shows	1-2	
			ii. Support local communities to encourage aquaculture as an element of household and community economic development planning	2	
		c. Facilitate increased access to private sector capital by putting in place a regulatory and policy framework that is more conducive to attracting private sector investment	i. Package incentives to attract and promote investments into the aquaculture sector e.g. tax holidays and duty exemptions	1	
			ii. Ensure aquaculture is included into agricultural programmes for fiscal incentives	1	
			iii. Develop realistic incentive schemes for subsidies/low interest for infrastructure establishment costs and on loan repayments	1-2	
4	Access to Land and Water: <i>Water is scarce and competition for water and land resources is high. Government intervention is required to develop an inventory and ensure access.</i>	a. Increase and secure access to available public and private land and water bodies to utilize for freshwater aquaculture purposes	i. Establish a task team with suitable technical expertise from relevant government departments to detail available land and water resources, especially geothermal groundwater sources for freshwater aquaculture	1	3 4 8 9 14
			ii. Identify and work with affected communities to secure access to appropriate land and water <ul style="list-style-type: none"> • Regional Councils/municipalities to identify and avail land to potential communities and investors • Liaise with Department of Water Affairs to secure 	1	

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
			<p style="text-align: center;">access to suitable public water bodies</p> <p>iii. Conduct an audit and compile an inventory of available water bodies, including reservoirs that can be converted/used for aquaculture purposes</p> <p>iv. Ensure that development for spatial planning and provincial government planning, including municipal planning schemes, includes freshwater aquaculture</p> <p>v. Conduct flood control and mitigation studies in flood-prone zones in collaboration with cross cutting ministries</p>	<p style="text-align: center;">1</p> <p style="text-align: center;">2</p> <p style="text-align: center;">2-3</p>	
5	<p>Access to Feed:</p> <p><i>Given the volumes, the private sector is unlikely to produce aquafeeds in the short to medium term. The government will be expected to take a lead role in securing and improving aquafeeds and given distances consider decentralization of feed production and distribution as production increases</i></p>	a. Specifically support R&D to develop cost-effective aquaculture feed to reduce aquaculture production costs especially for small to medium-scale producers	<p>i. Evaluate government fish feed plant on ways to improve ingredient quality and pellet type and stability</p> <p>ii. Explore feasibility to produce extruded feeds at a later date</p> <p>iii. Develop R&D programmes for alternative competitive feed ingredients in collaboration with education institutions</p> <p>iv. Develop guidelines on better practice in feed production, distribution and storage</p> <p>v. Create incentives for SMMEs and small farmers for infrastructure development for on-farm feed production</p>	<p style="text-align: center;">1</p> <p style="text-align: center;">1</p> <p style="text-align: center;">1</p> <p style="text-align: center;">2</p> <p style="text-align: center;">2</p>	<p style="text-align: center;">8</p> <p style="text-align: center;">13</p> <p style="text-align: center;">15</p> <p style="text-align: center;">17</p>

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
6	<p>Access to Seed:</p> <p><i>The choice of species for farming is limited. The government should consider using their hatcheries to make accessible seed to increase and diversify opportunities for freshwater aquaculture. Government should gradually shift to that of broodstock development and supply.</i></p>	a. Ensure and maintain high quality broodstock through broodstock management programmes	i. Identify potential species and strains for culture in different regions and areas	1	7 11 12 15 16 17 18
ii. Prioritize species for aquaculture with established technologies for mass production			1		
iii. Source species and strains of high quality disease free broodstock and develop a live gene bank of priority species			1-2		
iv. Ensure and maintain high quality broodstock through appropriate broodstock management programmes			1-2		
b. Ensure the establishment of infrastructure in hatcheries and seed production for species with established technologies to meet short to medium-term objectives		i. Upgrade state hatcheries and use as demonstration sites in consultation with provincial and municipal authorities	2		
		ii. Develop seed production training programmes for practitioners and interested parties	2		
c. Set up seed distribution centres and distribution channels		i. Compile and disseminate information on good hatchery management practices and procedures including broodstock management and biosecurity measures	2		
		ii. Consider decentralizing seed production regionally	1		
		iii. Provide technical and financial support to potential farmers in	1-2		

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
			<p>particular women and entrepreneurs to enter into fish nursery operations</p> <p>iv. Link private nursery operators to state/provincial government-owned hatcheries to supply certified broodstock for genetic quality, technical advice and guidance, and where possible to make buy-back arrangements</p>	2-3	
7	<p>Research and Technology Development:</p> <p><i>Government has made significant investments in infrastructure for R&D in freshwater aquaculture. The government should consolidate and focus resources on <u>needs driven research for freshwater aquaculture targeting increasing and diversifying production.</u></i></p>	<p>a. Establish, coordinate and budget national short to medium-term applied freshwater aquaculture research agenda developed by the Freshwater Aquaculture Council</p>	<p>i. Initiate and design targeted short to medium-term applied freshwater aquaculture research programmes with special emphasis on addressing pre-identified constraints and achieving the following:</p> <ul style="list-style-type: none"> • Innovative marketing research initiatives to establish local, national and regional needs • Promote appropriate and achievable freshwater aquaculture research with emphasis on achieving short to medium-term objectives • Build on available technologies worldwide and adapt to local conditions to avoid reinventing the wheel • Improved production efficiency and reduce production costs for species with well-established technologies • Develop appropriate lower cost production systems with widest socio-economic impacts • Development of good management practices • Promote aquafeed formulation and production options to ensure availability and reduce production costs • Broodstock development and management, reproduction and early life history for species with known technology to generate momentum • Aquatic animal health management, including disease 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>2</p> <p>1</p> <p>2</p>	<p>11</p> <p>12</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p>

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
			<p>diagnosis and prevention. Research should be conducted into possible disease outbreaks to enable the sector to have qualified people to identify, handle and if necessary refer such occurrences to the Competent Authority</p> <ul style="list-style-type: none"> • Improve on-farm environment management • Improve post-harvest value addition, quality and food safety 	<p>3</p> <p>2</p> <p>2</p>	
		<p>b. P</p> <p>c. Promote research programmes that will (i) support diversification of the sector, (ii) develop appropriate and effective farming systems, (iii) cater</p>	<p>i. Conduct an in-depth technical audit of R&D facilities to ensure staff are capacitated to deliver on objectives</p> <p>ii. Strengthen and capacitate the Directorate with a clear R&D strategy</p> <p>iii. Establish exchange programme with aquaculture centres in the region and elsewhere (e.g. Nigeria, Malawi, Egypt, South Africa, Thailand and China)</p>	<p>1</p> <p>1</p> <p>2</p>	

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
		for domestic and regional markets and (iv) address sector competitiveness	iv. Ensure and promote uptake and adoption of research outcomes (technology solutions) in aquaculture sector v. Design and implement targeted research that supports diversification of the sector based on good probability of success with special emphasis on: <ul style="list-style-type: none"> • investigating and facilitating provincial research and development fund • directing and brokering collaborative market-driven research and development to solve sustainable sector development issues • establishing a market-driven aquaculture R&D programme in partnership with government education institutions and the private sector in order to develop, establish and transfer technology and skills 	2 2 2 2	
			vi. Support the generation of required scientific information to fulfill government's national and legal international obligations whilst making a clear distinction between voluntary codes and protocols	2	
8	Te Technology Transfer and Demonstrations: <i>Given its infancy in Namibia, human capacity in aquaculture knowledge and technology is limited. The government should consider an awareness</i>	a. Develop a timely strategy for dissemination of technology and innovation	i. Develop a dedicated technology transfer and demonstration programme for hatcheries and on-growing that will support emerging and small-scale entrepreneurs ii. Create and enable partnerships between research institutions and private sector to ensure technology (skills, know how and capabilities) transfer iii. Undertake a skills audit or training needs assessment every 4-5 years for the freshwater aquaculture sector to implement	2 2 1	7 11 12 15 16

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
	<i>agenda and develop and disseminate appropriate technologies to promote uptake of aquaculture. The designs of current systems are inadequate with minimal functionality for purpose.</i>		appropriate action		
			iv. Establish public awareness and schools programmes for promoting aquaculture	2	
		b. Develop and implement demand-led aquaculture services programmes	i. Undertake a nationwide Training Needs Assessment and upgrade aquaculture extension training programmes	2	
			ii. Establish a bursary programme dedicated for aquaculture training	1-2	
			iii. Establish an aquaculture internship programme in partnership with the industry, research and academic institutions in order to produce well and appropriately trained personnel for extension services	2	
			iv. Develop appropriate and accredited aquaculture training programmes within universities and colleges	1-2	
		c. Develop effective transparent dissemination of aquaculture technology and practices	i. Ensure that in government funded programmes all knowledge is made accessible to the public	2-3	
			ii. Use upgraded and functional community farms as demonstration centres	1	
9	Training, Education and Extension Services:	a. Training and capacity building for the aquaculture	i. Undertake an audit of education institutions at 5 year intervals for appropriate action	1	11 12 15

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
	<i>As aquaculture is a new activity in Namibia, relevant knowledge is not currently integrated into training programmes at all tiers of education.</i>	sector	ii. Conduct a training needs assessment and upgrade the aquaculture extension training programme within MFMR and DOA (Department of Agriculture)	1	
iii. Establish public awareness and schools programmes for promoting aquaculture			2		
iv. Develop and implement accredited training programmes in partnership with training institutions to encourage progressive learning outcomes			3		
v. Familiarize government officials involved in decision making with issues related to aquaculture			1		
vi. Allocate funds to train researchers on identified priority research issues			1		
b. Support prospective and current private sector members in obtaining and upgrading the necessary accredited practical skills			i. Develop aquaculture technology manuals and training material and make them available in different media and distribution channels	2	
		ii. Work with the private sector and other stakeholders to identify and support education and training programmes that include practical, on the job training, including maintenance of relevant aquaculture and harvesting equipment	2		
		iii. Prepare and publish a directory of education and training agencies involved in capacity building in aquaculture in the region	3		
10	Aquatic Organisms	a. Develop a national	i. Conduct a needs analysis in aquatic organism health and	2	11

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2	
	Health Management: <i>Whilst it is acknowledged that freshwater aquaculture activities are currently limited, national measures should be put in place at the appropriate time to manage fish health. Currently, production does not warrant such interventions for freshwater aquaculture.</i>	strategy for aquatic organism health management at a suitable time	pathogen management		12 15	
ii.			Develop and maintain an on-farm pathogen early warning system and a management and response protocol and monitoring programme to support reporting to the OIE	2		
iii.			Identify and train staff in aquatic organism health diagnostics to overcome the shortage of adequate health expertise	1-2		
b.		Educate farmers and farm workers on holistic aquatic organism health management	i.	Train farmers on implementation of simple biosecurity measures and good husbandry practices	1	
			ii.	Develop and disseminate simple tools for routine fish health checks to be performed at pond side	2	
11	Product Quality and Safety: <i>As production volumes increase to meet urban and especially regional markets, product quality and safety will dictate sustainability of farms and will then need attention. Currently focus should be centred on food and personal hygiene</i>	a. Enhance relevant interdepartmental cooperation to ensure product safety	i.	For export of freshwater products ensure standards are aligned with relevant international export standards	2	15 17 18
ii.			Develop and deliver programmes to educate consumers and retailers about the safety, quality and handling of aquaculture products	2		
iii.			Upgrade and develop government services for practical and cost-effective technologies to detect, assay and reduce toxins, contaminants and residues in aquaculture products	2		
iv.			Develop and disseminate quality and safety standards and guidelines for aquaculture products	2		
v.			Compile a list of approved drugs, chemicals, vaccines and	2		

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
			anaesthetics for use in production for export products		
		b. Develop, maintain and promote product quality, safety and traceability standards, where required	i. Ensure standards are aligned with relevant international export standards	2	
			ii. Collaborate with the industry to develop, maintain and promote product quality and safety and a traceability system to meet export standards throughout the freshwater aquaculture production value chain	2	
			iii. Conduct training programmes for farmers on product quality, safety and traceability system	2	
			iv. Develop and disseminate HACCP (hazard analysis and critical control points) training manuals and posters for aquaculture practice	2	
		c. Ensure registration and availability of safe and effective therapeutants for use in aquaculture, especially for exports	i. Publish lists of permitted therapeutants in aquaculture industry as well as educate farmers on the importance of withdrawal periods with the use of therapeutants	3	
			ii. Improve cooperation with the private sector undertaking analytical services pertaining to product quality and safety of aquaculture products	2	
12	Marketing and Trade: <i>Currently Namibia should focus to meet domestic consumption and</i>	a. Development of new and existing local and regional markets for aquaculture products	i. Specifically conduct detailed market studies, including a survey and evaluation of local informal and formal markets with a focus on volume and prices	1	10 15 18
			ii. Develop production plans for prioritized freshwater aquaculture products	1	

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
	<i>promote consumption, whilst considering the regional markets as volumes increase.</i>		iii. Develop a local marketing network for collecting and transporting products to urban markets	1	
		iv. Focus on strengthening regional trade in view of the competitive nature of Western markets	1-2		
b.		i. Consolidate and expand the role of the Fish Promotion Trust	1		
Develop a plan to increase domestic consumption of freshwater aquaculture products		ii. Promote the consumption of fresh fish and utilization of local aquaculture products and services and develop and implement market awareness campaigns, especially promoting nutritional benefits of fresh freshwater fish to increase per capita fish consumption	1		
		iii. Diversify aquaculture products through innovative processing technologies and new product development recognizing the informal sector	1-2		
c.		i. Develop and maintain an industry trade database and intelligence information to inform investor decisions	3		
Facilitate access to trade information					
d.		i. Facilitate access to finance, particularly for SMMEs	1		
Develop and expand the aquaculture production value chain		ii. Develop and maintain an industry trade database and intelligence information to inform investor decisions	2		
		iii. Develop an incentive package to attract investment into the freshwater subsector	1		
	iv. Improve marketing education for producers, processors and consumers related to characteristics and handling of aquaculture products	2			

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
			v. Enable access to information on aquaculture products wholesale and retail prices and feed ingredient prices from main domestic and international markets to aquaculture farmers, processors and feed manufacturers.	2	
13	Transformation: <i>Entry into aquaculture can be cost prohibitive and is demographically non representative. Government initiatives should encourage a wider participation in aquaculture.</i>	a. Prioritize creating a platform for lower risk capital infrastructure, appropriate technology and appropriate species packages for uptake	i. Identify and organize committed disenfranchised and disadvantaged groups across the country and individuals for retraining and orientation to take up aquaculture for food and ornamental purposes as an economic activity, ensuring ownership ii. Develop a plan to promote and broaden participation of youth, women and people with disabilities through segmentation of the aquaculture value chain iii. Consolidate and maintain the low interest loan scheme for developing and funding appropriate technologies iv. Identify and train trade persons to construct and maintain lower cost production systems	1 2 1 1	7 10 11 12 14 16
14	Information Management And Dissemination: <i>The current level and structure of monitoring does not serve to monitor progress.</i>	a. Develop monitoring and evaluation capabilities within the subsector	i. Initiate a biennial bench-mark survey on the socio-economics and impact of inland aquaculture and capture fisheries in Namibia ii. Improve coordination and efficiency of data-collection efforts among government departments, agencies and private sector	1-2 2	All sub-sections

No.	Issue and its situation	Strategic element	Action plan and way forward	Proposed priority level	Sub-section reference in Section 2
			iii. Develop reliable and relevant monitoring mechanism and evaluate the expansion of the aquaculture sector in order to influence policy directives and services for aquaculture producers	1-3	

6 IMPLEMENTATION FRAMEWORK OF THE NATIONAL AQUACULTURE MASTER PLAN FOR FRESHWATER AQUACULTURE

- This Master Plan presents a working road map for addressing complex and multifaceted issues impeding the development and growth of the freshwater aquaculture sector and to put in place measures to kick-start, consolidate and expand freshwater aquaculture in Namibia.
- External leadership for implementation and supervision of the freshwater aquaculture plan should be in place.
- The operationalization of Master Plan will be driven by MFMR and coordinated by the FAC in collaboration with relevant line ministries mandated on cross-cutting issues and in consultation with relevant external expertise to guide the process.
- The FAC will be tasked with formulating a realistic and cohesive **time-bound** Activity Plan which will be put out for public comment.
- An externally facilitated workshop will be conducted to review and endorse the Master Plan and the Activity plan and used to prioritize time framed bound activities.
- The Master Plan and finalized activities will be disseminated within government with particular reference to specific government departments at national, provincial and municipal level that are mandated to manage local resources and development, and regulate the aquaculture sector.
- The government shall establish the necessary administrative and technical capacity and partnerships, secure required funding for implementation and put in place effective communication to review and update of the Master Plan.
- Freshwater aquaculture will be benchmarked and the Master Plan and its implementation will be reviewed on a biennial basis to ensure that the subsector development is on track.

7 CONCLUSION

Aquaculture is targeted by the GRN to contribute to the delivery of economic mobility through a pro-poor programme for inland aquaculture development. The National Freshwater Aquaculture Master Plan charts a road map for government and all related stakeholders to kick-start aquaculture to meet this objective. The principal goal of the Master Plan is to ensure that by 2023, freshwater aquaculture production reaches 4 000 tonnes

The government seeks to use this opportunity to ensure job and wealth creation, especially for its rural communities whilst ensuring food and nutritional security. The roadmap is based on four main interrelated corner stones: (i) fostering Inter-governmental governance aimed at establishing a pragmatic enabling regulatory and operational environment to promote uptake, (ii) securing required financial, natural and human, capital to facilitate development, (iii) Creating the technological and educational platform to implement development actions in an collaborative environment and (iv) Promoting freshwater aquaculture products.

The MFMR, being the mandated lead agency for aquaculture development has since 2001 developed an aquaculture policy and created a LRF and ensuing regulations for sustainable sector development. The policy will be revisited to ensure a clear freshwater development agenda and pro-poor focus. Whilst aspects of LRF are enabling there is undue environmental protection while missing some opportunity to develop aspects of freshwater aquaculture. The LRF requires re-evaluation to ensure parity with other food production sectors and to it creates an enabling environment for advancing the government's objectives of promoting pro-poor uptake and stimulating freshwater aquaculture e.g. EIA threshold to fast track uptake by small producers

In its first phase of development the GRN has invested heavily this millennium in required capital infrastructure (N\$126 million). The second phase will focus on consolidating gains and accelerating development. Greater access to finance for strategic needs driven research and financial services for small scale producers will be required and preferential interest rates and low or no collateral schemes are advocated to support governments target groups. Water is scarce commodity and competition for water and land resources is high. Government intervention, both national and local, is required to develop an inventory of water sources, especially geothermal ground water and ensure speedy access. Input recourses such as freshwater fish seed and aquafeeds are equally important. The country has a limited range of freshwater candidates for farming and the

Government will seriously and urgently consider introducing and developing high quality seed of new species, ideally with established farming technologies to rapidly diversify and expand freshwater aquaculture. The country is fortunate to have a government owned fish feed plant. Given its fledgling status and present low volume demands the private sector is unlikely to enter this market. The government will therefore take a lead role in securing and improving aquafeeds. The goal of 4000 tonnes of fish will require 6000 tonnes of feed. Therefore the government will need to ensure a phased increase in production capacity in keeping with fish production

To add value to the significant investments in infrastructure for R&D the government will consolidate and focus resources on **needs driven research** targeting increasing and diversifying production. The GRN will focus on Innovative marketing research, developing and piloting lower cost production systems, developing on-farm environment management and post-harvest value addition, quality and food safety. The government is committed to facilitate the development of required human resources and will upgrade educational establishment and put in place an appropriate training programme for the effective dissemination of technologies and farming skills.

Progress in fresh water aquaculture will have to be monitored and the government will put in place monitoring measures following a benchmark survey to track progress. The government has demonstrated significant political goodwill to date to develop freshwater aquaculture and firmly believes that the outlook for freshwater aquaculture in Namibia is promising and invites all stakeholders to collaborate and partake in its vision.

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