

SCOPING STUDY ON THE DEVELOPMENT AND SUSTAINABLE UTILISATION OF INLAND FISHERIES IN SOUTH AFRICA

Volume 1: Research Report

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Scoping Study on the Development and Sustainable Utilisation of Inland Fisheries in South Africa

Volume 1:
Research Report

Report to the
WATER RESEARCH COMMISSION
by

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EXECUTIVE SUMMARY

South Africa's inland fishery resource endowment has been overlooked as a means of supporting sustainable livelihoods in the democratic era, lacking a guiding policy and legislation aligned with the country's rights-based Constitution. The absence of an equitable inland fishing governance framework with defined use rights has resulted in growing unmanaged and unsustainable fishing practices, conflicts between resource users, and the perpetuation of Colonial- and Apartheid-era exclusion of rural communities from livelihood and economic opportunities linked to aquatic natural resources. In response to this problem, the Water Research Commission launched a solicited research project entitled "*Baseline And Scoping Study On The Development And Sustainable Utilisation Of Storage Dams For Inland Fisheries And Their Contribution To Rural Livelihoods*" to provide a knowledge base to inform the development of policy and institutional arrangements for inland fishery governance.

The project was executed by a trans-disciplinary team of researchers with fisheries and social science backgrounds from Rhodes University's Department of Ichthyology and Fisheries Science; the University of the Western Cape's Institute for Poverty, Land and Agrarian Studies (PLAAS), and the South African Institute for Aquatic Biodiversity (SAIAB).

The research approach consisted of a combination of literature reviews, community based surveys, fishery productivity modelling, and stakeholder consultations. The available literature on South African inland fisheries was reviewed, access rights arrangements and legislation analysed with recommendations for reform, and the production potential of South African impoundments estimated using morpho-edaphic models. A research survey was conducted among selected fishing communities to evaluate the role of indigenous and local knowledge in inland fishery utilisation, and to characterise the role of inland fisheries in rural livelihoods.

A series of consultations and workshops was conducted with rural fishing communities, mandated government department representatives, and recreational angling bodies. The results of the reviews and surveys were discussed with government departments to determine options for institutional and organisational arrangements. The organised recreational angling sector was presented with the project findings, and their views on inland fishery governance solicited.

The institutional and organisational requirements for inland fisheries governance were then analysed based on the project research results, South African development and environmental policies, and internationally accepted fishery "good governance" norms. Recommendations for institutional and organisational arrangements were presented to the relevant government departments and feedback incorporated into the research reports.

Review of the History and Status of Inland Fisheries

A review of the history and status of inland fisheries describes the evolution of inland fishery development and policy (Chapter 2).

South Africa's inland fisheries policy dates back to the Colonial era when comprehensive institutional support was provided, including the country's first fisheries legislation and state hatcheries, in order to stock alien fish species for recreational fishing purposes. During the Apartheid era, attempts to promote fisheries for commercial and livelihood purposes were made during the dam-building era of the 1960's and 1970's, and as part of the "homelands" development policy. Most attempts proved non-viable due to the low prices of fresh water fish and problematic conception of 'development' projects in the former 'homelands'. In the post-1994 democratic era, inland fishery resource management has largely been framed by the biodiversity conservation mandate of the provincial environmental management agencies, with little attention to the social and economic aspects. The lack of a policy on inland fisheries as a source of livelihoods is identified as a problem underlying tensions between growing small-scale subsistence/artisanal fishers and the recreational fishing sector.

Profiles of the small-scale fishing, recreational and commercial/artisanal fishing sub-sectors are provided,

including available estimates of their participation rate and economic value. The productivity of inland waters is deemed too low to support large-scale commercial fisheries. Most formal commercial fisheries attempted on inland waters in recent years have proved non-viable due to the low yields and the low prices for freshwater fish. Inland fisheries are thus characterised by widespread recreational fishing use and growing informal small-scale fishing for livelihood purposes.

The literature review revealed an urgent need for research, covering the biological, social, economic and governance aspects, if inland fisheries are to be developed in a rational and sustainable manner which promotes South Africa's national policy goals.

Inland Fishery Governance

A comprehensive review of property rights, legislation, regulation, management and governance systems revealed that South African inland fisheries governance institutions are fragmented and incomplete (Chapter 3).

In contrast with South Africa's marine fisheries, which are governed by the Marine Living Resources Act, inland fisheries lack supporting legislation that is constitutionally aligned. The National Environmental Management Act (NEMA) provides for sustainable development and equity through natural resource access, but a policy on inland fisheries governance flowing from these principles is lacking. This is problematic, as fishing on inland waters is primarily governed as a recreational activity based on biodiversity considerations, while fishing rights for livelihood purposes are not provided for in existing legislation and policy. This is despite constitutional recognition of customary practices and the need for equity of access to natural resources. The management mandate for inland fishery resources is currently delegated to the provincial environmental and nature conservation authorities, while the Department of Water Affairs and various authorities regulate activities on dams. The only specific legislative provisions governing the use of inland fish resources are rudimentary fishing "effort control" rules prescribed in the provincial environmental acts and ordinances, which have their origin in pre-democratic era policies. While small-scale fishers from local communities are generally regarded as having a legitimate claim to fish, in the absence of a supporting rights-based governance framework, their activities are usually illegal, unmanaged and often unsustainable. This has led to growing conflicts between water users on a number of impoundments. A significant institutional change was the designation of the inland fisheries mandate to the Department of Agriculture, Forestry and Fisheries (DAFF) which announced in 2012 that it would create an inland fisheries policy and programme.

The equitable and sustainable use of South Africa's inland fish resources thus requires fundamental reform of the very rudimentary existing inland fishery governance arrangements. The governance reform process should be led by the Department of Agriculture, Forestry and Fisheries (DAFF), due to its primary resource sector development mandate which now includes inland fisheries.

Case Studies on the Role of Small-Scale Fisheries in Rural Communities

Very little published information is available on the scale and livelihood contribution of small-scale fishing in rural communities, as it is largely an informal activity with no established system for stakeholder representation or data gathering. Case studies of a selection of fishing communities were therefore undertaken to assess the role of indigenous knowledge in inland fisheries and to characterise current small-scale fishery use (Chapter 4 and Volume 2¹).

Small-scale fishing for livelihood purposes was present on 77% of water bodies surveyed.

Small-scale fishing on most water bodies was not rooted in indigenous fishing traditions, however, but was found to be an adaptive livelihood strategy to modern socio-economic circumstances. Most small-scale fishers were poor, but the role of fishing in their livelihood strategies was diverse, ranging from a part-time

¹ TAPELA B, BRITZ PJ, and ROUHANI Q (2015) Scoping study on the development and sustainable utilisation of inland fisheries in South Africa. Volume 2. Case Studies of Small-Scale Inland Fisheries. A report to the Water Research Commission. WRC Report No TT 615/2/14.

subsistence activity to a full-time artisanal occupation. Value chains for freshwater fish were short, with no little evidence of value adding. The fish were generally sold fresh informally, or consumed by the family. In certain localities, a significant daily income could be generated to cover family living costs.

Indigenous knowledge relating to customary fishing culture, gear, and common pool resource governance was present in some communities such as the Thembi-Thonga and Makuleke people, but was adapted to modern circumstances. Rural community members also practised recreational fishing, but fish caught was usually consumed.

Unresolved or growing user conflicts were present on certain water bodies, arising from a lack of recognition of customary common pool rights, and the lack of capacity of communities to participate meaningfully in existing governance institutions. Community narratives around inland fishery use often reflected unrestituted legacies of dispossession and marginalisation from customary resource access arising from Apartheid and Colonial era dam building, forced removals and land dispossession. Formal statutory and customary or informal resource governance systems existed side by side on many water bodies with varying degrees of cooperation. While small-scale fishing was often tolerated by the authorities, and in some instances actively supported, small scale fishers remained vulnerable to prosecution, and their activities were often marginalized by other resource users and stakeholders. Artisanal gill netting by outsiders with vehicles and boats was seen by local communities as inequitable and unsustainable. Gill netting by local community members was tolerated on most water bodies, although some concerns were expressed about the sustainability of the method.

Recreational Fishing

A review of the recreational angling sector revealed that it has a substantial participation rate (estimated to be of the order of 1.5 million participants) and a significant economic impact associated with the tourism sector and angling services and supply value chains (Chapter 6). Recreational angling was recorded on 69% of dams surveyed during the study. It is therefore important that recreational anglers are recognised as important stakeholders in South African inland fisheries and that their interests are recognised in future fisheries development initiatives. The recreational angling disciplines are diverse, including bank angling for carp, yellowfish and catfish, artificial lure angling for bass and other species, flyfishing for trout, boat angling and informal recreational/subsistence angling. Angling is organised as a sporting code, affiliated to the South African Sports Confederation and Olympic Committee (SASCOC), under the Sport Anglers and Casting Confederation (SASACC). Recreational angling is a popular activity on state dams and is supported by the Department of Water Affairs (DWA) policy of promoting recreational activities on state dams. The management of recreational fishing activity on state dams was in the process of being formalised by the DWA, through the compilation of Resource Management Plans for major state dams. Despite its economic impact and ability to create rural livelihoods and decent jobs, recreational angling is not recognised or represented as a fishery sub-sector by the DAFF. Recreational anglers were concerned about sustainability issues, growing gill net fishing, and conflicts with small-scale fishers. The organised sports angling community was in the process of approaching the DAFF to obtain recognition of a proposed fisheries sub-sector association representative of all anglers, both informal and organised, in order to develop appropriate management and governance arrangements, and to realise the economic potential of the industry.

The Production Potential of Inland Fisheries

The fishery production potential of inland waters was estimated, and the possibility of enhancing production by means of stocking hatchery-reared seed evaluated (Chapter 7). A GIS model was developed to identify regions of high fisheries potential, using the relationships between climate, geography and fish yield to predict areas. A production potential of 15,000 tons was estimated for large South African impoundments. (By comparison, South Africa's marine fishery yields some 600,000 tons annually). The relatively low production potential of South African inland water bodies thus precludes the development of industrial or large-scale commercial fisheries on inland waters. Recreational and small-scale subsistence and artisanal fishing for livelihoods purposes are thus the optimal forms of inland fishery utilisation for maximal socio-economic benefit.

State Hatcheries

The role of state hatcheries was re-evaluated in terms of supporting inland fisheries and aquaculture development (Chapter 7).

A century of state-supported non-native fish stocking has left a mixed legacy of environmental impacts and socio-economic benefits. A number of non-native species, including carps, basses, trouts, tilapias and catfish were irreversibly established within aquatic ecosystems, and freshwater recreational angling developed into an economically significant activity with a significant participation rate. The state hatcheries were also instrumental in the promotion of small-scale and commercial fisheries and aquaculture, which yielded mixed results. The termination of state-sponsored fish stocking in the mid-1980's left a vacuum in terms of how best to manage inland fish populations for optimal socio-economic benefit.

The stocking of fish from state and private hatcheries, both indigenous and non-native, for fishery purposes was thus re-evaluated based on socio-economic goals, within the framework of South Africa's environmental and biodiversity legislation. A GIS model was used to develop guidelines for stocking fish from hatcheries in terms of the production potential of target waters, the National Environmental Management: Biodiversity Act's Draft Alien and Invasive Species Regulations (NEMBA-AIS), and environmental productivity and socio-economic considerations. From a fisheries management perspective, state and private hatcheries could enhance fishery production in specific circumstances such as 1) the re-stocking of temporary waters that dry up during periods of drought, 2) the stocking of trout in approved "green zoned" waters in terms of the NEMBA-AIS regulations and 3) for indigenous fish conservation purposes. It was recommended that there would be no point in stocking hatchery reared fish if 1) the target wild populations are self sustaining with adequate recruitment from natural spawning or 2) the target fishery or aquaculture enterprise is not economically viable or offers no food security or welfare benefit. A wider multi-purpose role for state hatcheries is recommended to support fishery and aquaculture development, including extension, training, environmental education, and research.

Stakeholder Consultations

The consultation process is particularly important where there is a lack of a guiding policy and established governance institutions, and little information about current resource use patterns – as is the case for South African inland fisheries. The formulation of recommendations for institutional and organisational arrangements for inland fishery governance was thus designed around a series of workshops and consultations with public sector representatives, small-scale fishing communities, the recreational fishing sector and other civil society stakeholders (Chapter 8). Two workshops with government departments on inland fisheries were held under the auspices of DAFF in 2102 to discuss the project findings and make inputs into recommended institutional and organisational arrangements, including the role of state hatcheries. Recommended actions flowing from the government stakeholder workshops were:

- DAFF will act as the lead agent for inland fisheries governance and develop an inland fisheries policy.
- Legislation for inland fisheries is required for DAFF to implement its mandate. DAFF should conduct a legal review on how to address this need.
- Based on the stakeholder consultation process, recommendations were made on the roles of national and provincial departments (agriculture, environmental and water affairs) in inland fisheries.
- Inland fisheries should be managed based on the principle of co-management with inland fishery user groups.
- State hatcheries could serve as multi-use facilities for promoting inland fishery development and aquaculture projects.
- The provincial agriculture mandate in respect of inland fisheries support needs clarification. DAFF would visit the provinces to elevate aquaculture and fisheries on HOD agendas, and include inland fisheries on the mandate of the Provincial Aquaculture Inter-governmental Forum.
- The DWA would move towards developing a framework for managing fisheries activities on dams through incorporation into Resource Management Plans. It would identify strategic areas culminating in a document to guide fishery access to dams.

As small-scale fishing activities by rural communities on inland waters are poorly documented, and fishing rights for customary or livelihood purposes are not formalised in law, consultations with a representative sample of small-scale fishing communities were undertaken to inform the process of developing fishery governance recommendations. The consultations confirmed that small-scale fishing in these communities is an important livelihood option that needs to be recognised and supported in an inland fishing policy. The extensive testimonies of fishers being crowded out of fishery resources as a result of their lack of capacity to participate in governance institutions, and to know and assert their common pool resource access rights, highlighted the need for a human rights based development approach to small scale fisheries.

Consultations with the organised angling organisations revealed that recreational angling has a massive participation rate and generates a large, but unquantified, socio-economic benefit. Appropriate policies to promote rural livelihood development linked to the recreational angling value chain could promote decent jobs and food security in rural areas. Recreational fishing representatives were concerned that their sector was not recognised as a fishery that generates a societal benefit, and that growing and unsustainable small-scale fishing, particularly gill-netting, threatened their activity on many waters. Policy was thus required to clearly define inland fishery user rights and establish sustainable resource management institutions. The concerns of trout anglers on the NEMBA regulations highlighted the need to manage the socio-economic aspects of the sub-sector along with the biodiversity aspects. The consultations facilitated by the WRC project team opened a channel of communication between angling bodies, DAFF and DEA, paving the way to establish representative stakeholder associations which could make input into the development of acceptable fishery management arrangements.

Institutional Arrangements and Organisational Structures

Recommendations for institutional arrangements and organisational structures for the governance of inland fisheries were compiled based on the project research findings and stakeholder consultations (Chapter 9). The recommendations were informed by South Africa's rights based constitution and environmental legislation, Government organisational mandates, the nature of the inland fishery resources, and the cultural, social, and economic characteristics of the fishery stakeholder groups.

As fisheries are a primary resource-based industry, the Department of Agriculture, Forestry and Fisheries (DAFF) is the mandated lead agency for the development and management of fisheries. In terms of national policy, the DAFF has a developmental role to maximise the equitable socio-economic utilisation of natural resources, particularly by rural communities. Interventions for governing inland fisheries thus need to be based on a developmental approach and move away from the customary resource conservation-orientated management approach. As inland fisheries are individual user-based, small-scale, and geographically heterogeneous, a devolved, cooperative governance approach based on "co-management" is most appropriate. The DAFF Marine Small-scale Fisheries Policy provides useful guidance on the elements that should be considered in formulating co-management arrangements, both for the recreational and small-scale fishery sub-sectors. It was envisaged that the provincial departments of agriculture would play a key role in a developmental approach to promoting rural livelihoods based on small scale fishing, which is analogous to small scale farming.

A legal review by DAFF is required to determine the best legislative arrangements for inland fisheries. Inland fisheries could be provided for as part of a single "Fisheries Act" covering both marine and inland waters, or under a separate Inland Fisheries Act. In the interim, inland fisheries will continue to be governed in terms of the NEMA, and associated provincial environmental acts and ordinances. Recommendations on the roles of the DWA, DEA, Department of Transport, provincial environmental departments and traditional authorities were proposed.

The lack of public sector human capacity and skills to manage inland fisheries was identified as a primary constraint to the establishment of appropriate institutional and organisational structures to promote a developmental approach to inland fisheries based on co-management. The reasons for this are two-fold, arising from, firstly, the lack of a policy to manage inland fisheries as an economic sub-sector and livelihood

activity, and secondly, modern fishery governance norms which have shifted dramatically over the last decade from a biological resource orientation to a user-centred one requiring new management skill sets. Human resource capacity building and skills requirements for government officials were assessed and training strategies and resources identified.

Policy and Governance Recommendations

The conclusions and recommendations of the WRC Inland Fisheries project are:

- 1. DAFF is the lead agent for inland fisheries.** The DAFF should promote cooperative governance arrangements with other departments and public sector agencies with mandates relevant to inland fisheries governance.
- 2. Policy and legislation.** Policy and legislation to implement the DAFF inland fishery mandate should be developed, and be aligned with DAFF policies such as the Growth and Development Plan 2011-2030, Zero Hunger, and Marine Small-scale Fisheries Policy.
- 3. Non-industrial fishery.** Inland fisheries are non-industrial and the sector is made up of mainly recreational, subsistence and small-scale commercial fishing activity. This user profile will shape management and governance approaches.
- 4. Developmental Approach.** Due to the context of rural poverty, inland fishery governance requires development interventions to address issues of equity and capacity in order for communities to realise livelihood opportunities based on inland fisheries.
- 5. Equity and Rural livelihoods.** Legal recognition of the use of inland fisheries for socio-economic benefit and the support of rural livelihoods is required. Inland fishery policy must take into account the historical inequity in access to inland fisheries and promote development interventions that empower disadvantaged rural communities.
- 6. Co-management.** Each dam is unique in terms of land and water rights, economic opportunities, production potential, and stakeholder composition, and so specific local management arrangements are required. Cooperative governance arrangements and institutions for co-management are thus essential to inland fishery development and management.
- 7. Precautionary approach.** A constraint to promoting inland fisheries on most South African water bodies is the lack of knowledge about the productivity and sustainability of the resource, and the potential impact on indigenous species biodiversity. To promote sustainable fishing, a precautionary approach to resource exploitation should be adopted in cases where information about the resource status and productivity is limited. Research surveys and stock assessments will be required in order to address resource information gaps and develop fishery management plans for sustainable fishing which meets the desired social and economic objectives.
- 8. Training needs.** Government managers require training in inland fishery management and should be provided with a “toolbox” of management resources and skills to address the situation on specific water bodies.
- 9. Value chain approach.** Inland fishery policy needs to be based on a value chain approach in order to maximize the socio-economic benefits. The recreational fishing value chain linked to the tourism service sector is the most economically valuable component of inland fisheries. Subsistence fishing plays a vital food security role in certain rural communities. While the commercial fishing potential of fresh waters is limited, growing illegal fishing on a commercial scale has the potential to marginalise community and recreational fishers from value chain benefits. Public sector interventions that enhance the value of fish to local communities should thus be promoted; for example, equity of access to fishery resources for rural communities and capacity building to participate in all levels of the associated value chains.

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ACRONYMS AND ABBREVIATIONS

ACWR	African Centre for Water Research
AIS	Alien and Invasive Species Regulations
CBO	Community Based Organisation
CD NGI	Chief Directorate National Geo-Spatial Information
CLR	Communal Land Rights
CMA's	Catchment Management Agencies
CPR	Communal Property Rights
CSOs	Civil society organisations
DAFF	Department of Agriculture, Forestry and Fisheries
DDA	Department of Development Aid
DDG	Deputy Director General
DEA	Department of Environmental Affairs
DEAET	Free State Department of Economic Affairs, Environment and Tourism
DG	Director General
DoT	Department of Transport
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
EAF	Ecosystem Approach to Fisheries
EKZN	Ezhemvhelo KwaZulu-Natal Wildlife
EPLTBAA	Eastern Cape Light Tackle Boat Angling Association
FAO	Food and Agriculture Organisation
FIPS-ed	International Freshwater Sport Fishing Federation
FIPS-Mouche	International Fly Sport Fishing Federation
GDP	Gross Domestic Product
GIS	Geographic Information System
IDPs	Integrated Development Plans
IG&DP	Integrated Growth and Development Plan
IUCN	International Union for the Conservation of Nature
FOSAF	The Federation of Southern African Flyfishers
LED	Local Economic Development
MEI	Morpho-edaphic Index
NEMA	National Environmental Management Act

NEMBA	National Environmental Biodiversity Act
NEMLA	National Environmental Management Laws Amendment Act
NEPAD	New Partnership for African Development
NFEPA	National Freshwater Ecosystem Priority Area
NGO	Non-Government Organisation
NWA	National Water Act
NWRI	National Water Resources Infrastructure
NWRS	National Water Resource Strategy
PFMA	Public Finance Management Act
PLAAS	Institute for Poverty, Land and Agrarian Studies
RMPs	Resource Management Plans
SAALAA	South African Artificial Lure Angling Association
SABAA	South African Bass Angling Association
SACRAA	South African Consolidated Recreational Angling Association
SADC	Southern African Development Community
SADSAA	South Africa Deep Sea Angling Association
SAFALFA	South African Federation of Artificial Lure and Fly Anglers
SAFBAF	South African Freshwater Bank Angling Federation
SAFFA	South African Fly Fishing Association
SAIAB	South African Institute for Aquatic Biodiversity
SASACC	South African Sports Angling and Casting Confederation
SASCOC	South African Sports Confederation and Olympic Committee
TAG	Trout Action Group
TLGF	Traditional Leadership and Governance Framework Amendment
TURF	Territorial Use Rights in Fishing
UN	United Nations
VCFP	Venterstad Community Fisheries Project
WfGD	Water for Growth and Development
WFW DWAF	Working for Water, Department of Water Affairs and Forestry)
WPALAS	Western Province Artificial Lure Angling Society
WRC	Water Research Commission
WTA	Wild Trout Association
WUA	Water Users Association
ZAR	South African Rand

1. INTRODUCTION AND OBJECTIVES

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1.1 A Perspective on Inland Fisheries Globally and in South Africa.

Globally, the inland fishery sub-sector is dominated by small-scale fisheries², which are increasingly recognised as significant contributors to food security, poverty reduction and income generation (Béné *et al.*, 2010; Béné *et al.*, 2007; Heck *et al.*, 2007; FAO, 2003). It is estimated that small-scale fisheries employ over 95% of all men and women engaged in fisheries worldwide, and that of these more than 90% are to be found in developing countries (FAO, 2009). Small-scale fisheries contribute about two thirds of catches destined for direct human consumption (FAO, 2013a). An assessment of global inland fisheries in 2003 estimated the total harvest at 8.7 million tonnes, which accounted for 6% of global fish production (FAO 2003). While the inland fisheries³ contribution on a global scale is relatively small, Neiland *et al* (2005) caution that simple comparisons of gross production can be misleading because inland fisheries in many developing countries and regions generate a wide variety of benefits for millions of people. Such benefits include food security, livelihoods and contribution to wealth and well-being of communities engaged in a variety of fisheries linked activities that collectively contribute significantly to the both the rural and national economies (Kapetsky & Petr, 1984; Sarch & Allison 2000; Allison *et al* 2002; Allison 2005).

Due to the informal subsistence and artisanal nature of most small scale fisheries, the socio-economic contribution production is often not captured in national statistics such as the gross domestic product (GDP). Consequently, the sector has historically been overlooked by fishery policy makers, who have focussed mainly on promoting commercial fisheries to generate rents which can be used by the state (Béné *et al.*, 2010). Concerns have arisen in recent years around the marginalisation of poor, small-scale fishers in favour of industrial fisheries, particularly in developing countries where millions depend on small-scale fisheries for a livelihood (Béné *et al.*, 2010). This has led to international efforts to reform fishery governance to recognise the rights of small-scale fishers and protect their livelihoods (FAO, 2013b). A significant international programme to promote the rights of marginalised small scale fishers is aptly named 'Too Big To Ignore' (toobigtoignore.net).

In Africa, the fishing sector is dominated by small-scale fisheries and provides income for over 10 million people engaged in fish production, processing and trade and contributes to the food security of 200 million people (<http://www.fishforall.org/ffasummit/africasummit.asp>). Inland fisheries play a prominent role in Sub-Saharan Africa where the great lakes (e.g. Victoria, Malawi/Nyasa, Tanganyika, Bangweulu), river systems and impoundments provide the main source of animal protein to populations in these regions. The role of inland fisheries in poverty reduction, food security and livelihoods provision and regional economic development in Africa has received increasing recognition (Marshall and Maes, 1994, FAO, 2003). The fishery sector has been identified by the African Union as a priority investment area for poverty alleviation and regional economic development, and given substance through the NEPAD 'Partnership for African Fisheries' programme (<http://www.nepad.org/foodsecurity/fisheries/about>).

The development challenges associated with inland fisheries in Africa are however significant. The FAO's 'Guidelines for Securing Sustainable Small Scale Fisheries' note that,

'the constraints to and challenges in achieving sustainable development in small-scale fishing communities include their often remote location, limited access to social and other services

² The understanding of the term 'small-scale' varies internationally (FAO, 2013b). In this report we use the term 'small-scale fishing' as defined in the Marine Small-Scale Fishing Policy (DAFF, 2012a), 'Small-scale fishing means the use of a ... living resource on a full-time, part-time or seasonal basis in order to ensure food security and livelihood security. For the purposes of this policy, fishing also means the engagement (by men and women) in ancillary activities such as, pre- and post- harvesting (including preparation of gear for harvesting purposes), net making, boat building, beneficiation, distribution and marketing of produce which provide additional fishery-related employment and income opportunities to these communities.'

³ For the purposes of this report, 'inland' fisheries are understood to be 'fresh water' fisheries, as distinct from marine fisheries.

as well as markets, low levels of education and inadequate organisational structures which make it difficult for them to make their voices heard. Many small-scale fisheries are effectively unregulated, unreported and poorly monitored, especially in developing countries and inland water areas. Customary practices for allocation and sharing of resource benefits that generally used to be in place in small-scale fisheries have often been eroded because of centralised fisheries management systems, technology development and demographic changes’.

In South Africa, the marginalisation of small-scale fisheries mirrors the international experience, as the fisheries sector is dominated by the commercial marine fisheries, and small scale fishing, in both marine and fresh waters, is conducted largely on an informal basis by disadvantaged communities. In recent years, marine small scale fisheries have achieved policy recognition (DAFF, 2012a), but the institutional support required to realise their potential contribution to poverty reduction and economic development has been lacking. Fresh water fisheries are not recognised at all in national policy, despite thousands of inland storage dams and impoundments (Table 1) which support growing small-scale and recreational fishing sub-sectors. Thus, despite their potential inland water resources remain largely underutilised as a source of fish protein, income and employment for the rural poor living in the vicinity of these resources. The responsibility for access to dams and their fishery resources is currently fragmented between government departments and is not directed by a coherent policy. This lack of a national policy is thus major constraint in the development of inland fisheries (Weyl *et al.*, 2007; Hara and Backeberg, 2014).

In contrast to South Africa's marine fisheries, which have constitutionally aligned sustainable development goals with supporting policies and institutions, fishing on inland waters has historically been regarded as a recreational activity, with management authority delegated to the provincial environmental and nature conservation authorities. Recreational fishing is recognised in the Department of Water Affairs policy, which promotes the development of recreational activities on state dams as a secondary beneficial use (DWAF, 2006). As the provincial environmental agencies do not have a development mandate, they have very limited capacity to promote livelihoods based on fisheries, although a number of projects have been promoted in various provinces over the years including the Free State, Limpopo and KwaZulu-Natal. The low value of freshwater fish (ZAR 6/kg, Ellender *et al.*, 2010b), and Apartheid era exclusion of people from accessing fish resources, have also contributed to in South African inland fisheries being utilised primarily by recreational anglers (Weyl *et al.*, 2007). More recently however, there is evidence of an increasing utilisation of inland fisheries by subsistence and artisanal fishers (van der Waal *et al.*, 2000; Ellender *et al.*, 2009; Hara and Backeberg, 2014). While small-scale fishers from local communities are generally regarded as having a legitimate claim to fish, in the absence of a supporting rights-based governance framework, their activities are usually illegal, unmanaged and often unsustainable. This has led to growing conflicts between water users on a number of impoundments. The institution of equitable and sustainable use of South Africa's inland fish resources will thus require fundamental reform of the very rudimentary inland fishery governance arrangements (Hara and Backeberg, 2014).

Province	Total Number of Dams
Eastern Cape	697
Free State	404
Gauteng	332
KwaZulu-Natal	924
Limpopo	312
Mpumalanga	479
Northern Cape	82
North West	149
Western Cape	1324
total	4703

Table 1 The Department Water Affairs (DWA) list of registered public and private dams.

1.2 Challenges in Aligning South African Inland Fisheries Governance and Policy with International Norms and National Development Goals

South Africa's inland fishery resource endowment has largely been overlooked as a means of sustainable livelihoods in the democratic era, lacking a guiding policy and legislation with social, economic and environmental objectives that are aligned with the country's developmental objectives. As a consequence, unmanaged and unsustainable fishing practices are growing, and opportunities are being missed for livelihood development to address the historical disadvantage and inequity experienced by poor communities. The lack of an equitable inland fishing governance framework has led to conflicts between water users on a number of impoundments. The provincial environmental authorities, being sensitive to rural food security needs and the political implications associated with prosecuting poor rural people for illegal fishing, have in many instances adopted a "no-management" approach to growing subsistence fishing use. In provinces such as the Free State, Eastern Cape, KwaZulu-Natal and the North-West Province, small-scale livelihood fishing projects have in recent years been promoted on an *ad hoc* basis by the provincial authorities (McCafferty, 2012). However, these initiatives have lacked the comprehensive institutional support required to create sustainable livelihoods, including clearly defined user rights, empowering co-management institutions, fishery management plans, and access to value-adding opportunities and markets.

South Africa's rights-based Constitution (Act 108 of 1996) has guided the formulation of policy and legislation governing the use of the country's natural resources in the democratic era, with rights to water, minerals, land, and marine fishery resources being subject to processes of restitution and reform to address Apartheid-era inequalities. While the Marine Living Resources Act (Act 13 of 1998) guided marine fishery reform, the primary environmental acts governing inland aquatic resources (the National Environmental Management Act, Act 107 of 1998; and the Water Act, Act 36 of 1998) are silent on inland fisheries, providing only generic principles for resource use flowing from the imperatives of the Constitution and international norms for environmental 'good governance'. Thus, while South Africa's environmental legislation is founded upon the principles of sustainable development and equity, no specific social and economic objectives are articulated to guide inland fishery governance. The only specific legislation on the use of inland fish resources are rudimentary fishing 'effort control' rules dating back to the pre-democratic era, which are prescribed in the provincial environmental acts and ordinances. This is problematic, as environmental managers responsible for fishery resources are not provided with guidance on how to manage their use for optimal social and economic benefit, which results in potential livelihood development opportunities not being realised, and also tensions between users of the resource. Another consequence is that legally defined recreational use rights tend to be entrenched, while widespread small-scale fishing activity for livelihood purposes falls outside of the existing rights and management framework is a marginal activity, which is often regarded as 'poaching'. In the absence of a comprehensive policy to guide inland fishery governance, the Apartheid-era inequalities of resource access by poor black communities tend to be perpetuated, and unsustainable fishing practices are becoming more prevalent.

The lack of policy to guide South African inland fishery governance has been highlighted previously (Weyl *et al.*, 2007; McCafferty *et al.*, 2012; Hara and Backeberg 2014), with suggestions to guide the establishment of appropriate institutional and management arrangements. Based on a case study of the inland fishery potential of the dams in the North-West Province, Weyl *et al.* (2007) provided recommendations for fishery development based on the productivity of each dam, biodiversity considerations, user group characteristics, and socio-economic objectives – particularly the promotion of rural livelihoods. These authors suggested that the provincial Departments of Agriculture, with their smallholder/ rural livelihoods development mission, should logically be mandated to promote inland fishery development. This subsequently came into effect through the creation of the Department of Agriculture, Forestry and Fisheries (DAFF) in 2009 (DAFF, 2012b). Weyl *et al.* (2007) however cautioned that the provincial agriculture departments did not possess the capacity to promote inland fishery development, and thus considerable institutional capacity building would be required. They concluded by highlighting the need for a comprehensive national policy to guide inland fishery development. Such a policy should be based on a development-orientated co-management approach, and aligned with existing national policies and legislation as well as relevant international agreements and conventions such as the FAO Code of Conduct on Responsible Fisheries, the SADC Protocol on Fisheries and the NEPAD Abuja Agreement on Fisheries and Aquaculture. As inland fisheries

are a provincial competency, cooperative institutional arrangements and the harmonisation of provincial ordinances governing inland fishing would be required. Weyl *et al.* (2007) noted that the development of inland fisheries governance arrangements is constrained by a paucity of information and identified ‘an urgent need for research covering the biological, social, economic and governance aspects, if inland fisheries are to be developed in a rational and sustainable manner which promotes South Africa’s national policy goals’.

The outdated and incomplete South African inland fishery policy framework is further highlighted by recent normative international fishery governance guidelines including the FAO’s “Framework for the Development and Management of Inland Fisheries” (Wellcome, 1997), the “FAO Code of Conduct for Responsible Fisheries” (FAO, 2010) and “International Guidelines for Securing Sustainable Small-scale Fisheries” (FAO, 2013). The FAO guides adopt a rights-based approach to fisheries governance with clearly defined social and economic objectives, to address the legacies of disadvantage and marginalisation borne by poor fishing communities.

Governance norms for fisheries have been greatly advanced in recent years, as weak governance, which results in open access and poorly defined property rights, has been attributed as the main cause of over-exploitation of fish stocks around the world (World Bank, 2004). The development of supporting governance institutions are therefore key to the successful implementation of property and access rights institutions. In this report, we use the governance definition of Kooiman *et al.* (2005), which is widely accepted in the fisheries governance literature:

‘Governance is seen as the whole of public and private interactions taken to solve social problems and create societal opportunities. It includes the formulation and application of principles guiding these interactions and care for institutions that enable them’

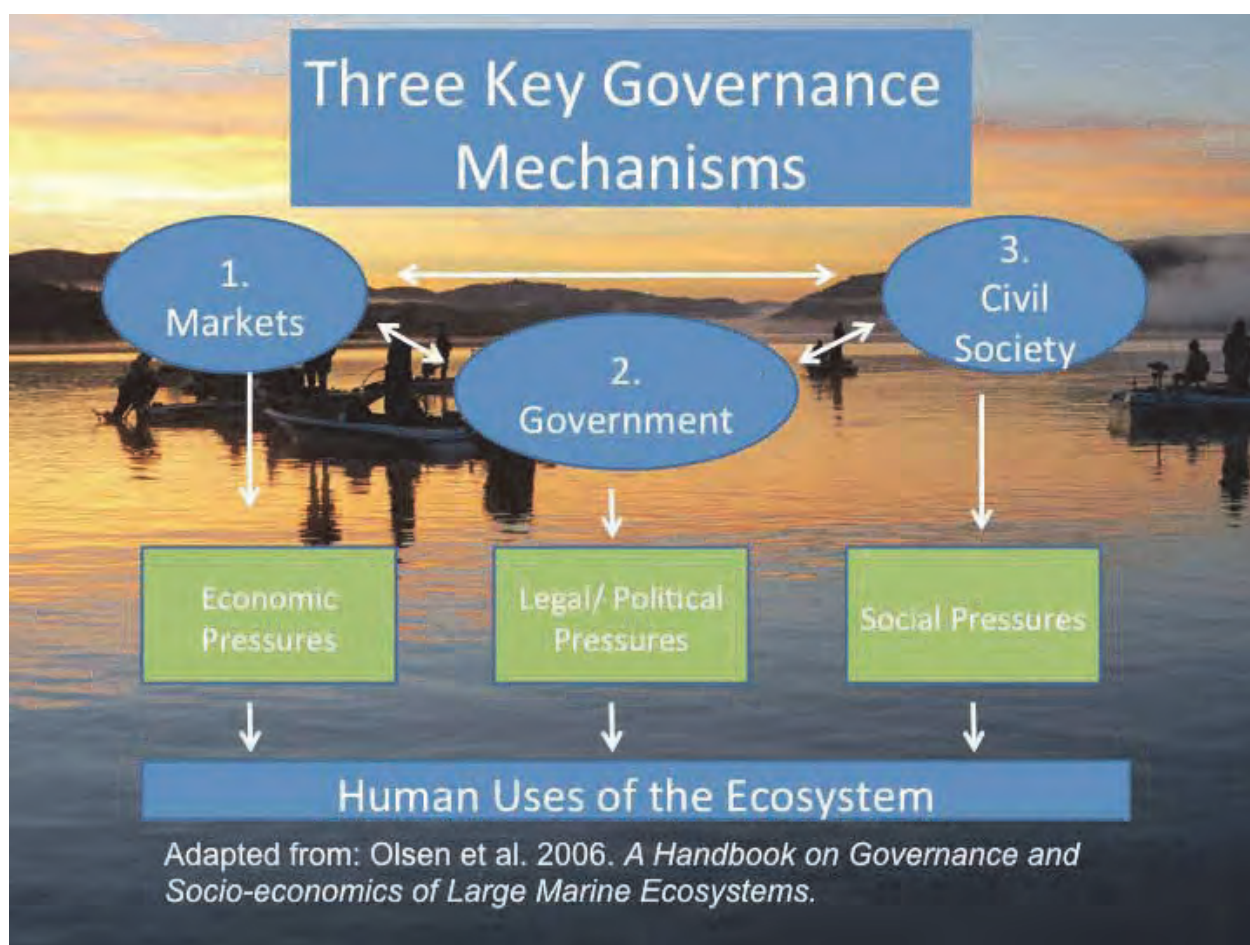


Figure 1 The governance of fisheries is determined by the interactions of institutions associated with markets, government and civil society

Governance is broader than 'management', in that whereas management is functionally defined and is perceived as a technical exercise employing means to achieve given goals, governance includes the deliberation and determination of values and principles that should underpin the way governors define their tasks and roles (Kooiman and Jentoft, 2009). Governance arrangements which determine sustainable use of the ecosystem are thus created through the interaction of market based, government, and civil society institutions (Figure 1). This approach enables a shift from a 'problem-solving' to an 'opportunity creation' approach (Kooiman and Bavinck, 2005), which is necessary to address the historical inequity and social disadvantage which characterises South African small scale fisheries.

Key principles of fishery 'good governance' include stakeholder participation, a precautionary approach, and the 'ecosystem approach to fisheries' (EAF) (De Young, Charles and Hjort, 2008). The EAF aims for an optimized balance between the different users of fishery resources, while preserving biodiversity, minimizing human impacts on aquatic ecosystems and promoting approaches to fisheries management that go beyond customary management by monospecific stock (Breuil, 2012). Stakeholder participation is given substance through the implementation of "fishery co-management" whereby the fishery management authority and users, establish participative institutions such as local "co-management committees" to negotiate management protocols and actions based on ecosystem considerations and user needs. In this context, good governance principles include openness and transparency, responsibility-accountability, effectiveness (and efficiency), participation, coherence, adaptability-responsiveness (Breuil, 2012).

The first step in establishing governance arrangements for inland fisheries is a policy to guide the establishment of governance institutions and organisational arrangements. While South Africa historically possessed a comprehensive inland fishery policy with economic, social and environmental goals, the current policy vacuum has resulted in missed livelihoods development opportunities, growing unmanaged and unsustainable fishing practices, and the perpetuation of Apartheid-era inequalities in terms of resource access rights. While fresh water fish stocks cannot support industrial-scale fisheries, small-scale and recreational fisheries do have the potential to support the creation of rural livelihoods and decent jobs, provided a policy with clear social and economic objectives is developed. The inclusion of inland fisheries into the DAFF Fisheries Branch mandate has created an appropriate institutional arrangement to develop an inland policy which is aligned with national developmental goals such the National Development Plan and the DAFF Integrated Growth and Development Plan (DAFF, 2012c).

Policy implementation will require legislative review and reform of the fragmented and deficient instruments currently used to govern inland fisheries. In the absence of an inland fisheries act equivalent to the Marine Living Resources Act, the constitutionally based principles of the NEMA and Water Act provide guidance to formulate inland fishery specific governance arrangements, including the revision of provincial environmental legislation, to provide for enhanced utilisation of inland fisheries for sustainable livelihoods. Pegram *et al.* (2006) in their review of South African water resource governance identify three key processes which are applicable to inland fisheries:

- Establishment of an effective regulatory framework (and implementation plan) for water resources management, linked to other sectors' activities and taking consideration of the available institutional capacity;
- Establishment of coherent institutional arrangements;
- Promotion and institutionalisation of appropriate of appropriate stakeholder involvement in.... management processes, taking account of the role of local government in democratic representation.

In terms of institutional and organisational arrangements it has long been recognised that the government mandate for inland fisheries should not fall under the provincial environmental departments, as their primary mandate is environmental and biodiversity management, and not economic sector development or sustainable livelihoods and job creation (Weyl *et al.*, 2007). Following the 2009 general elections, the merging of responsibility for promoting the production of primary renewable resources into a single ministry in the form of the Department of Agriculture, Forestry and Fisheries (DAFF) represented a significant

organisational change. Marine fisheries and aquaculture, which had previously been managed separately by the Department of Environmental Affairs and Tourism: Branch Marine and Coastal Management, would henceforth be governed together with inland fisheries and freshwater aquaculture by a single organisation, the DAFF's 'Fisheries Branch'. The DAFF announced that it intended creating a policy and programme on inland fisheries to promote economic opportunities around existing fish stocks within freshwater bodies and rivers (DAFF, 2012d), visibly:

'Following on the heels of DAFF's promising launch of its Aquaculture Programme, in the coming year DAFF anticipates creating a policy and programme on inland fisheries. The development of inland fisheries involves developing more economic opportunities around generally existing fish stock within freshwater bodies and rivers; in the South African context, the main target is storage dams, of which there are over 3 000 around the country. (Aquaculture by contrast usually involves more purpose-built earthworks and/or other infrastructure, as well as modification of the water environment to make it nutrient rich.) The job creation potential of such an initiative is in the tens of thousands, most likely without requiring massive investment. Another virtue of this development is that it has particular potential to promote job creation within the former homelands, where many storage dams have been built, and where their recreational and fish-harvesting potentials have been especially neglected. Most dams in South Africa are under the jurisdiction of the Department of Water Affairs, while the fish in these dams are under the Department of Environmental Affairs; the development of an inland fisheries policy will therefore require close collaboration with these two departments.'

As storage dams were under the control of the Department of Water Affairs and environmental management under the control of the Department of Environmental Affairs, it was recognised that close departmental collaboration would be required. The DAFF Fisheries Branch and the provincial departments of agriculture possess no dedicated human and organisational capacity for governing inland fisheries, and building it will thus be a primary implementation challenge.

A further key challenge is the legislative requirement for cooperative governance on environmental management (National Environmental Management Act 1998). This is a particular challenge for inland fisheries, as responsibility spans multiple mandates (e.g. fisheries, environment, water, economic development), and all tiers of government (national, provincial, local and traditional), and non-government and civil society stakeholder groups. An inland fisheries policy clearly specifying the mandates and roles of the respective public sector institutions is thus required.

In summary, the major institutional and organisational challenges going forward are: 1) the promulgation of empowering policy and legislation, 2) cooperative governance arrangements, 3) capacity building of public sector staff and fishery stakeholder groups, and 4) the establishment of inland fishery co-management institutions.

The "Baseline and Scoping study on the Development and Sustainable Utilisation of Storage Dams for Inland Fisheries and their Contribution to Rural Livelihoods" initiated by the Water Research Commission (WRC) was thus undertaken to provide a knowledge base to inform the development of policy and institutional arrangements for inland fishery governance. In this report, the evolution of inland fisheries policy in South Africa are reviewed; the current fishery uses and issues characterised; the environmental, economic and social potential of the resource discussed; and the existing regulatory and institutional framework evaluated in terms of modern fishery governance norms and national development objectives. Based on the research and consultations with public and private sector stakeholders, the report concludes with a set of recommended governance principles and institutional arrangements to inform the development of a South African inland fisheries governance, institutional and organisational arrangements.

1.3 Objectives and Project Methodology.

1.3.1 Project Background

The “Baseline and scoping study on the development and sustainable use of storage dams for inland fisheries and contributions to rural livelihoods” (Project No K5/1957) emanated from a solicited proposal to the Water Research Commission, under the Thrust: ‘Water Utilisation For Poverty Reduction And Wealth Creation In Agriculture. Programme 1: Sustainable water-based agricultural activities in rural communities’ (Water Research Commission, 2011).

The project was conceived in response to recommendations that rural livelihoods in South Africa could be enhanced by developing the potential of inland fisheries (Rouhani and Britz 2004, Weyl *et al.*, 2007). This would require assessment of the potential productivity and socio-economic contribution of inland fisheries resources, and formulation of appropriate management and governance arrangements to empower rural communities to share in the benefits of these resources. It was intended that the baseline survey would assist National and Provincial Departments, particularly the lead Department of Agriculture, Forestry and Fisheries (DAFF), in formulating a policy on inland fisheries including management and governance arrangements, in planning staffing and training requirements, and addressing research gaps. The aims of the project and terms of reference were conceived in a stakeholder workshop convened by the Water Research Commission (WRC) in 2009. In response to the WRC’s invitation, a consortium of researchers from Rhodes University and the University of the Western Cape jointly developed a proposal, which was accepted by the WRC and subsequently formalised in a contract with Rhodes University.

Due the requirements to synthesise both the biological and social aspects of South Africa’s inland fisheries, the project was trans-disciplinary, and executed by researchers with a combination of fisheries and social science backgrounds. The participating organisations included Rhodes University’s Department of Ichthyology and Fisheries Science; University of the Western Cape’s Institute for Poverty, Land and Agrarian Studies (PLAAS), and the South African Institute for Aquatic Biodiversity (SAIAB).

1.3.2 Project Aims

1. To review the existing private, communal and public access rights, legislation, regulation, management and governance systems that influence the current uses and conflicts with inland fisheries
2. To identify the number, location, distributing, size, water permanency and water quality of dams that have potential for inland fisheries
3. To characterise indigenous knowledge and practice, the current subsistence, commercial and recreational techniques and practices for using fishing storage dams in selected rural areas
4. To develop a framework for assessing the viability of stocking dams with fish with particular reference to bio-diversity and natural processes; choice of fish species; socio-economic benefits; monitoring and evaluation; and to develop guidelines for appropriate stocking and harvesting strategies for inland fisheries
5. To assess the role, viability and scale of private and or state hatcheries to provide fingerlings and support services for inland fisheries
6. To develop appropriate institutional arrangements (working rules) and organisational structures (cooperative relationships) that enable access to and ensure control over state dams for sustainable fish production and harvesting
7. To develop effective management processes and governance systems for inland fisheries in dams, including the roles and responsibilities of individual households, groups in rural villages and relevant authorities (at tribal, local, provincial and national level)
8. To propose a framework for the development of human resources capacity and skills to support inland fisheries

1.3.3 Methodology

The research approach consisted of a combination of literature reviews, community based surveys, fishery productivity modelling, and stakeholder consultations.

The available literature on South African inland fisheries was reviewed (McCafferty *et al.*, 2012), access rights arrangements and legislation analysed with recommendations for reform (Hara and Backeberg, 2014), and the production potential of South African impoundments estimated using morpho-edaphic models.

The research team then conducted a series of consultations and workshops with rural fishing communities, mandated government department representatives, and recreational angling bodies. A survey was conducted among selected fishing communities to evaluate the role of indigenous and local knowledge in inland fishery utilisation and characterise the role in rural livelihoods. The results of the reviews and surveys were presented at a workshop of government departments in April 2012 to determine options for institutional and organisational arrangements discussed. This was followed by a second workshop with relevant national and provincial government departments in May 2012, where guidelines for the potential stocking of impoundments with hatchery-reared fish from state and private hatcheries were discussed. In addition to consultations with fishing communities and government officials, the organised recreational angling sector was presented with the project findings and their views on inland fishery governance solicited.

The institutional and organisational requirements for inland fisheries governance were then analysed, based on the project findings, South African development and environmental policies, and internationally accepted fishery 'good governance' norms. Recommendations for institutional and organisational arrangements were then presented to the relevant government departments and feedback incorporated.

The overall conceptual approach used by the project team for analysing the institutional, organisational and management requirements for inland fisheries governance is summarised in Figure 2.

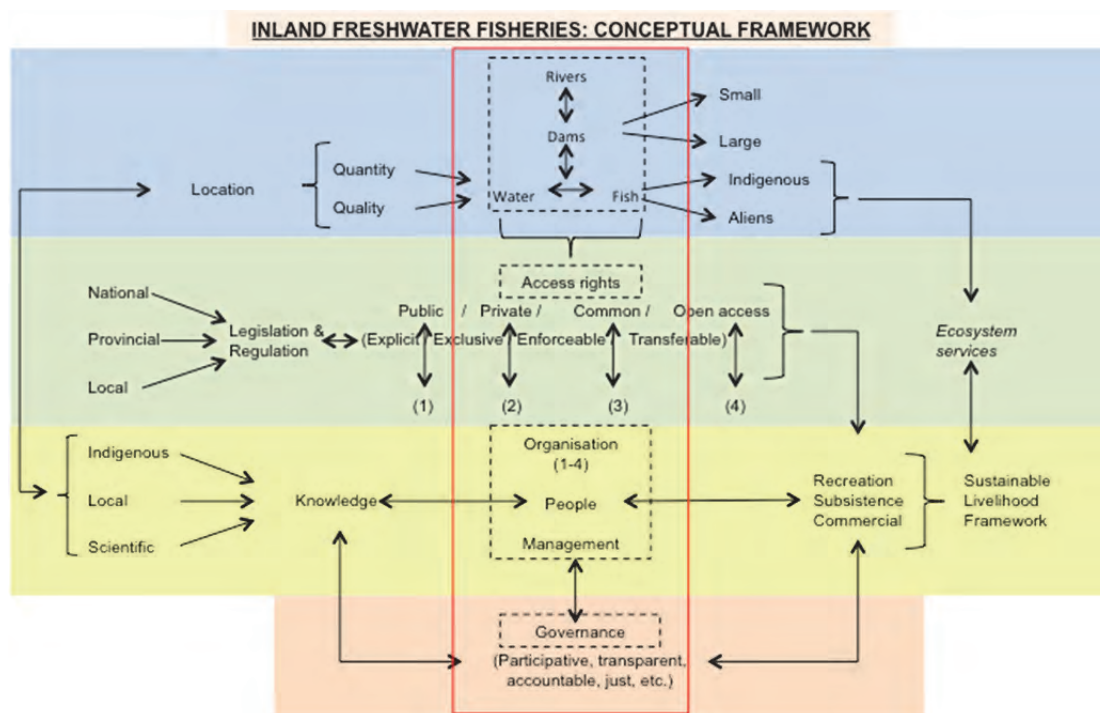


Figure 2 Conceptual framework for institutional and organisational arrangements for inland fisheries governance (Hara and Backeberg, 2014)

The research approach adopted to address each project aim is outlined below, with the detailed methodology presented in the relevant chapters of this report.

Aim 1. "To review the existing property and access rights systems (private, public, communal and open access) and legislation, management and governance systems that underpin the current uses (and conflicts thereof) in inland fisheries"

Most environmental problems can be framed as problems of incomplete, inconsistent, or unenforced property rights (Hanna and Munasinghe, 1995). This review drew on two sources of information:- 1. secondary material (including grey literature) in terms of national legislation and policies, journal publications and books/book chapters pertaining property/ownership and

access rights arrangements and the management of inland fisheries for sustainable exploitation and maintenance of biodiversity that dams and other water bodies fall; 2) unstructured interviews with selected government managers responsible for inland fisheries management, academics and stakeholders. A review of existing laws and policies relevant to inland fisheries at all levels (national, provincial and municipal) was conducted based the literature and interviews with government officials and researchers. Fishery access rights and property rights regimes, both formal (recognised in law) and informal (not legally recognised) were reviewed, with special consideration of the relationship between customary resource governance practices and formal rights regimes. Case studies were used to illustrate management, governance, sustainable use issues and lessons that can be learned. Based on the reviews, recommendations for the reform of law and policy for management of inland fisheries to contribute towards the goals of poverty alleviation and poverty reduction were proposed.

Aim 2: “To identify the number, location, distribution, size, water permanency, and water quality of dams which have the potential for inland fisheries.”

The suitability of dams for various levels of fisheries development was assessed through a comprehensive metadata analysis. A GIS database was developed to indicate the distribution, size, water permanency, temperature regime and water quality of dams in South Africa which have potential for inland fisheries. The suitability of dams for fisheries development was then be assessed using criteria such as potential yield, presence of suitable species, presence of endangered species of fish, distance from human settlement and water quality. Empirical models that allow for the estimation of potential fish yield from the chemical and physical characteristics of a dam were then be applied to determine whether a dam is productive enough to develop an inland fishery. The models were then tested using angling competition data to assess whether catch rates correlate with productivity predictions.

Aim 3: “To characterise indigenous knowledge and practice, the current subsistence, commercial and recreational techniques and practices for using fishing storage dams in selected rural areas”

Preliminary observations in a number of rural communities indicated a reliance by the landless, unemployed and rural poor on local inland fisheries. However, the characteristics and extent of such resource use, at a national scale, were not clearly understood. A survey was undertaken to determine the extent of fishery resource use as well as historical and current practices and techniques associated with subsistence, commercial and recreational fishing in both the larger and smaller dams and their proximal rivers, floodplains and impoundments. Firstly, a desktop study was undertaken to review existing literature on indigenous knowledge and practice, as well as the current subsistence, commercial and recreational techniques and practices for using fish in storage dams in selected rural areas. The review was followed by a baseline scoping study to survey and ground truth indigenous fishery related knowledge systems, practices and techniques, as well as current practices and techniques. A purposive sample of approximately twelve case studies of rural inland fisheries was selected from different provinces, and included large and small dams and their associated riverine, floodplain and impoundment fisheries.

Rapid and Participatory Rural Appraisal (RRA and PRA) methods were used to collect data. In addition to oral testimonies, which were be used in historical surveys of IKS in appropriate cases, two checklists of questions on indigenous knowledge systems (IKS) and current practices and techniques were used. Using these tools, in-depth interview schedules and focus group discussions were administered at three levels in each rural community. Focus groups targeted the fisher group level, while in-depth interviews will be addressed to key resource persons, and questionnaires were administered to not more than five male and female fisher households in each study site. The objective of questionnaires was to obtain indicative socio- economic and livelihood profiles of fisher households in order to gain some understanding of characteristics of inland fisheries resource users.

Aim 4: “To develop a framework for assessing the viability of stocking dams with fish with particular reference to biodiversity and natural processes; choice of fish species; socio-economic benefits; monitoring and evaluation; and to develop guidelines for appropriate stocking and harvesting strategies for inland fisheries.”

Based on the GIS database of dams with potential for inland fisheries (Aim 2), The South African Institute for Aquatic Biodiversity developed ecological niche models for fish species that are potentially suitable for stock enhancement in each region. In addition, current legislation such as the category 2a alien species zoning in the *NEMBA: Alien and Invasive Species Regulations* and the *National Freshwater Environment Protected Areas* were assessed to identify potential conflict areas and for recommending species for stocking or harvest. These data were incorporated as layers on a GIS map to identify areas suitable for fisheries development and distinguish between small-scale, commercial and recreational fisheries potential.

Aim 5. “To assess the role, viability and scale of private and/ or state hatcheries to provide fingerlings and support services for inland fisheries”

Culture based fisheries in small dams in South Africa could be an important component of developing the inland fisheries in South Africa. It was envisaged that a lead supplier of fingerlings to these dams could be the provincial state hatcheries which had largely fallen into disuse. A stakeholder consultation process and analysis of the need for stocking fish was undertaken to determine the potential role and viability of provincial state hatcheries in inland fisheries stock enhancement taking into account biodiversity management issues, the economic viability of stocking, and the cost-benefit of state funded stock enhancement. The role of private hatcheries in trout stocking was also evaluated.

Aim 6: “Develop appropriate institutional arrangements (working rules) and organisational structures (cooperative relationships) that enable access to and ensure control over dams for sustainable fish production and harvesting”

The development of recommendations for inland fisheries institutional arrangements were based on the reviews and analyses for aims 1 and 2 above and other stakeholder engagements. A stock-taking and diagnostic analysis of the existing institutions, legislation and policies underpinning the institutions and the capabilities of the stakeholders was undertaken, in order to proposed changes in institutional arrangements flowing from the recommended legal and policy revisions. A central challenge was the proposed shift in primary responsibility for fishery management to the provincial departments of agriculture, away from the provincial environmental affairs departments.

Consultations and engagement with stakeholders about the proposed changes were central to the process. To achieve this, a national process was initiated, whereby relevant departments such as national Department of Agriculture, Department of Water and Environmental Affairs, and provincial departments were engaged. This inclusive process sought to ensure that there was consensus and buy in.

Aim 7: “To develop effective management processes and governance systems for inland fisheries in dams, including the roles and responsibilities of individual households, groups in rural villages and relevant authorities (at tribal, local, provincial and national level).” Following

the reviews on inland fishery literature, rights, and indigenous knowledge, stakeholder participation was the main tool employed by the project team to develop appropriate management processes and governance systems for inland fisheries on dams.

Workshops brought together key stakeholders at various levels of the governance framework. A preliminary step in each context was to identify key stakeholders through consultation. Primary stakeholders included inland fisheries resources users and traditional and local leadership, while secondary stakeholders included relevant local, provincial and national government departments, non-governmental organisations, community-based organisations, civil society and the private sector. Workshops were initially be held at the local and/or provincial

level. The objective was to elicit views on and develop effective management processes and governance systems in various local contexts. The primary action research tool employed was participatory Stakeholder Analysis, which included techniques such as stakeholder tables, issues mapping, trend and time lines, role plays, Venn diagrams and stakeholder matrices. Particular attention paid to the issue of gender and the effective management of stakeholder power dynamics within workshops, in order to avoid the workshops serving to further entrench the marginalization of rural primary stakeholders. Following the local and provincial workshops, the findings were synthesized for presentation to policy makers, decision makers and practitioners.

Aim 8: “To Propose a Framework for the development of human resource capacity and skills to support inland fisheries”

Based on the proposed governance framework and associated institutional arrangements and organisational structures, a framework for the development of human resource capacity and skills to support inland fisheries was developed. As the mandate for fisheries now resides with Department of Agriculture, there was a primary focus on developing human resource capacity and skills within the national and provincial agriculture departments. Recommendations for human resource capacity building were also made for other relevant National and provincial departments (Water Affairs, Environmental Affairs, Department of Transport), and municipalities. As small-scale fishers generally come from a background of disadvantage and rural poverty, special attention was paid to capacity building and skills training to support participation on governance and co-management structures. Suggestions were made for skills training to empower recreational fishing stakeholders to participate in fishery co-management and governance processes. The study identified the types of skills and forms of training required.

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2. HISTORY AND CURRENT STATUS OF INLAND FISHERIES IN SOUTH AFRICA

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2.1 Introduction

The contribution of inland fisheries to food security, livelihoods provision, poverty alleviation, and economic development has been increasingly recognised in developing African countries, but there is surprisingly little literature on the potential of South Africa's inland fishery resources. A literature review was thus undertaken of peer-reviewed and grey literature in order to produce a synthesis of the history and current status of inland fisheries in South Africa.

The chronology of literary themes on inland fisheries is tracked and an overview of the information on key themes including the evolution of inland fishery policy and legislation, government measures to support fishery development, the biological and economic production potential of dams and inland waters, non-native fish introductions and biodiversity issues, and the characteristics of the small-scale, recreational and commercial sub-sector user groups is provided. The review summarises the current state of fisheries resources, outlines potential sources of data, highlights relevant and important information, and identifies knowledge gaps in information pertaining to South African inland fisheries.

A major gap not covered in this review is pre-Colonial inland fishery use, as no literature sources were found. It is however known that the indigenous peoples of certain areas, such as the Tembe-Tsonga, have a largely undocumented fishery tradition and culture dating back to pre-Colonial times (Heeg and Breen, 1982). The role of indigenous knowledge in South African fisheries thus formed a special research focus, the results of which are presented in Chapter 4.

This content of this chapter formed the basis of two peer-reviewed publications arising from the WRC Inland fishery project (McCafferty *et al.*, 2012; Britz, in review).

2.2 Categorisation of Inland Fishery Literature

When the WRC Inland Fishery project was initiated, information available on South Africa's inland fisheries was dispersed and had never before been collated or reviewed. As inland fishery development has a long history, dating back to the Colonial era, much of the key literature documenting the evolution of policy, non-native fish introductions and inland fishery development support was in non-digital 'grey' literature sources, such as annual government reports, and in popular angling books and journals such as the *Piscator* (Figure 3). Many of these sources were located in the archives of the South African Institute for Aquatic Biodiversity and digitised to provide future access.

In this section we categorise the literature on topics related to inland fisheries including: fish biological production in different water bodies; rural fisheries development potential; recreational fisheries; customary fisheries; and valuation studies (Figure 4). A comprehensive literature search using various databases as well as grey data available from fisheries projects revealed 173 publications dealing directly with inland fisheries. The nature of these publications is summarised in Figs. 3 and 4, and in Table 2.

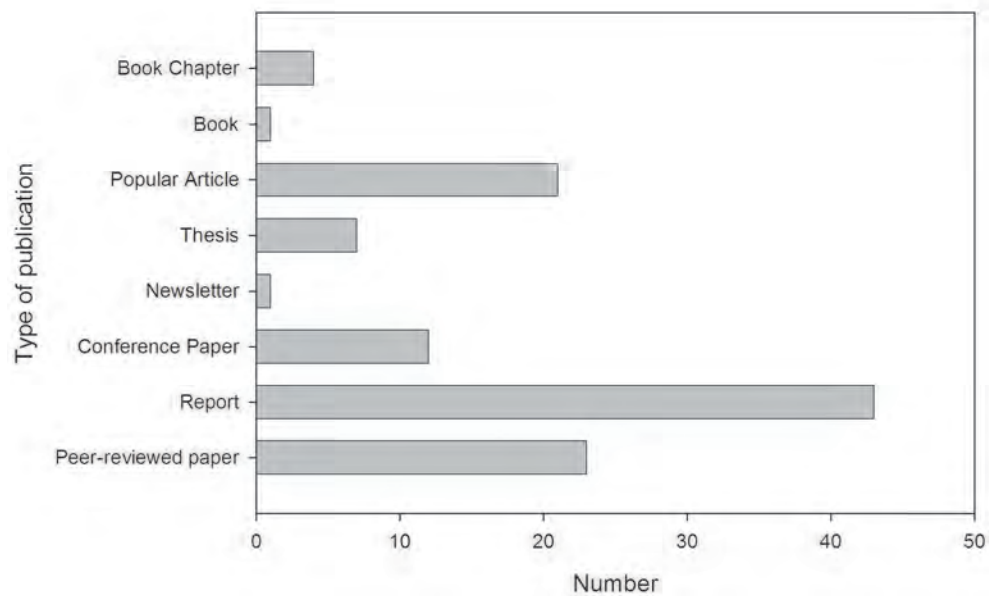


Figure 3 South African inland fisheries literature by type of publication. Note that peer-reviewed literature constitutes less than 25% (after McCafferty *et al.*, 2012)

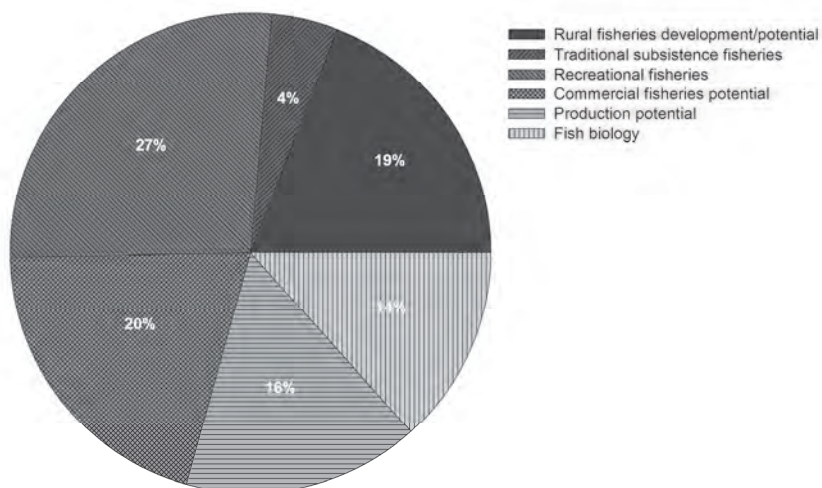


Figure 4 Proportion of South African inland fisheries literature by theme (after McCafferty *et al.*, 2012)

Table 2 Summary of publications by topic with regards to inland fisheries (after McCafferty *et al.*, 2012)

Rural Fisheries Development/ Potential
Andrew <i>et al.</i> , 2000; Andrew 2001; Burton <i>et al.</i> , 2002; de Satge 1978; Duncan – Brown 1980; Roode 1978; Rouhani & Andrew, 1998; Rouhani 2001, 2003, 2004; Rouhani & Davies, 2003; Schramm 1993; Seti 2002; van den Berg <i>et al.</i> , 1975; van der Waal 1978a, 1978b, 2000; Weyl <i>et al.</i> , 2007.
Traditional Subsistence Fisheries
Coke & Pott, 1973; Heeg & Breen, 1982; Jubb, 1973; LaHousse DeLalouviere, 1987; Merron <i>et al.</i> , 1993; Merron & Weldrick, 1985; Tinley, 1964; van der Waal, 1978a, 1978b.
Recreational Fisheries
Alletson <i>et al.</i> , 2004; Anon, 1970; Ashton <i>et al.</i> , 1986; Bruwer 1982; Cadieux 1979, 1980a, 1980b; Clark 2004; Cochrane 1987; de Villiers, 1998; du Plessis & le Roux 1965; Eccles <i>et al.</i> , 1983; Ellender <i>et al.</i> , 2009, 2010a, 2010b; Granek <i>et al.</i> , 2008; Hey 1926a, 1926b, 1941; Jackson 1976, 1989; Kinghorn, 2013; le Roux 1965; Leibold & van Zyl, 2008; McVeigh 1978; Nel 1988; Pott 1973; Rouhani 2003, 2004; Rouhani & Davies 2003; Rouhani <i>et al.</i> , 2010; Winker 2007; Weyl <i>et al.</i> , 2010.
Commercial Fisheries Potential
Allanson & Jackson (eds) 1983; Anon 1948; Eccles <i>et al.</i> , 1983; Ellender <i>et al.</i> , 2009, 2010a; Hamman 1981; Jackson 1973, 1974, 1976, 1981a, 1981b; Jubb, 1962; Koekemoer & Steyn, 2005; Nel 1988; Richardson <i>et al.</i> , 2009; Tomasson <i>et al.</i> , 1983; Tomasson <i>et al.</i> , 1985; van Senus <i>et al.</i> , 1992; Weyl <i>et al.</i> , 2007, 2010; Whitehead 1978.
Production potential
Allanson & Jackson (eds.). 1983; Andrew <i>et al.</i> , 2001; Andrew 2001; Cochrane 1987; Ellender <i>et al.</i> , 2010b; Potts 2003; Richardson <i>et al.</i> , 2009; Rouhani 2004; Weyl <i>et al.</i> , 2010.

The chronology of the literature broadly reflects the fishery issues and broader political economy each period (Table 3). The literature is thus reviewed chronologically according to these dominant themes in the sections below.

Table 3 Inland fishery literature dominant themes by period. (after McCafferty *et al.*, 2012)

Period	Research Focus
<1940	Focus on inventory surveys of inland waters and the suitability for the introduction of edible and sport fish
1940-1960	The establishment and maintenance of freshwater fish
1960-1970	Sport fisheries and quantifying recreational angling. Developing eel fisheries.
1970-1980	Prospects for inland fisheries exploitation and utilising inland waters for rural development in homeland areas. Angling development
1980-1990	Continued emphasis on fisheries potential, although some focus is placed on population dynamics of the target species. Also increased research on management of inland water bodies. Quantifying angling also emerges.
1990-2000	Fish population assessments and fisheries potential. Increased emphasis on the management on inland waters.
2000-2010	Focus on fish as a vehicle for rural development and poverty alleviation. Valuation studies. Quantifying inland fisheries utilisation and in depth studies on fish population dynamics

2.3 Colonial Era Fish Inland Fisheries Development Policy

The formal development of inland fisheries in South Africa dates back to the 19th century when the Cape Colonial government promulgated the first fishery legislation, and invested in institutions to develop inland and marine fisheries. It is interesting that the colonists' initial focus was not on the development of South Africa's rich marine fishery resource, but on the establishment of traditional British freshwater angling species in the '*tantalisingly empty streams*' (Harrison, 1951). Their motivation was articulated by Thompson (1913) who wrote:

'The Colonist, especially of British blood, seems unable to finally settle down in a new land until many of the animals and plants that minister to his pleasure or profit in the homeland have followed him: his horse and dog, his beehives and flocks, his fruits, his fish and even his oysters – none are as good in his eyes as those that come from his 'own country'.

This strong desire gave rise to a remarkably comprehensive policy of institutional support to develop the country's inland fisheries based on the stocking of alien fish, which remained largely in place for over a hundred years.

The series of fisheries legislation promulgated by the Cape Colonial legislature in the late 19th century provided a governance framework for inland fisheries development. Act 10 of 1867 provided for “*encouraging the introduction into the waters of this Colony of fishes not native to such waters*”. This was followed by Law 21 of 1884, that provided for the introduction of trout, and which was revised and expanded as the Cape Colony Fish Protection Act (Act 15 of 1893). This suite of legislation and subsequent amendments defined fishing rights and areas, prescribed fishing license fees and criminal sanctions for violations, provided for research, and other measures to promote an inland fishery development. The measures included the building of a state hatchery at Jonkershoek under the responsibility of the Department of Agriculture, the appointment of a marine biologist (John D. Gilchrist), a bounty on predators such as otters, and resource users' associations such as the *Western Game and Trout Establishment Association*, later reconstituted as the *Piscatorial Society* (Anon., 1944; Thompson, 1913; Harrison, 1956). Similar initiatives to establish trout followed in the Eastern Cape and the Natal colony (Thompson, 1913; Anon, 1944; Anon, 1950a). The development potential of the Cape's marine fisheries were of lower priority to the Colonial government initially, but were supported by the same legislation. Public sector institutional support was consolidated with the establishment of the Cape Province's Inland Fisheries Division in 1942 (Anon, 1944). As South Africa was now a Union of four provinces, provision for cooperative governance was made in 1942 with the establishment of the Joint Provincial Inland Fisheries Advisory Board (Anon., 1944). Thus, from the outset, South African inland fisheries were governed by what may be considered to be 'modern' policies and institutions.

Inland Fisheries Division Director, SD Hey, articulately summarised the Union's inland fisheries policy vision in 1926 (Hey, 1926b). This included the balancing of social, economic and environmental considerations within the department's institutional mandate:

'The primary object is to develop all inland waters to their maximum productive capacity selecting the most suitable species of fish from the viewpoints of table and sporting qualities. In doing so, there should be a nice balance between the interests of economic fisheries, sport fishing and the natural fauna... The Department is well aware of its obligation to provide well stocked waters for resident anglers and for the attraction of visitors. Care should be taken to preserve the indigenous fish fauna in certain areas for scientific and educational purposes.'

The economic, social and environmental objectives of the inland fisheries policy were explicit, and were articulated in the mission of the Joint Provincial Inland Fisheries Advisory Board (Anon. 1944):

'The aim of the Joint Provincial Inland Fisheries Advisory Board is to develop the inland waters of the Union, firstly for economic, and secondly for sporting purposes by the following means:

- 1. To take stock of the assets by a thorough survey of all inland waters.*
- 2. Where it is found that indigenous species of economic value are established, these shall be encouraged and the introduction of exotic fish shall be prohibited.*
- 3. Where it is found that waters are unstocked or stocked only with inferior species of fish, then the most suitable species of exotic fish shall be introduced.*
- 4. All waters shall be maintained in as favourable a condition as possible by taking measures to prevent pollution by trade wastes, etc.*
- 5. The adoption of inland fishery legislation which shall be applicable to all provinces.'*

The mandate of the Cape Province's 'Inland Fisheries Division' was expanded to include the conservation of terrestrial fauna and flora in 1952, and the organisation was renamed the 'Department of Nature Conservation' (Hey, 1977). Although the Cape's state hatcheries at Jonkershoek, Pirie and later at Amalinda continued to operate in line with the established inland fishery policy, this institutional change arguably sowed the seeds of the demise of state-supported inland fishery development.

2.4 Non-native Fish Introductions for Inland Fisheries Development

Inland fisheries development began with the importation and spread of non-native fishes in South Africa during the 19th century Colonial period. The details of the fish introductions are described in De Moor and Bruton (1988), and more recently discussed in van Rensburg *et al.* (2011) and Ellender and Weyl 2014. Early introductions of alien fishes primarily focused on providing opportunities for recreational angling.

The common carp, *Cyprinus carpio* Linnaeus 1758, was the first of the popular non-native recreational angling species to be introduced into South Africa (de Moor and Bruton, 1988). It was initially introduced in the 1700's by British colonists for ornamental purposes, and for its believed potential to provide food from South Africa's apparently "barren" rivers (Anon, 1959; Bruton and Merron, 1985; Bruton and van As, 1986; de Moor and Bruton, 1988; Skelton, 2001; van Rensburg *et al.*, 2011). Reports produced by the Inland Fisheries Department, under the Cape Provincial Administration, document that the first official introduction took place in 1896 when *C. carpio* were imported from England to the Jonkershoek hatchery in the Cape and, in the same year, to the Pirie hatchery in King Williams Town from Scotland (Anon, 1944; Anon, 1950a, 1950b). However, de Moor and Bruton (1988) noted that numerous other introductions of *C. carpio* probably occurred during the 19th century. Examples of such "unofficial" introductions include an article published in *The Cape Argus* in 1859 which documents the introduction of six *C. carpio* into the Botanical Gardens reservoir in Cape Town by Mr. C A Fairbridge, a member of the Cape Legislative Assembly (Anon, 1959). In addition, an article in *The South African Advertiser and Mail* refers to the introduction of three *C. carpio* from England by a Mr Ekstein into the pond on his estate (Harrison, 1966b). Following their official introduction to the Cape, *C. carpio* were distributed to farm dams across South Africa in 1900 (Anon, 1944). After the realisation of their impacts on natural ecosystems, including the introduction of parasites as well as their ability to drastically alter habitats, stocking activities were ceased and legislation was created in the 1920's in order to halt the further spread of *C. carpio* (Harrison, 1959; de Moor and Bruton, 1988).

The successful introduction of non-native salmonids into South Africa occurred in the latter part of the 19th century. The brown trout, *Salmo trutta* Linnaeus, 1758, a European species, was imported to the Boschfontein Hatchery in Natal in 1890 (Pike, 1980), and rainbow trout, *Oncorhynchus mykiss* Walbaum 1792, native to the Pacific coast of North America, were introduced to the Jonkershoek Hatchery in the Cape in 1897 (Manning, 1908; Anon, 1944; Skelton, 2001). Their introduction was a consequence of British colonists dissatisfaction with the lack of "suitable" indigenous angling fishes, and the realisation that many of the streams draining mountainous areas in the Cape and Natal would provide suitable trout habitat (Skelton, 2001). Following several importations from European countries, the first hatcheries to successfully produce trout were established at Jonkershoek, near Stellenbosch (Anon, 1944), and Pirie, near King Williams Town, in the Cape Province in the late 1890's (Harrison, 1954b). Just over thirty years later, several other hatcheries had been installed in different parts of South Africa including Tetworth and Lydenburg hatcheries in Natal and Transvaal respectively (du Plessis, 1961; Pike, 1980).

A large proportion of literature on trout fisheries from the Colonial period is contained within the *Piscator*, the journal of the Cape Piscatorial Society (established in 1931), which was first published in 1947 (www.piscator.co.za). Articles within the journal, as well as other popular publications, include accounts of the first introductions of trout into the country as well as attempts to acclimate and introduce them to various parts of the country (Day, 1932; Harrison, 1948; Anon, 1950a; Harrison, 1951; Harrison, 1953c; Anon, 1961/62; Donnelly, 1965; Harrison, 1972/73; Harrison, 1975).

Four centrarchid species, fishes native to North America were introduced into the country for angling purposes: the largemouth bass, *Micropterus salmoides* Lacepède, 1802; the smallmouth bass, *Micropterus*

dolomieu Lacepède 1802; the spotted bass, *Micropterus punctulatus* Rafinesque 1819, and the Florida bass, *Micropterus floridanus* (de Moor and Bruton, 1988; Skelton and Weyl, 2011). *M. salmoides* were first introduced in 1928 at the Jonkershoek hatchery in the Cape (Harrison, 1936; Anon, 1944, Harrison, 1952a, b), and were followed by *M. dolomieu* in 1937 (Anon, 1944; Anon, 1952; Harrison, 1953a; b; 1954b; Harrison 1962/63). These two species were introduced into various localities in the province and, in 1952, stocked in the newly established Umgeni hatchery in Natal which undertook their stocking in that province thereafter (Pike, 1980). *M. punctulatus* was introduced in 1939 into various localities in Natal and the Cape Province (Harrison, 1965/65a), but failed to establish successfully, and its distribution is now limited to only a few localities (Crass, 1955; de Moor and Bruton, 1988; Skelton, 2001). In 1980, *M. floridanus* was introduced to the Umgeni hatchery in Natal for experimental purposes (de Moor and Bruton, 1988) and is now present throughout the province (Skelton, 2001). Both *M. salmoides* and *M. dolomieu* were introduced widely around the country through the efforts of both anglers and conservation authorities and, as with trout, a large amount of literature on these introductions is available in the *Piscator* journal as well as other popular publications (Harrison, 1936; 1948; 1951; Anon, 1952; Harrison, 1952a,b; 1953a/b, 1954a; Crass, 1955; Harrison 1962/63; 1964/65; 1965/66; 1967/68; Coetzee, 1977; McVeigh, 1979a; Anon, 1980; Anon, 1981; Joubert, 1984; de Moor and Bruton, 1988). Unlike trout fisheries in South Africa – especially those located on reservoirs – which generally require continual stocking as populations cannot reproduce due to adverse ecological conditions, bass fisheries have thrived as a result of these fishes having far wider ecological tolerance limits and the concomitant ability to reproduce in a variety of different habitats (Skelton, 2001; Cooke and Philipp, 2009). These predatory fishes prompted many subsequent introductions of non-native fishes as fodder fish and for additional sport angling (de Moor and Bruton, 1988; Skelton, 2001; van Rensburg *et al.*, 2011).

Early research (pre-1940) therefore concentrated on surveying South African impoundments in order to assess their suitability for stocking a variety of non-native fishes. The earliest report on such suitability is Hey (1926a,b), while subsequent introductions of non-native fishes are comprehensively reviewed by de Moor and Bruton (1988). This focus on suitability of water for sport fishes, and the subsequent importation of a variety of fishes for recreational angling, dominated fisheries development and national stocking programmes until the mid-20th century (van Rensburg *et al.*, 2011). As a result inland fisheries were primarily developed for recreational angling (Hey, 1926a/b; McVeigh, 1978; Andrew *et al.*, 2000; Weyl *et al.*, 2007).

2.5 Interest in Fish as Food: 1960's Onwards

An increasing realisation that fisheries could be utilised for commercial purposes and for rural development and food security began in the 1960's, and this focus has continued through to the present. Inland fishery policies in the South African Union (1910-1961) and subsequently the Apartheid-era Republic (1961-1994) included the promotion of the sustainable use of indigenous species as well as established alien species such as carp (Anon. 1944, McCafferty *et al.*, 2012).

Under the Apartheid government's "homeland development policy", implemented by the then Department of Development Aid (DDA), subsistence fishery projects for food security were actively promoted in rivers and impoundments in the former 'homelands' in the 1970's and 80's with varying levels of success (Batchelor, 1988; McCafferty, 2012). DDA support included the appointment of a full-time fishery scientist and local fishery officers, research and extension support, and a fishery diploma course at the Tompi Selekla Agriculture College. Constraints included administrative issues associated with permits, the linking of fisheries development to the provincial Nature Conservation departments instead of Animal Production, and the lack of public sector human capacity to promote fisheries development (Batchelor, 1988).

The dam-building era of the 1960's and 70's stimulated research into the fishery potential of the new impoundments, but most commercial fishery projects failed due to their low productivity and the lack of a market for freshwater fish (McCafferty *et al.*, 2012). Studies that investigated the fisheries potential of dams for the establishment of capture fisheries included Jackson (1973; 1974; 1976; 1981), Bruwer and Claasen, (1978), Whitehead, (1978) Bruwer (1982), Koch and Schoonbee (1980), Eccles *et al.* (1983), Schramm (1993), Hamman (1981), Allanson and Jackson (1983), Tomasson (1983), Tomasson *et al.* (1983), Tomasson *et al.* (1985), Cochrane (1987), van Senus (1992) Marshall and Maes (1994), deVilliers

(1998, 2003), Rouhani and Andrew (1998), Andrew (2001), Rouhani (2001; 2003; 2004), Burton *et al.* (2002), Potts (2003), Rouhani and Davies (2003), Potts *et al.* (2004) Richardson *et al.* (2009), Ellender *et al.* (2009), Ellender *et al.* (2010a; b), Weyl *et al.* (2010) and Fouché *et al.* (2013). Research was focused largely on production potential and biological studies on potential target species for the development of harvest strategies (de Villiers, 1998; 2003).

The role of inland fisheries in potentially providing food received attention as part of South Africa's Apartheid homeland development policies of the late 1970's and 1980's (van den Berg *et al.*, 1975; Roode, 1978; van der Waal, 1978a; b; 2000; Mabitsela, 1981; Saayman *et al.*, 1983a; b; Batchelor, 1988; Schoonbee *et al.*, 1995), as well as by development practitioners (de Satge, 1978; Duncan-Brown, 1980; Taylor and Van Der Walt, 1985; Seti, 2002; Allison, 2005). In addition, wider human-ecosystem interaction and livelihood studies highlighted the role of fisheries in customary livelihoods.

A number of authors have described the floodplain fisheries of the Thonga people in Maputaland, and analysed the resource governance issues associated with the building of the Pongolapoort Dam which disrupted the annual flood and associated fishing activities (Tinley, 1964; Coke & Pott, 1971; Jubb, 1973; Heeg and Breen, 1982; LaHausse DeLalouviere, 1987; Merron *et al.*, 1993; Merron and Weldrick, 1995; Jaganyi *et al.*, 2008). van der Waal (2000) and Dederen *et al.* (2001), undertook a socio-biological study of the aquatic resources and their utilisation in an underdeveloped rural region, the Mutshindudi River catchment in Limpopo Province.

The former Orange Free State Province's Nature Conservation Department initiated a policy of issuing concessions for commercial harvesting on its major dams (Gariep, Kalkfontein, Bloemhof, Rustfontein and Krugerdrift) from 1979 onwards (Anon., 1982; Barkhuizen, 2012). However, despite the existence of a policy to accommodate commercial fishing (Angliss and De Villiers, 1999), the operations proved to be economically unsustainable due to the low market value of freshwater fish, and by 2012 only one marginal commercial enterprise was still operating on Bloemhof Dam (L Barkhuizen, Free State Department Economic Development, Tourism and Environmental Affairs, pers. comm., 2012). On Lake Gariep, repeated attempts by government to establish a commercial fishery failed, but a vibrant subsistence and recreational fishery developed organically, generating substantial local socio-economic benefit (Ellender *et al.*, 2009).

From the late 1990's and until the present, literature has increasingly focused on using inland fisheries as vehicles for food security and rural development (Andrew *et al.*, 2000; Andrew, 2001; van der Waal, 2000), and more recently is moving towards assessing the need for policy (Weyl *et al.*, 2007) and qualifying and quantifying resource use (van der Waal, 2000; Ellender *et al.*, 2009; 2010a; b). It must however be noted that, apart from these very preliminary analyses and site specific descriptions on resource use, there is no recent literature available which contextualises inland fisheries with respect to rural development, livelihoods and policy development in South Africa.

The general failure of commercial inland fishing concessions, seen together with the estimated participation in recreational fishing of over two million (Leiboldt and Van Zyl, 2008), and growing small-scale fishing for livelihoods in the post-Apartheid era, has highlighted the need for a revision of inland fishing policy to optimize the potential socio-economic benefits associated with resource utilisation (Weyl *et al.*, 2007, Ellender *et al.*, 2009).

2.6 Biodiversity Concerns Halt Government Support to Alien Fish Stocking

Growing concerns about the impacts of non-native fish species on freshwater ecosystems began to surface in the 1960's and 1970's (Gabie, 1965; Gaigher, 1973; Hey, 1977), culminating in a radical change to the century-old inland fisheries policy (Hamman, 1986). With the provincial conservation departments' policy focus now firmly on conserving indigenous fish fauna, the alien-based fisheries they formerly promoted were now deemed to be problematic from a biodiversity management perspective (Skelton, 1986). The state hatcheries were closed, privatised or converted to breeding endangered indigenous fish species; legal protection for trout was lifted in many areas; and the provincial inland fishery licensing systems largely abandoned, causing an outcry in trout angling circles (Davies, 2002, Rouhani and Britz, 2004).

A number of studies have subsequently documented the impacts of non-native fish introduced to establish inland fisheries (Bruton and Merron, 1985; Bruton and van As, 1986; Ashton *et al.*, 1986; de Moor and Bruton, 1988; Impson *et al.*, 2007; Lowe *et al.*, 2008.; Swartz, 2009; Ellender & Weyl 2014), and the aquatic focus of the provincial environmental departments turned to controlling, and if possible removing non-native fishes from some invaded areas (Marr *et al.*, 2012; Weyl *et al.*, 2013; Impson *et al.*, 2013). South Africa's approach to managing non-native fish impacts and beneficial uses was formalised with the promulgation of the National Environmental Management: Biodiversity Act (NEM:BA) of 2004 and the alien species regulations of 2014. Each non-native fish species is classified in terms of its potential to impact biodiversity and most fisheries species are in a category which stipulates various levels of control.

While this public sector shift was consistent with the provincial conservation mandates, it was not accompanied by a policy review to consider how best to govern inland fisheries to achieve social and economic goals. This effectively ended a century of state-supported inland fishery development. The stocking of trout and other species was still permitted as a privately funded activity, in waters where the threat to indigenous fauna was deemed to be low, but there was now effectively a policy vacuum on the potential public good benefits of stocking alien fish for inland fishery resource use.

2.7 Literature on legislation governing inland water resources

As the research focus and published literature has shifted from the introduction and propagation of non-native fishes, to fisheries development, and more recently the impacts of non-native fishes in South Africa, so too has the legislation regarding the utilisation of inland waters and their resources.

The series of fisheries legislation promulgated by the Cape Colonial legislature in the late 19th century provided a governance framework for inland fisheries development. Act 10 of 1867 provided for “*encouraging the introduction into the waters of this Colony of fishes not native to such waters*”. This was followed by Law 21 of 1884, that provided for the introduction of trout, and which was revised and expanded as the Cape Colony Fish Protection Act (Act 15 of 1893). This suite of legislation and subsequent amendments defined fishing rights and areas, prescribed fishing license fees and criminal sanctions for violations, provided for research, and other measures to promote an inland fishery development. The measures included the building of a state hatchery at Jonkershoek under the responsibility of the Department of Agriculture, the appointment of a marine biologist (John D. Gilchrist), a bounty on predators such as otters, and resource users' associations such as the *Western Game and Trout Establishment Association*, later reconstituted as the *Piscatorial Society* (Anon., 1944; Thompson, 1913; Harrison, 1956).

After the promulgation of the Union of South Africa Act of 1909 which devolved responsibilities for the preservation of fish to the provinces, regulation of fishing activities was largely an administrative function enforced by the South African Police Hey (1977). The Provincial administrations largely provided financial support for the development and protection of non-native species fisheries (Anon, 1936; Day, 1932; Harrison, 1949; Harrison, 1957). The formation of the Inland Fisheries Division in the Cape Province in 1942 preceded the first piece of legislation, the Inland Fisheries Ordinance, No. 12 of 1947, which enacted measures pertaining specifically to the protection of aquatic fauna in inland waters, most notably from water pollution (Hey, 1977). As outlined in Harrison (1949), this protection was in the form of proclaimed areas for non-native trout, black bass, perch and bluegill which could only be angled for with an inland fishing licence; no measures enforced the protection of carp, the sale and transportation of which was illegal. This ordinance expanded into the Nature Conservation Ordinance, No. 19 of 1974, which prohibited the transport of non-native fish species while still allowing for the protection of species such as trout through closed seasons, bag and size limits, and tackle restrictions (Hamman, 1986). The ordinance also allowed for the use of nets subject to the possession of a licence issued by the Director of Nature and Environmental Conservation. In Natal, the establishment of the Freshwater Fish Protection Ordinance, No. 9 of 1955 and legislation thereof is discussed in Anon (1968) with specific reference made to proclaimed trout and non-trout areas, fishing seasons and licence requirements. This was followed by the declaration of the Natal Nature Conservation Ordinance, No. 15 of 1974, which made no distinction between native and non-native fishes and rendered the use of nets, other than those used for landing fish, illegal. In the Orange Free State, inland fisheries

legislation was first outlined in the Nature Conservation Ordinance, No. 8 of 1969, and stipulated regulations including the enforcement of closed seasons, requirement of a licence for angling or netting, permitted fishing areas, and the importation of live fish. Anon (1970) describes fisheries management and legislation in the Transvaal: the Nature Conservation Division at this time was responsible for implementing fishing licence regulations and using these and other funding sources acquired to develop inland waters for public recreational angling through stocking programmes of native and non-native fishes. The proclamation of the Transvaal Nature Conservation Ordinance, No. 12 of 1983, amalgamated legislation regarding fisheries similar to that implemented in the Orange Free State.

Hamman (1986) documented the changing attitude of conservation authorities regarding legislation that protected non-native fishes; more specifically, the proposed removal of protective rights assigned to non-native angling species such as trout and bass by the Cape Department of Nature and Environmental Conservation. He referred to the need for a change in legislation that afforded protection to native species whilst no longer actively propagating non-native species at state hatcheries for distribution into inland waters. Walmsley and Pike (1989) outlined the legislation surrounding non-native species in South Africa and stressed the need for a revision of policy; this was accompanied by a document describing future guidelines for the promulgation of legislation which regulated non-native species importations (Anon, 1989).

The proclamation of the National Water Act (NWA, 1998) and the National Environmental Management Act (NEMA, 1998) in post-Apartheid South Africa, and the resultant governance measures introduced regarding inland fisheries, is discussed in Weyl *et al.* (2007). The authors note that access rights to all water is administered by the Department of Water Affairs (DWA) while resources, such as fish, are controlled by provincial governments as stipulated in the NEMA which promotes sustainability, biodiversity, and equitable allocation of resources. Provincial governments reserve the right to administer licenses for recreational, subsistence and commercial fishing, however, the paper illustrates the lack of cohesion between government departments and the fact that there is no national lead agent enforcing an overall policy regarding access rights to particular dams and their resources.

The National Environmental Management: Biodiversity Act (NEM:BA) was gazetted in 2004 within the principles outlined in the NEMA. The regulations pertaining to non-native fishes within the NEM:BA, and the contentions of recreational anglers regarding these regulations, have led to a profusion of popular articles published within angling magazines such as *Stywe Lyne* as well as official “position papers” published by various angling bodies such as the Federation of South African Flyfishers (Bainbridge *et al.*, 2005) and the Trout Action Group (TAG), in coordination with the Eastern Cape Flyfishers Club (Fick, 2009). These publications largely object to the NEM:BA. Conversely Roux *et al.* (2006), in a report which summarises requirements for the conservation of inland water biodiversity, describe the NEM:BA (2004) as well as the NWA (1998) as the two most important pieces of legislation concerned with the implementation of conservation measures in South African inland waters.

McCafferty *et al.* (2010) describe the structural change in inland fisheries governance. Where previously there was no national lead agent in inland fisheries, the mandate for this function came under the auspices of the Department of Agriculture in May 2009, which subsequently became the Department of Agriculture, Forestry and Fisheries (DAFF). The policies of the DAFF, which include food security, economic empowerment and poverty alleviation now apply to the development of South Africa’s inland fisheries resources, the implication being increased impetus to develop fisheries to achieve the above policies within the DAFF mandate.

2.8 South Africa’s Inland Fisheries by Sector

South African inland fisheries are somewhat anomalous in that recreational fishery development preceded subsistence and commercial resource use being recent developments (Smith 1986; Andrew *et al.*, 2000; Weyl *et al.*, 2007; Ellender *et al.*, 2009). This can be attributed to several factors including the relatively recent construction of inland impoundments, the associated lack of a fishing tradition in rural communities, as well as the lack of supporting developmental policies.

2.8.1 Recreational Fisheries

"Recreational anglers...utilise the resource primarily for leisure purposes but may sell some of their catch... They generally have permanent employment, use high technology gear consisting of a fibreglass or graphite rod, and a multiplying or spinning reel, and release, consume or sell a portion of their catch." (Ellender *et al.*, 2009)

It is estimated that more than 1.5 million people are involved in freshwater angling in South Africa (Leibold and van Zyl, 2008). For the past century, recreational angling has been the dominant activity on South African impoundments (Hey, 1926a; b; Anon, 1970; Anon 1971; McVeigh, 1978; Andrew *et al.*, 2000; Weyl *et al.*, 2007). It is therefore surprising that this sector remains largely un-quantified and that the only attempts at quantifying recreational angling have been in the Transvaal in the 1960's (Le Roux, 1965) and 1970s (Cadieux, 1980a, b). Besides these studies, only two other studies have been undertaken: by van der Waal (2000) who looked at fishery resources in the Mutshundudi River catchment in Limpopo province; and by Ellender *et al.* (2009) and Ellender *et al.* (2010a; b) which described user group dynamics and quantified the harvests from Lake Gariep, South Africa's largest impoundment.

The economic value of recreational fisheries is substantial. A non-peer reviewed study on the value of recreational fisheries in South Africa, commissioned by the South Africa Deep Sea Angling Association (SADSAA) in 2007, showed that the expenditure by freshwater anglers contributed significantly to the national economy (Leibold and Van Zyl, 2008). The study estimated that the average expenditure on angling related equipment and activities by anglers affiliated to angling clubs was ZAR 7 500 per angler per year, and that the total economic impact of these anglers, who represent about 10% of participants, was in the region of ZAR 900 million per annum. While up-calculations of this value for the unaffiliated anglers cannot be made with any confidence, the report demonstrates the economic contribution that the recreational sector makes to the national economy.

It is evident that recreational angling in South Africa remains the major use of inland fisheries, however, since the mid-1990's there appears to have been an increase in the utilisation of inland fisheries by people whose main motivation for using the resource is subsistence (van der Waal, 2000; Weyl *et al.*, 2007; Ellender *et al.*, 2009).

2.8.2 Small-scale Fisheries

"The understanding of the term 'small-scale' varies internationally (FAO, 2013). In this report we use the term 'small-scale fishing' as defined in the DAFF Marine Small-Scale Fishing Policy (DAFF, 2012), 'Small-scale fishing means the use of a ... living resource on a full-time, part-time or seasonal basis in order to ensure food security and livelihood security. For the purposes of this policy, fishing also means the engagement (by men and women) in ancillary activities such as, pre- and post- harvesting (including preparation of gear for harvesting purposes), net making, boat building, beneficiation, distribution and marketing of produce which provide additional fishery-related employment and income opportunities to these communities.'

The emergence of small-scale fisheries on South African impoundments is a fairly new phenomenon associated with the post-Apartheid era. This is because many of South Africa's rural communities do not have an angling tradition, and there is a lack of an institutional framework to facilitate managed and sustainable access to the fish resource in many inland waters (Weyl *et al.*, 2007). Small-scale fishing activity was not recognised during the Apartheid era, and although this activity has not yet been provided for in the legal reforms of the post-Apartheid constitutional democracy, water management authorities now tend to tolerate informal fishing activities by local communities, and in some instances have attempted to promote fishing projects. As a result subsistence use of impoundments is increasing (Weyl, *et al.*, 2007).

In a case study conducted to assess the fisheries resources in the North West Province, Weyl *et al.* (2007) reported that of the 10 dams surveyed, six had some form of small-scale angling activity. On Lake Gariep, small-scale angling dominated the fishery, accounting for 61% of fishing effort (Ellender *et al.*, 2009). Ellender *et al.* (2010a) also showed that there were some 450 regular subsistence anglers making use of the resource from adjacent settlements (Ellender *et al.*, 2010b). There are few other descriptions of small-scale

angling on impoundments and available reports focus on the Eastern Cape Province (Andrew *et al.*, 2000, Rouhani, 2003). In the Ntenetyana Dam, Alfred Nzo District Municipality, Eastern Cape, approximately 20-30 fishers from various communities living around the dam are currently angling in the dam using handlines (Rouhani, 2003). Therefore, although largely undocumented, small-scale use of inland fisheries is likely to be much larger than is indicated by the available publications.

Recent anecdotal evidence (Venter, 2012; Fouché *et al.*, 2013), and surveys undertaken during the present study (Chapter 4), indicate that the small-scale sector is becoming an increasingly important sector in rural livelihoods needs consideration in the long term planning process for inland fisheries.

2.8.3 Commercial Fisheries

A commercial fishery is operated by a private individual who is granted access at provincial level to harvest a pre-determined yield from a dam. The enterprise is profit-oriented, striving to minimise production costs and to maximise efficiency in production (Weyl et al., 2007).

Commercial inland fisheries are undeveloped as a result of a history of limited access to resources, low demand for fresh water fish, the lack of an inland fisheries policy and unclear fisheries management objectives (Weyl *et al.*, 2007). Commercial fishing in the form of single licences is only permitted on a limited scale on a few dams (e.g. the Gariep, Bloemhof and Moletedi Dams) (Weyl *et al.*, 2007). Although commercial fisheries remain largely undocumented, historically commercial fisheries operated on a few impoundments including the Kalkfontein Dam, Bloemhof Dam (Orange/Vaal River system) and Darlington Dam (Sundays River system) (Anon., 1982; Merron and Tomasson, 1984; Potts, 2003). Despite these attempts to develop commercial fisheries on larger impoundments in South Africa, and despite a number of studies on the fisheries potential of these dams for the establishment of capture fisheries (e.g. Koch and Schoonbee, 1980; Hamman, 1980, 1981; Allanson and Jackson, 1983; Cochrane, 1987, Andrew, 2001), the commercial viability of these enterprises has been marginal.

There have been numerous attempts to develop formal small-scale commercial fisheries in rural communities (e.g. Jackson, 1980; Schramm, 1993; Andrew, 2001). The more recent ones are summarised in Table 3. Unfortunately, few fisheries developed or remained operational after the initial project interventions. The reasons for this lack of success are unclear, but have been attributed to: the perceived low value of the resource; the lack of historic involvement in fishing; the limitation of artisanal and subsistence fishing to the former homeland areas under the Apartheid era; a cultural resistance to fishing (Andrew, 2001); and the concerns by management authorities that the support of small-scale and commercial use may threaten fish populations (Andrew *et al.*, 2000).

The overriding reason for the lack of development of commercial inland fisheries is probably economic. Recent estimations on profitability of various commercial fisheries options on Lake Gariep (Potts *et al.*, 2004) and Darlington Dam (Weyl *et al.*, 2010) found that the low fish price (ZAR 6-10/kg) coupled with the absence of a formal marketing system for inland fish precluded the economic viability of even small commercial enterprises in these water bodies. In addition, they showed that employment possibilities in commercial fisheries were relatively low, and pointed out that commercial fisheries would result in considerable conflict with other users of the resource. As a result, employment gains from commercial fisheries were likely to be countered by employment losses from tourism at sites where recreational fisheries were well established.

Commercial fisheries assessments and recent developments are summarised in Table 3. Despite such assessments, the only marginally successful, non-subsidised commercial fishery still in operation is on Bloemhof Dam in the Free State. While catch data from these fisheries are returned to local nature conservation offices and are compiled in internal reports, they are not published in an openly accessible form. As a result the literature on commercial level enterprise and catch rate is extremely sparse and comprises of non standardised or even anecdotal data. Whitehead (1978), for example, reports catches of one ton per day for 100 days from Darlington Dam and Andrew *et al.* (2001) report catches of 3.6 tons in 120 days for Tyefu Dam in the Eastern Cape. Such data lack the information on fishing effort required for any further analyses. The data available is illustrated for Lake Gariep, South Africa's largest inland water body. The fisheries potential of this dam was recognised as early as 1972 (Hamman, 1981), and

Hamman (1981) developed a detailed management plan for the fishery. Despite this, commercial fishery development remained dormant until 1992, when a small-scale commercial operation was initiated near the dam wall. This operation failed after some years, but Potts *et al.* (2004), reported two commercial operators on the dam in 2002. To date, the only reported data for any of these formal ventures is a short mention of commercial catches in Potts *et al.* (2004) which states that “a total of 4160 fish with a combined mass of 10 292 were captured between January 2000 to January 2001 in the gillnet and seine net fishery. The dominant species in terms of number and mass was the common carp and sharptooth catfish, while the other species were caught in very small numbers”(p. 22).

Fisheries assessments depend on the availability of commercial and recreational catch data and compilations of available raw data are an urgent national requirement that are necessary not only for assessments of yield, but also for decision making and economic feasibility analyses.

Table 4 Summary of literature on subsistence and commercial fisheries development by water body (after McCafferty *et al.*, 2012).

Water body	Province	Description	Main References
Gariep Dam	Free State; Eastern Cape	Fisheries assessments and various attempts to develop fisheries	Ellender <i>et al.</i> , 2010; Potts <i>et al.</i> 2004 Winker 2007; Jackson 1981; Hamman 1981
Darlington Dam	Eastern Cape	Commercial fishery 1970s & economic feasibility study conducted in 2010	Whitehead 1978; Jackson 1973; Weyl <i>et al.</i> , 2010
Umtata Dam	Eastern Cape	Attempt to develop fishery unsuccessful	Schramm 1993; Andrew 2001
Pikoli; Tyefu; Kat River, Laing, Lubisi, Sinqemeni, Sheshago, Binfield Park, Dimbaza & Ndlambe	Eastern Cape	Attempts with varying success to set up small scale fisheries 1999-2000.	Schramm 1993; Andrew <i>et al.</i> 2000; Andrew 2001; Potts <i>et al.</i> 2006; Potts 2003
Ntenetyana Dam	Eastern Cape	Attempt to set up fishery 2002-2003	Rouhani 2003
Cata & Mnyameni dam	Eastern Cape	Development of recreational fishery	Rouhani <i>et al.</i> , 2010
Xonxa dam	Eastern Cape	Fishery established in 1980 (unsuccessful); Fishery potential re-evaluated and quantified for yellowfish and catfish in 2010	Schramm 1993; Duncan-Brown 1980; Burton <i>et al.</i> , 2002; Richardson <i>et al.</i> , 2009
Macubeni, Indwe & Nqadu	Eastern Cape	Fishery assessment indicated limited scope for development of moggel, yellowfish and tilapia proposed.	Burton <i>et al.</i> , 2002
Pongolapoort Dam	KwaZulu-Natal	Gillnet fishery targeting Mozambique- and redbreast tilapia. Attempts to develop community-based recreational fishery	Jubb 1973; Alletson <i>et al.</i> , 2004
Boskop dam	North West	Assessment	Koch & Schoonbee 1980
Disaneng Dam	North West	Small fishery present – Proper assessment	Rouhani 2003; Weyl <i>et al.</i> , 2007
Setumo, Taung, LotlamoengDam	North West	Assessments indicated commercial fishery not viable.	Rouhani 2003; Weyl <i>et al.</i> , 2007
Ngotwane Dam	North West	Gillnet fishery for catfish proposed	Rouhani 2003; Weyl <i>et al.</i> , 2007

Table 4 (cont.)

Water body	Province	Description	Main References
Molatedi dam	North West	Existing commercial fishery and gillnet fishery for catfish and tilapia proposed	Rouhani 2003; Weyl <i>et al.</i> , 2007
Madikwe dam	North West	Gillnet fishery for catfish proposed	Rouhani 2003; Weyl <i>et al.</i> , 2007
Lindleyspoort; Koster; Bospoort & Vaalkop dam	North West	Various recommendations on appropriate fisheries development	Rouhani 2003; Weyl <i>et al.</i> , 2007
Roodekopjes dam	North West	Proposed gillnet fishery for catfish and tilapia.	Rouhani 2003; Weyl <i>et al.</i> , 2007
Doorndraai, Piet Gouws & Mutshindudi river	Limpopo Province	Assessed	Batchelor 1974, Schoonbee <i>et al.</i> , 1995, Dederen <i>et al.</i> , 2001, van der Waal 2000
Vaal dam	Gauteng Province	Assessed	Cadieux 1979 1980, 1981
Hartbeespoort dam	Gauteng Province	Assessed Remediation Programme with catfish and carp harvests.	Bruwer 1982; Cochrane 1987, Koekemoer & Steyn 2005
Loskop, Barberspan & Komati river	Mpumalanga Province	Assessment	Clark 2004
van der Kloof dam	Northern Cape	Fishery for yellowfish and mudfish proposed	Tomasson <i>et al.</i> , 1985; Allanson & Jackson (eds.) 1983
Voëvlei and farm dams	Western Cape	Fishery for catfish and carp	Anon. 2014

2.8.4 Managed Sport Fisheries

An important, but largely undocumented element of inland fisheries is the commercial management of private dams and public waters for sport fishing, particularly trout fishing which form the basis of a substantial tourism based local economy in suitable areas of Mpumalanga, KwaZulu-Natal and the Eastern Cape (Hecht and Britz, 1990; Du Preez and Lee, 2010).

The trout fishery and associated economy of Rhodes Village in the Eastern Cape was surveyed by Du Preez and Lee (2010), highlighting the value of recreational fishing as a means of stimulating tourism based local economic development (LED). A unique inland fishery management system for the local self-sustaining trout population has been created whereby recreational trout fishing in the rivers and streams in and around the Rhodes village is managed on behalf of riparian landowners by private individuals, the Mosheshs' Ford Angling Club and the Wild Trout Association (WTA). The waters include the upper Kraai, Bell, Klopershoekspruit, Vloikraalspruit, Bokspruit, Sterkspruit and Riflespruit. Recreational anglers pay a fee to fish and may also employ the services of a professional angling guide if desired (Du Preez and Lee, 2010).

Another example, based on a native species, is the tiger fishing charter operations which exist on the Pongolapoort Dam (www.pongolagamereserve.co.za).

2.9 The Suitability of Inland Waters for Fisheries Development

2.9.1 Fishery Productivity of South African Dams

South Africa is a water scarce country and, apart from historic fisheries on the Pongola Floodplain in northern KwaZulu-Natal (Merron and Weldrick, 1995), and the Orange River in the Northern Cape (Heeg and Breen, 1982), opportunities were not widely available for fisheries to develop until the dam building era of the 20th century (Andrew *et al.*, 2000). The primary function of these impoundments was to supplement urban and

agricultural water supplies, as well as for hydroelectricity. As a result, approximately 3150 impoundments with a surface area >1.2ha have been constructed countrywide (DWA, unpublished database) (Fig. 5). During the period from 1800 to 1940, impoundment numbers increased steadily to approximately 400, and since then that figure has increased by more than six times (Fig. 6). These impoundments have created significant inland water resources amounting to a surface area of more than 3000 km².

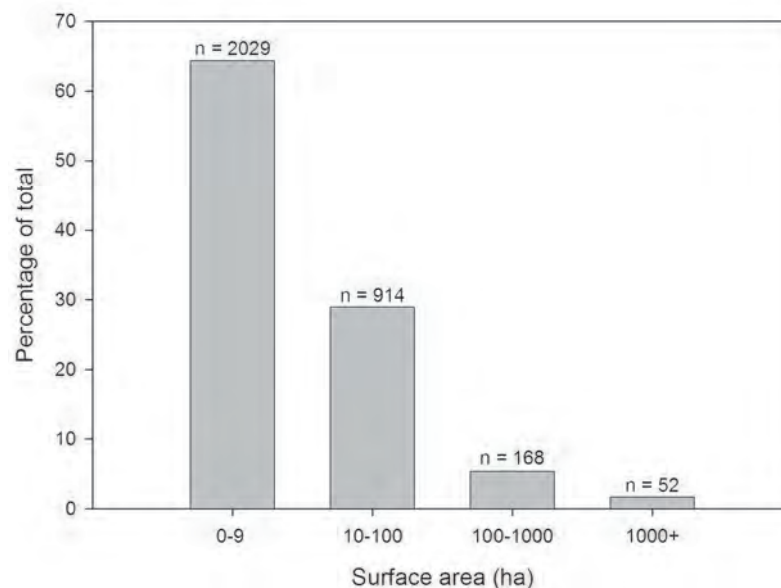


Figure 5 Size of constructed impoundments in South Africa measured as surface area. Source: Department of Water Affairs database (after McCafferty *et al.*, 2012)

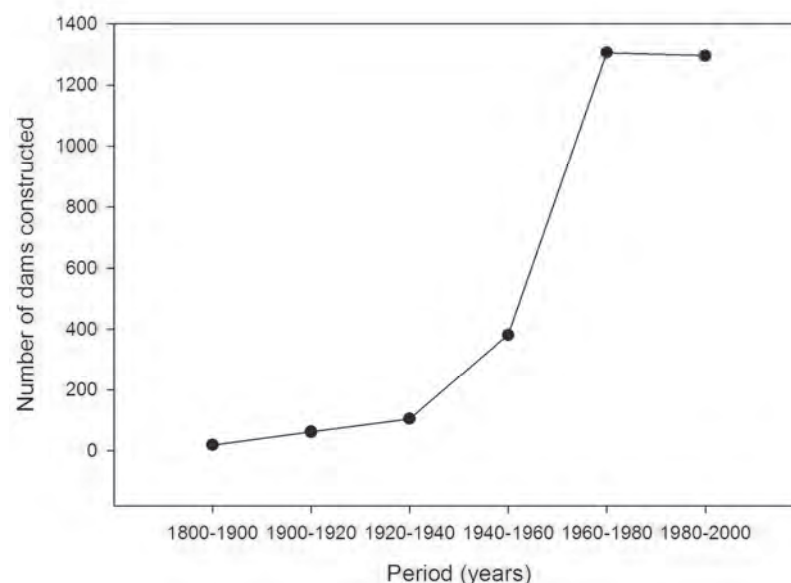


Figure 6 Construction of impoundments in South Africa between 1800 and 2000. Source: Department of Water Affairs database (after McCafferty *et al.*, 2012)

There are almost no studies on annual harvest rates from inland water bodies in South Africa. Annual catch rates have only been determined for recreational fisheries in Hartbeespoort Dam (Cochrane 1983), Lake Gariep (Ellender *et al.*, 2010a), and Darlington Dam (Weyl *et al.*, 2010). In each of these dams estimates are based on one-year assessments because of the lack of dedicated monitoring surveys. It is not known where the National inland fisheries yield of 900 t yr⁻¹ that is reported by the FAO (FAO, 2003) was derived from but it most likely includes the 695t yr⁻¹ estimated from recreational fishers in Hartbeespoort Dam in the 1980's (Cochrane, 1983). An estimate of total inland fisheries production in South Africa of 2300 t yr⁻¹ is provided in FAO reports on inland fisheries in southern Africa (Marshall and Maes, 1994; Van den Bossche and Bernacsek, 1990).

As a result of this lack of prior fisheries data, direct estimates of fish production cannot be determined, and all assessments of potential fish yield for South Africa are derived from applying empirical relationships to morphological data and chemical data. Such relationships, like the Schlesinger and Regier (1982) global, temperature-adapted morpho-edaphic index (MEI) model, only give rough indications of potential fish yield. These are summarised in Table 4. A conservative average fish production per hectare, based on documented studies indicates that the potential fish production from these water bodies could potentially yield in the 10,000-20,000 t yr⁻¹. Due to this relatively low yield, small-scale and recreational fisheries with their high user participation rates are likely to yield higher socio-economic benefits than commercial fisheries, which require large volumes of fish with few operators.

Table 5 Summary of fish production and calculated annual production per ha from studies on South African impoundments

Province	Water body	Surface area (ha)	Species	Actual estimate	Reference
Eastern Cape	Darlington Dam	4000	<i>L. umbratus</i>	1t day ⁻¹ -100 days	Whitehead, 1978
Eastern Cape	Darlington Dam	4000	<i>C. carpio</i>	11.3t yr ⁻¹	Weyl <i>et al.</i> , 2010
			<i>L. aeneus</i>	0.15t yr ⁻¹	
			<i>C. gariepinus</i>	11.5t yr ⁻¹	
			<i>L. umbratus</i>	0.1t yr ⁻¹	
			<i>A. mossambica</i>	0.25t yr ⁻¹	
			<i>O. mossambicus</i>	0.15t yr ⁻¹	
Eastern Cape	Tyefu Dam		<i>L. umbratus</i>	3.6t -120 days	Andrew 2001
Free State/EC	Gariep Dam	35956	<i>C. gariepinus</i>	6.1t yr ⁻¹	Ellender <i>et al.</i> 2010
			<i>L. capensis</i>	6.3t yr ⁻¹	
			<i>L. aeneus</i>	6.75t yr ⁻¹	
			<i>C. carpio</i>	70.6t yr ⁻¹	
			<i>All species</i>	89t yr ⁻¹	
North West	Hartbeespoort Dam	2000	<i>C. gariepinus</i>	102t yr ⁻¹	Cochrane, 1987
			<i>O. mossambicus</i>	144t yr ⁻¹	
			<i>C. carpio</i>	449t yr ⁻¹	
			<i>All species</i>	695t yr ⁻¹	
			<i>All species</i>	695t yr ⁻¹	
KwaZulu-Natal	Pongolapoort	13278	<i>All species</i>	7.5 t yr ⁻¹	Batchelor 1989
Limpopo	Hudson Nstanwisi	515	<i>All species</i>	3.5 t yr ⁻¹	Batchelor 1989

2.9.2 Potential Fishery Production from Small Water Bodies

Fisheries in the southern African region, an area encompassing those countries belonging to the Southern African Development Community (SADC), are primarily located on major lakes e.g. Lake Tanganyika or large man-made dams e.g. Kariba (Marshall and Maes, 1994). In many cases, the potential for further development of these fisheries is limited and some are already considered to be maximally- or overexploited (Marshall and Maes, 1994). In a report produced for the FAO, Marshall and Maes (1994) recognise that as a result of its arid to semi-arid climate and low, unpredictable rainfall, the southern African region has many small reservoirs constructed for water supply purposes that have significant fisheries potential but which are largely undeveloped. The report presents an integrated approach that reviews research and management strategies for small water bodies throughout the SADC region, their potential productivity, and approaches for their future development.

Unlike other countries in the SADC, which have significant amounts of fisheries data, South Africa did not join the SADC until 1994 and therefore data on small water bodies presented in the review for this country are not comprehensive. That which is presented highlights South Africa's limited natural lake area, large number of reservoirs, and fish yield which, in contrast to other SADC countries, is largely accounted for by recreational anglers. While data deficient, the report does provide an estimate of total fish production in South Africa of 2300 t yr⁻¹. A map illustrating all the South African impoundments is also included in the report. Importantly, the Marshall and Maes (1994) review also makes mention of the potential that stock enhancement may have in improving the productivity of small reservoirs in the region and highlights the introduction of non-native species in South Africa as an example.

2.9.3 Attempted Interventions to Establish Fisheries

Attempts to establish capture fisheries in inland waters date back to the 1970's. Few have been successful and while there is some literature on the establishment of some fisheries (see Table 3), no studies exist which evaluate the success rates or the current number of functioning enterprises. Some of the better documented case studies are summarised below.

2.9.4 Stock enhancement using mullet in the Eastern Cape

In the late 1970's and early 1980's a number of Eastern Cape impoundments were stocked with two species of mullet: *Myxus capensis* (Valenciennes, 1836); and *Mugil cephalus* Linnaeus 1758 (Bok 1983). The fingerlings were wild caught and subsequently stocked into impoundments to provide opportunities for the development of gill net fisheries. The stocking was aimed at enhancing the fisheries potential of impoundments with mullets, which were more favourable commercially than the resident species (*Labeo capensis* and *Cyprinus carpio*) (Bok 1983). While growth rates and catches were favourable, with yields of up to 500 kg ha⁻¹, the unpredictable recruitment of wild caught fry proved to be a significant bottleneck and constraint to future development of this fishery (Bok 1983).

2.9.5 Fisheries development in rural areas

During the 1970's and 1980's there was a movement toward promoting the use of freshwater fish in impoundments through stocking and training programs in the former homeland areas, and fisheries sections were active in the authorities of Transkei, Ciskei, KwaZulu, Qwaqwa, Venda, Lebowa, Gazankulu and Bophuthatswana (van den Berg *et al.*, 1975; Roode, 1978; van der Waal, 1978a; b; 2000; Mabitsela, 1981; Saayman *et al.*, 1983, Batchelor, 1988; Schoonbee *et al.*, 1995; Andrew *et al.*, 2000). A fishery for wild fish stocks was promoted for a short period in 1979/80 on Xonxa Dam in the Glen Grey District (Duncan-Brown, 1980). These homeland authorities promoted commercial angling from dams, and ran hatcheries to produce fingerlings for stocking purposes (Andrew *et al.*, 2000; Rouhani and Britz, 2004). There is little evidence suggesting that these efforts resulted in significant benefits for the communities involved (Andrew *et al.*, 2000).

In post-Apartheid South Africa, inland fishery projects have been undertaken in a few locations. In the Eastern Cape Province, a community driven fisheries project was undertaken on the Great Fish River, as well as two small impoundments. The fishery in the Fish River Valley was shown to contribute to food security and income generation for the communities living in the area (Andrew *et al.*, 2000). The Rural Fisheries Programme (RFP) of the Department of Ichthyology and Fisheries Science of Rhodes University was commissioned by the Alfred Nzo District Municipality to survey Ntenetyana Dam, to determine its fisheries potential. There was an existent subsistence fishery, and management recommendations indicated that a community-based, small scale- and recreational fishery were feasible (Rouhani, 2003).

Lake Gariep was constructed in 1972 and periodic attempts have been made to harvest fish commercially since 1992 (Potts *et al.*, 2004). In 2004, the Free State Department of Economic Affairs, Environment and Tourism (DEAET) provided support to the Venterstad Community Fisheries Project (VCFP), which aimed to provide poverty relief to historically disadvantaged communities in Venterstad and Oviston, through facilitating their access to the fishery in specific areas of the lake. An experimental fishing permit was issued by DEAET to allow the VCFP to harvest an initial quota of 50 t.yr⁻¹ of three potential target species (the common carp *C. carpio*, the African sharp-tooth catfish *C. gariepinus* and the Orange River mudfish *L.*

capensis). The permit was granted specifically for hook and line angling (Potts *et al.*, 2004). The project shut down after a short running period due to bad planning and management, and a lack of consultation and local knowledge (Potts *et al.*, 2004). Currently the fishery is used only by subsistence and recreational anglers (Ellender *et al.*, 2009).

The commercial fishery development attempts in Darlington Dam, Eastern Cape, are summarised in Weyl *et al.* (2010). In 1978, a fishery operation was initiated in Darlington Dam which comprised a team of five fishermen equipped with gillnets and a small boat. The operation provided gutted moggel (*L. umbratus*) and carp (*C. carpio*) to markets both in Grahamstown and Uitenhage. Catch rates were high and it was reported that one ton a day could be caught. While the operation was profitable, the operation fell through after a year due to the withdrawal of the manager (Walters, 2009). Subsequently, attempts were made to develop various gill net fisheries based on these species. In the 1980's, a gillnet fishery that salted and dried fish was set up under the management of Mr. Tiko Hirsch. During this time the dam was also stocked with mullet (two of which were caught during recent gill net surveys (Weyl *et al.*, 2010) by Dr Anton Bok to supplement the fishery. Due to economic reasons this commercial operator moved to the Free State to begin operations on Bloemhof Dam. The South African National Parks facilitated the initiation of a long line fishery for catfish in 2012, following an assessment of the fishery to develop sustainable harvest recommendations (Weyl *et al.*, 2010).

2.10 Biological Survey Information with Fisheries Management Recommendations

There is a paucity of available literature investigating the biological sustainability of harvesting fish population in South African impoundments.

Surveys on the biology and management of fish populations are limited to three Transkei reservoirs, Xonxa, Lubisi and Umtata (Schramm, 1993; Richardson *et al.*, 2009); two impoundments on the Orange River system, Lake Gariep and Lake Van der Kloof (Hamman, 1981; Allanson and Jackson, 1983; Tómasson, 1983; Tómasson *et al.*, 1985; Potts *et al.*, 2004; Ellender, 2009; 2010a; b); five small impoundments in the Eastern Cape (Potts, 2003; Potts *et al.*, 2006); Darlington Dam on the Sundays River system in the Eastern Cape (Weyl *et al.*, 2010); and the growth and survival of two mullet species (*M. capensis*, *M. cephalus*) stocked as wild caught juvenile fish into impoundments in the Eastern Cape (Bok, 1983).

Post impoundment surveys were conducted over an eight year period on Lake Gariep fish population dynamics and production potential (*L. kimberleyensis*, *L. aeneus*, *L. capensis*, *L. umbratus*, *C. gariepinus*, *C. carpio*), in order to develop a fisheries management plan (Hamman, 1981). The study concluded that a commercial gillnet fishery could be implemented and an annual catch of 886 tons (multi species) could be harvested. The biological sustainability of this harvest was uncertain however, and would result in changes in population structure of *L. capensis*, *L. aeneus*, and *L. kimberleyensis*. *C. carpio* was identified as the species with the largest harvest potential. A study undertaken on Lake Gariep in 2007/2008, on the effect of hook and line angling on *L. kimberleyensis* and *L. aeneus*, showed that *L. kimberleyensis* was an incidental by-catch species while *L. aeneus* made up 7% of annual catches and current harvest rates were biologically sustainable (Ellender, 2008).

In the period between 1978 and 1983, concurrent studies were undertaken on the limnology and fisheries potential of Lake Van der Kloof (previously Lake le Roux) (Allanson and Jackson, 1983; Tomasson, 1983; Tomasson, 1985). It was concluded that the physical characteristics of the lake inhibited the harvest potential and that approximately 150-200 tons could be harvested annually. The targeted species would predominantly be *L. capensis* and *L. aeneus*, the latter which could sustain intensive exploitation while *L. capensis* could complement catches but variable annual recruitment and growth were cited as inhibiting extensive harvest potential.

Table 6 Summary of potential yields and recommended harvest rates per ha from studies on South African impoundments.

Province	Waterbody	Surface area (ha)	Fish production indicator	Species	Actual estimate	Calculated minimum yield/ha	Reference
Eastern Cape	Darlington Dam	4000	Potential Yield	<i>C. gariepinus</i>	22-98t/yr	6	Weyl <i>et al.</i> , 2010
			Potential Yield	<i>O. mossambicus</i>	2-9t/yr	1	
			Potential Yield	<i>C. carpio</i>	3-12t/yr	1	
			Potential Yield	<i>L. aeneus</i>	3-15t/yr	1	
			Potential Yield	<i>L. capensis</i>	6-26t/yr	2	
			Potential Yield	<i>L. umbratus</i>	67-299t/yr	17	
			Recreational Harvest	<i>All species</i>	104-460t/yr	26	
Eastern Cape	Dimbaza Dam	46.2	Potential Yield	<i>L. umbratus</i>	2.16t/yr	47	Potts, 2003
	Kat River Dam	214	Potential Yield	<i>L. umbratus</i>	0.17t/yr	8	
	Laing Dam	211	Potential Yield	<i>L. umbratus</i>	1.73t/yr	8	
	Ndlambe Dam	16.2	Potential Yield	<i>L. umbratus</i>	1.18t/yr	73	
	Sinqameni Dam	9.3	Potential Yield	<i>L. umbratus</i>	1.62t/yr	174	
	Xonxa Dam	1450	Potential Yield	<i>L. aeneus</i>	23t/yr	16	
Free State/NC	van der Kloof Dam	13340	Potential Yield	<i>C. gariepinus</i>	4t/yr	3	Richardson <i>et al.</i> , 2009
			Potential Yield	<i>All species</i>	27-139t/yr	19	
			Recreational Harvest	<i>L. capensis</i>	75-100t/yr	6	
			Recreational Harvest	<i>L. aeneus</i>	75-100t/yr	6	
North West	Madikwe Dam	431.8	Recreational Harvest	<i>C. gariepinus</i>	5.5t/yr	13	Rouhani 2004
	Molatedi Dam		Recreational Harvest	<i>O. mossambicus</i>	4t/yr	5	
			Recreational Harvest	<i>C. gariepinus</i>	9.5t/yr	13	
	Ngotwane Dam	401.3	Recreational Harvest	<i>C. gariepinus</i>	8t/yr	20	
	Roodekopjes Dam	1571	Recreational Harvest	<i>O. mossambicus</i>	1t/yr	1	
			Recreational Harvest	<i>C. gariepinus</i>	4t/yr	3	
			Recreational Harvest	<i>C. gariepinus</i>	5.5t/yr	5	
	Vaalkop Dam	1110	Recreational Harvest	<i>O. mossambicus</i>	2t/yr	2	
			Recreational Harvest				

Schramm (1993) conducted gillnet surveys to investigate the fisheries potential of three Transkei reservoirs (Xonxa, Lubisi, Umtata) and documented the reproductive biology of the fish populations to determine their sustainability. Only Xonxa reservoir displayed favourable catch rates for the establishment of a fishery. The biological characteristics of *L. aeneus*, upon which the fishery would be based, were also favourable for sustainable exploitation. The fisheries potential of the Xonxa reservoir was revisited by Richardson *et al.* (2009), and the biology of *L. aeneus* and *C. gariepinus* were investigated to provide input parameters for stock assessment models upon which fisheries development and management could be based. The study indicated that two sustainable fisheries could be developed: a gillnet fishery for *L. aeneus* (60 mm stretched mesh), which could yield 23 t y⁻¹; and a longline fishery for *C. gariepinus* yielding a maximum of 4 t y⁻¹ (Richardson *et al.*, 2009).

The life histories and fisheries potential of populations of *L. umbratus* from five small Eastern Cape reservoirs (Katriver, Laing, Singameni, Ndlambe and Dimbaza) were investigated (Potts, 2003; Potts *et al.*, 2006). *Labeo umbratus* populations in small, shallow, slightly enriched reservoirs would be those more suitable for exploitation as populations with fast growth, larger ages at maturity and larger sizes at maturity are more likely to sustain fishing pressure (Potts, 2003; Potts *et al.*, 2006).

A study on the response of three species, *L. umbratus*, *C. carpio* and *C. gariepinus*, to current recreational angling as well as two proposed commercial level fisheries (long line and gill net fishery) was undertaken on Darlington Dam (Weyl *et al.*, 2010). Stock assessment models indicated that a 100 mm mesh size gill net fishery was feasible, although initial harvest levels for a gill net fishery should be conservative and annual harvests should not exceed 60 tons until the full impact on the stock is determined (Weyl *et al.*, 2010). It was estimated that the current recreational fishery targeting *C. gariepinus* on Darlington Dam could increase its catch five-fold before the spawner biomass would be reduced to critical levels. From the biological and experimental fishing (longlines) information obtained for *C. gariepinus*, a commercial fishery could harvest the species sustainably (Weyl *et al.*, 2010).

Bok (1983) investigated the suitability of two mullet species for the purposes of stocking and commercially harvesting in impoundments. Although growth rates and catches were favourable, with yields of up to 500 kg.ha⁻¹, the unpredictable recruitment of wild caught fry from estuaries and rivers made the development of such a fishery unfeasible (Bok, 1983).

From the abovementioned examples, it is evident that only scattered biological studies have been undertaken to determine the biological sustainability of harvesting fish from South African impoundments. Without information on the biology of species targeted by fisheries, development is severely hampered as a species life history characteristics directly influence their vulnerability to exploitation, and consequently also the economic feasibility of the fishery.

2.11 Value of Inland Fisheries

South Africa inland fisheries have been largely overlooked as a “beneficial use” of water in the literature on water resource management and governance. Studies such as Weyl *et al.* (2010) on fisheries in the North West Province, Leibold and Van Zyl's (2008) unpublished valuation of recreational fisheries, Brand *et al.*'s (2009) valuation of yellowfish angling in the Vaal river, and Du Preez and Lee's (2010) valuation of trout fishing at Rhodes Village, provide an initial insight into the value of the current inland fisheries.

What is evident is that recreational value is considerable. Brand *et al.* (2009) valued yellowfish-dependent recreational angling on the Vaal River in the region of ZAR 133 million per season. Du Preez and Lee's (2010) survey of the economic value of the trout sport fishery to Rhodes Village in the Eastern Cape showed that trout fishing was an important contributor to local tourism, generating ZAR 13.5 million and employing 85 people in a rural village of 600 people, where only 15% of the population were formally employed. Average expenditure was ZAR 5052 per angler per trip, which averaged 5 days. The study was conducted concurrent to the development of the alien species zoning regulations contained within the National Environmental Management Biodiversity Act (NEM:BA) and estimated the potential loss in jobs

and revenue to Rhodes Village if trout were to be eradicated from the local rivers and dams. The angler survey revealed that 39 angling-related jobs, and ZAR 5.5 million income, would be lost if trout were to be eradicated from the local rivers.

Insights into the value of the bass and trout sports fisheries in the Eastern Cape in terms of rural livelihoods in the Amathole District, the regional economy, and to anglers themselves was provided by Kinghorn (2013). The combined total economic impact of two weekend angling tournaments on the regional economy of the Amathole District was estimated to be R106 625, while the estimated social welfare value of the Amatola Bass Classic was R 1 960 090. *Amatola Wild Trout*, a community based trout fishing enterprise, generated a modest pecuniary impact on the community of Cata, although significant improvements in human capital were found to have resulted from the development of the fishery. These results provided insights into the economic dimension of fisheries in the Amathole District, and will prove useful when weighing up the positive and negative impacts of non-native fish species, particularly when informing decisions regarding their potential eradication.

From a subsistence use perspective, Ellender *et al.* (2009; 2010b) showed that in Lake Gariep, at least 59% of the total angling effort was exerted from a minimum of 448 regular subsistence (small-scale) anglers. This indicates that subsistence use of inland fisheries in South Africa requires formal recognition so that the rights of subsistence anglers to resource use are secured and their livelihoods protected.

The implementation of sustainable development requires that choices regarding environmental resource use, biodiversity conservation and livelihoods need to be informed by evaluations of ecosystem goods and services. These studies exemplify the need for future fisheries development to be guided by sound information that minimizes the negative economic impacts of future fisheries development and secures the livelihoods of subsistence users.

2.12 **Conclusions**

While inland fisheries in South Africa undoubtedly contribute to South Africa's economy, through the economic impact of recreational fisheries, and provide food security to rural people living in their vicinity, there is a general lack of literature upon which a national inland fisheries strategy could be based. The available literature is temporally disjunct, site specific and mainly not peer-reviewed.

Apart from a recent paper which describes the fisheries sectors utilising Lake Gariep (Ellender *et al.*, 2009) there is no recent description of any of the inland fisheries operating in South Africa. Proper descriptions of each sector, incorporating data on harvest rates, utilisation patterns and economic contributions are of utmost importance.

Unfortunately, inland fisheries are not routinely monitored. Membership in formal recreational angling organisations is in the region of 15 000 people (see Chapter 6 on the Recreational Fishing Sector). Subsistence- and recreational use by non-affiliated anglers is likely to be even greater. This lack of knowledge obviously constrains the decision making process because there are no data against which to gauge the impact of interventions such as the development of a commercial fishery. In Lake Gariep, for example, a commercial fishery employing, at most, 10 people would most likely negatively impact on 448 subsistence users (Ellender *et al.*, 2010a; b).

Catch rates and harvests are only available for 4 case studies (Cochrane, 1983; van der Waal, 2000; Ellender *et al.*, 2010; Weyl *et al.*, 2010). This is a major bottleneck in assessing the potential of inland fisheries because the *de facto* open access nature of inland fisheries to recreational and subsistence users (Weyl *et al.*, 2007) may already have led to unsustainable harvest rates and over-fishing in some dams. Globally, for example, there is increasing recognition that the impact of recreational angling (fishing with a rod, line and hook) on fish stocks is as significant as that of many commercial fisheries (Cooke and Cowx, 2004; Arlinghaus and Cooke, 2005). Catch data are therefore urgently required as, in the absence of such data it is largely impossible to determine whether additional fisheries could or should be developed on

many of the country's dams. As a direct result of the lack of catch data, all estimates of potential yield and production in the country are based on applying empirical relationships to morphological and chemical data for water bodies. While these relationships have been shown to be more than incidental (Ryder, 1965) they are, at best, only very rough indications of potential yield. Some data are, however, available. Recreational anglers have good competition data and nature conservation authorities keep records on catches and licence allocations. A collation of such data in a centralised database would provide important planning information for a variety of different impoundments.

There have been numerous attempts to develop fisheries in rural areas. Documented evidence shows that almost all have failed. Others have never been reassessed after the initial development and so there are no actual data upon which the success or failure of interventions could be analysed.

Economic assessments of inland fisheries are also very few. Those that have been undertaken, however, indicate that recreational fisheries contribute significantly to provincial and national economies (Cadieux, 1980; Brand *et al.*, 2009; Du Preez and Lee, 2010; Leibold and Van Zyl, 2010). This lack of information on the value of fisheries is a global problem, and Cowx and Gerdeaux (2004) point out that fisheries tend to be poorly- or under-valued in multiple aquatic resource user scenarios. Further valuation studies, such as that of Du Preez and Lee (2010) showing the benefits of recreational fishing to rural communities, are required if informed choices are to be made regarding the promotion of inland fisheries for rural livelihood development.

Additional information limitations include information on inland fisheries governance, fishery governance systems, licensing, resource allocations and policy. User conflicts, particularly between recreational and subsistence and commercial fishers are mentioned in some publications (Weyl *et al.*, 2007; Weyl *et al.*, 2010) and exist in many fisheries. However, there is little documented evidence on these conflicts, understanding the causes behind them is however essential for fisheries development and policy formulation.

The present literature survey reveals an urgent need for research covering the biological, social, economic and governance aspects, if inland fisheries are to be developed in a rational and sustainable manner which promotes South Africa's national policy goals.

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3. REVIEW OF PROPERTY RIGHTS, LEGISLATION, REGULATION, MANAGEMENT AND GOVERNANCE SYSTEMS OF SOUTH AFRICAN INLAND FISHERIES

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3.1 Introduction

South African inland fisheries are governed by a mix of often overlapping formal and informal property and access rights reflecting the country's socio-political history. While the Constitution promotes equitable access to natural resources and recognises customary practises, inland fishing rights have not been reviewed and reformed in the post-Apartheid era. Formal inland fishery access rights derive from Colonial and Apartheid era resource use policies, which promoted recreational angling and limited commercial fishing. Thus anglers, angling clubs, tourism operators and commercial fishers, who are mostly white, continue to enjoy preferential access rights to inland waters. By contrast, small-scale fishing rights for livelihood purposes are not provided for in policy and law, and fishing activities by members of poor communities are loosely governed by customary or informal resource use rules. As a consequence, fishing for livelihood purposes by poor rural communities using customary gear or nets is often criminalised (Tapela *et al.*, 2015). Thus in the absence of secure fishing rights and supportive management and governance arrangements, the marginalisation of black rural communities from the benefits of inland fishery resource use is perpetuated.

It is telling that two decades after the post-Apartheid dispensation, there is still no inland fisheries policy to guide the transformation of this sub-sector, and public organisations have not yet resolved the historical legacy of inequitable access to inland fisheries (Weyl *et al.*, 2007). The present research findings suggest a deepening of deprivation-induced anger within rural communities over the protracted exclusion and/ or harassment of local fishers by conservation agencies, police officials, privileged recreational anglers and tourism operators (Tapela *et al.*, 2015). Members of these fishing communities are thus increasingly demanding secure access rights to dam fisheries.

South African inland fisheries comprise largely of informal small-scale fishing for livelihood purposes⁴, and recreational fishing, with no commercial sector equivalent to the country's marine industrial fishery. Inland fisheries are not recognised as an economic sub-sector with a cabinet approved fishery policy and supporting governance institutions including legislation, formalised fishing rights, representative stakeholder groups, and state fishery management capacity and development support. Existing inland fishery property rights, legislation, regulation, management and governance systems are diffuse and often poorly defined, being a mix of formal and informal institutions which are often province or site-specific. It is thus necessary to describe and understand the nature of the existing inland fishery governance institutions in order to make recommendations for reform.

Historically, the fisheries policies of most countries have focussed on the development of economically efficient, commercial fisheries to grow the gross domestic product (GDP), and the welfare contribution of small-scale fisheries has, to a large degree, been overlooked by policy makers (Béné *et al.*, 2010). Recent studies have however demonstrated that they do contribute significantly to food security, poverty reduction and income generation (Béné *et al.*, 2010; Béné *et al.*, 2007; Heck *et al.*, 2007; FAO, 2013). The present study found that 77% of inland water bodies surveyed supported small scale fishing for livelihood purposes (see the inland fishery surveys by Tapela *et al.* (2015) – Volume 2 of this report). Despite their importance, many small-scale fishing communities around the world continue to be marginalised in favour of industrial fishing and other competing interests, and their contribution to food security and nutrition, poverty eradication, equity, and sustainable development is not fully realised (FAO, 2013).

⁴ In line with generally accepted terminology and policy, the more broadly defined 'small-scale fishery or fishers' is used in preference to 'subsistence fishery or fisher'. Small-scale fishing includes fishing for own consumption or for sale (FAO, 2013, DAFF 2012).

In recent years however, the growing recognition of the scale and socio-economic contribution of small-scale fisheries has resulted in great advances in the development of governance norms that address the rights of fishing communities (FAO, 2009, 2013). The FAO, recognising that small-scale fishing communities are vulnerable to marginalisation from access to fishery resource by sectors that have stronger political or economic influence, have developed the '*International Guidelines for Securing Sustainable Small-scale Fisheries*' which place emphasis on securing the rights of small-scale fishers and promoting empowering institutions to address their burden of disadvantage (FAO, 2013).

In South Africa, a similar trend has been followed, with the historically well-developed marine fisheries policy providing for the governance of the country's commercial fisheries, but overlooking the traditional rights of small scale fishers. While the Marine Living Resources Act of 1998 (MLRA) provided for the post-Apartheid reform of the country's commercial fisheries, it was only in 2012 that a 'small-scale fishing policy' was promulgated following a successful court challenge in the Equality Court by small-scale fishers who had lost their customary fishing rights in the rights reform process. Small-scale inland fisheries have however yet to be recognised in policy as being a source of food security and livelihoods. (Andrew, 2001, Weyl *et al.*, 2007). This, despite the existence of customary fisheries in certain areas such as the Phongola floodplain (Heeg and Breen, 1982), and the growing small-scale fishing activity on many water bodies (see the case studies documented by Tapela *et al.* (2015) in volume 2 of this report) As a result, fishing for livelihood purposes is largely unmanaged and opportunities to create jobs and enhance local food security are often missed. Similarly, the potential livelihood benefits associated with providing rural communities with a stake in the tourism-linked recreational fishing value chain are not recognised and promoted.

Globally, recreational fisheries have historically not been managed as a formal fishery sub-sector that makes a socio-economic contribution equivalent to harvest fisheries. However, this is changing in many countries, with the growing recognition of the value and scale of the recreational fishing. Unlike extractive fisheries, whose value is measured in terms of tonnage of raw product, recreational fisheries extract very little fish, but generate substantial value through tourism linked services. In South Africa, freshwater and marine recreational fisheries lack recognition as a beneficial use of the environment which can contribute to job creation and food security. Marine recreational fishing is subject to management control by the DAFF, but the socio-economic contribution of recreational fishing is not measured, and the sub-sector does not enjoy representation in DAFF commodity group system and the fishery sub-sector management working groups. The DAFF convenes a marine recreational forum once a year to solicit inputs from sports fishing groups. The interests of freshwater recreational fishing are currently not organised or represented at a government level. Small-scale and commercial fishing rights and interests thus tend to be favoured over those of recreational fishers, and opportunities for creating decent jobs and sustainable livelihoods for disadvantaged communities are not promoted.

Twenty years into South Africa's constitutional rights-based democracy, the lack of a policy articulating societal objectives for inland fisheries, both small-scale and recreational, is thus an anomaly. The inclusion of inland fisheries into the mandate of the newly formed Department of Agriculture, Forestry and Fisheries in 2009 however provided an appropriate organisational arrangement and opportunity to harmonise the governance of South Africa's inland fisheries along with its well-regulated marine fishery. The definition of property and access rights are central to any fishery policy, particularly in the context of the historical disadvantage and ongoing marginalisation from resource access experienced by the rural poor. The present chapter thus describes and analyses the existing property and access rights associated with inland fisheries in order to provide a knowledge base for defining secure property and access rights for improved governance of the sector.

In order to recommend reforms to the existing property rights regimes and access rights for inland fisheries of South Africa, a review of the theory underpinning property and access rights to natural resources is presented. This is followed by an analysis and evaluation of existing property rights regimes and access rights institutions currently governing inland fisheries in South Africa. Recognising that fishing for livelihood purposes is governed by customary and informal rules, a survey of fishery activity on South African dams was

undertaken in order to provide insights into the formal and informal governance institutions currently determining fishery resource use (see Chapter 4 this volume, and Volume 2 – Tapela *et al.*, 2015). Having outlined the theoretical aspects and analysed the existing situation in South Africa, recommendations for inland fishery property and access rights reform are suggested.

3.2 Methodology

3.2.1 Theoretical framework

A theoretical framework for analysing property and access rights was developed, by describing conceptions of property rights regimes, property and access rights, and how the property rights can be bundled by holders.

3.2.2 Sample survey of fishery governance arrangements on public dams

Case studies were undertaken on selected public dams supporting active fisheries to provide insights into the existing fishing rights regimes, and supporting governance institutions. The persons interviewed are listed in Appendix 1 and the detailed case study survey results are presented in Appendix 3. Given the large number (over seven hundred) of public dams that could be sampled, purposive sampling of nine dams was undertaken based on their geographic spread, nature of the fisheries and governance institutions (Table 7).

The information was gathered for each dam included: type of dam/water body; the legal custodian; the property rights regime under which the dam/water body exists; list of all the users of the dam/water body; management agency for the dam/water body; and institutional arrangements for management (Appendix 4).

The list of users of each dam was then extracted, and for each user, the following information was collated: the type of uses each user was making of the dam/water body; the type of rights they held; type of permit systems authorising use; and the management regime to which the user was subject to (Appendix 4).

In order to gather the requisite information, the research team interviewed representatives from the Department of Water Affairs (DWA), provincial Departments of Agriculture, provincial Environmental Affairs departments, angling clubs, guest lodges and other stakeholders.

Table 7 List of dams surveyed on governance arrangements

	Dam or Water body	Province
1	Driekoppies	Mpumalanga
2	Lake Fundudzi	Limpopo
3	Nandoni	
4	Makuleke	
5	Uphongolo (Lake Jozini)	KwaZulu-Natal
6	Voëlvlei	Western Province
7	Clanwilliam	
8	Theewaterskloof	
9	Bloemhof	Free State

A synoptic summary of information from the case studies, to support the analysis of the property rights regimes, property rights, access rights and institutional arrangements, was organised as follows:

- The owner (custodian) of the dam;
- The primary reasons for construction of the dam;
- Who the users of the dam are and what uses they are making of the dam;
- Management arrangements;
- The legal underpinning for management; and
- Fisheries aspects on the dam

3.2.3 Policy and Legislation for inland fisheries

An analysis of the policies and legislation relevant to inland fisheries was undertaken. This involved extracting the relevant fisheries sections of provincial legislation for resource management, and relevant national legislation such as the National Water Act (NWA), National Environmental Management Act (NEMA) and the National Environmental Management and Biodiversity Act (NEMBA). A review of the Traditional Leadership and Governance Framework Amendment (TLGF) Act (41 of 2003) and the Communal Land Rights (CLR) Act (11 of 2004) was undertaken with regard to how these relate to inland fisheries in communal areas. In the light of the inland fishery sector mandate residing with the Department of Agriculture, Forestry and Fisheries (DAFF), the relevant departmental development policy and strategy was analysed in terms of how this could facilitate inland fisheries development and policy and legislative gaps identified.

The theoretical framework, information from the sample surveys of public dams, and the analysis of legislation and policy were used to provide a diagnostic analysis of firstly, the existing property rights, access rights, use right practices and management arrangements on public dams, and secondly the legal instruments and policies in use or that could be used to develop inland fisheries governance arrangements. These analyses provided the basis for the recommendations for revisions to inland fishery property and access rights regimes (Section 3.6)

3.3 Principles Of Fishery Property Rights

3.3.1 Property rights

Property rights are a key element in the description and analysis of the human use of common pool resources, such as fisheries. Property rights assign benefit streams derived from the utilisation of a resource (Bromley, 1989), and are defined by a number of key characteristics including: exclusivity, transferability, inheritability, alienability and enforcement mechanisms (Hallowell 1943; Alchian and Demsetz 1973; Schlager and Ostrom 1992; World Bank, 2004). Property rights define the uses that are legitimately viewed as being enforceable and who has these rights. Thus property rights impart *entitlements* regarding resource use, and rules under which those entitlements are exercised. According to Bromley (1989) property rights entail *rights* for those holding them and *duties* for non-holders to respect the rights. With a recognised right, an individual is protected against the claim of another by their duty (Bromley, 1989). Thus rights to property are only secure if non-right holders respect the rights of those holding them. It is to be expected therefore both in law and practice that one's rights and his claims to them should be respected by those with duty. Such entitlements will therefore require an organised structure of institutional arrangements. The institutional arrangements include mechanisms for defining and enforcing rights, consisting of not only formal procedures but also social custom, and the legitimacy of the mechanisms (Hallowell 1943; Taylor 1987). It is important that property rights be consistent with social goals of equity, efficiency and sustainability. The above theoretical concepts are used to analyse the property rights regimes determining the use of South African freshwater fish resources, and to make recommendations for reform in line with the country's constitutional imperatives and policy objectives.

As the case studies illustrate below, existing fishing rights on inland waters are a mix of poorly defined *de jure* and *de facto* rights which exist as dual systems. As a consequence, the competing rights regimes often lack legitimacy in the eyes of different stakeholders, and non-rights holders do not necessarily recognise or respect existing rights.

3.3.2 Property Rights Regimes

Bromley (1989, 1991) and Berkes and Farvar (1989) have suggested that it is important to distinguish between the resource and the regime. The distinction between the resource itself and the property rights regime under which it is held is important because a particular resource can be held under more than one regime (Ostrom, 1986; Bromley, 1989). In fact Bromley (1991) suggested that the term 'Common Property Resources' be abandoned for the more correct 'Common Pool Resources.' By implication the term Common Property should be left for use in reference with regimes. Ostrom underscores the importance of the distinction between the intrinsic nature of the resource, and the property rights regime under which it is held, by defining such class of resources as "Common Pool Resources".

Property rights regimes refer to a set of institutional arrangements that define the conditions for access to, control over, and range of benefits arising from collectively used natural resources (Bromley, 1989, 1991; Bromley and Cernea, 1989; Ostrom 1986, 1990; Young, 1989). Property rights regimes define a variety of combinations of ownership, locus of control and *rights* (of the rights holders) and *duties* (of the non-rights holders). Four ideal analytic types of property rights regimes are distinguished. These are *non-property* (also commonly referred to as *open access* in most literature), *communal property*, *private property*, and *state property* (Berkes, 1989; Feeny et. al. 1990; Bromley 1989).

Property rights regimes are intended to function by limiting use, co-ordinating users and providing institutional mechanisms for responding to changing environmental conditions. Furthermore, it is essential to distinguish *de jure* property rights regimes from those that are *de facto* (Feeny, 1994) since many common pool resources are classified as state property, in their *de jure* designation, whereas in practice access is left unregulated and thus *de facto* the resource is subject to unwritten informal or customary governance norms, or is open-access. The role of property rights regimes and the way these influence management and governance of common pool resources will be central in restructuring of rights in inland fisheries of South Africa.

3.3.3 Property Rights as ‘Bundles of Rights’

Some scholars have equated the concept of a property right to the ability of the party holding the right (whether individual, family, organised group or government) to sell (alienate) the said right to another party (Schlager and Ostrom, 1992). This position holds that unless users have alienation rights, they do not hold a real property right to the resource in question. This has been extended to the argument that unless users had the right of alienation, they could not develop effective governance systems for the resource resulting in overuse. Following numerous empirical cases studies (Berkes, 1989; Bromley and Cernea, 1989; Ciriacy-Wantrup and Bishop, 1975; McCay and Acheson, 1987; NRC, 1986), such simple collation of the relationship between users and the resource have been demonstrated to be inaccurate and tenuous (having leading to many wrong policy prescriptions). Empirical evidence demonstrates that in many situations users do not have the right to alienate their right and yet have continued to successfully utilise resources albeit under robust institutional arrangements. In fact some scholars (see Netting 1981; McKean, 1982; 1992) have argued that they had found many well-defined and operational common-property systems that had existed for a long time without the right of alienation for the agents. This has led to thinking of property rights systems as *bundles of rights* (Schlager and Ostrom, 1992; Ciriacy-Wantrup and Bishop, 1975; Commons, 1968). In this context, five rights of operational property systems have been defined from empirical studies, namely: the right to access, the right to withdraw, the right to manage, the right to exclude and the right to alienate (Ostrom, 2008; Schlager and Ostrom, 1992). Summarised definitions of these are as follows:

1. **Access right:** refers to the right to enter a defined physical property
2. **Withdrawal right:** refers to the right to harvest (consumptive use) the products of the resource
3. **Management right:** refers to the right to regulate the use patterns of other harvesters and to transform a resource system by building improvements (e.g. fences) or taking actions that could improve the resource
4. **Exclusion right:** refers to the right to determine who else will have the right of access to a resource and whether that right can be transferred
5. **Alienation right:** refers to the right to sell or lease any of the above rights

The different ways in which these bundles can be combined by the agents can be related to a set of positions (rights and obligations) that agents (individuals or groups) hold with regard to the operational settings concerning the resource. Five types of user-resource relational positions can be defined in relation to the operational property systems defined above. These are Viewer, Authorised user, Claimant, Proprietor and Owner (Schlager and Ostrom, 1992). The possible bundles of rights that a rights holder can hold and combine and the associated position this entails for the right holder towards the resource is summarised and illustrated below (Table 8).

Viewer

If a person only possesses access (aesthetic) rights, then the user is categorised as a viewer. For example most 'bird watching' rights fall into this category. Other examples are camping rights. In England, Wales and Nordic countries there exist the famous historical rights for the general public to access certain public or privately owned land for recreation and exercise, the so called 'freedom to roam' or 'everyman's right' (sometimes called the 'rights of public access to wilderness or the right to roam' (http://en.wikipedia.org/wiki/Freedom_to_roam)). Thus ramblers in England and Wales fiercely protect these historical rights (<http://www.ramblers.org.uk>). Access rights holders will usually be required to follow some regulations for use, for example to keep to the established paths for the ramblers and not to litter for the campers. People exercising such rights have duties for management and protection of nature. Clearly, an access right does not include extractive (consumptive) rights.

Table 8 Bundles of rights and associated operational positions towards resource. (adapted from Ostrom, 2008; Schlager and Ostrom, 1992)

Type of Right	Associated Position				
	Viewer	Authorised user	Claimant	Proprietor	Owner
Access	X	X	X	X	X
Withdrawal		X	X	X	X
Management			X	X	X
Exclusion				X	X
Alienation					X

Authorised user

An 'authorised user' will have both access and withdrawal (consumptive) rights. Usually these rights go together with obligations with regard to timing of harvest, the equipment that can be used for harvesting and purpose that the harvest can be used. In Norway the 'freedom to roam' referred to above include codified (protected under law) historical rights, that the public hold to access and harvest berries, mushrooms and other nature when these are in season, even on private farms (<http://www.fishyfolk.com/2009/10/11/the-right-to-roam>).

Claimant

A person with access, withdrawal and management rights is referred to as a 'claimant'. In most instances, common property institutions (including the law) recognize the rights and obligations of claimants to build fences around resources, make improvements to the resource (for example improve irrigation systems) and many other improvements in relation to management of the resource system, enabling the claimant to take a long-term view and perspective of utilisation as a result of the investments made to achieve long-term productivity and sustainability of the resource (Ostrom, 2008).

Proprietor

When a right holder has the right of 'exclusion' in addition to those of 'access', 'withdrawal' and 'management', then s/he is termed a proprietor. A proprietor has rights and obligations to regulate use, invest in improvement in the resource system and determine (give permission) for other users to have access to and extract resource units.

Owner

An owner is a user who has all the five rights and obligations in relation to these rights. In some instances, owners can sell (alienate) or lease some of these bundles of rights or all the bundles to someone else. In some instances, they have to get permission from authorities holding stewardship of the resource on behalf of a nation's society in order to alienate such rights. In the case where authority to alienate is required, such rights might be legally termed as 'privilege rights'. For example, South Africa's policy for long-term commercial fishing rights stipulates that this right is a 'privilege to harvest' that is given to those granted the right, meaning that these are *pseudo* rights and that the ownership (or custody) of the property

right still resides with the state, and that the state can take this right away in case of serious breach of permit conditions by the holder that had been given these privileged rights or should there be need to re-distribute a portion of these rights (Department of Environmental Affairs, 2005). Under the same long-term commercial fishing rights policy, alienation of rights is allowed only among the Previously Disadvantaged Rights holders, with permission from the line agency (DEAT, 2009).

Schlager (1994) found that possessing claimant's rights (access, withdrawal and management) did positively affect the capabilities of the claimants (inshore fishers in this case) to self-organize. Having the authority to exclude others (proprietary rights) gave them even more capabilities to ensure that others did not invade their resource (fishing area) and gave the proprietors confidence to invest in regulating use and in other improvements in relation to sustainable utilisation of the resource. Evidence indicates that the right to alienate a resource is not the key and defining right for common property systems that have survived for a long time (Netting 1981; McKean, 1982; 1992) and for those agents who have been able to design and maintain long enduring common property rights systems (Ostrom, 1990; Schlager, 1994; Tang, 1994). Empirically therefore, many users of common pool resources such as fisheries have secure property rights bundles even though these may not include the right of alienation.

3.3.4 Types /Forms of Institutions for Operationalisation of Management Regimes

Management regimes consist of institutional arrangements supported by external and internal enforcement mechanisms. Types or forms of institutions important for making management regimes operational are found to be: *rules, rights, conventions and contracts* (Swallow and Bromley, 1995)

Rule

A rule is a standard that sets out or defines what actions users are expected to perform or must refrain from performing (Young, 1989). Although government as custodian of public resources (which most natural resources are) enacts rules and regulations designed to influence and control the behaviour of the agents, these might not be sufficient in practice to meet the goals of sustainable and efficient utilisation. It might therefore be necessary to move beyond formal official rules and regulations into informal (user generated or customary or customary) rules and institutions in order to design appropriate and innovative institutional arrangements.

Rights

A right is a guarantee given by an authority system to those who comprise or are part of the entity receiving the right (Swallow and Bromley, 1995). The agent's group (entity) and/or an individual belonging to the entity have a right to the opportunities or benefits deriving from such a right over an individual or group that does not (Dworkin, 1977). Rights are either held by states, directly by individuals, or indirectly by individuals through their membership to groups. Rights can also be held by all individuals in society or by occupants of certain social roles (for example, traditional authorities) on behalf of their group or subjects. Most natural resources are legally defined as public resources – belonging to the nation state – and are held in stewardship by the state on behalf all a nations' citizens. In many situations in Africa, Colonial governments (and later post-Colonial governments) declared customary rights structures as void and declared state ownership of resources that had been hitherto collectively owned common pool resources by immediate users (Mamdani, 1996; Swallow and Bromley, 1995). Despite the best of such intentions, few post-Colonial governments in Africa have been successful in effective management of publicly held natural resources that are in practice utilised at local-level in widely dispersed and diffuse locations (Hara *et al.*, 2009).

A right can be general, specific or particular. While a general property right may entitle an individual to some unspecified ownership or right to benefit from a resource, a specific property right would identify the specific benefit to which the individual is entitled (Swallow and Bromley, 1995). A particular property right would indicate the particular geographic boundary and aspect of the resource over which the right is valid and applicable. For example, customary rights are usually expressed in specific but not particular terms (Swallow and Bromley, 1989). For locally-enforced institutions to be effective, rights must be specified in particular terms. The lack of specified rights in a particular geographic area is a general problem underlying user conflicts in and unsustainable utilisation in many fisheries.

Conventions

Conventions are self-enforcing social institutions that provide agents with assurance with regard to the behaviour of other agents. The internal order of common property regimes can often be self-enforced by the actions and expectations of the individual resource users themselves (Runge, 1981, 1986). Before governments took over authority for natural resources, customary institutional structures and mechanisms provided a relatively stable and cooperative basis for resource use and the exchange and trade of basic commodities (Bromley and Cernea, 1989). These 'rules of the game' (North, 1990) were sufficient to assure each individual that his rights, duties and liberties would be respected by others (Runge, 1981).

Contracts

A contract is an agreement among agents that is supported by the actions of a third party, where the contract is externally enforced, or by the actions of the agents themselves, in the case of internally enforced contracts. The need for a contract might arise in a situation whereby there is 'transactional insecurity' i.e., where agents' actions deviate from the terms of an agreement or information on agents' action is too expensive to collect (Knonman, 1985). Internally-enforced contracts can either be explicit or implicit, the difference being the enforcement mechanisms. Explicit contracts are enforced by the deliberate actions of the contracting agents, while implicit contracts are enforced through implicit threats of future retaliation for current deviations (Swallow and Bromley, 1995). The authors point out that the deliberate actions taken to secure explicit contracts might include hostage taking, collateral requirements, hand tying, gain sharing⁵ or partial surrender of autonomy.

On the other hand dynamic (implicit) contracts are enforced through strategies based on credible threats of future punishments for deviations from the terms of agreement. A number of punishment strategies appear to be used to enforce dynamic contracts, for example *trigger*, *stick-and-carrot*, *exclusion* and *tit-for-tat*. Under the trigger strategy, an agent will comply as long as everyone complies, but will revert to Nash equilibrium⁶ behaviour if anyone deviates; under the stick-and-carrot strategy, an agent will respond to others deviations by imposing a harsh but short-term punishment, followed by compliance (Abreu, 1988); under the exclusion strategy, an agent will take steps to exclude deviants from future access to the resource (Hishleifer and Rasmusen, 1989); and under the tit-for-tat strategy, an agent will mimic others' actions, that is cooperation will be rewarded with cooperation while deviation will be punished by deviation (Axelrod, 1984).

3.3.5 Property and Access Rights: Implications for Management and Governance

Weak governance, which results in open access and poorly defined property rights, has been attributed as the main cause of over-exploitation of fish stocks around the world (World Bank, 2004). Similarly, FAO (2000) attribute overcapacity and overfishing to inadequate or ill-defined property rights (see also Ward *et al.*, 2004). Governance is therefore key to successful implementation of property and access rights.

The governance approach acknowledges that fisheries are governed by a combination of governing efforts from all kinds of actors and entities both public and non-public (Kooiman, 2003; Kooiman and Jentoft, 2009), and calls for joint and interactive responsibilities of state, market and civil society. Governance includes the formulation and application of principles guiding the interactions among the actors and care for institutions that enable these interactions. It proposes a shift from the problem-solving to the opportunity creation approach when handling fisheries issues (Kooiman and Bavinck, 2005). Governance is broader than management in that whereas management is functionally defined and is perceived as a technical exercise employing means to achieve given goals, governance includes also the deliberation and determination of basic relevant values and principles that should underpin the way governors define their tasks and roles (Kooiman and Jentoft, 2009).

⁵ Gain sharing refers to a system of management (used in business) that encourages involvement and participation of people in order to improve performance. As performance improves, employees share in the financial gains accumulating from improved performance.

⁶ In Game theory, Nash equilibrium refers to a situation whereby the set of strategies for each player gives the individual players no incentive to unilaterally change her action. The players are in equilibrium if a change in strategies by any one of them would lead that player to earn less than if she remained with her current strategy.

In order for property rights to be operationalised, they need to be formulated (and promulgated); communicated to those whom they apply – both rights holders and non-rights holders; interpreted; enforced; legitimised with the individuals or groups to which they apply; and they must be adaptable to changing needs and circumstances (Bull, 1977). In addition, authority systems that sanction rights, enforce rules, define the context in which conventions and contracts are negotiated are fundamental to the operations of common property regimes (Swallow and Bromley, 1995). Authority systems are concerned with governance, and governance refers to the process of deciding what action a collective will undertake and how it will carry out the action. Institutions provide order (and restraint) to the relations among the members of a collective (Bromley, 1989).

Another key governance issue is that for agents to come up with their own rules about boundaries and use practices and thus avoid destruction of the resource, they must solve the second level social dilemma of basic collective action (Leach, Mearns and Scoones, 1997; Mehta et. al., 1999; Ostrom, 1990). Empirical studies (Berkes, 1989; Bromley and Cernea, 1989; Ciriacy-Wantrup and Bishop, 1975; McCay and Acheson, 1987; National Research Council – NRC, 1986) show that cooperation among agents using a common pool resource collectively is more likely than not. The variables that influence cooperation and enhance the likelihood of crafting working property rights include: small sized and homogenous groups, active leadership, dependence on the resource (Baland and Platteau, 1996); market integration (Tucker, 1999; Tucker, Randolph and Castellanos, 2007); facilitatory external government policies (Rodriguez, 2007); cross-scale linkages (Berkes, 2002; Young, 2002); how the individuals within the groups are linked (possibilities of meeting and how often this happens); the type of production function that the users are facing; the type of transaction costs that the group faces, ease with which they can get information about past actions; and how beneficial it is for the users to solve the problem facing them (Ostrom, et al., 2007; Gibson et al., 2005; Marshall, 2005). In addition, developing trust and reciprocity is crucial to building the social capital needed to create workable property rights (Ostrom, 1998; Ahn and Ostrom, 2008).

To implement property rights belonging to a group, there needs to be a body to undertake this function. Such a body must also be able to interpret the aims of the larger society with regard to the use of the resource system; be able to judge between the rights and duties of competing groups; be able to enforce sanctions on individuals within the group (if internal mechanisms for enforcing sanctions within the group do not exist); be able to enforce sanctions between rights holders and non-rights holders (Ostrom, 2008). Also important is that for a group of resource users to be successful in maintaining an implicit internal agreement, they must have confidence that future entry into the group will be restricted, or at least limited to a known number of potential entrants. A minimum condition for the effective operation of dynamic implicit contracts may thus be that there is some social authority that enforces rights or rules regulating the entry of new individuals or groups, the mobility of individuals between groups, and the mobility of groups between resource systems (Swallow and Bromley, 1995).

An approach that has been suggested for dealing with over capacity associated with open access is *Rights-Based Fishing*. This refers a wide range of approaches such as group fishing rights, *Territorial Use Rights in Fishing* (TURF), *Individual Transferable Quotas* (ITQs), taxes and royalties. Cunningham and others (Cunningham et al., 2009) argue that unless rights-based systems are accompanied with properly specified rights and supported by appropriate fiscal, legal and other institutional measures that legitimise and protect these rights, then such systems might only offer partial solutions to destructive exploitation of fisheries. The lack of alternative livelihood opportunities in rural areas makes implementation of limited access very difficult (Hara, 2006; Pomeroy and Rivera-Guieb, 2006). Limitation to access has also been argued against in developing countries especially in situations where fisheries provide a safety valve in times of economic stress and act as a labour buffer in rural areas where unemployment is usually high (Bene et al., 2010; Jul Larsen et al., 2003).

In the context of South African inland fisheries that are/will largely be based on use of storage dams, property and access rights are/will be secondary to the primary use of dams as sources of water for domestic, industrial and irrigation purposes. The type (whether group, communal, territorial, individual, tax or permit based, open access, etc.) and form (whether subsistence, commercial or recreation) of fishing rights will depend on factors such as geographic location of the given dam in relation to potential fishing

communities, productivity of the dam and the species stocked in the dam (Weyl *et al.*, 2007). Also key will be the viable institutional arrangements necessary for ensuring sustainable utilisation of inland fisheries given that currently, ownership of dams and responsibility for management of the various resources that occur in dams is shared among a number of government departments and user group organisations.

3.4 South African Inland Fishery Legislation and Management

The dams and water bodies, including the flora and fauna therein, that are relevant to this study are those owned by government and therefore fall under the 'state property regime'. Private owners cannot be forced to open up use of their dams for public use since protection of private property is enshrined under South Africa's 1996 constitution. This analysis therefore concerns the existing property rights and access rights to public dams and water bodies and the fish therein.

3.4.1 Rights of access to public water bodies – the National Water Act

South Africa's freshwater resources belong to the state and all forms of use, including fisheries on state impoundments, are governed by the National Water Act of 1988 (NWA).

The NWA does not specifically mention fisheries as a beneficial use of public dams, although it is DWA policy to promote secondary socio-economic benefits for disadvantaged local communities from public dams (Dr N. Musekeni, Chief Director, Department of Water Affairs: Sector Coordination and Support, pers. comm., May 2012). Access to public dams for fishing activity is implicitly covered under the definitions of water use in Chapter Four of the NWA. Chapter Four is founded upon the principle that national government has overall responsibility and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest. The Act states that "a person can only be entitled to use water if permissible under the Act" (NWA, 1998: chapter 4 preamble, p17). This includes the various types of both licensed and unlicensed entitlements to water use. Part 1 of the Chapter sets out the general principles for regulating water use, and broadly defines what water use is. The preamble to the chapter further stipulates that, "In general a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a license" (NWA, 1998: chapter 4 preamble, p17). The preamble further states that "In making regulations the Minister may differentiate between different water resources, classes of water resources and geographical areas" (NWA, 1998: chapter 4 preamble, p17).

Section 21 of the NWA outlines the types of water uses. Two of the items under this section are applicable to fishing on public dams. These are items e and k:

- "(e) Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1)"; and
- "(k) Using water for recreational purposes."

Part 5 of Chapter Four outlines what constitutes controlled activities, and states that the Act makes provision for the Minister to declare controlled activities as need arises through public consultation and that once such an activity has been identified and declared as such, the Minister shall issue an authorization for the activity. Section 37 lists the controlled activities under the Act, with item (e) stating that a controlled activity is "an activity which has been declared as such under section 38". Section 38 states that:

- 1 "The Minister may, by notice in the Gazette, in general or specifically, declare an activity to be a controlled activity"; and
- 2 "Before declaring an activity to be a controlled activity the Minister must be satisfied that the activity in question is likely to impact detrimentally on a water resource".

Taken as a whole, these sections of the NWA provide for fishing activities on public dams. In order to facilitate the use of dams for fishing and other controlled activities (fishing is not specifically listed as a 'controlled activity'), a coordinating committee has been constituted under the Chairmanship of the Department of Water Affairs (Dr Debbie Sharp, Deputy Director, Department of Water Affairs, pers. comm., 19 December 2013).

As legal custodians of public dams on behalf of South African citizens, the concerned government departments (whether DWA, DAFF, Municipalities, etc.) hold all rights including the rights of alienation (in practice mostly lease

– principle 3). For the concerned departments that have custody of the dams (owners on behalf of all South Africans), most important is the 'ownership (or custodial) right' which gives them the authority to determine who will be allowed access, withdrawal rights, management rights and who will be excluded. For example, the DWA and provincial Departments of Agriculture give authorisations for bulk extraction of water for domestic or irrigation purposes to municipalities and farmers respectively. They also give authorisations for infrastructure development such as buildings by clubs, camping sites, lodges, etc. In the case of Voëlvlei Dam, the General Authorisation S53 agreement was applied to the use of dam frontage to build and fence off the physical infrastructure by the 9 recreational clubs (Barnes, *pers. comm.* quoted in Tapela *et al.*, 2015). The S53 agreement allocates specific areas of dam frontage land to recreational clubs or developers for a specified number of years (section 53 of the NWA). Unfortunately such instruments do not help to broaden public access to dams. For example, the DWA had tabled before Western Province Artificial Lure Angling Society (WPALAS), the mother body of the recreational clubs, the need for cooperation in broadening public access to Voëlvlei Dam. The WPALAS had responded that it was restricted to 99 members for the dam as per the agreement. Even though this restriction had fallen away, the current upper limit of 120 for WPALAS membership is still not large enough to facilitate broadening access for formerly marginalised groups. Regarding the development of infrastructure on public dam frontage, a key aspect of the regulation under which authorisations are issued is that such infrastructure has to be of temporary nature (those that can be removed within a 24 hour notice) and that these should be built above the flood line (also called the expropriation line or purchase line) (Bertrand Van Zyl, Chief Engineer, Infrastructure, DWA, *pers. comm.*, October 2011). They also issue authorisations for use of dams for water sports such as fishing, passenger boats, etc. Where vessels are being used, a vessel safety certificate (seaworthiness) and use of a qualified vessel operator (with a skipper's licence) are part of the conditions.

Another authorisation being used to build infrastructure by recreational clubs, guest houses and developers is on the basis of 'Existing Lawful Users', section 32 of the NWA, given that most have been using the dams since prior to the 1998 NWA. This section (32 of the NWA) recognizes and gives permission for an existing water user that had been using water before the NWA of 1998 to continue usage under certain conditions. Under this section, no licence is required for continuation of use for the 'existing lawful user' until a responsible authority requires that a person claiming such an entitlement needs to apply for a licence. These can be termed 'historical rights' that have now been formalised under the authority of the new NWA.

Resource Management Plans

In order to achieve the Department of Water Affairs and Forestry's (DWAF) policy objectives for recreational use of water resources, the Department developed guidelines for the development of Resource Management Plans (RMPs) for the integrated recreational water use (DWAF, 2006). The guidelines emphasize that to achieve the objectives of the NWA, it is imperative that DWAF involve all stakeholders in planning procedures to ensure that management objectives and actions for a water body reflect the needs and expectations of the stakeholders affected by the water resource, in particular communities living next to such water bodies. In addition, the guidelines stress that RMPs; have to compliment local Integrated Development Plans (IDPs); reflect the conservation value of the resource; and redress the past racial, gender and socio-economic imbalances suffered by communities. RMPs would enable informed decisions about the utilisation of water resources for recreational purposes and also facilitate public-private partnerships that could unlock the potential that such resources provide in an equitable and sustainable manner without perpetuating old negative norms.

Objectives of the RMPs

Thus the objectives for developing RMPs for the recreational use of water resources are stipulated as addressing the following four main areas (DWAF, 2006, p3):

1. Environmentally sound planning and management;
2. Equitable community participation and beneficiation;
3. Industry transformation and user satisfaction; and,
4. Effective and efficient institutionalization.

To achieve these objectives, it is seen as imperative that the following are undertaken (DWAF, 2006, p3):

- Promotion of equitable access to water resources;
- Promotion of the efficient, sustainable and beneficial use of water;
- Facilitation of social and economic development;
- Protection of water resources and reduce or prevent pollution and degradation thereof;
- Promotion of dam and public safety; and,
- Establishment of suitable water management institutions.

Thus, the main aim of RMPs is to “achieve the objectives underlying sustainability; compilation of functional, workable sustainable access and utilisation plans for water resources on state dams, through a process based on the attainment of harmony within the natural and cultural environment while addressing the needs and expectations of both the community, users and visitors; based on sound business principles; combined with a representative institutional structure that would take charge of the management of the resource in an equitable manner; and ensuring that the process is consultative, with interested and affected parties playing an essential role in the success of the final plan and implementation thereof” (DWAF, 2006).

RMP procedures are designed to legitimise and support recreational activities which include recreational fishing, but this potentially leaves small-scale fishing for livelihoods (and aquaculture) in a void. In addition, the technocratic approach for the compilation of RMPs favours existing empowered interests and institutions that already dominate governance bodies such as the Participatory Management Committees – as evidenced by the Phongola Dam example for developing the Sustainable Management Plan (SUP) for that water body (See Phongola Dam case study, Chapter 5). Interventions are thus needed in the development of RMPs that to address past inequities and imbalances so that disadvantaged poor communities are empowered to participate equally. DWA policy is that communities which live adjacent to water resources should share in the benefits emanating from the utilisation of these resources. It is thus important that communities have both physical access, as well as access to the water-based recreation and small scale fishing value chains through active and genuine participation in the development and implementation of RPMs. For example, entrepreneurs from communities should be provided the opportunity to undertake economic and developmental initiatives through the establishment of partnerships and concessions, which would help develop local skills and also increase economic benefits for communities. Encouragingly, small scale fishing was included in the development of the draft RMP's for dams such as Van der Kloof and Gariep (Mishelle Govender, Chief Director, DWA, pers. comm. July 2014). Ideally, however, a DWA inland fishery policy, and revision of the RMP guidelines to include non-recreational activities such as small-scale fishing and aquaculture is required.

3.4.3. Management Of Living Organisms In Inland Waters Bodies – NEMA, NEMBA and the Provincial Environmental Acts and Ordinances

While access to public dams is controlled by the NWA, management rights for flora and fauna in the state dams vests with provincial Departments of the Environment (formerly Departments of Nature Conservation) in terms of the provincial environmental acts and ordinances. Thus the provincial departments of the environment are proprietors of all fish in public dams. In this context control and authorisation of access, withdrawal, management and exclusion rights to fish in dams rests with these departments.

In the absence of dedicated national legislation for inland fisheries (equivalent to the Marine Living Resources Act), the main legal instruments used by the provincial departments of the environment to manage fish resources are the provincial Nature Conservation/ Environmental Ordinances and Acts, the National Environmental Management Act (NEMA) and the National Environmental Management and Biodiversity Act (NEMBA).

A summary of the natural resource use principles of NEMA and NEMBA relevant to inland fisheries is provided, followed by a description of the fishery provisions of the provincial environmental legislation for the surveyed provinces.

3.4.3.2 National Environmental Management Act (NEMA) (Act No. 107 of 1998)

The purpose of the Act is stated as:

“An Act to provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state; and to provide for matters connected therewith”.

The Act states that the principles set out by NEMA apply to the whole republic and to the actions of all organs of the state that may significantly affect the environment 2 (1). These principles shall;

- Apply alongside all other appropriate and relevant considerations....including fulfilment of the social and economic rights outlined in chapter 2 of the constitution (2,1 -a);
- Serve as the general framework within which environmental management and implementation plans must be formulated (2,1 -b);
- Serve as guidelines by which any organ of state must exercise any function when taking decisions concerning the protection of the environment (2,1 -c);
- Guide the interpretation, administration and implementation of any other law concerned with the protection or management of the environment (2 (1) -e);
- Promote that environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably (2 -2);
- Promote that development must be socially, environmentally and economically equitable (2-3);
- Promote sustainable development that would require consideration of all relevant factors (2-4-a) including the following:
 - Avoidance or minimisation of the disturbance of ecosystems and loss of biological diversity (2,4,a -i);
 - Environmental management must be integrated (2,4 - b);
 - Equitable access to environmental resources (2,4 -d);
 - Promotion of the participation of all interested and affected parties in environmental governance.. and that all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation (2,4 -f);
 - Decisions must take into account the interests, needs and values of all interested and affected parties, including recognizing all forms of knowledge, including customary and ordinary knowledge (2,4 - g);
 - Promotion of community wellbeing and empowerment through environmental education, raising of environmental awareness, sharing of knowledge and experience and other appropriate means (2,4 -h);
 - Consideration of and assessment of socio, economic and environmental impacts of activities (both benefits and disadvantages) and taking decisions on the basis of such considerations (2,4 -i);
 - Openness and transparency in decision-making including ensuring access to information in accordance with the law (2,4 -k);
 - Intergovernmental co-ordination and harmonisation of policies, legislation and actions relating to the environment (2,4 -l);
 - Global and international responsibilities relating to the environment must be discharged in the national interest (2,4 - n);
 - The environment is held in public trust for the people. The beneficial use of the environment must be protected as the people's common heritage (2,4 -o);
 - Recognition and promotion of the full participation of women and youth in environmental management and development (2,4 -q)

Chapter 2 of the Act outlines the organisations for management, their composition, their functions and procedures for formation of these bodies. Chapter 3 outlines procedures for co-operative governance, including the purposes, objectives and statutory requirements of environmental management and

implementation plans. It also outlines procedures for formulation of these plans. Chapter 4 is about fair decision-making and conflict management while chapter 5 outlines the objectives and implementation of integrated Environmental management. Chapter 6 outlines how to deal with international obligations and agreements. The final chapter (7) is about compliance and enforcement of the Act.

3.4.3.3 National Environmental Management and Biodiversity Act (NEMBA)

The purpose of the Act is stated as: "An Act to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA Act of 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bio prospecting involving indigenous biological resources.

The Act applies to the republic of South Africa and to human activity affecting SA biological diversity and its components. It binds all organs of state – in the national and local spheres of government and also the provincial sphere of government, subject to section 146 of the constitution. Section 146 (2) of the constitution stipulates that where there is conflict between national and provincial legislation, the national legislation that applies uniformly to the whole country shall prevail, on condition that the national legislation deals with a matter that cannot be regulated effectively using the legislation of the individual provinces (146 -2a) and, secondly, where the national legislation deals with a matter that in order to be dealt with effectively requires uniformity across the nation (146 -2b) and national legislation provides that uniformity. Further still, the Act gives effect to ratified international agreements affecting biodiversity to which SA is party, and which bind the republic. In terms of its relation to the application of other biodiversity legislation, the Act must be read with any applicable provisions of the NEMA. It is stated that NEMBA will be guided by the principles set out in section 2 of the NEMA.

The Act states that in the event of any conflict between a section of the NEMBA and:

- a another national legislation that had been in force prior to the date of commencement of NEMBA, the relevant section of the NEMBA prevails if the conflict specifically concerns the management of biodiversity or indigenous biological resources
- b provincial legislation, the conflict must be resolved in terms of section 146 of the constitution; and
- c a municipal by-law, the section of NEMBA prevails

Chapter 4 of NEMBA outlines the protection of threatened or protected ecosystems and species. Chapter 5 provides for: the handling of species and organisms posing potential threats to biodiversity; prevents the unauthorised introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur; management and control of alien species and invasive species to prevent or minimise harm to the environment and to biodiversity in particular; and the eradication of alien species and invasive species from ecosystems and habitats where they may harm such ecosystems and habitats.

3.4.3.4 Analysis of use of NEMA and NEMBA for Inland Fisheries

The National Environmental Management Act (NEMA) number 107 of 1998 is primary Constitutional legislation which gives legal effect to the environmental rights defined in the Constitution (Section 24). The environment is defined in terms of human wellbeing, and thus the main objectives of the NEMA are: 'to promote sustainable development through the utilisation and protection of South Africa's natural and cultural resources; to foster equitable access to the benefits that can be derived from South Africa's natural and cultural resources; to empower the South African public, community organisations through participation, environmental education, capacity building, and research and information services'. Additionally, NEMA establishes principles to guide the decisions and actions of all organs of state in environmental management; provides for establishment of institutions that can co-ordinate and harmonise environmental functions of the state and the promotion of participation of stakeholders in environmental governance; establishes procedures for cooperative governance; establishes procedures for conflict management; promotes integrated environmental management by establishing minimum procedures for environmental impact assessments, and also enables national or provincial authority agencies to

prescribe environmental impact assessment regulations; establishes procedures for ratification of, and giving effect to international environmental instruments; and promotes compliance and enforcement of provisions of the Act. In addition, NEMA promotes co-governance by enabling the establishment of environmental management cooperation agreements that can promote the principles of integrated environmental management.

The NEMA is thus a very progressive and powerful instrument to guide the reform of inland fishing rights and governance to be aligned with the Constitution.

The National Environmental Management Biodiversity Act (NEMBA) (amendment Act 10 of 2004), which is based on the principles of the NEMA, is concerned with the management and conservation of South Africa's biodiversity. The Act is binding for all organs of state, and all spheres and levels of government – that is national, provincial and local. The Act applies to both terrestrial and marine environment. It also applies to human activities affecting South Africa's biological diversity and its components. The Act specifically prevents the unauthorised introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur, and also provides for the eradication of alien species and invasive species from ecosystems and habitats where they may cause environmental or economic harm. The NEMBA also permits the use and retention of alien species where they are already established and will not have an impact on biodiversity. This allows for retention of alien species that had been introduced in dams. It makes provision for the introduction of species that might be suitable for the development and enhancement of inland fisheries. While all provincial legislation already contain provisions for the control of introduction of alien species into inland water and the transfer/transportation of live fish, the NEMBA provides the over-arching legislation for strengthening these controls and restrictions. Crucially, it gives the national minister and/or provincial ministers the powers to declare specific regions as biodiversity regions and therefore prohibit introduction of alien or exotic species in such regions and at the same time also gives the minister(s) powers to permit controlled introduction of alien species.

The NEMA adequately provides for the development and enhancement of inland fisheries based on the principle sustainable development. The Act potentially provides a powerful instrument through which inland fisheries could be developed and governed since it embodies principles of equitable governance, integrated management, sustainable management and social equity in the utilisation of fisheries. Arguably, the principles and instruments within NEMA and NEMBA jointly provide for a legalised developmental approach to inland fisheries. If correctly applied, these could redress the past inequities in terms of access to fisheries. These could (and should) be used to formulate comprehensive inland fishery specific legislation, or for the revision of provincial legislations that could provide for enhanced utilisation of inland fisheries for sustainable livelihoods. Recognising that NEMA and NEMBA are the over-arching legislation for environmental management, the provincial departments of environmental management are in a process of revising the existing provincial legislation to develop provincial guidelines for the management of natural resources including fisheries under their jurisdiction (Martine Jordaan, Aquatic Scientist, Cape Nature, *pers. comm.*).

3.4.4 Fisheries Aspects of Provincial Legislation and Ordinances

Agriculture and environmental management, excluding national parks, national botanical gardens and marine resources are listed as shared legislative competencies. Each province thus has dedicated provincial legislation for environmental management and biodiversity conservation which is guided by the principles of the relevant National Constitutional legislation, visibly, the NEMA and NEMBA.

The provinces are still in process of revising and aligning their provincial environmental legislation with NEMA and NEMBA. Section 104 of the Constitution entitles provinces to pass legislation for that province with regard to any matter within a functional area listed in Schedule 4 and Schedule 5. Schedule 4 listed those legislative competencies in respect of which a province shared legislative powers with the national legislature and schedule 5 listed those legislative powers that are exclusive to the provinces. Some provinces such as the Western Cape, Mpumalanga, Limpopo and Northern Cape have promulgated new environmental acts post-1994, while in others such as KZN, this process has not been finalised.

Provincial legislative provisions for fisheries have essentially remained unchanged since the Apartheid era, even where provincial environmental legislation has been revised post-NEMA. A table summarising the relevant fisheries legal provisions of provincial legislations is included in Appendix 2. In the sections below, the relevant aspects of provincial provisions for inland fisheries are outlined and analysed.

3.4.4.1 Western Cape Province (Western Cape Nature Conservation Laws Amendment Act No 3 of 2000)

The purpose of the Western Cape Nature Conservation Laws Amendment Act No 3 of 2000 is stated as, “An ordinance to consolidate and amend the laws relating to nature (and environmental) conservation and to provide for matters incidental thereto”. Regarding fisheries, the Act makes the following provisions:

- Protection of fish from pollution that is likely to cause injury to fish or fish food;
- Restrictions of placements that could obstruct free passage of fish;
- Prohibition of introduction of live fish or any other aquatic growth other than those placed as permissible ‘catch and release’;
- Restriction on killing or injuring of fish other than as part of permissible part of being caught as per permit conditions;
- Prohibition of catching of endangered species and catching of fish outside the angling season;
- Prohibition of use of fyke nets, crab-nets, staked nets or trek nets without a licence;
- Prohibition of the use of a staked net, trek-net or fyke net which, in each case, extends over a distance of more than half the width of such inland waters at the place where such a net is so used even in the event that a licence had been issued;
- Prohibition of use of fyke-nets if any device is used to guide fish to an opening if such net is more than six metres in length;
- Prohibition of placing a staked net or fyke net or using a trek-net within a distance of 30 metres from the extremities of any other such net being used in such waters;
- Prohibition of use of cast-nets unless under authorisation;
- Prohibition of exceeding stipulated bag limits and catching of undersized fish as stipulated in regulations;
- Prohibition of snatching or spearing as methods of fishing;
- Prohibition of angling without a permit;
- Prohibition of angling by means of: more than two lines, more than 2 single hooks attached to any line; a set line with more than two hooks attached thereto;
- Prohibition of sell or buying of an endangered spawn of fish;
- Prohibition of the sell, buying or transportation of live carp, bluegill sunfish, trout, black bass, banded tilapia or exotic invertebrate freshwater fauna;
- Prohibition of importation of live fish or the spawn of any fish in the province;
- Prohibition of sell of bait caught from inland waters unless permitted to do so;
- Prohibition of buying of bait from inland waters unless from someone permitted to catch and sell; and
- Prohibition of cultivation, possession, transportation, sell, donation, buying, importation into the province any noxious aquatic growth.

The Act states that ‘the Director or Board may grant exemption in writing from any of these provisions to any person doing research on fish or fish food. The Act further states that all these provisions do not apply to any privately owned inland waters.

3.4.4.2 Free State province (Nature Conservation Ordinance 8 of 1969)

This Nature Conservation Ordinance 8 of 1969 was published under Administrator’s Notice 184 of 12 August 1983. The ordinance makes the following provisions with regard to fisheries:

- A fishing licence shall be issued after payment of the determined amount by the Administrator subject to the following conditions: licence shall not be transferable, valid only in its original form; fees shall be non-refundable; shall lapse if lost or destroyed; and shall not exceed 12 months in validity;
- On any day (except under the authority of a permit issued by the Administrator), no person shall catch and keep more fish of a species than the number specified (for example: Yellowfish – 10; Trout – 6);

- There will be minimum size of fish that can be caught (smallmouth yellow fish – 45 cm; large mouth yellow fish – 45 cm; trout -30 cm);
- No person shall use live fish as bait;
- Except under administrator's authority, no person shall import into the province, keep in captivity, sell live or place or release in any water prohibited species of fish as listed in the consolidated list for Fresh water fish of the Department of Agriculture;
- No person shall organise or hold an angling contest or competition except under the authority of the administrator; and
- No person shall take part in an angling competition unless it has been authorised by the administrator.

3.4.4.3 Mpumalanga Province (Mpumalanga Nature Conservation Act No. 10 of 1998)

The purpose of the Act is stated as being "An Act to consolidate and amend the laws relating to nature conservation within the province and to provide for matters connected therewith".

The Act provides for the following in terms of fisheries:

- No person shall catch fish in water unless s/he has permission from the owner or occupier of land on which the waters are situated;
- No person shall catch fish other than by angling (unless with authorisation from relevant authority);
- No person shall employ angling methods that hook the fish on any part other than on the mouth;
- No Person shall angle with more than two lines with more than two single hooks;
- No Person shall angle in fly-fishing waters with other than one line with one non-spinning artificial fly attached to it;
- No Person shall catch fish with set-line, unless with a permit authorising such method;
- No person shall possess a net or trap with which fish may be caught;
- No Person shall possess a landing-net or keep-net designed for the purpose of landing or keeping fish caught with a line and fish-hook;
- No person of or above the age of 16 years shall angle unless s/he is the holder of a licence which authorises him or her to do so (and carries such a licence all the time when angling);
- No person shall place an obstruction in waters preventing the free passage of fish;
- No person shall drain water from a pond, reservoir or lake for the purposes of catching or killing fish
- No person shall cut through, breakdown or damage a dam wall, bank or barrier for purposes of catching fish;
- No person shall tamper or interfere with a sluice, gate, valve or outlet for purposes of catching fish; and
- The responsible official may by notice in provincial gazette declare a period a closed fishing season.

It is stated that the provisions of the Act shall not apply to an owner or occupier of land, the relative of the said owner or an employee of the said owner who catches fish in water surrounded by the land belonging to such an owner or occupier. In addition, the provisions forbidding the use of nets or traps shall not apply to privately owned waters.

3.4.4.4 KwaZulu-Natal Province (Nature Conservation Ordinance No. 15 of 1974)

Nature Conservation Ordinance No. 15 of 1974 and the KZN Nature Conservation Act No 29 of 1992 were repealed and replaced with KZN Nature Conservation Management Act No. 9 of 1997. The 1997 KZN Act does not expressly include any provisions for management of inland fisheries. The provisions below are therefore those from the Nature Conservation Ordinance No. 15 of 1974.

The purpose of the ordinance is stated as being: "An Ordinance to consolidate the laws relating to nature conservation and to provide for matters incidental thereto".

The Ordinance provided for the following in terms of fisheries:

- That the ordinance shall apply to all waters of the province and fish therein;
- Recognition of angling clubs or associations upon approval of their constitution;

- Establishment and maintenance of fish hatcheries upon approval by the Administrator;
- Prohibition of the introduction of fish from any hatchery unless by Board's approval;
- Prohibition of introduction of fish into any waters without prior approval of the Board;
- Agreements or leases for the acquisition of fishing rights in any water including rights of access to such waters by person holding licenses entitling them to catch fish in such waters;
- No person should promote, organise, conduct or take part in any angling competition unless authorised by the Board;
- Granting of licenses for any river conservancy or club or association to promote and conduct angling competitions;
- Powers for the Administrator to proclaim closed fishing seasons for specific species and areas for the purposes of protecting fish;
- No person could wilfully injure or disturb the spawn of fish or any spawning bed;
- Prohibition of any person from catching fish unless they were in possession of a license prescribing him or her to do so and that every licence was personal to holder and non-transferable; and
- Permission for a person who had been issued a licence to use a hand set net for the purposes of landing fish and permission to such persons to use a scoop net with a bag not exceeding 300mm diameter and 300mm in depth for purposes of catching bait.

These provisions did not apply to riparian owners (their spouse and children) of any land abutting to waters who could catch fish in such waters without a licence.

3.4.4.5 Limpopo Province (*Limpopo Environmental Management Act No. 7 of 2003*)

The purpose of the Limpopo Environmental Management Act (Act No. 7 of 2003) is stated as being "An Act to consolidate and amend the environmental management legislation of or assigned to the Province; and to provide for matters incidental thereto".

In terms of fisheries, the Act provides for the following:

- No person shall catch fish in any aquatic system otherwise than by means of angling;
- No person shall place in any aquatic system any obstruction preventing the free passage of fish;
- No person shall drain or attempt to drain any aquatic system in order to catch or kill fish;
- No person shall catch fish during a closed season;
- No person shall wilfully damage, disturb or destroy the ova or spawn of fish or the spawning bed, bank;
- No person shall while angling employ a method to hook fish on any part other than in the mouth;
- No person shall angle with more than two lines;
- No person shall angle with a line to which more than two single hooks are attached with natural bait;
- No person shall angle with a line to which more than one artificial lure or spoon is attached;
- No person shall catch fish with a set line;
- No person shall be found with a fishnet, a fish trap or similar device designed for catching fish unless holding a permit;
- No person shall establish or operate an aquaculture establishment without a permit;
- No person shall place or release live aquatic biota in any system exempted unless as part of catch and release;
- No person shall import live aquatic biota; and
- Prohibition of pollution of aquatic systems

3.4.4.6 Analysis of the Character of Provincial Acts and Ordinances for Inland Fisheries

The outstanding feature of provincial legislative provisions for inland fisheries is that unlike marine fisheries, they are not guided by any articulated national policy based on the goals of the overarching Constitutional legislation, the NEMA. Even where the provincial environmental legislation has been revised¹⁰, they fishery provisions largely address the management of recreational fishing and are silent on the governance of the consumptive use of the fish resources for livelihood or economic purposes. For example, the Mpumalanga Act specifically stipulates that 'No person shall catch fish other than by angling'. The common regulatory practice under recreational angling is 'catch and release'. The Mpumalanga and Limpopo legislations (both

revised) go on to forbid 'unsporting' methods of fishing including the provision that 'No person shall employ angling methods that hook the fish on any part of other than the mouth'. Similarly the Western Province Act has a provision that sounds like 'cruelty against animals' type that puts 'Restriction on killing or injuring of fish other than as part of permissible part of being caught as per permit conditions'. Of note is that none mention either subsistence fishing or any other form of fishing which could be linked to a form of livelihood (however the use of nets under permit is provided for). This despite the use (formally and informally) of many inland fishery resources for such purposes as demonstrated in the cases of Fundudzi, Phongolo, Nandoni, Makuleke and Driekoppies. Given the Constitutional recognition of customary rights and equitable access to natural resources, the lack of policy and provincial legislative provision for inland fisheries for livelihood purposes is clearly anomalous.

The stated purpose of most Provincial environmental legislation is the 'conservation of nature', and with regard to fisheries there is emphasis on 'recreational' or 'sport' angling, rather than consumptive use. In some dams, the fish species that are allowed to be taken away for consumption are the 'alien' introduced species that have become invasive such as carp and catfish in Voëlvlei dam, with the expressed aim of trying remove and expunge them from such dams. The banning or restrictions on use of nets in all the legislations sampled here is related to the conservation purpose. The environmental agencies view the use of nets as a very efficient fishing technique that can easily overfish the resource. The practice is thus mostly prohibited, unless under permission from the relevant authority. Thus for purposes of future inland fishing rights, the pros and cons of use of nets against other fishing methods will need to be evaluated in terms of sustainable development principles of environmental sustainability, equity, and economic efficiency. In addition, regulations that limit fishing on most public dams to 'catch and release' angling would have to be reviewed if communities are to exercise consumptive fishing rights.

While the enforcement of the requirement for recreational angling permits has largely fallen away in most provinces, net fishing permits are more strictly controlled. Where the relevant authority has decided to allow some form of net fishing, for commercial exploitation or scientific experimental fishing purposes, a license has to be issued by the said authority. For example, two commercial fishing licenses have been issued for Bloemhof dam (Mr L. Barkhuizen, Free State Department of Environment, Tourism and Economic Affairs, pers. comm. July 2012). The Western Province Department of Agriculture is promoting experimental commercial net fishing for alien species in collaboration with Cape Nature (Mr F. Endemann, Cape Province Department of Agriculture, pers. Comm. July 2012). For dams such as Voëlvlei this experimental fishing is seen by environmental agencies and recreational fisheries as an opportunity to reduce the population (or even exterminate) of the invasive species (carp and catfish) that have become a concern for the recreational anglers. This has necessitated negotiation between DAFF, DWA and Cape Nature Conservation for such licenses to be issued for the selected dams for the experimental fishing. In order to facilitate a livelihoods approach to inland fisheries, the regulatory instruments will also need to be revised to align these with permitting systems and fishing methods that are suitable, easily accessible and affordable for subsistence and commercial fishing by communities.

From the preceding, one of the key missing links in provincial legislation has been provision for promoting inland fisheries to enhance livelihoods and socio-economic benefits. None of these Acts legislate for the development of inland fisheries for the livelihoods potential that the sector provides. In addition, this shortfall gives rise to conflict on some dams and lost development opportunities on others. While there have been efforts in the past by some of the provincial agencies to promote fishing based livelihoods, these have usually foundered on lack of or inadequate legislation, policy and capacity to support a developmental approach to governance of fisheries based on the NEMA principle of sustainable utilisation.

NEMA, as the over-arching national legislation for environmental governance, provides for a developmental, equitable, cooperative governance and coordinated approach to utilisation of nature. Progress in revising provincial legislation to align these with NEMA, NEMBA and South Africa's Constitution has been uneven. Even where legislation has been revised, the provincial environmental agencies still see protection or management for "*biodiversity*" as their primary mandate while management of fisheries for sustainable human consumption is seen as secondary. In any case, dams are seen as artificial habitats of low conservation

importance, since they are often dominated by exotic fish species. The provincial environmental departments do not see themselves as “development” agencies with a mandate to promote the sustainable and equitable use of fish resources for livelihoods. Recent years have in fact seen increased withdrawal by most provincial environmental agencies from promoting fisheries, with all the old provincial fish hatcheries closed. In most provinces community interaction is largely limited to enforcement and education, the education being mainly about conservation of nature rather than its sustainable utilisation. A common aspect of this approach in Southern Africa has been to co-opt communities into eco-tourism projects that try to convince and move communities away from consumptive use of nature towards values based on non-consumptive use of nature.

In view of the foregoing, what is required is policy and guidelines on the development, promotion, enhancement and governance of inland fisheries from a developmental and livelihoods perspective that could give guidance and mandates to the relevant agencies (in particular DAFF, DWA and provincial environmental agencies) for governance of the sector from such a perspective. Revised legislation will thus have to ensure facilitation and creation of an enabling environment for such an approach to utilisation and governance of inland fisheries.

3.4.5 Natural Water bodies under Traditional Authority

Two pieces of legislation that are likely to have large bearing on property rights, access rights and natural resource management in rural areas are the Traditional Leadership and Governance Framework Amendment (TLGF) Act (41 of 2003) and the Communal Land Rights (CLR) Act (11 of 2004). This legislation is intended to improve rural people's rights to land and the resources thereof in communal areas and the administration of these rights.

The stated intention under these two pieces of legislation was to: secure property rights especially in the former homelands; facilitate development; extend democracy to rural areas; and ensure sustainable use (Pollard and Cousins, 2008). While these could, in principle, result in improved management of resources including inland capture fisheries if implemented successfully, the reality has been that both pieces of legislation have been hotly contested, resulting in delays and drastic revisions of the original principles. In this context, the Traditional Leadership and Governance Framework Act (2003) has been the foundation for the establishment of Traditional Councils (headed by Traditional Authorities or their representatives), which are empowered to administer and allocate land (and landed resources) in rural areas. According to Ntsebeza (2005), the survival of traditional authorities is linked directly to their continued control of the resource allocation processes at the local village and Tribal Authority levels through these councils.

Where it concerns inland fish resources such as Lake Fundudzi that are not public dams, custodianship is held by the Traditional Authority of the area even though the NWA does not explicitly recognise customary management. This also appears to be the case for public dams that are surrounded by rural communities such as Nandoni and Makuleke. In the context of these two dams, fishery access exists under dual property rights regimes – both public and communal. In the case of Lake Fundudzi, the chief has historically controlled access, withdrawal, management and exclusion rights. The fact that the chief holds these rights on behalf of his subjects appears to preclude him from alienating any of the rights. The community appears to respect the custodial and stewardship role that their chief plays. As the case study of Nandoni dam demonstrates (Appendix 3), these custodial powers can be abused as a traditional leader established a camping site for which he charges for use, allegedly personal gain. The leader also reportedly arrests those found using nets and confiscates the nets (Tapela *et al.*, 2015).

The holding of land surrounding water bodies under communal tenure such as at Lake Fundudzi provides the opportunity to enhance this tenure regime by formalising the property rights regime as ‘Communal Property’ and developing Community Based Management approaches in such contexts. Just as most of the existing provincial legislations protect the rights of owners of water bodies on private land to manage these on their own, the (revised) legislation should also recognise the rights of communities to manage water bodies on communal land under the communal property rights regime. There are many examples in literature on Southern Africa (Hara *et al.*, 2009) and elsewhere in the world (Feeny, 1994; Swallow and Bromley, 1995) which show that the formalisation of management of natural resources that had hitherto been

managed by user communities under communal property into public property resulted into *de facto* turning those resources into open access. Even where communities have taken over management of fisheries by default due to lack of presence by government agencies as the case is on Nandoni and Makuleke dams, it might be prudent to strengthen the existing Community Based Management regimes or introduce Co-management rather than trying to wrestle responsibility and authority from communities. The lack of capacity by government means that such strategies could merely end in introduction of open access regimes, having dis-embedded authority and responsibility from communities. Where communal tenure already exists or could be strengthened, it would be prudent to recognise these tenure systems in legislation and put in place institutional and governance arrangements that support and facilitate Community based Management.

3.4.6 Need for a Developmental Approach

While the current provincial inland fisheries legislation can be regarded as archaic and lacking a sustainable development orientation, the NEMA, NEMBA and the Constitution have adequate provisions for a developmental and livelihoods approach to the utilisation of natural resources such as inland fisheries. Policy and legislative reform will however require the leadership of the Department of Agriculture, Forestry and Fisheries (DAFF), which is the line agency for the development and management of fisheries and the promotion of rural livelihoods. In response to ministerial national goals as outlined in the DAFF's Medium Term Strategic Framework (MTSF) adopted in 2009, the Department has developed a twenty year (2011 to -2031) 'Integrated Growth and Development Plan' (IGDP) (DAFF, 2010). The IGandDP provides a long-term strategic plan for growth and development of the three sectors (Agriculture, Forestry and Fisheries) in line with government priorities. Thus the IGDP is meant to provide strategic direction for the sector, including fisheries. Another purpose of the IGDP is addressing the key challenges facing the sectors in order to improve their contribution to the stated national government goals. DAFF is also involved in a number of initiatives geared towards improving opportunities and well-being for the rural poor under the "Integrated and Sustainable Rural Development Strategy" which is being coordinated by the president's office. Of note is that the small-scale fisheries policy (DAFF, 2012) is for marine fisheries only. It does not incorporate inland capture fisheries. While there is no legislation legally recognising the existence of inland capture fisheries, the principles of the DAFF Small-scale Fishing Policy would largely be applicable to inland fisheries.

3.5 Existing Use Right Practices

Understanding the existing use right practices on public dams and other bodies is important for future restructuring of access rights, withdrawal rights and management rights. This is particularly relevant to *de facto* resource use rights by communities which are poorly defined and lack a supporting policy and legal foundation. Properly defined bundles of rights which are accepted as legitimate by all stakeholders are required in order to derive increased benefits and avoid user conflicts. This section examines the use right practices of the current key stakeholders and how these influence the rights of other stakeholders. The discussion is based on case studies of property rights regimes in South Africa (Appendix 3)

3.5.1 Recreational fishing clubs, water sports clubs and tourism concessions

Recreational angling and other sports clubs currently have a dominant presence on public dams. Legally, angling clubs have access and withdrawal rights conferred by the DWA that enable them to enter the dam area, engage in recreation fishing – including tournaments, and also to build infrastructure on the dam frontage for use by their members. Although access to dams is controlled through NWA authorisations, fishing rights, including fishing tournaments, are controlled by provincial departments of the environment. In some instances, they fence off the areas where they have developed facilities. Access to such areas is controlled through locked gates, with keys available to members or non-members who have been given permission to use club facilities. Recreational clubs (for example Voëlvlei dam) are thus exercising *de facto* exclusion rights beyond what their authorisations entail, visibly, access rights only which operationally only positions them as viewers.

The lease of land on the dam frontage to build lodges, guesthouses as part of tourism concessions legally gives such concessionaires access rights only. Proximity to the dam enables them to negotiate additional use rights (if these are not part of the authorised uses) such as access rights to the dam for water sports, cruises, etc. for their guests.

Authorisations for access and fishing rights for recreational anglers and tourism operators are thus well defined under existing legislation, visibly the NWA and provincial environmental legislation and management arrangements.

3.5.2 Creation of *ad hoc* rights

The strong presence and historical use of some public dams by recreational angling clubs, other water sports clubs and tourism concessions places them in very strong positions as 'existing lawful users' under the NWA. In a country with the history of racially based exclusionary practices, surrounding communities have come to think that they have no rights to access the dams given that the public dams have predominantly been used by whites in the past.

The declaration of nature reserves around many dams with concomitant policies on exclusive recreational use of the dams has further served to formalise the effective, and arguably inequitable, exclusion rural communities from fishing access for livelihood purposes.

Private clubs (recreational fishing, sports, etc.) and tourist operators that have built facilities on the dam frontage and have been operating on dams, especially well before 1994, exercise historical rights (through 'existing lawful uses' authorisation) in the sense of established "sitting tenants". This and the use of the economic argument that such activities are beneficial to the local economies (job creation and tourist spend) appears to bring force to bear on some of the rights that they exercise beyond what their authorisations entail and would allow. For example fencing off areas and denying access to those specific areas of the dam for the public, non-members and non-guests such as on Voëlvlei dam. When recreational anglers try to limit or deny other fishers the right to fish, going to the extent of, confiscating and destroying equipment such as happens on uPhongolo and Driekoppies dams (Tapela, this volume, Chapter 5) they are exercising exclusion rights that are not within the ambit of their rights as provided for by the authorisations that allow them usage of public dams (from DWA) and recreational fishing permits (from provincial environmental agencies).

In view of the preceding, an important economic analysis could be to evaluate how much the current recreational, tourism and eco-tourism activities contribute the local economies in terms of jobs and other benefits. Such an analysis would enable weighting the benefits of broadening use of dams to other beneficiaries, including development of inland fisheries, beyond the current dominant uses and users. Of real concern is that the creation of exclusionary rights by entrenched historical users has the potential for continued inequity in the allocation of subsistence and/or commercial fishing rights for communities. This would have to be addressed through reforms of property and access rights for inland fisheries.

3.5.3 Subsistence and commercial fishing by communities

Legally, communities have general access rights to dams in terms of the NWA which provides access to the public from 6am to 6pm (Jonathan Barnes, Control Water Control Officer, DWA, pers. comm.). In principle, they should also be able to fish using recreational permits just like recreational anglers in order to exercise withdrawal fishing rights. Poverty (the inability to buy such permits) or the lack of facilities where to buy such permits (distance from the nearest post office or Inland Revenue Office), fishing with nets or customary methods, might compel communities to fish without permits, in effect fishing illegally or informally. Where people have historically fished without permits such as in Lake Fundudzi, the introduction of such measures could cause friction unless they were introduced for good and justifiable reason and with the backing of the chief. This ambiguity is also the case on Nandoni and Makuleke dams where local fishers do not use permits and frown upon being harassed to produce them, whether by conservation officials or their own chiefs. Where fishing is for subsistence purposes, there is the clear dilemma whether permits are morally enforceable. For those using hook and line, there is little concern about fishers catching excessive volumes beyond home use and selling the extra catch for livelihood purposes (For example on Nandoni). The main conflict though arises where fishers from communities use nets (e.g. in Uphongolo, and Driekoppies dams) which are very powerful fishing tools. In most provincial legislation (see those for Mpumalanga and Limpopo – Appendix 2), the use of nets is banned, with rod and line angling being the only method of fishing legally allowed.

On uPhongolo Dam, the ongoing ambiguity of the legitimacy of fishing activities by communities has resulted in a fairly serious conflict between fishers from the communities on the east side of the dam, commercial fishing charter operators, and the EKZN Wildlife authorities (the reader is referred to a project case study video of fisher testimonies at Phongola Dam <https://www.youtube.com/watch?v=qKu3xbOiU4I>). EKZN Wildlife has not issued permits for use of nets on the dam since the original pilot net fishing project was conducted in 1998. Although the use of nets is technically illegal, the net fishers argue that they have authority from the Water User Association and/or DWA to use nets. From conversation with a DWA official (Mazwi Nyawo, Senior Water Control officer, DWA. Pers. Comm.), they do not see why fishers from the community should be stopped from fishing while recreational fishers are allowed to. The DWA officials thus simply take a blind eye to the fishing activities of nets fishers from the community. EKZN Wildlife at the same time refrains from arresting and prosecuting net fishers due to the volatility of the situation. Meanwhile, nets belonging to community fishers are confiscated by recreational anglers and/or guesthouse owners if they are found fishing in the middle of the lake, or on the western side of the Lake where recreational and tourist activities pre-dominate.

The predominant view (also enshrined in most provincial legislations) among most anglers and some environmental authorities is that nets are destructive, especially to the target species for angling and sports fishing and should therefore be banned. It is in this context of no clear fishery management and governance arrangements, that on some dams such Phongola and Driekoppies, anglers, lodge owners and recreational fishers take the law into their own hands and try to enforce the exclusion of use of gill nets on such dams.

Currently, the fishing use rights on dams are dominated by recreational angling. The historical use of dams by recreational anglers has created *de jure* fishing rights for this group. As will be demonstrated in section 7, the position of recreational angling on dams had been further strengthened by enabling supportive provincial nature conservation legislation that largely catered for recreational angling and biodiversity conservation. This legislation does not facilitate or cater for subsistence and/or commercial fishing, *de facto* restricting or denying fishing rights for communities. Thus the legal basis for inland subsistence and commercial fishing remains poorly defined. There is a need to revise the existing legislation so that this can provide for equitable and sustainable access to fish resources on dams. The lack of an inland fisheries policy has also meant that there has been lack of appropriate institutional arrangements for subsistence and commercial fishing on dams. Improved property and access for communities will require facilitatory enabling legislation and policies.

3.5.4 Co-Management Rights

Co-management of fish resources is seen as the most appropriate governance arrangement for fisheries especially involving multiple stakeholders (Hara, 2003; McCay, B. 1993; Bromley, 1991; Ostrom, 1990; Jentoft. S. 1989; McCay and Acheson, 1987). South Africa's National Water Act provides for co-management structures to manage the use of public dams for various purposes. Thus in terms of the NWA, the establishment of Catchment Management Agencies (CMAs) in the country's 19 designated water management areas is provided for. CMAs are meant to serve as vehicles for devolution of management authority and responsibility. The Act requires that each CMA draws up a management strategy for their catchment and for the CMA to perform core functions required to implement the Act including the active promotion of user participation including communities (section 80 (e) of the NWA). This has been given further substance by the implementation guidelines (DWAf, 2001) which emphasise that representivity and inclusivity of all stakeholders' interests, needs and values, especially those of hitherto marginalised communities and the rural poor will need to be considered as part of the catchment management processes. A second body proposed by the NWA are Water User Associations (WUAs), which are statutory bodies defined as cooperative institutions of individual water users that wish to undertake water-related activities for their mutual benefit. The involvement of users in management through CMAs and/or WUAs offers to create and extend management rights to users. WUAs have to date not been effectively used to manage fishing rights and it is questionable whether such bodies can be used for strengthening and protecting fishing property and access rights for communities without significant government intervention and support. Included in the Act as a way to incorporate farmer associations and irrigation boards, WUAs present formidable challenges as vehicles for inclusion of communities in

water and fisheries management. The problem is that WUAs usually involve power dynamics, resulting in capture of power and authority by the most economically powerful for their own interests (Sithole, 2011). Malzbender *et al.* (2005) argue that the WUA a highly bureaucratic and costly institution in terms of its establishment and management. The Pongola Dam Recreational WUA illustrates the point as this organisation has been ineffective in addressing the fishery conflicts on the dam. One can envisage inland fisheries management organisations being equally dominated by established angling clubs and interests. In effect, the poorly educated and resourced fishers from communities are likely to be vulnerable to marginalisation in such groupings unless there are specific facilitated interventions to promote their fair and equal participation (see the project video of fisher testimonies on Phongola Dam illustrating this point (<https://www.youtube.com/watch?v=qKu3xbOiU4I>)).

If the aim is to strengthen the participatory management rights of rural community fishers, the creation of co-governance bodies that will provide empowering space for management rights for communities is required. This will require the granting of access, withdrawal and management rights to co-management bodies on behalf of the members. Granting such rights to community user group organisations will require reforms to existing policy and legislation. The co-management bodies can then control the activities of their stakeholders by granting the group rights to the individual members. In order for communities to participate as equal partners, they will have to be empowered through training and awareness-raising about their rights, principles of sustainable use and the regulatory frameworks under which inland fisheries will be managed.

3.6 Recommendations For Revisions To Inland Fishery Property And Access Rights Regimes

3.6.1 Preliminary Recommendations

This section proposes recommendations on some of the key issues that will need to be addressed in order to enhance property and access rights to inland fisheries for livelihood purposes. The recommendations should not be taken as final for three reasons;- firstly, there is still a need for a consultative process on the findings of this project with key stakeholders; secondly, the analyses and views expressed herein assume that the selection of dams and reservoirs on which they are based is representative enough for us to generalise these findings to all public dams and communal water bodies in South Africa; and thirdly, stakeholders and interested parties will inevitably broaden the perspective presented here based on their experience and insight into the issues.

With this in mind, the following recommendations are made to guide the development of property and access rights for inland fisheries:

3.6.2 Guiding Principles and Objectives to Inform Property and Access Rights for Inland Fisheries

There are currently no guiding principles and objectives to inform the development and regulation of inland fisheries. The definition of property and access rights needs to be informed by clear objectives and principles. Below are the suggested principles or themes/issues for the guiding principles based on South Africa's constitution, and the policies and legislation flowing from it:

- **Sustainable development:** Inland fisheries development must be based on and be in support of sustainable rural development as articulated in NEMA, the NWA and the DAFF Integrated Growth and Development Plan.
- **Provision for livelihoods, food security and income:** Inland fishing rights must be developed and regulated for the enhanced provision of livelihoods, food security and income for the poor.
- **Property rights and access rights:** Inland fisheries are Common Pool Resources for which appropriate property rights and access rights need to be specified, recognised and enforced for the stakeholders who have been given such rights, in order to ensure sustainable utilisation. Specifically, recognised inland fishing access and property rights need to be broadened from recreational fishing to include the subsistence, artisanal, and commercial sectors. Commercial recreational fishing charter operators should be recognised and accommodated as a class of rights holders.

- **Property rights regimes:** Inland fisheries are Common Pool Resources that need to be governed under appropriate property rights regimes (state, private or communal) as specific local context would require and demand. Local communities adjacent to dams should be given preference in terms of access rights that promote livelihood opportunities and local economic development.
- **Context specific management:** Inland fishing rights are based on Common Pool Resources and need to be managed under appropriate institutional arrangements (state-centric, co-management, community based) as specific local context would require and demand.
- **Positive incorporation of communities in value chain economies:** Rights allocated for inland fisheries development must be accompanied by processes for the positive and beneficial incorporation of communities in all dam economic activities such as tourism and recreational angling.
- **Skills transfer:** In order to address issues of equity and transformation, the allocation of rights to previously disadvantaged persons and groups must be accompanied by the facilitation of the transfer of skills for fishing and participation in other value chains associated with other public dam economies such as tourism and recreational angling.
- **Good Governance:** The governance of Inland fisheries including the allocation of rights shall be based on and guided by the accepted principles of good governance, namely, inclusion, participation, transparency, accountability and equity.
- **Flexibility:** Given the social, institutional, environmental and economic diversity which characterises use of dams, the models for (property and access) rights, and management and governance frameworks will need to be flexible to accommodate local needs and contexts.

3.6.3 An Inland Fisheries Policy

The definition of appropriate property and access rights arrangements for inland fisheries requires a guiding policy based on the above principles, and the environmental, social and economic policies of South Africa. As fisheries now forms part of the mandate of DAFF, this department's policies (DAFF, 2010) for promoting small scale farmers/fishers, and rural livelihoods need to be applied to inland fisheries.

3.6.4 Leadership and drive for inland fisheries

As the mandated line agency for fisheries, DAFF should assume responsibility for inland fisheries and drive the process. The existing arrangement whereby provincial environmental agencies are responsible for management of fisheries has been shown to be inadequate as these departments primary mandate is biodiversity conservation and not rural livelihoods development. It makes sense therefore that DAFF should assume responsibility for managing the social and economic aspects of inland fisheries, while the environmental agencies retain their biodiversity management mandate. Taking charge of both development and management of inland fisheries will mean developing appropriate policies and strategies and also building the requisite human capacity within the department. Also, it will require enabling policy and legislation. Given that the dams belong to the DWA and other government departments while the provincial environmental agencies currently possess the existing management capacity, this will require cooperative arrangements for the development and governance of the sector among the three entities in the short to medium term, while DAFF develops its own inland fishery management capacity.

3.6.5 Enabling legislation for inland fisheries

Historically, the provincial departments of the environment (formerly nature conservation) have managed inland fisheries using the nature conservation ordinances and acts. Largely, these had been developed for non-consumptive use of nature and maintenance of biodiversity. Recreational fishing, being mostly based on 'catch and release' is mostly such use of nature. Post 1994, NEMA and NEMBA are also being applied by the said agencies as over-arching legislations for management of nature including inland fisheries. Given that developing inland fisheries for protein food security will entail consumptive use of inland fisheries, there is need to develop appropriate legislation for the establishment, legalization and management of such a sector. Such revised legislation will also need to confer authority for development and management of the sector to DAFF. In the short term, NEMA and the NWA have enough provisions for facilitating a livelihoods approach for use and management of dams for inland fisheries. In addition, the existing provincial legislations have provisions for issuing of fishing permits and regulatory frameworks. With cooperation among the various agencies (in particular DAFF, DWA and provincial environmental

agencies) the existing legislation could be used to begin the structured development of the sector. What is urgently needed is a policy on inland fisheries for DAFF while appropriate legislation is being developed. A legal review is required to develop appropriate legislation for inland fisheries. This would include

1. Revision of the existing provincial legislation so as to harmonised it with NEMA in terms of equitable distribution of fishing property and access rights and co-operative governance of the sector so that it can cater for a livelihoods approach to inland fisheries.
2. Consideration of an empowering Inland Fishery Act by the Minister of DAFF, which addresses issues such as fishing rights. An alternative would be the merger of inland fisheries legislative requirements with the Marine Living Resources Act, which would then be renamed appropriately, for example, the Fisheries Act.

3.6.6 Need for a developmental approach

Inland fisheries have historically been developed and managed for sport fishing (recreational angling). If the sector is to be re-structured or enhanced for food security for the rural poor and/or protein deficient communities, then this has to be done from a developmental perspective. Indeed such an approach is in line with DAFF's IGDP (DAFF, 2010) and also national government's rural development strategy. This will require change in thinking from conservation and non-consumptive use orientation towards viewing and developing inland fisheries as a source of fish protein for rural communities. Besides fishing, communities need to be included in other economic activities that occur on dams such as tourism and recreational angling. Thus, there is need for strategies that would promote improved inclusion of communities in the value chain for these activities. Appropriate policies and legislation towards this perspective will have to be developed and put in place.

3.6.7 Fishing rights

The categories of fishing rights among the various fisher groups (the main ones being recreational angling, commercial and subsistence) will need to be clearly structured and specified in the different contexts. Given that dams and water bodies are geographically specific while users (especially recreational fishers) might not be localised, a combination of approaches might be appropriate. For example, it could be appropriate to give Territorial Use Rights for Lake Fundudzi to the Vhatatsindi people living in the area under the stewardship of their traditional leaders. This does not mean that the government does not have a role to play. Government will have to provide technical support for fisheries management and resource enhancement, appropriate harvesting techniques, etc. As Chief Netshiavha of Lake Fundudzi stated, government should help in protecting Lake Fundudzi and the surrounding area because the burden is 'too heavy for one man to carry' (Tapela, this volume, Chapter 5). In situations where a combination of users are fishing in a water body such as Uphongolo, the rights will have to be structured in such a way as to provide security of tenure to all the users while ensuring sustainable utilisation. In particular, rights will have to strengthen and protect the rights of communities. But given the historical use rights of recreational fishers and the importance of this sector to the local tourism economy, the rights of this group will need to be protected also. The key issue is that the structure of rights should allow all users to exist and fish alongside each other with minimal conflicts and without such activities being detrimental to the resource and other uses. The fishing rights will ideally need to be those of 'claimants' (access, withdrawal and management). Including management rights in the bundle of rights will ensure the re-embedding of responsibility for management to users.

3.6.8 Organisational structures for management

Experience shows that embedding responsibility and authority for management within users by actively involving them in management decision-making provides for positive results in terms of sustainable utilisation of resources and lower transaction costs. The extension of management rights to users (so that they have access, withdrawal and management rights – making them claimants) is important if they are to invest time and resources in management institutions and other improvements to the resource. On most dams recreational fishers are already well established and organised as groups of users, whether this is for permitting systems, use of specific infrastructure that they have developed, organising angling competitions, etc. On some dams such as Voëlville, there are management committees that have been formed voluntarily by interested parties that are using the dam in order to represent and protect their interests. Although

the committee has no legal powers the members said that they control access on a voluntary basis. The legally enshrined bodies such as WUA and CMA could also provide another vehicle for user involvement in management of fisheries. Although the use of existing management committees, WUA, CMA and other existing user institutions provides for possibilities for using these as basis for co-management, the problem is that communities could be 'adversely incorporated' into such bodies resulting in their interests and voices being drowned. There is a need therefore to build and constitute new fisheries co-management bodies that could ensure equal representation and genuine participation by communities.

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4. INDIGENOUS KNOWLEDGE OF INLAND FISHERIES IN SOUTH AFRICA

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4.1 Introduction

In planning the present study, it was acknowledged that a major knowledge gap was the lack of published information on the historical and current role of inland fisheries in the livelihoods of rural and disadvantaged urban communities. While inland fisheries ecology, the introduction of alien species, and the development of recreational fisheries were relatively well documented, there was very little literature describing indigenous fisheries knowledge and practises (Chapter 2, Review of Inland Fisheries Literature). Moreover, it was evident that the growing small-scale fishing activity by rural communities on most major public water bodies, but was largely undocumented and unmonitored. Extensive anecdotal evidence, and a rare quantitative study on the Lake Gariep fishery (Ellender *et al.*, 2009), suggested that the actual and potential contribution of inland fish resources to local community food security could be substantial.

This asymmetry of information on inland fisheries usage was recognised as a part of the legacy of inequity of the Colonial and Apartheid eras. Given the historical marginalisation and crowding out of rural communities from customary entitlements to resources such as land and water, it could not be assumed that the lack of documentation of fisheries use by the rural communities implied that they did not exist historically, or that they did not play a significant role to play in current livelihood strategies. In order for the WRC Inland Fisheries study to recommend policy reforms and governance arrangements based on the rights of fishery stakeholders and South Africa's developmental policies, information on the actual and potential contribution of inland fisheries to rural livelihoods was urgently required.

A review of existing literature on indigenous knowledge and current in inland fisheries was thus undertaken, followed by a survey by University of the Western Cape's PLAAS, of the current fishery practises by communities on 12 water bodies. This was complemented by visits to a further 40 dams by Rhodes University's Rural Fishery Programme to determine the nature of fishery usage. The results are summarised in the present chapter. The case studies and survey results are provided in Volume 2 of the present report (Tapela *et al.*, 2015). In this chapter, the role of indigenous knowledge in inland fisheries is analysed based on the literature review and case studies.

4.2 Contextualising 'Indigenous' Knowledge

4.2.1 Defining Indigenous Knowledge

There is no uniform definition for the notion of indigenous knowledge. Indigenous knowledge refers to what indigenous people know and do, and what they have known and done for generations, that is, practices that evolved through trial and error and proved flexible enough to cope with change (Eyong, 2007, Melchias 2001). Vital as this definition is, it arguably trivializes indigenous knowledge as nothing more than a constellation of trials and errors (Eyong, 2007). The definition devalues indigenous knowledge especially in comparison with western (modern) knowledge, also known as science, which is recognised to be a product of experimentation (Eyong, 2007). Therefore, while indigenous knowledge is presumed to be clogged, concrete and inaccurate, western knowledge is portrayed as intangible, weighty, right and imbued with universal reasoning (Eyong, 2007).

It should therefore be emphasised that indigenous knowledge was also developed by an analogous process of experimentation, although such experiments were not documented, and knowledge systems were legitimised and fortified under suitable institutional frameworks, culture and practices (Eyong, 2007). Such knowledge has been passed on to other generations, though discriminatorily, and has enabled indigenous people to survive, manage their natural resources and the ecosystems surrounding them, including animals, plants, rivers, seas, natural environment, economic, cultural and political organisation (Eyong, 2007). Knowledge

of these elements forms a set of interacting units known as indigenous coping systems (Eyong, 2007). Indigenous knowledge systems, therefore are a set of interactions between the economic, ecological, political and social environments within a group or groups with a strong identity, who derive their existence from local resources through patterned behaviours that are transmitted from generation to generation to cope with change (Eyong, 2007). These patterns are sustained by micro-level institutional arrangements that are vested with differentiated responsibilities that ensure the group's continuous survival (Eyong, 2007).

Definitions provided by the IUCN (1997) and by Mpofu and Miruka (2009) are very similar and mutually reinforcing. According to IUCN, indigenous knowledge has been defined as “local community-based systems of knowledge, which are unique to a given culture or society and have developed as that culture has evolved over many generations of inhabiting particular ecosystem...” (Bisong and Andrew-Essien 2010: 149). Local people are therefore a reservoir of knowledge of the workings of the local ecosystems that they depend upon for livelihood and sustenance (Bisong and Andrew-Essien 2010). Indigenous knowledge may therefore be seen as acquired human or institutional capacity derived, within the confines of one's environment, from experience and learning (Mpofu and Miruka 2009). It is embedded in culture and is unique to a given location or society, and as such is integral in shaping community identities. Indigenous knowledge remains critical to informing the growth and evolution of all African societies and communities. Other definitions (e.g. Warren, 1991) emphasize the uniqueness of a given culture or society and contrast indigenous knowledge with “the international knowledge system generated by universities, research institutions and private firms” (Box 1). However, given the porous nature of rural community boundaries, which permits an inevitable diffusion of knowledge and practices over time and space, it is not feasible that knowledge and practices exist that can be definitively described as purely ‘indigenous’. Knowledge diffusion has, in most instances, led to a largely-undocumented fusion of endogenous local knowledge and practices with those emanating elsewhere, meaning that so-called indigenous knowledge is not static but dynamic in its evolution and development. Definitions by scholars such as Flavier *et al.* (1995) capture this dynamism and continual “influence by internal creativity and experimentation as well as by contact with external systems” (Box 1). Despite differences in emphasis, the various definitions are broadly valid and not necessarily dichotomous.

Indigenous knowledge, like other forms of knowledge, is not static but is continuously growing in response to new needs, challenges and experiences (Tagle, undated). Therefore indigenous knowledge “reflects the dynamic way in which the residents of an area have come to understand themselves in relation to their environment and how they organize that knowledge of flora and fauna, cultural beliefs, and history to enhance their lives” (Semali and Kincheloe, 1999). However indigenous knowledges do not reside in “pristine fashion” outside of influences of other knowledges (Dei, 2000 in Le Grange 2009). Indigenous knowledge as other bodies of knowledge is continually influenced by other knowledge demonstrating the dynamism of all knowledge systems (Dei, 2000 in Le Grange 2009). Indigenous knowledge of a particular locality continues to be influenced by knowledge from other localities far and wide, as much as it is influenced by western knowledge. As such a lot of what we regard as indigenous knowledge of some localities was actually acquired from other communities consciously or otherwise.

Ellen and Harris (2000) note that, as a term, indigenous knowledge emerged over the past two decades to describe the knowledge of a group of people local in a given situation. The term is sometimes used interchangeably with “local knowledge”, “traditional knowledge” or cultural knowledge and to distinguish this body of knowledge from others (Fischer, 2005). Indigenous knowledge is seen as vital to those who use it, which is why it did not die during the Colonial period when it was placed under incessant attack (Mapara, 2009; Fanon, 1967). Although it evolves and continues to change due to both internal and external influences, indigenous knowledge also draws its strength from its “embeddedness in the cultural web and history of a people including their civilization, and forms the backbone of the social, economic, scientific and technological identity of such a people” (Odora Hoppers 2001). It is therefore a people's way of life, defined by and defining a people within a locality or given territory.

Indigenous people protect their knowledge, which in turn preserves their identities. Their quest to protect their knowledge has over the decades gained prominence in international debates. The United Nations Declaration

Box 1 'Indigenous': Defining the Concept

Indigenous knowledge is:

- i. Local knowledge is unique to a given culture or society. Indigenous knowledge contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities" (Warren 1991).
- ii. The information base for a society, which facilitates communication and decision-making. Indigenous information systems are dynamic, and are continually influenced by internal creativity and experimentation as well as by contact with external systems (Flavier *et al.*, 1995: 479).
- iii. Institutionalized local knowledge that has been built upon and passed on from one generation to the other by word of mouth (Osunade 1994 in Nyong *et al.*, 2007).
- iv. The basis for local-level decision-making in many rural communities (Osunade 1994 and Warren 1992 in Nyong *et al.*, 2007; Warren, 1991).

on the Rights of Indigenous Peoples recognizes indigenous peoples' rights to maintain, control, protect and develop customary knowledge; however, not all customary knowledge may be considered as indigenous knowledge (Tagle, undated). Interest in indigenous knowledge continues to grow as debates continue, giving rise to several lines of research. Legal discussions with regards to the protection, exploitation and patenting of indigenous knowledge are also ongoing (Tagle, undated). In the context of fisheries, a principle of implementation in the FAO's normative "International Guidelines for Securing Small-Scale Fisheries is,

'Respect of cultures: recognizing and respecting existing forms of organisation, traditions, local norms and practices of small-scale fishing communities, including indigenous peoples. However, it is recognised that the social and cultural patterns of conduct of men and women may need to be modified with a view to achieving the elimination of prejudices and customary and all other practices which are based on the idea of the inferiority, or the superiority of the sexes or on stereotyped roles for men and women' (FAO, 2103).

For practical purposes, this report finds the definition by Osunade (1994, in Nyong, 2007) particularly useful. Osunade defines indigenous knowledge as,

"institutionalized local knowledge that has been built upon and passed on from one generation to the other by word of mouth".

From the foregoing and other definitions, the term indigenous is used in this study as shorthand for knowledge that is developed and adapted continuously to gradually changing environments, exposed and receptive to other forms of knowledge, passed down from generation to generation and closely interwoven with people's cultural values.

4.2.2 Defining 'Indigenous People'

The United Nations (UN) has no universally accepted definition of indigenous people but argues that indigenous communities, peoples and nations are those which, having a historical continuity with pre-invasion and pre-Colonial societies that developed on their territories, consider themselves distinct from other sectors of the societies now prevailing in those territories, or parts of them (Cobo, 1987). This notion is extended into the FAO's Guidelines for Securing Small Scale Fisheries which '...support responsible governance of fisheries and sustainable social and economic development for the benefit of current and future generations, with an emphasis on vulnerable and marginalized people – such as women, children and the elderly, indigenous peoples and food insecure groups – promoting a human rights based approach' (FAO, 2009).

The UN recognises that indigenous populations and other populations within the nation state have different degrees of power as a result of socio-political processes over time, such as conquest or Colonialism in the African context. Historically, African indigenous populations, who are also known as "natives" in Colonial

discourse, are groups of people that Colonial invading forces found residing within particular territories in which they had existed for many years. These groups were subdued and placed under European rule. An indigenous population is therefore characteristically one that was disempowered, marginalized, despised and conquered (Mamdani, 1996; Ranger, 1985, 1983; Fanon, 1967). During the Colonial era and, in the case of South Africa, the Apartheid era, indigenous persons were deprived of rights and privileges, including those to use and preserve the knowledge and practices that had informed and guided his existence for centuries. Systematic exclusion, disempowerment and impoverishment in Africa included the destruction of the knowledge, institutions, language and practices of indigenous populations, who were then considered heathen, backward, savage and barbaric (Lamming, 1995; Chennels, 1996; Ranger, 1985, 1983; Fanon 1967). The systematic exclusion of indigenous and vulnerable groups from access to fishery resources is pervasive worldwide and is specifically addressed in the progressive 'FAO Guidelines for Securing Small Scale Fisheries' (FAO, 2013). The guidelines adopt a rights based approach to fishery governance, in contrast to customary resource focussed fishery governance norms which do address social issues such as the burden of disadvantage carried by vulnerable groups such as indigenous people.

With the dismantling of Colonialism in the aftermath of the Second World War and the Bretton-Woods Agreement, indigenous populations across the African continent attained political 'independence' from the metropolises and their political leadership ultimately captured state power. Inequalities in access to bases of power and productive wealth emerged with accession to self-rule, such that there remained marginalized and vulnerable groups within indigenous populations (Mkandawire, 2002; Cooper, 1994). Such groups often lacked the voice to contest paths of development that undermined their interests and livelihoods in particular. In the case of South Africa, although the Broad Based Black Economic Empowerment (BBBEE) Strategy has sought to achieve 'representivity' among racial groups (Bernstein and Johnston, 2005), the strategy has not addressed issues of poverty and inequality has indeed resulted in a greater divergence in wealth among people of indigenous descent (Seekings and Nattrass, 2005; Edozie, 2009:172).

Cognisant of such inequalities, this study therefore adopts the definition provided by Eyong (2007) who refers to indigenous people as people living in an area within a nation-state, prior to the formation of a nation-state, but may identify with it; and have maintained a great part of their distinct linguistic, cultural, social and organisational characteristics. Other populations, the state and other institutions should also observe these people as indigenous for their claim of indigeness to be valid. It is this distinct knowledge, culture and social organisation and how it is applied to inland fishing, sustainable management and conservation of resources that makes the study of indigenous knowledge vital at this juncture.

4.2.3 Indigenous Knowledge And Sustainable Development

Indigenous people, knowledge and practice are considered to be vital vehicles for the achievement of 'sustainable development', especially in Africa where development is still at very low levels (Eyong, 2007). There is growing recognition of the value of customary and 'indigenous' fisheries knowledge, not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities (Mundy and Compton 1991 in Nyong *et al.*, 2007). Such recognition is manifest in emphatic calls for indigenous people's knowledge to be included in the formulation of small-scale fisheries resources management frameworks. A notable landmark in this regard is the Bangkok Statement on Small-scale Fisheries, which emerged from the 2008 Global Conference on Small-scale Fisheries (4SSF, 2008). In particular, the Statement from civil society organisations (CSOs), asserts the importance of small-scale fisheries as both an economic activity and a culture and way of life. The statement also clearly vocalizes the nature of social capital required for the transfer of indigenous knowledge. Such capital includes the skills, knowledge, social norms and systems of internal governance that are passed down over generations. With specific regard to indigenous knowledge and people, the Bangkok Statement underscores the following issues, among others:

- Rights of fishing communities and indigenous people to their cultural identities, dignity and customary rights, and to recognition of the customary and indigenous knowledge systems; and
- Rights of access of small-scale and indigenous fishing communities to territories, lands and waters on which they have traditionally depended for their life and livelihoods (ICSF-WFFP, 2009).

The Bangkok Statement was effectively given substance for implementation by national governments through the FAO's 'Guidelines for Securing Small Scale Fisheries' (FAO, 2013)

The rationale underpinning calls for a greater recognition of indigenous knowledge includes that the alienation and subjugation of such knowledge by western or Eurocentric forms knowledge, which are widely regarded as 'expert' knowledge, have from Colonial times not yielded positive developmental results in many parts of the world. A second underlying rationale emanates from views that there is a relationship between social capital and community-based governance over access to and the use fisheries resources (Nkhata *et al.*, 2008).

Predicating such views on historical evidence from rural communities in the Rovuma River valley along national boundaries of present-day Mozambique and Tanzania, Nkhata *et al.* (2008) observe that communities in the Rovuma valley have historically had relatively higher social capital, played more active roles in community-based fisheries governance, and regulated access to and use of the fishery as a common property resource. Such capital was undermined by "transforming forces", particularly Colonial administration, advocacy of Christianity, war and an emerging market economy. This in turn affected community-based resources governance. The deconstruction of social capital also resulted in attitudes and behaviours that tend to challenge governance processes, over-exploit fish stocks and adopt inappropriate capture practices, with dire consequences for sustainable resource utilisation. These scholars argue that, although the Mozambican government policy promotes community-based fisheries management in artisanal fisheries amid prevailing ineffective community-based governance, such interventions are unlikely to succeed without a strong focus on the reconstruction of social capital within rural communities. The scholars also suggest that since historical contexts such as those of the Rovuma valley are widely-shared by rural communities in the African continent at large, a focus on reconstructing social capital might have wider relevance.

A convergent perspective is expressed by Jul-Larsen *et al.* (2003), who observe that freshwater fish stocks in Southern Africa tend to be less threatened than many tend to believe. The scholars argue that classical management theory's emphasis on limiting numbers of fishermen and co-management strategies, such as exclusive economic zoning, may present a danger to the stability of this situation, even in instances where management might be required to maintain biodiversity. The scholars and others (Bene *et al.*, 2010) also argue that efforts by classical economics based management objectives to maximize economic rent and create exclusive enclosures might not be tenable, since pre-conditions for such interventions are largely non-existent over much of the Southern African region. In the event that pre-conditions for commercialized local access to inland fisheries utilisation become existent, Jul-Larsen *et al.* (2010) argue for gradualist rather than abrupt introductions of change. The latter might give rise to exclusions that reinforce the vulnerability of the poorest among rural households, while the former might allow sufficient time for livelihood adjustments to changing milieu of fisheries management regimes.

Implicit within the views of Jul-Larsen *et al.* (2010) are sentiments that emerging inland fisheries co-management approaches necessarily have to be predicated upon local institutional arrangements that rural people are familiar with. Since many such arrangements have evolved over prolonged communal histories, sentiments by Jul-Larsen *et al.* (2010) resonate with calls by various stakeholders for indigenous people's knowledge to be included in the formulation of small-scale fisheries resources governance frameworks (ICSF-WFFP, 2009; FAO, 2009) in efforts to improve conditions in rural localities (Mundy and Compton 1991 in Nyong *et al.*, 2007).

Collectively, such calls can be seen as a call for alternative approaches to rural development, agrarian reform and the development of inland fisheries. Ultimately, the crystallization of such calls seems geared towards keeping livelihood interests of local people at the centre of sustainable development discourses.

4.2.4 Challenges Of 'Indigenous Knowledge' In South African Rural Contexts: Discussion

For South African rural contexts, the foregoing review points to two pertinent policy and research questions. These are:

- Whether tangible indigenous fisheries knowledge exists within rural communities?
- Whether or not relics of such knowledge can effectively be tapped and used in formulating participatory and locally-accepted institutional arrangements for the co-management of inland fisheries?

Attempts to address these key questions are beset with a number of challenges. Recognising the lack of documented evidence on customary inland fishery use, there is a possibility that inland fisheries have historically not been a key source of food and livelihoods for many rural communities in South Africa. There is also a possibility that in rural communities which report past inland fisheries traditions, much of the indigenous institutional memory around such fisheries might have been lost due to Colonial dispossessions, forced removals during the Apartheid era and subsequent changes in socio-economic profiles of displaced rural communities (Platzky and Walker, 1995). Another challenge encountered in attempting to characterise indigenous knowledge and practices relates to the paucity of pertinent evidence-based literature on South African rural communities. This problem is well recognised and referred to as “silent backdrops” (according to Marks and Rathborne, 1982) in South African scientific and historical studies. Bozolli (1991 in Kloppe, 2001) attributes the problem to lack of attention by most South African historians to the oral history of rural black people while focusing on the history of white communities.

With specific regard to the utilisation of inland fisheries by indigenous populations, Rogers (2008) ascribes the problem to a focus by most scientific studies on purely ecological and hydrological facets of ecosystem management, to the exclusion of social, economic and political factors associated with rural communities (see Box 2). Such exclusion has been linked to perspectives such as Garret Hardin's ‘Tragedy of the Commons’ allegory, wherein natural resources in communal settings, including inland fisheries, have largely been viewed by scientists and conservation agencies to be ‘open access’ rather than ‘common property’ resources (Hara, 1999; Tapela, 1999, 2001; Jul-Larsen *et al.*, 2003; Rogers, 2008; Bene *et al.*, 2010). Although oral history programmes have attempted to write ‘inclusive histories’, from the 1970s, many of the narratives have tended to concentrate on African social history, resistance and political organisation in mining and other industrial labour centres (Bozolli 1991 in Kloppe, 2001; Marks and Rathborne, 1982). With a few exceptions, for example Harries (1984) and Heeg and Breen (1982,1994), Colonial and Apartheid scholarship largely does not appear to have documented rural black people's utilisation, management and conservation of inland fisheries.

Box 2 Excerpt from Professor Kevin Roger's Kilham Memorial Lecture, University of the Witwatersrand, 2008

The Pongolo experience had a profound effect on me personally...I was beginning a career in academia as the events played out and, at the time, felt that I let science down because I failed to ensure that scientific sense prevailed. I became determined that as my career progressed I would devote time to ensuring that my science was explicitly used wisely and sustainably. It would not simply remain implicitly useful. As time progressed and I learned more about the complex nature of interlinked social and ecological systems I realised that, in my scientifically naive early years, I had not so much failed science as I had the AmaThonga people. I decided then to promote science that was more in service of society than it was in service of a career in science (Rogers, 2008).

The absence of studies that report on successful small-scale fisheries development and use in South African rural communities has elicited debate about the extent to which inland fisheries can contribute to food security and livelihoods for communities, particularly where fishing has reportedly not been traditionally practiced (Andrew *et al.*, 2000). Given the existence of ‘silent backdrops’ in South African scientific and historical studies, however, the conceptual and ideological bases of such debate seem to be problematic. This written knowledge, which is often a preserve of the literate elite, becomes privileged, while oral knowledge, which is largely the domain of many people in rural communities, remains effectively silenced.

Given this known omission, indigenous knowledge of inland is thus more likely to be retained in the form of oral testimonies rather than in published and unpublished literature. Secondly, prolonged histories of dispossession, social fragmentation, possible losses of indigenous institutional memory and changes to demographic profiles of many displaced communities seem to further narrow the prospects of finding abundant

and largely intact relics of indigenous fisheries knowledge. Thirdly, the complexity and heterogeneity of rural 'communities' and the diversity of individual, household and interest group level attributes of members of such communities imply that responses to externally-induced inland fisheries promotion will vary according to individual, household, interest group and communal contexts, among other factors. Such diversity defies notions about the validity of blue-print frameworks and requires flexibility in policy formulation.

Caution is thus required in documenting the present-day oral testimonies about relative absence of fishing traditions. There is a danger that the opening up of spaces for oral testimonies to be heard might potentially be fraught with distortions associated with the complex, dynamic and subjective notions of what people in inherently heterogeneous rural communities perceive to be 'indigenous' at particular points in time and in specific places. Problems with generalized characterizations of the extent to which uptake of opportunities afforded by inland fisheries can contribute to food security and livelihoods in rural 'communities' are that local peculiarities can become lost the quest for widely applicable policy interventions.

The juxtaposition of these three problems presents a paradox to resolving the debate about the extent to which inland fisheries can contribute to food security and livelihoods for communities, particularly where fishing has not been traditionally practiced. Lest such debate should become 'lost' in unproductive pursuit of irresolvable questions, an acknowledgement of the diversity of local contexts and therefore the need for flexibility in crafting policy interventions seems requisite. For this study, a necessary practical challenge was thus the identification and documentation of the diverse characteristics of local contexts and rural people's multi-layered and multi-faceted requirements, expectations and aspirations regarding inland fisheries, or lack thereof. Such characterization required both a wide-ranging review of literature and a fairly representative empirical sample of local contexts. Oral testimonies on indigenous knowledge and historical exposure to inland fisheries, however, remain an important component of such characterization, since they can give useful insights into embedded contexts of specific communities. Baseline data on embedded histories of inland fisheries use, or lack thereof, provide benchmarks upon which new formulations for inland fisheries governance and co-management can be based. However, there is a need to guard against romanticist notions that such narratives necessarily provide an unquestionable basis for policy interventions or offer a panacea for present-day livelihood challenges for South African rural communities.

4.3 Indigenous Fishing Knowledge and Practices: South African Context

The little available literature on customary fishing practises in South African rural communities suggests that they straddle both the old and new worlds (Heeg and Breen, 1982, 1994; Harries, 1984; Van der Waal, 2000). This part of the report focuses on fishing knowledge and practices that have been developed and adapted continuously to gradually changing environments, exposed and receptive to other forms of knowledge, passed down from generation to generation and closely interwoven with people's cultural values. The main distinction between these 'indigenous' and 'current' practices, therefore, is that the latter are relatively recent, less embedded in long-standing cultural fishing practices in rural communities, and more strongly linked to technological innovations and social change induced from outside these communities.

The section explores two key research questions. The first key question is whether or not substantive body of indigenous fisheries knowledge exist within rural communities? The second is investigates the possibility that inland fisheries might historically not have been a key source of food and livelihoods for many rural communities. It is also linked to the possibility that much of indigenous inland fisheries knowledge, at least among communities with fishing histories, might have been lost. However, the paucity of literature on indigenous fisheries knowledge in South African rural communities limits the degree to which findings by this review can be extrapolated to the broader national context.

From the limited documentary evidence available, inland fisheries since pre-Colonial times have constituted an important resource among certain groups, such as Tembe-Thonga of northern KwaZulu-Natal and the Makuleke of Limpopo Province. For other tribes such as the Xhosa, available evidence indicates that fish did not form a major part of customary livelihood subsistence.

4.3.1 Customary Fisheries Of Tembe-Thonga People Of Kwazulu-Natal Province

4.3.1.1 Background

The Tembe-Thonga people, who occupy the land in and around Pongola floodplain in northern KwaZulu-Natal, have subsisted on floodplain fisheries resources for many generations (Bruton, 1979; Bruton and Cooper, 1980; Heeg and Breen, 1982, 1994; PRESPA Report, 2009). Their livelihoods, including fishing, were affected by a government decision in 1960 to construct the Pongola Dam upstream of the floodplain (Heeg and Breen, 1994; PRESPA Report, 2009). The objectives of the dam included flood control and water supply for irrigation of forty to fifty thousand hectares (40 000-50 000 ha) of sugar cane fields in the adjacent Makatini Flats. At the time of dam construction, scientists (including Charles Breen and Jan Heeg) recommended that dam releases should be management to simulate natural flow regime and thus maintain integrity of the unique floodplain ecosystem as well as ecosystem services that Tembe-Thonga people dependent on (Heeg and Breen, 1994; Rogers, 2008 – Box 3). While such recommendations were adhered to in the 1970s, the development in the 1980s of commercial maize production within the floodplain resulted in unstructured “negotiated” releases, which adversely affected downstream floodplain fisheries and other ecosystem services and sparked conflicts between fishers, maize producers and cattle owners. Despite ongoing controversy about the dam and the persisting impacts on Tembe-Thonga people, the dam has been earmarked by government for various development plans. In light of emerging principles for sustainable development of dams, is essential that cognizance be given to customary fishing rights, knowledge and practices of the Tembe-Thonga people.

Box 3 Excerpt from Prof. Kevin Rogers' Kilham memorial lecture, University of the Witwatersrand, 2008

Even today, we would consider this an unparalleled exercise in environmental flow determination because it had the express objective to deliver both social and environmental justice – Prof. Kevin Rogers, University of the Witwatersrand (Rogers, 2008)

4.3.1.2 Customary fishing knowledge and practices

Scholars (Bruton, 1979; Bruton and Cooper, 1980; Heeg and Breen, 1982) indicate that in South Africa, on the Pongola floodplain, the Tembe-Thonga of all ages practised a variety of fishing methods for subsistence purposes. The most spectacular amongst them was *isiFonya* fishing practised by many people all at once (Figure 7). The people all wielding baskets formed a line across a pan and drive fish towards shallow areas by moving their line while thrusting baskets into the water. Fish are trapped by the dome shaped basket and are extracted through a hole at the apex (Bruton, 1979; Bruton and Cooper, 1980; Heeg and Breen, 1982). This kind of fishing required community or group cooperation for it could not be profitably undertaken by an individual or a couple of friends. It therefore has the potential of enhancing social cohesion and solidarity within a fishing community. It allows fishers to regularly share an experience in which interdependence is more rewarding than divisionism.

Another variety of fishing that also used baskets but in a slightly different manner and that could be practised by an individual, group or community together is *mona*-basket fishing (Figure 8). Fishers used the basket known as the *mona*-basket which is a valved trap constructed out of reeds to catch fish by placing it in a specifically constructed reed fence barring a water course (Bruton, 1979; Bruton and Cooper, 1980; Heeg and Breen, 1982:66). The basket then trapped migrating fish and was commonly used during floods when fish are migrating into and out of the pans.

Women and children practised one of the most ancient fishing methods in the Pongola floodplain called seine netting. These groups of people made long bundles of grass and weeds and pushed these through the shallows and in so doing drove numbers of small fingerlings towards the edge of the pan and then caught these by hand (Heeg and Breen, 1982). This method, just like the *isiFonya*, has a uniting effect on society. It draws women and children together in their endeavour to make a better living and in so doing binds them together as a group. However both methods also have the potential of triggering negative forms of competition and jealousy among fishers especially if some continue to get better harvests than others.



Figure 7 IsiFonya fishing practice of the Tembe-Thonga of KwaZulu-Natal. Photograph courtesy of Professor Kevin Rogers, University of the Witwatersrand.



Figure 8 Mona-basket fishing technique of Tembe-Thonga people. Photograph courtesy of Professor Kevin Rogers, University of the Witwatersrand.

The floodplain had, in the 1980s, the potential of yielding between five hundred (500) and seven hundred-and-fifty (750) tons of fish per annum, while the total annual harvest by the Pongola population was estimated at about four hundred (400) tons per year (Heeg and Breen, 1982), demonstrating that it was making a significant contribution to the nutritional status of the local population. The Maputaland people residing along the floodplain were known to have the best nutritional status for any rural black population in Natal partly because of access to fish, and also because the floodplain gave the nearly forty thousand (40 000) residents abundant sources of animal protein from cattle and other livestock.

Studies carried out between 1974 and 1977 revealed no signs of over-fishing on the Pongola (Heeg and Breen, 1982). This reveals that the methods being used did not lead to resource over-exploitation on the highly productive floodplain habitat. Recent studies of the Pongola floodplain by Jaganyi *et al.* (2009) and the 'Pongola River Ecosystem Service for Poverty Alleviation' (PRESPA) Report of 2009 also showed that fish remain the most widely utilised and valued natural resource on the floodplain (PRESPA, 2009).

More recent field evidence shows, however, that customary subsistence practices of utilising inland fisheries resources associated with floodplain pans might be transitioning towards commercially-orientated resource harvesting and agricultural practices. Indications are also that the social capital of indigenous knowledge, which has hitherto ensured the maintenance of sustainable levels of floodplain resources use, might not alone be sufficient in averting looming threats to inland fisheries. Firstly, traditional leaders face challenges in reconciling customary law with Roman Dutch and English laws, which inform much of South Africa's natural resources legislation. Secondly, although traditional leaders have customarily played key custodianship roles for indigenous knowledge, their capacity to halt the erosion of such social capital is increasingly stretched. The intensity of rural people's hunger for incomes and aspirations to move out of poverty traps is such that without effective strategies to provide alternative opportunities for livelihood security and wealth creation, the risk of over-exploitation and degradation of resources is very real. In the case study on the Pongola (see volume 2 – Tapela *et al.*, 2015), young people regarded fishing as an activity of lower social status compared with modern agriculture practises. Aquaculture was also regarded as a desirable modern alternative to fishing.

Superstition was observed to influence traditional fishing behaviour. In the case of Tete Pan, subsistence fishers from the local Zamazama community reported that a mythical snake had caused most members of the community to abandon their use of the pan for different subsistence needs. According to key respondents, such fears were linked to an unresolved mystery surrounding the death of a male fisher in the neighbouring Madonela Pan in 2011, whose body could not be found until the community called in the Shembe Church to offer prayers. In the case of Tete Pan, traditional leaders convened three community meetings between May and August 2012 but were unable to resolve the case due to difficulties in overcoming the 'burden of proof' regarding the mythical snake in question. Of particular difficulty was the lack of practical options for reconciling the customary rules, which provided for the expulsion of a community member accused of witchcraft or wizardry, with the national constitutional provisions for the protection of human rights. The matter ultimately became 'resolved' when the suspect voiced his decision to leave the community, clearly asserting that his decision was specifically due to the social pressure exerted by the community. After this, local people had reportedly returned to fully using Tete Pan and a group of subsistence fishers simultaneously began pursuing their interest to engage in aquaculture.

The interest in aquaculture signalled an intention by the subsistence fishers to shift away from active practice of long-standing indigenous fishing techniques, such as *imfonya*, towards more commercially-orientated fishing. According to respondents, indigenous fishing techniques are currently dependent on dam water releases. The fish are caught for food. In the past, dam releases tended to bring smaller numbers of fish into the pans. More recently, however, the management of dam releases has resulted in an abundance water in the pans, and a fisher could catch around a bucketful or dishful of fish per day, depending on the fishing spot. During water scarce periods, such as in the drier winter months, local fishers use fish traps with yields of 2-3 fish per day. However, while water access in the floodplain pans is considered to be critical to fishers' livelihoods, the issue of dam releases has proved to be difficult for subsistence fishers to engage with, owing to differing interests and power dynamics among water users.

A general view among respondents was that dam releases should enable both the fishers and crop producers to eke their livelihoods. However, currently, those responsible for releasing water from Pongola dam only took into account the needs of commercial maize producers and not those of fishers. A few years previously, subsistence fishers in Tete and Menu Pans were injured when water was released without prior warning. Dam releases were said to normally occur around the 27th or 28th October and March, but the dates were subject to change. Tete Pan fishers reported that, as a group, they had failed to resolve the water release issue for a long time and talking about it would simply re-invoke their feelings of hurt over

past damages and injuries, and not solve anything. Furthermore, one of the respondent fishers stated, “In any case, the dam release issue is driven by people upstream in Jozini, who have no knowledge of our way of life down here.” The respondent then asked, “Will you build aquaculture dams for us or are you just interested in the pans?”

To elaborate on his views, the respondent explained that, at a meeting of Imfunda YoPhongolo WUA, when Tete and Menu Pan, subsistence fishers stated that due to water scarcity they had no food for their children and requested their water needs to be considered in decisions relating to dam releases. The wealthier and more influential commercially-orientated maize producers who opposed their request for water asked the subsistence fishers where their crops were grown, a tacit insult implying that the fishers were landless and too poor to grow food crops and hence resorted to foraging for fish in the pans to survive. Such class and power dynamics were partly the reason for the subsistence fishers’ resignation from claiming fair access to water for pan fisheries and instead looking towards acquiring aquaculture dams. Power and class dynamics such as these seemed to be drivers of the pressure towards commercially-oriented livelihood activities, such as aquaculture and sugar-cane production to supply a new mill in Makhatini Flats. Other drivers seemed to be linked to unpopular restrictions on local fishers’ access to pan fisheries.

Subsistence fishers were gravely concerned about the criminalization of traditional fishing activities and gear within pans located in communal land areas. Fishers reported being very afraid of law enforcers, who continually harassed them, and found it absurd and unacceptable that they continued to run away from the police and conservation officials 18 years after the introduction of a rights-based democracy. While they understood that Pongola (or Jozini) dam had entry restrictions, they did not consider it right that their fishing activities in the floodplain pans should be subject to similar restrictions. The participants asserted that subsistence fishers had rights and their voices should be heard. (the reader is referred a project video of Phongola fisher testimonies: <https://www.youtube.com/watch?v=qKu3xbOiU4I>)

4.3.2 Adaptation of Customary Fishing Knowledge to New Circumstances: The Makuleke of Limpopo Province

“In the ‘forgotten’ corner of the Transvaal made famous by T. V. Bulpin as the romantic ‘Crook’s Corner’, there lived a group of people who, named after their founding ancestor, were called the Makulekes. They were a branch of the Makuleke clan, and for about 140 years until their removal in 1969, occupied the triangle of land that separates the Limpopo from the Levubu River” (Harries, 1984).

4.3.2.1 Background

The Makuleke are a Thonga-speaking group of people who reside in the Nthlavheni Communal Area along the western boundary of the Kruger National Park. Prior to the forced removals that followed promulgation of the Bantu Promotion of Self-Government Act of 1957, the Makuleke occupied the Pafuri Area to the north of Kruger National Park, at the intersection of borders with Mozambique and Zimbabwe (Harries, 1984; Tapela, 1999; 2001). This area, which is a triangular plain located close to the confluence of and between Limpopo and Luvuvhu Rivers, is prone to seasonal flooding. Flood recession leaves behind pools of water that provide habitats for a diversity of species of fish and other fauna and flora. The diversity of the landscape and ecology are succinctly described by Robinson (1996 in Tapela, 2001) thus:

“The most spectacular scenery in the KNP occurs here [in the Makuleke Region] where vast floodplains are contrasted by high ridges and inselbergs of sandstone deeply dissected into dramatic gorges by the Luvuvhu River and its tributaries. Big timber riverine woodlands line the riverbanks where they are dwarfed by high cliffs. The diversity of landscape is matched by a great variety of soils which support an exceptional vegetation diversity and an unusually rich number of habitats and wildlife”.

With promulgation of the Bantu Promotion of Self-Government Act and northward expansion of the Kruger National Park, many of the Makuleke were forcibly removed from the Pafuri Area in the late 1960s. Members of the royal clan, who actively resisted removal, were initially confined to a small enclave then-called

'Makuleke Reserve' and finally removed in 1969 after the death of their leader (Harries, 1984; Tapela, 1999, 2001). The main reason advanced for removal of the Makuleke was to allow for the northward expansion of the Kruger National Park. Other reasons included views that the Makuleke were decimating wildlife through 'poaching', although evidence was to the contrary (Harries, 1984; Carruthers, 1996). Yet other reasons were that the Makuleke habitually connived with criminals, such as Stephanus Cecil Rutger Barnard or 'Bvekenya', who plied lawless practices in the remote Pafuri Area, also called "Crooks' Corner" (Bulpin, 1956; Carruthers, 1996). It would seem therefore that government expansion of the Kruger National Park was intended to 'stabilize' the frontier bordering Mozambique and Zimbabwe.

Patrick Harries (Harries, 1984) documented Makuleke oral testimonies in the 1970s soon after their removal and resettlement in the Nthlavheni area along the western margins of the Kruger National Park. Such testimonies reveal a well-established tradition of reliance on floodplain inland fisheries akin to that of the Tembe-Thonga people of Pongola Floodplain. This following section largely reviews anthropological work by Harries (Harries, 1984) and, to a lesser extent, historical work by Jane Carruthers (Carruthers, 1996).

4.3.2.2 Customary fishing knowledge and practices

According to Harries (1984), the people of the Makuleke clan historically and practiced fishing all year round in the Pafuri area of the north-eastern Limpopo Province. They used appropriate gear for each season. However, fishing was more prominent in winter than in summer and the gear used in the two seasons varied. The reliance on fishing increased in winter due to the "marked shortage of agricultural foodstuffs" that characterised that season (Harries, 1984). In winter, when floodplain waters were lower, fish were largely caught using *Xirongo* baskets, made of reed, while in summer the hook and line was used. On a fishing day during winter, several hundreds of people, each equipped with a *Xirongo* basket, would form chains which moved methodically through the shallow muddy waters hunting for fish (Harries, 1984). These muddy waters collected in natural pools and dams as well as rudimentary man-made dams as the summer floodwaters receded at the end of the summer season. Since the waters were muddy, fishers would not see the fish in the water and only knew that their baskets had caught fish when the captured fish splashed water in the basket, which was lowered into the water at regular intervals as the chain of fishers moved through the water.

Winter fishing was sanctioned by the chief after receiving word from elders indicating that specific pools were ready to be fished (Harries, 1984). Villagers would then pool together and agree on a day and time on which to go fishing using the *Xirongo* baskets. Fishing was therefore a community activity which had the potential of building a strongly knit community. Fishers depended on one another as a "production unit" (Harries, 1984).

Although fishers could catch up to seven species of fish during one hunt, their catch largely consisted of catfish and carp (Harries, 1984). Much of the catch was consumed fresh and the rest was preserved for the future, smoked, salted and dried. In summer, when waters were higher, fishers used hook and line to catch fish.

4.3.2.3. Alienation of inland fisheries resources

In 1930, Kruger Park authorities prohibited fishing with *Xirongo* baskets and fishing in general, unless one was licensed. The authorities argued that fishing practices of the Makuleke people resulted in the "overkill of young fish" (Harries, 1984). However, fishing did not stop but simply became an underground practice. Although prohibition could not destroy fishing as a survival strategy, Makuleke's access to inland fisheries resources of the Pafuri Area was ultimately terminated by their forced removal in the late 1960s.

The Nthlavheni area, where many Makuleke were resettled, was a drought-stricken savannah land where even drinking water was very scarce. Fishing as a coping strategy became untenable. It is possible that with alienation of Pafuri fisheries resources, passage of time and death of knowledgeable generations, indigenous know-how of making fishing gear and of fishing might have become eroded. However, the present day Makuleke community is beneficiary of the Makuleke water storage dam that was constructed in the late 1980s as part of irrigation scheme development. The survey component of this study thus had the opportunity to test the extent to which indigenous fishing knowledge and practices still prevailed within the community.

What was evident from documented oral testimonies, is that for a long time following their forced removals, the Makuleke yearned for a return to their places of origin. This yearning emanated largely from perceptions of a steep gradient of relative deprivation, whereby Nthlavheni area, which is located about thirty (30) kilometres from 'Old Makuleke', was seen as a place of severe hardship, while Pafuri ancestral area was perceived to have more abundant natural resources, such as edible wild plants, animals, fish, water and *ilala* palm (for beer brewing). The yearning was significantly embodied in song. According to Harries, a particularly powerful song is entitled '*Davula mananga*', which means "go into the unknown" in XiTsonga language and poignantly compares Pafuri and Ntlhavheni Areas (Box 4). Such testimony shows that historically fish, among other natural food resources, provided relish and vital source of nutrition for the Makuleke. As forced removals took away Makuleke people's access to inland fisheries in the Pafuri Area, they were left vulnerable to effects of drought, such as malnutrition, disease and death, which coincided with the removal.

Oral history of the Makuleke shows that members of this group of people have an enduring connection with subsistence inland fishing as a culture-embedded livelihood and source of food security. Following their resettlement along the western boundary of Kruger National Park and subsequent construction of a water storage dam within land occupied by the community, the more resilient among Makuleke fishers had adapted their fishing knowledge, practices and techniques while many had abandoned fishing altogether. Younger generations were also entering the informal inland fishing sub-sectors using adapted old techniques and new practices and techniques.

4.3.2.4. The Makuleke Today

This section presents a summary of key research findings the current indigenous knowledge related to fishing emerging from the Makuleke case study, which is presented fully in the case study in Volume 2 of this report (Tapela *et al.*, 2015) .

Box 4.4 *Davula Mananga* ("go into the unknown"): A Makuleke oral testimony in song

Davula mananga

Va hi tisa ka Nyamazana

Hi nga siya na makuwa na tihuhlu na vuchema

Hi siyile masirha ndzhawu leyi

Se ha hela ka nyamazana

Hi siyile mihandzu

Na xixevo xa hi dlaya tiko leri

Magidipo ma dlaya

Go into the unknown

They take us to the wild country

We have left our figs and our *tikuhlu* (wild fruits) and *lala* beer

We have left our graves behind us at this place

We are being overcome at the wild place

We have left the *mihandzu* (wild fruits)

And there is no relish (fish, meat, wild vegetables) in this place

Malnutrition is destroying us.

Source: Harries, 1984:12

The research findings revealed that the fish species caught in Makuleke Dam include bream or tilapia (*getle*: Tsonga / *kweya*: Venda), "goldfish" (*ndhungulu*: Tsonga / *thabyi*: Venda), catfish (*hlapfi-ncila*: Tsonga / *bavhuri* or *mbole*: Venda), eels (*hlunga*: Tsonga / *kunga*: Venda) and "sardines" (*xindhungulwana*: Tsonga). Although the so-called "sardines" are a small type of freshwater fish that seems akin to *matemba* or *kapenta* (Malawi, Zambia and Zimbabwe), the exact taxonomic identity needs to be ascertained. Venda and Tsonga terminology is used to identify different fish species, which indicates that although many of the local people around the dam speak Tsonga, their spoken language does not necessarily indicate these local communities' freedom from outside influences.

According to key respondents, there was no deliberate effort to establish a fishery at Makuleke Dam. No conscious effort was made to bring in fingerlings from hatcheries elsewhere and no arrangements had been made to manage stocking and harvesting levels. Rather, fish populations had established themselves during successive rainy seasons. While Makuleke fishers had not observed any definite depletion of fish stocks since the dam was constructed in the late 1980s, concerns had been raised about possible over-fishing when increasing numbers of outsider fishers, some of who had motorized boats, began coming to fish in Makuleke Dam. The local Tribal Authority and elected CPA Executive Committee had responded to voiced concerns and intervened through instituting measures to control access to the dam.

A significant research finding was that, whereas formerly, the Gazankulu Homeland government gave permits for use of fishing rods, fishers now went through the local leadership structures to obtain permission, particularly outsiders. Active fishery management by means of recreational permits has therefore *de facto* fallen away and, in their stead, local informal governance arrangements have emerged and are actively used to manage the common pool resource. Existing gear restrictions by the Limpopo Environmental Management Act, which limit fishers to the use of hook and line, are no longer relevant to local usage patterns;

Subsistence fishing use is regarded as legitimate by local customary and community property association (CPA) authorities as a livelihood. Local fishers have some local informal management institutions, such as “fishing spots”, whose access is recognised among local fishers to be the preserve of those who have already staked their claim and utilise them regularly. Those with established fishing spots can exclude others from access to these, and such exclusion is considered legitimate by other local fishers. While local fishers largely comply with the informal access rules, outsiders are often unaware of such arrangements and this compels local fishers to enforce the rules, usually through non-violent means, since outsiders generally comply when they are made aware of their inadvertent infringements of existing local arrangements.

Although local subsistence/artisanal fishers generally accept similar outsider fishers, they take exception to the use of the fishery by outsiders who “excessively” harvest the fishery using selective gillnets and boats, primarily for commercial purposes. Apart from concerns about decimation of fish populations and threats to local livelihoods, conflicts between local subsistence/artisanal fishers and outsider commercial fishers relate, firstly to incompatibility of harvesting methods (especially gillnet and motor-boat versus seine net use) and, secondly, competition over local informal markets. Gillnet users are deemed to have “unfair” advantage taking away subsistence fishers’ customers. While local fishers frown upon motor-boat based fishing, they have no power to control other than to appeal to local traditional and CPA authorities.

Local traditional and CPA authorities have intervened by prohibiting the use of fishing boats, requiring outsiders to ask for permission before gaining access to the fishery, charging outsiders an access fee, and arresting any outsiders who contravene the local rules. In essence, there is a strong sense of a common pool resource, whereby outsiders who respect local protocols and access and use rules and preferences are accepted or tolerated, but those who do not are unwelcome. Generally, however, outsiders do not resist local rules since they understand that they are in “other people’s land” and therefore need to respect local protocols. The Makuleke Tribal Authority control over land surrounding Makuleke Dam facilitates local management of the fishery;

There is a sense among local fishers that they control the fish population, which seems to be linked to perceptions about avoidance of excessive harvesting and assisting with the control of access by outsiders, particularly those using boats and large selective nets. In the absence of any clear guidelines regarding catch size, for example, it is not clear whether or not local fishers – who are invariably resource poor – would maintain their stance to avoid excessive fishing if they acquired the resources to conduct harvesting at a large scale.

It appears that there is no responsible authority clearly tasked with managing the dam. This accounts for the voiced perception that ‘government’ is not present, only knowing the dam ‘on the map’. There seems to be a need to build upon existing informal institutional arrangement and develop requisite management capacity and governance arrangements. Towards the development of local management capacity, insights on current roles played by the agricultural extension officer in Makuleke community suggest that extension staff such

as this could be used by DAFF as future fishery extension officers. Extension officers already work with the communities and would therefore merely require an expansion of roles and responsibilities, through training in fishery issues, which is cost effective. They would play a developmental role as opposed to the “rangers” compliance and enforcement role. A strong view by local leadership and institutional stakeholders is that the use of Makuleke Dam for fishery development will be acceptable if access to the fishery is well-managed and if the revenue generated from locally-issued fishing permits is used to contribute to community upliftment.

4.3.2.5 Conclusion: Options for Effective Co-Management of the Makuleke Fishery

In exploring possible options for effective co-management arrangements, the fishers emphasized that they considered the unsustainable practises of outsiders to be an issue to be prioritized. In communal property rights (CPR) theory, this co-management issue pertains to setting boundaries for the resource. A critical source of strength, however, is that a CPR has already emerged around Makuleke Dam fishery, which seems to be working fairly well despite limited modern scientific knowledge and emerging resource boundary enforcement challenges. This makes cases such as Makuleke suitable for community-based co-management options.

4.3.3 The Xhosa People of the Eastern Cape

With respect to rural Xhosa people of the Eastern Cape Province, scholars such as Peires (1981, in Andrew *et al.*, 2000) assert that fishing has never been an activity extensively undertaken as they are traditionally a farming nation, which focused on livestock and crop production as means of survival. Andrew *et al.* (2000) however refutes the generalized view that the potential contribution of fish to modern rural well-being is limited, as cultural avoidance of fish was not universal among the Xhosa, and that where such cultural beliefs did exist, they were not strong enough to deter a process of inland fisheries development. Without sufficiently extensive historical documentation of inland fisheries use by rural communities across the country, it is not possible to determine whether observations such as those made about Xhosa people represent an exception rather than the rule.

4.3.4 The Case of the Mutshindudi Catchment Communities, Limpopo Province

4.3.4.1 Background

The Mutshindudi catchment is located in northern parts of Limpopo Province, to the north of the Soutpansberg range and within the Nzhelele area. The Mutshindudi River is a tributary of Luvuvhu River and a constituent of the Limpopo Watercourse System. A number of rural communities reside close to Vondo and Phiphidi Dams along the river. This section reviews a study by Professor Ben van der Waal (van der Waal, 2000), who sought characterise fishing techniques and practices of Venda people residing within the Mutshindudi catchment.

4.3.4.2 Customary Fishing Techniques and Practices

According to van der Waal (2000), there is a general perception that Venda people do not have a fishing tradition such as found amongst the Tsonga-speaking people from Mozambique and that they are not really interested in fish as food. However, a 1920s study (Stayt 1931 in van der Waal, 2000) recorded the following fishing gear that was in use at the time, some of which resonates with that found in cases of the Tembe-Thonga of KwaZulu-Natal and the Makuleke of Limpopo Province:

- A fence of reeds with a fish trap;
- Bow and arrow;
- A thick bundle of vegetation used as a seine net; and
- A stick with a sharp thorn used as a kind of fishing hook.

Some of the above gear, which Stayt observed in the 1920s, was also encountered by van der Waal in 2000. The latter scholar commented that such gear also matched customary gear used by fishers in other parts of South Africa and the rest of Africa (van der Waal, 2000). However, there were newer adaptations of customary techniques and raw material. For example, fishers used gear such as the rod, hook and line, rod-less line, night line, draw net, and *Muthevhe* trap, which were bought or constructed from local material purchased from the local shop. Some of the gear was made out of home-made steel wire, barbless hooks and home-made cord. Studies therefore show that, in effect, there has been a fusion of indigenous and western knowledge and practices among the Venda people of Mutshindudi catchment area.

Likewise, current fishing techniques indicate a combination of customary and more recent innovations, and adaptations of both. Van der Waal (2000) observed that the Venda of Mutshindudi catchment area threw a hand-line into the water, pulled it taught and tied it to a stick pressed vertically into the bank with a warning weight called a 'policeman' on the line to alert the angler to bites. This technique was used for catching carp in Vondo Dam. The nightline was another elementary fishing gear used for subsistence fishing. The technique was made up of very thick builder's nylon or other strong rope, which was tied to a root on the riverbank and the large hook baited with a small animal or fish. The nightline was largely used for catching large catfish and eels. The draw net was another very simple gear that consisted of a piece of shade-cloth, old curtain or even towelling of about one-by-two metres (1x2m) in area and was used by two people standing in the water to herd and scoop fish. It was used to catch fish in shallower parts of rivers or in dams among weeds and rocks.

Stayt's study (1931 in van der Waal, 2000) reported that among Venda-speaking peoples fishing was conducted only by boys. Older men did not fish, and it was *taboo* for women to fish. By contrast, van der Waal's more recent study (2000) indicates that with passage of time, there has been a change in customary fishing knowledge and practices among Venda people within Mutshindudi catchment. Freshwater fish has become more readily caught and consumed.

4.3.4.3 Rationale for shifts in inland fisheries knowledge and practices

Van der Waal postulated that shifts in customary knowledge and practices might be related to Venda people's exposure to repeated efforts to establish fisheries and even aquaculture in their area. He linked the observed positive attitude towards fish partly to earlier attempts to stock the many smaller reservoirs in the relatively water-rich area by the then Native Trust Commissioner in the 1940s.

Such initiative saw a translocation of various tilapia species into Lake Fundudzi and streams around Palmaryville, as well as imported bluegill sunfish, *Lepomis macrochirus* and black bass, *M. salmoides*, and perch, *Perca fluviatilis*. The bluegill sunfish is still present in the Ebbe and Vondo Dams in the Mutshindudi system as well as in some forestry dams in the Nzhelele catchment. According to Ivy (1941, in Van Der Waal, 2000), the Native Commissioner also raised and released rainbow trout, *Onchorhynchus mykiss*, in the headwaters of the Mutshindudi. Later on in the 1970s, a fish hatchery was started at Dzindi, where tilapia, carp and later, catfish and silver carp, *Hypophthalmichthys molitrix*, were bred and produced.

Van Der Waal (2000) described some of the newer practices that emerged as a result of promotion of inland fisheries, including regular fish sales, which proved popular with the local people. Subsequently, a commercial fish farm now-called 'Crocodile Ventures', began operating near Thohoyandou in the mid-1980s and, until recently, sold tilapia and catfish to the local public. In Van Der Waal's view, the observed general acceptance of fresh water fish by locals might therefore be ascribed to efforts to popularize fish by earlier commissioners, nature conservation authorities and entrepreneurs.

4.3.5 Lake Fundudzi – Erosion of Customary Taboos on Fishing

4.3.5.1 Background

Lake Fundudzi is a relatively large natural lake located in the Nzhelele valley in the northern parts of Limpopo Province. The lake, which is three (3) kilometres long and has a surface area of one hundred and forty-four hectares (144 ha) and a maximum depth of twenty-seven (27) metres is surrounded by Venda-speaking rural communities of the Vhathavhatsindi group, who settled in the area a number of generations ago. These communities have historically considered the lake a sacred site.

4.3.5.2 Shifts from customary to current fishing knowledge and practices

Long-held perceptions that Lake Fundudzi is a sacred site have historically contributed to the conservation of natural resources within the vicinity of the lake. Cultural taboos precluded Venda people from eating fish from the lake or from any other sources, such as rivers. Effectively, this implies that Lake Fundudzi might not have been considered a fisheries resource by the Vhathavhatsindi group of Venda. More recent observations, however, indicate that there has been an erosion of indigenous cultural practices, partly

associated with contestations over control of the lake. As a result, small-scale commercial and subsistence fishing practices emerged on the lake, as well as concerns by some among traditional leadership that such practices compromise the integrity of the lacustrine ecosystem. Consequently, these leaders have insisted that any plans for the development and management of Lake Fundudzi need to take cognizance of indigenous knowledge systems and practices, including a prohibition of fishing on the lake.

While it is not clear to what extent such perceptions are currently shared by ordinary members of rural communities surrounding the lake, the case of Lake Fundudzi shows at least that, as from a particular point in history, fishing in the vicinity of Lake Fundudzi was precluded by Venda cultural beliefs and customary norms of the Vhatavhatsindi group. Although there have been shifts towards greater acceptance of fishing knowledge and practices from outside this cultural group, such changes clearly continue to co-exist with customary taboos. Unlike in the cases of Xhosa people of the Eastern Cape and the Venda people of Mutshindudi catchment area, who readily show acceptance and cultural adaptation to innovations in fishing knowledge and practices, the development of inland fisheries for livelihood enhancement around Lake Fundudzi seems likely to be dogged by long term contestation. From a co-management perspective, contestations revolve around issues of custodianship for the lake, power and control over benefits deriving from access to the lake and lack of shared understandings between indigenous knowledge systems and modern 'scientific' knowledge.

4.3.5.3 Contestation over Custodianship

The project case study revealed that there is very strong local contestation to Chief Netshiavha's claims to sole custodianship over the lake. Key respondent identified three other chiefs who claim they have legitimate jurisdiction over the lake fishery namely, Chief Tshivhase, Chief Netshidzivhe and Chief Netshiheni (who replaced the recently deceased Chief Tsharota). The contestation was a protracted issue, which had long defied previous efforts to resolve the dispute. It did not seem feasible that co-management arrangements would solve this contestation. Rather, co-management would need to steer away from involvement in any discussion about custodianship rights and be geared instead towards the conservation of lake fisheries and their protection from uncontrolled access and resource exploitation by outsiders. With conservation as an entry point to discussions about the lake fishery, it could be possible to get buy-in and consensus from all four chiefs surrounding the lake.

4.3.5.4 Power and Control over Benefits

Interviews with both Chief Netshiavha and local fishers seem to suggest that the custodianship issue is both a question of power and control over tangible and intangible benefits from a valued natural and spiritual resource and heritage. While Netshiavha's claim to be the sole traditional spiritual custodian over the lake confers to him benefits of power and control over the lake, it also seems to have given him authority over access and use rights of the fishery. Fishers reported that the chief sometimes conducts spot checks on fishers and other lake resource users and habitually confiscates any fish found in the possession of fishers without his permission to fish. The fishers felt aggrieved about that, citing their extreme poverty and need for food security as reasons why they should be allowed to keep their catch.

4.3.5.5 Lack of shared understandings between indigenous knowledge systems and modern 'scientific' knowledge

Lake Fundudzi is steeped in indigenous spiritualism and myths. These aspects are currently inextricable from the identity of the lake as an inland fishery, and indigenous knowledge systems are currently the only form that enjoys widespread local legitimacy. Outsiders have made a few attempts to utilise the fisheries using alien access rights systems, which include an Apartheid era attempt by white developers to forcibly establish an ecotourism lodge on the lake and recent post-Apartheid attempts by individuals to establish Black Economic Empowerment (BEE) recreational facilities on the lake shores. These attempts have failed to overcome local resistance, and rumours are rife that the attempts have been thwarted more by spiritual forces than by human agency. There will be a need to ensure that effective co-management arrangements build upon existing indigenous management and governance systems and avoid introducing radically new and untested formulations, which local people are not familiar with. For this reason, a community-based co-management option would be applicable in this case.

4.3.6 Discussion

The foregoing examples provide lenses through which to examine the two sets of questions raised by the observed paucity of South African literature on indigenous fisheries knowledge and practices. The first set of questions relates to the possibility that inland fisheries have historically not been a key source of food and livelihoods for many rural communities. The second is linked to the possibility that much of indigenous inland fisheries knowledge, at least among communities with fishing histories, might have been lost.

The Tembe-Thonga and Makuleke case studies clearly provide evidence that inland fisheries have historically been a key source of food and livelihoods for rural communities residing in close proximity to hydrological features, such as floodplains. However, there are limitations on the extent to which findings from these two case studies can be extrapolated to other communities with histories of living in close proximity similar floodplains and, for that matter, communities living in the vicinity of other types of water bodies, such as natural lakes. The case study of Lake Fundudzi is a case in point. For the Vathavhatsindi groups of Venda people, who reside on the shores of Lake Fundudzi, proximity to a natural water storage feature does not necessarily imply a strong fishing culture. To the contrary, cultural beliefs and practices have until recently precluded exploitation of the resource. By contrast, although fishing does not feature strongly in reported traditions of observed Xhosa communities and Venda people occupying Mutshindudi catchment area, this has not prevented these communities from welcoming new knowledge and practices associated with more recently developed dams and fisheries.

With regard to the second set of questions, the Makuleke case, in particular, points to the possibility that, for those communities with fishing histories, much of indigenous inland fisheries knowledge might have been lost alongside the destruction of pre-Colonial indigenous societies and the alienation of natural resources through Colonial land laws, notably the Land Act of 1913, and Apartheid legislation, such as the Bantu Promotion of Black Self Government Act of 1959. However, the extent of such loss has yet to be tested. By contrast, although livelihoods of Tembe-Thonga communities of the Pongola Floodplain were disrupted by the construction of Pongola Dam in 1960, these communities by virtue of long term tenure within the floodplain appear to have retained a significant amount of indigenous fishing knowledge and practices, albeit in apparent decline. It seems therefore that for communities with fishing histories, land dispossession and alienation of fisheries resources constitutes a key factor determining whether or not long-held customary fishing knowledge and practices persist.

4.4 Conclusion

All case studies demonstrate continuous adaptation of indigenous and customary knowledge to current circumstances. There is often a co-existence of indigenous and/or customary knowledge and newer knowledge, often with a blending of the two. Such knowledge relates to names of fish species, types of fishing gear and tackle, fishing techniques, fish processing and informal fish markets. Indigenous and/ or customary fishing knowledge and use of fish vary among different communities, ranging from strong fishing tradition and sophisticated fishing techniques (e.g. Maluleke) to taboo and ignorance surrounding the resource (Debe Nek).

The general pattern observed in many 'traditional' rural communities is erosion of indigenous and customary knowledge flowing from alienation of customary resource rights and weakening of customary governance systems. The cultural role of fishing in these communities is changing. For example, among Venda communities living around Lake Fundudzi taboos weaken, while among the Tembe-Thonga of Phongola floodplain social institutions associated with fishing weaken and, with the growth of smallholder commercial agriculture, fishing is increasingly viewed to be a "poor man's" livelihood. By contrast, there is increasing use of fish in non-traditional fish eating communities, such as Xhosa-speaking communities of the Eastern Cape and Venda-speaking communities around Mutshindudi dam in Limpopo Province. This adaptation appears to be a response to nutritional needs, increasing food prices and changing cultural values.

Among communities with evidence of longstanding fishing traditions, such as the Makuleke and Tembe-Thonga of Phongola floodplain, responses to Colonial and Apartheid dispossession have largely been shaped by the degree of disturbance of customary social organisation. The displacement of the

Makuleke from the Limpopo floodplain and their subsequent access to a water storage dam accounts for their greater level of acquisition of newer fishing techniques and practices than that of the Tembe-Thonga communities, who have largely remained undisturbed in the floodplain. By contrast, Tembe-Thonga people displaced from land close to the Pongola gorge and resettled adjacent to the northern shores of Jozini dam have developed much more robust artisanal fishing practices than the adaptations seen among Makuleke subsistence fishers. This could be related to differences in dam size, proximity to markets, level of institutional organisation, support of external agencies and scale of commercial orientation. Fishing for livelihoods purposes in both communities nonetheless remains a marginal occupation due to the lack of recognition of their fishing rights in law, increasing their vulnerability.

The potential for inland fisheries to contribute to rural livelihoods remains under-developed. Most customary fishing practises continue to be regarded as illegal. Fishing as a livelihood is not legally recognised. Within rural communities, fishing is largely seen as a marginal livelihood activity of last resort. Customary fishing practices and knowledge are not formally included into modern value chains, such as charter fishing, tourism and artisanal fishing (e.g. Jozini). Similarly, indigenous and local fishing terminology is not fully recognised in scientific guide books for South African fish species (e.g. Jubb, 1967). There is therefore a need for institutional support to enable inland fisheries to make greater contributions to rural livelihoods in communities associated with water storage dams.

Opportunities that can strengthen such effort include a strong sense of “common pool resource” by all local communities despite level of use by different parties and, in dams surrounded by communal land, some active management by traditional authorities. These factors can be used as a foundation for developing more effective co-governance and co-management arrangements.

The case studies profiling of current South African fishing practices in rural communities (Tapela *et al.*, 2015 – Volume 2 of this report) illustrates how the Colonial and Apartheid policies shaped the inland fish resource use and the concomitant governance arrangements. Recreational fishing emerges as the dominant resource use, with customary and subsistence fishing relegated to being marginal and often illegal activities due to a lack of formal recognition of their fishing rights.

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5. THE RECREATIONAL ANGLING SECTOR

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5.1 Introduction

In South Africa, inland fisheries are predominantly used by recreational anglers (Weyl *et al.*, 2007). Ellender *et al.* (2009) define recreational anglers as those which “utilise the resource primarily for leisure purposes... They access the resource by vehicle and sometimes receive a lift; they have permanent employment, use high technology gear consisting of a fibreglass or graphite rod, and a multiplying or spinning reel, and release, consume or sell a portion of their catch”. These recreational anglers through the utilisation of tourist facilities and associated services along many inland waterways contribute significantly to the regional economy (Du Plessis and Le Roux, 1965; Le Roux 1965; Cadieux, 1980; Leibold and van Zyl, 2008; Du Preez and Lee, 2010). In some countries this economic contribution exceeds that of commercial fisheries (Stage and Kirchner, 2005; TCW Economics 2008). The few assessments of the economic impact of recreational angling in South Africa all indicate that this impact is considerable (see Chapter 2). It is therefore important that recreational anglers are recognised as important stakeholders in South African inland fisheries and that their interests be recognised in future fisheries development.

Recreational angling in South Africa can be broadly subdivided into two categories: the formal sector, which comprises individuals/members affiliated to or belonging to an organised body such as a club, and the informal sector that comprises social anglers that are not linked to any organised body (Pledger, 2010). Formal angling organisations are important partners in long term planning and policy development around the utilisation of fisheries. Nationally there are more than 19,000 recreational anglers that are affiliated to various angling associations (Pledger, 2010). Some 7400 of these are affiliated to associations that only use inland waters (see Table 9).

The aim of this chapter is to describe recreational angling disciplines and provide a description of angling organisations that have an interest in inland waters in South Africa.

Table 9 Organised freshwater angling membership in South Africa.

Angling body	Clubs	Members
SA Freshwater Bank Angling Federation (SAFBAF)	169	5309
South African Artificial Lure Angling Association (SAALAA),	16	484
South African Bass Anglers Association	38	1184
Federation of South African Fly fishers	14	450
Total	237	7427

5.2 Angling Organisations – An Overview

The structure of organised freshwater recreational angling in South Africa is shown in Figure 9. It is important to note that all organised angling in South Africa falls under the auspices of the International Sport Angling Confederation (CIPS, Confédération Internationale de la Pêche Sportive), an organisation comprised of approximately 50 million members worldwide that represents saltwater and freshwater angling interests as well as the sport of casting (http://www.cips-fips.com/cips/index_en.html). Under this global body, two international federations, namely the International Freshwater Sport Fishing Federation (FIPS-ed) and the International Fly Sport Fishing Federation (FIPS – Mouche), are concerned with international freshwater angling and its organisation. At a national level, angling organisations then fall under these two federations. In South Africa, these are:

1. The South African Freshwater Bank Angling Federation (SAFBAF),

2. The South African Federation of Artificial Lure and Fly Angling Federation (SAFALFA). Both SAFBAF and SAFALFA are controlled, on a national level, by the South African Sport Anglers and Casting Confederation (SASACC). However, in terms of their international representation, SAFBAF fall under the FIPS-ed banner while the activities of SAFALFA are controlled by FIPS-mouche (Pledger, 2010). Contact points for all SAFBAF and SAFALFA affiliated associations are available on the SASACC website (<http://www.sasacc.co.za/wcontact.php>).

ORGANISED FRESHWATER ANGLING IN SOUTH AFRICA

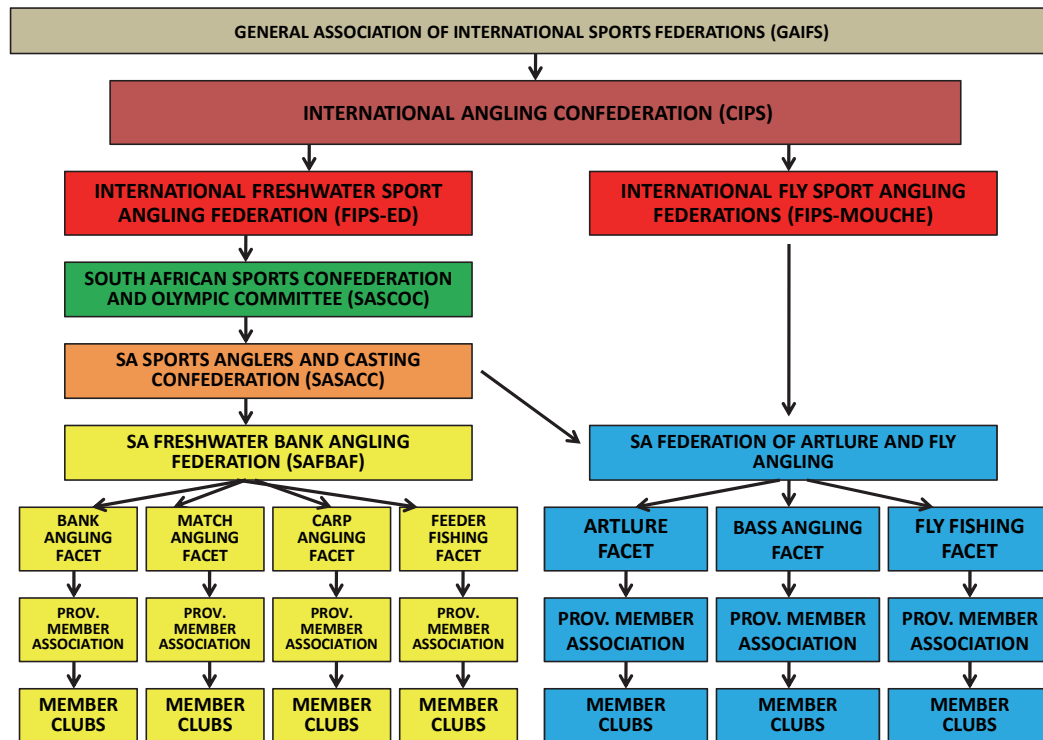


Figure 9 Structure of organised freshwater angling in South Africa (adapted from the South African Sport Anglers and Casting Confederation (SASACC)).

5.2.1 South African Freshwater Bank Angling Federation (SAFBAF)

The South African Freshwater Bank Angling Federation (SAFBAF) is the controlling body for four organised angling facets, namely bank angling; carp angling; match angling; and feeder fishing. The facets themselves do not have distinct administrative bodies and their activities are controlled and convened through representatives on the SAFBAF administration. There are currently more than 5300 SAFBAF registered anglers in the country (Table 10).

Province	Clubs	Registered anglers
Gauteng	27	899
Gauteng-North	12	621
Kwazulu-Natal	13	390
Limpopo	6	164
Mpumalanga	13	405
Northern Cape	10	198
North East Mpumalanga	10	280
North West	9	296
Eastern Province	5	126
Central Gauteng	19	720
Central Northwest	8	166
Southern Cape	6	62
Free State	24	725
Western Province	7	257
Total	169	5309

Table 10 SAFBAF – Number of Affiliated Clubs and Registered Anglers within those clubs by province (data compiled 2011).

5.2.1.1 Bank Angling

In Bank Angling, a baited hook is cast out and the participant waits for a fish to eat the bait. During bank angling competitions, fishing zones are demarcated along the shoreline, the number and size of the zones depends on the number of teams or participants in the event. Within each zone each participant is allocated a lot, generally no smaller than 30m, which determines the area to be fished by that participant (see Figure 10 A). The water in front of each lot is “ground-baited” by the angler, a practise which involves the dispersal of bait such as maize meal, nuts and/or seeds over an area to attract fish to the fishing site (Spencer, 2010). In competition, anglers are permitted to fish with a maximum of two rods at a time and two hooks per rod.



Figure 10 (a) Bank anglers on Lake Gariep. (Source: SAIAB, O.Weyl); (b) rod and reel used for carp angling on a specialised stand (Source SAIAB, O.Weyl) and (c) a match angler playing a fish during the Womens World Match Angling Championships, Bloemhof Dam, 2010 (Source: Visagie, 2010)

All freshwater fish species captured within an anglers' fishing area are considered eligible for weigh-in at competitive events with the exception of all yellowfish species which are to be released immediately. Captured fish are kept in keep-nets, the entire contents of which are weighed after the allocated fishing period which is typically 8 hours. (Visagie, 2010). Points are allocated to the angler for each fish caught and for the weight of all fish contained within the keep-net. While several species may be caught bank angling, the majority of competitive bank anglers target carp *Cyprinus carpio* and competitive events are only conducted where this species occurs (Visagie, 2010).

There are several competitive disciplines of bank angling which include bank angling, carp angling, match fishing and feeder fishing. While these disciplines differ in technique and tackle used, the general competition formats are similar. Carp angling, for example, is a form of bank angling where participants fish exclusively target common carp *Cyprinus carpio* and grass carp *Ctenopharyngodon idella*, with the provision that the bait must be attached to the hook in the form of a hair rig which allows the bait to be presented without sitting directly on the hook.

Match anglers attempt to catch as many fish (regardless of species) with as high a mass as they can within a certain time frame. Match anglers commonly fish off elevated platforms erected in the water a short distance off the bank from which they cast into- and groundbait their allotted area. Here ground-baiting or "feeding" may only be done using catapults to launch the bait or alternatively using hands.

Feeder fishing is a recently-formed facet of competitive bank angling in South Africa. The aim of feeder fishing is the same as bank angling however the angler uses only one rod and reel, a hook, and a single baiting device known as a "feeder". This feeder is typically in the form of a small cage into which bait is placed and cast out 25-50m in front of the angler, within his allotted area or "peg". Ground baiting the area is only permitted in the absence of a hook. As with match angling, the anglers commonly fish off erected platforms within small, defined pegs (Spencer, 2010).

5.2.1.2 Dams of importance to SAFBAF

Bank angling is based on the availability of the alien common carp, *Cyprinus carpio* (Figure 11), the first of the popular alien recreational angling species to be introduced into South Africa (de Moor and Bruton, 1988). Since its introduction in 1896, this species has been spread widely by anglers and their ability to invade a variety of different habitat has resulted in their presence in almost every river system in the country (De Moor and Bruton, 1988, Van Rensberg *et al.*, 2011).



Figure 11 A recreational angler proudly showing off a carp on Lake Gariep, South Africa's largest inland reservoir. (Source SAIAB, O.Weyl)

During 2009 priority localities for sport angling were discussed with SASACC during consultative meetings for National Environmental Management: Biodiversity Act (NEMBA) implementation planning. Dams were prioritised according to their level of utilisation – a ranking process for each dam according to the type of organised angling tournaments held at the dam e.g. club, provincial, regional, national and international. The resultant priority list indicates that only 22 dams were considered of high importance to bank angling, in that they were used to host national and international competitions under the SASACC and were frequently used by recreational anglers (Table 11). Other dams are used at varying levels, with 172 dams recognised as potential angling venues by the people consulted during the NEMBA process. It is also evident that only larger dams are of high importance to the bank angling facet.

Table 11 Ranking of 176 dams in order of importance by the South African Sport Anglers and Casting Confederation (SASACC). Importance is ranked from 1 = highest, with national and international fishing tournaments to 5 = not important or only occasionally used by social recreational anglers. (Source: Swartz, 2009)

Rank	Mean Full Supply Capacity (million m ³)	Number of Dams
1	571	22
2	111	31
3	159	38
4	240	32
5	59	49

The following is a list of reservoirs that are considered of high importance for bank anglers in each province:

Western Cape

Bulshoek; Misverstand; Floriskraal; Gamkapoort; Voelvie; Calitzdorp; Stompdrift; Kammanasie; Brandvlei; Quaggaskloof; Poortjieskloof; Ernest Robertson; Garden Route; Theewaterskloof; Hartebeeskuil; Paarl.

Eastern Cape

Grassridge; Kommandodrift; Lake Arthur; Wiggleswade; Darlington; Nuwejaars; Slagboom; Kouga; Elandsjacht; Alicedale; Northend; Gariep (Eastern Cape side) – both recreational and subsistence fishing occurs in this reservoir.

KwaZulu- Natal

Zaaihoek; Klipfontein; Ntshingwayo; Woodstock; Midmar; Inanda; Spienkop; Goedertrouw; Wagendrift; Craigeiburn; Albert Falls; Nagle; Shongweni.

Free State

Vaal Barrage (Free State side); Vaal Dam; Koppies; Bloemhof; Saulspoort; Allemanskraal; Sterkfontein; Erfenis; Krugersdrif; Rustfontein; Groothoek; Armenia; Tierpoort; Kalkfontein; Welbedacht; Vanderkloof; Gariep (Free State side).

Northern Cape

Spitskop; Boegoeberg; Vanderkloof and Bloemhof (Northern Cape side).

North West

Vaalkop; Roodekopjes; Marico-Bosveld; Bospoort; Hartbeespoort; Buffelspoort; Olifantsnek; Disaneng; Elandskuil; Rietspruit; Boskop; Barberspan; Klipdrif; Potchefstroom; Klerksdorp; Bloemhof (North West side).

Gauteng

Roodeplaat; Bon Accord; Rietvlei; Bronkhorstspuit; Vaal Barrage (Gauteng side); Vaal Dam (Gauteng side).

Mpumalunga

Da Gama; Klipkopjes; Witklip; Longmere; Kwená; Primkop; Loskop; Middelburg; Vygeboom; Doringpoort; Witbank; Nooitgedacht; Trichardsfontein; Leeuwpan; Jericho; Morgenstond; Grootdraai; Heyshope; Bronkhorstspuit.

Limpopo

Klaserie; Warmbad; Rust de Winter; Albasini; Glen Alpine; Middel-Letaba; Tzaneen; Nkumpi.

5.2.2 South African Federation of Artificial Lure and Fly Anglers (SAFALFA)

The South African Federation of Artificial Lure and Fly Anglers (SAFALFA) is the controlling body for three organised angling facets, namely artificial lure angling (art lure), bass angling, and fly fishing. The activities of these facets are controlled and administered by: the South African Artificial Lure Angling Association (SAALAA), the South African Bass Angling Association (SABAA), and the South African Fly Fishing Association (SAFFA), which act in the interests of artificial lure-, bass, and fly angling respectively.

5.2.2.1 Artificial Lure Angling

Organised artificial lure angling in South Africa is comprised of 11 Provincial bodies affiliated to SAALAA. SAALAA's mandate is to represent all aspects of competitive artificial lure angling in South Africa which ultimately involves the hosting of national championships which act as trials for the selection of the national team (Protea anglers) for international competitions (Venter, 2011). In artificial lure angling the participant attempts to catch all of the species present within a particular water body, irrespective of the size that a species may attain, using only artificial lures which imitate natural food items or induce an aggressive strike from a species (Figure 12). Nationally there are 16 registered clubs containing 484 anglers that compete at various levels of the sport.

Participants fish either from boats or the shoreline. Competition formats vary depending on the nature of the event i.e. club, provincial, national. Generally, points are awarded based on the number of different species captured and the weight of a particular species. In addition, different points may be allocated depending on whether the fish was caught from a boat or the shore.



Figure 12 A wide variety of artificial lures used in freshwater angling. (Source: SAIAB O. Weyl)

Province	Clubs	Registered Anglers
Kwazulu-Natal	3	172
Northern Gauteng	2	112
Mpumalanga	3	89
Central Gauteng	1	23
Western Province	1	19
Limpopo	1	11
Central North West	1	19
Free State	0	0
Gauteng	1	10
Boland	2	18
Northern Natal	1	11
Total	16	484

Table 12 Number of SAALAA affiliated Clubs and Registered Anglers within those clubs by province (Source: Venter, 2011)

5.2.2.2 Bass Angling

Bass angling focuses exclusively on the alien largemouth bass *Micropterus salmoides*, Florida Bass *Micropterus floridanus*, the smallmouth bass *Micropterus dolomieu* and spotted bass *Micropterus punctulatus*. These fish were introduced between 1928 and 1937 and have been widely stocked throughout South Africa by early Government initiatives and later, by anglers. Largemouth bass are the most widely distributed species and are thus the most common target species for anglers. Bass are now present in all major river catchments and while they are often caught both by social anglers as well as during targeted tournaments (Figure 13).



Figure 13 Bass anglers competing on Lake Pleasant in the Garden Route Classic, a tournament that attracts more than 50 boats. Note the electric “trolling motor” used for positioning the boat for fishing. Source: SAIAB, O. Weyl.

The South African Bass Angling Association (SABAA) is the national administrative body for organised bass angling. The organisation is comprised of five divisional bodies that incorporate different areas within South Africa and include: Northern division (Limpopo, Gauteng North, Mpumalanga); Southern Division (Gauteng Central, Gauteng South, Northern Free State, North West Northern Region) Western division (Western Province, Boland, Northern Cape); Eastern division (Eastern Cape, Border, and Southern Cape); KwaZulu-Natal division (Midlands, South Coastal, North Coastal, Northern KwaZulu-Natal). These divisional structures themselves are subdivided into regional chapters affiliated to SABAA, the eligibility of which is determined by a minimum number of affiliated SABAA members. Only anglers affiliated to a recognised SABAA chapter may fish competitively and achieve Provincial and National colours and there are currently SABAA 1184 registered bass anglers in the country (Table 13).

Division	Chapters	Registered anglers
Northern	10	Not supplied
Southern	8	Not supplied
Western	5	Not supplied
Eastern	5	Not supplied
Kwazulu-Natal	10	Not supplied
total	38	1184

Table 13 Number of Affiliated Clubs and total number of Registered Anglers (Source: Watson, 2011) (*missing data were not supplied by province*).

The principles of bass angling are very similar to those of artificial lure angling whereby fishing is conducted using a range of artificial baits. Competitive bass angling is conducted exclusively using high-powered, purpose-built “bass-boats” which allow for large amounts of water to be covered in short spaces of time (Figure 14). Typically, bass competition formats allow for the weigh-in of five fish larger than 30 cm. Fish are kept in live-wells within the boat and selectively “culled” i.e. upon capture of a larger fish, a smaller fish is released such that the angler is within the five fish limit. Scores are determined based on the total weight of the bag and the number of fish e.g. total score = total bag weight + 1 point for every fish caught. Competitions are usually run over two days, with an angling period of eight hours each day or occasionally six hours on the final day.



Figure 14 Bass anglers competing on Lake Pleasant in the Garden Route Classic, a tournament that attracts more than 50 boats. Note the electric “trolling motor” used for positioning the boat for fishing. Source: SAIAB, O. Weyl.

5.2.2.3 Dams of importance to bass angling

While bass angling is undertaken in many small farm dams and rivers we focus on those water bodies that are considered of importance by members of organised angling, in this case SABAA. Therefore, dams of significance are larger bodies of water (> 20 hectares) which have banks or shorelines that allow the angler to launch a vessel and allow for the use of outboard motors. Nationally, only 36 dams were considered of high importance and another 47 of medium level importance by stakeholders consulted during the NEMBA demarcation process in 2009 (Table 14).

Table 14 Ranking of 176 dams in order of importance by the South African Bass Anglers Association (SABAA). Importance is ranked from 1 (highest, with national and international fishing tournaments) to 5 (occasionally used by recreational fishers). Source: SAIAB, Dr E. Swartz unpublished NEMBA planning data, 2012.

Rank	Mean Full Supply Capacity (million m ³)	Number of Dams
1	140	36
3	185	47
5	224	89

Western Cape

Dams on three major river systems in the province are used extensively by bass anglers. These are the Clanwilliam and Bulshoek Dams on the Olifants River system; Voelvlei and Misverstand Dams on the Berg River; and Theewaterskloof- and Brandvlei/Quaggaskloof Dams on the Breede River system. In particular, the Clanwilliam-, Bulshoek-, Theewaterskloof, and Brandvlei/Quaggaskloof are used at all levels of organised bass fishing (club; divisional; provincial; national). Clanwilliam-, Bulshoek-, and Voelvlei Dams are smallmouth bass fisheries while the rest of these dams host large- and smallmouth bass (NEM:BA Maps, 2009). The Breede River itself is another smallmouth bass fishery although rarely utilised by the organised bass angling facet (Dohloff, 2004). In the east near Sedgfield, is Lake Pleasant or Groenvlei, a natural lake that is a popular bass fishery.

Eastern Cape

In the Eastern Cape, Wiggleswade Dam; Impofu Dam; Loerie Dam; Settlers Dam; Kouga Dam; Brakke duine Dam; Binfield Dam and Rooikranz Dam are considered important bass fisheries

KwaZulu-Natal

The region possesses several large waterbodies which are prominent bass fisheries and, notably, most of these fisheries contain a southern subspecies of the largemouth bass known as the Florida bass *Micropterus salmoides floridanus* (Skelton, 2001; Swartz, 2009). This subspecies is known for its rapid growth rate and ability to attain a very large size (de Moor and Bruton, 1988). The introduction of this subspecies has resulted in the establishment of many of the best bass fisheries in the country and the current South African record bass was captured at Midmar Dam. Significant bass fisheries in the province include: Midmar Dam; Albert Falls Dam; Craigieburn Dam; Inanda Dam; Hazelmere Dam; Wagendrift Dam; Goudertrouw Dam; and Bivane Dam. Smallmouth bass are well established in the Mooi River although there is no significant fishery on this river.

Mpumalunga

Largemouth bass are well established in many reservoirs throughout the province excepting the high-lying areas where trout fisheries are more prolific (Swartz, 2009). The prominent bass fisheries support high recreational angling pressure from the urban centres of Johannesburg and Pretoria. Those reservoirs with bass fisheries include: Witbank Dam; Jericho Dam; Westoe Dam; Morgenstond Dam; Heyshope Dam; Nooitgedacht Dam; Vygeboom Dam; Driekoppies Dam; Witklip Dam; Klipkopjie Dam; Longmere Dam; Primkop Dam; Kweni Dam; and Inyaka Dam (Ferreira, 2010).

North West

Due to its proximity to Gauteng – which includes Pretoria and Johannesburg – the reservoirs in this region supporting bass fisheries receive a significant amount of pressure from anglers based in these metropolitan

areas (Nortje, 2010). The notable bass fisheries in the province include: Hartbeespoort Dam; Ngotwane Dam; Bon Accord Dam; Rietvlei Dam; Buffelspoort Dam; Bospoort Dam; Roodeplaat Dam; Vaalkop Dam; Roodekopjes Dam; Molatedi Dam.

Limpopo

A large proportion of the bass fisheries in this province are located towards the north of the province e.g. Tzaneen, close to the sub-tropical zone, where water temperatures are conducive to the establishment of significant bass fisheries. These include: Tzaneen Dam; Ebenezer Dam; Mokolo Dam; Doorndraai Dam; Nandoni Dam; Rust de Winter Dam; Middel-Letaba Dam (NEM:BA Maps, 2009; Nortje, 2010).

Gauteng and Free State

The two bass fisheries of significance in these provinces include the Vaal Dam and the waterbody below the dam known as the Vaal Barrage. The Vaal Barrage is the most extensively used bass fishery in Gauteng while the Vaal Dam will soon become an international organised bass angling competition venue (Swartz, 2009).

5.2.2.4 Fly Fishing

Fly fishing is an activity in which an artificial “fly”, is used to catch a variety of different species, both in freshwater and saltwater. The fly is nearly weightless and requires a distinctive casting technique and tackle different to that used in other facets which employ artificial baits (Figure 15).

All organised fly fishing in South Africa is administered through the South African Fly Fishing Association (SAFFA), which is the only legal entity that may issue Provincial and National colours in this angling discipline (Babich, 2011). The association is comprised of the provincial bodies: the KwaZulu-Natal Fly Fishing Association; Western Province Fly Fishing; Boland Fly Fishing; Central Gauteng Fly Fishing; Limpopo Fly Fishing Union; and Gauteng North (www.fishingowl.co.za). In order to participate competitively, anglers must be affiliated to a club that falls under the auspices of a provincial structure. All rules and regulations governing competitive fly fishing in South Africa are those outlined by the international fly fishing body under FIPS-Mouche (Babich, 2011).



Figure 15 A fly-fisherman with a rainbow trout, a common target species in this fishery. Source: SAIAB, O. Weyl.

Competitive fly fishing is different from other facets in that anglers are accompanied by marshals and upon capture fish are immediately measured for length (not weighed) and returned to the water by the marshal. Points are awarded for number and size of fish captured and may vary depending on the species in question. The international competition format is comprised of two, three-hour sessions held over three days (<http://www.fips-mouche.com>). Commonly, sessions are held on rivers with at least one session held on an impoundment or lake. In the case of the river session, anglers are assigned a “beat” which determines the area in which they are allowed to fish – this may vary depending on the competition venue. Lake sessions are typically conducted using boats carrying two anglers. Competitive fly fishing is conducted exclusively in freshwater and the target species are commonly salmonids e.g. trout although in South Africa several events involve the capture of yellowfishes (Babich, 2011).

Federation of South African Flyfishers

In response to removal of government support to trout fisheries and non-native fisheries in the 1980s, the Federation of Southern African Fly-fishers (FOSAF) was formed to promote the sport of fly-fishing and provide fly-fishers with a platform for negotiation with higher authorities (Skelton and Davies, 1986, McCafferty *et al.*, 2012, <http://www.fosaf.co.za/history.php>). Currently there are some 450 members and many flyfishing clubs are affiliated. The organisation not only actively engages with government on issues regarding angling interests but also has several conservation initiatives (see www.fosaf.co.za).

5.2.2.5 Recreational trout fisheries

The management of trout fisheries is a significant aspect of flyfishing and deserves special mention. Rainbow trout *Oncorhynchus mykiss* and brown trout *Salmo trutta*, represent the traditional fly fishing target species, and their social and economic importance is demonstrated by the large number of small dams and rivers located in high altitude areas throughout South Africa that are managed as trout sport fisheries. A provincial description of important trout-based fly fishing venues and a description of how they are managed follows.

Western Cape

Trout fishing in this province is largely centred around headwater streams which are tributaries of the Breede River system. These streams, as well as several reservoirs, are largely on State-owned land. The Cape Piscatorial Society is the lead organisation controlling access to the majority of established fishing streams including the Smalblaar-, Holsloot-, Witte-, Jan du Toit's-, Elandspad- and Molenaars Rivers as well as the Lakensvlei and Ceres Arch reservoirs (Piscator, 2010). These waters require a provincial angling licence and, location dependant, a daily angling permit and forestry permit (www.piscator.co.za). In addition to these State owned waters are over 20 reservoirs providing trout sport fishing which are managed by a number of private service providers (Sutcliffe, 2004).

Eastern Cape

The topography of the Eastern Cape includes several high-lying areas and mountain ranges drained by upland streams which are highly conducive to the survival of trout. As is the case with most of the areas in South Africa that support trout fisheries, access to the majority of these waters is controlled either through a club or through private administration. The Eastern Cape has eight fly fishing clubs namely: the Wild Trout Association; the Maclear Fly Fishing Club; the Transkei Piscatorial Society; the Frontier Acclimatisation Society; the Stutterheim Trout Angling Club; the Queenstown Fly Fishing Club; and the Bankberg and Somerset East Trout Angling Clubs (Kietsman, 2004; Lewis, 2004; Peterson, 2004). In total these clubs provide access to well over 1000 km of trout streams as well as over 60 reservoirs in the province. The majority of stream fishing is located in the rivers draining the southern Drakensberg Mountains while reservoirs supporting trout fisheries are located around cool, higher-rainfall mountain ranges such as the Winterberg, Stormberg, and Amatola's. In addition to these club-controlled waters are several private operations providing trout fishing mostly in reservoirs.

KwaZulu-Natal

This province was the first region to receive trout (brown trout from Scotland) in South Africa. The trout fishery in this province is extensive. Almost all of the streams draining the eastern Drakensberg escarpment from the Tugela in the north to the Umzimkulu in the south have self-sustaining populations of trout

(Skelton, 2001). A large proportion of these waters, especially the upper reaches located close to the Drakensberg Mountains, are under the control of Ezemvelo KZN Wildlife and access is regulated through fishing permits (www.kznwildlife.co.za). In terms of reservoirs, KwaZulu-Natal has two distinct locales where trout sportfishing is available in well over 60 reservoirs: the Natal Midlands District, and the southern Drakensberg area around the towns of Underberg and Himeville. A large proportion of these reservoirs are controlled by three fishing clubs: the Natal Fly Fisher's Club; the Underberg/Himeville trout Fishing Club; and the Wildfly Fishing Club. In addition to club controlled waters, there are a host of private operators who offer reservoir and/or stream trout fisheries, with some of the reservoirs ranging in size from less than a hectare to over 100 hectares.

Mpumalunga

As is the case with most, if not all, trout fisheries in South Africa, the trout fishery in this province is located in the high-lying areas, in particular the towns of Belfast, Dullstroom, Machadodorp, Waterval-Boven, and Lydenburg. Unlike the Western- and Eastern Cape, as well as KwaZulu-Natal, the trout stream fisheries in this province are less developed although catchments like the Crocodile and Elands are well-known for their trout fishing. The area does, however, provide a great amount of small (<1 hectare) to medium-sized (10 hectare) reservoirs which, due to this area's proximity to the urban centres of Pretoria and Johannesburg in Gauteng are used by many recreational anglers. The tourism boom that has resulted from increasing numbers of fly fishing tourists, has been responsible for transforming some small towns. Dullstroom, for example, has become a major flyfishing hub in the region. While there are clubs controlling access to some reservoirs and streams, the number of private service providers in the province greatly outnumbers those in any other region in the country. Trout fisheries located in around the three major catchments (Olifants, Crocodile, and Nkomati) number over 60 establishments and excludes waters held by private syndicates and companies of which there are several (du Toit, 2004).

Limpopo

Trout fisheries in this province are restricted to the high-altitude headwater tributaries of the Letaba River. These headwater tributaries comprise the Broederstroom River and Helpmekaar River and there are less than ten reservoirs providing trout sportfishing, most of which are controlled by the Haenertsburg Trout Association (HTA) and are accessible only to members (Dennis, 2004).

Free State

Trout fisheries in this province are located in the higher-lying Eastern portion of the province which features the Maloti Mountain range. The Klein Caledon River provides trout fishing in its higher reaches although most of the fisheries comprise small reservoirs which are controlled mainly through the Clarens Fly Fishing Club and the Maluti Flyfishing Club. In addition to these small reservoirs, there are four large public access reservoirs: the Sterkfontein Dam; Swartwater Dam; Fika Patso Dam; and Metsi Matso Dam. Sterkfontein Dam is, however, no longer a trout fishery of significance but is used extensively by flyfishers targeting smallmouth and largemouth yellowfish (Dennis, 2004).

Gauteng and North West

Several small trout fisheries are located close to the urban centre of Johannesburg. These fisheries are mostly small "put-and-take" fisheries where fish are stocked for the express purpose of being caught within a limited timeframe. All fish captured are killed and waters are continually restocked. A few of the fishery operators have trout hatcheries on site which provide fish for their own fisheries and, in some cases, for fisheries outside of the province (Dennis, 2004).

5.3 Recreational Boat Angling

A facet of recreational freshwater angling that is not covered under the main organisational body for freshwater anglers is boat angling. Information on this sector has been difficult to source because these anglers normally associate with marine clubs. The Eastern Cape Light Tackle Boat Angling Association's (EPLTBAA) use of Darlington Dam in the Eastern Cape is however a good example of such utilisation (Figure 16). The ELTBAA uses this dam for three of their league events every year (Weyl *et al.*, 2010).

From January 2000 to October 2008 there were three boat angling competitions per year. During these competitions anglers generally camp on the lakeshore and fish on two days. Anglers target catfish and carp and catches are separated by species. On Darlington Dam this sector accounts for most of the 150 annual boat launches and approximately 720 angler days per year or 33% of the fishing effort on the dam. Their catches were either donated to the local community or are released.

Interestingly it is recognised that Darlington Dam plays an unexpected role in marine fish conservation. The dam is one of the only freshwater venues available to the competitive boat anglers (Figure 16). The 720 angler days of effort is part of the competitive league that includes events focused on the estuary and in Nelson Mandela Bay. As a result, the alien invasive based Darlington Dam fishery contributes directly to reducing effort on indigenous saltwater fishes by competitive anglers.



Figure 16 Boat anglers weighing their catches at an annual fishing competition. (Source, SAIAB, O.Weyl).

5.4 Informal Recreational Anglers

Most recreational anglers are not affiliated to organised sports angling or other angling institutions. This presents a significant challenge to incorporating recreational angling representation into national inland fishery sector policy and planning. The Bank Angler, a popular angling Magazine has a national distribution of 17000 (Kruger, 2011), while the Fishing and Hunting Journal, popular with artificial lure anglers has a print run of 4000 copies (Rudmann, 2011). Conservative estimates are that at most 5% of recreational anglers are formally affiliated and so recreational angling is far larger than demonstrated by formal memberships. Unfortunately, quantifying the absolute number of participants in this important sector is difficult. Decision making will therefore ultimately have to be based on estimates. It is, however, likely that informal recreational anglers would also make use of those waters considered important by formal organisations.

The governance management of the informal recreational angling presents a challenge as the anglers are not organised into a representative body, and the sub-sector is not recognised by DAFF as a resource-based sub-sector which can contribute to rural livelihoods, decent job creation and poverty reduction. The sports angling body SASACC executive had drafted a proposal for a recreational angling sub-sector association, the South African Consolidated Recreational Angling Association (SACRAA) which will seek recognition by DAFF as representative a stakeholder body. The aims of SACRAA will be angling self-governance, promotion of responsible resource use, and representing the interests of anglers.

5.5 Examples of Enterprises Based on Recreational Angling

Nationally there are a wide variety of enterprises which form part of the recreational angling value chain. While it is not possible to discuss all the different types of enterprise, the following section illustrates aspects of the angling value by highlighting examples of businesses that provide recreational angling and angling-related products and services.

Carp: Eco Catch CC – Specialist Bait Products

Carp *Cyprinus carpio* are one of the most important recreational angling species in South Africa. There is a specific facet devoted to their capture which is estimated to be worth over ZAR250 million rand (Leibold and van Zyl, 2008) and they are the primary target for Bank Anglers the biggest freshwater angling fraternity in South Africa (Leibold and van Zyl, 2008; Visagie, 2010). There is an industry associated with their capture

especially in terms of fishing tackle and accessories. An example of such an enterprise is Eco Catch cc., a business based in Bloemfontein which specialises in providing carp fishing bait products for the fishing tackle retail industry throughout South Africa (www.ecocatch.co.za). Their products include bait dips (Figure 17), sprays, mielies, floats dough, powders, boilies, floats and ground feed. They are also the distribution agents for a number of internationally produced products including accessories such as hooks. In addition, Eco-Catch also produce educational DVD's entitled "Explore Freshwater" in which they showcase bank angling activities in dams across South Africa while advertising their product.



Figure 17 Some of the dips produced and marketed by Eco Catch.

Bass : Bass World Pro Angling Equipment and bass.co.za

Bass are one of the most popular sportfish in South Africa with an associated industry – including fishing tackle, bassboats, trailers – worth over ZAR1 billion (Leibold and van Zyl. 2008). An example of a locally established enterprise which specialises in providing products for the bass fishing industry is the online distributor bass.co.za (www.bass.co.za). This company distributes fishing tackle locally and internationally (Figure 18).



Figure 18 Some of the bass fishing products marketed by Bass.co.za

Trout: Footloose Trout Farm

Footloose trout farm is a 'put and take' recreational fishery situated on the outskirts of Johannesburg comprised of 13 dams stocked with trout from the Mpumalanga region (Figure 19). The management of the fishery is purely coordinated on a "put-and-take" basis where anglers keep all the trout that they catch. Caught are "sold" for R90.00/kg and the dams are kept heavily stocked to cater for anglers of varying experience. There is an on-site abattoir where anglers can take their fish to be processed and vacuum packed. Fishing tackle and bait is available for hire. This enterprise specifically caters for families and non-anglers with an on-site restaurant as well as conference facilities (<http://www.footloosetroutfarm.co.za>).

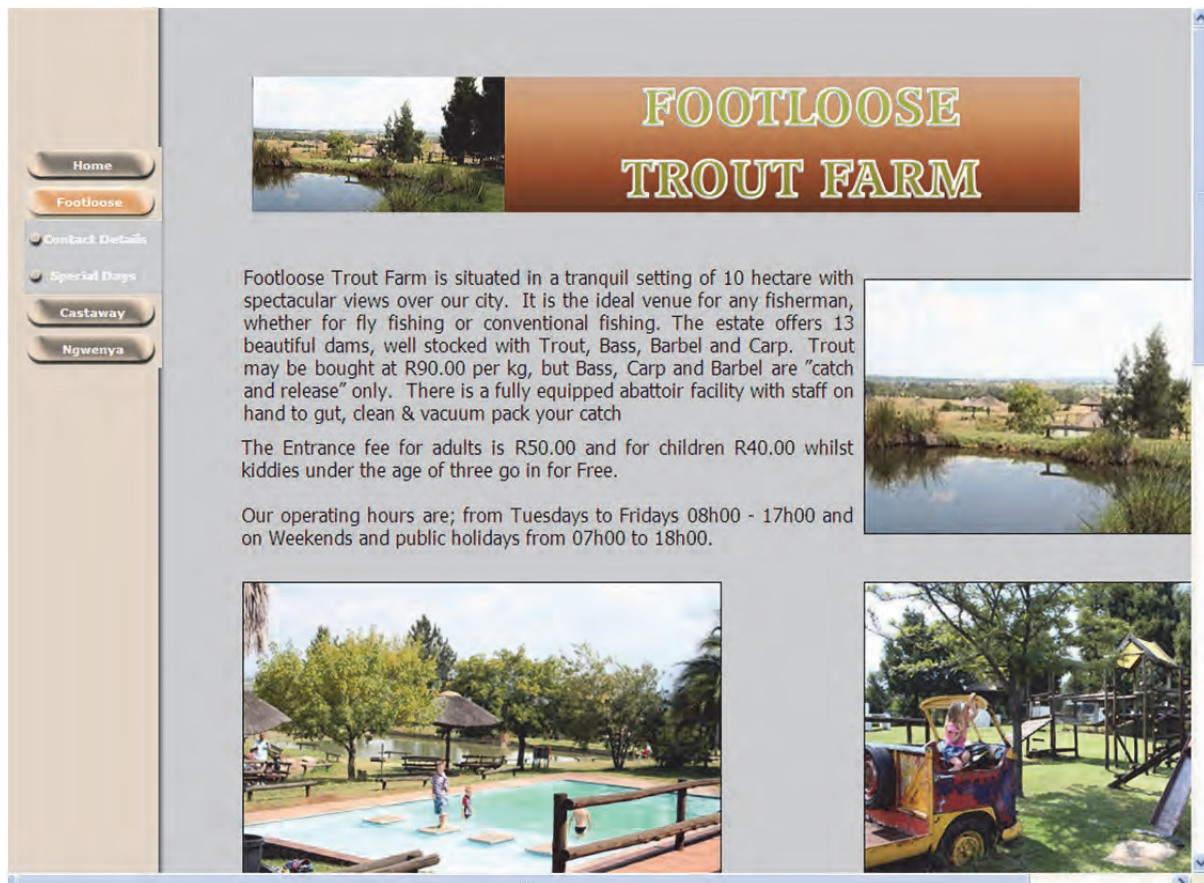


Figure 19 Footloose trout farm's webpage, exemplifying the range of recreational activities that are offered in association with recreational trout angling.

Tiger Fish Angling Charters

Tigerfish *Hydrocynus vittatus* are arguably one of Africa's most popular sport fishes. They are widespread in Africa, but in South Africa, they occur only in the warmer, low velt reaches of the Limpopo, Incomati and Phongolo River systems. The most famous tiger fishing destination in South Africa are the Jozini Dam and the lower Phongolo River (Figure 20). There are several fishing charters that cater for tourists. For example, Extreme Nature Tours, a guiding service, charges anglers for fishing trips. Their website http://www.extremenaturetours.co.za/Jozini_Dam/Jozini_Tiger_Fishing.htm also has links to various accommodation options including Lodges, houseboats and camping sites.



Figure 20 Tiger charter fishing lodge website

Syndicated Trout Lodge Properties

Much of the economic value associated with trout fishing lies in the value of syndicated property investments in which members own exclusive accommodation on managed trout fishing waters. Highlands Run Trout is an example of syndicated property based on the attraction of trout fishing. The development which has enhanced the local economy by attracting affluent investors and visitors, and restored the environment in a previously mined area (Figure 21).



Figure 21 Highlands Run Flyfishing Estate in the Mount Anderson private nature reserve, Mpumalanga.

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6. PRODUCTION POTENTIAL, STOCKING AND MANAGEMENT OF DAM FISHERIES FOR OPTIMAL SOCIO-ECONOMIC BENEFIT

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6.1 Introduction

In this chapter, the fishery production potential of South Africa's major dams is estimated using a GIS based morpho-edaphic model, and the stocking of alien fish species for fishery purposes is evaluated. A database of the suitability of South Africa's largest 425 dams for different fishery purposes is included as electronic appendix 1.

Inland fisheries in South Africa were founded upon the stocking of alien fish species for angling purposes by the British colonists, as the indigenous species were unfamiliar and were deemed to be inferior in terms of their attributes (see Chapter 2, History and Status of Inland Fisheries). A policy of state supported hatcheries to provide alien fish species for angling, and later aquaculture purposes, continued into the late 20th Century, only terminating when a growing awareness of biodiversity issues resulted in the nature conservation departments re-orienting their mission to conserving the indigenous fish fauna (McCafferty *et al.*, 2012).

A century of state-supported non-native fish stocking left a mixed legacy of environmental impacts and socio-economic benefits (Van Rensburg *et al.*, 2011, Ellender and Weyl, 2014). A number of non-native species, including carps, basses, trouts, tilapias and catfish were irreversibly established within aquatic ecosystems (DeMoor and Bruton 1988, Ellender and Weyl, 2014), and freshwater recreational angling developed into an economically significant activity with a high participation rate. The state hatcheries were also instrumental in the promotion of small-scale and commercial fisheries, and aquaculture, which yielded mixed results (see Chapter 2). As a result, a mixture of indigenous and non-native fish species now form the basis of fisheries on most inland waters, while trout are to date the only commercially successful freshwater aquaculture food fish.

The termination of state sponsored fish stocking in the mid-1980's left an inland fisheries policy vacuum in terms of how best to manage inland fisheries for optimal socio-economic benefit (Chapter 2). Current inland fish population management is biodiversity focussed, with an emphasis on conserving indigenous fish biodiversity and minimising the ecological impact of non-native species. In the absence a national inland fisheries policy and a supporting state institution, the management of inland fisheries to achieve socio-economic goals has fallen away in most provinces. Since 2009, it has however been accepted that inland fisheries fall within of the mandate of the Department of Agriculture, Forestry and Fisheries (DAFF), and that the benefits of the resource should be optimised to promote job creation, food security and rural livelihoods (DAFF, 2012). It is thus appropriate that the stocking and management of fish populations, both indigenous and non-native, for fishery purposes be re-evaluated based on the inclusion of socio-economic goals, within the framework of South Africa's environmental and biodiversity legislation. This is an important exercise both from an environmental policy and state institutional perspective as the constitution and the National Environmental Management Act (NEMA) promotes sustainable development with human wellbeing at the centre of environmental management.

At an institutional level, the provincial Departments of Agriculture are in a process of revitalising some of the state hatcheries, mainly for aquaculture purposes, but clear objectives and guidelines on their role in stocking dams are lacking. This presents a number of risks. Firstly, there is no point in stocking hatchery reared seed if the target fish populations are self-sustaining with adequate recruitment from natural spawning. Secondly, if the target fishery or aquaculture enterprise is not economically viable or delivers no food security or welfare benefit, then there is no point in stocking fish. Thirdly, if state sponsored stocking of fish is not founded on a scientifically based and stakeholder supported operational management plan,

overfishing may occur, and there are very real risks to biodiversity arising from the establishment of non-native species in new habitats, genetic hybridisation of related species, disease introduction, predation on and competition with native species and genetic introgression between native and non-native species or stocks (Ellender and Weyl, 2014).

6.2 The Rationale for Stocking Fish

Existing inland fisheries are based largely on alien or translocated species. The most important are trout (*Salmo trutta* and *Onchorhynchus mykiss*), black bass (*Micropterus salmoides*, *M. floridanus* and *M. dolomieu*) and carp (*Cyprinus carpio*) while indigenous fishes include tilapia (*Oreochromis mossambicus*), mudfish (*Labeo capensis*), moggel (*Labeo umbratus*) and catfish (*Clarias gariepinus*). Indigenous fish populations are also harvested where available (Weyl *et al.*, 2007, Ellender *et al.*, 2010). This report will thus only focus on four alien and five indigenous fishes that have the potential to be utilised for stock enhancement and drive fisheries development in South Africa.

In order to determine what fishes can be stocked into an impoundment it is important to consider why the stocking is required, the environment into which the species would be stocked, the regulations and policies that may be in place that determine the legality of the stocking procedure, the factors that affect a species' ability to survive and/or acclimatise and establish in an environment, and the overall risks associated with stocking procedures (Kohler and Stanley, 1984; Cowx, 1994; Welcomme, 2001). There is, however, a small distinction to be made between factors governing the suitability of a species for stocking and the *viability* of the stocking procedure i.e. what attributes of a species make it a good selection for stocking given prevailing social and economic contexts. The following section investigates the viability of stocking dams in South Africa by considering aspects of stocking, as outlined by Kohler and Stanley (1984), Cowx (1994) and Welcomme (2001), in addition to examining South African-specific factors which influence the identification of suitable species in the local context.

A key question to address is, why is the stocking required? Cowx (1998) outlines the motives behind stocking practices as follows:

- **Stocking for mitigation**, where fish are stocked into a water body as a form of compensation for activities such as dam building which may have disturbed the ecosystem;
- **Stock enhancement**, implemented, either temporarily or permanently, to maintain or improve stocks in a fishery and hence the productivity of that fishery.
- **Stocking to create new fisheries**, where new stocks are introduced into water bodies which the stock previously did not occupy or where non-native species are introduced into a fishery, commonly to improve productivity of a fishery which has a lack of suitable species (Cowx, 1994).
- **Improving the productivity of extant species**. An example is the introduction of fodder- or baitfish species to improve the quality of angling for predators, which has been commonly implemented in bass fisheries (Welcomme 2001).
- **Stocking for the restoration of native fish stocks** which have been reduced or eliminated in an area, a situation that is common in South Africa, is applicable to conserve natural ecosystems, but falls outside the scope of this report and is therefore not considered further.

South African inland fisheries are characterised by a well-developed, highly organised recreational angling sector and poorly developed commercial- and subsistence sectors (Weyl *et al.*, 2007; Leibold and van Zyl, 2008; Ellender *et al.*, 2009). The disparate level of development between the sectors has important implications for stocking activities. In developed countries, stocking strategies place emphasis on achieving ecological outcomes, especially the improvement of recreational fisheries, whereas the focus in developing countries is on achieving targets such as food security and poverty alleviation (Cowx, 1998).

The above scenario could be likened to the sectoral differences in South African inland fisheries i.e. developed recreational fisheries and underdeveloped commercial and subsistence fisheries, and the objectives for stocking will vary given these different contexts. In light of the motives for stocking highlighted by Cowx (1988) and Wellcome (2001), *stock enhancement* - to improve current resources in existing fisheries,

which is commonly implemented in put-and-take recreational trout fisheries (Hecht and Britz, 1990; Skelton, 2001) – and the *creation of new fisheries* for food security and livelihood support appear to be the most relevant objectives in the South African context.

Survival, Acclimation Potential and Establishment of Stocked Species

The environmental tolerance/preference limits of a species and the environmental conditions characterising an impoundment are of vital importance in identifying suitable species with which to conduct stocking – physicochemical parameters which fall outside of a species' tolerance range will ultimately preclude the ability of the species to acclimate to its new environment (Stanley and Kohler, 1984). However, as highlighted by Cowx (1998) and Welcomme (2001), certain inland fisheries rely on continual stocking for recruitment and are not dependent on the establishment, and subsequent reproduction of, a species for production. This is particularly true of recreational put-and-take trout fisheries in South Africa, where suitable habitat for reproduction is scarce and hence dams are continually stocked to maintain the fishery (Crass, 1986; Hecht and Britz, 1990; Skelton, 2001). In cases such as these, the objective of stocking is not the establishment of a breeding population, but simply that survival is ensured for a sufficient time period. Other species may have wider ecological tolerance limits and the ability to reproduce in a greater range of habitats, in which case the stocking of an impoundment may represent a temporary measure conducted only in order to establish a self-sustaining population.

Growth Potential

The production and yield of a fish population is influenced by, amongst other things, rates of growth. The selection of a species which has high growth potential will increase the yields derived from a fishery, especially important for associated socio-economic benefits in subsistence and commercial fishery sectors.

Market Price and Availability

From a socio-economic perspective, the availability of some form of market for a species should influence decisions regarding its stocking. Subsistence fishers and artisanal fishers are generally reliant on local markets for fresh fish, as the formal marketing of harvested fresh water fish in South Africa has proved non-viable. The palatability of a species may be important in determining market prices, and therefore species with a higher market price may represent more attractive stocking options for these sectors. From a recreational fishery perspective, where fish consumption is a secondary objective, or where catch and release is practised, the angling qualities of the fish will be the primary determinant of the choice of species to stock.

Selection of stocking environment, invasive capability, risks and biodiversity implications

Risks associated with stocking are summarised by Welcomme (2001) and include genetic effects, disequilibrium of a population of fish, and disease risks. Genetic consequences may include genetic introgression (swamping), where stocking of a species which is already established in an environment leads to the loss of original genetic characters in the host population. This is particularly relevant to translocations of indigenous fishes where stocking may result in, for example, changes in behaviour associated with breeding timing and location. Stocking may also lead to imbalances in a fish population where one or more target species are stocked, increasing the threat to non-target species as well as interfering with food chains. However, this is commonly used to skew fisheries towards high-value species. Lastly, stocking of fishes from aquaculture facilities always carries with it a risk of the spread of disease in the host population, a threat which can only be averted through increased precaution concerning the stocked species. It is therefore critical that species selected for stocking are not placed into an environment where they may have deleterious impacts in the system itself or in environments outside of the system into which they may be able to disperse (Kohler and Stanley, 1984).

In South Africa, documented impacts of introduced fishes on native ecosystems include the transfer of associated parasites (Bruton and van As, 1986), direct predation on indigenous fish (Cambray 2003) and ecosystem effects resulting from changing invertebrate community structure (Lowe *et al.*, 2008). In contrast, few studies have focused on the economic and social benefits of fisheries based on alien fishes. Those studies that do exist indicate that alien fishes contribute significantly to food security in rural areas (Ellender *et al.*, 2009; 2010) and that they provide economic opportunities through service provision

to recreational anglers (Leibold and Van Zyl 2008, McCafferty *et al.*, 2010). In order to utilise fisheries as a tool for rural economic development in South Africa, decisions will ultimately have to be based on trade-offs between socio-economic benefits, the risk of invasion, and ecological effects (Cowx, 1999).

6.3 Biodiversity considerations

6.3.1 South Africa's Approach to Managing Biodiversity

In 2009, the Department of Water and Environmental Affairs (DWEA) mandated the South African National Biodiversity Institute (SANBI) to use existing biodiversity information and expert knowledge to demarcate which species will be allowed in which areas of the country, as part of the National Environmental Management: Biodiversity Act (NEM:BA). SANBI, in turn, contracted the South African Institute for Aquatic Biodiversity (SAIAB) to facilitate the mapping phase for fishes based on expert opinion. These maps were produced with input from conservation authorities, organised angling bodies, the aquaculture industry and fisheries specialists. Although these areas are not included in the recently published NEM:BA Alien Species Regulations of 2014, the draft maps represent the best available knowledge on areas where introductions are likely to result in harm to native biodiversity. They are therefore included in this report as they will likely be included in provincial decision making processes on the use of fishes for stock enhancements.

It is therefore important to consider the invasive capability of a species before stocking. Traits that make fish suitable for stock enhancement e.g. fast growth, prolific reproduction and high levels of adaptability also confer a certain invasiveness to these fishes. With the exception of mullets, that are unable to reproduce in freshwater environments and native fishes stocked into impoundments within their natural distribution ranges, all fishes suitable for stock enhancement are invasive in South Africa (Table 15).

Table 15 Fish species considered suitable for stock enhancement in South Africa based on species characteristics, environment, potential use and NEMBA Alien and Invasive Species Regulations.

Species	Maximum Size Attained	Status	Limitations	Potential Uses	NEMBA Alien Species Regulations
<i>Oncorhynchus mykiss</i> Rainbow trout; <i>Salmo trutta</i> Brown trout	80 cm; 6 kg	Alien, common, stocked in impoundments	Narrow environmental tolerance limits narrow – stocking in higher altitude areas only. Requires continual stocking. Invasive in headwater streams.	High value recreational angling species.	a. The release of rainbow and brown trout into discrete catchment systems in which it does not occur, is prohibited. b. Rainbow and brown trout are exempted for a period of two years from the date upon which this notice takes effect, from applying for a Permit in terms of the Alien and Invasive Species Regulations, 2014, provided a person is in possession of a valid Provincial Permit issued in terms of Provincial legislation where required for rainbow trout. c. Catch and release of rainbow and brown trout is exempted in discrete catchment systems in which it occurs.
<i>Micropterus salmoides</i> Largemouth bass	70 cm; 6 kg	Alien, common	NEM:BA classification restricts stocking by area. Invasive due to wide ecological tolerance limits. Recreational utilisation focussed on large impoundments – limited development opportunities for small water bodies. Unfavourable growth in turbid waters.	High value recreational angling species.	a. The release of the listed bass species into discrete catchment systems in which it does not occur, is prohibited. b. The listed bass species may not be released in National Parks, Provincial Reserves, Mountain Catchment Areas and Forestry Reserves declared in terms of the Protected Areas Act. c. The listed bass species may not be released in any rivers or wetlands. d. The listed bass species may not be released in any dams in discrete catchment systems in which they occur, without a Permit. e. Each listed bass species is exempted for a period of two years from the date upon which this notice takes effect, from applying for a Permit in terms of the Alien and Invasive Species Regulations, 2014, provided a person is in possession of a valid Provincial Permit issued in terms of Provincial legislation where required for the specific listed bass species. f. Catch and release of the listed bass species is exempted in discrete catchment systems in which they occur.
<i>Oreochromis mossambicus</i> Mozambique tilapia	40 cm; 3 kg	Indigenous, common, has been translocated.	NEM:BA classification restricts stocking by area. Highly invasive species – well documented impacts	Angling, subsistence or commercial fishery	Native species, not listed but may not be introduced into systems where it has not been recorded as occurring.

Table 14 (Cont.) Fish species considered suitable for stock enhancement in South Africa based on species characteristics, environment, potential use and NEMBA Alien and Invasive Species Regulations.

Species	Maximum Size Attained	Status	Limitations	Potential Uses	NEMBA Alien Species Regulations
<i>Myxus capensis</i> Freshwater mullet; <i>Mugil cephalus</i> Flathead mullet	45 cm, 4 kg; 60 cm, 7 kg	Indigenous, stocked, rare.	Unpredictable recruitment of wild fry. No spawning in freshwater – stocking activities must be repeated.	Subsistence or commercial fishery.	Native species, not listed but may not be introduced into systems where it has not been recorded as occurring.
<i>Labeo umbratus</i> Moggel	45 cm; 2 kg	Indigenous, very common, has been translocated.	NEM:BA classification restricts stocking by area. Low market price.	Subsistence or commercial fishery	Native species, not listed but may not be introduced into systems where it has not been recorded as occurring.
<i>Cyprinus carpio</i> Common carp	100 cm; 40 kg	Alien, common, has been translocated.	NEM:BA classification restricts stocking by area. Highly invasive species. Low market price.	Recreational, subsistence or commercial fishery	The release of common carp into discrete catchment systems in which it does not occur, is prohibited. Common carp may not be released in National Parks, Provincial Reserves, Mountain Catchment Areas and Forestry Reserves declared in terms of the Protected Areas Act. Common carp may not be released in any rivers or wetlands. Common carp may not be released in dams without a Permit. Common carp are exempted for a period of two years from the date upon which this notice takes effect, from applying for a Permit in terms of the Alien and Invasive Species Regulations, 2014, provided a person is in possession of a valid Provincial Permit issued in terms of Provincial legislation where required for common carp. Catch and release of common carp is exempted in discrete catchment systems in which it occurs.
<i>Clarias gariepinus</i> Sharptooth catfish	140 cm; 30 kg	Indigenous, common, has been translocated	NEM:BA classification restricts stocking by area. Highly invasive species. Low market price.	Recreational, subsistence or commercial fishery.	Native species, not listed but may not be introduced into systems where it has not been recorded as occurring.
<i>Gilchristella aestuaria</i>	7 cm	Indigenous, common where stocked.	May require environmental impact assessment before stocking.	Fodder fish for use in recreational angling waters.	Native species, not listed but may not be introduced into systems where it has not been recorded as occurring.

6.3.2 Biodiversity legislation

The National Environmental Management: Biodiversity Act 2004 recognises the value that various alien fish play as a source of food security, sport, recreation, income from associated industry and other economic activities. The new NEMBA regulations set clear restrictions on the type of use permitted for each species and have clear categories of permitted and prohibited use for each species, depending on area. A summary is provided in Table 15.

Legislation governing fish stocking in South Africa

The most important piece of legislation governing the stocking of species into inland waters is the National Environmental Management: Biodiversity Act (NEM:BA). The act, gazetted in 2004, provides for the protection of native fish biodiversity and calls for interventions such as the removal of non-native fishes from areas of biodiversity concern (NEM:BA, 2004). In light of these consequences, NEM:BA has provided a framework for the management of non-native fish species by classifying them according to their potential impacts on biodiversity and their socio-economic uses.

6.4 Economic and Socio-economic Considerations for Fishery Development

Fisheries are human activity conducted for economic, food security, cultural and recreational purposes. In the absence of an inland fishery policy based on optimising human wellbeing, the management of inland fish stocks has been dominated by biodiversity considerations flowing from the environmental mandate of the responsible provincial environmental and conservation departments. Strategies for optimising the socio-economic benefits of fisheries have been largely overlooked, resulting in missed livelihood development opportunities, user conflicts and the perpetuation of Apartheid era inequalities. Such strategies include:

- Defining fishing rights
- Determining maximum sustainable yields for subsistence and artisanal fisheries
- Empowering communities to participate in co-management and value chains.
- Promoting angling tourism through managing stocks to provide trophy fish.

It is internationally recognised that the human dimension is central to ecosystem management, and the modern approach to fishery management is now termed the “ecosystem approach to fisheries’ (EAF). Management and governance approaches based on the EAF regard humans as an integral part of ecosystem function, incorporating the drivers of human behaviour such as economic incentives, culture, and livelihood development needs.

Thus, assessment of the potential of a fishery needs to include both an understanding of the biological dimension (the fish population characteristics and the level of sustainable harvest it can support) and the social dimension (the characteristics of the fishery users and their needs). Social and economic considerations include:

- Who and how many are the existing fishery users?
- What types of fishing are practiced?
- Are fishing rights clearly defined?
- Are fishing practices sustainable?
- Are fishing practices equitable?
- Are effective and stakeholder supported fishery management and governance protocols in place?
- How can disadvantaged groups be empowered to participate in fishery governance processes?
- What is the value of the fishery sub-sectors and how can they be enhanced?

6.5 GIS Model of Fishery Productivity in Major Dams and Assessment of Species for Stock Enhancement

An important component of the WRC “Baseline and scoping study on the development and sustainable utilisation of storage dams for inland fisheries and their contribution to rural livelihoods” was to assess and analyse existing information in order to develop a database to identify suitable dams and priority areas for fisheries development. Existing data sets on climate, geography, alien species legislation and access were combined with social and economic considerations to determine which of South Africa’s dams were most suitable for inland fisheries and to recommend what type of fishery would be most suitable (small-scale, commercial and recreational fisheries potential).

The data were used to evaluate the fisheries potential for 425 dams ranging in size from 0.01-368 km². Data for each dam are summarised in: **Electronic Appendix 1: Fisheries Potential of 425 South African Dams.xlsx**. All dams were considered to have some subsistence value, most had recreational potential, but only 29 dams in the country were likely to yield a sustained 100 t/yr which is necessary for the development of a small scale commercial fishery.

The GIS assessment was conducted in three phases (Figure 22):

- In Phase 1, regions of high fisheries potential were identified using the relationships between climate, geography and fish yield to predict areas of high fisheries potential.
- In Phase 2, these high fisheries potential areas were assessed in relation to maps developed during NEM:BA consultations, which reduced the potential area available for stocking due to biodiversity considerations.
- In Phase 3, the fishery potential of dams within high potential areas was assessed against factors including distributions of suitable fisheries species, public access, potential fish yield and distance to nearest settlement to prioritise and advise on the form of development in particular dams.

6.5.1. Phase 1: Regional assessment

Central to this analysis was the previous assessment of fisheries dependent and independent catch data which was used as a basis for weighting geographic (altitude, temperature, rainfall), morphometric (surface area, capacity, age) and edaphic (conductivity) variables that influence fish yield. This allowed for the use GIS methodologies to undertake a broad scale assessment of South Africa in order to predict regions where, based on good combinations of climatic and water chemistry (conductivity), fish abundance and fisheries productivity is expected to be high. The analysis was done on both a general level where indicators of overall fish abundance were based on environmental factors determined for combined species catches from gill net surveys described in McCafferty and Weyl (2012). South African water bodies include a variety of potential fisheries species, each with different environmental tolerances and environmental requirements. Therefore, to include all potential fisheries options, areas suitable for fisheries based on seven inland fisheries speciesgroups identified above were developed.

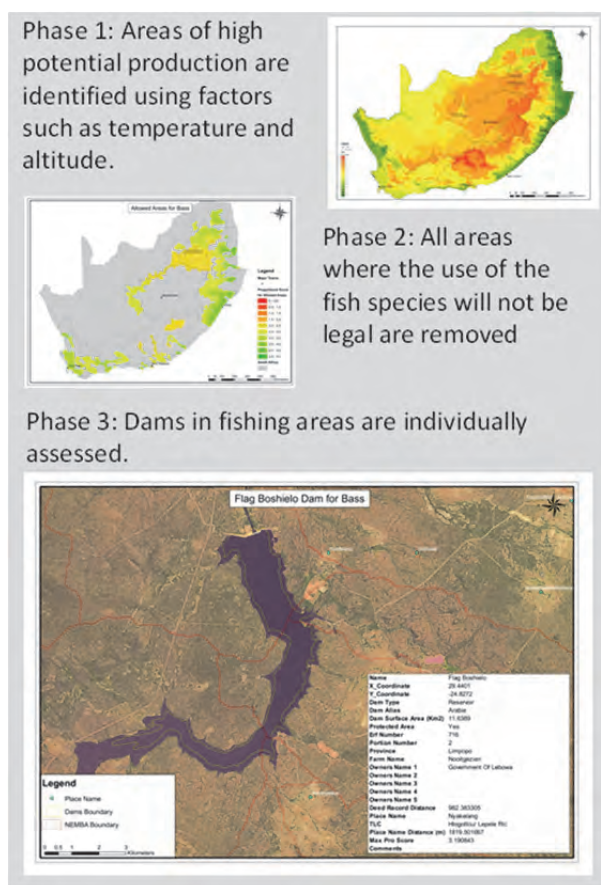


Figure 22 GIS methodology for identifying fishery production areas

Bass

The category bass includes the Centrarchid fishes; largemouth bass *Micropterus salmoides*, smallmouth bass *Micropterus dolomieu* and spotted bass *Micropterus punctulatus*. These are high value sportfish supporting major recreational angling industry primarily in still waters. Bass have a wide temperature tolerance – from below 10° - 32° C and are able to form self-sustaining populations, negating the need for continued stocking. The main use is for recreational fisheries and it supports a very important recreational fishery with an estimated 2000 participants. It is an easily targeted fish and informal subsistence fisheries are likely to occur in dams where there is community access. Centrarchids are unlikely to support commercial fisheries.

Carp

All forms of common carp *Cyprinus carpio*. This alien species is present in all major river catchments but generally prefer large, well-vegetated, standing water bodies with soft sediments. Carp are tolerant of a wide range of environmental conditions and highly regarded in South Africa as a premier angling species by bank anglers. Carp are also important in subsistence fisheries and commercially harvested in the Free State.

Catfish (*Clarias gariepinus*)

Native but often translocated African sharptooth catfish *Clarias gariepinus*. This species can establish in almost any habitat but favours large rivers and dams as well as floodplains. It is widely distributed throughout South Africa, particularly via inter-basin transfers, escape from aquaculture facilities and introductions by fisherman; introduced to the Eastern and Western Cape. It is an important angling species and is harvested by subsistence anglers. There is some interest to develop commercial fisheries for this species in the Eastern and Western Cape.

Native Cyprinids

The group native cyprinids comprises various native Labeo's (e.g. *Labeo capensis* and *Labeo umbratus*) and yellowfishes (e.g. *Labeobarbus aeneus*, *Labeobarbus marequensis*). Cyprinids dominate the fish faunas of many South African impoundments and are tolerant of a wide range of water qualities and water temperatures. Depending on species, native cyprinids such as the yellowfishes can be important for recreational fisheries or for subsistence and commercial fisheries. Labeo's for example are the focus of rural fisheries projects in small water bodies in the Eastern Cape in attempts to establish small-scale fisheries.

Trout

The two alien trout species, rainbow trout *Oncorhynchus mykiss* and brown trout *Salmo trutta*, are well established and are traditionally important recreational fishery species with associated value chains providing income generation and job creation. Recreational fisheries on dams typically rely on continual stock enhancement due to lack of suitable habitat and environmental conditions for reproduction. Most trout waters are privately controlled or access is administered through clubs or conservation authorities. Subsistence and commercial use is therefore negligible. They are included here because in some public waters located in high altitude areas they could be used to develop fisheries.

Box 6.1: Factors Influencing Fisheries Productivity

Conductivity – Conductivity is a commonly used positive correlate of productivity. Regional estimates of conductivity were used by averaging conductivities for impoundments within a catchment where these data were available.

Altitude – Elevation above sea level was identified during modelling of bass angling catch data as an important factor influencing catch rates. Low altitude was associated with higher catch rates and high angling quality with a decrease with increasing altitude. Also an important factor for trout fisheries; high altitude areas are more suitable for these fisheries than low altitude areas.

Rainfall – Precipitation (mm). Identified during modelling of bank angling catch data (carp angling) as an influential factor – higher catches were recorded in low rainfall areas for bank angling species.

Air temperature – Temperature (°C) is important for productivity and was shown to influence gillnet catches of native cyprinids and catfishes.

Tilapia

Native *Oreochromis mossambicus* are valuable subsistence and table fishes. They prefer standing waters but occur in most environments with the exception of the most fast-flowing rivers. In South Africa Mozambique tilapia are native to east coastal rivers from the Limpopo River in the north to the Bushman's River in the Eastern Cape. They have been translocated widely into inland waters outside of their natural range for aquaculture and for angling. They are currently a valued angling species and an important subsistence fishing species targeted by fishers where it occurs. This species has high commercial fisheries potential in suitable areas.

Regional assessment

In the assessment of potential fisheries productivity above, it was found that the factors conductivity, altitude, rainfall and temperature were most influential (Box 6.1). To develop the GIS models, a spatial score was calculated for each fish species group according to the average score from five abiotic factors: Conductivity, Altitude, mean annual Rainfall, mean annual air Temperature and the coldest months mean air Temperature using relationships developed in the GIS analysis above. For analysis these spatial scores were then weighted on a 1-5 scale (Table 16) to allow for individual species weightings. These weightings were then spatially analysed using the following 6-step process:

1. Altitude, mean annual rainfall, mean annual air temperature and the coldest month mean air temperature (July) was obtained in raster data format from the South African Atlas for Climatology and Argo hydrology (Schulze 2007). Conductivity data for catchment area was obtained from an average of conductivity values for dams in each catchment from the DWA database. The raster data set values were stored as floating points; therefore a conversion into integer value was performed using the ArcGIS "Int" tool found within the Spatial Analyst Tool Set. Once all data values were converted into integers, the raster was then converted into vector data using the "Raster to Polygon" tool from the Conversion Tool Set.
2. Each vector data set was assigned a field "Group" and "Score". Each abiotic factor was grouped according to five groups (please see Table 16). A group value was given to each polygon using the "Field Calculator" so that a dissolve could be performed.
3. Once groupings were given to each of the abiotic factors, a "Dissolve" was performed using the "Data Management/Generalization" tool. "Create multipart feature" was deselected so that individual features are kept independent and an "Intersect" can be performed.
4. Scores were then assigned to each grouping within each abiotic factor for each fish group using the "Field Calculator" according to Table 16 values. The score values were supplied by SAIAB and are based on their knowledge and understanding of the fish groups.
5. An "Intersect" was performed to produce a single file called "Scores". This was done to group all the abiotic factors within the same spatial reference. A new field (with a floating data type called "score_total") was created and the average score for all the abiotic factors were calculated. This was repeated for each fish group.
6. The data was then plotted for South Africa to represent the "score_total" in order to show areas that are suitable for inland fisheries according to their given abiotic scores and fish groups. All data is in the D_Cape Datum with the following variables:
 - a. Angular Unit: Degree (0.017453292519943299)
 - b. Prime Meridian: Greenwich (0.000000000000000000)
 - c. Datum: D_Cape
 - d. Spheroid: Clarke_1880_Arc
 - e. Semi major Axis: 6378249.144999999600000000
 - f. Semi minor Axis: 6356514.966395494500000000
 - g. Inverse Flattening: 293.466307656000030000

Table 16 Scoring Matrix used to Evaluate the Potential Productivity of Fish Groups based on Abiotic Factor Values.

Abiotic Factors/ Values	Fish Groups						
Conductivity	Bass	Carp	Catfish	General	Native Cyprinids	Trout	Tilapia
0-150	5	5	5	1	1	5	1
150-300	4	4	4	2	2	4	2
300-450	3	3	3	3	3	3	3
450-600	2	2	2	4	4	2	4
600-750	1	1	1	5	5	1	5
Altitude	Bass	Carp	Catfish	General	Native Cyprinids	Trout	Tilapia
1-400	5	5	5	5	5	1	5
401-800	4	5	5	5	5	1	4
801-1200	3	5	4	3	5	3	3
1201-1600	2	4	2	1	2	4	2
1601-2000	1	3	1	1	1	5	1
Mean Annual Rainfall	Bass	Carp	Catfish	General	Native Cyprinids	Trout	Tilapia
0-400	3	5	3	3	3	3	3
400-800	3	4	3	3	3	3	3
800-1200	3	3	3	3	3	3	3
1200-1600	3	2	3	3	3	3	3
>1600	3	1	3	3	3	3	3
Mean Annual Air Temperature	Bass	Carp	Catfish	General	Native Cyprinids	Trout	Tilapia
0-10	1	1	1	1	1	5	1
10-14	2	2	2	2	2	4	1
14-18	3	3	3	3	3	3	1
18-22	4	4	4	4	4	2	3
>22	5	5	5	5	5	1	5
0-8	1	1	1	1	1	5	1
8-12	1	1	1	1	2	4	1
12-16	3	3	3	3	3	1	2
16-20	4	4	4	4	4	1	3
>20	5	5	5	5	5	1	5

6.5.2 Phase 2: Integrating national legislation on alien fishes

Many areas of South Africa lack native species that grow large enough or fast enough for fisheries to be based on them. The use of alien species in fisheries development is therefore inevitable. However, South Africa has strong legislation pertaining to the permitted use of alien fishes and it is likely that most will soon be controlled by area. For this reason fisheries development will be constrained by regulations in the National Environmental Management: Biodiversity Act (NEM:BA). Fortunately the proposed NEM:BA fish distribution maps which were developed by SAIAB through expert consultations in 2009 were available as a GIS layer. These maps currently represent the best state of knowledge on distributions and areas of potential impact of alien fishes. Mapping fisheries according to the proposed NEM:BA areas was therefore the first level of fishery suitability assessment. In this process all areas where a fish species is likely to cause harm or is likely to be regulated as requiring comprehensive risk assessment or areas of exclusion were removed from the assessment framework and only dams in “allowed areas” were considered in the

analysis. There was a complication for trout in Natal because the provincial nature conservation authority insisted on developing its own regulations. As a result the current NEMBA based analysis excludes “trout” from the assessment.

6.5.3 Phase 3: Individual assessment of dams

Decisions on fisheries development will have to be made on a dam-to-dam basis. As a result, dams in regions assessed as being suitable for fisheries development were individually assessed. This was done following the framework developed by Weyl *et al.* (2007) using criteria of access, suitability for fisheries species, size and potential yield, distance from settlement and importance to organised recreational angling to develop a list of priority dams for each Province. Data sources for this analysis were:

- Deeds Records – WFW DWAF (Working for Water, Department of Water Affairs and Forestry)
- Place Names – WFW DWAF (Working for Water, Department of Water Affairs and Forestry)
- Dam records – WFW DWAF (Working for Water, Department of Water Affairs and Forestry)
- Imagery – CD NGI (Chief Directorate National Geo-Spatial Information)

Access

Public access availability to dams was used as an assessment criterion. This was done by querying whether the dam was surrounded by a protected area and the ownership of the land bordering the dam. Dams where access was limited because the shoreline was privately owned were excluded from the dataset. Dams where the access was de facto state owned e.g. municipal, customary or protected areas were included in the analysis.

Suitable fish species

Dams were scored for whether they were in areas where potential commercial fisheries species (tilapia, catfish, native cyprinids and carp) were allowed, or were likely to occur, or whether they were suitable for trout and bass (which are unlikely to support commercial fisheries but are likely drivers for recreational fisheries).

Size and potential yield

Surface area (ha) of impoundments may be a constraint in the development of fisheries. For example large impoundments are required for bass fisheries because bass-anglers prefer to fish large dams using boats. In addition, dams smaller than 1000 ha are unlikely to support commercial fisheries because their potential yields are simply too low to be commercially viable. Area based productivity was thus built into the assessment framework by calculating an optimistic yield for each water body. An optimistic yield was taken as 75 kg per ha per year. This value that was derived by using an average of fish production calculated using morpho-edaphic models on North West Province dams (Weyl *et al.*, 2007). We use the term “optimistic yield” because the value is based on a model as there are no data available on fish yields in South African dams.

Existing recreational interests

Interests of recreational anglers for dams in South Africa were evaluated during the NEM:BA mapping process conducted by SAIAB. Developing commercial fisheries in dams considered of high importance to organised recreational angling is likely to result in conflict. The potential use for each priority dam is therefore evaluated in this context. It should also be noted that because of the high economic value of recreational fisheries, this potential should be explored before engaging in the development of commercial fisheries.

6.5.4 Results

6.5.4.1 Phase 1: Regional analysis

The GIS generated map using the general fish model is shown in Figure 23. Because fisheries species are generally warm water fishes the highest scores were attained in warm and low-lying areas that had medium to high rainfall. Individual species maps are shown in Figures 24. With the exception of trout which require cooler high altitude areas, the models predicted highest fisheries potential in warm low lying areas. Limpopo Province and low lying areas of Mpumalanga, Kwa Zulu Natal, Eastern Cape and Western Cape

consistently produced the highest integrated scores for fish production. These regional scores are useful for planning regional fisheries development interventions such as the stocking of small (<5 ha) rural dams with fish to provide opportunities for subsistence fishing. If such interventions are planned in the future, then these should be focussed on low altitude areas of Mpumalanga, Kwa Zulu Natal, Eastern Cape and the Western Cape.

Care should however be taken to understand the limitations of broad scale analyses. For example, the Northern Cape while having a good overall score based on climate and altitude is unlikely to have sufficient water for fisheries production on a wider scale. It must also be considered that areas which are categorised as less productive, such as the central highveld which contains some of the country's largest dams, may still be areas where productive fisheries could be developed. The models just indicate that production per hectare on such dams is likely to be lower than in those located in more suitable areas. Alternatively, some dams are in areas of high conservation importance and fisheries development in such areas may be less than desirable. In the Western Cape for example, the Cape Floristic Region is an area of high conservation priority and fisheries development may not be feasible in many areas. For this reason, the results of the this regional analysis should only be used as an initial synopsis of fisheries potential and must be accompanied by finer scale analysis on a dam by dam basis.

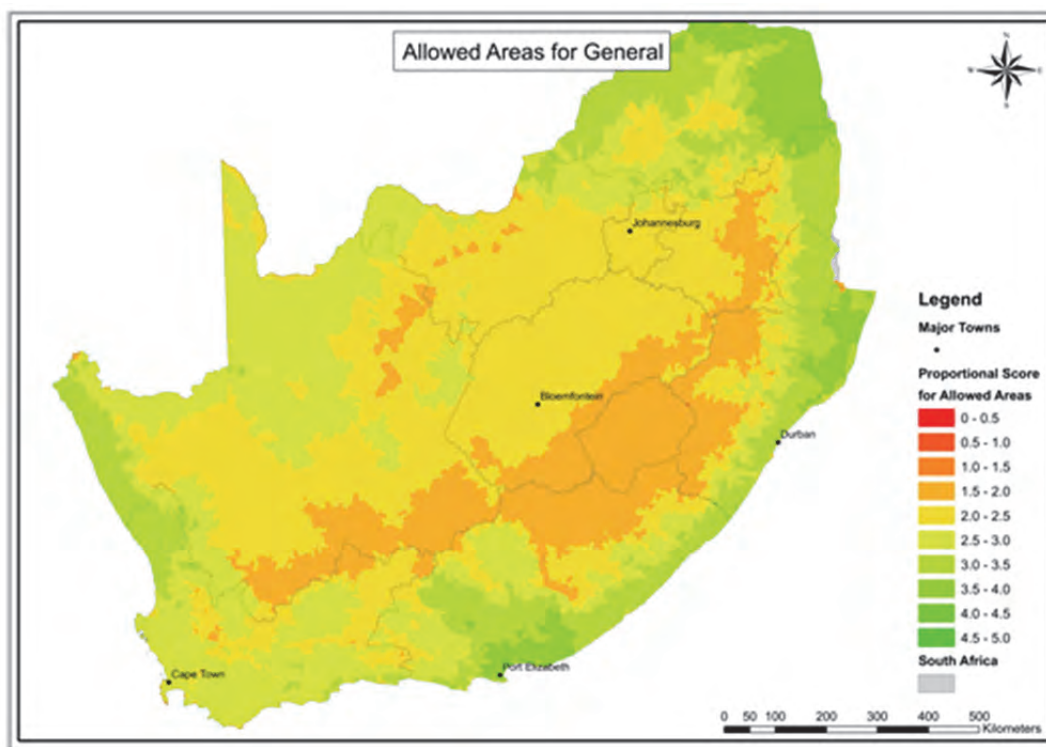
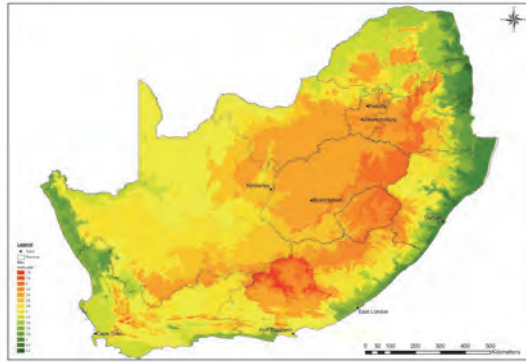


Figure 23 Generalised warm-water fishes area. The more suitable the area is for fish production the higher the score (green) and lower the score (red) areas are less suitable for fisheries development.

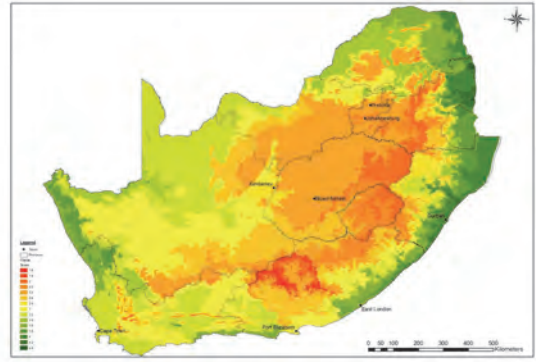
6.5.4.2 Phase 2: Integrating the NEMBA

Clipping of areas according to NEMBA regulations reduced suitable areas for fisheries of alien species considerably (Figure 25). However, this step was necessary because fisheries development needs to take place within the national legislative framework. In the current analysis a precautionary approach was adopted and all areas requiring "Risk Assessment" were also excluded from the analysis. Final areas for fisheries suitability will however require the integration of the finalised NEMBA alien species regulations.

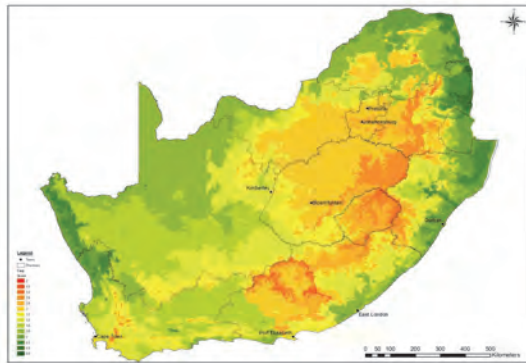
(A) Bass



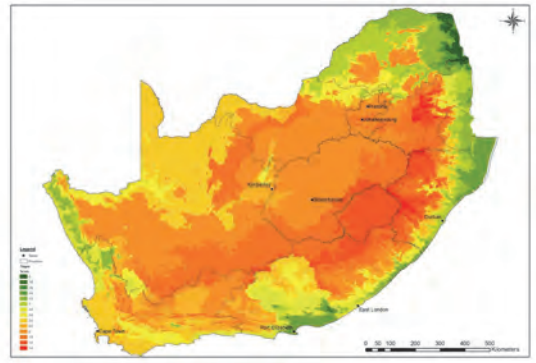
(D) Catfish



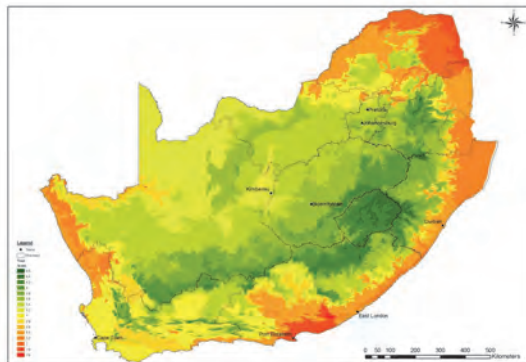
(B) Carp



(E) Tilapia



(C) Trout



(F) Native Cyprinids

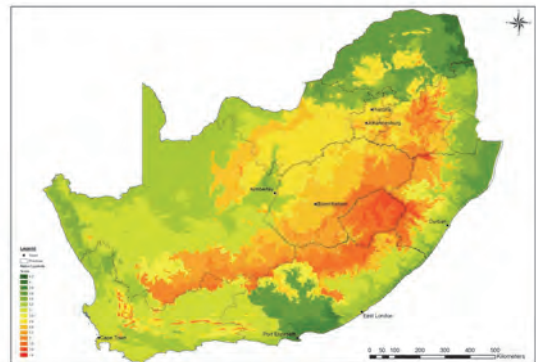
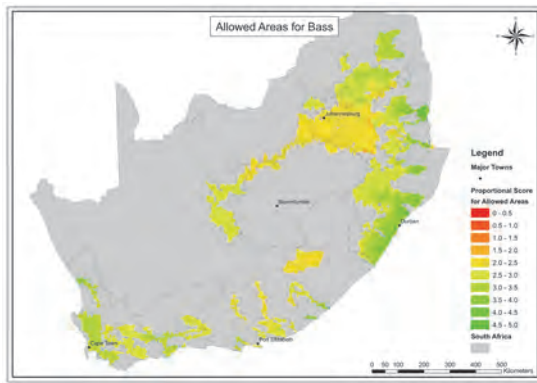
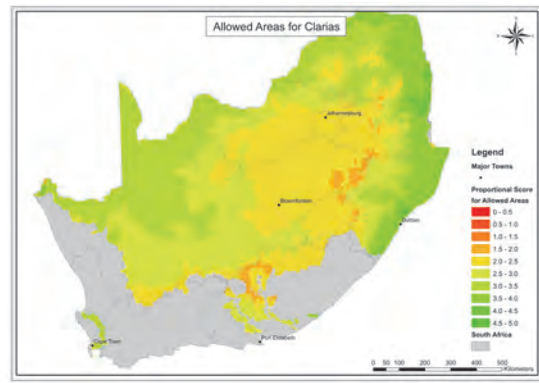


Figure 24 Results of GIS analysis modelling environmental suitability of areas for six potential fisheries species groups. The suitability index is graded by colour from green (most suitable) to yellow (marginal) to red (unsuitable). (A) bass, (B) carp, (C) trout, (D) catfish, (E) tilapia and (F) native cyprinids. Suitability analyses were based on environmental factors: conductivity, altitude, mean annual rainfall, mean annual air temperature and the coldest months mean air temperature.

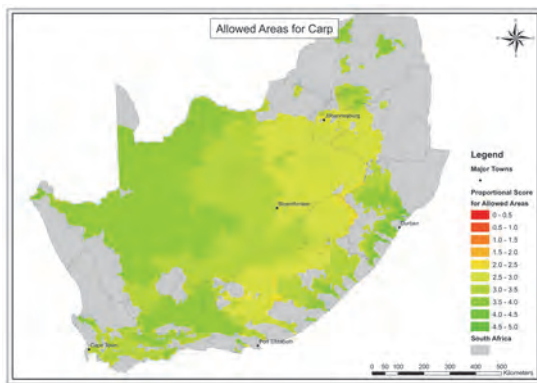
(A) Bass



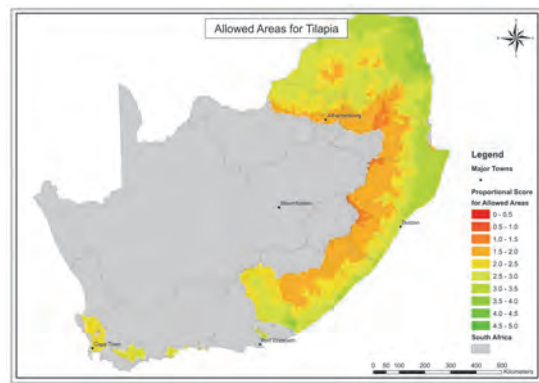
(D) Catfish



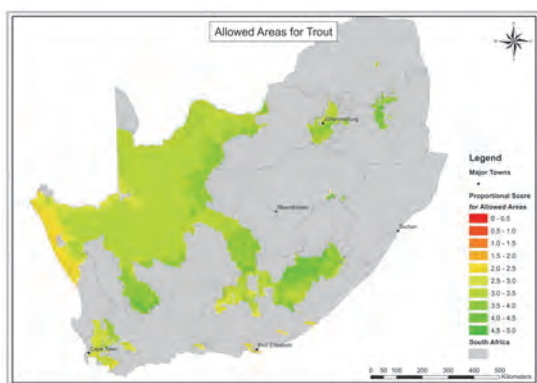
(B) Carp



(E) Tilapia



(C) Trout



(F) Native Cyprinids

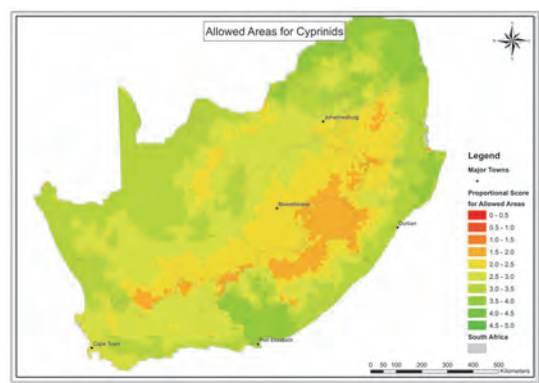


Figure 25 Results of GIS analysis modelling suitability of areas for six potential fisheries species groups overlaid with the maps developed in the 2009 version of the NEM:BA Alien Species Regulations. The suitability index is graded by colour from green (most suitable) to yellow (marginal) to red (unsuitable). (A) bass, (B) carp, (C) trout, (D) catfish, (E) tilapia and (F) native cyprinids.

6.5.4.3 Phase 3 – Dams Assessment

Data were available to evaluate the fisheries potential for 425 dams ranging in size from 0.01-368 km². Data for each dam are summarised in **Electronic Appendix 1: Fisheries Potential of 425 South African Dams.xlsx**

Access

Ownership Dams were assessed according to access by querying whether it was surrounded by protected area and the ownership of the land bordering the dam. There was some evidence of public access (municipal or government ownership) for 261 dams.

Suitable fish species

In total 425 dams were evaluated. Of these 156 were in the bass zone, 226 in carp zones, 297 in the Catfish zone, 196 in the tilapia zone and 82 in the trout zone (Table 17).

Species Group	Dams
General	425
Bass	156
Carp	226
Catfish	297
Cyprinids	425
Tilapia	196
Trout	82

Table 17 Number of dams assessed per species category

Size and potential yield

Surface area and potential yield for the assessed dams is summarised in Table 18. Only 52 of the 425 assessed dams are large enough to yield more than 100t of fish per year. Most of these would optimistically produce less than 400t per year and any commercial fishery would be small scale. Larger scale commercial fisheries with a potential production of >400t are only potentially viable on 29 dams in the country.

Size (Km2)	Number	Yield (t/y)
0-1	210	<10
2-10	165	10-100
11-50	43	100-400
51-100	4	400-750
101-200	2	750-1500
201-368	3	1500-3000

Table 18 Summary of dam size of the 425 assessed dams

Recreational potential

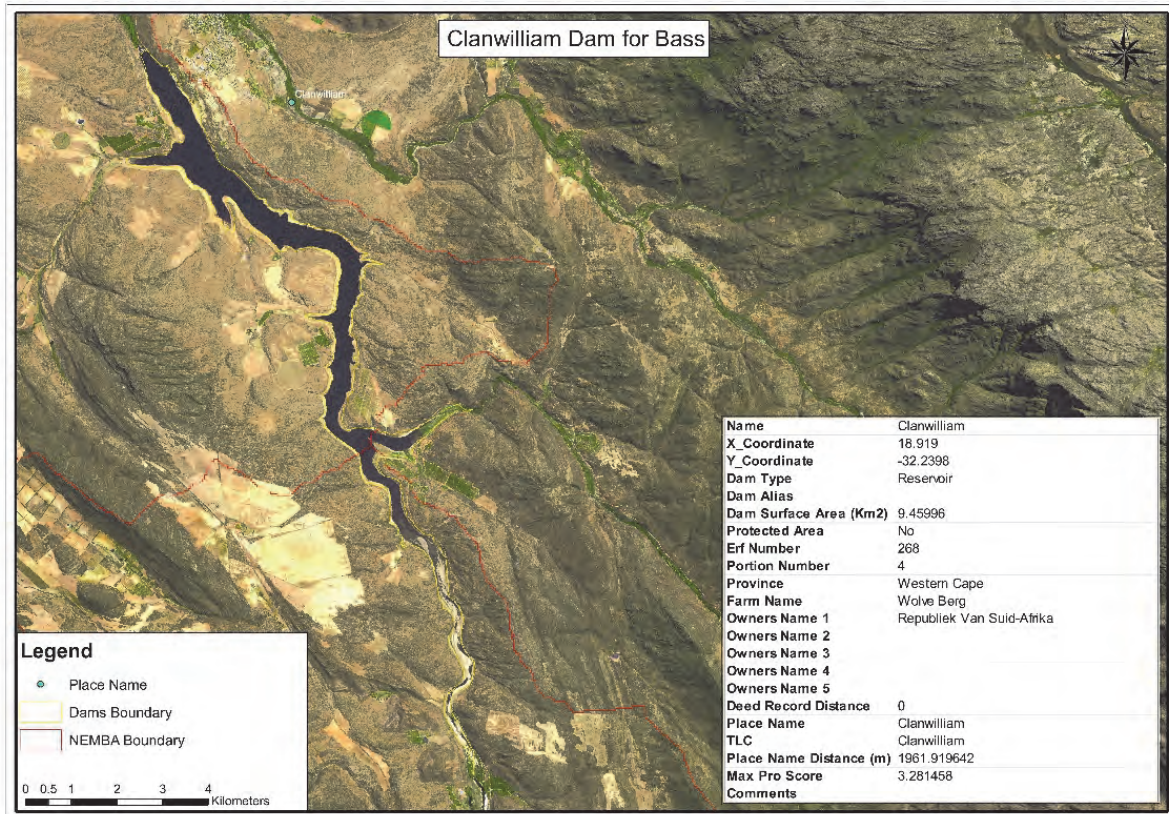
Recreational potential was estimated from whether the dam had a protected area on its boundary or if it was considered of recreational value by organised angling representatives. A total of 179 Dams had some recreational value.

6.5.4.4 Overall Assessment

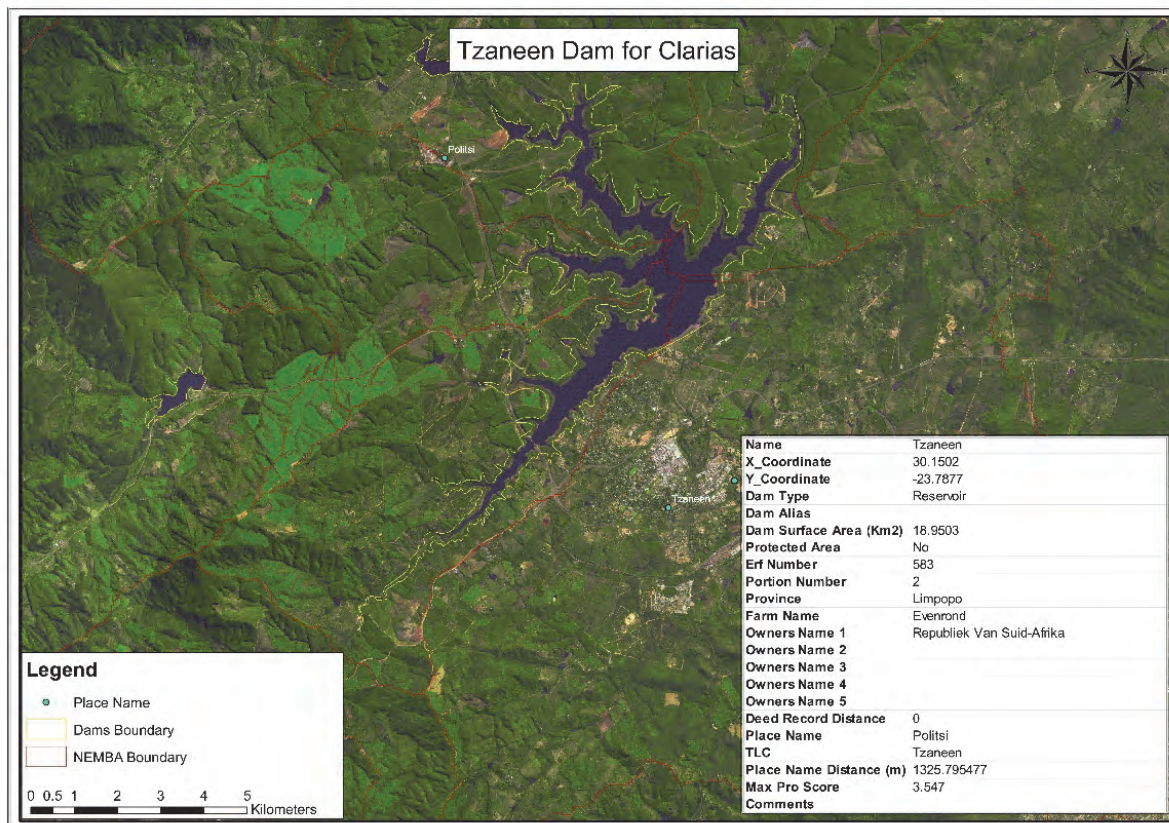
All 425 dams evaluated were considered to have some subsistence fishing value, and many had recreational potential. The development of commercial fisheries is however only deemed feasible on the relatively few large dams in the country. The assessment identified 29 large dams with production greater than 400t/y possibly suitable for commercial fishery development, and a further 22 with production potential greater than 100t/y possibly suitable for small scale fishery development.

To provide an example of the information available in the GIS fishery suitability analysis, the statistics for four dams are provided in Table 19, with the map outputs for each dam in Figures 26 and 27 (data for all dams are available in **Electronic Appendix 1: Fisheries Potential of 425 South African Dams.xlsx**). These data can now be used as an initial suitability analysis for each dam. For example:

- Clanwilliam Dam (Figure 26A) in the Western Cape is highly regarded by bass anglers as one of the premier waters for bass angling with national and international fishing tournaments held on it. The dam is long and narrow and has a surface area of 9.4 km². While the dam is productive for bass it is in a sensitive zone and additional species will not be permitted. In addition, a fishery on the dam is unlikely to yield 100 t/yr⁻¹ and therefore the recommended fisheries activity for this dam is recreational bass fishing. Because the dam is within 2 km of a town (Clanwilliam) subsistence angling is also likely to take place.
- Tzaneen Dam (Figure 26B) is also of high importance to bass angling. However, this dam is located in the warm Limpopo Province and is likely to contain significant stocks of tilapia and catfish (*Clarias gariepinus*). The dam is also large enough to potentially support a small scale commercial fishery that would optimistically yield in the region of 140t/yr⁻¹. In terms of development this potential would need to be weighed up against the economic benefits of the recreational fishery which is already active on the dam. In this case, although potentially feasible, small-scale commercial fishery development should proceed with caution.
- Bloemhof Dam (Figure 27A), in the Free State, is another example of a dam that is of importance to recreational bank anglers. However, this dam could potentially yield in excess of 1000t/yr⁻¹ and for that reason a commercial fishery could be developed. On this dam that is already the case and this fishery operates under strict area limitation as the shoreline of the dam includes nature reserve and the dam is an important recreational angling venue (Weyl *et al.*, 2010). Any development should therefore take into account the potential impacts on the local tourist economy.
- Darlington Dam (Figure 27B) in the Eastern Cape is an interesting case. Although suitable for small-scale commercial fisheries development the dam is 32 km from the nearest settlement, surrounded by nature reserve and falls under the jurisdiction of SANParks. For these reasons small-scale fisheries development is problematic, and the recreational value should be exploited fully.

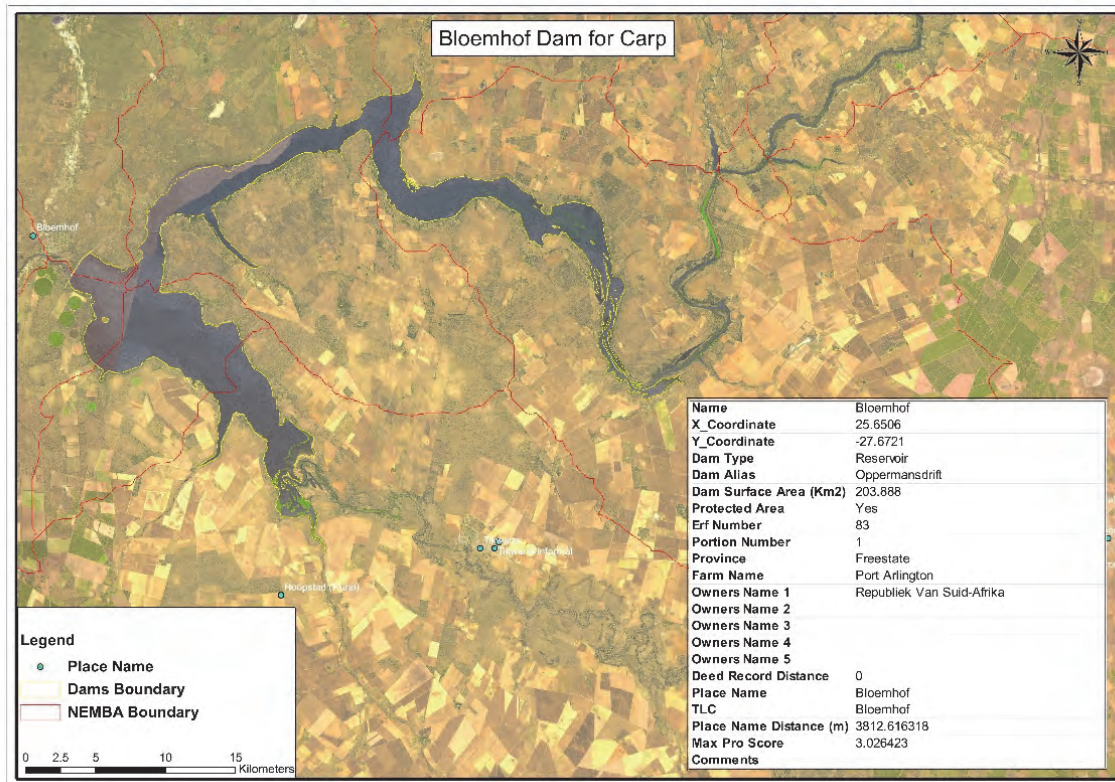


A

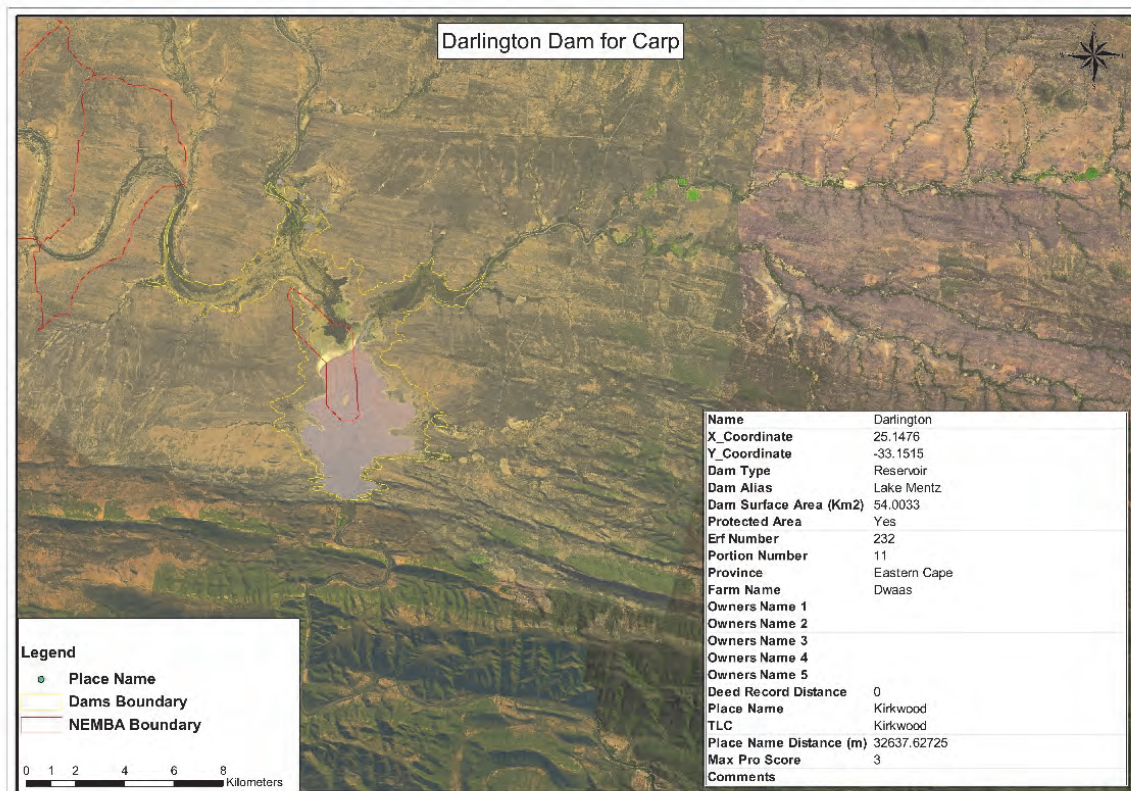


B

Figure 26 Clanwilliam dam (A) and Tzaneen dam (B) are both important recreational bass angling dams. Fisheries development in these dams will have to weigh up the potential benefits of developing small scale fisheries against potential tourism losses.



A



B

Figure 27 Bloemhof Dam (top) and Darlington dam (bottom) are both important recreational carp angling dams. Bloemhof Dam has high potential for commercial fisheries development but development would have to weigh up the potential benefits of developing commercial fisheries against potential tourism impacts. Darlington dam, although suitable for small scale commercial fisheries development is surrounded by the Addo Elephant National Park and is 32 km from the nearest town. It is therefore not a suitable venue for fisheries development.

Table 19 Extracted information from the Dams database for four large dams in South Africa.

Province		Western Cape	Limpopo	Free State	Eastern Cape
Dam Name		Clanwilliam	Tzaneen	Bloemhof	Darlington
Locality data	X_Coord	18.919	30.1502	25.6506	25.1476
	Y_Coord	-32.2398	-23.7877	-27.6721	-33.1515
	Area Km ²	9.46	18.9	203.9	54.0
	Area ha	946	1895.03	20388.8	5400.33
	Protected Area	No	No	Yes	Yes
	Place Name	Clanwilliam	Politsi	Bloemhof	Kirkwood
	Owner Name 1	RSA	RSA	RSA	SAN-Parks
	Local Council	Clanwilliam	Tzaneen	Bloemhof	Kirkwood
	ACCESS	Yes	Yes	Yes	No
	Settlement distance	2.0	1.3	3.8	32.6
Species suitability scores (5= best)	Bass	3.3	3.3	2.4	2.6
	Carp	0	0	3.3	3
	Catfish	0	3.5	2.4	2.6
	Cyprinids	3.1	3.6	2.6	3.6
	Tilapia	0	3.1	0	0
	Trout	0	0	0	0
	General	2.9	3.5	2.2	3.4
Commercial fishery suitability	Suitability Index (suitable species x mean score)	6.4	13.6	10.4	11.8
	Optimistic yield (tons/ha/ annum)	71.9	144.0	1549.5	410.4
	Productivity Rank	53/425	22/425	4/425	9/425
	Commercial Fishery Suitability	No	Small	Large	Small scale
Recreational anglers scoring of importance and comment	SABAA	High	High	None	None
	FOSAF	No	No	No	No
	SAFBAF	No	No	High	High
	Comments from all Angling Associations	Premier smallmouth bass water in WC. Used extensively by all levels of bass angling.	Well known as bass fishing venue and used extensively at all levels in sport. Popular destination.		Many carp present. Part of Addo Elephant Park. Used by boat and bank anglers for competitions.
Overall development suitability	Recreational	Yes	Yes	Yes	Yes
	Subsistence	Yes	Yes	Yes	Yes
	Commercial	No	Yes	Yes	Yes

6.5.6 Discussion and Conclusions

The GIS analysis presented in this report is a first step towards a prioritisation of areas and dams where fisheries development is most likely to succeed. On a regional scale the warmer provinces (Limpopo, Mpumalanga) and low lying coastal provinces (Eastern Cape and Western Cape) are likely to have the most productive dams. These provinces should be prioritised in terms of regional development of

subsistence fisheries in small dams (<10ha). While such small dams can contribute towards food security in rural communities they are unlikely to be of interest to recreational anglers and are too small to produce sufficient fish for commercial fisheries.

Specific high potential dams for fisheries development are listed by province in Table 20. These dams were chosen using a variety of factors to gain an understanding of the potential that each of the dams has for fisheries development.

In addition, a database ranking the fisheries potential of South Africa's 425 major dams was developed using the spatial data (**Electronic Appendix 1: Fisheries Potential of 425 South African Dams.xls**). What is evident is that, if all factors are considered then the development of commercial scale fisheries is only feasible in relatively few dams in the country. In total 29 dams with production potential >400t were identified as potential starting points for commercial fisheries development (Table 20). These dams are not high use recreational venues. At most the combined fish production from these dams is likely to be in the region of 12,500 t/yr. A further 22 dams with annual production >100t/yr were identified which could potentially support small-scale fisheries.

Table 20 Dams with commercial fisheries potential listing locality, size, species suitability, potential use and productivity.

PROV – province, EC – Eastern Cape, FS – Free State, KZN KwaZulu-Natal, LIM – Limpopo, MPU – Mpumalanga, NW – Northwest, WP – Western Cape, BA – Bass, CA – carp, CL – catfish, TI – Tilapia, TR – Trout, G – General, REC – recreational, SUB – subsistence, Com – commercial.

Prov	Dam		Nearest Settlement		Species Suitability Score						Potential Use And Production (Tons/Year)		
	Name	Size (Km ²)	Name	Dist (Km)	BA	CA	CL	TI	TR	G			
EC	Beervlei*	19.3	Willowmore (Rural)	20		4				3		SUB	COM (<400 t/yr)
EC	Binfield	2.4	Mazotshweni	0				2		3	REC	SUB	
EC	Bridle Drift	5.8	Blue Rock	1	4	4	4	3	2	3	REC	SUB	
EC	Gariep	368.4	Gariep Dam	1		3	3			2	REC	SUB	COM (>400t/yr)
EC	Grassridge	13.2	Hofmeyer (Rural)	28	2	3	2	3	4	3	REC	SUB	COM (<400 t/yr)
EC	Groendal	0.4	Tirryville	10						3	REC		
EC	Gubu	1.0	Mont Thomas	3					4	2	REC		
EC	Howisons Poort	0.2	Grahamstown	8						4	REC	SUB	
EC	Impofu	6.8	Oyster Bay	9	4	4				3	REC	SUB	
EC	Jameson	0.2	Grahamstown	7	2				2	3	REC		
EC	Kommandodrift	8.5	Tarka (Rural)	15		3		3		3	REC	SUB	
EC	Kouga	7.0	Hankey (Rural)	19						3	REC	SUB	
EC	Krom River	2.5	Humansdorp (Rural)	9						3	REC	SUB	
EC	Laing	2.0	Qongqotha	0	4	4	4	3	2	3	REC	SUB	
EC	Loerie	0.5	Loerie	2	4	4				3	REC	SUB	
EC	Maden	0.1	Tyhusa	3				2		3	REC	SUB	
EC	Milner	0.1	Albany (Rural)	7	2				2	3	REC	SUB	
EC	Nahoon	2.2	Mzonkeshe	1				3		3	REC	SUB	
EC	Ncora	13.4	Mtshanyane AA	0		3		2	4	2		SUB	COM (<400 t/yr)
EC	Settlers	0.5	Grahamstown	9	3					4	REC	SUB	

Table 20 (cont.) Dams with commercial fisheries potential listing locality, size, species suitability, potential use and productivity.
 PROV – province, EC – Eastern Cape, FS – Free State, KZN KwaZulu-Natal, LIM – Limpopo, MPU – Mpumalanga,
 NW – Northwest, WP – Western Cape, BA – Bass, CA – carp, CL – catfish, TI – Tilapia, TR – Trout, G – General, REC
 – recreational, SUB – subsistence, Com – commercial.

Prov	Dam		Nearest Settlement		Species Suitability Score						Potential Use and Production (tons/year)		
	Name	Size (Km ²)	Name	Dist (Km)	BA	CA	CL	TI	TR	G			
EC	Umtata	16.0	Kambi AA	0		3		2		3	REC	SUB	COM (<400 t/yr)
EC	Van Stadens – Lower	0.0	Langgewag	6					2	4	REC	SUB	
EC	Wriggleswade	0.0	King Williams Town (Rural)	8		3		2		3	REC	SUB	
EC	Xonxa	14.7	Rwantsana AA	2	3	3		2	3	2	REC	SUB	COM (<400 t/yr)
FS	Allemanskraal	28.6	Senekal (Rural)	10		3	2			2	REC	SUB	COM (<400 t/yr)
FS	Bloemhof	203.9	Bloemhof	4	2	3	2			2	REC	SUB	COM (>400t/yr)
FS	Driekloof	1.9	Langkloof	9		3	2			2	REC	SUB	
FS	Erfenis	32.4	Makeleketla	6		3	2			2		SUB	COM (<400 t/yr)
FS	Fouriespruit	0.8	Ha-Rasebei	8		3	2			2	REC	SUB	
FS	Kalkfontein	45.2	Ipopeng	15		3	2			2	REC	SUB	COM (<400 t/yr)
FS	Krugersdrift	16.5	Soutpan	10		3	2			2	REC	SUB	COM (<400 t/yr)
FS	Rustfontein	10.8	Botshabelo-R	4		3	2			2	REC	SUB	
FS	Sterkfontein	66.0	Phuthadijhaba	8		3	2			2	REC	SUB	COM (>400t/yr)
FS	Vaal	276.6	Vaalmarina	0	2	3	2			2	REC	SUB	COM (>400t/yr)
FS	Welbedacht	13.5	Wepener (Rural)	4		3	3			2	REC	SUB	COM (<400 t/yr)
GP	Leeukuil	1.1	Bedworthpark	1	2	3	2		3	2	REC	SUB	
GP	Roodeplaat	3.7	Roodeplaat	3	2	3	2	2	3	2	REC	SUB	
KZN	Albert Falls	23.4	Albert Falls	1	4	4	4	2		3	REC	SUB	COM (<400 t/yr)
KZN	Amanzimnyama	1.6	Malangeni	1			4	3		4	REC	SUB	
KZN	Craigie Burn	2.2	Umvoti (Rural)	25	3	3	3	2		2	REC	SUB	
KZN	Goedertrou	10.9	Mehlomasha	0	4		4	3		3	REC	SUB	
KZN	Hluhluwe	3.6	Mvutshini	1			4	3		4	REC	SUB	
KZN	Inanda	7.2	Emadineni	0	4	4	4	3		3	REC	SUB	
KZN	Klipfontein	3.3	Lakeside	2	3		3	2		2	REC	SUB	
KZN	KuHlange	31.2	Kosi Bay Lodge	1			4	3		4	REC	SUB	COM (<400 t/yr)
KZN	KuShengeza	1.5	Malangeni	3			4	3		3	REC	SUB	
KZN	KuZilonde	0.8	Mahlungulu	5			3	3		3	REC	SUB	
KZN	Midmar	15.4	Howick	2	3	4	3	2		2	REC	SUB	
KZN	Nagle	1.4	Nonzila	2	4	5	4	3		3	REC	SUB	

Table 20 (cont.) Dams with commercial fisheries potential listing locality, size, species suitability, potential use and productivity.
 PROV – province, EC – Eastern Cape, FS – Free State, KZN KwaZulu-Natal, LIM – Limpopo, MPU – Mpumalanga,
 NW – Northwest, WP – Western Cape, BA – Bass, CA – carp, CL – catfish, TI – Tilapia, TR – Trout, G – General, REC
 – recreational, SUB – subsistence, Com – commercial.

Prov	Dam		Nearest Settlement		Species Suitability Score						Potential Use and Production (tons/year)		
	Name	Size Km ²	Name	Dist (Km)	BA	CA	CL	TI	TR	G			
KZN	Nhlabane	3.8	Ezindabeni	1			4	4		3	REC	SUB	
KZN	Ntshingwayo	20.4	Dannhauser (Rural)	4	3	3	3	2		2	REC	SUB	COM (<400 t/yr)
KZN	Pongolapoort	124.3	Mpondwane	1			4	3		4	REC	SUB	COM (>400t/yr)
KZN	Richards Bay	13.6	Meerensee	2			3	3		3	REC	SUB	COM (<400 t/yr)
KZN	Spioenkop	15.0	Hambrook	2	3	4	3	2		2	REC	SUB	COM (<400 t/yr)
KZN	Wagendrift	5.1	Dalton	2		3	3	2		2	REC	SUB	
KZN	Woodstock	28.2	Rookdale	0			3	2		2	REC	SUB	COM (<400 t/yr)
LIM	Black Heron	0.2	Mbaula	19			4	4		4	REC	SUB	
LIM	Blyderivierspoort	2.7	Apara	4			3	3		3	REC	SUB	
LIM	Doorndraai	5.7	Maroteng	23	3	3	3	2		2	REC	SUB	
LIM	Ebenezer	2.0	Haenertsburg	2	2		2	3	4	2	REC	SUB	
LIM	Glen Alpine	4.4	Driekoppies	2		4	3	3		3	REC	SUB	
LIM	Kanniedood	0.9	Altein	53			4	4		4	REC	SUB	
LIM	Lola Montes	0.2	Letebejane Kromdraai	1	3		3	2		2	REC	SUB	
LIM	Middle Letaba	5.0	Ndengeza	2	3	4	4	3		4	REC	SUB	
LIM	Mokolo	8.3	Onverwacht	33			3	3		3	REC	SUB	
LIM	Phalaborwa Barrage	1.2	Mapikiri	13			4	4		4	REC	SUB	
LIM	Rooibosrand	0.4	Mahlathi	24			4	3		4	REC	SUB	
LIM	Tzaneen	19.0	Politsi	1	3		4	3		4	REC	SUB	
MPU	Driekoppies	0.8	Middelplaas	2			4	3		3	REC	SUB	
MPU	Grootdraai	36.0	Meyerville	6	2	3	2			2	REC	SUB	COM (<400 t/yr)
MPU	Heyshope	53.7	KwaNgema North	1	3		3	2		2	REC	SUB	COM (>400t/yr)
MPU	Jericho	8.5	Amsterdam	18			3	2		2	REC	SUB	
MPU	Klipkopjes	2.1	White River-Country Est.	7	3		4	2		3	REC	SUB	
MPU	Kwena	10.7	Belfast (Rural)	21		3	4	2		3	REC	SUB	
MPU	Loskop	25.6	Ntwane-Letamong	9	3	4	3	3		3	REC	SUB	
MPU	Middelburg	4.4	Eastdene	6	2	3	2	2		3	REC	SUB	
MPU	Morgenstond	6.5	Kwathandeka	15			3	2		2	REC	SUB	
MPU	Nooitgedacht	7.0	Carolina	9	3		3	2	4	2	REC	SUB	
MPU	Vygeboom	6.6	Embhuleni	7	4		3	2		2	REC	SUB	
MPU	Witbank	9.7	Doornpoort	0	2	3	2	2		2	REC	SUB	

Table 20 (cont.) Dams with commercial fisheries potential listing locality, size, species suitability, potential use and productivity.
 PROV – province, EC – Eastern Cape, FS – Free State, KZN KwaZulu-Natal, LIM – Limpopo, MPU – Mpumalanga,
 NW – Northwest, WP – Western Cape, BA – Bass, CA – carp, CL – catfish, TI – Tilapia, TR – Trout, G – General, REC
 – recreational, SUB – subsistence, Com – commercial.

Prov	Dam		Nearest Settlement		Species Suitability Score						Potential Use and Production (tons/year)		
	Name	Size (Km ²)	Name	Dist (Km)	BA	CA	CL	TI	TR	G			
MPU	Witklip	1.9	White River-	12	3		4	2		3	REC	SUB	
NC	Spitskop	34.6	Thota ya Tau	1		3	3			3	REC	SUB	COM (<400 t/yr)
NC	Vanderkloof	120.7	Vanderkloof	1		3	3		4	2	REC	SUB	COM (>400t/yr)
NW	Boskop	3.6	Potchefstroom (Rural)	15	2	3	2			2	REC	SUB	
NW	Buffelspoort	1.3	Mooi-nooi	8	3		3	2		3	REC	SUB	
NW	Hartbeespoort	17.3	Meerhof	1	2	4	3	2		3	REC	SUB	
NW	Houwater	1.4	Pilanesberg National	2			3	2		2	REC	SUB	
NW	Klerkskraal	4.0	Carletonville	16	2	3	2			2	REC	SUB	
NW	Klipvoor	14.1	Ga-Habedi	1			3	3		3	REC	SUB	COM (<400 t/yr)
NW	Roodekopjes	9.9	Brits (Rural)	5	3		3	3		3	REC	SUB	
NW	Vaalkop	10.8	Dikampeng 2	5	3		3	3		3	REC	SUB	
NW	Wemmershoek	3.0	Groendal	6		3			3	3	REC	SUB	
WC	Bot River Vlei	11.6	Fisherhaven	1	3	3			3	3	REC	SUB	
WC	Brandvlei	19.3	Avian Park	3	3	3				3	REC	SUB	
WC	Buffeljags	1.3	Swellendam	8	3	4				3	REC	SUB	
WC	Bulshoek	1.4	Clanwilliam	17	3					3	REC	SUB	
WC	Ceres	0.0	Bella Vista	5	2				3	3	REC	SUB	
WC	Clanwilliam	9.5	Clanwilliam	2	3					3	REC	SUB	
WC	De Hoop Vlei	4.8	Waenhuiskrans and Arniston	25						3	REC	SUB	
WC	Eikenhof	2.0	Grabouw	3	4	3			4	3	REC	SUB	
WC	Groenvlei	3.4	Sedgefield	3						3	REC	SUB	
WC	Grootvlei G	0.4	Waterwerke Informal	3	4	3			4	3	REC	SUB	
WC	Hartebeeskuil	0.8	Mossel Bay (Rural)	5	3	4		3		4	REC	SUB	
WC	Kleinplaas S	0.2	Da Gama Park	2						3	REC	SUB	
WC	Kwaggaskloof	8.7	Avian Park	10	3	3				3	REC	SUB	
WC	Lower Langvlei	1.4	Hoekwil	2						3	REC	SUB	
WC	Noordhoek lagoon	0.6	Noordhoek	2						3	REC	SUB	
WC	Rockview	0.7	Strand (Rural)	4	4	3			3	3	REC	SUB	
WC	Rondevlei G	0.6	Zeekoevlei	0	3	4	3	2	3	3	REC	SUB	
WC	Rondevlei K	1.1	Hoekwil	8						3	REC	SUB	
WC	Stompdrift	3.2	De Rust	6	3	4				3	REC	SUB	
WC	Swart River	0.0	George	5	3					3	REC	SUB	

Table 20 (cont.) Dams with commercial fisheries potential listing locality, size, species suitability, potential use and productivity. PROV – province, EC – Eastern Cape, FS – Free State, KZN KwaZulu-Natal, LIM – Limpopo, MPU – Mpumalanga, NW – Northwest, WP – Western Cape, BA – Bass, CA – carp, CL – catfish, TI – Tilapia, TR – Trout, G – General, REC – recreational, SUB – subsistence, Com – commercial.

Prov	Dam		Nearest Settlement		Species Suitability Score						Potential Use And Production (tons/year)		
	Name	Size (Km ²)	Name	Dist (Km)	BA	CA	CL	TI	TR	G			
WC	Theewaterskloof	52.0	Goniwe Park	3		3			3	3	REC	SUB	COM (<400 t/yr)
WC	Upper Langvlei	2.0	Hoekwil	4						3	REC	SUB	
WC	Voelvlei	15.0	Gouda	4	3	3	3	2	3	3	REC	SUB	
WC	Zandvlei	1.0	Marina Da Gama	0						3	REC	SUB	

6.6 The need for a comprehensive survey and monitoring programme

The literature review of inland fisheries in South Africa (McCafferty *et al.*, 2012) and the GIS analysis highlights the paucity of information available on the fish stocks and fisheries potential of South Africa's inland water bodies. Most historical survey data is focused on the bio-physical aspects of fisheries ecology, with very little on the socio-economic and social aspects of the inland fisheries. If sustainable inland fisheries are to be developed for optimal social and economic benefit, comprehensive integrated research surveys and monitoring will be required on the dams with identified potential.

The GIS assessment should therefore only be seen as an initial suitability analysis of each dam that would need to be followed by:

1. An initial fishery survey to determine to estimate the current yield of the dam, catch composition, user characteristics and fishing methods, value chain descriptions, social issues and conflicts.
2. Resource survey to determine what the actual productivity of the dam is likely to be and what the population structure of harvestable fish is in the dam
3. Stock assessment to determine the optimal sustainable harvest strategy to meet the social and economic goals of the different fisheries. For example, in the case of a recreational fishery the stock may be managed to produce large trophy fish, whereas for a small scale artisanal fishery the fish stock would be managed to produce the maximum sustainable yield in terms of tonnage.
4. Economic feasibility to determine how best to optimize the value of the fishery. This would include an optimal harvest strategy, nature of fishing rights and quantum of harvest by individual fishers, market research and options for value chain development.
5. Monitoring and surveillance plan to ensure sustainability is achieved and that the rights of fishers are protected once a formal fishery is put into place.

Once such an assessment has been undertaken, the final decision to develop the fishery can be made. It is therefore recommended that full assessments be undertaken of the listed dams.

6.7 Guidelines for stocking and harvesting of dams

A conceptual decision making tool was developed to evaluate the risks and benefits associated with stock enhancement and fisheries development (Ellender, 2013). This study evaluated the intentional stocking of non-native fishes in South African impoundments using a case study from the Amatole region of the Eastern Cape. Ecological, social and economic parameters were integrated to ensure that stock enhancement does compromise biodiversity and is biologically and ecologically sustainable. A framework was then developed to guide decision makers on the most appropriate options when considering stocking. The information required for the comprehensive development of a conceptual decision making tool for viability of developing headwater impoundments included knowledge on the current status of all species in the river system

and their biology and ecology which relate to their success as development species and the threat they pose to native biodiversity. A framework or set of key questions was then developed to facilitate the stock enhancement process. The questions are focussed on two major priorities, maintenance and protection of biodiversity and ensuring biological and economic sustainability. This can be achieved if the following minimum information requirements are met:

1. Full biodiversity assessment including species distributions and abundance in the impoundment as well as in the river up and downstream of the impoundment.
2. From species distribution data identify current status and biodiversity threats.
3. Full fisheries assessment on current usage to prioritise development options.
4. Comprehensive understanding of the biology and invasive potential of the selected target species
5. Economic and biological feasibility study.

Using the minimum data requirements the following key questions were developed into a framework to investigate the viability of stock enhancement in impoundments:

1. Does it contain species of biodiversity concern?
2. Does it contain species with fisheries potential?
3. Is there currently an existent fishery on the impoundment?
4. Proximity to urban area.
5. Are the potential species native or non-native to the river system?
6. Are there species of biodiversity concern above or below the impoundment?
7. Are there mitigating measures in place to limit dispersal?
8. If the species were to escape would it establish in areas of biodiversity concern?

6.8 The Role of State and Private Hatcheries in Stocking Dams

6.8.1 Introduction

A critical element of developing an inland fisheries policy is to consider options for the organisation of state institutions, management and infrastructure. A key issue in the development of governance and public sector support arrangements for inland fisheries development is the role of the state and private hatcheries, as fishery stock enhancement with hatchery reared fish can potentially support rural fishery development (Rouhani and Britz, 2004).

South Africa possesses a number of provincial state hatcheries dating back to the Apartheid and Colonial eras, which have largely fallen into disuse and poor repair as a result of changing policies and lack of demand for their services (Rouhani and Britz, 2004; 2011, Chapter 2 of this report). The main purpose of the hatcheries was either stocking of fish for recreational purposes or aquaculture development. In recent years, the revitalisation of certain state hatcheries has been considered to support provincial aquaculture strategies (Rouhani and Britz, 2011). In the light of the assumption of the mandate for inland fisheries development by DAFF, it is appropriate to consider the state hatcheries as a potential vehicle for supporting inland fishery development.

The present evaluation builds on the diagnostic survey of the status of state hatcheries undertaken by Rouhani and Britz (2011) and provides guidance on the potential role of state hatcheries in supporting inland fishery development. The potential support role of private hatcheries is also briefly considered in this context.

A major input into the present report was a consultative workshop with national and provincial government departments with mandates affecting state hatcheries held on 30 May 2012 in Pretoria at DAFF's Chief Directorate: Animal and Aquaculture Production. Following the workshop, the DAFF undertook a technical assessment of the status of state hatcheries which recommended strategies for their rehabilitation and future role in aquaculture and fisheries development.

6.8.2 Environmental and Biodiversity Issues

As highlighted above, the stocking of fish into the natural environment requires careful management due to the potential negative impacts on the ecosystem (Van Rensburg *et al.*, 2010). Previous indiscriminate stockings have resulted in the establishment of alien fish populations in many South African catchments, with a variety of consequences including predation on indigenous fish and other fauna, competition, spread of new disease causing organisms and habitat alteration. Where indigenous fish are bred and stocked, the genetic profile of wild populations may be affected. The continued stocking of hatchery reared fish may be justified if there is an economic or public good benefit, and the environmental impacts are acceptable in terms of the NEM:BA risk assessment and management protocols.

6.8.3. Institutional and Organisational Issues

Most state hatcheries fall under the jurisdiction of the provincial departments of agriculture or environmental affairs, but in the absence of national policy to guide inland fishery development and management, most of these facilities do not currently serve any fishery related function. National and provincial policy and strategy will be required to define the institutional and organisational arrangements to utilise state hatcheries for inland fishery development. It has been agreed that DAFF will act as the lead agent for inland fishery development and cooperate with its sister national departments (Departments of Water and Environmental Affairs) as well as relevant provincial departments to define conducive governance and environmental management arrangements.

In terms of public sector resources for support, inland fishery development support does not yet form part of most provincial agriculture department strategies or budgets, and this imposes an immediate constraint on government capacity to support inland fisheries development. It is logical that agriculture extension service institutions be harnessed to include inland fishery development support, but this will require departmental planning, project conceptualisation, changes in job descriptions, training, and budgets. If state hatcheries are to be effectively used in promoting inland fishery development, it is essential that their role is clearly defined and integrated into the overall provincial Agriculture Department strategies, plans and budgets.

6.7.4 Potential Role of State Hatcheries in Supporting Inland Fishery Development

The state hatcheries which are currently operational or in good repair are orientated to supporting aquaculture development (Rouhani and Britz, 2011). However, with the inclusion of inland fisheries in the DAFF mandate, it is logical to consider extending their purpose to support for inland fishery development for rural livelihoods where appropriate.

Most permanent inland water bodies, whether they be impoundments or rivers, do not require stocking with hatchery reared fish as they sustain naturalised breeding populations which provide the necessary recruits to replenish fish lost to fishing mortality. There is however a case for stocking temporary impoundments and water bodies with seed from state hatcheries to support fisheries for food security purposes. Another exception is trout which do not breed in most South African waters, and are thus stocked from private hatcheries into various waters support recreational fisheries.

The government stakeholder workshop on state hatcheries identified further possible roles for state hatcheries, based on the development requirements of the inland fishery sub-sector. It was concluded that state hatcheries should be viewed as multi-purpose support facilities with potential roles in supporting extension and training, research, and development projects. These options are considered below, followed by recommended options and strategies for provincial state hatcheries.

6.8.4.1 Stocking of Small Impoundments for Food Security

South Africa's relatively arid environment is characterised by thousands of small dams in rural areas, many of which dry up during the periods of low rainfall. Small, shallow water bodies are highly productive biologically due to light penetration, warm temperatures, and nutrients in the form of manure from stock. The periodic stocking of small dams with hatchery-reared fish is thus an option to enhance the food security of rural communities.

The cost of fingerlings is always an issue in the viability of state hatcheries, as poor rural farmers cannot afford to buy them. However, if the stocking of fingerlings is viewed as a form of grant to promote food security in vulnerable rural communities, then public funding is justifiable.

Species that could be stocked depending on the characteristics of the area include tilapia, carp, catfish, catfish and mullet. Mullet (*Mugil cephalus*) are an interesting option as they are a marine species that does well when stocked as fingerlings into large dams. As they feed low on the food chain, they appear to exploit a vacant trophic niche and the stocking of dams in the Eastern Cape and Free State by Bok (1983) in the 1980's yielded significant tonnages of harvested fish. Bok collected newly recruiting young mullet in estuaries, a practice which forms the basis of the Israeli mullet culture industry. If this was to be pursued, an evaluation of the impact on the recruitment into the wild mullet population would need to be conducted to determine the sustainability of the practice. However, as mullet are not targeted by anglers, a certain level of fry harvest would probably be sustainable.

6.8.4.2 Stocking for Angling

Although many state hatcheries were originally constructed for the purpose of breeding and stocking alien fish for angling purposes, this practice was phased out in the 1980's with the shift in conservation policy to protecting indigenous fish fauna (see Chapter 2). Trout was a major focus with hatcheries such as Jonkershoek (W.Cape), Pirie (E.Cape), Camberg (KZN), De Kuilen and Lydenburg (Mpumalanga) supplying trout for angling purposes, but with the closure of these hatcheries, the breeding of trout was taken over by the private sector and universities (Rhodes and Stellenbosch).

If inland fisheries are viewed from a sector development point of view, there may be a case to consider breeding trout in state hatcheries for the stocking of public waters if this can create livelihood opportunities in rural communities linked to angling tourism services. Areas of the Eastern Cape and Free State are potentially suitable, but careful evaluation of the cost-benefit will be required, and measured against the alternative of simply purchasing trout fingerlings from the private sector.

The Cata community based flyfishing project at Keiskammahoek has demonstrated that it is possible to create livelihood opportunities in the tourism value chain through flyfishing (Kingham, 2012). Communal or state-owned areas in mountainous areas such as the Amatola's, southern Drakensberg and Eastern Free State provide potential opportunities for community-based flyfishing tourism.

The breeding of other species, either indigenous or exotic, for sport angling purposes does not generally seem justifiable. Non-native species such as carp and bass have spread through most catchments, establishing breeding populations, and there is thus no demand or need for fingerling supply. Furthermore, from a biodiversity conservation perspective their further spread to new waters would be undesirable and illegal. Indigenous yellowfish have been bred at localities such as Gariep, partly with the objective of enhancing wild populations for angling purposes. However, the rationale for this is questionable, both from a bio-economic viability and genetic management point of view.

6.8.4.3 Extension and Training

As hatcheries are an operational infrastructure with buildings, trained personnel, fish culture facilities and education facilities, they are logical sites for aquaculture and fisheries extension and training.

The major challenge in realising livelihood opportunities for rural communities from inland fisheries, particularly in the recreational angling sub-sector, is the level of education and capability of members of rural communities. Thus, education, training and mentorship needs to be central to any initiative to promote inland fisheries as a means to livelihoods.

It is not only the rural community members that need education and training, but also hatchery and extension personnel. A diagnostic analysis by Rouhani and Britz (2011) identified the inadequate skills and ability of hatchery and extension personnel a major constraint to effective state hatchery operations. Most extension officers are generalists who may have done an aquaculture short course. If fishery development work

is to succeed, full time qualified staff with the necessary experience will be required. Operational state hatcheries thus form a logical base at which station and train such staff.

6.8.4.4 Research

State hatcheries have traditionally had a strong research role supporting aspects such as aquaculture technology development, fish stock assessment surveys, and captive breeding of endangered fish species. Research is vital to determining sustainable levels of fish harvest, devising management strategies and addressing other fishery related ecological issues such as biodiversity, water quality and product health. In addition to addressing research needs and generating innovations in fisheries management and aquaculture, researchers are high-level manpower capable of providing leadership, adaptive decision making ability and innovative solutions to local problems. Historically, when state hatcheries that have been led by researchers with post-graduate tertiary university qualifications, there has been innovation and more effective performance.

6.8.4.5 Development Projects

In the context of inland fishery and aquaculture development for livelihood purposes, the purpose of state hatcheries is a developmental, which entails more than technicalities of supplying fish fingerlings. State hatcheries should therefore be equipped and resourced around well defined development goals, which are given substance in the form of specific programmes and projects.

Successful rural livelihood development requires a strong focus on governance, co-management and institution building with the target communities. Thus in addition to the technical requirements of fishing (or aquaculture) projects, rural fishery projects will require a holistic approach to empowering communities to participate in inland fishery value chain opportunities. The FAO's Guidelines for Viable Small Scale Fisheries provide a principles and guidance on how to achieve this (FAO, 2013). Each state hatchery is located in a unique ecosystem and social environment, and this projects need to be development which address local needs and opportunities. A one-size-fits-all approach will result in inappropriate public sector interventions. Fishery development projects should be designed to address instances of market failure (e.g. fingerling supply where the commercial sector can't provide) or promote a public good.

It is essential that before the state "revitalises" hatchery facilities, a process is undertaken with local communities and stakeholders to conceptualise what are appropriate development strategies and what their public sector support needs are. All too often capital has been invested into culture facilities with no clear development goal and strategy defined.

6.8.5 Options and Strategies for Provincial Hatcheries

In this section, options and strategies for the use of existing state hatchery facilities are identified, based on previous assessments (Rouhani and Britz, 2004; 2011) and State Hatchery Workshop inputs by national and provincial officials.

6.8.5.1 Turfloop

Turfloop hatchery is a revitalised facility operated by the Limpopo Province Agriculture Department, with the purpose of supporting rural aquaculture development. The facility is currently operational following a R3 million refurbishment. The hatchery has been refitted and 12 ponds have been rehabilitated (Figure 28). A hatchery manager and a scientist are based at Turfloop. The mandate is to serve communities and supply fingerlings. The establishment of aquaculture in irrigation balancing dams, which are being divided into fish ponds, is being promoted as part of integrated production systems. Provincial support includes Investment in both hatchery capacity and community capacity building. Provincial extension officers, who have been trained by Rhodes University as part of a WRC Provincial Aquaculture Project (Rouhani and Britz, 2011) are being used. A community fish farm is proposed at the old Dzindi government fish farm and efforts are underway to revive the Tompi Seleka training college hatchery. Training is part of the Turfloop hatchery purpose. The breeding of *Oreochromis niloticus* is also an option at Turfloop, but needs to await the outcome of a risk assessment.

The provincial manager responsible for aquaculture has indicated that if national DAFF provides a written mandate to promote inland fishery development, the Turfloop facility could be used for this purpose.

In terms of inland fishery development, the Limpopo Department of Agriculture's programme to revitalise small-scale irrigation schemes in communal areas provides a potential opportunity. The stocking of these temporary water bodies with fish could be evaluated as a source of food security for local communities. A survey of other temporary water bodies near to rural communities needs to be conducted to determine the feasibility of stocking with fish. Obvious candidate species are local varieties of tilapia (*Oreochromis rendalli* and *Oreochromis mossambicus*) and catfish (*Clarias gariepinus*).



Figure 28 Turfloop hatchery and ponds revitalisation.

6.8.5.2 Makhatini Research Station

The Makhatini hatchery situated in the Makhatini Flats in KwaZulu-Natal is a small facility which forms part of an agricultural research station (Figure 29). Originally built to develop and demonstrate integrated small-scale agriculture – aquaculture during the Apartheid homeland era, the facility has been unproductive for several years. One scientist with a BSc Honours heads the facility. Plans by the KZN Agriculture Department to revitalise the hatchery to supply tilapia fingerlings to enhance the floodplain fishery on the Phongola Flats in 2009 were put on hold.

At present little is known about the current status and trends in the highly productive traditional Phongola floodplain fishery which historically supported a catch of ca. 400t/annum (Heeg and Breen, 1982). A recent (2009) study of the Pongola floodplain, showed that fish remain the most widely utilised and valued natural resource on the floodplain (PRESPA, 2009), and that of the local population enjoys the highest nutritional status of rural populations in KwaZulu-Natal due to its ready access to fish protein (Heeg and Breen, 1982). Anecdotal reports suggest that fishery yields have declined due to badly timed releases of water from the Jozini Dam and encroachment of commercial agriculture.



From a fishery development perspective, a logical starting point would be an assessment of the current state of the floodplain fishery, and an evaluation of whether it is recruitment limited due to a decline in natural spawner stock. This would determine whether there is a need to enhance the fishery with hatchery reared fish.

Figure 29 Hatchery facilities at Makhatini Research Station.

6.8.5.3 Jonkerhoek Hatchery

The Jonkershoek provincial hatchery, which is operated by Stellenbosch University, is financially sustainable facility which has delivered a number of “public good” outcomes. The facility has been instrumental in the development of trout aquaculture sector in the Western Cape Province. Specific achievements include the supply of trout for small-scale farmer projects, the genetic improvement of local trout and the training of both students and community members in trout production.

The operational model for this facility can be deemed a success and there is no need to change it. The needs of recreational trout fishing in the Western Cape Province appear to be met by existing private facilities and there does not appear to be a case for breeding subsidised trout fingerlings for fishery purposes. If a developmental aspect to trout fishing is identified in the Western Cape Province, e.g. an opportunity for disadvantaged communities to participate in the trout fishing value chain, support could be provided from the Jonkershoek hatchery.

6.8.5.4 Amalinda Fish Station

The Amalinda Fish Station was originally a provincial nature conservation facility conducting research on fish breeding and stock enhancement, and breeding fish such as bass for stocking (Figure 30). The widespread stocking of mullet in dams for stock enhancement was pioneered at Amalinda. The facility was closed in the 1990's when most research staff elected to take government retrenchment packages. It was subsequently been semi-privatised as an ornamental fish production facility and is currently operated by a group of ex-MK veterans. While a ready market for ornamental fish exists, and government grants have funded capital and operating costs of the projects, a lack of fish culture and enterprise management skills has prevented it from becoming a financially viable enterprise.

As a state-owned facility, the role of Amalinda hatchery should be reviewed. If it is to continue as a private enterprise, a new business model with a capable management is required. Alternatively, it could fulfill a possible inland fishery development support role, visibly, a base for fishery staff, fingerling supply for stocking, training communities in fishing techniques, and the promotion of fishery development projects. It could also play a parallel development support role for aquaculture.



Figure 30. Amalinda fish farm which was leased a group of MK Veterans to operate as a commercial ornamental fish farm.

6.8.5.5 Lydenburg and De Kuilen

Lydenburg and De Kuilen hatcheries are owned by the Mpumalanga Parks board and are situated in close proximity just outside Lydenburg. Lydenburg is an older facility (established in 1948) which was built for fish breeding, research and stocking. De Kuilen was constructed as a dedicated commercial scale trout hatchery in 1975 capable of producing 2-3 million ova a year. The fish stocking role of both facilities was terminated in the 1980's with the change in policy to conserving indigenous aquatic fauna. Lydenburg is still operated as an aquatic conservation research facility by Mpumalanga Parks board, although no fish production takes place and most ponds have deteriorated to the point of no return. De Kuilen was privatised in the 1980's and operated successfully as a trout ova export facility for some years. Following the closure of the private operators business, the facility has been dormant. An assessment of hatchery facilities in 2006 noted the decline in water supply

available to both Lydenburg and De Kuilen hatcheries, but made recommendations for their rehabilitation as centres to support the participation of disadvantaged communities in the trout fishery value chain (Rouhani and Britz, 2011). Subsequently no progress has been made in this regard, the major constraint being the absence of communication between Mpumalanga Agriculture and Mpumalanga Parks Board. Recent reports indicate that the building and facilities at De Kuilen have been vandalised and are in a poor condition.

As trout angling and aquaculture are important value chains in the Mpumalanga region, a multi-purpose trout facility to promote economic opportunities for previously disadvantaged people would be useful. The Jonkershoek hatchery provides a good working example of how a state hatchery can be used to breed fingerlings as well as provide a base for research, training, extension support and the promotion of development projects. To achieve this, a policy change is required to use Lydenburg and/or De Kuilen for trout fishery development which implies a transfer from Mpumalanga Parks Board to Department of Agriculture.

6.8.5.6 Gariep

The Gariep Dam Hatchery was recently (2010) upgraded into an aquaculture technology demonstration centre by the Chinese government. The purpose of the centre includes research, demonstration, promotion and training of freshwater farming technology demonstrating aquaculture technology for African catfish and tilapia. The viability of the Gariep facility is questionable, given the lack of demand for catfish and tilapia fingerlings, its remote location, the regions sub-optimal temperatures, and lack of suitable land or water.

In terms of a future fishery role for the Gariep facility, there appear to be few options. Subsistence and recreational fishing on the Gariep dam is well established, obviating the need for support facilities. There is opportunity for expanding trout farming and fishing in the Eastern Free State, and so there could possibly be a need for trout fingerlings. However, the water at the Gariep hatchery would need to be cooled for this purpose, and fingerlings could probably be sourced more cost-effectively from private sector hatcheries.

6.8.5.7 Umtata Dam

Umtata Dam hatchery was constructed in the 1980's for the purpose of promoting rural aquaculture. The facility is still staffed and maintained by the Eastern Cape Department of Agriculture but has not produced fish for many years.

As land use in the Transkei region is largely communal, there is a case for breeding fish for stocking small dams and water bodies with fish for subsistence angling purposes. Careful evaluation of the opportunity would be required in terms of:

- identification of non-permanent water bodies that would be suitable for stocking,
- what species to stock based on biodiversity and consumer preference considerations,
- the needs of local communities and training in fishing techniques,
- production potential of the water bodies.

6.8.5.8 Rhodes University Hatchery

Rhodes University's hatchery exists to serve the public good by providing an aquaculture and fishery training facility, trout fingerlings for sport fishery development and a research facility (Figure 31). The hatchery produces over 100,000-150,000 fry per annum and is the main source of trout fingerlings for the Eastern Cape Trout sport fishery. Rhodes University staff provide technical and extension support services for fishery development projects in rural communities. For example, Rhodes University's Rural Fisheries Programme has facilitated:

- the development of a trout sport fishing project for the Cata community
- the development of subsistence fisheries on various dams and rivers in the Eastern Cape
- performed feasibility studies on potential sport and subsistence fisheries for communities at various Eastern Cape localities
- regular training courses in fishery and aquaculture management for government officials and community members.



Figure 31 The Rhodes University hatchery serves as an aquaculture training facility and supplier of fingerlings for trout angling in the Eastern Cape Province.

The facility is thus well positioned to continue to support fishery development initiatives in the Eastern Cape Province.

6.8.6 Potential Role of Private Hatcheries in Supporting Inland Fishery Development

Private hatcheries in South Africa produce trout, catfish, and tilapia for angling and aquaculture purposes, and could play a potential role in promoting the development of inland fishery opportunities, particularly trout angling.

The rationale for state hatcheries should be either a public good function (e.g. development support, training, research) or to address a market failure (e.g. no fingerlings available on the market to supply a particular demand). If private hatcheries are in a position to supply fingerlings at a competitive cost, then the need for a state hatchery may be redundant and scarce public funds can be deployed to support other development needs.

As private hatcheries are market driven, they tend to be more efficient and reliable than state facilities. Thus, in the development on inland fisheries, the proximity and capacity of private sector hatcheries should always be considered.

Trout hatcheries exist in the Western, Eastern, KZN and Mpumalanga Provinces. Tilapia hatcheries in the Eastern Cape Province, Gauteng and Limpopo Province. One catfish hatchery is located in the Northwest province.

6.8.7. Way Forward

The maintenance of state hatcheries to support fishery (or aquaculture) development requires careful justification. The present report has outlined possible opportunities and strategies for utilising state hatcheries in support of inland fishery development. However, the historical existence of a state hatchery does not imply that it has a future purpose. State hatcheries are provincial assets which require substantial resource commitments, and therefore justification of their continued operation must be based on a careful evaluation of their potential developmental role.

Inland fishery development planning needs to begin at national level with policy and strategy. Until clear policy guidance is received by the provinces, the future role of provincial hatcheries will remain uncertain. Once the provinces are provided with guidance on inland fishery development, holistic provincial fisheries development strategies can be developed, based on the regional needs and circumstances. This will facilitate the conceptualisation of inland fishery projects, decisions on whether the stocking of fish from state hatcheries is required, and whether they can play a wider multi-purpose role in supporting fishery and aquaculture development. In conclusion, the stocking of fish from state hatcheries cannot be seen in isolation from comprehensive provincial and national fishery development strategies. It is thus recommended that as provinces develop their inland fishery strategies, careful evaluation of the role of state hatcheries be undertaken, and resources provided appropriately.

6.8.8. RECOMMENDATIONS

1. View state hatcheries as multi-use facilities for promoting inland fishery development projects.
2. Clarify provincial agriculture mandate in respect of inland fisheries support.
3. Specific hatchery plans requires an expert technical assessment and integration into an overall provincial inland fishery development plan.

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7. STAKEHOLDER CONSULTATIONS

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7.1 Introduction

Stakeholder consultations are a central element to the development of Constitutionally principled 'good governance' arrangements that are credible, equitable and address the needs of fishers and other stakeholders. Meaningful stakeholder participation is also a central component of internationally accepted fishery governance norms (FAO, 2013). The consultation process is particularly important where there is a lack of a guiding policy, established governance institutions, and little information about the current resource use patterns, – as is the case for South African inland fisheries. The Water Research Commission "Baseline and scoping study on the development and sustainable utilisation of storage dams for inland fisheries and their contribution to rural livelihoods" was thus designed around a series of workshops and consultations with public sector representatives, small-scale fishing communities, the recreational fishing sector and other civil society stakeholders.

The workshop and consultation objectives were to;-

- 1 *Brief participants* on the need to develop an inland fishery policy and appropriate governance arrangements in order to realise the potential of the resource in respect of rural livelihoods,
- 2 *Present the project research findings* on various issues including access rights, the production potential of inland waters and potential for stock enhancement, user groups characteristics and needs, fishery 'good governance' norms, and institutional and organisational requirements for the managing inland fisheries to promote sustainable rural livelihoods, economic development and job creation.
- 3 *Elicit discussion and input* to identify stakeholder issues and needs and identify options for institutional and organisational arrangements for inland fishery governance.
- 4 *Work towards consensus* on key issues in order to recommend inland fishery policy options and institutional and organisational arrangements.
- 5 *Obtain stakeholder buy-in and ongoing participation* in the process of developing inland fishery governance arrangements.

The consultation process began in 2011 with a formal announcement of the project to national and provincial government departments, and a request for their input into the consultative process. This was followed by two workshops in 2012 for national and provincial government departments with mandates relevant to inland fisheries governance, and various follow up meetings and individual consultations (Britz, 2012a, 2012b). A series of workshops with rural fishing communities to understand their fishing use patterns, formal and informal governance arrangements, key issues, and needs. The community workshops concluded with a major multi-stakeholder consultation on the conflicted Phongola Dam fishery. A series of consultations were held with the organised angling sector to brief them on the project and elicit their inputs. The formal consultative workshops and meetings were complemented with an ongoing series of individual meetings and correspondence with stakeholders. To conclude the project follow-up briefings on the project findings and recommendations were conducted with representatives of the mandated government departments. Recommendations for developing recreational fishery governance arrangements with DAFF were made to the South African Sports Angling and Casting Confederation.

The chapter concludes with a summarised set of recommendations for inland fishery management arrangements and governance.

7.2 Government Consultations

7.2.1 Announcement of the WRC Inland Fisheries Project

In 2011, the WRC Inland Fishery scoping project was formally announced to national and provincial heads of government departments with a mandate relevant to inland fisheries, and their input into the consultative process requested.

7.2.2 Inland Fisheries Consultative Workshop for Government Stakeholders

This was followed by an inland fishery consultative workshop for government stakeholders at the Water Research Commission offices in Pretoria on 7 March 2012 (Britz, 2012a). Representatives with responsibility for inland fisheries were invited from:

- Department of Agriculture Forestry and Fisheries
- Department of Water Affairs
- Department of Environmental Affairs
- Provincial Environmental Agencies
- Provincial Departments of Agriculture

The workshop objectives were:

1. To bring together national and provincial government department officials who bear responsibility for inland fisheries management.
2. To present the findings of the WRC inland fisheries research team so far.
3. To provide a conceptual framework for understanding inland fisheries access rights, organisation, management and governance with potential for reform.
4. To discuss revised approaches to governing inland fisheries which promote South Africa's environmental, rural livelihood and socio-economic policy objectives.
5. To create a forum for communication and debate between government officials responsible for inland fisheries to support the process of developing options for inland fishery governance and policy.

The workshop was well attended and important inputs and consensus achieved on a number of key issues. Importantly, DAFF officials confirmed that the Fisheries Branch was responsible for the inland fishery development mandate. Valuable policy recommendations emerged following the presentation of the outputs of the WRC Inland Fisheries Project. These were:

- 1. DAFF is the lead agent for inland fisheries.** DAFF representatives announced that the Department would assume the lead agent role for inland fishery development. This function would presumably be integrated into the existing DAFF fishery management capacity at national level and into agriculture extension capacity at provincial level.
- 2. Policy and legislation.** Policy on inland fisheries is lacking and national legislation is largely silent on fisheries. The Water Act and NEMA/NEMBA provide guiding principles flowing from the Constitution, which can be applied to develop inland fishery policy and regulations. DAFF requires specific policy and legislation to implement its inland fishery mandate. This should be aligned with DAFF policies such as the Growth and Development Plan 2011-2030, Zero Hunger, and Small Scale Fishing Policy, and international obligations and fishery governance norms.
- 3. Non-industrial fishery.** It was accepted that inland fisheries are non-industrial, and that the sector is made up of mainly recreational, subsistence and small-scale commercial fishers. This user profile will shape management and governance approaches.
- 4. Developmental Approach.** Due to the context of rural poverty, inland fishery governance requires development interventions for communities to realise livelihood opportunities from inland fisheries.

- 5. Equity and Rural livelihoods.** There is currently no explicit legal recognition of the use of inland fisheries for rural livelihoods, and consequently rural subsistence fishing activity often criminalized. Disadvantaged rural fishers are sometimes “crowded out” of access to fisheries opportunities due to lack of empowerment and absence of institutions to address equity issues. Thus, an inland fishery policy needs to recognise institutionalised historical inequity, and promote development interventions which empower disadvantaged communities.
- 6. Co-management.** Each dam is unique in terms of land and water rights, economic opportunities, production potential, and stakeholder composition, so specific local management arrangement required. Cooperative governance arrangements and institutions for co-management are thus essential to inland fishery development and management.
- 7. Management toolbox.** Government managers require an inland fishery management “toolbox” to address the situation on specific water bodies.
- 8. Value chain approach.** Policy needs to be based on a value chain approach to inland fisheries. Subsistence fishing plays a vital food security role in certain rural communities. The recreational fishing value chain linked to the tourism service sector is the economically most valuable component of inland fisheries. Commercial fishing potential is very limited, growing illegal commercial scale fishing a concern as it reduces opportunities for subsistence and recreational fishing.
- 9. Government organisational arrangements.** The consultation process conducted by the WRC project team informed recommendations on the roles of national and provincial departments (agriculture, environmental and water affairs) in inland fisheries.

Recommended actions flowing from the government stakeholder workshop were:

- DAFF will take the lead on inland fisheries governance and request assistance as required from the WRC project team to provide input.
- The WRC project team will coordinate an intergovernmental forum to circulate information and obtain inputs into the development of recommendations for inland fisheries governance, institutional and organisational arrangements.
- A legal basis for inland fisheries is required for DAFF. Inland fisheries will be included in the current MLRA review process.
- Government organisational arrangements. The consultation process being conducted by the WRC project team will provide recommendations on the roles of national and provincial departments (agriculture, environmental and water affairs) in inland fisheries. A DAFF representative suggested that a DAFF Inland Fisheries Provincial Forum could be formed to facilitate arrangements with the provincial agriculture departments.
- Recommendations on governance arrangements for co-management will be made by the WRC project based on stakeholder consultations.

7.2.3 Inland Fisheries Consultative Workshop on State Hatcheries

A key issue in the development of governance and public sector support arrangements for inland fisheries development is the role of the state and private hatcheries, as fish stock enhancement with hatchery reared fish can potentially support rural fishery development. Historically, the state hatcheries played a key role in inland fishery development, but with the provincial environmental and nature conservation departments’ shift to focussing on the conservation of indigenous fish fauna, these facilities largely fell into disuse in the late 1980s and 1990s. It was uncertain whether there was a role for these facilities to play in an revived inland fisheries development strategy under the leadership of DAFF. Following the Consultation Workshop for Government Stakeholders on 7 March 2012, DAFF had initiated a technical assessment of provincial hatchery facilities (Britz, 2012b). A DAFF convened Inland Fisheries Consultative Workshop on State Hatcheries was thus convened to address the issues on 31 May 2012.

The role of state hatcheries was considered in terms of inland fishery development, aquaculture and biodiversity issues. In addition, the Department of Water Affairs delegated a senior manager to participate in the development of inland fishery governance arrangements. The recommendations arising from the workshop were:

1. View state hatcheries as multi-use facilities for promoting inland fishery development projects.
2. Clarify provincial agriculture mandate in respect of inland fisheries support.
3. Specific hatchery plans require a technical assessment on the ground by DAFF.
4. DAFF would visit the provinces to elevate aquaculture and fisheries on HOD agendas.
5. Include inland fisheries on the mandate of the Provincial Inter-governmental Forum.
6. DWA would move towards developing a framework for fisheries management. It would identify strategic areas culminating in a document to guide fishery access to dams. The contact point for Water Affairs was designated as the Chief Director: Sector Coordination and Support.

7.2.4 Follow up Meetings and Consultations

7.2.4.1 Department of Agriculture, Forestry and Fisheries

Based on the WRC project research and consultations, a document entitled; “**Organisational and Institutional Arrangements for Management and Development of Inland Fisheries**” was forwarded to DAFF for consideration in 2013. Project researcher, Prof Mafa Hara, consulted with the DAFF Fishery Branch: Aquaculture Technical Services (which was mandated to deal with the inland fishery issue) to present the research report, and a proposal for a National Stakeholder Meeting on Inland Fishery Governance to be convened by DAFF as the mandated national department. The objective of the meeting would be to present the final WRC project findings and agree on a process to develop policy and governance arrangements going forward.

It was agreed that the proposed meeting should include all the key government stakeholders in order to form a Working Group, develop a Terms of Reference and Work Programme. The main stakeholders identified were: Department of Agriculture, Forestry and Fisheries (DAFF), Department of Water Affairs (DWA), Department of Environmental Affairs (DEA), Department of Transport (DoT) and a number of relevant Provincial Departments of Nature Conservation (they have the responsibility for managing fisheries of state dams) from provinces such as Limpopo, Mpumalanga, North West, Eastern Cape, KZN and Western Cape. In addition, it was agreed that DAFF Aquaculture Research and Small-scale fisheries Directorates should be included.

In a follow up meeting in December 2013 with staff of the DAFF Directorate: Aquaculture Technical Services, it was indicated that there was still lack of clarity about the DAFF mandate for inland fisheries and what this mandate entailed. It was agreed that in order to take things further, the WRC project team should write to the Deputy Director General (DDG): Fisheries Resource Management about the project and its background and request a meeting of the concerned people both within DAFF and other departments about how to take this initiative forward. The WRC inland fishery research project recommendations were provided to the DDG: Fisheries Resource Management in early 2014, and the DAFF subsequently indicated that it was in the process of formulating a policy on inland fisheries.

7.2.4.2. Department of Environmental Affairs

Project Researcher Prof Mafa Hara conducted a consultation on inland fishery governance arrangements with Dr Debbie Sharp, Department of Environmental Affairs (DEA) representative responsible for the environmental and ecosystem management issues associated with dams. Based on inputs from the consultation, the role of DEA in managing fish populations in dams is synthesised below.

1. The National Water Act (NWA) and Fisheries. The use of public dams for fisheries is based on section 21 under chapter 4 of the NWA. Chapter 4 deals with water use which includes the various types of both licensed and unlicensed entitlements to water use. Part 1 of the chapter sets out the general principles for regulating water use and importantly broadly defines what water use is. Included in the definition of water use are ‘controlled activities’ and ‘recreation’. The preamble to the chapter further stipulates that “In general a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a license” (NWA, 1998: chapter 4 preamble, p17). The preamble further states that “In making regulations the Minister may differentiate between different water resources, classes of water resources and geographical areas” (NWA, 1998: chapter 4 preamble, p17).

Section 21 outlines the types of water uses. Two of the items under this section are applicable to fishing on public dams; these are items e and k:

“(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1)”; and

“(k) using water for recreational purposes.”

Part 5 of chapter 4 outlines what constitutes controlled activities and states that the Act makes provision for the minister to declare controlled activities as need arises through public consultation and that once such activity has been identified and declared as such, the Minister shall issue an authorization for the activity. Section 37 lists the controlled activities under the Act, with item (e) saying that a controlled activity is “an activity which has been declared as such under section 38”.

Section 38 states that:

- 1 “The Minister may, by notice in the Gazette, in general or specifically, declare an activity to be a controlled activity”; and
- 2 “Before declaring an activity to be a controlled activity the Minister must be satisfied that the activity in question is likely to impact detrimentally on a water resource”.

Taken as a whole, these sections of the NWA would seem to provide for fishing activities on public dams. In order to facilitate use of dams for fishing and other controlled activities, a coordinating committee has been constituted.

2. Coordination of management and development activities on public dams

The inter-departmental committee for coordination of management and development activities on public dams is chaired by the Department of Water Affairs.

One of the key issues is that each dam needs to have a Resource Management Plan (RMP). A RMP provides authority for the activities on the dams. The process of developing the Resource management plans for the dams in the country falls under the DWA.

For an activity to be approved by the Minister, the committee has to consider at all the aspects that need to be met. For example, the Department of Water Affairs requires a resource management plan for each dam. Currently, the Department Water Affairs, through the work of the committee, has drafted resource management plans for the 5 pilot dams (Theewaterskloof (WC), Boskop (North West), Midmar (KZN), Vanderkloof (NC) and De hoop (Limpopo)) under the Cooperative Inland Water Safety Programme (CIWSP) programme but is aiming to have RMP's drafted for all government owned waterworks.

The membership for the committee for developing RMP comprises of: Department of Water, Department of Environmental Affairs, Department of Transport, South African Maritime Safety Authority, South African Police Service as the key role players. The CIWSP is spearheaded by the Department of Transport and is being piloted on 5 dams currently with roll out planned on all dams in the country. The programme governs the safety on dams in the country. The committee falls under the management of the Centre for Public Service Innovation. Notably, the DAFF has not been a participant on the DWA coordination committee.

The Department of Environmental Affairs (DEA) ensures that the National Environmental Management: Biodiversity Act (NEM:BA) aspects of the management plans are taken cognizance of and adequately covered. As part of NEMBA, there is an eradication programme for exotic species. This proposes the removal of introduced and/or exotic species from dams and rivers where they posed high risk of biodiversity reduction and where this is achievable. This is being piloted in five systems namely, Theewaterskloof (WC), Boskop (North West), Midmar (KZN), Vanderkloof (NC) and at a later stage, De hoop (Limpopo).

Under the National Environmental Management Act (NEMA), the utilisation of indigenous species requires a permit. It is a listed activity that requires an Environmental Impact Assessment (EIA) to be undertaken before approval. Furthermore, under NEMBA a list of prohibited species in specific areas has been developed which are not indigenous as this posed high risk on biodiversity.

7.3 Fishing Community Consultations

7.3.1 Community Fishery Survey

As small-scale fishing activities by rural communities on inland waters are poorly documented, and fishing rights for customary or livelihood purposes are not formalised in law, it was particularly important that consultations with a representative sample of small-scale fishing communities were undertaken to inform the process of developing fishery governance recommendations.

A survey of twelve selected case studies of inland fisheries located in six provinces was conducted in 2011 under the leadership of Dr Barbara Tapela of PLAAS, University of the Western Cape (Volume 2 – Tapela, 2015). The survey and associated consultation process informed a diagnostic analysis of governance issues which would need to be addressed in the development of an equitable and sustainable inland fishery policy.

The consultation process was based on a participatory approach comprising of which formal community meetings, focus groups and individual interviews.

The communities consulted were selected based on their geographic location, existence of fishing activity, human population characteristics, types of fishery, and resource use issues, in order to profile the contexts that future fishery governance development processes would have to incorporate. The selected case study sites were Phongola Dam and Floodplain (KwaZulu-Natal), Voelvlei dam (Western Cape), Flag Boshielo Dam (Limpopo Province), Nandoni Dam (Limpopo Province), Makuleke Dam (Limpopo Province), Middle Letaba Dam (Limpopo Province), Lake Fundudzi (Limpopo Province), Zeekoeivlei Lake (Western Cape), Driekoppies Dam (Mpumalanga Province), Masibekela Dam (Mpumalanga Province), Roodekopjies Dam (North-west province), and Debe Nek Dam (Eastern Cape Province). Recognizing the need to link the community based research to other components of the broader national baseline and scoping study, the researchers carried out additional local consultations with key institutional stakeholders and resource users.

7.3.2 Community Consultations on Small-scale fishery Management Processes and Governance Systems

In follow up consultations in 2012, Tapela re-visited selected small-scale fishing communities (Phongola Dam and Floodplain, Flag Boshielo Dam, Nandoni Dam, Makuleke Dam, Middle Letaba Dam, Lake Fundudzi) to document the current fishery access rights and governance institutions, both formal and informal.

The extensive series of consultations provided in-depth insight into the existing inland fishery governance arrangements, both formal and informal, and the challenges of developing empowering co-management arrangements to promote sustainable livelihoods.

7.3.3. Phongola Multi-Stakeholder Consultative Workshop

In light of preceding research and the above-mentioned perspectives, and user conflicts on Phongola dam, PLAAS researchers convened a participatory multi-stakeholder workshop at Mkuze on 13 June 2013. The objectives of the workshop were to share research findings, conduct a rigorous Stakeholder Analysis and obtain stakeholder perspectives on co-management and governance. The sixty persons who attended the workshop represented various sectors ranging from government departments at local, provincial and national levels, traditional leadership, municipalities, non-governmental organisations (NGOs), civil society organisations (CSOs), Community Based Organisations (CBOs), interest groups (e.g. recreational angling clubs, boating clubs, farmers, fishers and fish sellers' associations), Water User Associations (WUAs), and the private sector. Stakeholder participation in the workshop became broader than planned due to a convergence of interests associated with the inception of new projects to effectively link the Pongola Dam fishery to market value chains, which are supported by a number of institutions and organisations.

An important finding of the workshop was that in addition to the currently recognised stakeholders listed in WUA records, there were a number of other stakeholders with existing and potential interest in Phongola Dam fisheries, who were not recognized. These included women of Ntlalavini village community, Phongola Floodplain Adventure River Company, Impala WUA, Ohlalwini Fishers' Group, Africa Agribusiness Thinktank, subsistence farmers and fishers of Phongola floodplain, Thapavusi Project and South African Police Services. Details on stakeholder interests, as expressed by the stakeholders themselves, are summarised in Table 21.

The inputs received at the Phongola were used to formulate recommendations for the development of governance institutions for the co-management of small-scale fisheries outlined in Chapter 8.

Table 21 Stakeholder Interests And Pongola Dam Related Fishery Issues, 2013

Name of Stakeholder		Interests/Capacities/Resources/Roles/Responsibilities	Fishery Issue(s)
DWA	CMA (WUA)	Water resources management, control and regulation	Local know-how Enforcement Operations and Maintenance (O and M) Accessibility/ Permits Conservation, Water quality Water storage and release
	NWR Infrastructure	Abstraction control and basin management	
Dept of Economic Development (DTI)		Supporting small and medium enterprises (SMEs)	Fishing permits
COGTA (incl. Trad. Houses	Umkhanyakude District Municipality	Water Services Authority (WSA) Water Services provider (WSP)	Job creation Political buy-in Inclusion in IDP
	Jozini Local Municipality	Water supply distribution Local Economic Development (LED)	
Agri-Business Development Agency		Business planning for SMEs	Funding, training and marketing
Mjindi Farming Scheme (Makhathini FA)		Water user	Perceived opportunity
KZN Dept. for Agriculture, Environmental Affairs and Rural Development (DAEARD)		Environmental management, control, regulation and planning; Hatchery for supply of fingerlings; Extension services Downstream aquaculture projects Ne project support to Sizabantu artisanal fishers	Need for endorsement by Ezemvelo KZN (NB: This has subsequently been obtained)
Department of Public Works		Water User	Development around the dam Water quality
Jozini Boat and Angling Club (and other recreational clubs)		Recreational Angling Tourism	Conservation of species Species preservation Controlled angling
Phongola Floodplain Adventure River Company		Canoeing, bird watchers and tiger fishing	Too little water in Nhlanguano pan for bird watchers and tiger fishing

Name of Stakeholder	Interests/Capacities/Resources/Roles/Responsibilities	Fishery Issue(s)
Impala WUA: Located upstream of Phongola Dam and 		

Name of Stakeholder	Interests/Capacities/Resources/Roles/Responsibilities	Fishery Issue(s)
Women of Nhlalaveni Village	Access to water for basic human needs and subsistence food production	1. Long distance to walk to informally access water (1 hour to and fro). 2. Dirty water shared with donkeys, dogs, cattle and goats. 3. Displaced and lost food gardens and livelihoods when the dam was built and were not compensated. 4. During flood releases, the Nhlalaveni area has no water at all because deep mud makes impossible and risky to attempt to get to the water's edge. 5. Women still live with the negative results of such displacement, and their lives are hard, insecure and vulnerable, along with their households. 6. Example: One elderly woman (umama)
Sizabantu Artisanal Fishers (from Jozini)	Inland fishing on Phongola Dam, for livelihoods	1. We are constantly arrested, our nets and boats confiscated, and we are taken to court. Although we win the cases, our gear is not returned to us. We end up using unsafe boats, which puts our lives at risk. 2. Our vulnerability is such that even visiting tourists boldly confiscate our nets wherever they find them. This unjust harassment undermines our rights and livelihoods, and those of women fish sellers who depend on our artisanal fishing. 3. We have no power to prevent these problems. However, what is critical is that we have hope that government will help us in our quest to obtain fishing licences, sound fishing boats and skills training ("nokuqeqeshwa"). 4. Our objective is to broaden our marketing beyond the local area, and to ultimately enter international export markets. 5. We also would like to more effectively contribute to local food security, particularly in rural communities.
Sizabantu Women Fish Sellers (Abathengi boFish)	Marketing of fish in various villages and towns, such as Jozini, Mkuze, Pongola, Mtubatuba, Bhambanana, Ngwavuma, Mbazwane, Hluhluwe and Skhemelele.	1. Lack of proper fish processing and marketing facilities. 2. The arrest of Sizabantu fishers and confiscation of their nets hurts and impacts negatively on us ("siyahlukekumezeka"). 3. Lack of refrigerated facilities to store left-over fish, hence the high risk of loss due to spoilage.

Name of Stakeholder	Interests/Capacities/Resources/Roles/Responsibilities	Fishery Issue(s)
Ohlawini Fisher's Group (These are floodplain pan artisanal fishers whose livelihoods have been severely undermined by unfavourable dam releases.)	Recognition of floodplain artisanal fishers' interests in decision-making regarding dam releases. Support with obtaining fishing permits and gear (boats and nets), so that they can fish legally and avoid constant arrest and insecurity . Need their voices to be heard.	Lack of fishing permits; Unemployment Livelihood insecurity Contribution to rural food security
Africa Agribusiness Thinktank (members include the Great North Development Forum, DEDT, ADA, KZN Department of Agriculture and Environmental Affairs (DAEA) and Lontfo Projects SA)	Aquaculture Inland fishing Marine fishing	1. Capacity building: Training in skills, regulations and policy. 2. Access: Dams for inland fishing, licensing and concessions. 3. Infrastructure: For aquaculture
Subsistence farmers and fishers from Mboza, Makhani and Dumu communal areas in the floodplain.	Fishing Farming Access to potable water (for domestic use) and irrigation water.	1. Silting up of pans 2. With habitat degradation, increasing scarcity of fish. 3. Fencing off of crop fields, which limits access to the pan fisheries 4. Conservation of natural river ecosystems 5. Long distance from farming areas to the sugarcane mill. 6. Alternative economic benefits from floodplain use, instead of sugar production. 7. Water access for irrigation 8. Rehabilitation of river ecosystem natural resources (e.g. water, matting rushes like incema (<i>Juncus kraussii</i>), ibhuma (<i>Typha capensis</i>) and imizi (<i>Cyperus sexangularis</i>)) and related resources.

7.4 Consultations with the Organised Angling Sector

A series of consultations was conducted with representatives of the organised recreational angling sector to brief them on the WRC Inland Fisheries project, and to solicit their inputs into the development of recommended inland fishery governance and institutional arrangements.

7.4.1 The South African Sport Anglers and Casting Confederation (SASACC)

The WRC inland fishery project leader (Prof. Peter Britz) facilitated a series of consultations the South African Sports Angling and Casting Confederation (www.sasacc.co.za). The WRC project research findings were presented at the SASACC Annual General Meeting on 3 November 2012, and inputs solicited from the constituent angling facets. This was followed by correspondence with SASACC President, Mr John Pledger, and a second consultative meeting on developing a self-governance proposal for recreational angling on 16 January 2013.

SASACC is an umbrella body for the 19 angling disciplines including both fresh and salt water sport angling facets. SASACC is the official national sports angling body affiliated to the South African Sports Confederation and Olympic Committee (SASCOC). SASACC represents over 20,000 paid up members of angling associations.

The consultations revealed that recreational anglers were acutely aware of the need for a stakeholder institution through which the collective interests of recreational anglers could be represented and promoted.

The concerns of the SASACC members included:

- Representation of the angling sector to government.
- Recognition of socio-economic contribution of angling.
- Representation of non-affiliated recreational anglers – How?
- Inclusion of anglers in policy and governance processes
- Sustainable fishing such as the promotion catch and release angling.
- Concerns about the impact of gill net fishing on sustainable resource use.

SASACC member organisations were very conservation conscious, promoting sustainable fishing, particularly catch-and-release angling. Deep concerns were expressed over the expansion of illegal and uncontrolled gill net fisheries which were regarded as unsustainable, and a threat to recreational angling (Venter, 2012).

SASACC was particularly concerned with the lack of recreational fishing stakeholder representation in government fishery policy and management processes. Angling is organised as a sport along international rules, but no formal stakeholder body existed to represent the rights and interests of anglers in fishery policy and management at government level. The SASACC delegates were very interested in the WRC project outputs and learning more about how to form a formal stakeholder group which would be recognised as representative by the Department of Agriculture Forestry and Fisheries and other national and provincial departments. SASACC members were particularly concerned that the social and economic contribution of angling be recognised in order for recreational angling to be recognised as a fully-fledged fishery sub-sector alongside the commercial fishery sub-sectors. This arose out of a concern that the interests of recreational angling and the potential socio-economic contribution of the sector were sometimes not taken into account in resource management decision making which tended to favour commercial and subsistence livelihoods from extractive fishing. The growing number of conflicts between recreational and subsistence/ artisanal angling was also seen as a symptom of the lack of policy and management guidelines on the achievement of socio-economic goals by different forms of fishing.

While SASACC is a sporting governance structure affiliated to the South Africa Sports Confederation and Olympic Committee (SASCOC), most recreational anglers are however not affiliated to any club structure. This is problematic as it is difficult to mobilise representative stakeholder inputs and actions on issues affecting recreational anglers. Since the issuing of inland fishing licences by the provinces has largely fallen

away, it is difficult to know how participants there are in the activity⁷. While organised sport angling has some 20,000 members affiliated to SASACC, recreational anglers are believed to number around 2.5 million (Leibolt and Van Zyl, 2008). SASACC in recent years has become concerned that recreational angling interests are not represented in fishery policy and management decisions, for example, the promotion of small-scale fishing livelihoods and full time commercial fishing rights over recreational angling, and the growing illegal use of gill nets. While the commercial marine fishery sub-sectors are represented through the DAFF commodity association and fishery management “Working Group” institutions, recreational fishing is not formally recognised as a contributor to economic activity and social benefits. In the absence of the recognition of the social and economic contribution of recreational fishing, and appropriate management institutions, fishery policy and resource management decisions tend to favour commercial and small-scale fishing over recreational resource use. SASACC thus initiated a process to establish an angler stakeholder body that would promote sectoral self-governance, the proposed South African Consolidated Recreational Angling Association (SACRAA).

The SACRAA mission is:

‘To become a recognised regulating body of recreational anglers in Southern Africa through partnerships with recreational anglers, organised angling bodies, businesses, learned institutes and governing bodies with a vested interest in our natural and or fishing resources, whereby we combine our efforts to protect our natural resources to ensure a sustainable future fisheries, thereby ensuring a future trading market.’

SACRAA seeks to establish a high degree self-governance by the recreational angling sub-sector through the administration of fishing licenses, the promotion of sustainable fishing through angler education, negotiation of management measures with authorities, co-management of water bodies, fish stock rehabilitation, compliance initiatives and research.

Following consultations with the SASACC president, John Pledger, the WRC fishery project leader (Professor Peter Britz) advised SACRAA to seek recognition as a commodity association of the DAFF. This would require proof that the organisation is properly constituted and representative of the sector according to DAFF guidelines for commodity associations (DAFF, 2010). In response, SACRAA appointed a consultant to draft the necessary documentation to approach DAFF to initiate a process of forming a recreational angling commodity group (Wood, 2014).

In terms of organisational arrangements for effective inland fisheries governance, the proposed SACRAA angler stakeholder association will be a valuable institution provided there is 1) buy-in from the recreational angling community, 2) support from government in the form of recognition as a representative stakeholder body and 3) a gazetted mandate from the Minister of DAFF to collect SACRAA membership fees.

A follow up meeting with the SASACC president and Gleneagles Consulting was held on 7 February 2014 where the progress towards the establishment of a commodity group was discussed as well as the need for policy on the management of inland fisheries. The WRC project leader (P. Britz) provided inputs into the SASACC initiative to value the economy associated with recreational angling and into strategy and documents motivating the formation of a DAFF recognised commodity group.

7.4.2 The Federation of Southern African Flyfishers (FOSAF)

The organised flyfishing angling body, the Federation of Southern African Flyfishers (FOSAF) was consulted on their concerns on representation and input into policy and regulatory processes affecting flyfishing. Their main concerns were the implications of the National Environmental Management: Biodiversity Act (NEM:BA) and regulations for the trout angling sector. Following email correspondence and telephonic discussions with FOSAF representatives, the project leader (P. Britz) facilitated a series of engagements to develop appropriate representation and governance arrangements for trout fishing and aquaculture.

⁷ The former Transvaal province issued 1.5 million angling licenses a year (J. Pledger, SASACC President, pers. comm., Jan 2014)

Trout anglers and farmers were concerned that the regulations published in July 2013 under the NEM:BA which listed trout nationally as an “alien and invasive” species would result in the extinguishment or restriction of existing rights to farm and fish for trout in many areas. Particular concern was expressed that the listing of trout as ‘invasive’ obligated the eradication or control of trout, even where it posed no biodiversity threat. FOSAF were informed that the DEA DDG, Dr Guy Preston, had stated that they recognised the problem and that the DEA did not intend implementing the regulations as promulgated. Instead, trout would be re-categorised to be managed by area in terms of their invasive potential and threat to aquatic biodiversity. This was made possible by an amendment to the NEM:BA, (the National Environmental Management Laws Amendment Act – NEMLA, July 2013) allowing for management of alien species by area. It was thus essential that trout interested and affected parties make inputs into the geographical zoning process which would determine where trout could be stocked and under what conditions.

An analysis of the cooperative governance requirements of the National Environmental Management Act (NEMA), and the implications for the management of trout fishing and farming in terms of the NEM:BA, was drafted by the Prof Britz and presented at the DAFF-DEA workshop on 8 October. Following the advice of DAFF, the trout sub-sector was advised to approach the DAFF: Chief Directorate Aquaculture and Socio-economic Development to facilitate a process with the Department of Environmental Affairs to develop an area based plan for the management of trout which included biodiversity issues, as well as the social and economic aspects of trout fishing and aquaculture. Dr Guy Preston, DEA Deputy Director General, responsible for Biodiversity Management indicated that the DEA encouraged the formation of a representative stakeholder group with whom it could interact formally to develop workable area-based trout stocking guidelines.

FOSAF and the trout farmers were advised by the WRC project leader to form an aquaculture value chain commodity group, following guidance obtained from the DAFF (Hlatshwayo, 2014). Dr Hlatshwayo stated that because trout angling relied upon the stocking of hatchery reared fingerlings, its interests would be best represented as part of the aquaculture sector which DAFF was actively promoting as a priority economic activity. A national policy framework for aquaculture development was Gazetted in 2013 which included aquaculture as an Industrial Policy Action Plan (IPAP) priority and thus trout interests would enjoy priority in the negotiation of cooperative governance arrangements to promote the sector.

The WRC project leader participated in a workshop with FOSAF and trout farming representatives on 16 December 2013 which led to the constitution of TroutSA, which would seek recognition from DAFF as a representative sub-sector commodity group

7.4.3 Recommendation for Inland Fishery Management, Organisational Arrangements and Governance

The consultative process conducted by the WRC project team was effective in soliciting inputs from government, small-scale fisher communities and recreational angling stakeholders.

The extensive consultations conducted with small scale fishers were embedded within original research into the governance context and livelihood needs of marginalised rural communities. The consultations confirmed that small scale fishing are an important livelihood option in these communities that needs to be recognised and supported in an inland fishing policy. The extensive testimonies of fishers being crowded out of fishery resources as a result of their lack of capacity to participate in governance institutions, and to know and assert their common pool resource access rights, highlighted the need for a human rights based development approach to small scale fisheries. The project reports documenting the small scale fisher case studies and consultations provides a sound knowledge base for the development of an inland fisheries policy.

The consultations with the organised angling organisations revealed that recreational angling has a huge participation rate and generates a large, but unquantified, socio-economic benefit. Appropriate policies to promote rural livelihood development linked to the recreational angling value chain could promote decent jobs and food security in rural areas.

Recreational fishing representatives were concerned that their sector was not recognised as a fishery that generates a societal benefit, and that growing and unsustainable small-scale fishing, particularly gill-netting, threatened their activity on many waters. Policy is required to clearly define inland fishery user rights and institute sustainable resource management institutions.

The concerns of trout anglers on the NEMBA regulations highlighted the need to manage the economic aspects of the sub-sector along with the biodiversity aspects.

The consultations facilitated by the WRC project team opened a channel of communication between trout anglers, DAFF and DEA, paving the way to establish a representative stakeholder association which could make input into the development of acceptable trout fishery management arrangements. The consultations and inputs on fishery governance based on the National Environmental Management Act facilitated by the WRC project leader assisted the DEA in the revision of the NEMBA Alien and Invasive Species regulations to allow for the management of the trout angling sector.

The consultations with government stakeholders elicited positive support from DAFF for taking up the inland fishery mandate, recognising the need for policy and legislation, and initiating a technical assessment of the condition of state hatcheries. Enthusiastic support was indicated by provincial officials who experienced many of the fishery issues first hand on the ground and desired policy and institutional support for inland fishery development. The roles of the national Departments of Water Affairs, Environmental Affairs, and Transport in inland fishery governance were acknowledged and officials made inputs into the consultations based on their legislated mandates.

The consultative process with DAFF stalled following the 2012 workshops, due to consecutive leadership changes at Director General and Deputy Director General level. As a consequence, managers in the Fishery Branch: Aquaculture and Technical Services Directorate were not provided with a mandate or guidance on how to take the recreational fishing governance issue forward. However, repeated approaches to the DAFF Fishery Branch in 2013, yielded a commitment from the DDG: Fisheries Resource Management to formulate an Inland Fisheries Policy in 2014.

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8. INSTITUTIONAL ARRANGEMENTS AND ORGANISATIONAL STRUCTURES AND GOVERNANCE FOR SUSTAINABLE INLAND FISHERIES

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8.1 Introduction

The WRC inland fishery project confirmed the presence of a large recreational fishing sector, and growing subsistence and small-scale commercial fishing activity on most inland public water bodies (Chapter 4 and the Small Scale Fishery Case Studies in Volume 2 of this report – Tapela *et al.*, 2015). Legislation and established institutions governing recreational fishing exist, but are in need of reform as small scale as livelihood activity on inland waters is not formally recognised in policy and legislation. Thus, while South Africa possesses many public dams and natural water bodies with inland fishery potential, institutions and organisations to promote their optimal use for livelihood development and food security purposes are generally lacking. The research conducted during the present study has shown that as a consequence of the lack of defined rights and governance institutions, small-scale fishing on inland waters tends to be marginalised, perpetuating Colonial and Apartheid inequities related to natural resource access and benefits.

A recognised and legal inland fishing sector governed on the basis of optimising socio-economic benefits, could potentially be a valuable contributor to rural livelihoods and food security. Decent jobs in the tourism sector based on recreational fishing could also contribute to rural food security, and therefore strategies for including rural communities in the recreational angling and tourism value chains should be promoted, in addition to fishing for food. An inland fisheries policy, aligned with Constitutional legislation and international norms for small-scale fisheries governance, is thus required to provide guidance on institutional arrangements and organisational structures that enable access to dams for sustainable fish production and harvesting.

The review of inland fishery access rights (Chapter 2), revealed that small scale and subsistence fishing rights are currently poorly defined, and not recognised within the existing provincial legislations that govern fishing on public dams. This ambiguity of the legal status of subsistence fishing is at the root of increasing conflict between subsistence fishers and other users on certain dams where these co-exist, such as Phongolo Dam in KZN (see Case Study in Volume 2). The exclusion of disadvantaged communities from local natural resource use for livelihood purposes is inconsistent with the equity provisions of the Constitution, National Environmental Management Act and National Water Act, and thus the challenge is to formalise subsistence and small scale commercial fishing and accommodate the activity alongside the other established secondary uses. Enterprises associated recreational fishing are largely white-owned and operated, and thus appropriate institutions and organisational arrangements are required to the promote participation of rural communities in inland fisheries value chains.

Most public dams belong to the Department of Water Affairs (DWA) which utilises a suite of well-defined legislation and policies to manage and optimise their public good benefits of society. The primary legal instruments are the NWA (Act 36 of 1998) and the national Water Services Act (Act 108 of 1997), which provide for the issuing of various types of permits and authorisations. Access to natural water bodies within communal lands mostly fall under Traditional Authorities who derive their powers from the Traditional Leadership and Governance Framework Amendment (TLGF) Act (14 of 2003), even though under the NWA all water belongs to the state. In such contexts, the Traditional Authorities exercise control on behalf of their subjects.

Provincial environmental departments and/or boards of the environment have historically held the authority and mandate for management of fisheries and biodiversity on public dams. In this context, provincial environmental departments and/or boards of the environment issue permits and authorisations for all forms and types of fishing on public dams. On most dams, there are well-established formal and institutionalised

uses such as recreational angling, water sports, guesthouses and other tourism and leisure industry ventures. On some dams, for example Bloemhof in Free State, there are permitted forms of commercial fishing, while on many others there is informal subsistence/commercial fishing (for example Pongolo, Nandoni, Driekoppies, etc.) by surrounding communities (Chapter 2; Tapela *et al.*, 2015).

In the absence of a policy on inland fisheries for livelihood purposes, rudimentary recreational fishing rules in the provincial nature conservation ordinances and acts, which derive from the pre-democratic era, are used by provincial agencies to manage inland fisheries. While environmental legislation has been revised post-1994 in some provinces, the new statutes have retained the old conservation orientated fishery regulations that are geared towards regulation and support of recreation fishing rather than the consumptive use of the fish resources (see Chapter 2). The promulgation of the Constitution (Republic of South Africa 1996) which enshrines environmental rights for all South Africans (section 24 of the constitution outlines the rights of all citizens to the environment) and the National Environmental Management Act No. 107 of 1998 (NEMA) however create an imperative to revise the provincial legislation to promote more equitable participation and benefit for rural communities from public natural resources such as inland fish resources. This goal requires the creation an appropriate institutional framework which places people's needs at the centre of inland fisheries management and governance.

As fisheries are regarded a primary industry, the Department of Agriculture, Forestry and Fisheries (DAFF), is the line agency for the development and management of fisheries has a developmental role in line with DAFF's Growth and Development Strategy (DAFF, 2010), government's rural development strategy (Department of Rural Development and Land Reform, 2009) and the National Development Plan (National Planning Commission, 2011). These require the maximisation of equitable socio-economic utilisation of natural resources for rural communities. Thus interventions for governing inland fisheries need to be based on a developmental approach and a move away from the customary resource conservation orientated management approach.

As inland fisheries are largely individual user based, small scale, and very heterogeneous geographically, it was agreed at the WRC Inland Fisheries stakeholder workshop for government departments in 2012 that a cooperative governance "co-management" approach would be most appropriate for managing inland fisheries (Britz, 2012; Chapter 7 – Stakeholder Consultations). Co-management is defined as "a partnership in which government agencies, local communities and resource users, non-governmental organisations and other stakeholders share, as appropriate to each context, the authority and responsibility for the management of a specific territory or a set of resources." (IUCN World Conservation Congress, 1996). The general functions of co-management can be identified as; the encouragement of partnerships; provision of local incentives for sustainable use of resources; and the sharing of power and responsibility for conservation. Co-management is a compromise between government concerns for sustainable utilisation and conservation on the one hand and resource users' desire for equal opportunities, self-determination and self-control. The co-management approach makes two assumptions; that local people must have a stake in conservation and management and secondly, that partnership of government agencies and resource users is essential for positive management outcomes. Co-management advocates and recommends a shift away from autocratic and paternalistic modes of management to models that rely on the joint efforts of government agencies and users. Ideally, co-management gives user groups a real influence, in the sense that their practical knowledge makes a difference in the management decision-making process.

South Africa's Constitution (Act No. 108 of 1996), in particular sections 40 and 41, provides the foundation for co-operative governance. It enshrines the involvement of citizens in decisions over issues that affect them including the management of natural resources. This is further strengthened by the National Environmental Management Act (Act No. 107 of 1998) which expounds a 'people centred' and 'cooperative governance' approach towards management of natural resources. Public participation in environmental management is therefore a legal requirement in South Africa. Regarding public dams, the NWA provides for and requires the establishment of co-management decision-making structures for the use of public dams for various purposes. At the government stakeholder workshop for inland fisheries held on 7th March 2012 in Pretoria, it was agreed that co-management would be the appropriate governance approach for inland fisheries (See Chapter 7 – Stakeholder Consultations).

The recommendations for the organisational and institutional requirements for management and governance of inland fisheries are thus premised on the institution of co-management, and informed by South Africa's rights based constitution and environmental legislation, the nature of the inland fishery resources, and the cultural, social, and economic characteristics of the fishery stakeholder groups.

8.2 Institutions and Organisations Defined

Institutions are generally understood as 'rules of the game' (North, 1990). They shape human behaviour in economic, social and political life. Institutions provide for predictable and stable patterns of interaction among individuals of a community (Scott, 2007). Institutions do not only create restraints, but they enable, empower, and provide license and hence opportunities. They confer rights as well as responsibilities (ibid). Thus institutions are best thought of as durable social rules and procedures, formal and informal, which structure the social, economic and political relations and interactions of those affected by them (Leftwich, 2006 and 2007). Institutions are thought of as being either 'formal' or 'informal'. Formal institutions are understood to be (written) laws, regulations, legal agreements, statutes, contracts and constitutions, etc., that are enforced by third parties. On the other hand, informal institutions are thought of as the (usually unwritten) norms, customary practices, standard operating procedures, routines, conventions and traditions (Hall, 1992) that are often deeply embedded in culture and its associated ideology. Social, economic and political institutions overlap and have inter-penetrative relations. Thus economic institutions are political in their provenance, effect and impact. At the same time, political institutions and processes affect the shape and the functioning of economic institutions and practices. Scott (2007) argues that "the *normative*, *cognitive* and *regulatory* are the three pillars of institutions". In fisheries management the third pillar (regulation) has generally been the one emphasised resulting in an overly legalistic approach to fisheries management (Jentoft, McCay and Wilson, 1997). The co-management model holds that there is a third way to avoid over-exploitation of natural resources: In addition to legal and market mechanisms, there are organisations, which can co-ordinate user behaviour.

Organisations are manifestations of a particular set of institutions (Bromley, 1991). Organisations are best understood as the formally or informally co-ordinated vehicles for the aggregation, promotion or protection of a mix of individual and shared interests and ideas. In other words, if institutions are 'rules of the game', organisations are 'players of the game'. Organisations have their own internal rules which apply only to the members of a given organisation. They have their own internal systems of authority, hierarchy and command. Like institutions, organisations may be formal or informal and may operate within, across or outside economic, political or social institutional arrangements (Scott, 2007). Thus while public departments and ministries, companies, trades unions, political movements, churches, professional and business associations are formal organisations, they are not institutions. Informal organisations tend to have less or no public profile, no formal constitution and operate behind the public space. The mafia, secret societies, criminal gangs, cabals and some forms of social movements and cartels are all examples of informal organisations.

The interaction between institutions and organisations – that is the games and the players is an important aspect of understanding the concept of institutions and organisations. Organised human agency, in the form of formal and informal organisations plays a central political role in the shaping, maintaining, undermining, avoiding and changing institutional arrangements (IDS, 2010; Helmke and Levitsky, 2006). Thus economic, political and social institutions are shaped, implemented, undermined or reformed by individuals and organisations. The effectiveness of institutions and hence outcomes for which institutions are put in place depends therefore on the way in which institutions interact with organisations and individuals. Organisations and individuals may play the game according to the rules or they may seek to evade and avoid the rules, thereby undermining the game; and they also seek to shape or influence the rules (IPPG, 2010; Scott, 2007; Helmke and Levitsky, 2006). Understanding when, how and why institutions work involves understanding how they are negotiated, how they evolve, and the conditions of their effective implementation. In other words, this involves understanding the politics of how individual players, organised interests and institutions interact. Hence while it is true that 'institutions matter', individuals and organisations matter too, for it is they who forge, maintain, implement and change institutions (IPPG, 2010).

8.3 Existing Organisational Structures And Legal Frameworks

This section describes the organisational structures for the key departments for the development and Management of Inland fisheries and also the legal frameworks that are likely to be key for institutionalising formalising, and management of the sector. These are the DAFF: branch Fisheries, the Department of Water Affairs (DWA), the Department of Environmental Affairs (DEA) and the provincial departments and boards of the environment.

8.3.1 DAFF: Branch Fisheries

The line agency for management of fisheries is the Department of Agriculture, Forestry and Fisheries (DAFF): branch Fisheries, with the organisational structure outlined in Figure 32. The ultimate responsibility for all management decisions on fisheries rests with the Minister responsible for Department of Agriculture, Forestry and Fisheries (DAFF). Usually the Minister delegates her or his responsibilities to the Deputy Director General (DDG) who heads the Department (DEAT, 2005). The Department is organised into four technical directorates, namely:

- Aquaculture and Economic Development
- Monitoring Control and Surveillance
- Marine Resource Management
- Fisheries Research and Development

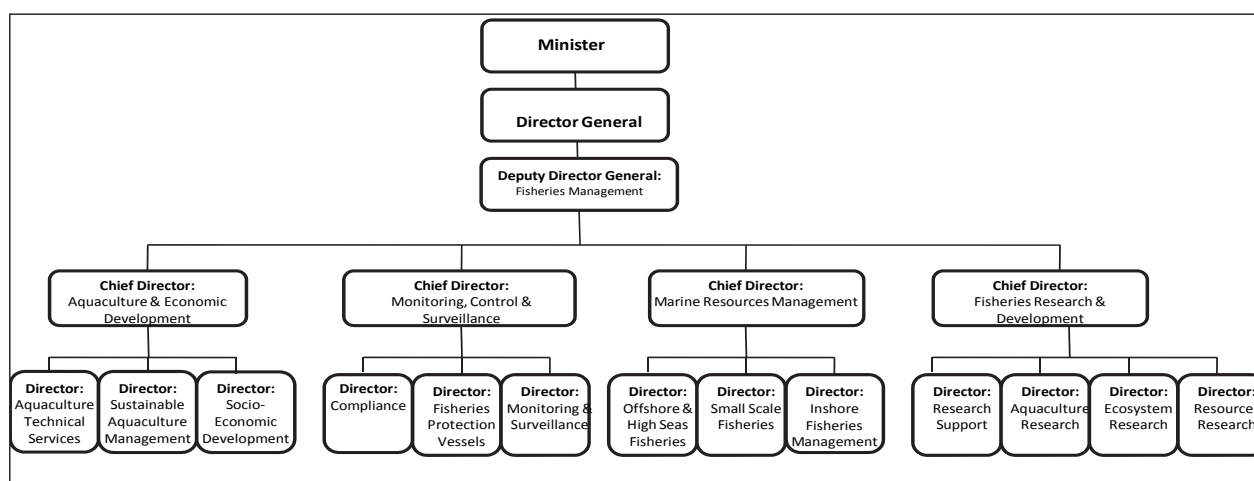


Figure 32 Organisational structure of DAFF: Branch Fisheries

The 'Technical Services' sub-directorate within the Aquaculture and Economic Development Directorate is currently assigned responsibility for the DAFF inland fisheries mandate but lacks a guiding policy, performance objectives and any dedicated capacity (Morake, 2012).

DAFF Fisheries Legal framework

The lack of specific legislation to promote inland fisheries development is an obvious constraint to sustainable and equitable resource governance. This need is illustrated by considering the well-developed legislation and policy governing marine fisheries. South African marine fisheries are managed as a national competency by the DAFF, except for KwaZulu-Natal where responsibility has been delegated to Ezemvelo KZN Wildlife. The national Fisheries authority is legally mandated through the Marine Living Resources Act (Act No 18 of 1998), which paved the way for establishment of the department for Marine and Coastal Management (MCM) in 2000. Following the restructuring that resulted in fisheries being grouped together with Agriculture and Forestry after the 2009 general elections the Department was renamed into DAFF: Branch Fisheries. The mandate of this new department was extended to management and development of inland fisheries and incorporated into the DAFF Strategic Plan 2012/13-2105/16:

'Following on the heels of DAFF's promising launch of its Aquaculture Programme, in the coming year DAFF anticipates creating a policy and programme on inland fisheries. The development of inland fisheries involves developing more economic opportunities around

generally existing fish stock within freshwater bodies and rivers; in the South African context, the main target is storage dams, of which there are over 3 000 around the country. (Aquaculture by contrast usually involves more purpose-built earthworks and/or other infrastructure, as well as modification of the water environment to make it nutrient rich.) The job creation potential of such an initiative is in the tens of thousands, most likely without requiring massive investment. Another virtue of this development is that it has particular potential to promote job creation within the former homelands, where many storage dams have been built, and where their recreational and fish-harvesting potentials have been especially neglected. Most dams in South Africa are under the jurisdiction of the Department of Water Affairs, while the fish in these dams are under the Department of Environmental Affairs; the development of an inland fisheries policy will therefore require close collaboration with these two departments.’ (DAFF, 2012)

The grouping of the inland fisheries mandate with DAFF implicitly shifts the emphasis of inland fishery resource management from a conservation orientation (under the provincial environmental agencies) to a developmental approach. The challenge is thus to develop appropriate institutional and organisational arrangements which are analogous to those governing the more established marine fisheries sector. The characteristics of South Africa's marine and inland fisheries however differ substantially, and thus only parts of the existing legal and policy framework are applicable to inland fisheries.

The principal legal and regulatory framework for governing fisheries comprises of section 24 (which outlines the rights of all citizens to the environment) of South Africa's Constitution (Republic of South Africa 1996), the National Environmental Management Act (Act 107 of 1998) and the Marine Living Resources Act (Act 18 of 1998, MLRA). Notably, no specific fisheries legislation equivalent to the MLRA exists to provide inland fisheries. For the marine fishery sector, each sub-sector has a clear policy that provides guidelines for the issuing of fishing rights in that sector, management plans and strategies and indicative frameworks for sectoral transformation (DEAT, 2005). There is therefore a requirement for the development of appropriate policy and legislation for inland fisheries.

As inland fishing for livelihood purposes is predominantly 'small-scale' and 'recreational', and lacks a guiding policy, the marine Small-scale Fisheries Policy (Republic of South Africa, 2012) provides useful guidance on the elements that should be considered. The policy has a strong developmental focus and the need to for utilisation of marine resources for poverty alleviation. The challenge is the implementation of the policy which is based on developing strong community based organisations for co-management of inshore marine resources and joint stewardship of the sector between the department and communities. The new small-scale fisheries policy proposes a paradigm shift from past top-down management approaches to community based co-management based on allocation of a basket of species to identifiable user groups. This is based on both the Territorial User Rights of Fisheries (TURF) and communal ownership. The Marine Small Scale Policy proposes that communities should form community entities (cooperatives) that will hold the rights on behalf of the community. While the small scale policy only has legal jurisdiction over marine fisheries, it provides important principles and management guidelines for developing inland fisheries governance arrangements. In particular, given the predominantly recreational and subsistence use of inland fisheries, a co-management approach will be essential.

Ideally inland fisheries should be part of a single "Fisheries Act" covering both marine and inland waters. The MLRA was revised in 2013 to provide for community small-scale fishing rights, but inland Fisheries and aquaculture were excluded from the current revision. It was suggested by DAFF representatives that inland fisheries could be included in the Act at a later stage, however, in the interim a legislative vacuum exists as DAFF has no legal powers over inland waters.

8.3.2 Department of Water Affairs

The Department of Water Affairs (DWA) is a key national department in terms of inland fisheries governance as it owns most public dams, and its policies determine access rights for secondary uses such as fishing.

Organisational structure

The line agency for management of water is the Department Water Affairs (DWA), the organisational structure of which is shown in Figure 33. The ultimate responsibility for all management decisions on water rests with the Minister of Water Affairs. Usually the Minister delegates her or his responsibilities to the Director General (DG) who further delegates operational decisions to the Deputy Director Generals (<http://www.dwaf.gov.za/structure>).

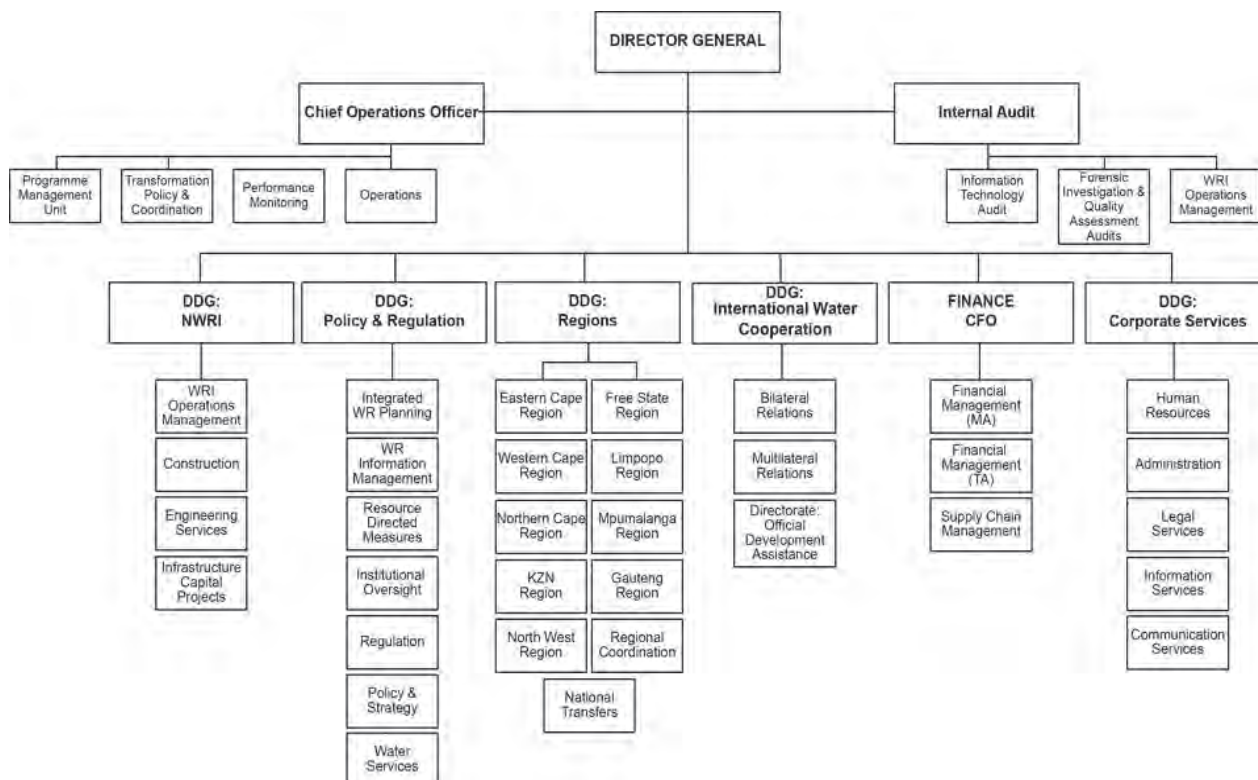


Figure 33 DWA Departmental structure (source – <http://www.dwaf.gov.za/structure>)

Four technical branches, each headed by a Deputy Director General (Figure 34), can be distinguished, namely:

- National Water Resources Infrastructure (NWRI)
- Policy and Regulation
- Regions (provinces)
- International Water Cooperation

For inland fisheries the relevant technical directorates are likely to be Policy and Regulation, and Regions (provinces). The first includes Institutional Oversight which is responsible for overseeing water resources management institutions (Figure 34) while the later groups the provincial offices responsible for management of dams in their region of responsibility.

Legal framework

Department of Water Affairs (DWA)'s legislative mandate is to ensure that the country's water resources are protected, managed, used, developed, conserved, and controlled in accordance with the requirements of the policies of the Department. The Department's core functions are outlined as being: policy formulation, water resource management, infrastructure development, capacity building, intergovernmental and intra-sectoral coordination, and water regulation. The work of the Department is informed by the National Water Act (Act No. 36 of 1998), the Water Services Act (Act No.108 of 1997) and the Water Research Act (Act No. 34 of 1971).

According to the revised National Water Act (NWA) (36 of 1998), all water (surface and underground) is a national asset legally held under the stewardship and custodianship of the state (principles 12 and 13 of the Act) on behalf of its citizens. The objective of the Act is to ensure that South Africa's water resources are protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons. The Act provides the Department the power to regulate the use, flow and control of all water in the Republic. The Act groups priority water allocation rights into that required for 'basic human use' (principle 8 of the Act) and 'ecological needs' (referred to as 'the reserve' principle 10). All other uses are regulated through 'registration' and various types of 'authorisations' (Principle 3). There are four types of water authorizations, namely: Schedule One; General Authorisations; Existing Lawful Uses; and Water Use Licences.

Water Management Institutions

The legislative framework provides a basis for establishment of various organisations to assist the DWA in the delivery of its mandate for water management. The Water Resources Management organisational framework comprises of three tiers namely, the national DWA, Catchment Management Agencies (CMAs) and Water User Associations (WUAs). The Chief Directorate: Institutional Oversight (under the Deputy Director General: Policy and regulation) (Figure 34) is responsible for water management institutional oversight. Institutional Oversight aims to ensure an enabling environment for the establishment, development, financing and audit of local and regional institutions for water resources management, water services, stakeholder participation and stakeholder empowerment. The water sector organisations that the Chief Directorate is responsible for are the Water Services Institutions (Water Boards) and Water Management organisations (Catchment Management Agencies and Water User Association) (Figure 34).

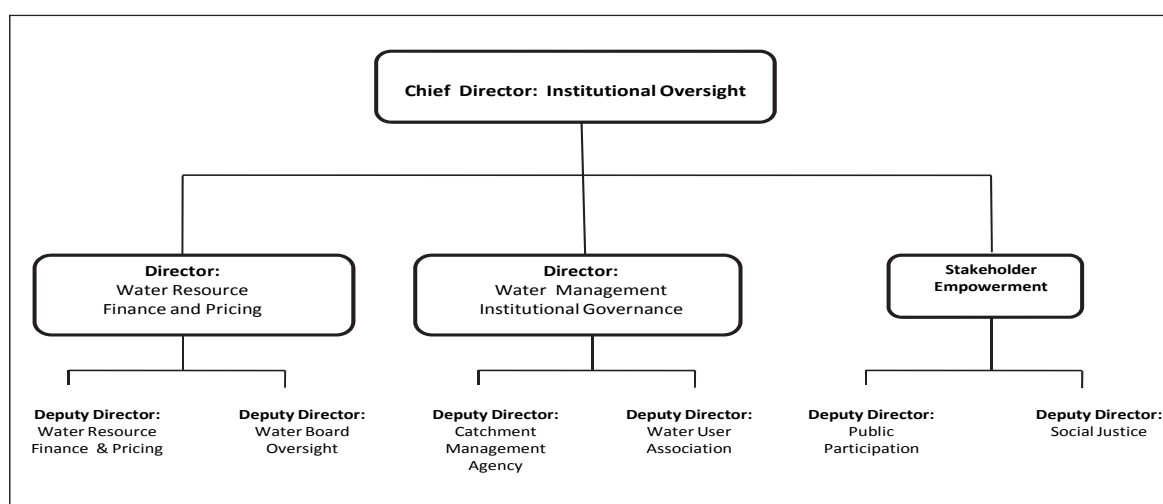


Figure 34 Chief Directorate: Institutional Oversight organogram

Water Boards

Water Boards derive their mandate from section 34(1) of the Water Services Act (Act No. 108 of 1997), Water Boards are categorised as national government business enterprises in terms of schedule 3B of the Public Finance Management Act (PFMA)(Act No. 1 of 1999). Water Boards are separate legal entities that have their own boards of governance, assets and are required to be self-funding. The Minister appoints board members and chairpersons. The boards are key strategic organisations charged with the responsibility for providing bulk potable water services to municipalities, other water service organisations and major customers within designated service areas. They vary in size and in terms of their activities, customer mix, revenue base and capacity. While most of the older and more established water boards are located in areas where there are significant urban development nodes (e.g. Rand Water, Umgeni Water and Magalies Water), the others operate in more demographically diversified areas straddling both urban and rural areas with a mixed customer base.

Catchment Management Agencies (CMAs)

The National Water Act (NWA), 1998 (Act No. 36 of 1998) makes provision for the progressive establishment of Catchment Management Agencies (CMAs). The role of a CMA is described as managing water resources in a water management area (WMA), coordinating the functions of other organisations involved in water-related matters and involving local communities in water resources management. The intention is to meet the basic human needs of present and future generations; to promote equitable access to water; and to

redress the results of past racial and gender discrimination and facilitate social and economic development. The CMAs are service delivery agencies and are listed in the PFMA as Schedule 3A public entities. Of the eight gazetted CMAs only two have been established and are operational, namely; the Inkomati and Breede-Overberg Catchment Management Agencies. These two have Governing Boards, a Chief Executive and first-line managers in place. Significant progress has been made in the implementation of their initial functions as stipulated in the NWA and the delegation of functions has also been approved.

Water User Associations (WUAs)

Chapter 8 and Schedule 3 of the NWA stipulates that all irrigation boards established under the Water Act of 1956 must be transformed into Water User Associations (WUAs) in order to provide for an integrated use of water resources. Of the 279 Irrigation Boards (IB) that existed when the NWA was promulgated in 1998, 111 (40%) have been transformed into fifty nine WUAs. Thirty five new WUAs have been established. Most of the newly established boards are focused on supporting resource-poor farmers. The challenges that have slowed down transformation of the remaining 129 irrigation boards can be largely attributed to: irrigation infrastructure assets liabilities; lack of racial and gender representation on WUA management committees; poor membership in WUAs; historical divisions; and lack of delegation of functions between WUAs and IB. There have been initiatives to use WUAs as vehicles for fisheries co-management such as on the Pongolo dam (see Phongola case study in Chapter 2). The problem though has been the dominance of well organised stakeholder groups at the marginalisation of communities and fisheries issues within the WUAs.

National Water Resource Strategy

The DWA is also in the process of reviewing the National Water Resource Strategy (NWRS). The review is seen as providing an opportunity to ensure that water is at the centre of planning and that it supports the broad national economic and social development goals through the Water for Growth and Development (WfGD) framework without compromising the long-term sustainability of water resources. A methodology and a framework to establish an Economic Regulator for effective economic regulation of the entire water value chain is being developed. It is intended to ensure the alignment of all legislation and also develop an operational model to deal with the current challenges resulting from the growing imbalance between supply and demand for water in South Africa.

There is also realisation that South Africa needs a baseline and platform for water sector organisations to facilitate discussion for the country's water security and to ensure that water underpins economic growth. The Department has thus initiated institutional and organisational reforms and re-alignment with the aim of enhancing institutional capability for fast-tracking service delivery and also to handle water management challenges both at present and in the future. This process entails:

- Developing an institutional and organisational framework that clearly defines roles, responsibilities and accountability within the water value chain.
- Enabling water sector organisations to have sufficient economies of scale in order to be efficient and have financial resources to employ skilled managers, professional staff and technicians.
- Promoting good governance in the water sector organisations so as to ensure separation of policy making, shareholding and regulation functions.
- Rationalising and aligning the number of organisations reporting to the Minister in order to have effective control.

One of issues under this current review of strategy is DWA's undertaking to facilitate access to and the use of dams for secondary activities such as fisheries, aquaculture and tourism through the development of appropriate policies and legislation where these do not already exist such as developmental inland fisheries.

Resource Management Plans

The Department of Water Affairs is developing Resource Management Plans (DWA, 2006) to manage recreational activities on all dams. Resource management plans encompass all activities on state dams including the Department of Transport has promulgated maritime regulations for inland fisheries, aquatic environmental management (DEA), recreational fishing. Although the RMP's are intended to manage

recreational use, subsistence fishing is included in the draft Van der Kloof dam RMP. As the RMP's are essentially technical documents based on activity zoning and activity rules, a concern is that their implementation will further marginalise subsistence and artisanal fishers from access to fishery resources. A facilitated intervention which takes the historical disadvantage borne by these communities into account is required to ensure their equitable participation in resource based opportunities.

8.3.3 Department of Environmental Affairs

The mandate of the Department of Environmental Affairs (DEA), deriving from Section 24 of the Constitution, is *'to ensure the protection of the environment and conservation of natural resources while balancing this with sustainable development and the equitable distribution of the benefits that can be derived from natural resources'*⁸ The Department's legal mandate is underpinned by a suite of legislation and policies⁹, the key of which is the National Environmental Management Act (NEMA) (Act No. 107 of 1998), which is the over-arching act for regulating the natural environment and biodiversity in South Africa. Inland fish resources are thus currently managed in terms of NEMA and related legislation. The Department fulfils this mandate through formulation, coordination and monitoring the implementation of national environmental policies, programmes and legislation. The organisational structure of the DEA is outlined in Figure 35.



Figure 35 Department of Environmental Affairs (DEA) Organisational structure

At National level, the DEA is organised into seven technical branches, namely: Biodiversity and Conservation; Climate Change and Air Quality; Chemicals and Waste Management; Environmental Advisory Services; Environmental Programmes; Legal Authorisations and Compliance Inspectorate; and Oceans and Coasts. Each of these is headed by a Deputy Director General. Each province has a department responsible for the environment, as well as parastatal boards mandated to manage environment assets in some provinces (KZN, Mpumalanga, Eastern Cape, Western Cape). In respect of fish resources, DEA is responsible for national policy flowing from the National Environmental Management Act (NEMA), particularly biodiversity management. Actual management of inland fish resources in terms of NEMA is delegated to the provinces through provincial environmental legislation and organisational capacity.

8.3.4. Provincial Departments and Boards of the Environment

Each province has a Department responsible for the environment, which includes management of natural resources and other environmental mandates such as Environmental Impact Assessments. The provincial departments under which environmental management falls in each province is illustrated in Table 23. Each Department is headed by a Member of the Executive Council (MEC), while the day to day operations are under a Head of Department (HoD). Each province has provincial legislation for environmental management (Table 23) that legalises and guides the execution of its mandated activities. In some provinces (Eastern Cape, KwaZulu-Natal, Mpumalanga, North West and Western Cape), there also parastatal environmental conservation boards (for example Cape Nature in the Western Cape and Ezemvelo KZN Wildlife in KwaZulu-Natal) responsible for conservation of biodiversity. Thus in provinces where there exists both departments of the environment and environmental conservation boards, the responsibilities are split between the two organisations. The boards are responsible for conservation of biodiversity in terms of the provincial

⁸ http://www.environment.gov.za/overview_department.

⁹ see <http://www.environment.gov.za/legislation/guidelines>

conservation ordinances and newer environmental acts, which are aligned by the NEMA suite of national legislation. The protection of indigenous fish species is particularly important in the execution of the mission of the Boards. In provinces where Boards exist, fisheries are mainly been managed by them. In provinces where such boards do not exist (Free State, Gauteng, Limpopo and Northern Cape) the Departments of the Environment are responsible for all environmental issues including fisheries.

Provincial Fisheries Management

The authority to manage and regulate the use of living organisms (flora and fauna) in dams is assigned to the provincial Departments of the Environment or Conservation Boards. In the absence of dedicated legislation for inland fisheries, the legal instruments used by the provincial departments of the environment and the boards are the provincial nature conservation ordinances and acts, the National Environmental Management Biodiversity Act (NEMBA) (amendment Act 10 of 2004), and aspects of the National Environmental Management Act (NEMA) (Act No. 107 of 1998) (Impson, 2012). The Departments and Boards are responsible for control of access to inland fisheries, determining the harvesting levels and generally formulating the conditions under which fishing rights in inland fisheries are exercised. This is done through a recreational fishing permit system (fishing permits can be purchase either at departmental offices, Office of Inland Revenue Authority or at the post office) for both individuals and recreational angling clubs.

Provincial Legislation for Fisheries Management

The Provincial Environmental Departments and Boards are empowered to manage fisheries in terms of provincial environmental management and nature conservation legislation, and also the NEMBA. The environmental legislation of certain provinces (Western Province, Mpumalanga and Limpopo) has been revised post-1994, while in others (for example Gauteng, Eastern Cape, Free State, KZN) the old ordinances still apply. Even where the legislation has been revised, the underlying tone remains the promotion of recreational fishing rather subsistence fishing. The Mpumalanga (Mpumalanga Nature Conservation Act No. 10 of 1998)¹⁰ and Limpopo (Limpopo Environmental Management Act No. 7 of 2003) legislations (both revised) forbid 'unsporting' methods of fishing. Similarly the Western Province Act (Western Cape Nature Conservation Laws Amendment Act No 3 of 2000) has a provision that puts restriction on 'killing or injuring of fish other than as part of permissible part of being caught as per permit conditions'.

Of note is that none of the provincial legislation (both old and revised) mention either subsistence fishing or any other form of fishing for livelihood purposes. Thus, in contrast to marine fisheries governed by the Marine Living Resources Act, socioeconomic objectives for the consumptive or recreational use of inland fish resources are largely lacking from all provincial legislation. This despite the fact that most alien species are not controlled in terms of catch, and also that generous catch limits for most indigenous species exist in most ordinances (except that for the Western Cape), which could allow scope for subsistence fishing using accepted angling methods of fishing (Impson, 2012). Both revised and old provincial legislation still largely exist in language aimed at the conservation of nature. This is also clearly stated in the purposes of most of the legislations¹¹. In most instances subsistence fishing is restricted or disallowed (in particular the use of gillnets) (Weyl, 2007; Tapela *et al.*, 2015). The banning or restriction on use of nets in all the provincial legislations is related to conservation concerns. Such restrictions have given rise to conflict on some dams (for example such as the UPhongolo – see Chapter 2, and Tapela *et al.*, 2015) and the loss of community livelihoods development opportunities. While there have been efforts by some of the provincial agencies to promote fisheries based livelihoods, these have usually foundered on lack of or inadequate legislation, policy and capacity to support a developmental approach to inland fisheries utilisation (see Chapter 2 on the history of subsistence and commercial inland fisheries). On the whole, provincial departments of the environmental and boards do not view themselves as “development” agencies with a mandate to promote the sustainable and equitable use of fish resources for livelihoods. Rather they see protection or management for 'biodiversity' as their primary responsibility.

¹⁰ The revised Mpumalanga Act still specifically stipulates that 'No person shall catch fish other than by angling' (Mpumalanga Nature Conservation Act No. 10 of 1998)

¹¹ See Western Cape Nature Conservation Laws Amendment Act No 3 of 2000 – section 7.2.1; Mpumalanga Nature Conservation Act No. 10 of 1998 – section 7.2.2; and KZN Nature Conservation Ordinance No. 15 of 1974 – section 7.2.4).

Table 22 Provincial departments of the environment, boards for the environment and provincial legislation for environmental management

Province	Environmental Management Agencies	Provincial Legislation
Gauteng	Department of Agriculture, Conservation and Environment	Nature Conservation Ordinance 12 of 1983 (Transvaal) still applies in Gauteng
Eastern Cape	Department of Economic Development and Environmental Affairs Eastern Cape Parks Board	Conservation Act 10 of 1987 (Ciskei 'Republic') still applies in the former Ciskei region Eastern Cape.
Free State	Economic Development, Tourism and Environmental Affairs	Nature Conservation Ordinance 8 of 1969
KwaZulu-Natal	Department of Agriculture, Environmental Affairs and Rural Development Ezemvelo KZN Wildlife	Nature Conservation Ordinance No. 15 of 1974
Limpopo	Department of Economic Development, Environment and Tourism	Limpopo Environmental Management Act No. 7 of 2003
Mpumalanga	Department of Economic Development, Environment and Tourism Mpumalanga Parks Board	Mpumalanga Nature Conservation Act No. 10 of 1998
Northern Cape	Department of Environmental Affairs and Nature Conservation	Northern Cape Nature Conservation Act 9 of 2009
North-West	Department of Economic Development, Environment, Conservation and Tourism North West Parks and Tourism Board	North West Province Environment Conservation Act 73 of 1989
Western Cape	Department of Environmental Affairs and Development Planning Cape Nature	Western Cape Nature Conservation Laws Amendment Act No 3 of 2000

Where the relevant authority has decided to allow some form of net fishing, for commercial exploitation or scientific experimental fishing purposes, a license has to be issued by the relevant authority. For example, two commercial fishing licenses have been issued for Bloemhof dam (Barkhuizen, 2012). DAFF Western Province has started a project involving an experimental net commercial fishery on several dams (Impson, 2012) in close cooperation with DAFF: branch Fisheries, DWA and Cape Nature Conservation.

Overall, the primary objective of the provincial departments and boards of the environment remains the preservation of biodiversity rather than catering for human consumption and livelihood development. In this context, the provincial legislation in respect of inland fisheries is not in line with NEMA principles and objectives, constitutional imperatives, and also government rural development policy in terms of providing for a livelihood approach to utilisation of inland fisheries. NEMA, as the over-arching national legislation for environmental governance, provides for a developmental, equitable, cooperative governance and coordinated approach to utilisation of nature. Notwithstanding the foregoing, the primary operational mandate of the provincial environmental agencies is environmental conservation, and the developmental capacity of DAFF and the provincial Agriculture Departments will be required to promote rural livelihoods and optimal socio-economic benefit from inland fishery resources.

NEMA and NEMBA Provisions and Inland Fisheries

In the absence of dedicated inland fisheries legislation equivalent to the Marine Living Resources Act, the National Environmental Management Act (NEMA) (Act No. 107 of 1998) provides guiding principles for equitable fishery resource management. NEMA is the first step in giving legal effect to the environmental rights in the Constitution (Section 24). The main objectives of the NEMA are:

- to promote sustainable development through the utilisation and protection of South Africa's natural and cultural resources;
- to foster equitable access to the benefits that can be derived from South Africa's natural and cultural resources;

- to empower the South African public, community organisations through participation, environmental education, capacity building, research and information services.

NEMA establishes principles to guide the decisions and actions of all organs of state in environmental management; provides for establishment of organisations that can co-ordinate and harmonise environmental functions of the state and the promotion of participation of stakeholders in environmental governance; establishes procedures for cooperative governance; establishes procedures for conflict management; promotes integrated environmental management by establishing minimum procedures for environmental impact assessments; enables national or provincial authority agencies to prescribe environmental impact assessment regulations; establishes procedures for ratification of, and giving effect to international environmental instruments; and compliance and enforcement of provisions for the Act. In addition, NEMA promotes co-management by enabling the establishment of environmental management cooperation agreements that can promote the principles of integrated environmental management.

The National Environmental Management Biodiversity Act (NEMBA) (amendment Act 10 of 2004) is particularly relevant to inland fisheries, as the target fish populations are made up indigenous and introduced species. The Act is binding for all organs of state, and all spheres and levels of government – that is national, provincial and local. It applies to both terrestrial and marine environment. The Act specifically prevents the unauthorised introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur and also provides for the eradication of alien species and invasive species from ecosystems and habitats where they may harm such ecosystems and habits. NEMBA also permits the use and retention of alien species where they are already established and will not have an impact on biodiversity. This allows for retention of alien species that had been introduced in dams. The Act therefore also gives provision for the introduction of species that might be suitable for the development and enhancement of inland fisheries. While all the provincial legislation contains provisions for the control of introduction of alien species into inland water and the transfer/transportation of live fish, the NEMBA provides over-arching legislation for strengthening these controls and restrictions. Crucially, it gives the national minister and/or provincial ministers the powers to declare specific regions as biodiversity regions and therefore prohibit introduction of alien or exotic species in such regions while at the same time also giving the minister(s) powers to permit controlled introduction of alien species.

NEMA and NEMBA therefore adequately provide for the development and enhancement of inland fisheries based on principles of utilisation of nature for sustainable development within the stipulations of enhancing biodiversity. The development of maps to guide the utilisation of valuable invasive alien fish species under NEMBA (Impson, 2012) is an example of initiatives that are possible under this legislation. The Acts potentially provide a powerful instrument through which inland fisheries could be developed and governed since they embody principles of equitable governance, integrated sustainable management, socioeconomic equity and biodiversity maintenance in the utilisation of fisheries. Arguably, the principles and instruments within NEMA and NEMBA provide for a legalised developmental approach to inland fisheries. Correctly applied, these could redress the past inequities in terms of development and utilisation of inland fisheries. The two Acts could thus be used to formulate comprehensive inland fishery specific legislation or for the revision of existing provincial legislations that would provide for enhanced development and utilisation of inland fisheries for sustainable livelihoods. Of particular relevance is the potential to enhance inland waters with fish cultured in state hatcheries for the purpose of food security or rural livelihood development (see Chapter 6 on Stocking and Managing Fish Populations).

8.3.5 Traditional Authorities

South Africa's Constitution (Act 108 of 1996) recognises traditional leadership authority in areas where communities would like to protect their traditional and customary practices within the framework of a federal system of government (Figure 36). Traditional Leadership is legislated for under the Traditional Leadership and Governance Framework Amendment Act No. 41 of 2003. The Act provides for: recognition of traditional communities; establishment and recognition of traditional councils; statutory framework for leadership positions within the institution of traditional leadership; recognition of traditional leaders and their removal from office; houses of traditional leaders; functions and roles of traditional leaders; dispute resolution and the establishment

of the Commission on Traditional Leadership disputes and Claims; code of conduct; and amendment to the Remuneration of Public Office Bearers. Six Provincial Houses of Traditional Leaders have been set up in Eastern Cape, Free State, KwaZulu-Natal, Mpumalanga, Limpopo and North West. Each Provincial House nominates three members to a National House of Traditional Leaders. The Provincial House's job is to advise Provincial Government on matters concerning and affecting traditional laws and customs. The National House also advises the national Government on the rights of communities in areas where traditional customs and laws apply. These include customary practices such as circumcision and polygamy, etc.

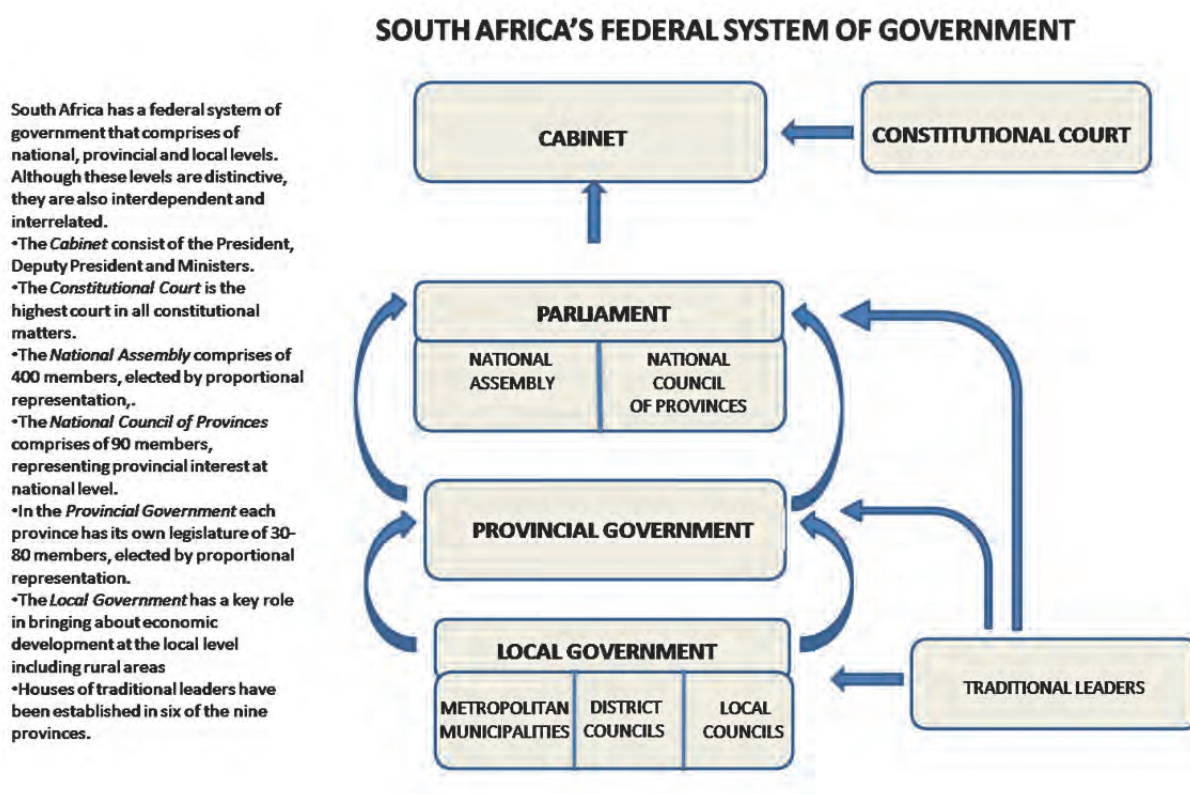


Figure 36 South Africa's Federal system of Government

Traditional Authority and Fisheries Management

For inland fisheries on water bodies that occur in customary land areas, *de facto* custodianship is often exercised by the Traditional Authority of the area, even though the NWA does not recognise customary ownership and management of water. This is illustrated by some the case studies of small scaling fisheries presented in Chapter 2, for example Lake Fundudzi and the Makuleki people. While the Constitution recognises customary rights, the Traditional Leadership and Governance Framework Amendment (TLGFAA) (Act No. 41 of 2003) is intended to improve rural people's rights to land and other natural resources in communal areas. The Act is aimed at providing for security of tenure to natural resources for rural communities; facilitate development; extend democracy to rural areas; and ensure sustainable use of natural resources (Pollard and Cousins, 2008). The holding of such water bodies under communal tenure also gives opportunity to develop 'Community Based Management' (CBM) approaches in such contexts.

Just as the Constitution and existing legislation protect the rights of owners of dams on private land to manage these on their own, the TLGFAA legislation could also recognise the rights of communities to manage water bodies on communal land under the Communal Property Rights regime. There are many examples of successful management of natural resources under the Communal Property Rights regime (Hara 2003; Feeny, 1994; Swallow and Bromley, 1995). Thus in these areas recognising these tenure and management systems in legislation and putting in place governance arrangements that support and facilitate Community Based Management could be the way to go. Thus potential exists for improved management of inland capture fisheries if the provisions under the TLGFAA were implemented successfully.

Recent court judgements (*State versus Kenneth George* and *State versus Gonggose*) have confirmed that constitutionally protected customary rights to fishery resources cannot be extinguished by legislated fishing rights regimes or the declaration of protected areas (Wicomb and Smith, 2012). Thus the challenge for inland fisheries governance is to reconcile customary use rights and institutions with the broader imperatives of the Constitutional state.

8.4 Proposals and Recommendations for Organisational Arrangements for Inland Fisheries

Based on the diagnostic analysis of existing arrangements above, the following are proposals and recommendations for organisational arrangements for a developmental and livelihoods approach to inland fisheries.

8.4.1 A Developmental Approach

In principal there is agreement within government for a shift towards a developmental approach to inland fisheries so that the sector will contribute towards poverty alleviation and food security. This is in line with government's National Development Plan (National Planning Commission, 2011), DAFF's Integrated Growth and Development Plan (DAFF, 2010) and is confirmed in DAFF's strategic plan 2012/13-2015/16 (DAFF, 2012).

While the legislation currently applicable to inland fisheries might not fully provide for a developmental approach, the Constitutionally based principles of the NEMA and NEMBA provide for the utilisation of fish resources for livelihood purposes. It is proposed that a legal review is commissioned by DAFF to provide guidance on whether new legislation is required, or merely the development of supporting policy and regulations. DAFF officials at the Inland Fishery Workshop for Government Departments held on 7 March 2012 (see Chapter 7 on Stakeholder Consultations) emphasised the need for legislation equivalent to the MLRA to empower the department to implement its mandate in respect of fishing rights and other related issues. The choice is either to develop a single Fisheries Act which governs both the marine and inland fisheries, or to retain the Marine Living Resources Act and develop a new Act for inland fisheries.

8.4.2 Need for DAFF to Leadership Inland Fisheries Development

The formalisation and development of an inland fisheries sector requires the leadership of DAFF: Branch Fisheries, the mandated national department. There is need for a clear a national policy, an organisational 'Terms of Reference' and also crucially, the requisite manpower requirements if it is to fulfil its mandate with regard to inland fisheries. As the Provincial Agriculture departments are responsible for the operational aspects of rural livelihood development, inland fisheries should be included the strategies and budgets of provincial departments of agriculture. It is recommended that a task group comprised of key stakeholders should be convened by DAFF; Branch Fisheries, to guide the development and formalisation of the sector.

8.4.3 Align Sector Development Goals with Resource Productivity

The potential productivity for inland fisheries is estimated to be around 15,000 tonnes annually. This is not evenly spread throughout the country. The most potential is in the warmer areas of the country such Limpopo, Mpumalanga, North West and KwaZulu-Natal (Chapter 6). Caution is therefore required around raising expectations about the sector being the panacea for most rural community problems of poverty and food insecurity. The potential for contribution of the sector towards rural economic development needs to be balanced with a science-based sustainable productivity analysis of the specific water bodies. Large scale commercial fisheries equivalent to the marine sub-sectors are thus not feasible, and recreational and small scale fishing value chain development should thus be prioritised. The socio-economic value of fish should not be measured only in terms of the fishery yield tonnage and value, but also in terms of the benefits generated by tourism service industry, angling accessory market, and welfare payment savings arising from enhanced food security.

8.4.4 Management Arrangements for Inland Fisheries

Given that most of the public dams belong to DWA, effective management needs to be based on co-operative governance between the relevant government departments (DAFF: Branch Fisheries, DWA, DEA, the provincial agencies of the environment and DoT), recreational fishers, water users and communities that are

the target for the development of inland fisheries. It is recommended that the formation of co-management committees should be context specific based on the existing situation in an area, relationships among the various stakeholders and the power relations underlying these relationships. Lessons on organisation for co-management in marine fisheries in South Africa and in fisheries in general from elsewhere should provide guidance for the formation of viable co-management arrangements for inland fisheries. Legislation will be needed to empower co-management and fishing rights. The role of DAFF provincial departments as the key government partner in co-management arrangements will be crucial. The use of agriculture extension officers at the local level is a logical step in the development of co-management arrangements.

8.4.5 Organisational structure for inland fisheries

Currently, inland fisheries reside under the Aquaculture Technical Services sub-Directorate in the Aquaculture and Economic Development Chief Directorate of DAFF: Branch Fisheries. In order to facilitate the development of inland fisheries, DWA and DEA have each nominated a person to be the liaison official with regard to inland fisheries in their departments. The DoT will also need to be brought on board with regard to the policy for requirement for management plans for all inland water bodies.

It is proposed that a national working group for inland fisheries composed of the key departments (DAFF; branch Fisheries, DWA, DEA and DoT and also the provincial heads of departments for the environment and/or boards) and civil society stakeholder groups such as the National Recreational Angling Association, National Small-scale and Subsistence Fishers Association (should this be created in future), University Based Researchers, etc. needs to be established under the leadership of DAFF: Branch Fisheries. The main responsibility for the national working group shall be to give guidance on the development of policy and strategy for inland fisheries. The size of the working group shall need to be limited to only those stakeholders that can and need to contribute towards national policy and strategy for inland fisheries.

It is proposed that at provincial level, the DAFF provincial department have the ultimate authority for inland fisheries although at operational level the existing historical arrangement whereby provincial departments or boards for the environment have been responsible for fisheries management at provincial level is likely to continue for some time given that DAFF: Branch Fisheries does not currently have the capacity to manage fisheries both at provincial level and local level on the ground. The problem though is that even under the current arrangement, little is happening because the departments and boards for the environment do not have adequate capacity either. In fact most do not have aquatic scientists. It is proposed that DAFF: Branch Fisheries should thus urgently take steps to build capacity at provincial/regional and local levels so that it can urgently take over the development and management of inland fisheries. It is further proposed that task groups for inland fisheries should be formed at provincial level. These should be composed of all the key stakeholders at provincial level. The task groups should also include departments of economic affairs so that fisheries is included in economic planning in each province. The responsibility of the provincial task groups will be strategic and operational decisions at provincial level and also resolution of disputes and issues emanating from the local level. The use of the existing agriculture extension services for fisheries is recommended as an avenue for DAFF taking over responsibilities for inland fisheries at the local level.

The lowest tier management body would be the co-management committees responsible for the management of particular water bodies. These could be built afresh and be beach based or village based (territorial) or could be built around existing functional organisations such as WUAs. Recreational fisheries on many water bodies are already effectively run on co-management principles with well organised angling clubs and associations managing their activities under agreement with various statutory authorities. What model to follow shall depend on analysis of the existing situation and dynamics on the ground. Co-management committees shall be composed of all key stakeholders at the local level of an area, and could also include chiefs or/and ward councillors where this is necessary and appropriate. Co-management committees shall be responsible for the day to day operational management decisions (e.g. formulation of *operational rules*) and *process issues* about fisheries in their areas of jurisdiction.

The proposed organisational and decision structure for fisheries is shown in Figure 37.

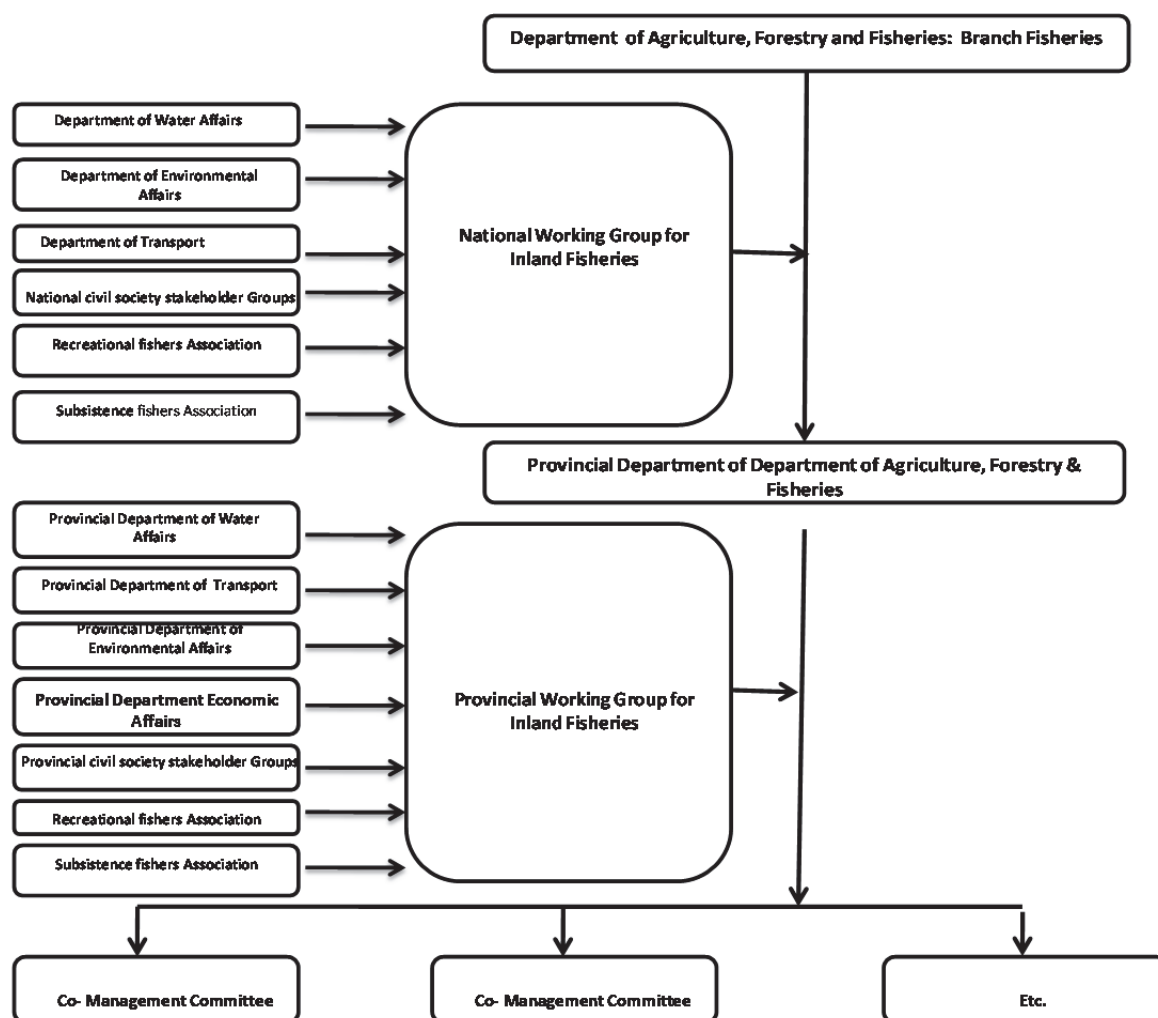


Figure 37 Proposed organisational structure for inland fisheries

8.5 Fisheries Co-management

Given that inland fisheries will either be recreational or communally and rural based, and geographically dispersed, the most appropriate form of management is 'co-management'. Co-management refers to an institutional and organisational arrangement between government and user groups for effective management of a defined fish resource (Hara, 2003; Hauck and Sowman, 2003; Sen and Raakjaer Nielsen, 1996; McCay, B. 1993; Bromley, 1991; Ostrom, 1990; Jentoft, 1989; McCay and Acheson, 1987). The general functions of co-management have been identified as; the encouragement of partnerships; provision of user incentives for sustainable use of resources; and the sharing of power and responsibility for management decision-making. Co-management is a compromise between government concerns for sustainable utilisation and conservation (as the public custodian of natural resources) on the one hand and users' demand for equal opportunities, self-determination and self-control on the other.

A pilot programme for the introduction of co-management in small-scale and subsistence fisheries in South Africa yielded useful insights and lessons for extending co-management to inland fisheries. The overall objectives of the project were the development, implementation and consolidation of functional co- management arrangements at pilot sites; strengthening of institutional capacity amongst resource users and managers to operate within a co-operative style of management; provide ongoing facilitation and technical support to MCM in their efforts to ensure the long term sustainable management of subsistence and small- scale fisheries resources; and strengthen linkages and facilitate mutual learning with co-management researchers and practitioners at other national and international institutions doing similar work. A number of lessons can be drawn from these pilot projects for co-management arrangements in South Africa:

- **Empowering Local Co-management Committees.** The primary organisation giving effect to co-management is the local co-management committee, which is vested with significant decision making powers to empower the local stakeholders to in the management process. However co-management committees may not be effective if the user group stakeholders do not have the capacity for effective participation in the arrangement. In this context, it is critical that a local driver, whose role should include the building of capacity of the stakeholders for understanding the principles and ethos of co-management, is identified and appointed to drive the arrangement.
- **Communication.** Open and transparent communication amongst stakeholders to ensure the smooth running of the co-management arrangements is a key aspect. Thus a clear communication strategy is vital in order to ensure that all the stakeholders involved understand their functions, roles and level of engagement. Apart from the co-management meetings and workshops, other avenues need to be devised to ensure that there is communication amongst stakeholders.
- **Holistic Livelihoods Approach.** Fishery co-management needs to be nested in a development approach which encompasses all activities and issues determining the livelihood activities of the community. Thus fisheries co-management needs to have linkages to other poverty alleviation initiatives in a given area. This will ensure that all the issues, challenges and problems related to community development initiatives are dealt with holistically by all stakeholders.
- **Limiting Fishing Effort within Resource Sustainability.** While the co-management arrangement may seek to extend formal fishing rights to communities that had been formerly marginalised, fishing rights and effort have to be allocated within the limitations of the fishery resource. It is crucial therefore that communities are involved in the formulation of the '*operational rules*' regarding the selection of rights holders, transferability and sharing of such rights among the community members, structuring of the rights within families and also in '*process issues*' of how to elect committees, who can get elected to the committee(s), replacement of committee members, etc. Without involvement at these two levels, buy-in for co-management by communities will be low and conflicts are likely to prevail.
- **Cooperative Governance.** Management responsibilities for the various aspects of inland fisheries resources fall under a number of departments, ministries and agencies. When there is lack of coherence among and between such agencies, it becomes confusing for communities as to who they should be dealing with and therefore who is their main partner in the co-management arrangement. This will be particularly pertinent in the present case whereby most of the dams to be used for inland fisheries belong to DWA, and DAFF: Branch Fisheries might continue to cede management responsibility to provincial departments and boards of the environment. Lack of a coherent approach and common messages from the various agencies can derail co-management arrangements.
- **Stakeholder Involvement.** Where a resource is used by multiple stakeholders, the question arises as to whether co-management should be built around the participation of all users rather than on fishers only. Regarding inland fisheries, other organised groups such as recreational fishers and tourist operators will continue to have strong interests in the use of public dams. While it is important to have committees largely populated by 'vested interests' it is also important that other stakeholders are involved if such committees and their functions are to be viewed as legitimate by all stakeholders. The type of multi-stakeholder governance must therefore be inclusive enough to serve the interests of all key stakeholders without becoming too big as to alienate the vested interests. The implementation of Resource Management Plans on dams by the DWA provides for the formation of Recreational Water Users Associations. Such organisations can potentially accommodate small-scale fishers as stakeholders, but are not designed to serve the co-management and developmental needs of small scale fishers. This is illustrated by the failure of the Phongola Recreational Water Users Association to address the needs of small-scale fishers (Chapter 3) highlights their potential shortcomings when stakeholders of unequal capability and competing interests sit together. If development support is not provided to address the lack of capability of small scale fishers to participate equally, their involvement in stakeholder organisations and processes is unlikely to be effective.

The foregoing review of co-management in South Africa and elsewhere provides general guidance about the applicability of co-management to inland fisheries and the challenges involved in the institutionalisation of this management approach. Future co-management arrangements need to take these lessons seriously for sustainable inland fisheries.

8.6 Human Resource Capacity and Skills Requirements

The lack of public sector human capacity and skills to manage inland fisheries presents a primary constraint to the development of appropriate institutional and organisational structures to promote a developmental approach to inland fisheries based on co-management. The reasons for this are two-fold arising from firstly, the lack of a policy to manage inland fisheries as an economic sub-sector and livelihood activity, and secondly, modern fishery governance norms which have shifted dramatically over the last decade from a biological resource orientation to a user-centred one requiring new management skills sets.

South African inland fisheries were historically managed as an economic sub-sector by dedicated provincial fishery units, but this capacity was largely lost following the policy decision in the mid-1980's to cease stocking alien fish species for angling purposes (see Chapter 2 on the history of inland fishery governance). Subsequently, the associated fishery research units were scaled back or dissolved, state hatcheries closed, mothballed or privatised, the fishing permitting systems for inland fishing abandoned in most provinces, and many fishery officers in the provincial departments either left the service or were deployed to other roles (Rouhani and Britz, 2004). In the absence of a guiding national inland fishery policy, the provinces have adopted individual approaches to inland fisheries management, with the mandated environmental departments focussing mainly on aquatic biodiversity goals and sustainable use. With some exceptions, such as the Free State Province which has activity supported inland fishery development for commercial and subsistence use, most provinces have until relatively recently not managed inland fisheries to achieve socio-economic goals. It was only in 2009, with the amalgamation of the mandates for primary industry into the Department of Agriculture, Forestry and Fisheries (DAFF), that the fisheries sector was deemed to include both marine and inland fisheries. This has imparted a renewed obligation on the state to expand its fishery governance and management capacity to inland fisheries. However, inland fisheries, which are characterised by recreational and subsistence use, differ substantially from the main commercial marine fisheries, and the lack of public sector human skills to implement the inland fishery component of the mandate is a fundamental constraint to inland policy, strategic planning and implementation of projects.

The modern “good governance” approach to fishery management, which flows from the concepts “sustainable development” and “ecosystem approach to fisheries” (EAF), adds a further requirement to human resource capacity building. Governance systems need to take account of, and integrate the biological and human components of ecosystems to achieve the objective of sustainable fishery use for optimal socio-economic benefit. Key principles of fishery good governance, such as the normative FAO Code of Conduct for Responsible Fisheries (FAO, 2010), include stakeholder participation, a precautionary approach, and the EAF (De Young, Charles and Hjort, 2008) which seeks an optimized balance between the different users of fishery resources while preserving biodiversity, minimizing human impacts on aquatic ecosystems and promoting approaches to fisheries management that go beyond customary management by monospecific stock (Breuil, 2012). Stakeholder participation is given substance through the implementation of “fishery co-management” whereby the fishery management authority and users, establish participative institutions such as local “co-management committees” to negotiate management protocols and actions based on ecosystem considerations and user needs. In this context, good governance principles include openness and transparency, responsibility-accountability, effectiveness (and efficiency), participation, coherence, adaptability-responsiveness (Breuil, 2012). This presents a public sector human capacity challenge as most career fishery managers were trained primarily in the biological science and environmental conservation disciplines, and lack training in the social and economic aspects of the EAF. Thus, a key need is the training of fishery authority staff in modern fishery governance principles, particular the ability to facilitate stakeholder participation processes.

A further key human resource capacity challenge is the legislative requirement for cooperative governance on environmental management (National Environmental Management Act 1998), which is a particular challenge for inland fisheries which spans multiple mandates (e.g. fisheries, environment, water, economic development), all tiers of government (national, provincial, local and traditional) and non-government and civil society stakeholder groups. Given the history of managing inland fisheries on an individual provincial basis, and the provincially based operational mandates for both the agriculture and environmental government

departments, it is logical that provincial government staff will be primarily responsible for managing inland fisheries on the ground, with the respective national departments (DAFF, DEA) guiding fisheries policy and supporting strategic interventions through development orientated programmes. Thus national department staff would require training in inland fishery policy and governance, while provincial level staff in the Departments of Agriculture, Environmental Affairs and Water Affairs would require operational training in fisheries management, particularly stakeholder-based co-management processes.

An inland fisheries policy clearly specifying the mandates and roles of the respective public sector institutions is required to define their required staff training needs. The WRC Inland Fisheries project has laid a foundation for the development of an inland fisheries policy through a series of consultations with key stakeholders. The consultations have produced a set of recommendations for policy development, outlined in section 8.4 above and Chapter 10, and these are used as a basis analysing and defining the human resource capacity building requirements for inland fisheries development.

The human resource and training requirements of public sector officials and resource managers are analysed and recommendations made. Most departments possess officials with general management capability, however, few have a background in fisheries, particularly implementation of the relatively new concept of participative co-management. Thus training in both the technical resource-related aspects of fisheries, as well as the human dimension is essential to equip resource managers to be effective in facilitating modern fishery management and governance processes.

A co-management approach recognises the knowledge and skills of local resource users, as well as the value and benefits of involving them in management activities and decisions. Such an approach is contrary to the traditional authoritarian environmental management style that is still prevalent amongst some public sector officials. Fishery co-management training thus emphasizes the development of stakeholder participation in appropriate institutions (Box 8.2).

Box 8.2. Hauck and Sowman (2005) recommend that training aimed at resource managers in fisheries co-management could include:

- Participatory approaches to management
- Participatory research methods
- Conflict management
- Appreciating the value and role of indigenous knowledge
- Making sense of traditional structures and systems
- Change management (coping with change and restructuring)
- Principles of community development
- Principles, objectives, benefits and methods of co-management
- Policies and laws relevant to coastal resource users
- Resource monitoring
- Concepts and principles of sustainable use
- Principles of resource management

8.6.1 National Government

A cooperative governance approach is envisaged for inland fisheries with the three primary government departments being Department of Agriculture, Forestry and Fisheries (DAFF), Department of Environmental Affairs (DEA), and Department of Water Affairs (DWA). The Department of Transport is a further national department with a mandate affecting inland fisheries, insofar as they are responsible for the regulation of the safety of activities on dams. At a national level, high level skills are required to formulate and implement policy, cooperative governance arrangements, strategic plans, stakeholder interactions and to guide the provincial departments in on-the-ground implementation of aspects of fisheries co-management flowing from the departmental mandates.

8.6.1.1 Department of Agriculture, Forestry and Fisheries (DAFF)

The DAFF as the lead agent for inland fisheries governance will be responsible for policy, legislation, strategic plans and facilitating cooperative governance arrangements with other national departments, provincial agriculture departments and municipalities. The will require a range of high level human capacity with expertise in:

- Fishery policy and legislation.
- Fishery governance principles based on the ecosystem approach to fisheries (EAF).
- Fishery science and ecological training to manage fish populations sustainably.
- Economics of fisheries management to achieve optimal socio-economic benefit through promoting a value chain approach to inland fisheries development.
- Stakeholder facilitation and conflict resolution skills to promote the establishment and operation of cooperative governance and co-management.
- Public administration and management skills to lead inland fisheries strategy programme implementation, particularly the setting up of cooperative governance structures.
- Fishery co-management, particularly training techniques and process to address equity issues and facilitation of interventions to include marginalised rural communities in fishery governance and management.
- Database management to organise the collections and management of inland fishery data on participation, production, and value.

Staff with post-graduate qualifications (Honours, Masters, PhD) will be required from the associated university disciplines including fisheries science, ecology, environmental science, economics, public administration, social science, and management.

It is likely that existing staff with the above post-graduate training and some fisheries management experience will be deployed by the DAFF to assume responsibility for inland fisheries governance. Specialist short courses, inland fishery management resource materials and experiential visits to other countries would then be sufficient to equip these officials with the requisite skills to implement inland fishery governance arrangements.

8.6.1.2 Department of Environmental Affairs (DEA)

The DEA is responsible for policy on aquatic biodiversity and environmental management under the National Environmental Management Act and associated acts such as the National Environmental Management: Biodiversity Act. The DEA is required to provide guidance on the management of the exploitation of fish populations with reference to the impact of the activity on ecosystem biodiversity and function. This dictates different approaches for indigenous species which require conservation and for alien species which require control. High level human capacity is required in the following areas:

- Aquatic ecosystem ecology and management.
- Management of alien species.
- Environmental legislation and policy.
- Fisheries science
- Public administration, legislation and policy.
- Stakeholder facilitation and conflict resolution skills to promote the establishment and operation of cooperative governance and co-management
- Fishery co-management

Staff with post-graduate qualifications (Honours, Masters, PhD) will be required from the associated university disciplines including ecology, environmental science, fisheries science, public administration, social science, and management.

It is likely that existing DEA staff with the above post-graduate training and possibly some fisheries biodiversity management experience will be deployed to assume responsibility for DEA's mandate in

respect of inland fisheries governance. Specialist short courses and inland fishery management resource materials would then be sufficient to equip these officials with the requisite skills to participate in formulating and implementing inland fishery governance arrangements.

8.6.1.3 Department of Water Affairs (DWA) (Now Department of Water and Sanitation)

The DWA is responsible for policy and guidelines on the beneficial uses of water flowing from the National Water Act. The DWA is thus responsible for allocating rights of access to dams for fisheries usage, and needs to ensure that such usage is socially desirable, environmentally sustainable, equitable, safe and does not compromise other water users rights. High level human capacity is required with skills in the following areas:

- Aquatic ecosystem ecology and management.
- Environmental legislation and policy.
- Fisheries management (could be contracted in)
- Public administration, legislation and policy.
- Stakeholder facilitation and conflict resolution skills to promote the establishment and operation of cooperative governance and co-management through water users associations and other bodies
- Fishery co-management

Staff with post-graduate qualifications (Honours, Masters, PhD) will be required from the associated university disciplines including ecology, environmental science, fisheries science, public administration, social science, and management.

The DWA employs specialists in various fields and it is likely that staff with the above post-graduate training will be deployed to assume responsibility for DWA's mandate in respect of inland fisheries governance. Specialist short courses and inland fishery management resource materials would then be sufficient to equip these officials with the requisite skills to participate in formulating and implementing inland fishery governance arrangements. It would be desirable for the DWA to develop guidelines for establishing fisheries on government water works which would serve as a guide to officials tasked with responsibility for considering applications for rights to fish in government water works.

8.6.1.4 Department of Transport

The Department of Transport (DoT) has a mandate for safety on marine and inland waters and has initiated the Cooperative Inland Water Safety Programme (CIWSP), which requires that resource management plans (RMPs) are drafted under the auspices of the DWA to control activities on all major dams. As fishing on dams will be affected by the RMP's, DoT staff should have an broad understanding of inland fishery activities. Officials responsible for RMP's should thus have some background in:

- Aquatic ecosystem ecology and management.
- Environmental legislation and policy.
- Fisheries management (could be contracted in)
- Public administration, legislation and policy.
- Stakeholder facilitation and conflict resolution skills to promote the establishment and operation of cooperative governance and co-management through water users associations and other bodies
- Fishery co-management

Staff with post-graduate qualifications (Honours, Masters, PhD) will be required from the associated university disciplines including ecology, environmental science, fisheries science, public administration, social science, and management. While it is likely that the DoT may contract out its specialist requirements in respect of inland fisheries, and devolve responsibility for compiling RMP's for public water works to the DWA, it would be desirable to have at least one senior official with some background on inland fisheries governance. This could be achieved through specialist short course training.

8.6.2 Provincial Government

The operational mandates for primary industry (Agriculture, Forestry and Fisheries) and Environmental Affairs are Provincial competencies, and thus the primary management of inland fisheries will be carried out by provincial government officials.

8.6.2.1 Agriculture Departments

Provincial Departments of Agriculture are staffed by managers, extension staff, and specialist researchers including discipline specialists and agricultural economists. The primary operational responsibility for rolling out inland fisheries projects with a social and economic purpose will fall on these personnel. As fisheries is not a customary activity, new skills will be required for effective inland fishery project support to occur.

It is instructive to consider the experience of building capacity to support aquaculture as a non-customary in the provincial Agriculture and Environmental Affairs departments, and apply the lessons learned to defining the human capacity and skills requirements to promote inland fisheries as a livelihood activity (Rouhani and Britz, 2011). Aquaculture was effectively recognised as an agricultural activity in the late 2000's and the provincial agriculture departments started building human capacity to support extension to small scale farmers and as well to promote dedicated projects. Some provincial environmental agencies invested in staff capacity to manage aquaculture permit applications and to guide development so that it did not impact negatively on the aquatic ecosystems. The WRC report of Rouhani and Britz (2011) on provincial government aquaculture capacity building in the agriculture departments, revealed that the effectiveness of the interventions in different provinces was uneven. Short course training provided generalist extension officers does not appear to have been very effective as aquaculture is a non-traditional, and technically complex form of farming. Very often the fish farmers requiring assistance knew more than the extension officers, and the problems to be solved were often beyond the capability or means of the both the farmers and extension officers. Issues to be addressed were often not farm level problems, but related to the lack of efficient services and supplies associated with the poorly developed aquaculture value chain. Thus to establish a new agriculture sub-sector, more strategic interventions are required to address fundamental supply chain, value chain and sub-sector economic viability determinants. A more effective investment in provincial human capacity investment was the appointment of specialist aquaculture officers, usually with a BSc/MSc in aquaculture who were tasked with promoting integrated aquaculture projects. These more highly skilled staff possessed the vision, networks and strategic ability to identify critical support needs and to muster necessary support, often through partnerships with the established commercial aquaculture operators and/or University aquaculture research and development departments.

Inland fisheries are analogous to aquaculture, in that the sub-sector is a non-traditional mandate that requires promotion by the provincial agriculture departments. The putative fisheries sub-sector is similar to aquaculture in that there is often a lack of established supply chain facilities and services, legal constraints relating to environmental regulations, access to dams, and fisher human capacity and resource constraints arising from the legacy of inequity. Thus, the building of provincial human capacity to promote inland fisheries livelihoods will need to be designed to address strategic issues as well as on the ground extension requirements.

Some provincial initiatives to promote inland fisheries for livelihood purposes have not been successful, primarily as a result of a lack of provincial government skills to promote fishery development projects. For example, the Kwazulu-Natal environmental agency (Ezemvelo KZN Wildlife) initiated a community based gill-netting project on Jozini dam, but later withdrew the fishing permits rendering the fishery illegal. This example highlights the lack of co-management skills which resulted in a withdrawal by the responsible department and conflict within the community. Thus fishery development projects need to be promoted by personnel with the skills to build co-management institutions, promote sustainable fishing, and address policy issues if required.

An example of an integrated approach to inland fishery development is the North-West Province which has launched a community based fishing projects on dams based on a value chain approach. This has required high-level politically supported coordination between the provincial departments of Agriculture,

Environmental Affairs and Economic Development. Specialist consultants worked with provincial officials and mentored them in fishery management.

Thus provinces which wish to promote fishery projects for livelihood purposes, will require a range of high level human capacity with expertise in:

- Fishery governance principles based on the ecosystem approach to fisheries (EAF).
- Fishery science and ecological training to manage fish populations sustainably.
- Economics of fisheries management to achieve optimal socio-economic benefit through promoting a value chain approach to inland fisheries development.
- Stakeholder facilitation and conflict resolution skills to promote the establishment and operation of cooperative governance and co-management.
- Fishery co-management, particularly training techniques and process to address equity issues and facilitation of interventions to include marginalised rural communities in fishery management and governance.

High level skills can be contracted in on a project basis, however, if support is to be sustainable it would be desirable to have at least one manager with specialist fisheries training appointed by the province. Other senior management staff with responsibility to fisheries projects can be provided with specialist fishery short courses to equip them with an understanding of fisheries co-management.

Similarly, extension and other staff interfacing directly with fishers will require training in fisheries co-management. A knowledge foundation can be provided through short courses and on-the-job mentorship by a fisheries specialist. The latter is probably the most effective human capacity building intervention.

8.6.2.2 Environmental Affairs Departments

The provincial departments of environmental affairs incorporated the old “Nature Conservation” divisions with a broadened mandate reflecting the sustainable development philosophy of South Africa’s environmental legislation. The management of inland fisheries has however not been reviewed and revised in line with a sustainable development approach which reflects societal goals for the resource, and as pointed out above, fishery specialist capacity has shrunk in most Provincial environmental departments. Nonetheless, staff of the provincial environmental affairs remain in charge of inland fishery management using regulations dating back to the pre-NEMA era.

Human capacity and skills in respect of fisheries are very uneven in the provincial environmental affairs departments and their agencies, with some employing fisheries specialists (Western Cape, Free State, Kwazulu-Natal) and others using on managers with a generalist environmental conservation background to manage their inland fishery obligations. Predictably, the provinces employing fishery specialists have the most substantial policies and programmes in respect of fish biodiversity conservation and fishery management. As the provincial environmental affairs departments are legally mandated to control fishery activities (until DAFF promulgates inland fishery legislation), it is essential that departmental staff work closely with other departments (e.g. Agriculture, Economic Affairs) to promote fishery livelihood projects. Cooperative governance in respect of fisheries between provincial departments appears to be well coordinated in the Western Cape, North-West and Free State Provinces. In some provinces, an old “conservation” mindset often prevails reflecting a lack of skills in the area of sustainable development and developing fishery resources for livelihoods objectives.

Thus, provincial environmental agencies which wish to promote fishery projects for livelihood purposes, will require a range of high level human capacity with expertise in:

- Fishery governance principles based on the ecosystem approach to fisheries (EAF).
- Fishery science and ecological training to manage fish populations sustainably.
- Economics of fisheries management to achieve optimal socio-economic benefit through promoting a value chain approach to inland fisheries development.

- Stakeholder facilitation and conflict resolution skills to promote the establishment and operation of cooperative governance and co-management.
- Fishery co-management, particularly training techniques and process to address equity issues and facilitation of interventions to include marginalised rural communities in fishery management and governance.

8.6.3 Local Government

Many public dams are managed by municipalities which have a mandate for local economic development (LED) as well as environmental management. Municipalities appoint LED officials with generalist commercial or public administration background, and environmental officers with an environmental science training.

If fisheries projects are to be promoted by municipalities, these officials will require some background in the potential of fisheries for livelihood purposes, and how to implement a co-management approach which takes the needs of multiple stakeholders into account.

Municipal officials promoting inland fishery projects would thus require some grounding in:

- Economics of fisheries management to achieve optimal socio-economic benefit through promoting a value chain approach to inland fisheries development.
- Stakeholder facilitation and conflict resolution skills to promote the establishment and operation of cooperative governance and co-management.
- Fishery co-management, particularly training techniques and process to address equity issues and facilitation of interventions to include marginalised rural communities in fishery governance and management.

8.6.4. Capacity Building and Skills Requirements of Resource Users

Most inland fishery resource use is informal, be it for subsistence or recreational fishing. In some cases access to waters is controlled by institutions such as tribal authorities, angling clubs, municipalities and public water works authorities. However the lack of socio-economic objectives for inland fisheries, and the decline in provincial licensing, has resulted in the fisheries on most inland water bodies not being actively managed and most fishers are not represented in stakeholder institutions. If inland fisheries are to be actively managed for socio-economic goals, the empowerment of users to participate in fishery management and governance processes is essential. The two main fishery user groups, subsistence and recreational fishers, have very different socio-economic profiles, motivations for fishing, and capacity building needs.

Subsistence fishers generally originate from disadvantaged rural communities and lack education, knowledge of their rights, access to networks, and the capability to assert their resource use rights through formal institutions. Being thus vulnerable, their fishing activities are often criminalised and may conflict with recreational fishing. Approaches to including customary rural and disadvantaged fishers in fishery governance institutions are identified by Tapela *et al.* (2015). Subsistence fisher groups thus require capacity building interventions which will empower them to assert their rights and participate meaningfully in building fishery co-management institutions (Box 8.3).

Box 8.3. Hauck and Sowman (2005) recommend that training aimed at resource users and organisations could include:

- Interdependence between humans and the environment
- Concepts and principles of sustainable use
- Principles of resource management
- Principles, objectives, benefits and methods of co-management
- Participatory research methods
- Resource monitoring
- Policies and laws relevant to resources being harvested
- Livelihood options and enhancement
- Organisational development
- Business development
- Life skills
- Conflict management

Recreational fishers are a diffuse stakeholder group, with varying degrees of institutional representation. A very small proportion of the recreational angler population (ca. 1%) belong to sport angling clubs which compete competitively accordingly to international rules. Others belong to bodies which manage access to local waters such as dams. However, most have no affiliation at all which presents a challenge to soliciting their participation in co-management. Recreational anglers nonetheless have a keen interest in decision affecting their activity and need support to facilitate their participation in inland fishery co-management processes. Thus, when inland fishery policy and co-management arrangements are being developed, recreational fisher representatives should be included in training initiatives to acquire the skills outlined Box 8.3.

8.6.5. Inland Fishery Training Resources

Human resource and skills development for inland fisheries development and co-management in a South African context can benefit from resources and institutional capacity that has been developed to support marine small-scale fisheries.

These resources include:

- **Institutional capacities** with expertise in fishery co-management training such as University of Cape Town's Environmental Evaluation Unit and Rhodes University's Rural Fisheries Unit. Both institutions have experience and resources for fishery training, mentorship, courses and development project support which is available on a contract basis. Rhodes University runs an annual FAO supported "Ecosystem Approach to Fisheries" course for regional fishery managers
- **Fishery guidelines.** Local and international resources available to support fishery capacity building (Box 8.4).

Box 8.4. Selected Resources Available for Supporting Human Capacity and Skills Training in Inland Fisheries.

Hauck, M. and Sowman, M. 2005. *Guidelines for Implementing Coastal and Fisheries Comanagement in South Africa*. University of Cape Town.

FAO, 2013. *International Guidelines for Securing Sustainable Small-scale Fisheries*. ftp://ftp.fao.org/FI/DOCuMENt/ssf/SSF_guidelines/TC/2013/2e.pdf

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8.7 Conclusion and Next Steps

In order to fulfill the potential for a livelihoods approach to inland fisheries that exists in some regions of South Africa, enabling institutions and organisational structures will have to be put in place. DAFF will need to take leadership for such a developmental shift to the utilisation of inland fisheries. Even then, this will require co-operative governance efforts from all key stakeholders and at all levels of government.

A workshop for all the concerned government departments and all the other stakeholders, especially those proposed in the organisational structure above, is proposed. This will discuss the proposed institutional and organisational arrangements for inland fisheries and the way forward for inland fisheries. It is recommended that a National Working Group for Inland Fisheries be convened from such a workshop which would then take the necessary processes forward within government to establish conducive governance arrangements for inland fisheries based on the recommendations in this report and further stakeholder inputs.

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9. PUBLICATIONS, TECHNOLOGY TRANSFER AND CAPACITY BUILDING

The Water Research Commission solicited project has had a significant impact on shaping the discourse on inland fisheries utilisation and governance through the activities and outputs of the research team. These have included collegial exchanges, stakeholder consultations and presentations, peer reviewed journal and popular publications, conference papers, and the training of post-graduate research students. Government departments and other stakeholders responded well to the project programme, and supported project workshops and consultations. This has resulted in an emerging vision and consensus towards an emerging inland fisheries policy, culminating in the development of an inland fisheries policy by the Department of Agriculture, Forestry and Fisheries.

As research in inland fisheries in South Africa is a neglected field, particularly from a multi-disciplinary point of view, the series of original scientific publications emerging from the project will provide original insights into the governance of inland fisheries in South Africa to realize their potential to support rural livelihoods.

The outputs of the project will provide the requisite foundation for informing the development of a policy on inland fishing, and the development of institutional and organisational arrangements to for good governance of this resource in line with the imperatives of the constitution. The researcher and student intellectual capacity emanating from the project will provide a valuable resource to assist government in the implementation of its inland fishery development mandate.

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9.4.2 Technology Transfer

The main emphasis of the stakeholder consultation process was on briefing and obtaining buy-in from government departments and inland fishery user groups. Extensive individual consultations were carried out with government officials in the provinces and with fishers from rural communities as well as the recreational sector. The project research outputs have provided a valuable conceptual base for informing stakeholders about the constitutional, social and environmental imperatives which define principles for inland fishery management. This has contributed to empowering stakeholders to engage meaningfully the participative process of defining governance and institutional arrangements for inland fisheries. Selected stakeholder meeting presentations are listed below.

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10. CONCLUSIONS AND RECOMMENDATIONS

The present Water Research Commission solicited project succeeded in putting inland fisheries access, management and governance on the environmental policy agenda through the project research outputs, capacity building, stakeholder interactions, awareness raising and contributions to the discourse on the equitable and sustainable utilisation of freshwater fish stocks. This has culminated in the Department of Agriculture, Forestry and Fisheries taking up its inland fisheries mandate and developing a policy on inland fisheries. A synthesis of the requirements for effective management processes and governance systems for inland fisheries in South Africa is presented below. A diagnostic summary of issues requiring attention is presented, followed by recommendations for inland fisheries management and governance issues and needs. The section concludes with a consideration of knowledge gaps and priorities for future research.

10.1 Diagnostic Summary of Inland Fisheries Management and Governance Issues

10.1.1 Inland Fisheries Productivity is Low

In contrast to South Africa's predominantly industrial marine fishery, yielding around 600 000 tons per year and valued at R7-billion (DAFF, 2012a), the inland fishery sub-sector is characterised by comparatively low productivity. A fishery production potential of 15000 tons per year was estimated for large South African impoundments using a GIS-based, morpho-edaphic model of fishery productivity. The low yield precludes the development of industrial or large-scale commercial fisheries and limits the sub-sector's development potential to small-scale fisheries for sustainable livelihoods, and recreational fishing with the associated socio-economic benefit of the equipment supply and tourism value chains. The main value of the inland fishery to society is therefore not the commodity value of the landed tonnage, but lies in 1) the food security and sustainable livelihood benefits to rural communities and 2) the socio-economic benefits of the tourism and equipment supply value chains associated with recreational fishing.

10.1.2 Small-scale Fishing is an Existing Livelihood Activity

The WRC Inland Fisheries scoping study confirmed widespread fishing for livelihood purposes on state dams and other inland water bodies. The dam surveys revealed 77% of all sites visited supported some form of fishing for livelihood purposes. This highlights the need for fishing for livelihood purposes and livelihood fishing rights to be recognised in policy and legislation.

Anecdotal evidence indicated that fishing for livelihoods purposes is a growing activity that is largely unmanaged, ranging from individual part-time subsistence to full-time artisanal/ small-scale commercial fishing. Inland fisheries served as a social welfare and food security safety net in many areas, increasing the resilience of local communities to unemployment and lack of economic opportunity. All fish were sold fresh to local markets or consumed by the family. In certain localities, a significant daily income could be generated to cover family living costs. Stakeholders and resource users expressed concerns about resource sustainability, growing user conflicts, and poorly defined fishing rights, highlighting the need for a policy to guide inland fishery management and governance.

In areas with a fishing tradition and/or traditional governance, indigenous knowledge was adapted to modern circumstances. This included fishing techniques, fishing cultural traditions, and traditional governance institutions which often operated alongside, or in cooperation with modern institutions of state. The cultural importance of fishing on the Phongola floodplain appeared to be declining with fewer 'Fonya' drives, and fishing for livelihood purposes was perceived as socially inferior to more 'modern' occupations such as aquaculture and agriculture which were supported by government development policies.

Small-scale fishers generally lacked formal rights and their activities were unmanaged which leading to conflicts on certain water bodies. Fishers gill nets and boats were often confiscated or destroyed by recreational anglers, usually acting with the sanction of law enforcement agencies. Fisher communities expressed concerns about the sustainability and equity of unmanaged artisanal gill net fishing, which was often conducted by outsiders.

10.1.3 Large Scale Commercial Fisheries are Non-viable

The GIS-based analysis of large state dams revealed that only 29 dams were capable of yielding more than 100 tons of fish a year, and that their total productivity was of the order of 12,500t/y.

Commercial fishing concessions promoted by the Free State Province (on Bloemhof and Gariep dams), and in other provinces have generally proved commercially non-viable due to low harvest volumes, and the low price of freshwater fish.

One small-scale commercial operator was successfully harvesting alien fish from Western Cape Province dams for sale to the West African expatriate market.

10.1.4 A Substantial Recreational Fishing Sector

The inland recreational fishing sub-sector has a substantial participation rate and supports a vibrant tourism industry and services and supplies value chain. The numbers of recreational anglers are unquantified but believed to be of the order of 1.5 million. Sports angling is a recognised sporting code, affiliated to the South African Sports Confederation and Olympic Committee (SASCOC), with some 15,000 members in the South African Sports Angling and Casting Confederation (SASACC) and associated facets.

Recreational fishing is sustainable as anglers extract a small tonnage of fish and catch-and-release fishing is widespread. Recreational fishing is recognised as a legitimate form of resource use in provincial environmental legislation with management control measures designed to protect biodiversity and prevent over-harvesting.

Recreational fishing has a considerable economic value and socio-economic impact through the tourism and angling service and supplies value chains. Rural poor people communities however do not participate in many of the recreational fishing opportunities that offer social and economic benefits associated with, for example, ownership of fishing tourism enterprises such as accommodation, services and supplies.

The concerns expressed by recreational anglers included unsustainable fishing, pollution and degradation of aquatic ecosystems, conflicts with small-scale fishers, and security.

A policy is thus required to guide interventions to optimise the socio-economic benefits of recreational angling. Such a policy would need to address the inclusion of disadvantaged groups, resource management issues and user conflicts.

10.1.5 Rural Small-scale Fishers are Marginalised and Disempowered

The survey of small-scale inland fishing revealed that fishers from rural communities often felt marginalised and discriminated against due to:

- Unrestituted legacies of exclusion from aquatic resources.
- A lack of legal recognition of resource access rights, and 'crowding out' from aquatic resources by empowered resource users with legal rights.
- Exclusion from resource management decision-making institutions.
- Policies which favour the development of other resource-based sectors such as agriculture and recreation over fishing.
- Their low capability to participate in fishery resource opportunities due to a lack of education, assets, access to networks, empowering knowledge and representative institutions.

10.1.6 Existing Governance Arrangements do not Recognise Inland Fisheries as a Livelihood Provider

There is no inland fishing policy, equivalent to that for the marine fishery sector, supporting sustainable development and the creation of rural livelihoods based on the state-owned inland fish resource endowment. Inland fisher communities continue to experience Apartheid and Colonial era inequities due to marginalisation from resource access resulting from a lack of legal recognition of rights, and the absence of supporting governance institutions to promote sustainable resource use for livelihood purposes.

The WRC field surveys found that formal, customary and informal fishery resource governance systems exist side by side on many water bodies with varying degrees of tension, conflict and cooperation. Small-scale fishing is generally tolerated by resource management authorities, and in some provinces actively supported. However, in the absence of formal rights, fishing as a livelihood activity remains vulnerable to prosecution and marginalised by competing resource users and conservation authorities.

The review of legislation and rights revealed that Constitutional and NEMA provisions to promote sustainable development and equity based on resource access are not reflected in existing governance arrangements for inland fisheries. Existing legislation governing inland fisheries is rudimentary, deriving from Colonial and Apartheid era provisions contained in the provincial environmental acts and nature conservation ordinances, and is mainly designed to limit recreational fishing effort. This legislation is silent on fishing as a livelihood activity, and on fishing rights. Existing inland fishery governance is carried out by the provincial environmental agencies with a mandated primary focus on managing biodiversity. "Common pool" resource rights to resources which characterise customary resource governance systems are not recognised in existing statutory provisions governing access to public waters and fish resources. Hence, local communities have no preferential claim in law to local fishery resources over better-resourced outsiders.

The developmental mandate for inland fisheries resides with DAFF, but no specific policy, legislation, designated organisational capacity, funding and supporting management institutions are in place to facilitate the development of governance arrangements based on Constitutional principles, national environmental legislation and policies, and international norms such as the FAO's Code of Conduct for Responsible Fisheries. Modern fishery governance, which is supported by Constitutional and NEMA principles, is strongly human rights based and includes the recognition of customary practises and restitution of the marginalisation from resource access suffered by disadvantaged groups.

10.1.7 Existing Governance Arrangements do not Recognize Recreational Fisheries as a Resource-Based Economic Sub-sector

National policies on primary industries (agriculture, forestry and fisheries) do not recognise the recreational fishing value chain as a sub-sector of fisheries which contributes to the economy through the creation of rural livelihoods, decent jobs, economic opportunities and food security. This consequences of this include:

- Potential development opportunities for rural communities associated with access to fishery resources with recreational fishing potential are overlooked.
- Resource managers tend to preferentially promote fishing for food security, and overlook the potential socio-economic benefits of recreational fishery development linked to the tourism value chain.
- Resource managers lack policy guidance and governance protocols to resolve resource use conflicts between recreational fishers and small-scale fishers. As a result recreational fishers on certain water bodies are deterred from participation by user conflicts and overfishing.

10.2 Recommendations for Inland Fisheries Management and Governance Issues and Needs

10.2.1. Draft an Inland Fisheries Policy.

The actions of government are guided by policy. Thus, to realise the potential socio-economic contribution of South Africa's inland fishery resource endowment, an inland fisheries policy based on Constitutional imperatives is required. The key policy requirements flowing from the WRC study are:

- Recognition of inland fisheries as an economic sub-sector under the DAFF Mandate
- Recognition of the socio-economic contribution of inland fisheries, specifically the potential to provide food security and a safety net for the poorest and most vulnerable rural households, and to create livelihoods, economic value and rural development based on the food fish and recreational fishing value chains.
- Policy guidance to develop appropriate institutional and organisational arrangements for inland fisheries governance aligned with DAFF primary sector development policies

- Cooperative governance arrangements with other relevant government departments, resource users and stakeholders.

More detailed recommendations on policy options are presented under the headings below.

10.2.2. Promulgate Empowering Legislation.

The actions of government are guided by policy As provincial legislation governing inland fisheries is very rudimentary, lacking definition of sectoral objectives and user rights, new legislation will be required to give substance to the policy imperatives highlighted above.

This requires:

- A legal review of legislation relevant to inland fisheries.
- The drafting of empowering legislation under the DAFF mandate
- The creation of fisheries management and governance arrangements based on modern norms for fishery 'good governance'
- Revision of legislation and regulations to align other relevant government mandates with the inland fisheries policy, for example, the Water Act, the National Environmental Management Act, provincial environmental acts and ordinances, and related legislation.

Inland fisheries legislation needs to confer appropriate legal status on those involved in fishing and supporting activities to:

- Define the appropriate political and administrative levels at which decisions regarding the fishery are made and regulations are enforced;
 - Allocate exclusive fishing rights to individuals and defined groups;
 - Benefit users individually and collectively from any measures they take to improve the fishery;
 - Empower them to negotiate collectively with other users of the basin;
 - Enable them to participate in co-management; and
 - Enable them to seek redress for damage to their resource provoked by other users of the water.
- (adapted from Wellcome, 1997)

There are several legislative options:

- The Marine Living Resources Act (Act 18 of 1998) could be revised to include inland fisheries into a new "Fisheries Act"; or
- A dedicated "Inland Fisheries Act" could be promulgated; and/or
- The existing NEMA- and NEMBA-aligned provincial environmental legislation could be expanded to include more comprehensive fishery provisions with delegation of specified responsibilities to DAFF;
- The Water Act (Act 36 of 1998) provides for rights to various forms of water use, including fisheries, and thus a policy and guidelines could be promulgated by the Department of Water Affairs to guide the management of access to water for inland fishery purposes.

10.2.3 Adopt a Developmental Approach to Sector Management

Due to the burden of disadvantage and marginalisation from resource access borne by rural communities, realising the potential socio-economic benefits associated with small-scale inland fisheries requires a developmental approach, supported by appropriate public sector interventions, to empower fishers to participate in fishery-associated value chains. This requires:

- Alignment of institutional and organisational arrangement for inland fisheries with DAFF policies to promote sustainable rural livelihoods and job creation, food security and the small-scale farming and fishing sector (DAFF 2012a, DAFF 2012b, DAFF 2012c).
- A co-management approach. Due to the diverse and small-scale characteristics of inland fisheries, centralised management from national level by the DAFF Fisheries Branch (as is applied to the

marine fishery sub-sectors) would not be an appropriate governance arrangement to achieve the socio-economic potential of the resource. Rather, local co-management institutions with devolved powers appropriate to the needs of local small-scale and recreational fisheries need to be established.

10.2.4. Apply 'Good Governance' Norms for Small-Scale fisheries

The recently published FAO Guidelines for Securing Sustainable Small-scale Fisheries (FAO, 2013) recognise the marginalised and vulnerable nature of most rural fishing communities, and promote “a human rights based approach to achieve poverty eradication, equitable development and sustainable resource utilisation”. The FAO Guidelines seek to achieve this by “empowering small-scale fishing communities, including both men and women, to participate in decision-making, enjoy their human rights, and assume responsibilities for sustainable use of fishery resources”. Given the historical marginalisation and disadvantage suffered by poor South African communities, the South African Constitution (and associated Constitutional legislation) and the FAO's small-scale fisheries guidelines provide appropriate normative guidance to developing inland fishery governance arrangements.

10.2.5 Adopt a Value Chain Approach

In contrast to South African marine fisheries, the economic and welfare benefits of inland fisheries are not directly linked to the commodity price of the landed fish, but accrue more through the community welfare gains flowing from access to fish for food security by small-scale fishers, and the angling equipment and tourism-linked services and supplies associated with recreational fishing.

Public sector interventions to optimise the socio-economic benefits of inland fisheries thus need to move beyond growing fish production through the promotion of primary fishing operations, to adopting a value chain approach to inland fishery development. This would include strategies for post-harvest value adding, and promoting employment and entrepreneurship opportunities in the tourism-linked recreational fishery sub-sector. The value of harvested fish should also be considered in terms of the welfare savings for the state generated by access to a secure, nutritious and sustainable supply of fish. Interventions which enhance the value of fish to local communities should thus be promoted; for example, equity of access to fishery resources for rural communities and capacity building to participate in all levels of the associated value chains.

10.2.6. Adopt a Precautionary Resource Management Approach

A constraint to promoting inland fisheries on most South African water bodies is the lack of knowledge about the productivity and sustainability of the resource, and the potential impact on indigenous species biodiversity (McCafferty *et al.*, 2012). To promote sustainable fishing, a precautionary approach to resource exploitation should be adopted in cases where information about the resource status and productivity is limited (FAO, 2010). Research surveys and stock assessments will be required in order to address resource information gaps and develop fishery management plans for sustainable fishing which meets the desired social and economic objectives.

10.2.7. Government Organisational Arrangements

Based on consultations and workshops conducted by the WRC project team, recommendations were developed on the roles of the national and provincial departments that have mandates affecting inland fishery governance.

- Government stakeholders accepted that DAFF is the mandated lead agent for inland fisheries, and will develop cooperative governance arrangements with the other departments and public sector agencies in respect of inland fisheries. The primary national departments with whom cooperative governance arrangements will be required are the Department of Environmental Affairs which bears responsibility for the National Environmental Management Act, the Department of Water Affairs which controls access to public dams, and the Department of Transport which is responsible for water user safety on inland waters.
- In line with their legislated mandates for environmental and agricultural matters, the national departments will primarily be responsible for policy, legislation, strategy, and promoting cooperative governance.

- The operational management and promotion of inland fishing projects is logically a provincial competency to be carried out by the provincial agriculture departments, in concert with their provincial environmental affairs and economic development counterparts.
- The existing fishery responsibilities and infrastructure (e.g. fishing licensing, state hatcheries) under the control of the provincial environmental departments should be reviewed and, where appropriate, transferred to the provincial agriculture departments, or devolved to resource user co-management institutions.
- Self-governance by recreational angling stakeholders based on the agreed principles of the proposed inland fishing policy is an win-win option which can be explored.
- Cooperative governance organisational structures, equivalent to the erstwhile Union of South Africa's "Joint Provincial Fisheries Advisory Board", will be required to coordinate a harmonized approach to inland fishery management and governance.

10.2.8. Training Needs

Most career fishery managers were trained primarily in the biological science and environmental conservation disciplines, and lack training in fishery co-management. Thus, a key need is the training of fishery officials in modern fishery governance principles, particularly the skills required to facilitate stakeholder participation and building of co-management institutions.

- National department staff will require training in inland fishery policy and governance
- Provincial-level staff in the departments of Agriculture, Environmental Affairs, and Water Affairs will require operational training in fisheries management, stakeholder-based co-management processes, and promoting a value chain approach to fishery development.
- Training for small-scale fishers needs to extend beyond the technical aspects of primary catching operations, and include aspects such as knowledge of rights, participation in co-management institutions, and post-harvest value adding skills. The development of supporting institutions for South Africa's small-scale marine fishery sub-sector has produced some useful co-management training guidelines which are applicable to inland fishery development (Hauck and Sowman, 2005).
- Recreational fishing representatives are generally better educated and fully employed, but will also require training in fishery governance processes in order to participate meaningfully in fishery co-management institutions.

10.3 Knowledge gaps and priorities for future research.

Policy and planning need to be informed by sound information on the potential of the resource, the nature of existing fisheries, and the social, environmental and economic issues that shape resource use. The WRC Inland Fisheries scoping study highlighted significant knowledge gaps requiring attention for the development of a sustainable inland fisheries sector that creates rural livelihoods, decent jobs and food security. The knowledge gaps fall into two categories: 1) information required by government departments to shape policy and action and 2) priority research needs.

10.3.1 The Need for a Comprehensive Survey and Monitoring Programme

The literature review of inland fisheries in South Africa (McCafferty *et al.*, 2012) and the GIS analysis highlighted the paucity of information available on the fish stocks and fisheries potential of South Africa's inland water bodies. Most historical survey data is focused on the bio-physical aspects of fisheries ecology, with very little on the socio-economic and social aspects of the inland fisheries. If sustainable inland fisheries are to be developed for optimal social and economic benefit, comprehensive integrated research surveys and monitoring will be required on the dams with identified potential.

The GIS assessment should therefore be seen only as an initial suitability analysis of each dam that would need to be followed by:

1. An initial fishery survey to estimate the current yield of the dam, catch composition, user characteristics and fishing methods, value chain descriptions, social issues and conflicts.

2. A resource survey to determine the likely productivity of the dam and the population structure of harvestable fish.
3. A stock assessment to determine the optimal sustainable harvest strategy to meet the social and economic goals of the different fisheries. For example, in the case of a recreational fishery the stock may be managed to produce large trophy fish, whereas for a small-scale artisanal fishery the fish stock would be managed to produce the maximum sustainable yield in terms of tonnage.
4. An economic feasibility study to determine how best to optimize the value of the fishery. This would include an optimal harvest strategy, nature of fishing rights and suitable quantum of harvest by individual fishers, market research, and options for value chain development.
5. Monitoring of fishery performance to ensure that sustainability is achieved.

10.3.2 Economic Valuation and Socio-economic Impact of Inland Fisheries

A major gap in knowledge is the actual and potential value of inland fisheries to society measured in terms of economic value, food security, jobs and welfare gains. This information is essential to inform policy and planning and the investment in capacity by government to support sector development. As inland fisheries yield a low tonnage of fish which is not formally marketed in the seafood value chain, the 'commodity' value of the resource has little meaning.

For the recreational fishing sector, the economic value of the resource needs to be measured in terms of the local economic impact generated by the in the tourism value chain and angling services and supplies such as accommodation, bait, guides, restaurants, equipment, food and so on.

For the subsistence fishing sector, the value of the fish should be measured in terms of food security metrics including income, nutritional status, and welfare savings by the state.

10.3.3 Social research

Effective inland fishery management and governance is founded on user-centred co-management institutions. The evolution of co-management is still in its early stages and participatory action research is required to evaluate the unfolding experience of setting up co-management institutions, to understand the social dynamics determining their functionality, and to feed back into the management process in order to address shortcomings. A central need is to understand the capabilities and needs of local communities and other resource users in order to design interventions which address issues of historical disadvantage and inequity. A further area for research is the relationship between formal statutory and customary and/or informal community-level governance institutions, as both will be central to designing effective co-management structures. Issues of conflict, for example between recreational and small-scale fishers point to a need for social research to diagnose where existing governance systems are failing and to propose interventions to resolve these problems.

10.4 Conclusion

While South Africa historically possessed a comprehensive inland fishery policy with economic, social and environmental goals, the current policy vacuum results in missed opportunities for livelihoods development, growth in unmanaged and unsustainable fishing practices, and the perpetuation of Apartheid-era inequalities in terms of resource access rights. The outcomes of the research results demonstrate that while inland fish stocks cannot support industrial-scale fisheries, small-scale and recreational fisheries do have the potential to support the creation of rural livelihoods and decent jobs, provided a policy with clear social and economic objectives is developed. The inclusion of inland fisheries into the DAFF Fisheries Branch mandate has created appropriate institutional arrangements to develop an inland fisheries policy which is aligned with national developmental goals such as the National Development Plan and the DAFF Integrated Growth and Development Plan (DAFF 2012b). The major institutional and organisational challenges still to be addressed are: 1) the promulgation of empowering policy and legislation, 2) cooperative governance arrangements, 3) capacity building of public sector staff and fishery stakeholder groups, and 4) the establishment of inland fishery co-management institutions. The current research has provided a solid base of knowledge and information, together with recommendations, to support further work required to fully realise the socio-economic potential of South Africa's inland fisheries.

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11. APPENDICES

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Nhlengani Elias Shondlani of Xihimu Local Community. For inputs on Makuleke Dam, many thanks go to Mr Humphrey Mugakula (Chief Makuleke's eldest son, who represented the chieftainship), Mr Risenga Norman Mugakula (representing the Makuleke Royal Family), Mr M. P. Makamu (Secretary of Makuleke Irrigation Scheme Executive Management Committee), Mr Ndhimande (local agricultural extension officer) and Mr K.S. Maluleke (Makuleke Communal Property Association). For inputs on Flag Boshielo Dam, thanks go to Mr Burnett Marais (IDP Manager, Ephraim Mogale (ex-Greater Marble Hall) Local Municipality), Mr Frank Phineas Lekola (ex-farm manager and leader of informal fishers' group), Sehlo-kola Aquaculture Cooperative Limited, Headman Mr Samuel Lekola and his village council (Phetwane Community), Mrs Vermeulen (Matlala Aloe Park, a local community-based fishing camp); Schuinsdraai Nature Reserve's Mr Solomon Manganyi (Reserve Manager) and Ms Linda Munyai (Tourism Officer); DWA's Mr Kobus Pretorius (Manager at the Grobersdal Office); Limpopo Department of Economic Development and Environment and Tourism's (LEDET's) Mr Sam Makhubele (Permits Officer) and Mr Rufus Mphahlele (Environmental Compliance and Enforcement officer, based at Flag Boshielo Dam but responsible for many dams in the province). Contributors to research on Lake Fundudzi fisheries included Chief Netshiavha (indigenous custodian of the lake).

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In KwaZulu-Natal Province, contributions were made by KZN DWA (now DWS) officials namely, Mr Nkosi Mkhize, Mr Bhabha Mkhungo, Mr A. M. Sayed (Regional Director – Infrastructure), Ms Michelle Govender (National Office), Mr Sipho E. Shange (Regional Operations Officer) and Mr M. M. Nyawo (Pongolopoort Dam); Former DWA and currently KOBWA official, Mr Colin Zwane; KZN Department of Agriculture officials namely Mr Mbongeni Khanyile and Mr Sibusiso Ndwandwe; Members of Pongola Dam Water Users Association (WUA), notably Mr Ronald Radebe (Chairman) and Mr Dennis Marshall (ZDM); Ezemvelo KZN Wildlife's Ms Catherine Hanekom, Mr Robert Karssing and Mr Johannes Ntsele; Private Tourism Lodge Operator, Mr Carel Landman; South African Fishery and Aquaculture Development cc's Mr Patrick Kilroe; Sizabantu Artisanal Fishers Association, Mr King Mthombela (Chairperson); *Abathengi BoFish*; Federation of SA Flyfishers' (FOSAF's) Dr Scotty Kyle; Prof Kevin Rogers (WITS); Prof Charles Breen (UKZN) Charles Breen; Jozini Local Municipality's Mr T. L. Mathenjwa; Mjindi Farm's Mr Zama Ngubo; Imfunda Yo Phongola's (downstream Floodplain WUA's) Mr Ismael Gumede; Impala (upstream) WUA's Mr Danie Cronje and Mr J. Boonzaaier; and Mr T. S Myeni of the South African Police Services (SAPS). Other contributors includes Ohlwalwini Subsistence Fishers' group, local commercial and subsistence farmers and fisher groups, and the traditional leadership of various rural communities of the Nyawo, Gumbi, Jobe, Myeni and Nsinde. Special thanks go to members of the Ntlalavini village community in the Nyawo Traditional Authority area, who voluntarily went a long way to ensuring that their own lived experiences are documented and used in transformative policy engagement. Particular thanks also go to the numerous informal fisher groups and individuals encountered in many fishing villages and fishery sites.

In the Western Cape, special thanks go to Cape Nature's Martine Jordan, Dean Impson, Pierre de Villiers (Estuaries) Antoinette Veldtman (Regional Ecologist: Scientific Services) and ecologists (Mr Johan Burger & Ms Jennifer Gouza; City of Cape Town's Biodiversity and Catchment Management Sections (Ms Candice Haskins, Ms Julia Wood and Mr Dalton Gibb), Department of the Agriculture Forestry and Fisheries (DAFF) – Inshore Resources Research, Branch: Fisheries – Mr Steve Lamberth; WESSA'S Phillippa Huntly; CSIR'S Lara van Niekerk; Elsenburg's Mr Ferdie Enderman (RG member); Verlorenvlei Coalition's Felicity Strange; Capenature's Dean Impson; Messrs Urs Schwarz, Albe van der Westhuizen and Sam White of the Western Province Artificial Lure Angling Society (WPALAS); Mr Jonathan Barnes of the DWA Voelvlei Dam Office; Mr

Michael Lewis of Capenature: Groenberg Conservancy; Silwerfontein Guest Farm owner, Mrs Karin Wild (Muller), recreational anglers, Voelwei Yacht Club, local WUA's Mr Douglas van Niekerk; and Ms Geraldine Barnes, who represented unemployed local women in and around Gouda, Voelwei and Tulbagh.

In the Eastern Cape, contributions were made by Mr Eric Qonya (DEAET, Eastern Cape and WRC Reference Group member; DAFF's Ms Nomvisiso Mzanya (Agricultural Technician) and 3 members of Ward 18 around Debe Nek Dam.

In the rest of the other provinces, many thanks go to the following: Mr Peter Ramollo of the Northern Cape Department of Tourism, Environment & Conservation (DTCET), for his valuable inputs on Spitskop Dam; Mr Daan Buijs (Assistant Director: Fishing permits) of the North West Department of Agriculture, Conservation and Environment (DACE) and Advocate Bernard Venter (Secretary and Conservation Officer of NGALAA), who both provided information on Roodekopjes Dam; and Mr Leon Barkhuizen of the Free State Department of Tourism and Environmental Affairs (DTEA), who shared insights on Bloemhof Dam.

APPENDIX 2. LIST OF PEOPLE INTERVIEWED

Date	Name of Interviewee	Organisation
15.06.11	Dean Impson	Cape Nature
18.06.11	Voelveli Dam committee	Various
12.07.11	Dan Mahlangu	Mpumalanga Parks and Tourism Agency (Provincial Dept)
03.07.11	Fanyana Mntambo	DWA, Mpumalanga
04.08.11	Rob Karssing	Chief Aquatic Research Technician, Biodiversity Division, Ezemvelo KZN Wildlife
04.08.11	Jonathan Barnes	Control Water Control Officer for Western Cape (areas 17and 19)
04.08.11	Mazwi Nyawo	DWA – Senior Water Control Officer (Pongola Dam)
05.08.11	Catherine Hanekom	Ezemvelo KZN Wildlife
08.08.11	Monwabisi Tom	Scheme Manager: Berg River Integrated System, DWA, Bellville Regional Office
08.08.11	Bertrand van Zyl	Deputy Director: Operations Western Cape, DWA, Bellville Regional Office
12.08.11	Jan Nortje	Dam Safety Office – DWA, Pretoria
15.08.11	Sengani	DWA – Limpopo
14.08.11	Norman Itani Tshihatu	DWA Limpopo
19.08.11	Leon Barkhuizen	DETEA – Free State
22.08.11	Francois Roux	DWA- Mpumalanga
07.12.12	Michael Brouckaert	

APPENDIX 3. PROVINCIAL ORDINANCES: INLAND FISHERIES LEGAL PROVISIONS

Province	Legal Item	Provisions
Western Province (Western Cape Nature Conservation Laws Amendment Act No 3 of 2000) Purpose: Ordinance to consolidate and amend the laws relating to nature (and environmental) conservation and to provide for matter incidental thereto.	Protection of fish in inland waters (chapter 5)	Pollution that is likely to cause injury to fish or fish food
	Obstruction of fish	Restrictions of placements that could obstruct free passage of fish, other than authorised nets
	Fish introductions	Forbids introduction of live fish or any other aquatic growth other than those placed as permissible 'catch and release'
	Killing of fish	Restriction on killing or injuring of fish, other than permissible catch specified in permit conditions
	Prohibition of catching of certain species or catching outside season	Prohibits catching of species endangered species and catching outside the angling season
	Angling licence	Angling shall be allowed only for those with a permit
	Netting licence	Prohibits use of fyke nets, crab-net, staked net or trek net without a licence
		Prohibits use of cast-nets unless under permit
	Exceeding bag limit or catching under sized fish	Prohibits exceeding one bag limit Prohibits catching undersized fish as stipulated in regulations
	Prohibit methods of catching	Snatching or spearing
		Use of a staked net, trek-net or fyke net which, in each case, extends over a distance of more than half the width of such inland waters at the place where such a net is so used
		Fyke-net if any device is used to guide fish to an opening if such net is more than six metres in length
		Placing a staked net of fyke net or by using a trek-net within a distance of 30 metres from the extremities of any other such net being used in such waters
		By angling by means of: more than two lines, more than 2 single hooks attached to any line; a set line with more than two hooks attached thereto.
	Sale of certain species of fish	Prohibits sell or buying of an endangered spawn of fish
		Sell, buy or transport any live carp, bluegill sunfish, trout, black bass, banded tilapia or exotic invertebrate freshwater fauna
	Importation and export of fish	Prohibits importation of live fish or the spawn of any fish in the province
	Removal and sell of bait	Prohibits sale of bait caught from inland waters unless permitted to do so

Province	Legal Item	Provisions
		Prohibits buying of bait from inland waters unless from someone permitted to catch and sell bait
	Noxious aquatic growth	Prohibits cultivation, possession, transportation, sell, donation, buying, importation into the province any noxious aquatic growth.
	Privately owned inland waters	All these provisions do not apply to any privately owned inland waters
	Exemption for scientific purposes	The Director or board may grant exemption in writing from any of these provisions to any person doing research on fish or fish food.
Free State Province (Nature Conservation Ordinance 8 of 1969 – Published under Administrator's Notice 184 of 12 August 1983)	Licence	A fishing licence shall be issued after payment of the amount determined by the Administrator subject to the following conditions: licence shall not be transferable, valid only in its original form; fees shall be non-refundable; shall lapse if lost or destroyed; and shall not exceed 12 months.
	Bag limits	On any day (except under the authority of a permit issued by the administrator), no person shall catch and keep more fish of a species than the number specified: Yellow fish – 10; Trout – 6
	Minimum takable size	There will be minimum size of fish that can be caught; smallmouth yellow fish – 45 cm; large mouth yellow fish – 45 cm; trout -30 cm
	Bait	No person shall use live fish as bait
	Prohibition of imports	Except under administrator's authority, no person shall import into the province, keep in captivity, sell live or place or release in any water prohibited species of fish as listed in the consolidated List for Fresh water fish of the Department of Agriculture
	Angling	No person shall organise or hold an angling contest or competition except under the authority of the administrator. No person shall take part in an angling competition unless it has been authorised by the administrator.
Mpumalanga Mpumalanga Nature Conservation Act No. 10 of 1998. Purpose: An Act to consolidate and amend the laws relating to nature conservation within the province and to provide for matters connected therewith	Application	Provisions of the Act shall not apply to: owner or occupier of land, their relative of said owner or an employee of said owner who catches fish in water surrounded by the land of such owner or occupier.
	Closed season	The responsible official may by notice in provincial gazette declare a period a closed fishing season
	Catching fish by angling	No person shall catch fish other than by angling (unless with authorisation from authority) No person shall employ angling methods that hook the fish on any part other than on the mouth

Province	Legal Item	Provisions
	Permissible fishing tackle and bait	No Person shall: Angle with more than two lines with more than two single hooks Catch fish with set-line, unless with a permit authorising such method Angle in fly-fishing waters with other than one line with one non-spinning artificial fly attached to it
	Possession of nets or traps	No person shall: Possess a net or trap with which fish may be caught Possess a landing-net or keep-net designed for the purpose of landing or keeping fish caught with a line and fish-hook Such a net or trap can be used on private dams/waters
	Angling without licence	No person of or above the age of 16 years shall angle unless s/he is the holder of a licence which authorises him or her to do so (and carries such a licence when angling) The above provision does not apply to private owners of dams, their relatives or employees
	Permission necessary to catch fish	No person shall: Catch fish in water unless s/he has permission from the owner or occupier of land on which the waters are situated before hand
	Placing obstructions and draining waters	No person shall: Place an obstruction in waters preventing the free passage of fish Drain water from a pond, reservoir or lake for the purposes of catching or killing fish Cut through, breakdown or damage a dam wall, bank or barrier Tamper or interfere with a sluice, gate, valve or outlet.
KwaZulu-Natal (Nature Conservation Ordinance No. 15 of 1974 – The administration of the Ordinance had under Proclamation 107 of 1994, published in Government Gazette 15813 of 17 June 1994, been assigned to the Province of KwaZulu-Natal with effect from 17 June 1994). Purpose: An Ordinance to consolidate the laws relating to nature conservation and to provide for matters incidental thereto.	Application	Applied to all waters of the province and fish therein
	Official recognition of angling clubs or association	Provided for recognition of angling clubs or associations upon approval of their constitution
	Fish Hatcheries	Provided for establishment and maintenance of fish hatcheries upon approval by administrator
	Stocking of waters	Provided for introduction of fish from any hatchery by board Prohibition of introduction of fish into any waters without prior approval of the board
	Fishing rights	Provided to agreements of leases for the acquisition of fishing rights in any water including rights of access to such waters by person holding licenses entitling them to catch fish in such waters

Province	Legal Item	Provisions
	Angling competitions	Unless provided for , no person shall promote,organise, conduct or take part in any angling competition Provided to granting license for any river conservancy or club or association to promote and conduct angling competitions
	Open and close seasons and protective measures	Provided for the administrator to proclaim closed fishing seasons for specific species and areas for the purposes of protecting fish No person could wilfully inure or disturb the spawn of fish or any spawning bed.
	Licences to catch fish	Prohibited any person from catching fish unless they were in possession of a license prescribing him or her to do so Every licence was personal to holder and non-transferable to another person These provisions did not apply to riparian owner (his spouse and children) of any land abutting to waterswho could catch fish in such waters without a licence.
	Use of nets for certain purposes	A person whose has been issued a licence could use a hand set net for the purposes of landing fish and s/he may use a scoop net with a bag no exceeding 300mm diameter and 300mm in depth for purposes of catching bait
Limpopo Province (Limpopo Environmental Management Act No. 7 of 2003) Purpose: An Act to consolidate and amend the environmental management legislation of or assigned to the Province; and to provide for matters incidental thereto).	Catching of fish	No person shall: catch fish in any aquatic system otherwise than by means of angling; place in any aquatic system any obstruction preventing the free passage of fish; drain or attempt to drain any aquatic system in order to catch or kill fish catch fish during a closed season wilfully damage, disturb or destroy the ova or spawn of fish or the spawning bed, bank
	Angling	No person while angling shall: Employ a method to hook fish on any part other than in the mouth; angle with more than two lines angle with a line to which more than two single hooks are attached with natural bait angle with a line to which more than one artificial lure or spoon is attached catch fish with a set line
	Use of Fishnet	No person shall: Be found with a fishnet, a fish trap or similar device designed for catching fish unless holding a permit.
	Protection of aquatic systems	No person shall: Establish or operate an aquaculture facility Place or release live aquatic Place or release live aquatic biota in any systemexcept as part of catch and release Import live aquatic biota
	pollution	Prohibits pollution of aquatic systems

APPENDIX 4. CASE STUDIES OF SOUTH AFRICAN INLAND FISHERY ACCESS RIGHTS, MANAGEMENT AND GOVERNANCE

4.1 Dams With Potential Inland Fisheries In South Africa

This present project investigated the current utilisation and production potential of public dams for inland fisheries for recreational and small-scale fishing (see Chapters 4 and 5 for more detail). This section provides an overview of the number, regional location and surface area of storage dams in South Africa.

The Department Water Affairs (DWA) list of registered dams of March 2010 (<http://www.dwa.gov.za/DSO/Publications.aspx>) lists a total of 4703 dams in South Africa in both categories of private and public dams. The Western Cape has the most dams at 1324 while the Northern Cape has the least at 82 (Table 23).

Table 23 Total number of Registered Dams in South Africa

Province	Total Number of Dams
Eastern Cape	697
Free State	404
Gauteng	332
KwaZulu-Natal	924
Limpopo	312
Mpumalanga	479
Northern Cape	82
North West	149
Western Cape	1324
Total	4703

In terms of size, there are 162 (3.5% of the total number) large dams (with wall over 30 metres high), 951 (20.2% of the total number) medium dams (with wall between 12 and 30 metres high) and 3213 (68.3% of the total number) small dams (with wall less than 12 metres high). 377 (8% of the total number) dams are not categorised in terms of size.

Of this national total, 704 (15% of the total number) are listed as public dams (belonging to DWA, municipalities, Department of Agriculture Forestry and Fisheries (DAFF), Department of Correctional Services, etc.). Of this total number public dams, 132 (18.8% of this total) are large, 273 (38.8% of this total) medium size and 293 (41.8% of this total) are small. Six are not categorised in terms of size.

The total surface area for all dams (private and public) in South as listed in Table 24 is 1500422 hectares (<http://www.dwa.gov.za/DSO/Publications.aspx>). Of this 791643 hectares are public dams listed in Table 24. Thus 53% of the total surface area of all dams is public dams. Thus over half of the total surface area of storage dams in South Africa is public dams that can be harnessed for inland fisheries. These are spread in all the nine provinces including those that exhibit the most rural based and impoverished populations in the country such as Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga and the North West.

Table 24 Total number of Public Dams in South Africa according to size

Province	Size of dam				Total
	Large	Medium	Small	Non-categorised	
Eastern Cape	31	52	41	1	125
Free State	8	33	36		77
Gauteng	12	17	59		88
KZN	12	24	26		62
Limpopo	14	26	12		52
Mpumalanga	16	35	19	2	72
Northern Cape	2	5	9	2	18
North West	7	21	29		57
Western cape	28	59	53	1	141
Total	132	273	293	6	704

Nine case studies of existing fishing rights systems on public dams were undertaken and summarised below. These dams were Driekoppies dam, Lake Fundudzi, Nandoni dam, Makuleke dam, Uphongolo dam, Voëlvlei Dam, Clanwilliam dam, Theewaterskloof dam and Bloemhof dam.

4.2 Driekoppies Dam

Driekoppies Dam provides an example of highly developed institutional arrangements controlling access to, and activities on the water body. However, small-scale fishing for livelihood purposes is not legally recognised, nor are fishers represented in any dam governance stakeholder institutions.

The Driekoppies Dam (also locally called the Matsamo Dam) in Mpumalanga Province is within the Komati River Basin that supplies water to South Africa, Swaziland and Mozambique. This triangular shaped area, a zone of about 2,400 square kilometres, is surrounded by Swaziland on the western side, the Kruger National Park on the northern side and by Mozambique on the eastern side. Under Apartheid, the area was shared between the 'Republic of South Africa' and KaNgwane Homeland in the south. In the context of the latter, the Dam is also located within Matsamo Tribal Authority (Tapela *et al.*, 2015). The Matsamo (or Driekoppies) Dam in South Africa with a capacity of 237 million cubic metres on the Lomati River became operational in 1998. Within South Africa, the Driekoppies Dam is in Mpumalanga Province and is located at 25° 43' 0" S, 31° 32' 25" E.

Stakeholders

The Dam is owned by the governments of South Africa and Swaziland through the Komati Basin Water Authority (KOBWA) and was primarily built for irrigation purposes. KOBWA is a bi-national company formed in 1993 through the treaty on the Development and Utilisation of the Water Resources of the Komati River Basin signed in 1992 between the Kingdom of Swaziland and the Republic of South Africa (<http://www.kobwa.co.za>). In South Africa, Driekoppies Dam is a government Dam belonging to the Department of Agriculture, Forestry and Fisheries (DAFF). In South Africa, the dam stakeholders are: DAFF, DWA Nelspruit, Mpumalanga Parks Board, Mpumalanga Development Corporation, Mpumalanga Department of Agriculture, Lomati Irrigation Board (representing both large-scale and small-scale farmers, Mfumfane Irrigation scheme), Komati Irrigation Board (representing both large-scale and small-scale farmers), Ngogolo farmers scheme, small-scale farmers pumping water directly from the river, Mpumalanga African Farmers Union, Nkomazi Municipality, fishers from local communities who fish for both subsistence and commercial purposes, and recreational fishers. It must also be noted that the dam falls within the Matsamo Tribal Authority. There are four villages within this Authority that surround the Dam, namely Schoemansdal, Middleplaas (between which the dam wall is located), Schulzendal and Jeppe's Reef (<http://www.kobwa.co.za>, Tapela *et al.*, 2015).

Water Uses

In the Nkomazi region, the water uses are basically for irrigation purposes (222 million cubic metres), drinking water (11 million cubic metres) and forestry (12 million cubic metres) (see KOBWA, Germany Federal Ministry for Economic Cooperation and Development and Capacity Building International, Germany. 2009; <http://www.kobwa.co.za/index.cfm>)

Irrigation. The economy of the area is based on irrigated agriculture, which consists mainly of sugarcane farming. Overall, at least 45,000 ha are cultivated, of which around 29,000 ha are irrigated. There are currently approximately 120 commercial farmers and 1,000 small-scale farmers in the area. The two Irrigation Boards in charge of managing water are the Lomati Irrigation Board (LIB) and the Komati Irrigation Board (KIB). They were created to control the amount of water pumped by the commercial farmers during periods of drought. In 1995-1996, both Irrigation Boards (IBs') areas of jurisdiction were broadened to encompass the small-scale growers.

Domestic and Industrial Use. A large part of the Nkomazi area belongs to the former KaNgwanehomeland, which is densely populated and at the year 2000 count had around 220,000 inhabitants (KOBWA, Germany Federal Ministry for Economic Cooperation and Development and Capacity Building International, Germany. 2009; <http://www.kobwa.co.za>). Several drinking water schemes bring water to the communities. The local Nkomazi Municipality is the Water Service Authority. There are neither large towns nor water-consuming industries in the catchment.

Environmental use. There is a game reserve in the area, situated between the IBs, outside their areas of jurisdiction.

Fisheries

The dam supports a recreational fishery and small-scale fishery for livelihood purposes. Fishing also takes place in the river. In the downstream part of the river, the Inkomati Tiger Fish Action Group lobbies for the protection of fish on the Lower Komati. The common fish species in the Dam are largemouth bass, catfish and kurper (Tapela *et al.*, 2015). The dam is used by surrounding communities for both subsistence and commercial fishing. Hook and line and fishing nets are used, though the nets are illegal. Even those using hook and line should possess fishing permits which stipulate an allowance of three fish per day, but most fish illegally without permits (Tapela *et al.*, 2015). The recreational fishers are mainly white people from Nelspruit, Malelane and Johannesburg who angle from boats. A fee of R80 per boat is charged and there is requirement for the boat to have a water worthiness certificate and for the vessel operator to have an operator's licence. Most practice catch- and release, despite the three fish per fisher per day allowance. Fishing competitions are also organised on the Dam (<http://www.fishingdestinations.co.za/letsstofish>; http://www.sealine.co.za/view_topic).

There is no clear policy on fishing on the Dam mainly because of lack of overall fisheries policy within DAFF/DWA. In terms of provincial environmental legislation, the KOBWA security officer told Tapela *et al.* (2011) that it was illegal to fish with nets and he was thus obliged to remove or confiscate any nets found in the Dam. In addition, recreational fishers (mostly whites) also remove and confiscate nets found on the Dam or being used on the Dam voluntarily, using a request to them by DWA enforcement agencies to make 'citizens confiscations' (or even arrest) if they find people using nets on the dam.

Integrated management

The Komati Basin Water Authority (KOBWA) is in charge of the dam, with the aim of satisfying the needs of the farmers while meeting the international and legal requirements of a tripartite agreement between South Africa, Mozambique, and Swaziland, and the forthcoming definition of an ecological reserve in South Africa. In order to include other users in management, a Water Users Association (WUA) will have to be formed (<http://www.kobwa.co.za>). Even then, the WUAs will have fewer responsibilities with regard to the technical side of water distribution because of the existence of KOBWA (ibid). The WUA will be more focused on the role of sharing information, both top-down and bottom-up, and will constitute a central place for discussions among stakeholders.

Integration of Non-farming Users into the WUAs

The Nkomazi municipality is a non-farming user that has to be associated with the WUA, first as a representative of the drinking water users, to solve issues like the management of the Tonga Weir, and secondly as the local government, since irrigated agriculture is the backbone of the economy in this region. Mpumalanga Parks Board (MPB) brings with it useful expertise to the problem of implementing the ecological reserve. For this reason also, it will be fruitful for the MPB to be a fully-fledged member of the Water User Forum in-charge of discussing management strategies with KOBWA.

In transformation of the irrigation board into a WUA, the main activity remains the management of water quantity, i.e., the maintenance of existing works (weirs), and the management of the water metering system. Three categories of users have to be defined in the reform. Category I users are users belonging to the existing irrigation boards (that is commercial farmers and emerging farmers). Category II users are non-farming- users that have a water license for drinking water use and industries (for example the municipality). Category III users are stakeholders with no specific water license (for example DWA and MPB). Hence the formation of the WUA and definition of category II and III users will potentially open up a representative governance institution for other users, such as fishery stakeholders, in order to achieve more integrated dam resource management.

Concluding remarks – access, withdrawal and management rights for fishing

Driekoppies dam is jointly owned by the governments of South Africa and Swaziland, and governed through KOBWA which is the management authority for the dam. Access to the dam in South Africa resides under Department of Water Affairs. Fisheries on the South African side is managed by the Mpumalanga provincial department of Economic Development, Environment and Tourism. The current fishing activities on Driekoppies dam are based on provincial environmental legislation implemented by the Mpumalanga Parks Board while the rules of access to the dam are determined by KOBWA. The provincial environmental legislation mainly provides for recreational fishing activities whereas subsistence fishing and commercial fishing activities are poorly defined and thus exist outside the existing legal framework. As the responsible management authority, the provincial department of the environment lacks strong presence on the dam in terms of management activities. Although subsistence fishing without permit appears to be tolerated, gill net fishing is not to the extent that recreational fishers sometimes take the law in their own hands and enforce this on their own (especially given the weak capacity for undertaking enforcement activities by the responsible department). The planned WUA has the potential for creating an institution for co-management of the dam's use including fisheries. Currently though, there were no dedicated fishery stakeholder institutions or governance processes.

4.3 Lake Fundudzi

Lake Fundudzi provides an interesting example of intact customary governance of natural resource access, including for subsistence and recreational fishing. Fishery control rules occasionally enforced by the environmental authorities are generally not recognised as legitimate and not respected by the local community.

The Sacred Lake

Lying in the heart of the Soutpansberg, Lake Fundudzi in Limpopo Province (22° 51' 17" S 30° 18' 20" E), is one of the few truly inland lake systems in South Africa. The lake, which is on the Mutale River, was formed by a landslide. Lake Fundudzi is the most sacred place in these mountains for the Venda People-the Vhatatsindi (People of the Pool) – who live in the area. The Lake is so sacred, in fact, that when you approach the lake, your first view of it should be from between your legs. Permission to visit the lake shore is rarely granted to tourists, but the lake may be seen from one of the roads in the surrounding mountains. It is said that the sacred water of the lake does not mix with normal water. Because there is no obvious outlet, the lake was believed to be bottomless as far as the human world is concerned.

Apart from its cultural role, the main uses of the Lake are fishing, occasional swimming, and as a source of drinking water when people are at the Lake. But people do not carry the water home in compliance with local culture (Tapela *et al.*, 2015).

Management and Conservation

The People of the Pool have been part of Lake Fundudzi's conservation since their ancestors migrated here centuries ago. Chief Netshiavha claims that Lake Fundudzi was discovered by the Netshiavha ancestors centuries ago (Tapela *et al.*, 2015). Chief Netshiavha and the royal family remain the custodians of the Lake. For decades, Chief Ntsandeni Netshiava, his father, and grandfather before him, were the only people who could give permission to strangers to approach the Lake. The local population also recognises that custodial stewardship of the lake and surrounding resources rests with Chief Netshiavha and the royal family, not government (*ibid.*). The respect for the Lake and the taboos that disallowed visits have meant that the lake has survived in quite good condition, although long-held traditions are not being sustained with quite the same authority as previously. In interviews with Tapela and Jenjezwa (Tapela *et al.*, 2015), Chief Netshiavha reaffirmed his desire and wish to maintain the ecological integrity of the Lake and its catchment due to the cultural importance of these to his people. In this context, he said that he would not accept developments that could disturb the existing natural state of the Lake and its hinterland. He hoped that the Lake would be declared as a heritage site. In recent years though, there had been a growing general lack of regard for the Lake's historical cultural values and sanctity which is fast leading to the lake's degradation. Deforestation, agriculture and development are causing erosion and the lake to silt up, although a local project is busy rehabilitating the area. The Chief believed that declaring the Lake and its catchment as a heritage site would help towards eliminating the increasing threats to the ecological and cultural integrity of Lake Fundudzi and the surrounding catchment.

Fisheries

The lake is used for subsistence and recreational fishing subject to a mix of customary governance norms and legislated rules. The fishers interviewed by Tapela *et al.* (2015) mentioned that there were seven species of fish namely *Tilapia Mozambicus* (*Tshikwea*), *Threespot Barb* (*Thanzwana*), *Large-scale Yellow fish* (*Thanzwi*), *Carp* (*kappa*), *eel* (*khunga*), *pulisani* and *Nemulambo*. The fishers mostly use fishing rods (hook and line) while a few use casting nets (*mambule*). All these fish are all edible. According to the fishers, they believe that there is plenty of fish in the Lake, but that it is hard to catch the large fish (most of the catch consists of fish between 16 and 20 cm). Apparently, summer is the best fishing season. Fishing is usually restricted to daytime due to taboos about night fishing. Both men and women can fish, and fishing knowledge is passed on through generations as adults passed on this knowledge and skills to their children. Apart from taking fish home for food, fishing is also seen as a recreational activity. On a good day a fisher can catch up to 10 kg of fish. Extra fish is also sold. No fishing boats appear to be used due to the local belief that the middle of the Lake is a no-go area since it is a 'place of things', that is, the middle of the Lake is a place where things or people that go there never come back (Tapela *et al.*, 2015).

In terms of access, fishers said that all people from the surrounding villages are allowed to fish including those from outside the area and not belonging to the local communities (Tapela *et al.*, 2015). No permit is required to fish and the local people do not have any problem about people from other communities further afield fishing in the Lake. Fishers expressed the concern and grievance that environmental conservation officials sometimes stopped them from fishing and confiscated their fish without real reasons.

Concluding remarks – access, withdrawal and management rights for fishing

Fundudzi is a natural lake and not a constructed dam under authority of Department of Water Affairs. The local communities have strong historical and cultural links to the lake, to the extent that they argue and believe that it belongs to them. The local chief Netshiavha thus holds custodial stewardship of the lake on behalf of his subjects. Thus although in terms of the law all water belongs to the state under the National Water Act, and management of fisheries in the Limpopo province is under the provincial department of Economic Development, Environment and Tourism, both the DWA and the provincial environmental department have

little involvement in management of the lake. Control of access, including to fishing, vests with the chief. The management of the Fundudzi fishery and the lake's catchment is thus largely community-based, and the chief wants to keep it that way. The growing lack of regard for the Lake's historical cultural values and its sanctity that is fast leading to the lake's and the surrounding catchment's degradation is concern for the chief, so much so that he would like government to assist in having the lake and the surrounding catchment declared a heritage site.

4.4 Nandoni Dam

Nandoni Dam, situated in a highly populated customary rural area, provides an example of a burgeoning and unmanaged small-scale fishery, existing alongside an established recreational fishery. The lack of legitimate governance institutions and small-scale fishing rights has resulted in weak fishery management, user conflicts and concerns about the sustainability of the resource.

Nandoni Dam, previously known as Mutoti Dam is in Limpopo province (22° 59' 20"S 30° 36' 10"E) falls within the Vhembe district and Thulamela Local Municipality. The Dam, completed in 2005, is impounded on Rivers Luvuvhu and the Greater Letaba River and has a surface area of 1570 hectares and a capacity of 164 million cubic meters. It was built to supply drinking water to Thohoyando and surrounds (Tapela *et al.*, 2015).

Uses of the dam include supply of bulk water to local municipalities and surrounding communities (though communities complain that this is said to be patchy and inadequate so far), fishing, washing clothes, bathing and watering of animals. Local people expressed the desire for to use the dam's water for irrigation to boost their agricultural production and therefore livelihoods.

Main stakeholders

The Dam belongs to the DWA and is surrounded by six small rural communities, namely, Budeli, Mutoti, Tshiulungoma, Mulenzhe, Dididi and Pitiboyi, who control the land around the Dam. The communities share equal access rights to the Dam and its resources. Some local chiefs were asserting control over access to the dam by building pay-per-entry facilities such as picnic sites.

The local people justify their *de facto* access rights to the Dam resources (though it is owned by DWA) on the basis of their displacement without compensation. In this context, they feel that the area where the Dam is established and therefore the resources therein belong to them (Tapela *et al.*, 2015).

Fisheries

The dam supports a recreational fishery and growing small-scale fishery (Tapela *et al.*, 2015, Fouche *et al.*, 2013) for both subsistence and commercial purposes. Small-scale fishers use cast nets (*Mambule*), gill nets and hook and line (*Tshinjovho*). Fishing takes place during both day and night. Boats are also used for fishing. The fish caught is mostly sold in the surrounding urban areas. The fish is sold either fresh or dried. The survey by Tapela *et al.* (2015) revealed that individual fishers' catches are worth up to R2, 500 in a single day.

In a Water Research Commission funded study on the fishery potential of Lake Nandoni, Fouche *et al.* (2013) described the growth of a thriving and unmanaged small-scale fishery on Lake Nandoni. The number of small-scale fishers using canoes and gill nets increased from an estimated 20 in September 2009 to 50 in September 2010 stimulated by good prices for road-side sale of fresh fish in the local area. The unit of sale was a 20 l bucket which would contain at least 30 fish, mainly *Oreochromis mossambicus*, weighing at least 10 kg. Concern was expressed that the expanding fishery could be the cause of a downward trend in fish size. Recommendations were made on gill net stretch mesh size to selectively harvest larger fish. Growing conflict between small-scale fisher gill-netters and recreational users was reported.

Management

Fishery access rights are poorly defined with weak institutional arrangements, some of questionable

legitimacy. Although the DWA owns the Dam, it does not control nor monitor the fishing activities on the Dam. No permits are required for fishing and the traditional authority represented by Chief Pitiboyi exercises controlled access to the Dam frontage from the land under his authority. Fishers are to purchase fishing permits for R20 if they are to access the dam from the picnic area he has established. A local regulation, probably based on safety concerns, forbids children less than 14 years old fishing on their own. One of the fishery governance problems mentioned was the theft of nets (Tapela *et al.*, 2015).

It was alleged by some interviewees that Chief Pitiboyi has had fisher's gill nets and fishing equipment confiscated and destroyed, probably because gill nets are illegal in terms of the provincial environmental regulations. He reportedly tried to have fishers arrested by the police or conservation officials, though these officials did not arrest the fishers.

Concluding remarks – access, withdrawal and management rights for fishing

Nandoni dam belongs to the DWA and the management of fish resources in Limpopo Province resides with the department of Economic Development, Environment and Tourism. The surrounding communities have outstanding grievances arising from lack of or inadequate compensation for loss of land, houses and other infrastructure for being removed to make way for construction of the dam. As a result, they strongly feel that the dam and the resources thereof including fish still belong to them. The lack of strong management presence on the dam by the department of the environment has strengthened the assertion of local community ownership, and also community based management. In terms of property rights regime, the lake thus exists both as state and *de facto* communal property. The lack of an accepted and legitimate governance institutions is resulting in user conflicts, lack of effective resource management, and concerns about the sustainability of fishing effort.

4.5 Makuleke Dam

The Makuleke Dam fishery highlights unresolved resource rights arising from Apartheid-era land dispossession and community relocation, inadequate restitution for land loss, the erosion of common pool resource use traditions, nested fishery access rights systems, and the lack of legitimate fishery governance institutions.

Makuleke Dam is located (22° 52' 3" S 30° 54' 18" E) on land belonging to the Makuleke Community near Giyani in Limpopo province. It is on the western boundary of the Kruger National Park about 18 kilometres from the Punda Maria Gate of Kruger National Park. It was constructed in the late 1980s (commissioned in 1990) by the Department of Agriculture for irrigation purposes on the Mphongolo River. The Makuleke are a Tsonga speaking people who lived in the Pafuri area north of the Kruger National Park at the intersection between the Mozambique, Zimbabwe and South African border before they were forced to move from the area under Apartheid forced removals. The Dam was established for irrigation purposes, and the water is usually sufficient for both commercial and subsistence farmers in years of normal to high rainfall (Tapela *et al.*, 2015).

The Makuleke people assert that they have the right to control activities on the Dam because;- the Dam belongs to the community and is named after the community; the Dam is located on their land; and its construction resulted in displacement of the community and crop losses. Other local communities, that use the water from the dam include Nkavele, Maviligwe, Hlungwane, Maphophe and Saselamani.

Fisheries

The Makuleke tribe has a long history of fishing using customary methods in their former location at Pafuri, and spontaneously began fishing on the Makuleke dam following the community's relocation from Pafuri (Tapela *et al.*, 2015).

The dam supports an active small-scale fishery. Commonly used methods for fishing are hook and line, gillnets and scoop nets. Fishing is usually done at night and also early in the morning. Some fishers, particularly outsiders, were reported to use motorised boats and non-selective fishing gears such as small mesh gill nets which catch under-sized fish. Fishers sell their daily catch to people within the community

and also to neighbouring communities when they catch quantities that are over and above their household requirements. Although the fishers from the community stated that had not observed any decline of catches, with some asserting that there was plenty of fish in the Dam, they were concerned that the increasing number of outsiders (members of neighbouring communities and others from afar also fish in the Dam) fishing in the Dam would result in depletion of the fish stocks.

The Tribal Authority and the Community Property Association (CPA) had instituted measures to control access to the dam with the help of the Department of Economic Development, Environment and Tourism. The community reports any fishers from outside that are fishing without a permit to the elected local or tribal leaders. Interviewees reported that tribal security is tasked with the arrest and laying of charges against outsiders caught fishing without the relevant fishing provincial fishing permits. The chief's elders asserted that there was no need for permits for subsistence fishing. While the provincial government is responsible for issuing fishing permits, fishers (especially outsiders) are required through the local leaders to ask for permission to fish in the Dam. What is clear is that there is need for more coherent fisheries management and governance arrangements.

Concluding remarks – access, withdrawal and management rights for fishing

Access to fishery resources on the Makuleke Dam for small scale fishing purposes is characterised by a mix of customary resource access institutions and government environmental regulations and permits. The Makuleke dam was built as an irrigation dam by the Department of Agriculture. The community insists that the dam was built on their request. Thus because the dam is built on land that belonged to the local community and on their request, the local community believe that the dam belongs to them. Like Nandoni therefore, the access to use of the dam's fish resource exists under dual property rights regime – state and communal. Control of access to the dam and fishing is effected through the Community Property Association with the assistance of the provincial management authority – the Department of Economic Development, Environment and Tourism. In addition, local communities, through tribal authority, can arrest offenders and institute charges. Thus there exists a seemingly workable co-management institution for fisheries on the dam, which involves both a decision-making structure and enforcement activities.

4.6 uPhongolo Dam (Lake Jozini)

The Phongola dam supports a valuable recreational charter fishery for tiger fish, and an artisanal small-scale gill-net fishery by local community members which has been subject to periods of fishing under permit and without. In the absence of an effective fishery governance institutions, particularly formalised fishing rights and a fishery management plan, the situation is highly conflicted with the mainly white recreational sector actively involved in pursuing criminal sanctions against the gill net fishers from the community who they regard as 'poachers'. The community fishers feel dispossessed of their traditional land and right to make a livelihood from fishing. (see project case study video of fisher testimonies <https://www.youtube.com/watch?v=qKu3xbOiU4I>)

Phongola Dam (formerly known as Pongolapoort Dam) or Lake Jozini Dam is situated in a beautiful part of northern KwaZulu-Natal (KZN); on the western side of the Lebombo mountain range in an area characterised by bushveld, wildlife and subtropical weather. Situated on the Phongola River at the "Heart of the Zulu Kingdom", just outside the town of Phongola (30° 19' 3" S 30° 11' 3" E). The Dam was completed in 1974 and covers an area of 13,276ha.

The dam was built for agricultural purposes and also to control flood water downstream into the Makhadini flats. It irrigates more than 80000 hectares of agricultural land for growing sugar cane (50 km² of sugarcane), rice, coffee, subtropical fruit plantations, etc. The dam is largely surrounded by game reserves, which support several tourist lodges. The reserve and game farms offer game drives, boat cruises, guided walks, rhino tracking, canoeing and recreational fishing charters for tiger fish. Phongola town and traditional communities from the surrounding areas use the water for drinking washing and small-scale fishing.

The dam (including the land adjacent to the water body known as the Admiralty Reserve) is owned by

the Department of Water Affairs (DWA) while the land itself is owned by a combination of the provincial government (EKZN Wildlife game reserve), private landowners (some of who have built game farms and lodges) and communities (under the stewardship of Traditional Authorities). Thus the main stakeholders for the dam are: DWA, EKZN Wildlife, private landowners, farmers who get water for irrigation and local communities (in particular those of Nyawo and Myeni Tribal Authorities).

Fisheries

Jozini Dam is one of the most popular recreational fishing destinations in South Africa, with catches of tiger fish comparable to popular tiger fishing destinations such as the Okavango Delta and the Zambezi River. Jozini however is much closer and easily accessible by vehicle for South African tiger fishing enthusiasts. Recreational fishing under permit occurs through access to the Dam frontage provided by Lodges such as the newly built Jozini Tiger Lodge near the dam wall. Recreational fishers either practice catch and release or take the fish away for own use.

There is also informal (without permits) commercial fishing by use of gillnets from the DWA slipway, which is the only legal public access to the dam. The fish is sold to buyers, who are all local women, who sell it further afield. The history of the gillnet fishery is reportedly as follows: Experimental gillnetting in the Dam was initiated in the 1980s by the then KwaZulu Department of Nature Conservation in order to determine whether this harvesting method could be sustainable. One gillnetter who had been working on the experimental project (Mr. Ndlazi) was granted a permit to operate in the gorge area of the Dam. Large catches and data were collected for some years from this fisher. However following the amalgamation of the KwaZulu-Natal Department of Nature Conservation (KNDNC) and the Natal Parks Board (NPB) to form the EKZN Wildlife, management and supervision of the operation became diluted, permit conditions were not complied with and fishing expanded out of the demarcated gorge area. The permits were subsequently not renewed by EKZN Wildlife.

The gill-netters believing firmly that they possess a right to fish have carried on their activities spreading throughout the dam, most notably along the western shores from private land and on EKZN Wildlife land, resulting in increasing conflicts with private land owners and the EKZN Wildlife management. There are also informal subsistence fishers who fish at the gorge area, and on the eastern shores of EKZN Wildlife land. In interviews conducted by EKZN Wildlife staff, the netters consistently stated that the Water Users Association (WUA) had granted them authority to continue netting in the gorge area. Another version is that DWAF took out a blanket permit from EKZN Wildlife on behalf of the netters. The interviews also revealed that the netters are operating under the assumption that they are permitted to continue netting until the legal permit issue is sorted out. They furthermore maintain that they are permitted to fish in both the gorge and the eastern shores, as they had complained that there is no fish in the gorge. Contrary to this, Honorary Officers of the EKZN Wildlife stated that gill netting was supposed to be restricted to the gorge area only and is not allowed in the other dam areas until the permit process has been finalised. According to these officers, all netters and operators found outside of the gorge area should be arrested and charged.

The different stakeholders are not happy with the perceived unequal benefits and value being derived from fish resources from the dam. On the one hand the local communities on the eastern shores who do not have infrastructure from which to access the dam see their benefits as much lower than those by the private land owners on the western shores who have developed lodges and game farms on the dam frontage. These inequities are also perceived in terms of historical racial inequities.

Management

A Sustainable Use Plan (SUP) for the Jozini Dam was commissioned in 2004 by the Department of Water Affairs and Forestry (DWAF, 2004). The purpose of the SUP was the fulfilment of NWA objectives, in particular section 2 regarding: equitable access to water; redress of past gender and racial discrimination; efficient and sustainable utilisation of water; facilitation of social and economic development; ensuring adequate provision for the growing demand for water particularly for recreational purposes; protection of aquatic and associated ecosystems including their biodiversity; reduction and prevention of pollution and degradation of the water resource; meeting of international obligations; promotion of dam safety; and

adequate representation of communities in terms of both race and gender on the management institutions. Despite the intention to address equity issues, increased integration of communities into use and economic activities on the dam has been lacking.

As the DWA delegated the management of the activities on the dam to the KZN Province in 1979, be managed as part of a nature reserve, the SUP was conservation focussed and did not recognise customary fishing activities or rights of the local community. Sport fishing was seen as a primary activity, but provision was made for commercial fishing. EKZN Wildlife is thus responsible for biodiversity conservation and management of the fishery (e.g. enforcement of legislated fishing methods, permits for recreational fishing, etc.). Apart from law enforcement activities by EKZN Wildlife, a group of Honorary Officers with recreational fishing interests assists. The department has also deployed community conservation staff, that undertake education and awareness-raising programmes in surrounding communities.

One of the major problems in terms of management is the lack of coordination among stakeholders. Thus although a Recreational Water Users Association (WUA), with representation by all key stakeholders, was set up in 2005 (Uphonogolo Dam Recreational Water User Association, 2005), the association has largely been ineffective in co-operative management. A concern is that the DWA had actually transferred the management of all recreational activities and regulatory authority to the WUA, resulting in overlapping functions between the WUA and EKZN Wildlife. The EKZN continues though to monitor activities and enforce regulations in the face of the ineffectiveness of the WUA.

Concluding remarks – access, withdrawal and management rights for fishing

Phongola dam and its frontage area therefore exhibit a mixture of all the property rights regimes, namely state, private and communal. Although the DWA made a serious attempt to establish stakeholder based resource governance in the form of the Sustainable Use Plan – with policies to guide equitable resources use, and Water Users Association, these institutions largely failed to achieve their goals. Although fisheries management officially resides with EKZN Wildlife, the lack of clear policy and guidelines in terms of fishing rights and regulations has resulted in a vacuum of authority and conflicts between subsistence and artisanal fishers from local communities on the one hand, and recreational and tourism operators on the other, particularly regarding the use of gillnets outside the gorge area. The conflicts have resulted in heightened political tensions along racial lines, with EKZN Wildlife caught in between. Some (especially fishers from the communities) believe that authority for management of the dam and fisheries was transferred to the WUA. In practice though, the WUA has remained non-functional since its formation, leaving the EKZN Wildlife to continue carrying the management responsibilities. In the light of the general failure of WUA's and DWA's intention to phase them out, a rethink is required of appropriate resource governance institutions. Given the legacy of disadvantage that local communities bear, it is clear that institution building to promote equitable resource access needs to proceed from this starting point with government led intervention to ensure local community needs are included in the design of governance institutions, resource use objectives, and management plans. In the case of fisheries, governance arrangements need to be based on a formal recognition of the rights and duties of communities, recreational users and commercial fishing charter contractors. A review of rights of existing users in terms of DWA objectives and criteria would be a good starting point.

4.7 Voëlvlei Dam

Voëlvlei Dam is predominantly used for recreational fishing and yachting, with very well organised local club structures managing access and activity on the dam under authorisation from the DWA. The lack of a dam resource management plan and policy on inland fishing has retarded a proposal to initiate a commercial fishery for carp and catfish, and the restricted public access to the dam raises issues of equity.

Voëlvlei Dam is in the Berg River catchment (33° 20' 15" S 19° 2' 30" E) in the Western cape Province near the Cape Town metropole. It supplies bulk water to the City Cape Town and Swartland Municipality for domestic distribution through a water licence. The farms (mostly grape vines and fruit) in the area withdraw water from the Berg and Klein Berg rivers downstream from the dam. The dam is a popular recreational venue for angling and boating.

Stakeholders

The dam is owned by the Department of Water Affairs and some twelve clubs have an authorisation from the DWA for use of the grounds on the dam shores for recreational activities. The angling clubs and the yachting club control access to the dam for non-members by selling day-permits to non-members for use of the facilities (camping grounds for caravans, tents, toilets, braaing areas, etc.). Membership for angling clubs and the yachting club is based on the constitutions developed by the individual clubs. There is a limit in terms of maximum number of members clubs might admit.

Fisheries

The dam is a popular recreational angling site located close to the Cape metropolitan area. Smallmouth Bass are the main attraction and the dam has been labelled as “The definitive South African Bass fishing site” (<http://www.bigbass.catch.com/id5A7.12>). Other fish species found in the Dam include carp, rainbow trout, catfish and Cape witvis (*Barbus andrewi*). Fishing can be done legally through a license that can be bought from the Receiver of Revenue or from the Post Office. Anglers are allowed two bass/day and are not allowed to sell the catch. Most anglers practise catch-and-release. There is no control on fishing of alien species, especially carp and catfish, as these are viewed as being not good for the Dam because they are bottom feeders and thus discolour the water whereas the bass do not.

The Western Cape Department of Agriculture commissioned a project to evaluate the potential for a semi-commercial/commercial fishing on public dams with a view to targeting the West African expatriate market for fresh water fish. This followed a realisation that there are a growing number of ‘African’ shops in cities such as Cape Town that specialise in stocking food for foreigners from other African countries including frozen or dried/smoked fish (mostly tilapia and cat fish species) imported from other countries. Clearly there is a growing niche market for freshwater fish in South African cities. In addition product development could be undertaken to develop markets for inland fish among South Africans through awareness raising, marketing campaigns and the introduction of new fish product forms based on inland fish species from South African Dams and other inland fish resources. This is particularly pertinent in inland impoverished areas where the need for a cheap source of protein supply exists. For recreational fishers, the concern is that the dam is being taken over by large alien invasive species, namely catfish and carp, which are causing the recreational fishery for bass to decline. The experimental gill net fishery for these invasive species is seen as one of the solutions. But the allocation of a commercial fishing access right is problematic for the relevant authorities (Cape Nature and Western Cape Province Department of Agriculture) due to the lack of a guiding policy (D. Impson, Pers. comm., September 2011).

Management

The DWA is responsible for the issuing of authorizations for use of the Dam and dam perimeter for recreation activities and extraction of water. Cape Nature is responsible for management of biodiversity in the Dam, the Dam perimeter and its catchment. Access is legally free for the general public (including members of the local community) from 6 a.m. to 6 p.m. (Barnes, DWA, pers. Comm.). DWA does not charge for access because it does not provide facilities for the public. In order to facilitate public access, the DWA has established entry points for public access near the Dam wall. The DWA has by-laws that stipulate the rules for dos and don'ts for the public accessing the Dam and its perimeter. For example, these relate to lighting of fires only in designated areas, entry points for the public, littering, the 6am to 6pm rule, etc.

There is a dam committee composed of DWA, the angling clubs, the yachting club and Cape Nature Conservation. According to DWA, the committee has no legal powers especially control of access. The committee exists to represent the interests of the stakeholders. Despite the foregoing, the committee members pointed out that the committee controls access to the Dam on a voluntary basis (for example, the Guesthouse through keeping the gate locked and also the angling clubs selling day permits for use of their facilities and issuing entry keys to such day permit users). The DWA stipulate though such controls are illegal as the Dam is open to the public from 6am to 6pm. In this context, according to the DWA, the Guesthouse and the private clubs should not be charging people for access to the Dam. This raises the question as to what the Terms of Reference for the Management Committee and powers that its members can derive from these.

In view of this lack of clarity about the role of the Management Committee, all current stakeholders agree that there is need for consultation to discuss how to improve access for local communities and the general public while ensuring sustainability of Dam's (and catchment) biodiversity at the same time. The questions this raises are *who could benefit from increased access? and would such improved access include better fishing rights for local communities?*

Concluding remarks – access, withdrawal and management rights for fishing

Voëlvlei dam belongs to DWA. There is a strong presence of recreational fishing and a yachting club on the dam. The fact that it is located in a farming area and there are also small towns in the area means that there is potential for fishing by farm worker and township communities. CapeNature is responsible for management of fisheries on the dam. The fencing of some of most accessible areas of dam perimeter (where private facilities have been built) by private angling, yachting clubs and the Guesthouse demonstrates how access for other users can be limited or denied through such *ad hoc* privatisation of use. Thus although the public has the right to have access to public dams from 6.00 am and 6.00 pm under the NWA, access can be restricted or denied through such privatisation of the dam perimeter as show by what is happening on Voëlvlei Dam. The formation of a dam committee shows how well organised existing users can organise themselves in order to protect their interests. Although such initiatives should be welcome (especially in the vacuum of management authority taking the initiative) and can be used as basis for co-management arrangements, such institutionalised organised interests have also got the potential to deny the less organised and less powerful communities use rights and participation in management.

4.8 Clanwilliam Dam

Clanwilliam Dam is a well-established water sport recreational venue and a prime bass angling destination. No subsistence or artisanal fishing takes place and no fishery conflicts were present on the dam. Existing rights of access and management arrangements appear to cater well for users' needs and promote a vibrant tourism economy.

Established in 1935, Clanwilliam Dam (32° 11' 5" S 18° 52' 1" E) is a concrete gravity dam on the Olifants River near the town of Clanwilliam in the Western Cape Province. The Dam belongs to the DWA.

Uses

The primary use of the Dam is for irrigation and water to surrounding municipalities. The dam has become very popular for recreational purposes of all kinds including boating, water-skiing and fishing. With chalets as well a camping area, the resort area situated along the banks of the dam is a popular weekend and holiday destination that caters for all tastes. The Resort is open to both overnight and day visitors.

Fishing

There are very little or no subsistence fishing activity on the dam. Recreational fishing is mainly for Large or Small Mouth Black Bass. For Small Mouth Bass fishing, the Dam is said to be one of the best locations in the country. The local Angling Club arranges regular competitions, of which the Bass Classic in October is probably the most significant. While the indigenous fish should legally be caught on a 'catch and release' basis, fishers are encouraged to keep alien fish species such as rainbow trout, carp and bass in an effort to eradicate these from the Dam.

Management

Cape nature is responsible for management of fisheries and biodiversity on the dam and its catchment.

Concluding remarks – access, withdrawal and management rights for fishing

Access to the dam is controlled by DWA while management of fisheries falls under Cape Nature. Existing rights of access and management arrangements appear to cater well for users' needs and promote a vibrant tourism economy. Given the lack of subsistence fishing on the dam by the surrounding communities, and the strong economy associated with recreational use, desirability of providing for small-scale consumptive fishing rights would need careful evaluation in terms of whether any additional socio-economic benefit would accrue.

4.9 Theewaterskloof Dam

Theewaterskloof Dam supports a well-established watersport recreational sector, real estate developments, and is a prime angling destination. There is no subsistence or artisanal fishing component and no fishery conflicts were present on the dam. Existing rights of access and devolved management arrangements appear to cater well for users' needs and promote a vibrant tourism economy.

Theewaterskloof Dam (34° 4' 45" S, 19° 17' 30" E) is situated just outside (about 7 km) Villiersdorp Town in the Western Cape, about an hour's drive from Cape Town. The Dam belongs to the DWA and was completed in 1980, with the aim of supplying water to the greater Cape Metropolitan area and the Riviersonderend Valley. It is the 7th largest dam in South Africa and covers an area of 5,100 ha. The dam is surrounded by farmlands (especially fruit farms) and provides an important source of irrigation water.

Recreational Activities

A number of recreational activities are taking place as part of the dam economy. These include golf, swimming, skiing, yachting, walking, wind surfing, photography, boating (sailing) jetskiing, jogging, kite surfing, hiking, biking, fishing, bird watching and picnic areas. The dam has been zoned into areas where different activities (e.g. skiing, boating, and angling) are allowed (B. van Zyl, Deputy Director: Operations Western Cape, DWA, pers. comm.).

Theewater Sports Club (TSC)

Most recreational activities are managed by the Theewater Sports Club, one of the largest water sports clubs in the Western Cape. The excellent sailing conditions on the dam, good infrastructure and the picturesque setting have made TSC one of the most popular hosts of water sports in South Africa (<http://www.theewaterskloof.co.za/index>). The club has a Clubhouse, regatta office, racing bridge, youth clubhouse, administration offices, cafeteria, ablution facilities and staff accommodation on the premises. A vast area on the Club premises is also available for public camping, with caravan and tent sites on grassed areas being situated very close to the water's edge.

The club claims to have a vast membership, with most of its members coming from the greater Cape Metropolitan area, the Overberg and the Wine lands. The club has various membership categories including angling.

Theewaterskloof Country Estate

Exclusive private properties have been developed, such as on the Theewaterskloof Country Estate on the eastern shore of the dam. This housing estate has 162 stands with access to a private beach, and slipway (<http://www.theewaterskloof.co.za>).

Fishing

Fresh water angling has a high profile on the dam which supports black bass, rainbow trout, carp, catfish, blue gill and kurpers. The dam has always been known for its excellent Bass fishing. In the last few years however, some of the biggest Carp have been caught in the dam. A freshwater angling license is compulsory for fishing on the dam. Anglers wishing to fish the top reaches of the dam (beyond the road bridge) must obtain a permit, as this is a proclaimed conservancy area. No angling is permitted in any of the inland ponds. There is currently no or very little subsistence fishing activities on the dam.

Management

Access to the dam is delegated by the DWA to Cape Nature, the Theewater Sports Club and other riparian property owners. Cape Nature is responsible for management of fisheries and biodiversity on the dam and its catchment.

Concluding remarks – access, withdrawal and management rights for fishing

While Theewaterskloof dam is primarily a storage dam belonging to DWA, it has become a highly successful location for recreational fishing, water sports, tourism and also a growing residential estate. Recreational

fishing is managed under the auspices of Cape Nature with daily management delegated to angling clubs and riparian property owners. The fact that the dam is surrounded by farms and there is a town a few kilometres away indicates potential for subsistence fishing activities for the farm worker and township communities. As with Clanwilliam dam, the absence of subsistence fishing on the dam by surrounding communities means that its desirability and socio-economic benefit would need to be carefully assessed against the impact on the well-established recreational use of the dam.

4.10 Bloemhof Dam

Bloemhof dam supports a well-managed multi-user fishery with a commercial, recreational and subsistence component. Clearly defined use rights and a capacitated management authority are key to the relatively conflict free fishery.

Bloemhof Dam is situated on the Vaal River (27° 40' 15" S 25° 37' 40" E), downstream of the Vaal Dam near the town of Bloemhof. The dam supplies water to various industrial and municipal users, although most of the water released from the dam is used for irrigation.

The area around the Dam comprises of two provincial nature reserves, Bloemhof Dam Nature Reserve on the North West Province side, and the Sandveld Nature Reserve on the Free State Province.

Fishing

Bloemhof Dam is one of South Africa's most popular angling and freshwater fishing destinations and is a site for major local and international angling competitions. In terms of angling yields, Bloemhof is probably the most productive freshwater fishing dam in the country with anglers targeting Carp, Mudfish, Yellowfish and Catfish.

Bloemhof dam has supported a permitted commercial gillnet fishery since 1979, two commercial fishing operators licensed to fish on the dam. The commercial viability of the commercial fishery appears to be marginal and recent reports suggested that the commercial operators were not actively fishing (L. Barkhuizen, Free State Department of Economic Development, Tourism and Environmental Affairs, pers. comm.). Subsistence anglers also fish on the dam.

Other sports and recreation

The Dam is one of a major weekend attraction (being only 320 km from Johannesburg). Apart from fishing, the dam is also very popular with various types of water sports including jet skiing, water-skiing, and parasailing.

Management

The DWA is responsible for issuing of authorisation for water extraction and other uses of the dam and its frontage while the Free State Department of Economic Development, Tourism and Environmental Affairs controls the water surface and all aspects relating to the fauna and flora at the dam.

Concluding remarks – access, withdrawal and management rights for fishing

Bloemhof Dam represents a well-managed multi-user fishery which includes recreational fishing, subsistence and commercial fishing. Clearly defined use rights and a well capacitated provincial management authority appear to be a key factor facilitating this.

4.11 References

TAPELA B, BRITZ PJ, and ROUHANI Q (2015) *Scoping study on the development and sustainable utilisation of inland fisheries in South Africa. Volume 2. Case Studies of Small-Scale Inland Fisheries*. A report to the Water Research Commission. WRC Report No TT 615/2/14

APPENDIX 5. SUMMARY TABLE ON PROPERTY RIGHTS AND ACCESS RIGHTS ON SAMPLED DAMS

Table 25 Property and Access Rights on Sampled Dams

Variable	Western Cape			Limpopo			Mpumalanga		KZN	Free State
	Voelvlei Dam	Clanwilliam	Theewaterskloof	Nandoni	Makuleke	Lake Fundudzi	Driekoppies	Pongola	Bloemhof	
Type of Resource										
Storage dam	Y	Y	Y	Y	Y		Y	Y	Y	
Lake						Y				
River										
Legal Custodian	DWA	DWA	DWA	DWA	DWA	Local community	KOBWA	DWA	DWA	
Property Rights Regime										
Public (name of legal custodian)	Y	Y	Y	Y	Y		Y (Govts of South Africa and Swaziland)	Y	Y	
Communal				Y	Y	Y				
Non property (open)										
Who are the agents (users)	DWA	DWA	DWA	DWA	Irrigation	Local communities	KOBWA	DWA	Farmers downstream	
	City of Cape Town	Cederberg Municipality	City of Cape Town, Paarl, Wellington	Communities	Community		DWA	EKZN Wildlife	Commercial fishing operators	
	Swartland Municipality	Clanwilliam Water Users Assoc (includes farmers)	Yacht Club	Boating club	Farmers		Komati irrigation Schemes	Nyawo community	Boat clubs	
	Irrigation Farmers	Lower Olifants River Water Users Assoc (includes farmers)	Overberg Municipality	Campers (caravan parkings) – informal			Irrigation Farmers	Private landowners (with frontage and use)	Irrigation farmers downstream	

Variable	Western Cape			Limpopo			Mpumalanga		KZN	Free State
	Voelvlei Dam	Clanwilliam	Theewaterskloof	Nandoni	Makuleke	Lake Fundudzi	Driekoppies	Pongola		
	Angling clubs	Anglers	Private housing developments on the upper catchment	Picnics (one sites run by local chief)			Angling clubs	Swaziland Govt	Recreational anglers	
	Yachting club	Yachting Club	Irrigation farmers (Riviersonderend, Upperberg, Eerste and Wynlandboards)				Local communities	Private Tourism Concession (access and use only)	Subsistence anglers from Bloemhof	
	Guest House	Guesthouses	Guesthouses				General Public		General public	
	Farm workers	Water sports	Campers				Mozambique (downstream)		Nature Reserves	
	General public		Water sports							
	Environment (reserve)	Environment (reserve)	Environment (reserve)	Environment (reserve)	Environment (reserve)		Environment (reserve)	Environment (reserve)	Environment (reserve)	
Management										
• Who is responsible for management	DWA, Cape Nature and Dam committee	DWA and Cape Nature	DWA and Cape Nature	DWA and Local chiefs	DWA and Local chiefs	Traditional Authorities	DWA and KOBWA	DWA and EKZN Wildlife.	DWA and FS DETEA	
• Source of stewardship power	NWA, Provincial legislation, NEMA and NEMBA	NWA, Provincial legislation, NEMA and NEMBA	NWA, Provincial legislation, NEMA and NEMBA	NWA and Local Informal TA	NWA and Local Informal TA	Local Informal TA	NWA, Provincial legislation, NEMA, NEMBA and KOBWA pact	NWA, Provincial legislation, NEMA and NEMBA	NWA, Provincial legislation, NEMA and NEMBA	
Management Arrangements										
• Centralised	DWA and Cape Nature	DWA and Cape Nature	Y	Y	Y		KOBWA	Y (DWA and EKZN Wildlife)	Y (DWA and FS DETEA)	
• Communal				Y	Y	Y				
• Co-management committee	There is a Dam committee	WUAS	Cape Nature works with Yacht Club		DWA, CUAs and Municipality working together		Irrigation boards, DWA, CUAs, Municipality	uPhongolo WUAs		

Table 26 Use right practices: Driekoppies

	Agents (Users)								Mozambique
	KOBWA	DWA	Komati irrigation Schemes	Farmers	Angling Clubs	Local Community	General Public	Environmental Reserve	
Use Types									
• Domestic	Yes – staff	Yes	Yes	Yes	Yes	Yes	Yes		
• Irrigation	No	No	Yes	Yes	No	Yes	No		Base flow
• Water sports	No	No	No	No	No	No	No		No
• Camping	No	No	No	No	No	No	No		No
• Recreational Fishing	Yes	No	No	No	Yes	Yes	Yes		No
• Subsistence fishing	No	No	No	No	No	Yes	?		No
• Environmental reserve								Environmental flow	yes
Type of rights									
• Access	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Withdrawal			yes	Yes	yes	yes			?
• Management	Yes	Yes	Yes	yes	?	?	No		Yes
• Exclusion	yes	yes	No						
• Alienation	yes	?	no						
Permit System									
• Individual license					Yes	Yes	Yes		
• Group license			Y	Y					
• Day permit									
• Other									
None									

	Agents (Users)								
	KOBWA	DWA	Komati Irrigation Schemes	Farmers	Angling Clubs	Local Community	General Public	Environmental Reserve	Mozambique
Management Regime									
• Rules	Yes KOBWA and DWA regulations	Yes KOBWA and DWA regulations	Yes KOBWA and DWA regulations	Yes KOBWA and DWA regulations	Yes KOBWA and DWA regulations	Yes KOBWA and DWA regulations	Yes KOBWA and DWA regulations	Yes KOBWA and DWA regulations	Yes KOBWA and DWA regulations
• Rights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Conventions	Agreement South Africa, Swaziland Mozambique	Agreement South Africa, Swaziland Mozambique	Yes for bulk water extraction						
• Contracts									

Table 27 Use Right Practises: Lake Fundudzi

		Agents (Users)				
		Local Communities				
Use Types						
• Domestic		Y				
• Irrigation						
• Camping						
• Recreational Fishing						
• Subsistence fishing		Y				
Type of Rights						
• Access		Y				
• Withdrawal		Y				
• Management					Y (Traditional Authority)	
• Exclusion					Y (Traditional Authority)	
• Alienation						
Permit System						
• Individual license						
• Group license						
• Day permit						
• Other					Outsiders have to obtain permission from chief to visit lake	
• None						
Management Regime						
• Rules					Y (Traditional systems- rituals)	
• Rights					Y (Traditional systems)	
• Conventions					Y (Traditional authority- rituals)	
• Contracts						

Table 28 Use Right Practises Nandoni

Agents (Users)						
Use Types	DWA	Boating club	Community	Caravan Parks	Picnic Site	
• Domestic	Y	N [because they have pipes accessing water from Vondo dam]	N [not directly, community accesses water from Vondo dam]	Y	Y	
• Irrigation	N	N	N [boreholes and from Vondo dam]	N	N	
• Water sports	N [maybe staff in their own capacity]	Y	N [not familiar with these sports]	Y	maybe	
• Camping	N [maybe staff in their own capacity]	Y [at no cost/ maybe they do pay to the chief]	N	Y	maybe	
• Recreational Fishing	N	Y	N	? not sure	N	
• Subsistence fishing	N [but maybe as individuals]	Y/N [because the villagers themselves fish and eat so they could be doing the same.	Y [for their livelihoods]	Y	Y/N because there are securities in the park maybe it's forbidden, when visiting the park.	
Type of Rights						
• Access	Y	Y	Y	Y	Y at cost to the Chief not sure how much.	
• Withdrawal	DWA and municipality	N	N [no need to]	N	N	
• Management	DWA	Y/N [maybe amongst themselves]	N [but DWA has, no CMA in structure yet]	Y [between themselves and Chief has final say]	Chief does his own thing there	
• Exclusion	Y	N	N	N	N/ Maybe yes	
• Alienation	Y	N	N	N	N	

	Agents (Users)					
Permit system						
• Individual license	Nothing formalised in this dam	N [nothing that DWA knows about] still in planning	N	Not sure maybe through the chief	N	
• Group license	N [for compliance purposes there are talks about this]	N	N	Not sure maybe through the chief, nothing formal from DWA.	N	
• Day permit	N	Y/N [maybe through the chief]	N	Maybe through the chief, nothing from DWA	Yes via the chief	
• Other	N	N	N	N	N	
• None	N	N	N	N	N	
Management Regime						
• Rules	N [but there's planning for that] maybe each village may have its own way of overseeing to this	Y [maybe amongst themselves]	Y [most villages set up's have regarding these kind of resources]	Y [between themselves]	Traditional authority	
• Rights	N [for now it's a thoroughfare]	Y	Y	Y	Y	
• Conventions	N	Y	Y [between themselves]			
• Contracts	N	N	N	N	N	
• Co-management	DWA and Community					

Table 29 Use Rights Practises: Makuleke

	Agents (Users)			
	DAFF	DWA	Commercial Farmers (Irrigation)	Local Community
Use Types				
• Domestic				
• Irrigation			Y	
• Water sports				
• Camping				
• Recreational Fishing				
• Subsistence fishing				Y
Type of Rights				
• Access	Y	Y		Y
• Withdrawal	Y	Y		Y
• Management	Y	Y		Y
• Exclusion	Y	Y		Y
• Alienation	Y			
Permit System				
• Individual license	Y	Y		Y
• Group license	WUL (for irrigation boards)			
• Day permit				
• Other				
• None				
Management Regime				
• Rules	Y (water abstraction)			
• Rights	Y			Y
• Conventions				Y
• Contracts	Y			

Table 30 Use Rights Practises: Phongola

	Agents (Users)							
	DWA	EKZN Wildlife	Nyawo and Myeni Community	Private Landowners (Game Farmers Especially – With Frontage And Use)	Swaziland (Extraction Frontage)	Govt. And	Private Tourism Concession (Access and UseOnly)	Irrigation Farmers?
Use Types								
• Domestic			Y	Y	Y		N (if guesthouse, where do they get water for guesthouse?)	
• Irrigation			N	Y – Farmers?	Y		N	y
• Water sports		Y for guests	N	Y for guests	Y		Y	
• Camping		Y – camping	N					
• Recreational Fishing		Y for guests	N	Y – for guests	Y for guests		Y (for guests?)	
• Subsistence fishing	Y – staff at dam?		Y		Y for communities		N	
• Commercial fishing			Y – gillnetting					
Type of Rights								
• Access	Y	Y	Y	Y	Y		Y	y
• Withdrawal	Y	N –what about staff at dam?	Y	Y – for domestics and irrigation?	Y		N (not guest house?)	Y (though the Mjidi water board)
• Management	Y	Y	N (not on WUA?)	Y (WUA)	Y		N (Y if on WUA)	?
• Exclusion	Y		N	N	Y		N	
• Alienation	Y		N	N	Y		N	

	Agents (Users)						
	DWA	EKZN Wildlife	Nyawa and Myeni Community	Private Landowners (Game Farmers Especially –With Frontage And Use)	Swaziland (Extraction Frontage) Govt. and	Private Tourism Concession (Access and Use Only)	Irrigation Farmers?
Permit System				What permits for use of dam? Non?	What permits for use of dam? None?		
• Individual license		N – what about to individual recreational		N	N	N (Y if guesthouse)	
• Group license		N (what about to clubs and association?)		N	N	N	Water user Authority
• Day permit		Y – for recreational fishing?		N	N	Y – access via EKZNW	
• Other	Gillnet permits?	Y – accommodation		N	International agreements / TFCA agreements	N	
• None			Y – supposed to fishing illegally		N	N	
Management Regime							
• Rules	Y	Y	N	Y – subject to DWA and EKZN rules	Y	Y – subject to DWA and EKZN rules	Y -subject to DWA rules
• Rights			Y	Y	Y	Y	Y
• Conventions		Y – etiquette with other users	Y – among themselves	Y – etiquette with others users	N	Y – etiquette with other users	
• Contracts	Y	Y	N	Y (– with DWA and EKZN?)	Y	Y (with who? DWA or EKZN)	MOU

Table 31 Use Rights Practices: Voëlvlei

Name of Resource System:	Agents (Users)									
	DWA	City of Cape Town	Swartland Municipality	Farmers	Angling Clubs	Yachting Club	Guesthouse	Local Community	General Public	
Use Types										
• Domestic	Y- for staff members at dam	Y – for staff members at dam	Y – for staff members at dam		Y – direct use during time at dam and when camping	Y – direct use during time at dam and when camping				
Bulk for distribution		Y	Y							
• Irrigation				Y – indirectly beyond dam wall						
Water sports Y Y										
• Camping					Y	Y	Y – some guests camp at dam shores	Y	Y	
• Recreational Fishing					Y	Y	Y – some guests fish for recreation. Have to buy permit from PO or receiver		Y	
• Subsistence fishing	Y – staff member at dam?	Y– staff member at dam?	Y – staff member at dam?					Y		
Type of Rights										
• Access	Y	Y	Y		Y	Y	Y – guesthouse and farm on shores of dam	Y	Y	
• Withdrawal	Y	Y	Y		Y – direct and camp use	Y – direct and camp use				
Management	Y	Y	Y		Y	Y	Y			

Name of Resource System:	Agents (Users)								
	DWA	City of Cape Town	Swartland Municipality	Farmers	Angling Clubs	Yachting Club	Guesthouse	Local Community	General Public
• Exclusion	Y								
• Alienation	Y								
Permit System									
• Individual license									
• Corporate license		Y	Y						
• Group license					Y	Y			
• Temporary permit					Y to non-members	Y – to non-members			Y – from Angling clubs or yachting club
• Other								PO or RoR permit for fishing	PO or RoR permit for fishing
• None									
Management Regime									
• Rules	Y	Y – subject to DWA rules/regulations	Y – subject to DWA rules/regulations		Y – subject to DWA rules/regulations	Y – subject to DWA rules/regulations	Y – subject to DWA rules/regulations	Y – subject to DWA rules/regulations	
• Rights		Y	Y		Y	Y	Y – indirectly through location	Y – general public, societal	Y – general public, societal
• Conventions				Y – to enough water down stream	Among members and between other users (etiquette)	Among members and between other users (etiquette)	Etiquette (decorum) from other users	Etiquette (decorum) from other users	Etiquette (decorum) from other users
• Contracts	Y	Y – for bulk water extraction	Y – for bulk water extraction		S53 form	S53 form			

Table 32 Use Rights Practises: Clanwilliam Dam

	Agents (Users)					
	DWA	Cederberg Municipality	Clanwilliam Water Users Association	Lower Olifants River Water Users Association	Yachting Club	Clarkson Power
Use Types						
• Domestic	Y – staff at dam	Y	Y (farmers)	Y – (farmers)	Y	
• Irrigation		Y	Y			
• Water sports					Y	
• Camping		Y				
• Recreational Fishing	? – staff at dam					
• Subsistence fishing	? – staff at dam					
• hydro electric power						y
Type Of Rights						
• Access	Y	Y – through arrangement	Y – through arrangement	Y	Y	Y
• Withdrawal	Y	Downstream river and canal	Y – Downstream river and canal	Y – Up and down stream	Y -domestic	
• Management	Y		Y – WUA	T- WUA		
• Exclusion	Y					
• Alienation	Y					
Permit System						
• Individual license						
• Group license						
• Corporate licence		Water user authorisation	Water user authorisation	Water user authorisation		
• Day permit						
• Other					MOU (9 year lease agreement)	MOU (20 year lease agreement)
• None						
Management Regime						
• Rules	Y	Y	Y		Y	Y
• Rights			Y	Y	Y	Y

	Agents (Users)					
	DWA	Cederberg Municipality	Clanwilliam Water Users Association	Lower Olifants River Water Users Association	Yachting Club	Clarkson Power
• Conventions			Y -etiquette	Y -etiquette		
• Contracts	Y	Y	Y - (Operation and maintenance agreement)	Y (Operation and maintenance agreement)	Y – (MOU)	Y

Table 33 Use Rights Practises: Theewaterskloof Dam

	Agents (Users)					
	City of Cape Town	Yacht Club	Overberg Municipality	Irrigation Boards	Private Developments	
Use Types						
• Domestic	Y	Y	Y	Y	Y	
• Irrigation				Y		
• Water sports		Y				
• Camping		Y			Y	
• Recreational Fishing		Y			Y	
• Subsistence fishing						
Type of Rights						
• Access	Y	Y	Y	Y	Y	
• Withdrawal						
• Management						
• Exclusion						
• Alienation						
Permit System						
• Individual license			Y			
• Group license						
• Day permit		Y				
• Other						
• None						

	Agents (Users)				
	City of Cape Town	Yacht Club	Overberg Municipality	Irrigation Boards	Private Developments
Management Regime					
• Rules		Y	Y	Y	
• Rights					Y
• Conventions					
• Contracts	Y				

Table 34 Use Rights Practises: Bloemhof Dam

	Agents (users)							
	Recreational anglers	Farmers downstream	Commercial fishing operators	Boat clubs	General public	Irrigation farmers	Subsistence anglers	Nature Reserves – Sandveld and Bloemhof Nature Reserves
Use Types								
• Domestic	Y		Y			Y		Y
• Irrigation	Y					Y		
• Water sports	Y	Y		Y	Y			Y
• Camping	Y			Y	Y		Y	Y
• Recreational Fishing	Y	Y		Y	Y	Y	Y	Y
• Subsistence fishing							Y	
Type of Rights								
• Access	Y		Y	Y	Y		Y	Y
• Withdrawal		Y				Y		
• Management								Y
• Exclusion								
• Alienation								
Permit System								
• Individual license	Y	Y	Y	Y	Y	Y	Y	

	Agents (users)							
	Recreational anglers	Farmers downstream	Commercial fishing operators	Boat clubs	General public	Irrigation farmers	Subsistence anglers	Nature Reserves – Sandveld and Bloemhof Nature Reserves
• Group license								
• Day permit	Y			Y	Y		Y	
• Other								
• None								
Management Regime								
• Rules	Y – FS DETEA and NW DETEA	Y – DWA	Y – FS DETEA	Y – FS DETEA AND DWA and NW/DETEA	Y – FS DETEA and NW/DETEA	Y – DWA	Y – FS DETEA and NW DETEA	Y – FS DETEA and NW DETEA
• Rights	Y	Y	Y	Y	Y	Y	Y	Y
• Conventions								
• Contracts		Y	Y			Y		

