Review of environmental impact assessment and monitoring in aquaculture in Africa

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ABSTRACT

This section makes an extensive review of the legal and regulatory instruments relating to the application of EIA (Environmental Impact Assessment) in Africa, and of the current state of application of these laws and the practice of EIA in the field of aquaculture. Forty-eight of the fifty-four African countries have enacted environmental laws, most including specific requirements for EIA and 50 percent of these make specific mention of aquaculture. These laws are generally quite recent and in most countries their application is only just beginning. On a continental scale their application in aquaculture is still infrequent. However, both the letter and the spirit of these laws suggest this may change in the future. This presents an opportunity for the countries of Africa to reflect on experience elsewhere and on national objectives, in order to develop an approach to EIA that will benefit aquaculture development in the future.

In particular, the screening and monitoring steps of the EIA process deserve special attention. Good screening procedures including risk assessment can make the imposition of EIA much lighter on the development of aquaculture. Exemptions of installations with low impact and mandatory EIA only for those larger installations with a clear potential for negative impact provides an opportunity for the other projects to be guided during the planning/screening phases towards basic requirements of best aquaculture practice.

Good environmental assessment requires good data. At present this is often insufficient in the regional context and accumulating knowledge about environmental impacts as well as basic environmental data that are important for aquaculture projects will also be a potential benefit of the application of EIA. This emphasises the importance of the monitoring step. In the absence of some data, it may well be more appropriate to approve a project and monitor closely the impact and subsequently adjust practices, than to block the project altogether. Appropriate use of SEA (Strategic Environmental Assessment) would also contribute to facilitating the implementation of project level EIA.

Using EIA as a bureaucratic licensing step should be minimized and the didactic potential of the process emphasised with the input and support of the private sector. Care should be taken to avoid EIA requirements contributing unnecessarily to barriers to entry of new farmers and investors. The use of impact assessment needs the political will to provide the minimum of resources, to ensure the transparency of the process as well as the adequate participation of public stakeholders. There is also scope for greater international cooperation to harmonise the approach between neighbouring countries wherever river basins or other ecosystems cross national boundaries.

CONTENTS

Acronyms and abbreviations

ACCNNR	African Convention on the Conservation of Nature and Natural Resources
AfDB	African Development Bank
AMCEN	African Ministerial Conference on the Environment
ANAF	Aquaculture Network for Africa
BOD	Biological Oxygen Demand
CBD	Convention on Biological Diversity
CPB	Cartagena Protocol on Biodiversity
CCRF	Code of Conduct for Responsible Fisheries
CIANEA	Community Based Impact Assessment Network for Eastern Africa
CIFAA	Committee for Inland Fisheries and Aquaculture in Africa
CITET	Tunis International Centre for Environmental Technologies
CLEAA	Capacity Development and Linkages for Environmental Assessment in Africa
DEAT	Department of Environment Affairs and Tourism (South Africa)
DOA	Department of Agriculture (South Africa)
DWAF	Department of Water Affairs and Forestry (South Africa)
EA	Environmental Assessment
EAA	Ecosystem Approach to Aquaculture
EAAIA	Eastern Africa Association for Impact Assessment
EAP	Environmental Assessment Practitioner
EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental Impact Assessment
EIS	Environment Impact Statement
EMP	Environmental Monitoring Programme or Plan
EQO	Environmental Quality Objectives
ESD	Environmentally Sustainable Development
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FEPA	Federal Environment Protection Agency (Nigeria)
GAPCM	Groupement des Aquaculteurs et Pecheurs de Crevettes de Madagascar
GMO	Genetically Modified Organism
ICB/CBEAPSA	Interim Certification Board/Certification Board of Environmental Assessment Practitioners in South Africa.
IOAEA	Indian Ocean Islands Association for Environmental Assessment
LVFO	Lake Victoria Fisheries Organisation
NACA	Network of Aquaculture Centres in Asia-Pacific
NALO	National Aquaculture Legislation Overview (FAO)
NASO	National Aquaculture Sector Overview (FAO)
NEMA	National Environmental Management Authority (Uganda)
NEMC	National Environment Management Council (Tanzania)
NEPAD	New Partnership for Africa's Development

NESREA	National Environmental Standards and Regulations Enforcement Agency (Nigeria)
NGO	Non-governmental organization
PEA	Preliminary Environmental Assessment (Tanzania)
PEA	Preliminary Environmental Report (Ghana)
PREE	Programme d'Engagement Environnemental or "Environmental Commitment/Responsibility Programme/Plan"
SADC	Southern Africa Development Conference
SACNASP	The South African Council for Natural Scientific Professions
SAIEA	Southern African Institute for Environmental Assessment
SAIEES	The Southern African Institute for Ecologists and Environmental Scientists
SEA	Strategic Environmental Assessment
SEACA	Secretariat for the Environmental Assessment in Central Africa
SIA	Social Impact Assessment
UNEP	United Nations Environment Programme
USA	United States of America
WAAEA	West African Association for Environmental Assessment
WWF	World Wildlife Fund

Summary

Recently enacted Environmental Impact Assessment (EIA[1]) legislation across the African continent comprehensively encompasses aquaculture and this is an important factor for the sector to take on board as implementation and enforcement of these laws increases.

Aquaculture is not as well established in Africa as elsewhere and EIA regulations are still being refined, which indicates an opportunity for the sector to work with environmental authorities to innovate and to further develop appropriate Environmental Assessment (EA[1]) mechanisms for aquaculture.

There are opportunities to emphasize a didactic and enlightening role for EA/EIA with the goal of influencing farmers to improve the sustainability of aquaculture practices in Africa, while reducing the need for extensive and repetitive EA studies and enforcement.

At the present level of aquaculture development, African countries should consider opportunities for strategic studies using Strategic Environmental Assessment (SEA[1]) for the sector rather than relying only on project-level environment impact regulations. Extending the assessment boundaries in this way will provide the information needed for good strategic planning (such as zoning decisions), as well as environmental information vital for the planning of individual projects. Successful SEA should make project-level EIA more efficient and less onerous.

The platform of EA can serve to guide aquaculture in Africa towards sustainable and ultimately more beneficial options. There are many aspects of integration of aquaculture with other agricultural activities which bring potential environmental benefits and these can be promoted to counter some of the negative perceptions of aquaculture in this regard.

Africa is fortunate in possessing many relatively unpolluted aquatic ecosystems. There are opportunities for using EA processes that can confirm the adoption of environmentally friendly aquaculture methods, to achieve added value in the marketing of aquaculture products from Africa's pristine environments. The feasibility of this is being demonstrated by initiatives in Madagascar and Zimbabwe to access premium export markets.

Biodiversity is a critical element. EIA for alien introduction needs clarification. Given the uncertainty of predicting the impact of an introduction, opportunities should be taken for effective application of risk assessment and management and for adapting up-to-date technologies to local species.

The key stages in the EIA process for aquaculture in its present stage of development are *screening* and *monitoring*, rather than in universal in-depth environmental impact studies. Screening, focussed mainly on a few significant parameters, is needed to identify high-risk proposals. Effective monitoring is probably the most valuable part of the EA process to Africa at present, needed to provide the missing information on real-life impacts and ensure this feeds back into the process, thereby improving planning and screening and future EA.

EIA is most obviously applied to large-scale intensive enterprises. However, small and medium scale farmers will be important to the future and the EA processes need to be adapted to their reality. This could be with a simple field "check-list" type

[1] EA: Environmental Assessment (general)
EIA: Environmental Impact Assessment (project-level regulatory obligation)
SEA: Strategic Environmental Assessment (strategy at national, regional or waterbody level)

appraisal, or it could simply be by exemption. Eventually the sector needs to consider a mechanism to deal with aggregated impacts from multiple small farms. Fixing reasonable thresholds at which EA becomes necessary, appropriate to each national context, makes the EIA process more "workable".

It will be important that care is taken to avoid EIA contributing unnecessarily to barriers to the entry of new farmers and investors. Cost, risk and lack of information about environmental impact are all restraining factors that need to be constantly reviewed. It is also important that countries do not weigh down future development with excessive regulation of which EIA is a part; investors must be given enough freedom to develop the sector. This is another reason to emphasize the screening stage (to filter out for further study only those proposals with obvious risk to the environment) and the monitoring stage (to gather data on real problems as they occur) as being the parts of the process that need most effort at present.

Public participation is an important element of a successful EIA and there is a lot still to be done to convince government authorities and investors of possible benefits of appropriate public participation.

EA considerations in general and stakeholder consultation in particular, will bring greater benefits and less opposition if applied earlier in the project planning sequence.

Knowledge and data about the environment and about alternative aquaculture options is very incomplete at present. Accumulating this information and making it openly available to new entrants should be an active priority for both the public and private sectors together. EIA studies and the conclusions of project monitoring, should be in the public domain and contribute to this national database.

Enacting the legislation is only the beginning for the national bodies responsible for the environment. Overseeing the EIA system requires substantial competent staff resources to successfully review the different documents produced throughout the process, critically interpret the technical data in the environmental impact statement (EIS), take appropriate note of public concerns and finally take an important decision on complicated evidence. The national capacities required fall short of requirements at present and building these up is recognized as being a priority.

The sector must be aware of the risks to the integrity of EIAs. Two to note are (a) the partiality of EIA studies led by project proponents in the absence of robust oversight and (b) the reduction of the process to a paper-based bureaucratic authorization exercise bringing delay and inefficiency to efforts to develop aquaculture.

None of this can make any progress without substantial political will. Both public and private sectors will gain from active engagement in this environmental debate in order to put the case for aquaculture growth.

International and regional cooperation over EA has a number of benefits. Coordination of appropriate articles of the legislation will make it easier to deal with the transboundary impacts that can occur through the ecosystem. Sharing of experiences and expertise in this field can compensate for some of the shortfalls in current national capacities.

Presentation of this study

This study is one of four regional studies reviewing environmental impact assessment practice in aquaculture across the globe. The aim is to review the requirements for EIA and monitoring, describe the practices and to appraise the effectiveness of procedures that are in place. Given that there is limited experience in Africa in both aquaculture and EIA, the document attempts to describe the evolving situation bringing these two activities together.

The section is in three main parts. First, a broad review of the key issues confronting African aquaculture stakeholders, as they seek to intensify the development of aquaculture, against a background of increasing concerns for the natural environment. A second part presents case studies of the situation in six countries from across the continent. The final part attempts to analyse the impact of current arrangements and discuss the efficacy of some of the new EA initiatives being applied to aquaculture.

Introduction

As awareness of the importance of environmental issues has grown across the world over recent decades, efforts to manage and mitigate man's impact on the environment have intensified. The need to establish methods for measuring the potential for negative impacts on the environment, and to enshrine these in statutes, was first felt in the United States of America (USA) and Europe where it became necessary to manage the choices being made in the way new technologies were applied. Environmental Impact Assessment (EIA[2]) has been a central component of these statutes, and this was made a mandatory process for most large-scale developments. It is a process that is proving useful for aquaculture, a sector which has been seen to have created some significant environmental problems in the course of its recent rapid global development.

More recently, African legislators have also found it necessary to take steps to regulate in a similar manner as pressures on the environment increase as a result of increasing population, economic development, urban growth and other factors. It has also been necessary to mirror regulation elsewhere in order to avoid the displacement of environmentally damaging developments away from regions with stricter laws. EIA regulations are a part of these new legal frameworks and already over 75 percent of African countries have passed specific statutes relating to EIA. Over half of these have only been passed into law in the past five years and are yet to be tested in many situations.

Aquaculture is a sector that has seen extraordinary global growth over the past decade, and Africa certainly has the resources to contribute significantly to this growth in the future. However, this is still largely a development waiting to happen and Africa only contributes about 1 percent of world production (Hecht *et al*., 2006; FAO Fisheries Department, 2006; see bibliography for FAO National Aquaculture Sector Overviews in Africa).

Considering that the legal frameworks are still maturing, and the number of new developments in aquaculture is still small, this review focuses on some of the options that are available to making EIA relevant to the future of aquaculture in Africa. A small number of EIA studies have been carried out for individual aquaculture projects, but many of these have not been done as part of national legal requirements, but rather at the request of external investing institutions. These few experiences do not follow a set pattern and could not form the basis of a continent wide analysis, although the country case studies presented here provide some lessons that could be of relevance elsewhere.

[2] The acronyms EIA and EA are freely used in this text. EIA refers to the legal process of Environmental Impact Assessment, while EA refers to Environmental Assessment in a more generic sense.

Summary of issues surrounding EIA and aquaculture

INCREASED AWARENESS OF ENVIRONMENTAL ISSUES

EIA is a process that has evolved out of growing global awareness of the importance of the environment in making both local and strategic decisions about almost any human activity. Africa shares these concerns, although it has been manifested more recently in the institutions and legislation. The Abuja Declaration made in 2005 by African Union leaders clearly states that although aquaculture development is a continental priority, it should be sustainable and environmentally friendly (NEPAD, 2005):

"Foster small, medium and large-scale aquaculture production in a sustainable and environment-friendly manner … Conserve aquatic environments and habitats essential to living aquatic resources and aquatic biodiversity; and take measures to prevent or mitigate adverse impacts of aquaculture on the aquatic and coastal environment and communities"

It is activities with an obvious potential for negative impact, such as oil drilling, mining or urban development that spring quickly to mind when considering the importance of making an environmental assessment, but it is now widely recognized that precautionary assessment is also necessary for activities previously perceived as relatively benign, such as agriculture or aquaculture. Aquaculture, in particular, is very closely linked with the wider natural environment and this is illustrated by its dependence on good quality water sources, as well as by its potential to have negative impacts on that resource downstream.

There is a question over how the scope of the "environment" is perceived from different viewpoints and how this affects the assessment of aquaculture, as it does for other activities. For some the situation to be assessed refers to a simple interaction of a fish farm with local environmental parameters "at the farm gate"; essentially an approach for "pollution control". For others it refers to the wider ecosystem and aims for a holistic assessment of the interaction between aquaculture and many levels of its surroundings - physical, social and economic. In Africa, some of these differences over the definition of environment can be seen in the philosophy and wording of particular national legislation, while in other cases it reflects the level of knowledge about, and commitment to the EIA process. In general, however, there seems to be a tendency to move towards assessment of the impacts on the environment in its wider sense.

Since the origins of increased legislation and the push to better management of the environment has largely been from outside the continent, this does give Africa the opportunity to learn lessons from experiences of success and failure elsewhere. It is mostly true to say that environmental law and institutions have not often been primarily created in response to domestic public pressure or concern for the environment. However, this is changing and there is now a greater sense of urgency over environmental issues among both the public and national institutions in Africa. This is very important for the future application of EIA in all sectors, including aquaculture. A new domestic environmental activism will contribute enormously to the definition of the standards of what is acceptable or not to local/national society/communities, not only in relation to the natural environment (e.g. pollution, habitat loss) but especially in terms of impact on social and economic parameters. Without

such reference points established in a local context, it is difficult for processes such as EIA to be fully effective in the decision making process. While transferring external or "international" standards can be a useful starting point for typical physical and chemical factors in the environment, it is not appropriate when applied to impacts on factors where national and regional conditions have to be taken into account.

We now know a good deal about the potential of aquaculture development to impact on the natural and human environment, and although much of this information comes from outside of the continent it is available to be applied with care to African situations.

NATURE OF ENVIRONMENTAL IMPACTS LINKED TO AQUACULTURE

While some of the national legislation relating to environmental impact does contain references to aquaculture, even occasionally citing specific potential impacts, there is always the likelihood of an aquaculture project being required to conduct EIA under the generic definition of projects that "are expected to have a significant impact". Experience has shown both globally and on the continent, that aquaculture can have a number of impacts on the environment as summarised in Table 1.

TABLE 1
Environmental costs and benefits of aquaculture

Negative environmental impacts of irresponsible aquaculture	Environmental benefits from responsible aquaculture
• Loss or degradation of habitats such as mangrove systems; • Salinization of soil and water; • Coastal and freshwater pollution; for example, contamination of water and fauna through misuse of chemicals and antibiotics; • Alteration of local food webs and ecology; • Alteration of catchment water flows; • Depletion of wild resources and biodiversity for seed or broodstock; • Spread of parasites and diseases to wild stocks; • Depletion of wild genetic resources through interactions between wild populations and cultured populations; • Impacts of introduction of exotics (deliberate or inadvertent).	• Agricultural and human waste treatment; • Water treatment and recycling; • Nutrient sink; • Pest control; • Weed control; • Disease vector control; • Desalinization of sodic lands; • Recovery of depleted wild stocks; • Preservation of wetland.

Source: World Bank, 2006.

These impacts can be negative, but also sometimes positive, and are usually only critical when the farms are particularly large or there is a local concentration of smaller units. It is also necessary to realize that the sustainability of aquaculture depends greatly on the quality of environmental factors "upstream" of the farm. Many unrelated activities can have a negative impact on these and an assessment for an aquaculture installation would only be complete if it also looks at risks from this "other direction". While most environmental legislation covering environmental assessment tends to focus on potential negative impact "downstream" of the activity, a few recent statutes, such as Ghana's fisheries law, have taken a "defensive" sectoral view seeking to limit "upstream" negative impacts on aquaculture (Ghana, 2002).

Clearly the interactions between aquaculture, the environment and other elements of the ecosystem are complex and impact both "from" and "on" the activity can be summarised as follows:

Potential impact of aquaculture on the natural environment

Recent growth in aquaculture has, not surprisingly, had a mixed record with the environment. In the early stages of the recent rapid global expansion of aquaculture there have been cases where massive growth, coupled with ill-informed management

practices have become notorious examples of cause of undesirable environmental impact. In most cases, significant strides have been made in improving these situations and better knowledge and practice are changing the negative perception that aquaculture had been given in certain quarters. Interestingly, Africa has benefited from these improvements and is in the vanguard of efforts to demonstrate that aquaculture can be effectively managed in environmental terms. This is illustrated by African developments in at least two of the most notorious problem areas for aquaculture of the past decade – shrimp culture in mangroves (Madagascar) and cage culture (Zambia, Zimbabwe).

Downstream impacts of aquaculture on the natural environment that would normally be considered as carrying a risk and may need to be included in environmental assessment include the following:

Water quality, including:

- altered physico-chemical characteristics in farm structures (such as ponds) and in water released as effluent back into natural water courses, waterbodies, drinking water supplies;
- release of chemicals used in veterinary treatments into aquatic systems;
- release of suspended organic material, usually from fish feed and faeces, into aquatic systems, altering ecosystem characteristics and carrying risk of eutrophication.

Water quantity

- in a situation where water is a limited resource aquaculture consumes water; for example where increased surface area increases evaporation and water seepage into soil;
- alteration of flow patterns, impacting other users and natural systems (tidal flows in coastal infrastructure, stream flows or lake/sea current);
- influence on underground water flows e.g. springs which can be important to small-scale rural agriculture.

Space

Sensitive habitat

- irreversible destruction of sensitive habitats such as mangrove or inland wetland;
- alteration to natural ecological processes in sensitive habitat in proximity to aquaculture installations.

Impact on biodiversity in the ecosystem

There are potential consequences for ecosystem biodiversity that can occur as a result of any of the above mentioned possible impacts that might be caused by aquaculture. The resulting ecosystem changes could, for example, affect the distribution of local species (plant, animal, micro-organisms) some of which may be of economic importance.

Often a major concern is for the impact a cultured organism may have on the natural biodiversity of the region (Halwart and Moehl, 2004). If the aquaculture species used is alien to the region there will be significant risks to local biodiversity should it escape into the wild, something that is particularly difficult to prevent. In other cases there may be some concern about a domesticated strain of a local species with different selected characteristics to the wild population (which may support important fisheries) or about use of genetically modified organisms (GMOs).

Potential sources of impact from the environment on aquaculture

It is necessary to include consideration of the environmental relationships between aquaculture and "upstream" factors (Calamari and Naeve, 1994). While these may not always seem to be a priority in EIA regulation, they are closely interlinked with the

overall picture and will affect the capacity of the aquaculture installation to control its own "downstream" impacts.

Important "upstream" influences include:

Quantitative changes in water resources

- flow reduced by upstream consumers;
- flow patterns changed by dam construction.

Upstream terrestrial activity

- soil erosion/degradation can affect sediment loading and hence productivity (based on primary production) and can be caused by far distant activities of many kinds;
- severe qualitative variations such as mining, introducing heavy metals into the aquatic system.

Agricultural, urban or industrial runoff/pollution

- very often aquaculture is present in areas of multiple agricultural activity. Many agricultural activities can affect aquaculture downstream; impacts include variations in water run-off from the cultivated land, and washing of fertilizer and chemicals into the water flowing downstream. Many of these show seasonal variations, and some are very short lived events, which need to be planned for in aquaculture management.

Positive or neutral environmental impact

It is not all bad news and aquaculture in many of its forms is not inherently damaging to the environment, not least because the fish need to be raised in conditions at least equivalent in quality to their own natural environment. Good environmental management is in the self-interest of the farmer and needs to be incorporated into generally accepted "best practice" within the sector.

In Africa, aquaculture has demonstrated its capacity to contribute to sustainable use of ecosystems through enhancing or combining with other productive activities, such as fisheries (e.g. aquaculture-based fisheries), agriculture (e.g. rice–fish farming) and animal husbandry (e.g. pig/poultry–fish farming). These culture systems can contribute positively to environmental improvement by recycling nutrients and organic matter through integrated farming systems. Integrated aquaculture–agriculture practices have shown how rice–fish culture can help farmers reduce the use of environmentally damaging pesticides, while fish culture naturally improves the fertilization of rice fields, protein production and economic viability. Wastewater-fed freshwater aquaculture and coastal mollusc and seaweed farming can be used to recover excess nutrients, thereby reducing risks of eutrophication and other negative effects. In Egypt extensive fish-culture has long been a part of traditional agricultural practice, because when carried out on certain types of unproductive land common in the Nile delta, it can improve the quality of soil that is subsequently used for cropping.

Not only are these benefits key to promoting a more positive image of aquaculture in some quarters, but they need to be highlighted in the EIA process as valuable actions mitigating negative environmental impact from other sources.

Interaction between aquaculture production units

There are specific risks that can occur as a result of the proximity of other similar aquaculture farms. As well as the general competition for land and water resources, the most specific risk is from the transmission of disease between farm stocks and the consequent increased risk of contamination of wild populations.

Questions of scale, aggregation of small impacts

Isolated aquaculture farms of the types most common now in Africa will rarely have more than limited local environmental impact. Two general scenarios can occur where there may be heightened concerns for potential negative impacts on the environment.

The first is for the big commercial farms, which due to their large scale may carry greater risk of negative impact that can be magnified by adopting highly intensive management options. Nevertheless, commercial aquaculture has access to technologies that can mitigate these risks. It is for this category of farm that EIA is most obviously needed and has most often been applied in Africa.

The second scenario occurs with a geographical concentration of small-scale aquaculture farms, which individually may not be considered of great environmental risk. However, if the activity is successful and profitable, a large number may spring up in close proximity and the resulting aggregation of minor impacts can be expected to cause problems at least as great as a single large commercial farm. EIA procedures are less easily applied to this situation: individually the small farms may not fall under EIA obligations and may have no problem in meeting normal standards. An adapted procedure would have to be developed to deal with the aggregated impact of many individual farms.

CROSS CUTTING ISSUES

Grouped under the description of "cross cutting" issues are the many possible impacts that can be expected when considering the wider environment beyond the immediate natural environmental parameters summarised above. The extent to which these are actually expected to be included in an EIA study varies with the legislation in different countries. However, as aquaculture in Africa develops and grows, decision-making processes will need to include assessment of more and more of these wider but interlinked issues.

These include social and economic dimensions and the ways in which resources are shared. Equitable sharing of resources can be an important issue with environmental ramifications and is sometimes a difficult issue to master in Africa when unfamiliar commercial/industrial imperatives disturb a predominantly traditional approach.

Land tenure, access to land resources

Land tenure practice varies considerably across Africa. It is not only an issue of ownership, but also frequently of traditional communal or community access to land for various essential uses. Creating aquaculture infrastructure can disturb the local equilibrium of land access and use.

If a country wishes to promote the development of commercial aquaculture it is necessary to provide investors willing to invest in these types of activity with sufficient long-term security of occupation, especially where outright purchase of land is not possible. At the same time it will be wise to ensure that local communities are not deprived of the resources and the ecological services of the land on which they depend.

Water rights, access to water resources

Across the continent, Africa has a wide variation in availability of water resources. However, even in areas of relative plenty, there can easily be competition for these resources that are required for agriculture, irrigation, livestock, domestic use, town supply and industry. Estimating the potential for sustainable use has to include all sectors including aquaculture and needs to recognise the wide seasonal variations that are experienced in many parts of Africa. Aquaculture investors need to have some kind of security of access to water, something that is not always easy to obtain if legal frameworks do not exist, do not recognize the needs of aquaculture or are not enforceable.

Impact on capture fisheries

Aquaculture development has the potential to affect capture fisheries in several ways:

- reducing the recruitment of juveniles into the fished population where wild seed are harvested for stocking aquaculture – such as the use of brackish water species (mullets) in Egypt;
- creating a source of disease which can be transmitted to wild populations;
- biodiversity impacts from escapees of alien or domesticated strains – as in Madagascar where most inland fisheries are now dominated by introduced species;
- problems with navigation, occupation of space;
- competition in the marketplace with capture fishery products.

Human health

Human health issues can arise including water borne diseases like bilharzia, or indirect impacts such as spread of HIV/AIDS as a result of demographic changes that might occur as a consequence of development of a successful aquaculture industry.

Gender participation

Impacts from aquaculture might not be felt in the same way by both genders within a local community, especially in a rural environment where, for example, women may lose access to key resources such as firewood, or fishermen may face changes to their traditional activities. Comprehensive EIA approaches would take these issues into consideration when consulting community stakeholders.

Economics, poverty

Aquaculture development is encouraged with the objective of increasing production and economic activity, with the promise of jobs and other benefits. This may raise further questions of impact. Does it actually reduce local poverty, or does it risk increasing poverty by disturbing established local economic activities? Does aquaculture displace alternative agricultural activities and at what cost?

Impact of supply and distribution

As the aquaculture sector grows in a country or region, there will be concerns for the additional impact of expanded industrial or agricultural development that accompany the increase in aquaculture enterprises. These activities include the supply of inputs and services, as well as the increased infrastructure needed for the distribution, storage and marketing of its products. Some of these additional impacts should be included in project EIA studies for individual large commercial farms, but in many cases it is difficult to control this "bigger picture" from a project level perspective.

One of the major issues is that of feed used in aquaculture. In some cases the feed required has to be of very high quality and include significant proportions of fish meal. Often, as in the case of Madagascar, it has to be imported raising questions of economics. In Africa there will also be concerns when using locally produced ingredients that there are difficult decisions to be made about channelling a country's agricultural endowment or capacity to produce fish feed, rather than using it directly for food production for local consumption, especially when the fish products are destined for export.

BIODIVERSITY

Questions over the impacts that can occur on the biological diversity of an area as a result of aquaculture activities are often high on the agenda when undertaking environmental assessment. As indicated above there are many possible effects that aquaculture can have on its physical surroundings which can in turn affect natural populations of animals and plants and their diversity. However, the key issue is that

of the introduction of alien species for aquaculture. These can escape and change the composition of the indigenous ichthyofauna. This has an international dimension as there are many situations where there is a risk of transboundary impact across aquatic ecosystems and major river basins.

The concern is not only for the survival of indigenous species. Changes in fish biodiversity can have significant knock-on effects and cause social and economic upheaval whenever capture fisheries are affected. This is very much a live issue in Africa as the fisheries in Lake Victoria continue to be subjected to the consequences of the introduction of Nile perch (*Lates niloticus*) into the lake system. Another risk comes from the possibility of importation of disease vectors along with the introduced species.

Pressure to introduce alien species often comes from investors in aquaculture who see the immediate advantages of importing a species as part of a proven technology or with the attraction of a known viable export market. Research into the use of local species is seen only as a long-term option, if it is considered at all.

National environmental law in Africa, including EIA regulations, is often specific in mentioning species introductions as being subject to prohibition or to strict control and only approved under exceptional circumstances. The African Union (African Union, 2003) has added political weight to this position and stated that member countries should:

"strictly control the intentional and, in as far as possible, accidental introduction, in any area, of species which are not native to that area, including modified organisms, and endeavour to eradicate those already introduced where the consequences are detrimental to native species or to the environment in general".

This commitment is further confirmed by the adhesion of most African countries to international agreements or codes of conduct that also seek to establish a precautionary approach to the use of alien species. These include the Convention on Biological Diversity[3] (CBD) and the FAO Code of Conduct for Responsible Fisheries[4] (CCRF). The CBD defines biodiversity at three different levels - ecosystem, species and genotype – and suggests that EIA is one of the appropriate tools for the conservation of biological diversity. At each of these three levels aquaculture in Africa has already raised concerns and these would be expected to be taken up as part of the EIA process.

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[3] The Convention on Biological Diversity (CBD, 1992): The introduction of alien species into ecosystems has the potential to adversely affect biological diversity. The Convention on Biological Diversity, an international agreement with 182 member countries including 53 in Africa, requires parties to prevent the introduction, control or eradication of those alien species that threaten ecosystems, habitats or species. The parties to the Convention have developed guiding principles for the prevention, introduction and mitigation of impacts of alien species, which are an important guide for managing species introductions. The Convention also addresses the more specific issue of biosafety, referring to the need to protect the environment and human health from the possible adverse effects of organisms that are modified using techniques of modern biotechnology. The parties to the Convention developed and adopted an agreement on biosafety, known as the Cartagena Protocol on Biosafety, aimed at ensuring an adequate level of protection in the safe transfer, handling and use of living modified organisms resulting from modern biotechnology. (www.cbd.int/convention/convention.shtml)

[4] FAO Code of Conduct for Responsible Fisheries (FAO, 1995): Fisheries, including aquaculture, provide a vital source of food, employment, recreation, trade and economic well-being for people throughout the world, both for present and future generations and should therefore be conducted in a responsible manner. This Code sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The Code recognizes the nutritional, economic, social, environmental and cultural importance of fisheries and the interests of all those concerned with the fishery sector. The Code takes into account the biological characteristics of the resources and their environment and the interests of consumers and other users. States and all those involved in fisheries are encouraged to apply the Code and give effect to it

"9.1.1 States should establish, maintain and develop an appropriate legal and administrative framework which facilitates the development of responsible aquaculture." CCRF, Article 9 (ftp://ftp.fao.org/docrep/fao/005/v9878e/v9878e00.pdf)

Given this regulatory background and the obvious risks that exotic introductions involve, the question of using an introduced species must obviously be included in the studies and recommendations when carrying out an EIA for a project. However, given the lack of control over the consequences of an introduced species establishing itself in the wild and the irreversible nature of the impact on biodiversity once it has occurred, it is difficult to see to what extent a project EIA can satisfy the precautionary constraint that the legislation requires. Mitigation measures can be proposed to minimize escape from the project, but this cannot be guaranteed and experience would question whether it could ever be possible to do so. There are exceptions, such as for species which are proven to be unable to reproduce in the new local conditions.

AFRICAN EXPERIENCE OF ENVIRONMENTAL IMPACTS FROM AQUACULTURE

Despite the fact that aquaculture in Africa is relatively undeveloped when compared to some regions and that the most notorious incidents of negative impacts have occurred elsewhere, there have been some salutary experiences already in Africa that illustrate actual environmental impact, or at least the perception among various stakeholders of a potential for negative impact.

The most widely registered impact has been the use of exotic species that have escaped from aquaculture installations and become established in the wild outside of their natural range, sometimes with disastrous consequences on local species and habitat (Moehl *et al.*, 2006). There is not sufficient background research into the consequences of these introductions to apprehend their overall impact on biodiversity, although in some cases the introduced species now contribute to economic capture fisheries. Not all introductions for aquaculture involve fish or other organisms from outside Africa; there are many instances of the movement of African species for the purpose of aquaculture across the continent outside of their natural range, e.g. *Tilapia* sp., *Clarias* sp., *Heterotis*. Madagascar has had a particularly dramatic experience of introductions into its freshwater habitats and counts at least 29 alien fish species (FishBase, 2008). These alien species have come to dominate the ichthyofauna in many of the island's aquatic systems, and are now very important in some fisheries. At the same time 26 Malagasy endemic freshwater species are classified as threatened. While this may not entirely be attributable to the presence of aliens, it seems likely that this is a major factor.

Other cases indicate a growing awareness of the potential impacts that large-scale aquaculture can have, prompted by the realisation that similar projects elsewhere have had negative effects on the environment. The following incidents have highlighted the usefulness of the EIA process to both the public and the authorities and they seem to have set a precedent for aquaculture projects in the countries concerned:

- campaigning brought a large initial proposal for shrimp culture in the Rufiji Delta in the United Republic of Tanzania to a halt, partly based on perceptions of the negative impact on communities and ecosystems of shrimp farming in South and Southeast Asia. Shrimp culture can be an economic force leading to excessive destruction of mangrove forest habitat and disruption to local fisheries and communities, and it was feared this could happen in the Tanzanian context, despite significant political support for the proposal.
- the potential of cage cultures to pollute the water and benthos around them has received a lot of coverage in the media. In Zambia, some small-scale trials of cage farming in Lake Kariba provoked a sharp response from the environmental authorities who reacted to local objections and felt that the reputed risks associated with cage farming were sufficient to justify a temporary stop to the trials. Environmental assessment is now undertaken for similar activities (see Box 1).

Other examples where aquaculture has raised diverse environmental concerns on the continent include cage farming in the river Nile in Egypt, the use of chemicals by

some catfish farmers in Nigeria, or the installation of ocean cages in a popular tourist location for shark watching in South Africa. Elsewhere impacts will have been localised, or contained within acceptable limits as a result of the use of preliminary environmental assessment as in Madagascar, Mozambique or South Africa.

Shrimp farming has a high profile and it has been of particular significance to early implementation of EA in Africa. This is an aquaculture practice that has attracted a significant amount of criticism for its environmental impacts and created many problems for itself when unsustainable methods have been used. Lessons have been learnt from this, and one of these is the need for good EA (including strict regulation) to ensure that short-term profit motives do not lead to wholesale negative impacts on the environment. In Africa there have been a number of important investments across the continent including:

- Gambia (project which failed after encountering environmental problems now operating again using more sustainable methods);
- Guinea (Sakoba project, the failure of which is in part attributed to inadequate environmental assessment);
- Madagascar (successfully established after putting the environment as a central concern of the operations)
- The United Republic of Tanzania (early proposal rejected for its potential negative impacts, new projects now operating after implementing new environmental regulations).

BOX 1

Sunday Times of Zambia report on cages in Lake Kariba 2004

Ban cage Fishing – Farmers

By Sunday Times Reporter

FISH farmers on Lake Kariba in Siavonga district have alleged that the newly introduced fishing method known as "cage culture" is blocking their full access to the lake.

The farmers have called for an immediate ban on the method.

"The cage culture method entails aligning huge reed baskets along a large area on the banks of the lake thereby restricting people's movements into the water.

Speaking for local fishermen in during the week, Edward Habeenzu said apart from introducing unknown chemicals in the lake, the cages were a hindrance because they were blocking easy access to the lake.

He condemned the Environmental Council of Zambia's (ECZ) decision to merely fine the cage culture farmers and allow them to continue exploiting the lake using the new methods before it could complete its environmental impact assessment.

"The problem we have in Zambia is that we allow experiments to be undertaken by business people whose aim is to convince you that what they are doing has no negative results to the environment before finishing our own investigation," he said.

ECZ education officer Justin Mukosa said it was too early to impose a ban on cage culture because his organisation was still carrying out investigations.

He said the basic findings on the impact of an alien species of fish called tilapia (bream) that had been illegally introduced in Lake Kariba indicated that potassium permanganet was being used to protect the caged fish against fungal diseases.

Meanwhile, the ECZ has fined the three fish farmers using cage culture and ordered them to conduct individuals environmental impact assessment on the Zambian side to determine the safety of their fishing method on the lake.

The institutional and regulatory framework for EIA in Africa

FIFTEEN YEARS OF EVOLVING ENVIRONMENTAL PROTECTION LAW

The past 15 years have seen a rapid change in environmental law frameworks in response to changing perceptions on the part of governments and civil society; over the same period there has been growing concern about the environmental impacts of aquaculture activities (Spreij, 2004). New environment laws have been passed in most African countries (see Table 2 and Box 2 for a summary of laws identified by this study). Many of these are so recent they do not yet have a significant history of application or enforcement, particularly in aquaculture and fisheries. This applies equally to the anglophone, francophone and lusophone countries although the literature on this subject is primarily in English (Almeida, 2001).

BOX 2
In figures: legislation in Africa relating to EIA and aquaculture

A survey of the legislation of 54 countries in Africa, possibly incomplete because some legislative texts are hard to obtain, revealed that aquaculture is significantly affected by regulations covering environmental management and more specifically EIA:

- 48 *(89 percent)* countries have already enacted framework environmental laws;
- 40 *(75 percent)* countries have enacted detailed EIA regulations;
- these EIA regulations are relatively recent and 31 *(78 percent of EIA regulations)* have been passed in the past ten years, and 21 *(53 percent)* in only the past five years;
- 20 *(50 percent)* of these EIA regulations make explicit reference to the requirements for aquaculture; this increases to 28 *(70 percent)* if references to related infrastructure are included (e.g. reservoirs, canals);
- 16 countries with EIA regulations specifically mention the introduction of alien species as requiring EIA *(40 percent)*;
- at least 24 countries have published detailed guidelines for implementing EIA *(60 percent of EIA regulations)*;
- four countries have produced specific guidelines for aquaculture;
- 11 *(20 percent)* countries have included Strategic Environmental Assessment (SEA) in either the framework or the EIA regulations.

Source: analysis of the documentation summarized in Table 2.

Specific EIA enabling regulations have also been created in the majority of African states as part of this process (see Table 2), although they are not so widespread and take various legal forms. Some framework laws go as far as including detailed articles concerning EIA in the main law, whereas in most instances provision is made in the law for subsidiary legislation to define the detailed obligations and procedures for EIA. These vary greatly in content: some do not specifically mention aquaculture, which would be included in a general category as an "activity" requiring EIA if it is expected to have a significant impact on the environment; others specifically mention aquaculture, and if not requiring EIA for all projects, go on to define exactly the size threshold of aquaculture projects that must carry out the full process.

The genesis of many of these laws is of interest. International banks and bilateral aid donors put pressure on countries through the 1990s to enact environmental framework law. Many were authored with external assistance and modelled to some degree on European and North American precedents. As a result many countries went rapidly from a situation of weak environmental legislation to one of strong or even draconian legislation. In most cases this occurred in the absence of urgent domestic pressure and without many civil servants, the private sector

TABLE 2
Summary of environmental law and EIA regulations affecting aquaculture in Africa (to 2006)

Parties to relevant international treaties: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety (CPB); African Convention on the Conservation of Nature and Natural Resources (ACCNNR). Y = yes; N = no.

Country	Environment Law	EIA Regulations	CBD CPB ACCNNR	Explicit mention of aquaculture in EIA regulations	Explicit mention of EIA regarding introduction of alien species	EIA Oversight Institution	Guidelines published for EIA: general or aquaculture	Explicit SEA/SIA provision
Algeria	2003	1990	YYY	Aquaculture and mariculture is **excluded** from the EIA regulations. Mention made in fisheries law a requirement for "an evaluation of the consequences of implanting a project on the environment" as part of a licencing process		DGE	General guidelines	No
Angola	Environment Framework Act 1998	(2001)	YNN					No
Benin	1999 Framework Law on Environment 98-030	2001	YYY	Simplified EIA mandatory for aquaculture / fish culture	"The laws and regulations determine the conditions for the introduction, from whatever source, of any species which might have an impact on existing species or on their natural habitat..."	ABE/BEA	General guidelines	No
Botswana		2005	YYY			DEA	General guidelines	Yes
Burkina Faso	1997 Law on Environmental Code 005/97	2001	YYY	Category A (requires EIA): dams over 10m height Category B (requires a notice of impact): - small dams between 3m and 10m height - construction of ponds for aquaculture	Except when already forbidden, any works or activities that might have a significant impact on protected aquatic ecosystems must submit an EIA, whatever their size or cost.	CONAGESE		
Burundi	Code on the Environment 2000		YNY		The introduction of any animal or plant species must be subjected to a full analysis... to provide assurance that the proliferation of the proposed species will not cause any harm to indigenous species nor to the natural ecosystem equilibrium.	INECN		
Cameroon	1996 Framework Law on Environmental Management 96/12	1996	YYY		EIA compulsory for a project likely to peturb biodiversity in aquatic environnement	CIE	General guidelines	No
Cape Verde	Act No. 86/IV/93 of 26 June 1993 defining environmental policy.	2006	YYN			CAN		
Central African Rep.	1989 Decree No 89-047 (Establishment of National Committee in charge of the Environment)		YYY					No

Country	Environment Law	EIA Regulations	CBD CPB ACCNNR	Explicit mention of aquaculture in EIA regulations	Explicit mention of EIA regarding introduction of alien species	EIA Oversight Institution	Guidelines published for EIA: general or aquaculture	Explicit SEA/SIA provision
Chad	1998 General principles on the protection of the environment		YYY		Conditions to be published by statute for introductions	HCNE		
Comoros	1994 Framework Law on the Enironment 94/018		YNY		The importation of living speciments of species not native to each of the Comores is banned	DGE		
Democratic Republic of Congo			YYY					
Congo	1991/1997 Law on the Protection of the Environment	1986	YYY			CGE/ANPE	General guidelines	No
Côte d'Ivoire	1996 Code on the Environment	1996	YNY		Any proposed activity must avoid any negative impact on biological diversity	BEI/MLCVE, ANDE		No
Djibouti	2000 Framework Law on the Environment	2001	YYY		EIA is required for the introduction of exotic species or new genetic material for extensive use	CNE		No
Egypt	M Environment Law 4/1994	1995	YYY	Aquaculture on the grey list: may need EIA		EEAA	General guidelines	No
Equatorial Guinea	1990		YYN					
Eritrea	1996 Environment Proclamation		YYN		Assessment required for introduction of alien species into an ecosystem			No
Ethiopia	1995	2002	YYY			NEPA	General guidelines	Yes
Gabon	1993 Law on the Protection and Improvement of the Environment	1979	YYY			DGE		
Gambia	1994 National Environment Management Act 94/13	1999	YYY	EIA required: for storage dams, barrages, weirs; fisheries especially large scale commercial projects;	EIA required: Introduction of alien species of fauna and flora into ecosystems;		General guidelines	No
Ghana	1994 Environment Protection Act 490/94	1999	YYY	EIA regulations: EIA mandatory for land-based aquaculture EIA for construction of dams / reservoirs Fisheries Act: EIA required to accompany any application for a licence for aquaculture; Fisheries Impact Assessments required for any activity impacting on a fishery (as well as EIA)		EPA	General guidelines	Yes
Guinea	1987 Code on the Environment	1990	YYY	EIA required: Aquaculture installations		Ministry		No
Guinea-Bissau	1993		YNN					
Kenya	Environmental Management and Coordination Act 1997	2003	YYY	Indirect: mandatory for dams, reservoirs, irrigation and large scale agriculture	EIA mandatory: introduction of alien species of fauna and flora into ecosystems	NEMA		Yes

Country	Environment Law	EIA Regulations	CBD CPB ACCNNR	Explicit mention of aquaculture in EIA regulations	Explicit mention of EIA regarding introduction of alien species	EIA Oversight Institution	Guidelines published for EIA: general or aquaculture	Explicit SEA/SIA provision
Lesotho	Environment Act 2001	2003	YYY	EIA required: dams, reservoirs, storage dams, weirs, canals …. etc.; projects which affect streams, floodplains, wetlands;	EIA required: introduction of alien species of fauna and flora into ecosystems; genetic modification of organisms and release of such organisms;	LEA		
Liberia	Environment Protection and Management Law	2002	YYY	mandatory for: 'artificial' fisheries (aquaculture for fish, algae, crustaceans, shrimps, lobster or crabs)	EIA mandatory for: Introduction of new species in waterbodies	EPA		No
Libya	1982 Law for protection of the environment		YYY					
Madagascar	1991 Environment Charter	1992/2004	YYY	EIA mandatory for industrial or intensive aquaculture PREE for semi-industrial and artisanal aquaculture Special measures for shrimp aquaculture	EIA mandatory for introduction of alien species; transfer of native species outside natural distribution; use/ introduction of any GMO; PREE for reintroduction of native species to area where previously present;	ONE	aquaculture guidelines	No
Malawi	1996 Environment Management Act (No. 23)	1998/2001	YYY	EIA mandatory: Construction of fish-farming or ornamental pond(s) where the capacity is greater than 100 cubic metres or where there is any direct discharge from a fishpond to a receiving waterbody. Reservoirs greater than 100ha	EIA mandatory: Any proposal to introduce fish species in an area where they do not presently exist.	DEA	General guidelines	No
Mali	1991 Protection of Environment and Life Framework 91-47	1999	YYY	EIA required: for dams and other permanent installations intended to retain or to stock water.				No
Mauritania		2004	YYY			Ministry		No
Mauritius	Environment Protection Act 2002	2006	YYY	EIA required: construction of dam and dyke; Preliminary environmental report required: Parcelling out of land above 5 hectares for agricultural purposes involving infrastructural work	EIA required: development, production, release, use, marketing and application of genetically modified organisms; rearing of introduced species…;	Ministry	General guidelines	Yes
Morocco	2003	2003	YYN	EIA required: aquaculture and fish culture projects; dams and reservoirs	"the laws determine the conditions for the introduction, from whatever origin, of any animal or plant species which could harm protected species or their natural environment"	DE/CNEIE		No
Mozambique	Framework Environmental Act (No. 20 of 1997)	1998	YYY	EIA required: fish farming projects, with an area equal to or greater than 5 hectares		MICOA	General guidelines	
Namibia	Environmental Management Bill (2007)	policy 1994	YYN	EIA required: aquaculture and mariculture	EIA required: genetic modification of organisms and releases of such organisms	EC/DEA	aquaculture guidelines	Yes
Niger	1998	2000	YYY	Indirect: EIA required for dams and reservoirs >5 ha;		BEEEI		Yes

Country	Environment Law	EIA Regulations	CBD CPB ACCNNR	Explicit mention of aquaculture in EIA regulations	Explicit mention of EIA regarding introduction of alien species	EIA Oversight Institution	Guidelines published for EIA: general or aquaculture	Explicit SEA/SIA provision
Nigeria	58/1988; 59/1992	1992	YYY	EIA required: Land based aquaculture projects accompanied by clearing of mangrove swamp forests covering an area of 50 hectares or more; dams and man-made lakes and artificial enlargement of lakes > 200 ha		FEPA	General guidelines	No
Rwanda	Organic Law No 04/2005 Measures to protect, safeguard and promote the Environment		YYY			BEIE		Yes
São Tomé and Principe		1999	YNN	indirect: EIA for projects or programmes of agriculture or elevage which singly or cumulatively exceed 20 ha				Yes
Senegal	1983 Code on the Environment	1983	YYY	Indirect: preliminary review for irrigation and small and medium agri-business.	EIA compulsory for projects likely to have negative consequences on biodiversity	Ministry	General guidelines	Yes
Seychelles	1994 Environment Protection Act	1996	YYY	EIA required: fish farming works and extension, aquaculture; dams and reservoirs;	Avoid the introduction of foreign species, except when assured that there is no risk that these might escape into the natural environment		aquaculture guidelines	No
Sierra Leone	2000 Environmental Protection Act		YNY	EIA required: substantial changes in farming and fisheries practices eg introduction of new crops...; dams, drainage or irrigation projects…;				No
Somalia			NNY					
South Africa	1998 National Environmental Management Act 107/98	2006	YYN	Basic envionmental assessment required for: aquaculture production, including mariculture and algae farms, with a product throughput of 10 000 kilograms or more per year; The release of genetically modified organisms into the environment; Full EIA required for dams over 10 ha	Assessment of risks and potential impacts on biodiversity must be carried out for introduction of alien species	NEMA	aquaculture guidelines	Yes
Sudan	Environmental Protection Act of 2001.	N	YYY	N				No
Swaziland	2002 Environmental Management Act	2000	YYY	N		SWA	General guidelines	Yes
United Republic of Tanzania	2004 Environmental Management Act	2004	YYY	EIA mandatory: 'artificial' fisheries such as aquaculture for fish, algae, crustaceans shrimps, lobster or crabs; large scale fish farming including prawn farming; EIA may or may not be required for: small-scale fish culture; small animal husbandry and urban livestock keeping; sea weed farming	EIA required: introduction of new species in waterbodies; introduction of genetically modified organisms	NEMC	General guidelines	Yes

Country	Environment Law	EIA Regulations	CBD CPB ACCNNR	Explicit mention of aquaculture in EIA regulations	Explicit mention of EIA regarding introduction of alien species	EIA Oversight Institution	Guidelines published for EIA: general or aquaculture	Explicit SEA/SIA provision
Togo	1988 Code on the Environment 88-14	2006	YYY	Require EIA: dams and reservoirs(> 5ha < 10 ha: Simplified EIA, > 10 ha: In-depth EIA); Aquaculture/Fish culture (< 300 ha: Simplified EIA, > 300 ha In-depth EIA). Extraction of water from rivers, underground, lakes, lagoons and the sea… for aquaculture, requires authorisation from the Ministry of Environment	Require EIA: Introduction of alien species (in-depth EIA); Introduction of genetically modified organisms (in-depth EIA); transfer of existing species out of current distribution range (simplified EIA).	Ministry		Yes
Tunisia	1988 Law No 88-91 Establishment of a National Agency for the Environment	1988/ 1991	YYY	EIA is mandatory for mollusc farming (category A); aquaculture projects (category B).		ANPE	General guidelines	No
Uganda	1995 National Environment Act	1998	YYY	EIA required: storage dams, barrages and weirs	EIA required: "introduction of alien species of fauna and flora into ecosystems";	NEMA	General guidelines	No
Zambia	Environmental Protection and Pollution Control Act, No. 13 1990	1997	YYY	EIA required: dams and barrages > 25ha; fish farms (production > 100t per year);	EIA required: Introduction of alien species of flora and fauna to local ecosystems.	ECZ	General guidelines	No
Zanzibar (United Republic of Tanzania)	Environmental Management for Sustainable Development Act, 1996	2002				Dept Env		No
Zimbabwe	2002/05 Environmental Management Act	1997 g'lines	YYN	EIA required: dams and man-made lakes; irrigation schemes	prohibit or control the importation of and introduction into the wild of exotic animal and plant species;		General guidelines	No

Sources: Algeria, 1990, 2001, 2003; Benin, 1999, 2001; Botswana, 2005; Burkina Faso, 1997, 2001; Burundi, 2000; Cameroon, 1996; Cape Verde, 2006; Chad, 1998; Comoros, 1994; Congo, 1986; Côte d'Ivoire, 1996; Djibouti, 2001; Egypt, 1994, 1995, 2004; Ethiopia, 2002; Gabon, 1993; Gambia, 1994; Ghana, 1999, 2002; Guinea, 1989; Kenya, 2003; Lesotho, 2001; Liberia, 2002; Madagascar, 2004; Malawi, 1996; Mali, 1999; Mauritania, 2004; Mauritius, 2002; Morocco, 2003a, b; Mozambique, 1998; Namibia, 1994, 2002; Niger, 2000; Nigeria, 1988, 1992, 2007; Rwanda, 2005; Sao Tome and Principe, 1999; Senegal, 2001; Seychelles, 1994, 2003; Sierra Leone, 2000; South Africa, 1998, 2004, 2006a, b; Swaziland, 2000; Togo, 1988, 2006; Tunisia, 2005; Uganda, 1998.

or civil society being fully aware of the extent of the changes. Although institutions responsible for the environment are now given a higher profile than previously, there is a perception in some countries that they are still relatively lightweight when compared to some of the traditionally heavyweight sectoral ministries that manage policy priorities for economic and production growth. Unless it has been developed with close inter-ministerial collaboration, this can leave environmental law in some isolation making application more difficult. In more and more cases sectoral ministries are taking environmental concerns on board and harmonising their own legislation. At the same time environment ministries are receiving a higher profile and these factors, combined with growing awareness of government personnel, are making it increasingly likely that EIA will be required and applied.

EIA OBJECTIVES

Although EIA is intended as a project specific study in most African regulations, the extent of the assessment expected can differ according to the overall objectives of the process as defined by different national policies.

At one level it can be implemented as a quite limited licensing procedure for a new installation, ensuring that it will meet minimum standards and essentially limiting the study to impacts "at the farm gate", in an exercise that can be described as control of pollution and local habitat degradation.

With commitment from both farmers and environmental authorities EA can become a much more substantial tool in support of "best practice" for sustainable aquaculture. This adopts wider boundaries than a project-level EIA for the environmental assessment incorporating concern for social and economic spheres as well as upstream and downstream interactions with the natural environment.

EIA, ESIA, SIA, SEA, ESMP, ESD, EAA[5], etc.

There are many related and sometimes confusing acronyms. As the focus of environmental assessment has evolved over the past two decades a number of approaches have been put forward to assist the decision-making process for sustainable development, and the acronyms cited here represent just a few of these variations. They all recognize the interlinked nature of our existence and the way that any new activity can produce reverberating effects through our environment, sometimes in unexpected ways. Put simply, they are an indication of how the boundaries of our definition of the environment have changed in relation to assessment, recognising that some of the key impacts of developments are found away from the project site – either elsewhere in the ecosystem, outside in the community or linked to parallel developments in the supply chain.

Africa, which in most cases has yet to commit to extensive use of these procedures, is still able to reflect on how best to position itself in relation to the environmental debate. The African Union has set some markers for this and has tended to recognize that the wider boundaries of environment are important. The Abuja declaration (NEPAD, 2005) identifies impacts on communities from aquaculture as needing to be managed and the African Convention on the Conservation of Nature and Natural Resources (ACCNNR)(African Union, 2003) recognizes that impacts are on the whole of the ecosystem irrespective of national boundaries.

How this will affect aquaculture, which is still a sector on the brink of development,

[5] **EIA**: Environmental Impact Assessment
ESIA: Environmental and Social Impact Assessment
SIA: Social Impact Assessment
SEA: Strategic Environmental Assessment
EAA: Ecosystem Approach to Aquaculture
ESMP: Environmental and Social Management Plan
ESD: Environmentally Sustainable Development

is now being decided in the different countries as they start to acquire experience in environment assessment for the sector. It is still partly a case of deciding which impacts are acceptable to local society and political opinion, and which mitigation measures are considered necessary or affordable. The debate is already far better informed than a few years ago, and with reasonable reliance on environmental awareness and assessment, most negative impacts from aquaculture can be avoided or greatly reduced.

LEVEL OF USE OF EIA IN AFRICA FOR AQUACULTURE PROJECTS

The progressive introduction of EIA regulations in Africa over the past 15 years has not yet resulted in a large number of EIAs being carried out in aquaculture. In part this is to do with the low level of growth of aquaculture at present and this can be expected to change. However, as will be seen from the case studies below, there are already precedents in aquaculture in a few African countries where EIA is becoming an active part of the decision-making processes.

Apart from the generally low level of aquaculture development there are some other reasons why EIA is not more widely used in aquaculture:

- aquaculture is not often perceived as "high risk" so is not a priority to environmental authorities; there have been few, if any, obvious negative impacts from aquaculture in many countries;
- the small-scale of most aquaculture in Africa;
- a reluctance to appear to put obstacles in the way of local investors when well established local policies are tilted towards increasing food production and economic expansion;
- the laws are new and untested and there are insufficient trained staff in environmental and fisheries departments;
- aquaculture is a low priority for under-resourced environmental institutions.

Many of the EIAs to be carried out for aquaculture projects in Africa have been for big commercial farms, that have often received investment from private sources overseas or support from international agencies or banks. The expectation of these partners is such that EIA is part of the project installation, even where there may not have been comprehensive national legislation. Most of these agencies have introduced a requirement for EA (World Bank, 1999a), usually using the instrument of EIA, and have established their own criteria and guidelines for this. In the absence of national legislation, guidelines and local expertise, new projects have carried out the EIAs principally with their own resources using guidelines and methodologies of the institutions such as the World Bank and the United Nations Environment Programme (UNEP). A major factor in the bias towards EIA being used for internationally financed projects is their larger scale, as opposed to most domestic initiatives which are often of a much smaller size.

EIA within the context of international investment and development assistance

Three of the major institutions financing projects, including aquaculture, in Africa are the World Bank, the African Development Bank (AfDB) and the European Union (EU). They now all have policies and detailed procedures which ensure that environmental assessment is carried out for aquaculture projects which they finance. Sometimes this will require a full EIA study of the project, but if the anticipated environmental impact is not significant then a reduced assessment may be sufficient. These institutions screen their projects to determine the nature of the assessment that is appropriate (see Box 3). In cases where the national regulations operate and thresholds are higher, a project will have to satisfy those thresholds if it is to receive support; in cases where the national thresholds are lower or there are no equivalent regulations, the institutional EA requirements would be applied.

BOX 3
Aquaculture thresholds for EIA determined by external institutions

A. World Bank (World Bank, 1993)
A.1. "*Category A projects that are likely to have adverse impacts: a full EIA is needed in accordance with the specific requirements of the Bank's EA policy … including in areas such as public disclosure, public consultation…"* These include:
– aquaculture and mariculture (large-scale);
– dams and reservoirs;
– irrigation, drainage and flood control (large-scale).
Also *likely to induce significant impacts upon biodiversity* and so classified as Category A (World Bank, 1997):
– fisheries/aquaculture projects involving conversion of important natural migration, breeding or nursery sites, over-fishing, introduction of exotic species.
A.2. "*Category B projects that may have environmental impacts for which more limited EA is appropriate"*. The following projects and components may have environmental impacts for which more limited (Category B) EA is appropriate:
– agro-industries (small-scale);
– irrigation and drainage (small-scale);
– protected areas and biodiversity conservation;
– watershed projects (management or rehabilitation).
B. African Development Bank (AfDB, 2001)
B.1. "*Category 1 projects are those that are likely to have the most severe environmental and social impacts and require a full ESIA."* These include:
– large-scale aquaculture/mariculture;
– river basin development;
– large scale dams and reservoirs.
B.2. "*Category 2 projects are likely to have detrimental and site-specific environmental and social impacts that can be minimized by the application of mitigation measures included in an ESMP."*
– small-scale aquaculture/mariculture;
– small-scale irrigation and drainage;
– watershed development (management or rehabilitation);
– intensive animal production;
– dams and small reservoirs.
B.3. "*Category 2 projects would be subject to Category 1 EA if they i) affect environmentally sensitive areas or ii) impact on socially sensitive issues."* These include e.g. mangrove swamps, small islands, tropical rainforests, wetlands of national importance.
C. European Union (CEC, 1993)
C.1. "*Screening List C: Projects requiring full EIA"*. Includes:
– industrial fisheries.
C.2. "*Screening List B: Projects requiring further environmental analysis."* Includes
– intensive aquaculture (large-scale);
– extensive aquaculture (exceeding 50ha, or exceeding 10ha if affecting mangroves);
– artisanal fisheries (large-scale);
– introduction of new species;
– introduction of new harvesting technology.

As far as aquaculture is concerned, although the general principles behind the use of EIA are very similar, the screening thresholds do vary slightly between these investing institutions. None of the thresholds are intended as inflexible, and there is always the proviso that any project which appears likely to have significant impact should undergo

EA. The World Bank distinguish between "large-scale" and "small-scale" aquaculture and mariculture, while suggesting that the final category designation should always be a matter of "professional judgement". The AfDB has similar distinctions between large and small-scale, but is more prescriptive and introduces detailed definitions of special conditions whereby Category 2 project types should be included as Category 1 for EIA. The EU takes a slightly different approach and includes most aquaculture as "requiring further environmental analysis", which may or may not involve EIA. The EU guidelines regret that development assistance agency EIA procedures designed for large and complex infrastructure projects are often applied to the assessment of smaller, more routine, projects.

POLITICS AND EIA

Although EIA is supposedly a rational approach to deciding the merits of a project on the basis of predictions of its impact on the environment, there are less tangible influences on how the process is actually used. One of these is politics, whether national or local, and there is usually a political dimension to an EIA. Environmental concerns have been moving closer to the centre of political debate in Africa, as it has globally. This is particularly marked in some countries such as Uganda, South Africa or Ghana where both politicians and media are now quick to focus on the environmental aspects of an issue. This political awareness is important for the effective use of EIA, as it provides the will to follow through on the national legislation as well as encouraging the public's participation in the process. On the other hand, a lack of political will – or worse, deliberate smothering of environmental debate – can make EIA ineffective.

In cases where "Environment" is seen as a distinct and separate sector of government, there is a risk that its policies can be, or at least perceived to be, in competition with other national policies which may have top level support – such as economic growth targets or creating a favourable climate for foreign investment. When this happens, the environmental regulations can be perceived by senior decision makers in government as obstructing their development plans. Authorities in the United Republic of Tanzania, for instance, have struggled with this issue over certain aquaculture project proposals (see Box 8).

"Mainstreaming" of environmental concerns into the wider political sphere, at both national and local levels, is the route that would make EIA less controversial (by the setting of common goals by partners inside and outside the sector) and less costly (by encouraging appropriate choices early in the project cycle).

CAPACITY AND HUMAN RESOURCES

Although EIA is usually defined as a project level activity, it in fact requires the involvement of a variety of "stakeholders" at each stage of the process, and resources must be made available to train and inform all of them before they can be effective managers or participants in what is quite a complex methodology.

First of all the national authority responsible for oversight of the environmental regulations needs the expertise to elaborate policies for environmental assessment, prepare comprehensive guidelines, conduct project screening, EIA scoping, EIS review and follow-up of monitoring. In some countries – such as Ghana – there is already a considerable workload of over a thousand EIA applications each year, although very few concern aquaculture. Without strong oversight capacity, it is very difficult to ensure proper compliance with the regulations.

Elsewhere in the public sector, the aquaculture agency/department needs to acquire similar expertise in order to fulfil their role in promoting and organizing the sector within the requirements of the legal framework. Strategies and policies will need to be adjusted to the evolving concerns about the possible effects of activities like

aquaculture on the environment. Managers of the important resources sectors, such as water, also need to be included.

There is also a need to build capacity in the private sector so that competent consultants are available to conduct the EIA studies for project investors (CLEAA, 2007b). Producers associations do get involved in promoting controls on professional capacity, setting minimum standards or certifying procedures.

Apart from these core services that are required, there is also much to be done in less specialized spheres of civil society, especially in Africa where there is little experience of public participation in environmental decision-making. Committing efforts towards informing and sensitizing some of the following groups about the environmental issues at stake will greatly improve the quality of EIA output:

- Non-governmental organizations (NGOs) involved in e.g. development, environment, human rights;
- media journalists;
- teachers, students, parliamentarians, rural communities, traditional leaders;
- practicing fish farmers/aquaculturists themselves;
- lawyers/judges and the court system for resolving conflict.

Country case studies

EGYPT

Brief background to aquaculture activities

Aquaculture has a long history in Egypt but it is over the past 10–15 years that there has been a rapid increase in production (FAO, 2004-2008. NASO Egypt). Total production now exceeds 500 000 tonnes of fish, making Egypt the major producer in Africa by some distance.

Traditional methods have been extensive, based on growing out wild caught fry of tilapia and mullet in shallow ponds, usually without significant inputs. Carp have also been increasingly cultured since the 1970s; grass carp notably being well established for biological weed control in irrigation and drainage canals.

The rapid growth of recent years has been achieved by the increase in number of aquaculture farms, but also significantly by the intensification of farming techniques. Improved pond construction as well as new structures such as cages, tanks and raceways have been introduced. Hatchery produced fry, feeding, fertilisation of ponds and aeration are now common. Tilapia *(O. niloticus)* have become the dominant species, but other species such as seabream, seabass and shrimp have been introduced into the sector.

Background for the legal framework

The legal framework for aquaculture in Egypt is relatively well established (FAO, 2004-2008. NALO Egypt) and has developed out of necessity over several decades. Egypt has uniquely severe constraints on its water and cultivatable land resources and as a result, a body of legislation has been created to govern essential resource use that applies also to aquaculture and fisheries. A substantial number of the regulations are directed at minimising degradation of the aquatic environment centred on the Nile River, although their formulation predates the current environmental approach, and does not use current vocabulary such as "environmental assessment".

Fresh water, for which virtually the only source for the country is the inflow of the river Nile, has long been the object of control by the authorities. There is no "surplus" and water has to be shared in an orderly manner; agricultural crop production and urban supply and sanitation are the main priorities. Freshwater aquaculture has had a small presence upstream of the Nile delta but water would not normally be made available there for this use. The situation in parts of the Nile delta is somewhat different; here the land and water conditions are less favourable to traditional agriculture, and aquaculture has long found a niche. Some of this uses freshwater, but there have been important opportunities for aquaculture in brackish water, partly due to salinization of soils and encroachment of seawater. In fact, aquaculture has been encouraged in some areas as being an activity that can improve the quality of the land being used and make it more suitable for agriculture.

In these conditions there are extensive aquaculture practices that have proven successful and until recently the most common methods used shallow ponds to produce mullets, tilapias and carp. However, even in the delta the resource pressures have increased and this has favoured the introduction of new more intensive aquaculture methods.

Good returns on investment in the current market for fish have encouraged new farms, and production has recently soared as the more intensive methods are developed

using both traditional species (tilapias, mullets, carps) as well as new species (seabass, seabream and shrimp). At the same time new approaches to agriculture are being developed and land reclamation projects are being implemented; the pressure on water and land continues to increase. Water is in short supply and is re-used more than once, which raises questions of water quality – in terms of the quality of water being made available for an activity/use and at the same time the quality of water in the drainage or outflow from that activity/use. Together, these conditions explain the comprehensive and detailed nature of the Egyptian legislation governing pollution control, resource sharing, water quality and licensing of activities, all of which are concerns to be addressed in any EIA for aquaculture.

Legal framework influencing environmental issues and aquaculture

The overall legal framework within which the aquaculture sector works is quite complex as can be seen from Table 3. All these laws grapple with environmental concerns over the quality and quantity of resources available to different users (Egypt EEAA, 2001; Egypt, 1982; FAO, 2004-2008. NALO Egypt).

The Ministry of Water Resources and Irrigation (MWRI) has the primary legal responsibility for the planning and management of all water resources in Egypt. It is responsible for providing water of suitable quality to all users. To accomplish this goal, the ministry has to ensure that appropriate measures are undertaken to protect both the quantity and the quality of Egypt's water resources. With increasing trends of pollution, MWRI is intensifying its attention towards pollution control and water quality management.

The Ministry of Health and Population (MoHP) has also been given a central role in water quality management, especially in setting standards for the quality of the following:

- potable water sources (River Nile, canals and groundwater wells);
- drain water that can be mixed with other water for drinking water;
- industrial and sewage treatment plant discharges.

TABLE 3
Statutes governing aquaculture in Egypt

Environmental law	Date	Objectives	Decrees Regulations	Implementing Agency
Law 12 (and its supplementary Law 213/1994)	1984	Main legislation for irrigation and drainage	Has recently been revised and submitted to Parliament	MWRI
Law No. 4 on Environment	1994	Establishment of EEAA and Environmental Protection Fund; requirement of EIA; regulation of air pollution, hazardous waste management and marine pollution	Decree No. 338 of 1995 (Executive Regulation including Prime Ministers Decree No. 1741 of 2005)	MoEA; EEAA
Law No. 102 on Natural Protectorates	1983	Designation and management of natural protectorates	Decrees designating sites	MoEA; EEAA
Law No. 124 on Fisheries	1983	Management and protection of fisheries and marine animals		MALR
Law No. 48 on Protection of Nile and its Waterways	1982	Control of pollution of surface waters	Decree No. 8 of 1983 (standards for wastewater discharges to surface waters)	MWRI
Law No. 137 on Labor	1981	Control of work place safety and environment		Ministry of Manpower and Immigration
Law 92/1962 Waste water discharge	1982	Control of wastewater discharge into public sewers	Decree 9/1989	MHUNC

The Egyptian Environmental Affairs Agency's (EEAA) functions, as established by the Environmental Law 4/1994, include:

- conducting studies; formulating the national plan for environmental protection;
- preparing legislation, decrees and regulations as needed to protect the environment;
- setting requirements for EIAs of projects;
- monitoring compliance with standards and norms;
- coordinating enforcement actions;
- managing natural protectorates;
- promoting environmental education.

The EEAA has significant authority over industry under this law, including the authority to require industries to keep records of the environmental impact of their activities and to collect and analyse samples to ensure that standards are being met.

The fundamental issues of environmental impact are also governed by earlier laws for resource sharing and pollution control that are still applied, but which date from before the current environmental framework being put in place, and use a rather different vocabulary.

The Law 93/1962 regulates discharge into the public sewers and in this respect Decree 9/1989 sets out specific limits to many potential pollutants. Law No. 124 / 1981 prohibits the use of fresh water in aquaculture. Law 48 /1982 enforced by the Ministry of Water Resources and Irrigation regulates discharge into branches or canals of the Nile, to the main stream of the Nile, and elsewhere. The concerns covered by these two laws would necessarily be included in an EIA, and the relevant measurements could be a significant part of the data included in the environmental register required by Law 4/1994.

In addition, Law 124/1983 covering fishing, aquatic life and aquaculture, has several articles specifically on aquaculture and its relationship with the nation's resources and environment (Egypt, 1983). This law requires licensing of aquaculture farms by General Authority for Fisheries Resources Development (GAFRD). Conditions that should be satisfied for obtaining a license (valid for up to five years) include:

- land used should be in areas allocated for fish farming and should normally be otherwise unsuitable for agriculture e.g. uncultivated un-reclaimable (fallow) lands, drain outfalls and certain Northern Lakes;
- license must indicate the quantity of water permitted for water use, its source, inlet size and the method of drainage;
- authorization for water use obtained from the Ministry of Water Resources and Irrigation, in conformity with Law 48/1982;
- a satisfactory EIA and the consequent approval of EEAA.

Egypt is also a party to the Convention on Biological Diversity (CBD) and to the Biosafety Protocol, which might influence choices relating to species introductions and use of modified strains of fish.

Aquaculture and requirements for EIA

The Environment Law No. 4/1994 (Egypt, 1994) is the principal legislation enacted to govern interactions with the environment in Egypt. It is this law that creates the obligation to undertake EIA under certain conditions. This is the case of aquaculture which is designated as an activity "which may have a noticeable impact on the environment" and requires an EIA to be submitted before approval can be given, and before work can commence. This law also requires that any establishment of this nature prepares an environmental register which must be regularly updated to record the impact of the establishment's activities on the environment. The executive regulations determine the standard form of the required register, the time table required to keep it up to date and the data to be entered (Sadek, 2007).

Screening and establishing liability to EIA

Sectoral ministries and governorates can be the competent administrative authorities for EIA, as they possess the executive powers in relation to development authorization. Additionally, they are required by Law 4 and its executive regulations to conduct the screening of projects (METAP, 2000).

The central EIA department of the EEAA is responsible for supervising the screening process, managing the review of EIA reports (either by undertaking reviews itself or by assigning independent bodies or individuals to do so), taking decisions on the acceptability of EIA reports and giving an opinion on the development and proposals for mitigation measures. EEAA also has the responsibility for issuing EIA guidelines.

The recommended process for the EIA is generally well defined in guidelines issued by the EEAA, and follows a sequence of steps and required documents:

Project presentation >> screening >> scoping >> consultation >> baseline data collection >> impact prediction and evaluation >> monitoring plan >> environmental impact statement.

Screening criteria have been published and activities separated into three categories according to the severity of possible environmental impacts as follows:

1. White list projects for establishments/projects with minor environmental impact, which do not require an EIA;
2. Grey list projects for establishments/projects which may result in substantial environmental impact and which may require a scoped EIA;
3. Black list projects for establishments/projects which require complete EIA due to their potential impacts.

Aquaculture, in principle, is included in the Grey List, although it could be Black List if proposed in a designated environmentally sensitive area. In practice this means that an EIA would normally be expected unless the project can demonstrate early in the screening process that it would have only minor environmental impact.

Once an EIA is declared necessary, the next stage is scoping to decide which environment impacts have to be covered and in what detail. Consultation with the public is expected to be initiated at this stage and would continue until the potential impacts have been identified and mitigation measures are considered. Once the scoping has been completed, the details of the EIA can be planned. Baseline data, using both existing and new original data, is now collected.

A significant part of the data to be studied in the Egyptian situation involves water, both quantity and quality; the impact concerns are not necessarily in relation to the "natural" environment, but often in relation to other economic users upstream and downstream. Issues of impact on the natural environment are more important in some of the sensitive wetland habitats of the delta previously uncultivated. Occupation of space is important, whether in potentially cultivatable land or water surface of the shallow Nile delta lakes, as it is (or will become) an issue of competition for space. Social impacts are not negligible as aquaculture will often be replacing alternative land uses and also affecting the fishing industry (e.g. impacts on the areas available to fish, on natural fish populations and their movements).

Practical issues for applying EIA to aquaculture

Mechanisms for the control of pollution, in particular of the aquatic environment, have been in place in Egypt for a long time before the process of EIA was introduced. Law 4/1994 takes the "bigger picture" on the environment, although the earlier laws and the divided responsibilities of the multiple ministries and agencies remain in place. In theory the introduction of EIA provides a mechanism to bring together these various – sometimes "competing" – institutions so that the diverse legislation relating

to environmental resources is applied in a coordinated manner towards the objective of sustainable resource use.

These multiple laws could present some difficulty to aquaculture farmers. There is a risk that the EIA becomes just one more in a series of bureaucratic hurdles for the farmer/entrepreneur each of which has to be resolved independently with each institution involved: EEAA, the Ministry of Agriculture and Land Reclamation (MOLAR), Ministry of Water Resources and Irrigation, GAFRD and other local Competent Administrative Authorities.

In practice, EIA is rarely conducted for aquaculture activities *per se*. The vast majority of these are activities operating in fresh/brackish-water environments and they continue to be regulated by the "older" legal frameworks of the various sectoral ministries, coordinated to some degree by GAFRD. EIA is not required before a farmer begins aquaculture production. The only situation, which may become more frequent if open sea aquaculture develops, where the EIA required is in the marine environment (coastline, open marine waters) where the established rules for inland waters do not apply and the Environment Law administered by the EEAA holds sway.

EIA and the environmental logic behind the process are unlikely to succeed as priority of environmental ministries on their own, without wider understanding and support from the rest of the administration, the business and farming sectors and from the community as whole.

The slow uptake of the use of full EIA studies is not unique to freshwater aquaculture, and has been noted in a wider context (Genena, 1996). The reasons suggested are perhaps not surprising and are reflected in similar challenges in other African countries:

- high costs of environmental monitoring and testing;
- lack of skilled and trained human resources;
- unclear roles, responsibilities and legal requirements;
- overlap with existing inflexible permitting arrangements.

Cage based aquaculture provides an example of how environmental impact concerns can influence development. Cages have been used for freshwater aquaculture since at least 1985, mostly for tilapia – although more recently silver carp has been used and in 2003 production reached 32 060 tonnes from 3 753 cages. However, since that date the practice of cage farming in the channel of the two major branches of the Nile has encountered stiff opposition from legislators (based on the general water use regulations and navigation concerns) and environmentalists. There are currently efforts being made to reverse this decision and EIA has been proposed as part of the process of finding a solution acceptable to all parties.

Limited land and water resources (physical and self-imposed by existing legislations and policies) and the relatively low levels of production, indicate that the way forward for Egyptian fish farmers will probably be to intensify their production and take full advantage of new technologies and management procedures. However, with intensification come higher environmental risks from adverse effects on the environment, as well as higher production risks from higher levels of inputs, the need for water quality and fish health management. EIA may come to be seen by the whole sector as a key tool in managing this transition in a way that is sustainable and protects the resources from the ever increasing pressures of its multiple competing users.

MADAGASCAR

Brief background

Aquaculture has a relatively long history, and the first recorded efforts of fish farming date back 70 years. Freshwater fish farming has been established the longest, and historically this has primarily been focussed on rice/fish culture, raising fish in the

rice paddies that are so widespread across the country (FAO, 2006-2008. NASO Madagascar). The methods used are mostly extensive or semi-intensive, with carp as the main species. In the past 20 years more intensive methods have been applied to carp fry production, although the hatcheries are all also at a small-scale. In environmental terms, the impact of these activities is quite minimal and is absorbed into the general agricultural landscape.

More recently Madagascar has developed an aquaculture industry of global reputation for the indigenous shrimp *Penaeus monodon*. Since the inception of this activity in Madagascar the shrimp producers have made a virtue of striving for an environmentally sustainable approach, to avoid some of the major pitfalls that have overtaken the development of shrimp culture elsewhere in the world. The success of this approach has significantly influenced the environmental legislation and its application in Malagasy aquaculture. The country is actively seeking to develop the commercial exploitation of other new species, both in fresh and marine/brackish water environments, which if practiced at a large scale, as projected, can also be expected to raise issues of environmental impact; these include e.g. seaweeds, sea cucumbers and eels.

The uniqueness of the indigenous biodiversity and the natural ecosystems that exist in Madagascar is well known, and there is a long history of national and international interest in protecting these exceptional environmental assets. This is one reason why Madagascar has a notably comprehensive and well developed environmental legal framework which has evolved over the past two decades. This framework addresses concerns not only for conservation of the island's unique flora and fauna, but also for all major sources of impact such as mining, causes of soil erosion and the wider issues arising from urbanisation and economic development. Aquaculture and fisheries are explicitly included in environmental legislation.

Of note to this general background, however, is the special situation concerning freshwater aquatic biodiversity. The freshwater ichthyofauna of Madagascar is unusually influenced by alien species. There are 29 introduced species, some of which were introduced specifically for aquaculture. These include such genera as Ophiocephalus sp., Oreochromis sp., Tilapia sp, which have come to dominate many of the aquatic environments and fisheries. Exactly how they have affected the biodiversity of endemic aquatic fauna and flora is more or less unknown, because the latter are also under pressure from habitat loss (Shumway, 1999), but we do know that there are 50 fish species (all aquatic environments) considered to be threatened (extract from FishBase, 2007). This would raise challenging questions when considering the future introduction of species for aquaculture as part of an EIA, and conflicting points of view should be expected when considering the potential impact. Does the parlous state of some endemic species make new introductions unthinkable? Should the established species of alien origin, which includes several of economic and social importance, be protected from adverse potential impacts as part of the status quo of the country's biodiversity, or could the freshwater aquatic ichthyofauna be considered so "cosmopolitan" already that a further introduction is not of great consequence to aquatic biodiversity and can be judged uniquely on economic criteria? Against this background the current legislation requires that EIA be applied to both the introduction of alien species, as well as the movement of native species outside their range.

Legal framework for environmental assessment

The present framework of environmental law dates from 1984 when the Malagasy Strategy for Conservation and Sustainable Development was adopted (décret n° 84-445 du 14 décembre 1984). In 1990 The Malagasy Environmental Charter was adopted by the Law n° 90-033 (Madagascar, 1990). This lays out a comprehensive approach to environmental policy, including the need to legislate for the mitigation

TABLE 4
Malagasy legislation concerning aquaculture and the environment

Sector	Statute name	Reference	Content	National Institution
General Environment	Malagasy Environmental Charter	Law No 90-033 of 21 December 1990	Lays out overall national environmental policy	
	Creates the National Environment Office (O.N.E.)	Decree No 95-607, 1995 on the establishment and organization of the National Environment Office (O.N.E.).	Creates the National Environment Office (O.N.E.)	Autonomous under the technical control of MINENEF
	Law to ensure Compatibility Between Investment and the Environment ("MECIE")	Decree MECIE No 2004-167 of 03 February 2004 modifying certain provisions of Decree 99.954	Procedures for obtaining environmental permits; EIA regulation	MINENEF, O.N.E., and sectoral Ministries e.g - MAEP
Marine Aquaculture	Fisheries and Aquaculture Regulations	Ordennance 93.022 of 04 May 1993	Overall sector legislation	MAEP
	Law for the Development of Sustainable Shrimp Culture	Law No 2001.020 of 12 December 2001	Procedure authorization of aquaculture farm, environmental regulation, disease control	MAEP
Freshwater Aquaculture	Fish Hatchery Regulations	Arrêté 5321-2002/ MAEL/SEPRH of 17 October 2002	Procedures for obtaining authorization	Fisheries Department
	Creation of Technical Committee for the promotion of monosex tilapia production	Interministerial Order No 22914/2004 of 29 November 2004	Procedures, including use of hormones	DPRH, FOFIFA, MINSAN, DSAPS, MINENV, ARDA, APAM, MPE

of environmental impacts of development activities. The consequent legislation introducing procedures for obtaining environmental authorization, including the implementation of environmental impact assessments, was introduced in decrees in 1999 and 2004 (see Table 4).

The details of the EIA regulations are laid out in the Law 2004/167. The title of this statute "Law to ensure compatibility between investment and the environment" ("MECIE") is unusual and worthy of note – most are simply called "EIA regulations" or something similar. This one, however, makes an interesting reference to *compatibility* between *(development) investment* and the *environment* and thus encapsulates the notion that it is a balance that most African countries will strive to achieve between economic development and the inevitable impacts this will have on parts of the environment.

Under the MECIE (Madagascar, 2004) regulations aquaculture could fall under more than one article when considering whether a project is required to carry out an EIA before commencing:

Under article 5 and its annexes: Any animal production project which falls into the categories "semi-industrial or small-scale enterprise" ("*Tout projet d'élevage de type semi-industriel et artisanal*") would require the approval of a PREE (Environmental Commitment/Responsibility Plan). This stops short of a full EIA and applies to smaller scale activities.

Under article 4, and its annexes, the following are required to complete a full EIA before obtaining an Environmental Authorization from the environmental authorities:

- any industrial or intensive animal production project ("*Tout projet d'élevage de type industriel ou intensif*");
- any water extraction over 30 m^3/h - ("*Tout prélèvement d'eau (eau de surface ou souterraine) de plus de 30 m^3/h*");

- any introduction of a new species, or genetically modified organism, into the country (*"Toute introduction de nouvelles espèces, animales ou végétales, ou d'organismes génétiquement modifiés (OGM) sur le territoire national"*);
- any introduction of a species present in Madagascar but not already present in the project zone *("Toute introduction d'espèces présentes à Madagascar mais non préalablement présentes dans la zone d'introduction"*);
- any project to be created in a sensitive area (*"Tous aménagements, ouvrages et travaux pouvant affecter les zones sensibles"*).

Practice

In practice most aquaculture operations must consider whether or not they are liable to prepare a PREE or undertake an EIA. Article 5 of the EIA regulations requires all "semi-industrial and artisanal" aquaculture projects to provide a PREE (Environmental Commitment Programme), while "industrial or intensive" projects should normally undertake a full EIA as defined by article 5/annex 1 (Madagascar, 2004).

The key stage for this will be the screening process. There is some discretion as to which category an individual project will fall into, not least because in most cases the terms used in the law (e.g. intensive, semi-intensive) are not precisely defined. Some situations requiring EIA are better defined such as projects in sensitive habitats or involving water extraction of more than 30 m^3/h.

In the current situation in the freshwater environment, the large numbers of farmers involved with rice/fish culture are not expected, now or in the near future, to be included in either of these approaches. A rural fry production hatchery might be required to prepare a PREE, depending on its size and the methods used. To date this hasn't occurred.

The situation in coastal aquaculture, specifically the shrimp aquaculture sector, is quite different. Since the early days of investment into this activity, there has been an effort by government authorities to maintain a sensitive attitude towards the environment, especially as it was possible to benefit from hindsight and avoid some of the errors made in other parts of the world. This focus has increased as the shrimp aquaculture sector has made a virtue of its environmental credentials which have played a key role in disease control and in efforts to gain recognition for a premium product in export markets. Initial guidelines were created in 1998 and are known as the Management Scheme for Shrimp Aquaculture (*Schéma d'aménagement d'aquaculture de crevette* or SAAC). As the national policy towards shrimp culture evolved, a separate law was passed in 2001, relating to responsible and sustainable aquaculture development (Madagascar, 2001). This is much more detailed than the EIA regulations which were adopted first in 1999 and revised in 2004, and makes the assumption that both industrial and artisanal aquaculture would be subjected to full EIA. To what extent the "artisanal" farmer has the means to undertake a complete EIA study is not discussed.

In the context of biodiversity, the issue of introductions is more clearly defined. From the way the article 4/annex 1 of the EIA law is phrased, anyone planning to introduce a species into an aquaculture project (whether an alien species or moving a native species out of its established range) will be obliged by law to carry out an EIA. This also applies to GMOs. There is no guidance, in the decree or in the aquaculture guidelines, as to how this might be carried out or definition of the criteria that must be satisfied in order for approval for the introduction to be given. The issue of how far an individual project EIA might be able to satisfactorily tackle the wider biodiversity issues of a species introduction is discussed elsewhere in this paper.

Madagascar is fairly unique in the extent of guiding documentation that has been published by the Office nationale pour l'environnement – National Environment Office (O.N.E.) to assist in the interpretation of the laws; this includes general guidance for

EIAs (O.N.E., 2006a) as well as specific advice contained in guidelines for carrying out aquaculture EIA (O.N.E., 2005). Although this guideline document is entitled as being relevant to "aquaculture projects", the content is clearly moulded primarily by the approach of the shrimp culture industry. Applying such a rigorous schema to all types of aquaculture might not be possible or cost effective, and the authorities will need to apply discretion as new types of aquaculture activity attract investment.

Madagascar has published a number of other useful guidelines, see Table 5. These include one targeting existing projects which under the regulations should also undertake studies similar in scope to EIA, in a process called **Environmental Conformity**. Although not yet used for aquaculture, this regulation also applies retrospectively to new projects that have failed to follow correctly the EIA process, although they should have done so by law. There is another set of guidelines for carrying out an **Environmental Audit.** These are not a fixed legal obligation (although there are situations in which an audit can be demanded by the authority), but the audit is proposed essentially as a tool for businesses and projects wanting to improve their environmental credentials. The approach is not dissimilar to EIA. Although these guidelines are comprehensive they do not establish any actual national numerical standards for most of the common environmental parameters such as water quality, and these are left to local review for each project.

Of particular note is the publication of guidelines for those with the responsibility for appraising an EIA report. Interpretation of law is important, and as this is something that will evolve over time, publication of the official approach to interpretation is a significant step, as this guide is also available to promoters and EIA consultants as well as staff of the reviewing authority. This should give all the "stakeholders" of an EIA a better chance to understand the process and each other. This is a document that will need to be regularly updated as new situations are encountered.

An important part of any EIA report is the proposal of mitigation measures and of monitoring of key environmental parameters that are identified in the report as being of potential risk. This is included in the statutes as the PGEP (Project Environmental Management Plan) which needs to be approved and validated by the environment authority alongside a quantified statement of the project's environmental commitments (*Cahier des charges environnemental* - CCE) for which progress must be regularly reported to the agency. A typical document will indicate which parameters should be

TABLE 5
Guidelines for environmental issues with relevance to aquaculture, as published in Madagascar

Scope	Title
Shrimp culture development	Schéma d'Aménagement d'Aquaculture de Crevette (SAAC). [Shrimp aquaculture management scheme]
Code of Conduct for sustainable shrimp culture	Code de Conduite pour le Développement d'une Aquaculture de Crevette Responsable et Durable (Madagascar and GAPCM, 2005). [Code of Conduct on the Development of Responsible and Sustainable Aquaculture]
General EIA	Directive Générale pour la Réalisation d'une Etude d'Impact Environnmentale (O.N.E., 2006a). [General guideline for the conduct of an environmental impact study]
General EIA	Présentation du Décret MECIE (O.N.E., 2006b). [Presentation of the Decree MECIE]
Aquaculture EIA	Guide pour la Réalisation d'une Etude d'Impact Environnementale des Projets Aquacoles (O.N.E., 2005) [Guide for the conduct of an environmental impact study of aquaculture projects]
Environmental Audit	Audit Environnemental: Guide Général (O.N.E., 2007a) [General guide to environmental audit]
Environmental Conformity (of existing projects)	Mise en Conformité: Guide Général (O.N.E., 2007c) [General guide to environmental conformity]
Evaluation of EIA reports	Guide d'Evaluation des Etudes d'Impacts Environnementaux (O.N.E., 2007b). [Guide for Evaluation of EIA reports]

monitored without necessarily determining the acceptable levels of these parameters. Here the promoter is asked to compare the measurements with the pre-project levels. In fact even the most careful management will have some impact on the environment; it is important to eventually define how much change is considered tolerable. This is an aspect which can be improved in future with the acquisition of experience.

Public participation/consultation is a clear requirement in the statutes and all promoters must undertake this. The complete process for the different levels indicated for the public consultation should take within a period of 10 to 70 days. During this time the public may consult "documentation", including a summary written in accessible non-technical language. Specific reference is not made to the access to the EIA report itself, and this is not statutorily put into the public domain. Experience shows that it is not easy to gain access to this document after the process is completed.

Effectiveness and future development of EIA

As one of the countries with the most experience of EIA, Madagascar also provides to some degree an opportunity to gauge its effectiveness, because it has been carried out for several aquaculture projects. The situation is rather unusual in that so far it mainly involves a focussed group of investors (shrimp aquaculture in mangrove areas of north west Madagascar) who have been pro-active in promoting their environmental credentials, and in this respect they have probably always been ahead of the evolution of the national regulatory process. To date, it is clear that the industry sector's close attention to environmental management, which includes the strict adherence to EIA as part of the process, has contributed to the current success of the aquaculture projects at several levels: avoidance of negative environmental impact, successful technology maintaining a quality disease-free production and international market recognition of a premium product.

The degree to which EIA can be credited with avoiding negative environmental impact, which might otherwise have occurred, remains to be tested with time. Certainly it would appear that the environmental policy adopted in this case has succeeded so far in that the Malagasy industry has not experienced the problems that the shrimp industry has experienced elsewhere, such as South and Southeast Asia, where initial development was not sufficiently controlled. Madagascar farms remain essentially disease-free. Long term damage to the mangrove ecosystem has been minimal, and with targets for re-afforestation included in the EIA's mitigation measures, there may be areas where there have even been improvements in mangrove habitat.

Environmental assessment has been extended here to include the wider implications of the effect of the projects on local demographics and social welfare, and the possibility that these may in turn lead to impacts on the coastal environment. It has been suggested that a successful shrimp farming industry, providing jobs and improved community infrastructure, against a national background of insufficient employment opportunities, is likely to become a magnet driving population movements significantly greater than just the increase in employment in the industry itself. This raises the possibility that this could lead to the growth of large new "pioneer" towns close to the sensitive coastal habitats on which the industry depends (Gruzen, 2005). Monitoring and periodic reappraisal of the immediate environment of these projects will provide the long term answers to the benefits of the EIA process.

The semi-intensive techniques being used for *Penaeus monodon* culture and the high quality disease free environment maintained on the farms, have contributed to a product that has become recognized as one of the best in a competitive international market where they command a significantly higher than average price. This has led to one farm gaining official recognition in the French market where it has been awarded the "Le Label Rouge", a premium label. Another farm has been awarded "organic status" for its products.

Ecocertification

The next step planned by the Malagasy association of shrimp farmers/fishermen (Groupement des Aquaculteurs et Pecheurs de Crevettes de Madagascar, GAPCM) is to develop a national ecocertification procedure to maintain these standards, and serve as a base for market promotion. This will build on principles and recommendations provided by a consortium of international agencies promoting sustainable approaches to shrimp culture (FAO/NACA/UNEP/WB/WWF, 2006). The Consortium is composed of FAO, the Network of Aquaculture Centres in Asia-Pacific (NACA), the United Nationsl Environment Programme (UNEP), World Bank and the World Wildlife Fund (WWF), and it is the WWF that has been collaborating with the GAPCM in developing a version of the principles adapted to the Malagasy situation. The criteria used for eco-certification will be based on the principles outlined by the Consortium in eight main areas: farm siting, farm design, water use, broodstock and postlarvae, feed management, health management, food safety and social responsibility. EIA will remain integral to the decision-making process of creating shrimp farms, and the guidelines for EIA as well as for the Environmental Management Programmes that are agreed following approval of the EIA studies, are being harmonised with the criteria adopted for the eco-certification procedure. This will include a number of published standards of technical parameters that must be met, as well as greater clarification of issues such as use of antibiotics, which are important both in terms of bio-safety as well as customer perceptions of "green credentials". Criteria for social responsibility are expected to be given greater attention at the EIA stage, as well as during project operations.

The drive to develop regulations for shrimp aquaculture has resulted in statutes which are well adapted to this particular case – a high value product produced in a sensitive habitat with an international conservation spotlight focussed on it. It is not certain that the same approach is applicable to all aquaculture in Madagascar, especially when one considers its development in an agricultural or semi urban landscape in freshwaters or coastal areas. To deal with this, the environment authorities will need to show flexibility, adapting guidelines and interpretation of the laws to a wide variety of situations that currently include: rice/fishculture, seaweeds, *Spirulina*, small-scale hatcheries, molluscs, sea cucumbers and cage culture. Some of this is already considered in the guide for the evaluation of EIA dossiers (O.N.E., 2007b).

Cost and bureaucracy can be powerful dissuasion to people entering the sector, particularly at the small-scale end of the spectrum. The regulations include fees to be paid to the official institutions to cover costs of oversight of EIA and Project Environmental Management Programmes (or PGEP), as well as public hearings. These are calculated as a proportion of total investment and can be over 0.5 percent of the total cost of smaller projects. The shrimp management plan deliberately sets very high environmental standards, which would be very difficult to meet for unskilled artisanal operators with limited financial means. This is seen as necessary to maintain industry disease-free conditions, with uncontrolled small-scale operators being potentially a risk due to inadequate management. In other cases there is a likelihood that semi-intensive or artisanal farmers would be subject to "lighter" solutions that would be more appropriate to their situation (e.g. PREE rather than EIA, or simple authorization of an application).

NIGERIA

Brief background

Nigeria provides one of the brightest examples of progress in aquaculture on the African continent, as can be seen by the rapid growth of this sector in the past 15 years. Although the practice has existed for over 50 years, the level of production has

remained very modest for most of this time, particularly when one considers the size and population of the country. Current production is considerably over 50 000 tonnes annually and recent inventories of aquaculture activity have recorded over 2 500 fish farms in the country, a number which is growing rapidly and stimulating many related activities such as fish feed production by over 200 feed mills (Miller, 2006). Traditionally fish farming was carried out using extensive or semi-intensive techniques, mostly in fish ponds, but the methods employed now include ponds, dams, cages, tanks, raceways, re-circulating systems and rice paddies. The potential for even greater growth is evident given the market demands of a growing, increasingly urban population, complemented by a dynamic fabric of small-scale enterprise (Ohen and Dixie, 2006).

The increase in aquaculture activity is mostly accounted for by the introduction and spread of techniques for the production of *Clarias*, the African catfish. Production has been increasing rapidly by about 20 percent per year as producers have moved to supply markets in the many urban centres. Market demand remains strong as a number of factors encourage continuing growth – such as the positive image of the catfish among consumers in many areas of Nigeria, and the possibility of distributing live fish to market which reduces reliance on cold chains. The techniques being used are very varied. At one end of the spectrum, semi-intensive farming in large and small ponds is preferred, particularly in rural areas where there is sufficient land available, as well as on some large private farms. However, there is increasing use of more intensive grow-out systems in concrete tanks, raceways and sophisticated re-circulating water systems. These "high-tech" farms, both large and small-scale, require less land and are being built close to, or even within, the main urban areas.

Another important characteristic of recent development has been the increasing sophistication of the complete supply and marketing chain. Although some farmers are virtually independent for all their requirements, there are more and more specialists in the chain, including fry producers, fish-feed producers, equipment suppliers, wholesalers and processors, new market structures and even specialized fast food chains using the product.

The move to more intensive methods, along with parallel increases in the allied activities, will certainly raise significant issues in the future as far as the environment and EIA are concerned. This will be particularly so in the new developments in the urban and "peri-urban" settings, where the farmers will face environmentally related challenges both in how their activities affect their very close residential/industrial neighbours, and also in how the quality and quantity of essential resources – especially of water – are affected. For the time being, however, aquaculture continues to be perceived a "low-risk" activity.

Legislative background

Nigeria has developed its legislative framework for environmental management over a number of years, and was one of the first African countries to give significant emphasis to specialized environmental institutions. The country has some of the most important industrial concentrations on the continent – particularly with all the allied activities to the oil and petroleum industries, and it is as a consequence of these that there has been increasing political and social awareness of environmental issues. An incident of toxic waste dumping from foreign sources was the trigger in 1988 for the government to put in place legislation to govern environmental management along with the creation of a specialized institution to oversee and implement the legislation – the Federal Environment Protection Agency (FEPA).

Since that date, the principle of environmental protection has been enshrined in the Federal Constitution of 1999 which contains provisions for the protection and improvement of the environment and safeguarding of water, air and land, forest and wildlife of Nigeria (Makinde and Ayanbule, 2006).

Nigeria's National Policy on Environment (1989) sets out the following goals (Anago, 2002):

- securing the quality of the environment for health and wellbeing;
- conserving and using the environment and natural resources for the benefit of present and future generations;
- restoring, maintaining and enhancing the ecosystem and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of natural resources;
- promoting public awareness on the link between development and the environment;
- international co-operation with countries and international organizations in the protection of the environment.

The Federal Government of Nigeria has promulgated different laws and regulations to safeguard the environment. These include the following of relevance to EIA in aquaculture, although there are overlapping statutes and guidelines which apply mainly to the oil industry:

1. Federal Environmental Protection Agency Act of 1988 (FEPA Act). The following Regulations were made pursuant to the FEPA Act:
   (i) National Environmental Protection (Effluent Limitation) Regulations;
   (ii) National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations; and
   (iii) National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations.
2. Environmental Impact Assessment Act of 1992 (EIA Act).
3. Harmful Wastes (Special Criminal Provisions etc.) Act of 1988 (Harmful Wastes Act).
4. The National Environmental Standards and Regulations Enforcement Agency Act 2007 (NESREA Act).

The different States within Nigeria also have the power to make laws to protect the environment within their respective jurisdictions; e.g. in Lagos State, there is the Environmental Protection Agency Law Cap L23, Laws of Lagos State of Nigeria, 2003; and in Akwa Ibom State, there is the Environmental Protection and Waste Management Agency Law, Cap 47, Laws of Akwa Ibom State of Nigeria 2000.

Nigeria is also committed to a wide range of international environmental and biodiversity agreements that could affect the way choices are made for aquaculture development in general, as well as the particular aspects of an EIA (Anago, 2002).

These include:

- 1968 African Convention on Conservation of Nature and Natural Resources;
- 1972 UN Conference on the Human Environment (Stockhom declaration) which established the nexus between development and environmental integrity;
- 1992 UN Conference on Environment and Development (Rio Summit), which produced a suite of five documents:
  - Agenda 21– an action plan for sustainable development in the 21st century;
  - The Rio Declaration – Principles on healthy environment and equitable development;
  - The Convention on Biodiversity;
  - The Convention on Climate Change;
  - A statement of Forest Principles.
- 1993 Lugano Convention on Civil Liability for damage resulting from activities dangerous to the Environment;
- Kyoto Accord/Kyoto Protocol on global warming;
- African Charter on Human and People's Rights;
- Abuja Declaration – Fish for All Summit, hosted by Nigeria - demanded good environmental management in aquaculture (NEPAD, 2005).

Thus it is clear that Nigeria has extensive statutory instruments in place with which to implement and enforce many aspects of environmental management. For this review, the key statute in this collection is the Environmental Impact Assessment Act of 1992 (FAO, 2006-2008. NALO Nigeria).

Institutionally the application of the EIA statute has been the responsibility of the Federal Environmental Protection Agency over most of the time since 1992. This was an independent agency, attached to the Federal Presidency. Recent institutional changes have occurred which moved the agency into the Federal Ministry of the Environment, and in 2007 FEPA was abolished and replaced by the National Environmental Standards and Regulations Enforcement Agency (NESREA).

The NESREA Act repealed the FEPA Act and established the NESREA in its place (Nigeria, 2007). The new agency has responsibility to enforce compliance with environmental standards, regulations, rules, laws, policies and guidelines. NESREA is also responsible for the protection and development of the environment, biodiversity conservation, sustainable development and the development of environmental technology (Awogbade *et al.*, 2008).

The EIA process as laid down by the Act is defined in fairly standard terms, and these are summarised in Box 4 as an example of similar procedures followed in other case study countries (Echefu and Akpofure, 2002). Under the Act, FEPA published various sectoral EIA procedures together with EIA Procedural Guidelines in 1995.

The liability of aquaculture projects to EIA is determined by the priorities given to different categories of development activity by the Nigerian government. The Act defines three categories – High Risk, Low Risk and No Significant Impact – see Table 6. In theory aquaculture can be interpreted as being in either category

TABLE 6
Categories used for screening for liability to EIA, Nigeria

Category 1	**Category 2**	
High risk of environmental impact	**Low risk activities**	
EIA mandatory	**EIA only when required by the Authority**	**However liable to EIA if project is sited in/close to:**
• Agriculture/agro-allied • Fisheries • Forestry • Industry (manufacturing) • Food, beverages and tobacco processing • Infrastructure • Ports • Housing • Airport • Drainage and irrigation • Railways • Transportation • Resort and recreational development • Power Generation • Petroleum • Mining • Quarries • Waste treatment and disposal • Water supply • Land reclamation • Brewery	*Agriculture and rural development* • Any reforestation / afforestation project • Small-scale irrigation and drainage • Small-scale aquaculture and mariculture • Saw-milling and wood logging • Rubber processing • Any fish processing • Any other agro-allied *Industry and infrastructure* • Mini hydro-power development • Any small-scale industry development • Small-scale power transmission • Any renewable energy development • Telecommunications facilities • Rural water supply and sanitation • Public facilities (hospitals schools and housing) • Small-scale tourism development • Road rehabilitation • Any form of quarry or mining	• Environmentally sensitive areas • Coral reefs • Mangrove swamps • Small islands • Tropical rainforest areas with erosion prone soils • Mountain slopes areas prone to desertification • Natural conservation areas • Wetlands of natural or international importance • Areas with protected/ endangered species • Areas of unique scenery • Areas of particular scientific interest • Areas of historic/archaeological interest • Areas of importance to threatened ethnic group

Source: adapted from Nigeria, 2007

BOX 4

EIA process in Nigeria

The proponent initiates the process in writing to the responsible officer. A notification form is duly completed with all relevant information on the proposal:

- magnitude – probable severity of each potential impact;
- prevalence/extent and scope – extent to which the impact may eventually extend;
- duration and frequency – is activity short term, long term or intermittent;
- risks – probability of serious environmental effects;
- significance/importance – value attached to a specified area;
- mitigation – measures available for associated and potential environmental effects.

NESREA does internal screening to determine the project's category under the mandatory study activities list. Where no adverse environmental effects exist, the Environmental Impact Statement (EIS) is issued and the project commences with appropriate mitigation and monitoring measures. Otherwise within ten working days of receipt of the proposal, the screening report is sent to the proponent for scoping and the preparation of terms of reference. The Terms of Reference embody the scope of the proposed EIA study and this is examined and the scope of the study defined accordingly by NESREA. The proponent carries out the study, generally using consultants, and the draft EIA report in 15 copies is submitted to the responsible officer. For this draft report to be complete it must as an annex record the results of public participation in a public form.

Within 15 working days of the receipt of the draft report, NESREA concludes evaluation of the draft and determination of the review method which it communicates to the proponent in writing. The four methods are:

- in-house review;
- panel review (sitting may be public);
- public review – an elaborate display of the report for 21 working days with appropriate display venues chosen by NESREA for the convenience of the public stakeholders and communities. Through newspaper advertisement NESREA invites interested groups/persons to participate;
- mediation.

Within one month of the review process, review comments are furnished to the proponent. In this review stage, the public participates only when NESREA's chosen method of review guarantees its participation. The final EIA report, addressing and proffering answers to review comments, is submitted within six months to the responsible officer. At this early stage, and on mutual agreement, NESREA and the proponent set conditions establishing a follow-up programme (mitigation, compliance and monitoring plan), a monitoring strategy and audit procedure. A "no project' decision is communicated to the proponent if the review comments are adverse and/or improperly addressed in the final report and the final EIA report is unsatisfactory. The decision-making body is the NESREA technical committee chaired by the Director General/Chief Executive.

Within one month of the receipt of a final EIA report which has been adjudged as satisfactory, the committee approves and issues the environmental impact statement followed by certification by the responsible officer complete with appropriate conditions and with a validity period. Armed with the certificate, the proponent commences the project subject to the conditions and specifications contained in the environmental impact statement. If the project is not commissioned within the validity period on the certificate, a revised and updated EIA report becomes necessary for revalidation.

The progress of the project is monitored to ensure compliance with all conditions and mitigation measures. Environmental audit, assessing both positive and negative impacts of the project, is carried out periodically. In its exercise of discretionary powers, FEPA refers any project likely to cause significant environmental effects that may not be mitigated (or where public concern about the project warrants it) to the NESREA council for mediation or panel review.

1 (fisheries) or category 2. Category 2 only includes small-scale activities without defining the boundaries between large and small-scale. In practice it seems that the trigger point used is 50 ha of production area. This in fact rules out almost all the existing farms, which would not be liable to mandatory EIA, unless they are sited in one of the defined environmentally sensitive areas. This type of trigger point is not fully relevant to the type of intensive production unit now being created, which have significant production volumes on areas much less than 50 ha. It may be reasonable to assume that the more intensive methods carry a higher level of environmental risk than a more extensive pond-based system.

The perception that aquaculture is low-risk means that few producers feel very concerned by this legislation, and indeed the use of full EIA is not the norm for individual aquaculture farms. This position of low priority is reinforced by the far greater and very real problems faced by Nigerian society and the institutions charged with enforcement of environmental legislation when dealing with the threat of environmental impact from industry – most especially the oil industry. Most aquaculture producers do not engage with the EIA process at all; some of the larger investors are able to obtain an EIS and clearance to proceed with only a brief preliminary assessment/application to either a state agency or to FEPA.

This relatively light handed approach to aquaculture would seem to be a quite rational one in the circumstances, and a position that in the short term is contributing to (or at least not detracting from) the forces favourable to the continuing growth of the aquaculture sector in Nigeria. It is reasonable to consider aquaculture as low-risk in general. While the current policy gives investors the benefit of the doubt in terms of environmental risk, it is nevertheless clear that the statutes are largely in place to deal with any negative situation should anything go wrong, should permits be abused or should the combined numbers of farms create an aggregate impact that cannot be tolerated without some mitigation. The EIA law is also ready to be invoked in sensitive areas for such cases as shrimp farming proposals in mangroves or constructing farms in important wetlands.

Monitoring of the impact of a project on the environment, and the option of periodic audit at the request of the Agency, are measures that are included in the EIA Act. Actual cases of obligatory monitoring are not documented, and it seems likely that only parameters that are of immediate benefit to the farm operation are being monitored by farm managers with any consistency.

Reports of the EIA process as used outside the aquaculture sector have identified a number of difficulties in the implementation of the law, and in general the quantity of EIAs undertaken is well below what might be expected. These problems may have some relevance to aquaculture, and are recognisable as actual or potential difficulties encountered in other countries as well. Many of these are institutional problems, and one of the major challenges relates to the relationship of FEPA with other ministries and public institutions (Adegoroye, 1994; Adegoroye, 1996; Echefu and Akpofure, 2002). The introduction of the environment laws/agency in 1988 created a new framework, without necessarily modifying and adjusting the role and legislation of existing (and often more powerful) institutions. The result was that there were overlapping statutes and interests in such matters as water, land and especially the management of the oil industry, and being more entrenched in the system these have continued to control many aspects of environmental management to the detriment of FEPA's capacity to intervene. A further complication in Nigeria is overlap with state responsibilities in these same domains, and a lack of cooperation with states when they are not associated with an EIA until late in the process when the EIA documents are being reviewed. Sometimes the will of the political establishment is called into question, when powerful institutions or individuals are able to intervene to bypass the EIA process using diverse development priorities as justification (Adegoroye, 1994).

SOUTH AFRICA

Brief background

South African aquaculture has a long history, going back to the 1890s when trout were introduced, but for a long time it did not become an important activity and has only recently attracted a lot more attention making it one of Africa's top producers. Early fish farming was entirely in fresh water, using mainly trout at a small-scale, with more recent interest in tilapias, catfish and ornamentals. Many of these initiatives used introduced species of fish, several of which have now established populations in the wild. Freshwater crayfish production has also been on the increase and eel production is being developed. More recently, there has been increasing interest in marine aquaculture which has now overtaken freshwater production in both quantity and value.

Molluscs – abalone, oysters, mussels – are the most valuable products, although shrimp farming projects and seaweed production are now expanding. There is one project developing open-sea cage culture of Atlantic salmon, and other indigenous marine finfish are currently being researched for culture.

In summary, the South African aquaculture sector is developing fast, with a varied multi-species base in freshwater, brackish-water and marine environments using a range of methods from the extensive to very intensive. Some project proposals are very ambitious and their scale suggests that these may require close attention to their potentially significant environmental, social and economic impacts.

Legislative framework for environmental assessment

Background

South Africa has a well developed legal system and since the change to full democracy there has been an opportunity to revise many laws and regulations: this gives the national legislation a modern outlook that is reflected in the treatment of environmental concerns. The most fundamental expression of this is in the environmental provisions that are included in the Bill of Rights in Chapter 2 of the Constitution of South Africa Act which states:

Everyone has the right –

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

This amounts to a near perfect defining justification for EIA.

As a result of these ideals the government has sought to integrate environmental responsibilities across many sectors of national, provincial and local government.

EIA regulations are new in South Africa, but the process has been supported for some years on a voluntary basis within the context of the now repealed Environment Conservation Act of 1989.

Aquaculture and environmental legislation

The principal laws governing the environment that impinge on aquaculture, and hence must be taken into account during EA for any new activity, are:

- National Environmental Management Act of 1998; *(general framework);*
- National Environmental Management: Biodiversity Act of 2004; *(focused on biodiversity – including issues of introduced species, GMOs);*

- National Environmental Management: Protected Areas Act of 2003; *(identifies sensitive areas for special protection);*
- "(EIA) Regulations in terms of Chapter 5 of the National Environment Management Act, 1998" of 2006; *(EIA regulations);*

The Environmental Management Act spreads environmental responsibility widely through the sectoral departments, with a coordinating role for the Minister of Environmental Affairs and Tourism who is responsible for the National Environmental Advisory Forum and the Committee for Environmental Coordination. Departments (national and provincial) whose activities have an impact on the environment or who are responsible for environmental management participate in these coordination bodies, and must produce and regularly update an environmental implementation plan or an environmental management plan, respectively.

New draft regulations propose to widen the scope of the articles of the Act concerning EIA to include:

(i) environmental management frameworks;
(ii) strategic environmental assessments;
(iii) environmental impact assessments;
(iv) environmental management plans;
(v) environmental risk assessments;
(vi) environmental feasibility assessments;
(vii) any other relevant environmental management instruments that may be developed in time.

However, aquaculture is not administered within just one sector and regulation as well as policy, promotion and development are quite fragmented across more than one ministry and several sectoral departments. Each of these is backed by sector legislation with some application to aquaculture. At present, the legislation controlling freshwater aquaculture is administered by three lead departments (DEAT, DOA, DWAF)[6], while mariculture is overseen primarily by DEAT.

Other departments – Department of Land Affairs, National Port Authority (marine waters leasing), Department of Trade and Industry and Department of Health also administer legislation that impacts directly or indirectly on aquaculture. Although not expressly environmental in intent, this legislation is also relevant to EIA studies dealing with aspects of social and economic environments – alternative land uses, impacts from supply chain development and disease transmission for instance.

These diverse Acts are not integrated and this has created a situation where no single department has either the mandate or the capacity to provide the one stop service that the sector would need to rationalize the procedures.

(i) DEAT administers Acts that deal with the sustainable use of natural resources:
- The National Environmental Management Act, 1998;
- The National Environmental Management: Biodiversity Act, 2004;
- The National Environmental Management: Protected Areas Act, 2003;
- The Marine Living Resources Act, 1998 *(fisheries, mariculture).*

This is the legislation that essentially governs the processes of environmental assessment, including EIA.

(ii) DOA legislation deals with the sustainable use of agricultural resources (AAPD, 2006):
– Conservation of Agricultural Resources Act, 1983 (zoo-sanitary and phyto-sanitary control);
– Agricultural Pests Act, 1983 (pests and chemical use);

[6] DEAT: Department of Environment Affairs and Tourism
DOA: Department of Agriculture
DWAF: Department of Water Affairs and Forestry

– Animal Diseases Act, 1984 (diseases, animal movements);
– Animal Improvement Act, 1998 (importation of animals and genetic material, genetic improvements, strains);
– The Genetically Modified Organisms Act, 1997 (introduction and testing of GMOs).

Any agricultural development involving freshwater aquaculture would be subject to this legislation as well as the DEAT legislation. In addition, any movement of aquatic animals would be subject to both DOA and DEAT legislation requiring more than one permit.

(iii) DWAF in turn administers legislation that provides for the management of water resources:

– The National Water Act, 1998 (Act No. 36 of 1998)

Water is a key and usually scarce resource in South Africa and its use is strictly regulated by water sector institutions (DWAF, 2007). Many water uses require a "water use licence" in terms of this Act. This includes some similar information as for an EIA to be provided and section 41(2) requires "the applicant (for a licence), at the applicant's expense, to provide ...an assessment by a competent person of the likely effect of the proposed licence on the resource quality;" One can assume that most freshwater aquaculture activity using resources or impounding water would therefore be subject to this legislation as well.

Environmental laws are administered at several levels: national/state, the province and the municipality level. National level institutions are responsible for issuing the general regulation for EIA and the national guideline. The provinces are responsible for the bulk part of EIAs. But where the national environment is affected, or national governmental bodies are the applicant, the authority moves up to the national level (DEA&DP, 2006f; South Africa, 2006b). The authority can also be given to the local municipal authorities.

The screening of aquaculture for EIA liability in South Africa

The screening of projects for environmental regulation in South Africa is progressive and flexible. There are three main outcomes from screening:

– No further assessment;
– Basic Assessment;
– EIA / Scoping Report

The EIA regulations provide two lists: Listing 1 which indicates the activities that would normally only require a Basic Assessment; generally each category has a minimum size threshold for inclusion and below this threshold no assessment is needed (although other permits may still be required). Activities included in Listing 2 will normally require a Scoping Report and full EIA study (South Africa, 2006a).

Aquaculture is explicitly included as follows in Listing 1 and so normally liable for a Basic Assessment:

"Activity 1 (i): The construction of facilities or infrastructure, including associated structures or infrastructure, for aquaculture production, including mariculture and algae farms, with a product throughput of 10 000 kgs or more per year;"

The aquaculture project may also be liable to a basic assessment because it meets other category definitions such as: dams and reservoirs over 50 000 m^3, certain construction or earth moving activities in the sea or within 100 m inland of the high-water mark of the sea, or the release of GMOs into the environment.

However, an aquaculture project may be liable for a full EIA if the project:

"Involves building a dam over 5 m high, certain construction or earth moving activities in the sea or within 100 m inland of the high-water mark of the sea, or the introduction of an alien species".

Or it may need an EIA purely because of its size:
"Any development activity, including associated structures and infrastructure, where the total area of the developed area is, or is intended to be, 20 ha or more."

Key points of the EIA process in South Africa

It is necessary to apply for an environmental authorization for any activity that falls into a category included on Listing 1 or Listing 2 of the regulations, or for any other activity with potentially significant environmental impacts. Obtaining the authorization depends on successful review of either a Basic Assessment Report or a full EIA Report. There is a procedure by which exemption from this process can be obtained in exceptional circumstances. It is worth noting here that the Basic Assessment is not a summary form filling screening exercise that is stipulated in some other national regulations, but is an assessment process that is akin to a streamlined EIA and requires key inputs such as stakeholder/public consultation and is normally carried out with the assistance of an environmental assessment practitioner (EAP).

Basic Assessment is applied to smaller scale activities, the impacts of which are generally known and can be easily managed. Typically, these activities are considered less likely to have significant environmental impacts and, therefore, do not require a full-blown EIA.

A Basic Assessment Report is a more concise analysis of the predicted environmental impacts of the proposed activity than Scoping EIA Reports. However, Basic Assessment still requires public notice and participation, consideration of the potential environmental impacts of the activity, assessment of possible mitigation measures and an assessment of whether there are any significant issues or impacts that might require further investigation. If the competent authority (national or provincial) is unable to make a decision based on Basic Assessment Report alone, they may request that an applicant undertakes the more thorough scoping and EIA process.

Scoping and EIA requires a thorough environmental assessment for activities contained in Listing 2, which are those activities that (due to their nature and/or extent) are likely to have significant impacts that cannot be easily predicted. They are therefore higher risk activities that are associated with potentially higher levels of pollution, waste and environmental degradation.

A Scoping Report (including plan of study) requires a description of the proposed activity and any feasible and reasonable alternatives, a description of the property and the environment that may be affected and the manner in which the biological, social, economic and cultural aspects of the environment may be impacted upon by the proposed activity; description of environmental issues and potential impacts, including cumulative impacts that have been identified, and details of the public participation process undertaken. In addition, a Scoping Report must contain a roadmap for an EIA, referred to as the "Plan of Study for the EIA", specifying the methodology to be used to assess the potential impacts, and the specialists or specialist reports that will be necessary.

An applicant may only conduct an EIA after the competent authority has approved the Scoping Report and the Plan of Study for the EIA. The scoping and EIA process culminates in the development and submission of the EIA Report and the Draft Environmental Management Plan to the competent authority. The Environmental Authorization specifies amongst other details the period of validity, conditions that must be complied with before the activity begins, requirements for monitoring and environmental audits and requirements for financial or other security to cover the risks to the state and the environment for non-compliance.

Approach to biodiversity issues

One of the important potential environmental impacts of the aquaculture sector comes from introducing species alien to the local ecosystem. In the past there has been significant interest in importing alien species, and most current aquaculture operations depend on them. Importing a species is almost certainly taking a risk of introducing it into the wild, as it is probable that whatever the security arrangements on farms there will be escapes, and given the right conditions the introduced species will establish wild populations with consequences for the local species and ecosystems. The widespread introduction of alien fish such as trout and carp into South Africa's rivers, streams and dams and the translocation of indigenous fish between catchments are reported as having had an extremely serious impact on native fish species (DEAT, 2005). It is possible for the impacts resulting from an introduction to be catastrophic to the indigenous biodiversity, although equally there may at the same time be positive economic benefits.

Given this potential for environmental impacts, it is possible that any species introduction could be interpreted by the Minister as requiring an EIA to be carried out in the terms of the EIA regulations. However, alien introductions are not specifically mentioned in the regulations, just as EIA is not specifically required under the new Biodiversity Act in which the issues of introductions and translocations are dealt with. Under the latter Act there are substantial controls on all introductions and use of alien species, as well translocations out of natural range, in terms that are not dissimilar to those used to frame the EIA process:

"A person may not carry out a restricted activity[7] involving a specimen of an alien species without a permit…
A permit… may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out".

Under these rules for biodiversity, the decision is vested principally in the Minister, with less detailed regulation of the decision making process than for EIA. The process is less open than EA and public and stakeholder participation, for instance, is not as comprehensive as that prescribed in the EIA regulations, although there is provision for consultation and for objections to be made in writing to the Minister.

There is however a further article in the Biodiversity Act that may well make investors think hard before proposing the importation of a new alien species:

"Should an alien species establish itself in nature as an invasive species because of the actions of a specific person, a competent authority may hold that person liable for any costs incurred in the control and eradication of that species".

This could become a substantial financial risk for an investor to consider as testified by current endeavours in South Africa to control or eliminate invasive aliens. South Africa is unusual in Africa in putting significant resources into controlling invasive species and there are attempts to quantify the costs of dealing with the consequences of uncontrolled introductions. The cost to clear the alien plant invasions in South Africa is estimated to be around R12 billion (1.6 billion US$), or roughly R600 million (80 million US$) per year for the estimated 20 years that it will take to deal with the problem (DEAT, 2005). The total cost to the nation could be much higher as there are often extremely serious, negative impacts on the trade, tourism, construction, health, fisheries, forestry and agriculture sectors. It is of note that DEAT have indicated that marine ranching would require full EIA based largely on biodiversity issues (DEAT, 2006b).

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[7] Restricted activity includes: importing, possessing, growing, breeding, moving, selling an alien species

Improving the EIA process

Human resources

The promulgation of the EIA Regulations and the requirement that Basic Assessments and EIA applications must now be managed by recognized environmental assessment practitioners (EAP), has acted as a catalyst to growth within the environmental assessment profession. This has prompted a plan to introduce a minimum standard for competence in this profession and, through certification, to introduce some measure of quality assurance and to satisfy the regulatory requirement for practitioners.

There are three main bodies which maintain (voluntary) registers of professionals who can practice as EAPs (Brownlie, 2006). The ICB/CBEAPSA[8] is the specialized body for EA and had 87 registered members in 2006. Two other bodies register professionals with primarily a natural resources speciality[9].

Qualifications for recognition vary and practitioners come from university level training in different relevant fields, e.g. natural sciences, human and social sciences, built environment, mining. As far as specialized input to EIAs for aquaculture projects is concerned Fisheries, aquaculture and marine sciences are taught in a number of universities and institutions in South Africa. Specialized EIA courses are available in over 20 universities and training institutions.

Guidelines

In the past two years there have been a number of EIA guidelines published by government departments involved in environmental regulation. Some of these provide detailed information for carrying out EIAs in various situations, although there are four documents specifically providing guidance for aquaculture (see Box 5). An important part of these guidelines is information about the various different permits and approvals that must be obtained in starting a commercial aquaculture operation.

Multiple legislation: EIA in a complex framework

As can be seen from the above information, aquaculture investors are faced with a quite complex "web" of regulation and guidance. The current more comprehensive environmental laws, including the EIA regulations are very recent and it is too early to draw conclusions on efficacy. However, overall regulation is still open to criticism by producers that it is complex with insufficient integration between sectors involved and that unrelated sectoral statutory frameworks and procedures have failed to encourage the development of aquaculture and entrepreneurship (Botes, Thompson and Louw, 2006).

In a survey carried out in 2000 (before mandatory EIA statutes) of perceptions among mariculture operators, regulation (in the context of operational constraints) is rated predominantly as "very difficult" (Sauer *et al.*, 2003). A more recent survey carried out among fresh/marine producers asked about barriers to entry to the sector, the top ranked issue was that of "environmental regulatory requirements" (Botes, Thompson and Louw, 2006). Interestingly, in both these surveys the idea of a "one stop shop" is not seen as a priority "magic" solution, but rather producers wish for better bureaucratic performance as a solution to time consuming permit application processes (better administration, better communication). The need for regulation and the requirement for the different departments to be involved seem to be accepted.

The task facing a prospective aquaculture producer to obtain all the necessary approvals is illustrated in Figure 1, which is a flow chart combining the various sectoral requirements that are now part of the "legal environment". Environmental authorization

[8] The ICB/CBEAPSA: Interim Certification Board / Certification Board of Environmental Assessment Practitioners in South Africa.

[9] SACNASP: The South African Council for Natural Scientific Professions
SAIEES: The Southern African Institute for Ecologists and Environmental Scientists

BOX 5

Guidelines produced by state institutions for EIA

Guidelines for aquaculture EIA

- Guideline to the authorization requirements for aquaculture in the Western Cape (DEA&DP, 2006c);
- Draft guidelines for fin fish farming, marine aquaculture experiments and pilot projects in SA (DEAT, 2006a);
- Draft guidelines for marine ranching in South Africa (DEAT, 2006b);
- Guideline for authorizing the use of water for aquaculture (DWAF, 2007).

Guidelines for EIA

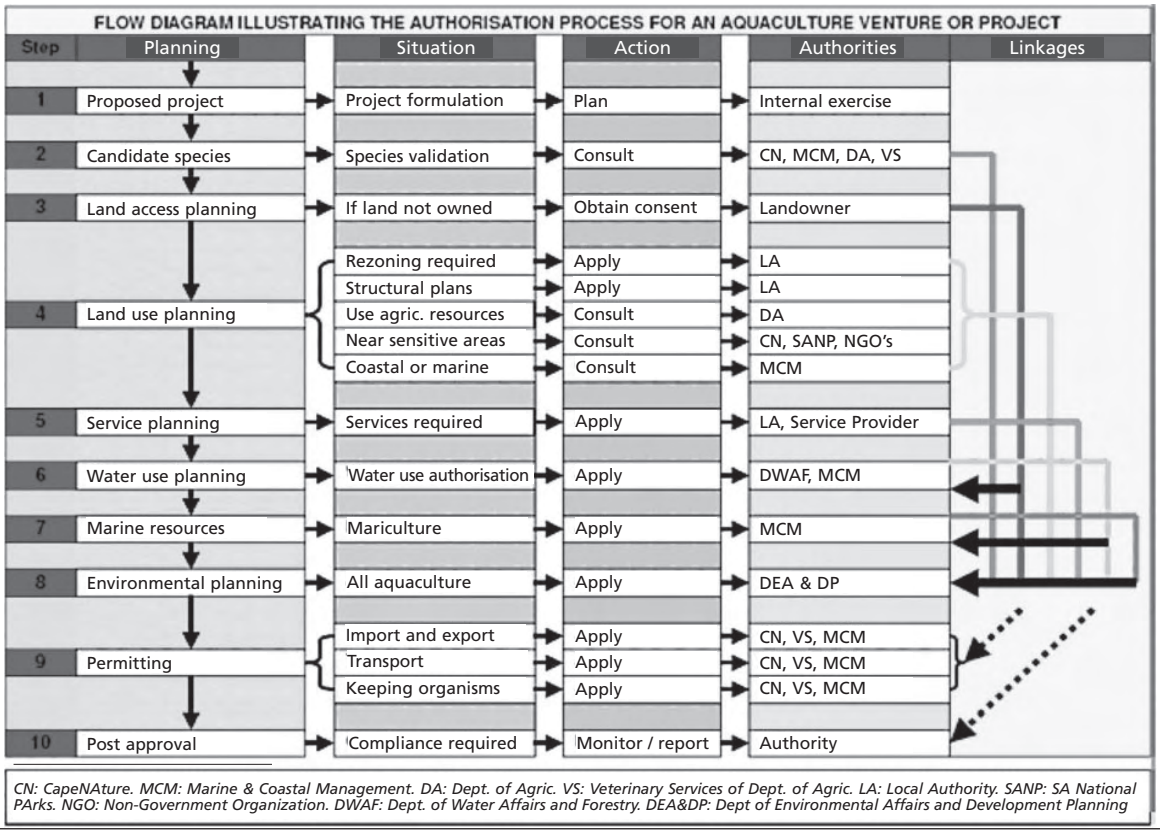
- Guideline 3: general guide to the environmental impact assessment regulations, 2005 (DEAT, 2006d);
- Guidelines on the interpretation of the listed activities (DEA&DP, 2006f);
- Guideline on public participation (DEA&DP, 2006b);
- Guideline on exemption applications (DEA&DP, 2006e);
- Guideline on appeals (DEA&DP, 2006d);
- Guideline on alternatives (DEA&DP, 2006a);

Other EIA guidelines produced by the Province of the Western Cape (DEA&DP, 2006c):

- Guideline for determining the scope of specialist involvement in EIA processes;
- Guideline for the review of specialist input into the EIA process;
- Guideline for involving biodiversity specialists in EIA processes;
- Guideline for involving heritage specialists in EIA processes;
- Guideline for involving visual and aesthetic specialists in EIA processes;
- Guideline for involving economists in EIA processes;
- Guideline for involving hydro-geologists in EIA processes;
- Guideline for environmental management plans.

FIGURE 1

Flow diagram for authorization of aquaculture (adapted from DEA&DP, 2006c)



CN: CapeNAture. MCM: Marine & Coastal Management. DA: Dept. of Agric. VS: Veterinary Services of Dept. of Agric. LA: Local Authority. SANP: SA National PArks. NGO: Non-Government Organization. DWAF: Dept. of Water Affairs and Forestry. DEA&DP: Dept of Environmental Affairs and Development Planning

(via Basic Assessment or full EIA) is just one part of this (step 8). However it could be a major part given the need to combine information from the other steps into the EA study (e.g. planning, species choice, land use, water use, natural resource impacts and economic implications). With the cooperation of the different sectors involved the EA might provide a vehicle for the integration of permitting processes and so reduce the number of separate approaches that a producer has to make.

This fragmentation of the regulations is a major challenge for investors, and has highlighted critical shortfalls in the following service delivery areas:

(i) Management - the capacity to provide an effective service in each of these departments at national and provincial levels in terms of the human resources and quality of expertise.

(ii) Compliance - the capacity to promote cooperation in enforcement of the principle regulatory criteria such as monitoring and evaluation, inspection services and standards.

Aquaculture development zones

Area-wide planning and zoning is being seriously considered, and could facilitate investment by minimizing conflict with other users and more importantly by removing some of the risk and uncertainty from EA (AAPD, 2006). This would offer "ready to invest" sites zoned for aquaculture, preferably with the support of all the involved institutions cited above. These zones would be identified as suitable and secured for aquaculture use and where appropriate would indicate the suitability of cultured species. This would have the added advantage of clustering aquaculture producers in a concentrated geographical area, where they would be able to "cooperate towards common goals, and establish close linkages and working alliances to improve their collective competitiveness". Designing and implementing an aquaculture zoning policy, would require EA to be carried out on a local or regional basis, either in the form of an EIA or as an SEA which would also look at alternative zonal uses.

As can be seen from the review of legislation above, the various institutional involvements and the large amount of guiding information that is available to the prospective aquaculture investors, the regulatory situation is not simple or straightforward. These regulations are very new, very comprehensive and obviously a lot of consideration and effort has been invested in their conception. The efficacy of this framework will have to be assessed over the next few years.

THE UNITED REPUBLIC OF TANZANIA

Brief background

Aquaculture has quite a long history in the United Republic of Tanzania, dating back to the colonial period although it did not develop into a major productive activity. In the past decade there has been greatly increased interest and accelerating production.

Extensive and semi-intensive fish farming in earth ponds in rural areas is the most widespread category of aquaculture, although recent advances in extensive mariculture of seaweeds for export have increased total national production. Efforts to introduce intensive culture of shrimp in the 1990s greatly raised the profile of aquaculture among the public and investors and although these early efforts met with opposition, there are now new investors planning to increase shrimp/prawn production. At present, rural aquaculture accounts for about 1 100 tonnes and seaweeds 1 500 tonnes, with trout and shrimp less than 100 tonnes (FAO, 2006-2008. NASO United Republic of Tanzania; FAO, 2007).

The United Republic of Tanzania has exceptional wildlife resources, as well as a rich unspoilt coastline. The country has created dynamic institutions to manage these resources not least because of their importance for tourism, an important revenue

earning sector, and as a result the protection of the natural environment seems to have been on the public agenda for some time.

Of note is the relatively long established legal framework explicitly directed at management of the environment. The 1983 National Environment Management Act 19/1983 is one of the oldest statutes of this kind on the continent. This law created the National Environment Management Council (NEMC) and pre-dates the widespread introduction of EIA (Box 6). During the past 10–15 years the United Republic of Tanzania has experienced a number of contentious environmental situations which became very visible to the public and to the government authorities. Two cases are particularly relevant to the aquaculture and fisheries sector and have also gained a considerable degree of international notoriety. These first-hand experiences of major impact on the national environment have contributed to shaping attitude of institutions to the control of these aspects of development, and helped create the momentum for the introduction of a new set of comprehensive legislation designed to improve environmental management.

These two examples of environmental impact that relate to aquaculture are set out in some detail in Box 7 and Box 8. They provide important examples of the real environmental risks that could face the continent and have been used as arguments in the justification for the modern environmental laws even in countries fortunate not to have experienced such problems themselves. The first of these incidents is the impact of the introduction of an alien species of fish, the Nile perch *(Lates niloticus)* into Lake Victoria. Although it was done for fisheries reasons rather than aquaculture in this case, it illustrates the high degree of uncertainty associated with any species introduction as seen in the spectacular changes to the indigenous fish populations, the fishery and the local economy, as well as other far reaching social effects.

The second example is the proposal for the large-scale development of shrimp culture in 19 000 hectares of mangrove forest in the Rufiji delta. Although it was officially supported this proposal underwent two environmental assessments and was eventually blocked by popular opposition for various reasons, the most important being fear of the impact of the project on the wider natural and social environment (SAIEA, 2003).

BOX 6

Duties of the National Environment Management Council under Law 19/1983 now replaced by Law 4/2004

(a) to consider means and initiate steps for the protection of the environment and for preventing, controlling, abating or mitigating pollution;

(b) to carry out investigations into the problems of environmental management,

(c) to obtain the advice of persons having special knowledge, experience or responsibility in regards to environmental management;

(d) to keep under review the progress made in the pursuance attainment of the objects and purposes of the Act and to publish reports and provide information for the purpose of enhancing public awareness of such progress and of the problems and remedies that exist in relation to the management of the environment;

(e) to promote, encourage, coordinate, and carry out short-term and long-term planning and projects in environmental management and protection together with or separate from other public bodies and other organs; and

(f) generally, to administer and give effect to the provisions of this Act and to carry out other functions as may be prescribed by the Council.

BOX 7

Impact from the introduction of alien species: case of Lake Victoria

The story of the introduction of the Nile perch (*Lates niloticus*) into Lake Victoria is probably globally and regionally one of the best known incidents of environmental "impact' relevant to the debate around the introduction of alien species, for aquaculture or any other reason.

Introduced into Ugandan waters for fisheries reasons in the late 1950s and early 1960s this top predator has spread throughout Lake Victoria, which extends into three national territories – the United Republic of Tanzania, Uganda and Kenya (two other countries, Rwanda and Burundi, are in the lake's catchment area). Over the following five decades Nile perch has been at the centre of spectacular and controversial changes in the "environment' of the lake, of the lakeshore communities and of the wider national economies.

The introduction was of course not accompanied by an EIA or indeed any in-depth assessment of the risks, although there was "for and against' discussion mostly among technicians. The impacts of the introduction have been many and varied. Those considered "beneficial' include its contribution to the growth of the lake fishery from its 1950s level of about 100 000 tonnes to an estimated 1 000 000 tonnes in 2006 (LVFO, 2007), of which *Lates* contributed about 250 000 tonnes; *Lates* is bought by an important processing industry around the lake supplying export markets in Japan, Europe and the USA. "Negative impacts' include reduced biodiversity as the new predator decimated indigenous cichlids, driving some species to extinction, as well as impacts outside the lake such as increased demand for wood for smoking Nile perch leading to deforestation, population movements and even suggestions of contributing to the spread of HIV/AIDS. These are all issues that might be included in environmental risk assessment today. Although this was a deliberate introduction to found a fishery, the scenario is not greatly different from the consequences that might occur as the result of an introduced alien species escaping from aquaculture installations into the surrounding environment.

One not unexpected consequence of the success of Nile perch has been the population fluctuation of the fish fauna over time as the system became quite unstable. Even today experts are not in agreement over whether the lake is approaching stability or whether there will be further major fluctuations of the Nile perch or other species. The important lesson here is that it is difficult to predict with any certainty at all. How an EIA could satisfactorily resolve this uncertainty in relation to a new introduction is not evident.

All three riparian countries have now made EIAs mandatory before the introduction of an alien species into native ecosystems. This effectively applies to any such introductions for aquaculture, as any intentions to prevent escape from installations, however well planned, are likely to be utopian.

Katima (2000) suggests the Rufiji case indicates that to be effective the EIA regime will depend among other things on the following factors which were not in place in the United Republic of Tanzania (and probably not in most developing countries) leading to frustration on the part of environmental impact assessors, governmental advisors and the public at large:

- the government's political will;
- effective environmental legislation;
- institutional support;
- proper development objectives;
- trained personnel.

The debate surrounding these direct encounters with real environmental problems has contributed to a legislative momentum to address issues of impact of development following the publication of the National Environment Policy in 1997. The United

BOX 8

The role of EIA in the proposals for shrimp culture in Rufiji delta, The United Republic of Tanzania

The Rufiji delta on the Indian Ocean coast is the largest of a number of mangrove forest sites in the United Republic of Tanzania, covering 53 000 ha (reputedly the nursery grounds for up 80 percent of the United Republic of Tanzania's shrimp). Shrimp farming had been suggested since the 1980s and in 1995 a company put forward a proposal to build a very large shrimp farm of 6 000 ha on 10 000 ha of sites in the delta, which would include a feed mill, processing facilities and hatchery, as well as production ponds. The farm was export oriented and projected to produce annual foreign exchange earnings of 300–500 million US$, a persuasive argument in seeking government support. At the time the United Republic of Tanzania did not have formal EIA regulations, but the company conducted an EIA in 1996 using qualified external consultants. Once the EIA was completed, and its content made public, considerable opposition and controversy built up around the proposal, drawing from a number of issues – land tenure, mangrove deforestation, fisheries disruption and population displacement . While some of this opposition was informed by international NGOs aware of poor outcomes of shrimp culture in mangrove areas elsewhere, significant opposition came from affected populations in the Delta supported by local environmental NGOs (Lissu, 1999).

As a result the company was required to submit a more thorough EIA, which was completed in 1997. The government asked the National Environmental Management Council to coordinate an exhaustive review of the EIA report, which involved other ministries and consultants. This review of the EIA advised the government not to approve the project for a number of reasons, including the environmental impact on sensitive habitat, and social and economic impact on the existing population of the delta. The review also recommended that better legal frameworks were necessary before such a project could be considered, and that the delta should be subject to a land use master plan to help resolve conflicts. Despite this conclusion based on the review of the EIA, and submissions of other national institutions, the government went ahead and approved the project nevertheless. This created a very public debate in the media, and in 1998 the residents of the Rufiji delta filed suit in the Tanzanian High Court and eventually won an injunction to stop the implementation of the project. A number of observations can be made from this affair, and some important actions have resulted from it.

A significant issue is that of public participation and public information (Hambrey *et al.*, 1999). There was only superficial consultation in the early stages and once the public had more information the whole situation quickly changed. Clearly it would have been preferable if the populations who were going to be significantly affected had been involved early in the EIA process, when there may have been opportunities to elaborate strategies to get around some of the difficulties. One result has been that the delta population has gained a voice in the management of their own environment. At the same time throughout the United Republic of Tanzania there is now greater awareness of the issues of environment, EIA and the potential for public participation in environmental decisions (Nshala, 2001).

A good legal framework is required if the use of EIA is going to play an effective role in such major projects as this. Without it the decision-making process can be chaotic, especially if there is no provision for the qualified authority to take a binding decision and there is no formal appeal process. In this case, despite what turned out to be decisive objections, there was a political willingness to approve the project which is not surprising given the financial stakes involved and differing perceptions of national interest. It also highlights how oversight capacity is important to the implementation of environmental law, especially EIA. EIAs are carried out by the project promoters and it is not unexpected if they tend to favour the investors viewpoint, especially in the case of new unfamiliar activities such as aquaculture. In this case the EIA was done on the initiative of the promoter, partly as a justification of their initial plans and at least partly as a defensive exercise, as expressed by the project manager at the time: "to defend us from attacks from the environmental community" (Rosenberry, 2007).

Republic of Tanzania has now completed a comprehensive update of the overall legal setting, which effectively puts environmental concerns at the centre of any future development of aquaculture. This includes a new framework law (including details of obligations for public participation and clear decision making responsibilities) and regulations for EIA, backed up by guidelines for promoters and stakeholders.

Legal framework for environmental assessment

The 1983 Act does not mention EIA, which is a specific legally required process introduced in the 2004 Act. In between these two Acts of 1983 and 2004, the use of EIA was undertaken for some major projects involving external investment, partly motivated by the requirement of institutional investors themselves.

First in the National Environmental Action Plan of 1994, and then formally in the National Environment Policy (NEP) of 1997, EIA was given official backing as a key tool in national planning and decision-making in order to avoid unnecessary damage to the environment. The Marine Parks and Reserve Act, No 27 of 1994 also imposes tight restrictions on installations within some of the sensitive habitats that might attract investors in shrimp farming and other mariculture. It was at this stage of legislative evolution that EIA was used during the contentious proposals for shrimp farm development in the Rufiji Delta.

The 1983 Act has now been replaced by the Environmental Management Act 4/2004 (United Republic of Tanzania, 2004b), which is a very comprehensive law providing for the detailed management of all aspects of the interaction of human activity with the environment. As well as the usual articles detailing management obligations such as EIA or pollution control, this Act enshrines in very clear language a number of principles behind the articles of the law, for example "the precautionary principle" and the "polluter pays principle". The result is a comprehensive and potentially powerful legal tool bringing environmental concerns into most areas of national development. The 2004 Act includes provision for SEA which could be the basis for assessing planned initiatives for land use along the coast, including growth of aquaculture. In the case of aquaculture, the 2004 Act should be looked at in combination with another updated law, the Fisheries Act of 2003 (United Republic of Tanzania, 2003). This conforms to the aims of the National Environment Policy and the Environmental Management Act 2004, and enshrines policy positions on ecosystems, species diversity and EIA obligations, among others. As far as the Fisheries Act is concerned it appears that the articles are more concerned with controlling the impact of aquaculture on others, than they are at protecting the aquaculture sector's interests in the environment from negative impacts caused by other activities. This was perhaps a missed opportunity to demonstrate to stakeholders and investors a potential benefit to aquaculture from having environmental regulation.

Once the framework law of 2004 was passed the government was able to follow this up with the EIA and Audit Regulations of 2005 (United Republic of Tanzania, 2005). This body of regulation applies principally to the mainland and some of the islands. Zanzibar, which retains a degree of legal autonomy within the republic, has a distinct set of laws regulating the environment on the island (Majamba, 2005).

Following the enactment of the National Environmental Policy for Zanzibar in 1992 which already included the basis for EIA, the Environmental Management for Sustainable Development Act, 1996 introduced detailed rules for conducting environmental impact assessment process nine years before the mainland. Actual compliance has not been consistent (EAAIA, 2007) and EIA has not been used for any major aquaculture projects. One experimental fish farming project at Makoba included an EIA for the change in the land use from solar salt mining to fish and shellfish mariculture (Mmochi and Bhai, 2005). However Zanzibar will be attractive to investors in mariculture, and this activity would be included in the EIA process through the article:

"no licensing institution shall issue a license, permit, certificate, or other forms of approval for an activity which is likely to have a significant impact on the environment unless an EIA certificate has been issued for the activity."

The Zanzibar regulations provide for some interesting innovations for dispute resolution and enforcement of environmental regulations. A mechanism is provided for out-of-court settlement for resolving environmental disputes. Special environmental mediators can be officially appointed; they must be persons trained in alternative dispute resolution, have experience in environmental matters and be acceptable to the parties in dispute. According to Majamba (2005) this is likely to need far less resources than the setting up of a full environmental tribunal, something which is provided for in other national frameworks but which often do not operate properly for lack of resources. Should a dispute come to court, there is also a provision for the designation of a state attorney responsible for representing the interests of the public, as opposed to representing the state's interests as would be the usual situation.

EIA and aquaculture

The Tanzanian EIA regulations make the basic stipulation that if any *"project is likely to have significant adverse environmental impacts"* then it must undertake the full EIA process, while a lighter process called "Preliminary Environmental Assessment" (PEA) is required if the *"project is likely to have some significant adverse environmental impacts but that the magnitude of the impacts are not well-known"*. These regulations go on to specify in some detail certain activities that are liable to these two levels of environmental assessment. Aquaculture is specifically mentioned as follows:

Liable to EIA (first schedule):

4. Fisheries
   - artificial fisheries (aquaculture for fish, algae, crustaceans shrimps, lobster or crabs);
   - introduction of new species in waterbodies;
   - large scale fish farming including prawn farming;
   - introduction of genetically modified fish species and other aquatic species.

Small-scale activities that require registration and a PEA (may or may not require EIA):

- fish culture;
- seaweed farming.

There are, however, several other specified categories that overlap with aquaculture and make it even more likely that an EIA would be required for a large project:

- water resources development projects (dams, water supply, flood control, irrigation, drainage);
- intensive livestock rearing units;
- industrial fish processing and storage;
- canalization of water courses;
- diversion of normal flow of water.

The Fisheries Act 2003 aims to ensure "aquaculture development is ecologically sustainable and allows rational use of the resources shared between aquaculture and other activities" and specifically reinforces the requirement for EA (United Republic of Tanzania, 2003).

In the particular case of introduction and translocation of species, the regulations make a particularly strong statement by listing this issue under a total of *eight* headings as being liable to EIA, apparently indicating a clear reluctance to countenance such

initiatives (alien species four headings, new breeds/strains two headings and GMO two headings).

Concurrently with the development of these laws, authorities have also produced a number of detailed guidelines for proposals that might be subject to EIA (United Republic of Tanzania, 2004a). Although there are none yet published specifically for EIA and aquaculture, similar issues for aquaculture/mariculture are dealt with in some detail in guidelines for sectoral development published before the EIA regulations were finalized (Tanzania Coastal Management Partnership, 2001).

The fact that EIA has increasingly been employed for projects and programmes is a sign that environmental awareness has been improving amongst decision-makers, donors and the general public, and progress is being made in mainstreaming environmental concerns into decision-making (Assey *et al.*, 2007). Still, when it comes to effective public participation into the process there is much progress to be made to increase understanding among the general public and government decision makers (EAAIA, 2007).

Public participation, an issue that came to the fore in the Rufiji case, is an important part of the EIA regulations and it states that the "proponent shall in consultation with the Council, seek the views of any person who is or is likely to be affected by the project". He is expected to do this by publicizing the project proposal, holding meetings with the aid of an approved facilitator and recording the comments of the public to be attached to the EIS. Any person aggrieved by a decision approving or disapproving an EIA has the right to appeal to the Environmental Appeals Tribunal.

UGANDA

Background

Fish has always had a prominent position in Uganda, providing employment principally in the lake fisheries and supplying markets where fish is in demand as an important part of Ugandan food supply. Aquaculture has quite a long history in the country having been introduced during the 1950s, but it has remained a minor activity until renewed interest over the past years (FAO, 2006-2008. NASO Uganda). Currently there a number of new initiatives being implemented and further growth can be anticipated.

According to the Department of Fisheries there are two key species cultured in Uganda contributing over 90 percent of the total aquaculture production in the country. African catfish (*Clarias*) has overtaken Nile tilapia (*O. niloticus*) and is now the most common culture species in the country. However, with the efforts of the government to improve the infrastructure for export of fish products to premium markets and investors" interest in tapping this market, it is possible that Nile tilapia will overtake African catfish in a few years, given its international market position.

Traditionally, most aquaculture has been carried out using extensive and semi-intensive methods in small rural ponds. Today there are an estimated 20 000 ponds in Uganda, with an average size of 500 m^2 producing between 1 500 kg/ha/year and 15 000 kg/ha/year. Recently, some of these farmers have been encouraged to improve their methods and there are now about 200 classified as "emerging commercial farmers" producing up to 15 000 kg/ha/year by incorporating improvements in the quality of fish seed and feed. In addition there is now a prospect of significant growth in production with a number of proposals for large farms from industrial/commercial investors attracted by the favourable conditions/resources and the established fish-exporting infrastructure. Overall, this confirms a trend towards greater intensification of aquaculture in Uganda, and if the methods traditionally used have caused no environmental concerns, it must be expected that this will change and that new intensive methods, such as farming in cages in Lake Victoria, will in future raise significant questions.

The fisheries sector provides the backdrop to one of Uganda's highest profile debates over the environmental issues, following the introduction of Nile perch into Lake Victoria (see Box 5). Certainly, this debate has contributed to heightening Uganda's awareness of environmental issues and is a warning of the potential (for both good and bad) of causing major disruption as the result of an (apparently) minor development decision. Media, environmental NGOs, national and local politicians have a much greater engagement with environmental issues than in most countries in Africa, as is demonstrated by popular debate over issues such as converting forest land for sugar and oil palm production and use of plastic packaging that are currently going on. The heightened concerns of civil society are reflected in the introduction of a comprehensive new legal framework and the institutional initiatives of the past ten years.

Legal framework for environmental assessment

The current framework for environmental management came into existence with the Environmental Management Act of 1995, which at the same time created the National Environmental Management Authority (NEMA) an institution with responsibility for coordinating environmental interventions in Uganda. Subsequent statutes have been passed to complete the framework with the necessary tools, including the use of EIA:

- The Environmental Management Act (Uganda, 1995/2000);
- The Environmental Impact Assessment Regulations (Uganda, 1998);
- The National Environment (Conduct and Certification of Environment Practitioners) Regulations 2003;
- The Aquaculture Rules 2003.

Other policies and guidelines have been issued as part of the overall management framework in Uganda:

- Environmental Impact Assessment Public Hearings (Uganda, 1999);
- The National Biodiversity Strategy and Action Plan (NEMA, 2002).

Also, there are guidelines concerning "Environmental Economics", "Environment Audits", "Environmental Management at Local Government Level", "Environmental Indicators for Uganda" and an "Environmental Audit Manual for the fish processing sector in Uganda". Guidelines for aquaculture are under study.

Liability of aquaculture to EIA

Projects are initially screened into three major categories to determine their liability to the process, on the basis of a project brief:

a. Small-scale projects whose potential adverse environmental impacts can easily be identified and for which mitigation measures can readily be prescribed; these would normally be approved on the basis of the identified mitigation measures without the need for a detailed environmental impact study requiring field investigations.
b. Projects for which there is some level of uncertainty on the nature and level of impacts, thus requiring a more in-depth environmental impact review, which provides the information to determine whether or not a full EIA is required.
c. Projects which clearly will have significant impacts whose mitigation measures cannot readily be prescribed unless a detailed environmental impact study of the project and its possible alternatives is conducted.

In the original text of the Act, there is no mention of how exactly aquaculture projects should be assessed for their liability to submit an EIA before they start. It is assumed that subsistence aquaculture would not require any approvals of this kind. This is partially clarified in the aquaculture rules, which define intensive and "large-scale semi-intensive" farms as being required to seek environmental approval from NEMA. The triggers for this decision were originally set at 4 000 m^2 and/or three fish/m^2, but

these criteria are under review. EIA is however mandatory for "storage dams, barrages and weirs" as well as "introduction of new crops and animals" – both likely scenarios for some aquaculture proposals.

If the project brief is not considered adequate, a full environmental impact study is required, following which an EIS is submitted to NEMA for review. If the final judgement of the review is favourable, a Certificate of Approval is issued along with the recommendations for subsequent monitoring.

Challenge of developing the human resources for EA

Authorities in Uganda have been unusually proactive in the steps taken to address the problems of improving the institutional capacity for environmental management and of acquiring the human resources necessary to implement the environmental regulations. Internal training is carried out by NEMA alongside training for personnel involved in environmental management in partner institutions such as local councils, government ministries and departments and selected NGOs.

The Makerere University Institute of Environment and Natural Resources offers post-graduate diploma courses in EIA and environmental information management (EIM) targeted at environmental practitioners and public sector professionals. Nevertheless there is still a need to increase the capacity of staff available to institutions and the consultancy sector and to improve the quality of EIAs being carried out (Ecaat, 2004). Considerable progress has been made in recruiting district environment officers and providing subsequent training on EIA and this has helped local government capacity to contribute to EIA reviews (IUCN *et al.*, 2007).

The private sector has also improved its organization. The increase in the demand for EIA professionals initially brought with it a problem of inexperienced practitioners, which prompted NEMA to enact new regulations[10] and create a database of Registered and Certified Environmental Practitioners (NEMA, 2008) which is maintained and published for the benefit of developers who are obliged to carry out EIAs.

Environmental practitioners themselves have created the Ugandan Association for Impact Assessment (UAIA) founded in 2001 to represent their profession. It is also potentially significant that producers are getting more organised, and have formed the Uganda Commercial Fish Farmers Association, which as a professional organization could be used to improve farmers" engagement with the EIA process.

Public participation in the EIA process

Environmental awareness in Uganda, both in government and civil society, is as well developed as anywhere in Africa and has been witnessed in recent years in the lively debates around a variety of environmental issues. EIA is quite a familiar term and can be a "hot" subject in the media. Although the Ugandan EIA system has provided the opportunity for public participation, there remains the challenge of ensuring that the public, beyond some NGOs and active individuals, take full advantage of the opportunity that is afforded to them (Ecaat, 2004).

The regulations (Uganda, 1998) make it necessary during an EIA for the public to be systematically associated with the decision-making process at three main stages:

1. In preparing the environmental impact study, the developer must:
   - publicize the proposal in the media;
   - within 14 days hold public meetings with affected communities;
   - hold meetings at convenient times and places in agreement with local councils.
2. The NEMA should invite comments on the EIS:

[10] National Environment (Conduct and Certification of Environmental Practitioners) Regulations of 2003

- by publishing an invitation for written comments from the public (the invitation should make clear the nature and location of the project, the anticipated positive and negative impacts and possible mitigation measures);
- by requesting comments directly from individuals and institutions most likely to be affected by the proposal.

3. The NEMA should call for a public hearing where it is required in the interests of a fair and just decision, or necessary for the protection of the environment and promotion of good governance.

Effectiveness

The willingness to legislate and impose a procedure like EIA brings with it the risk of making entry to the aquaculture sector unnecessarily difficult. Observers have noted that the number of different permits that can be required by a fish farmer is becoming excessive (DTIS, 2006a). The 2003 aquaculture rules attempt to establish the regulatory framework for aquaculture. The rules impose permits for different aquaculture related activities: semi-intensive and intensive aquaculture, fry production and marketing and for domestic movement of cultured fish. In some respects, the existing aquaculture rules are too onerous; in others they do not address key requirements. The rules also restrict import of live fish, use of genetically modified fish and require certification of aquaculture inputs including feeds, fertilisers and veterinary compounds (DTIS, 2006b). The approval and permit requirements of the rules would be on top of an EIA, although an EIA alone might be sufficient as the latter would anyway have to verify that a farm is operating correctly under national statutes and rules.

NEMA as an independent agency has had difficulties coordinating environmental interventions in a climate of intersectoral "competition", and has been perceived as intervening on an ad hoc basis motivated by political agenda. In response NEMA has experimented with environmental units within the key sectoral institutions, in a programme for creating environmental liaison units (ELUs) (PADELIA, 2002). These units have had mixed success. Also with the objective of decentralising the environmental function, NEMA have trained district environmental officers, who are employed by local government, and are responsible for overseeing local environmental activities including EIA.

With respect to sustainable aquaculture development, it has been suggested that the government should undertake a GIS based exercise for aquaculture, mapping environmental and natural resource parameters among other things, and use the data collected to designate "aquaculture development zones" in areas that can meet suitable environmental criteria for aquaculture (climate, water supply characteristics, soil conditions, production technology – both ponds and cages), as provided for in the provisional Fisheries Sector Strategy Plan. This could be seen as an opportunity to apply the principles of SEA to the promotion of sustainable aquaculture. Aquaculture development zones would become the focus of rural infrastructure development (roads, electricity, supply canals), and could be subject to generic environmental impact assessments, thus facilitating small and medium scale investments in suitable areas (DTIS, 2006a).

Options for greater efficacy of EIA when used for aquaculture in Africa?

Although the quantitative lack of EIA studies in aquaculture in Africa is due in large part to the low level of large scale aquaculture operations on the continent, it is widely expected that the coming decades will see greatly accelerated growth. This growth will bring with it increased risk of major negative environmental impact, and the national provisions for EIA will become more and more relevant to both farmers and government. There is an opportunity in the next few years to sharpen the EIA process to make it cost effective and well adapted to local environments and capacities, and at the same time guide the whole sector towards the best possible practice relative to the environment.

The continent is large and varied and there will be few "one size fits all" solutions to the problems of EIA use in aquaculture. This variety can be seen at many different levels, most of them needing their own adapted solutions, and includes differences:

- between major regions, watersheds, climate zones;
- between countries at different stages of economic or political development;
- between landlocked and coastal states;
- between water-blessed and arid areas.

Finding these solutions is a "work in progress", and it can be seen in those countries with the greatest commitment to EIA that regulations are evolving with a distinct local flavour. From the starting point of a basic "imported" concept, and generalized framework environmental laws, these countries have developed the process through detailed statutes, regulations and guidelines which have been added to the basic framework.

HAS EIA BEEN EFFECTIVE SO FAR?

It is a fact that use of EIA in aquaculture has been limited to a small number of projects in just a few countries in Africa, and so it is not possible to come to sweeping conclusions about the effectiveness of the process in achieving its overall objectives. Beyond aquaculture, EA is evolving rapidly with changes in attitude and elaboration of policies and legal frameworks. Reviews of the general effectiveness of EIA in Africa however have raised a number of points (IUCN *et al.*, 2007):

- institutional and regulatory frameworks established in many countries;
- number of EIA applications increasing;
- increased inter-agency collaboration;
- administration/regulation remains too centralised;
- regional professional networks increasingly being formed;
- quality and review systems hampered by inadequate capacity;
- public participation increasing, but inadequate;
- influence of EIA on decisions still not significant;
- some countries conducting SEAs;
- institutionalization still slow;
- political will and support still to materialize in many countries.

Nevertheless the experiences so far do give some insight not only into the quality of the EIA exercise itself, but also the effect the introduction of the EIA regulations has had on the sector in general.

Probably the most noticeable contribution has been to focus the minds of farmers, investors, fisheries staff and the general public on the important issues of environmental quality and management. Of course it is not EIA on its own that has improved this awareness of the issues, but the combination of many elements – government policy, creation of new laws and institutions, general public awareness, media messages, NGOs and public campaigns. EIA, as a legal obligation, is the innovation that requires action (and expense) and gives it a higher profile.

Changing perceptions about EIA

Undoubtedly the first reaction of farmers to the introduction of EA will often be negative, in reaction to what will be perceived as a supplementary and unnecessary additional piece of "interference". As it is a legal obligation, this reaction is not surprising, especially when the local implementation of the process emphasizes aspects of control and interference by public authorities.

The challenge is to emphasize the positive contribution that a careful approach to environmental interactions can make to aquaculture, to the benefit of all concerned and in particular to the farmers, producers and investors involved. EIA and environmental monitoring need to be promoted as a tool to achieve better standards of practice, with medium and long-term benefits for sustainability and business profitability as well as wider aspects of national well-being. There should be little to fear in the process.

Pioneers and EIA

Most commercial aquaculture investors at the moment are "pioneers" in the African context and this amplifies to some extent the complexity of EIA. For the "pioneers" there are few if any precedents which can provide guidance, which may in itself be discouraging at least to any investors averse to risk. There is a paucity of easily accessible technical and environmental knowledge, which makes the studies more challenging and probably more costly as the studies carried out will effectively be carrying out original research.

ARE EIA LAWS AND LEGAL FRAMEWORKS ADAPTED TO AQUACULTURE/ AFRICA?

It has been suggested above that the environmental legal frameworks introduced by African countries have to some extent been modelled on statutes and procedures from outside the region. This raises the question on the rate of adaptation of these models to the situation in different countries in Africa.

Extent of legislation, EIA obligations

Box 2 and Table 2 above give a summary of the statistics concerning the legislation surrounding EIA in 54 countries and territories in Africa.

Almost all African countries, anglophone, francophone and lusophone – now have framework environment law. They are quite varied in the details, although for historical reasons there are clear resemblances in the laws within each language group. The countries still without modern environmental laws are mostly those undergoing, or coming out of, periods of extreme political upheaval.

Three quarters of all countries have published specific EIA regulations. In all of these countries aquaculture could be liable to assessment and an investor should be aware of this possibility and include it in their plans. Half of all these EIA regulations make explicit mention of aquaculture, which must therefore satisfy at least a preliminary review that determines whether or not there is potential for significant impact. Considering that many aquaculture initiatives in Africa are at a small-scale, the threshold at which EIA becomes mandatory for aquaculture is significant. In fact this threshold is extremely variable. In some countries it applies in theory to all aquaculture

projects irrespective of size (examples: Ghana, Liberia, Namibia, Seychelles), but in other cases EIA is only mandatory above a certain size (examples: Mozambique if area over 5 ha; Zambia if production over 100 tonnes/year; Malawi if water capacity over 100 m^3). In one case, Algeria, aquaculture is specifically excluded entirely from the EIA regulations (in favour of other regulations).

One very important component of many of the EIA regulations is the definition of a two tier environmental assessment, whereby some activities are exempted from conducting a full EIA study, but are submitted to a lighter less comprehensive process instead. This has various titles: e.g. basic assessment, preliminary assessment, project brief, environmental impact notice. In some countries aquaculture is generally only included in the lower tier (example: South Africa – basic assessment for aquaculture, and only if production over 10 tonnes/year). In other examples, two thresholds are defined for aquaculture (example: Togo – "simplified EIA "under 300 ha, and "in-depth EIA" over 300 ha, or Madagascar – "PREE" for semi-intensive aquaculture, "EIA" for intensive aquaculture).

There are three other important concerns that show a great deal of variation between country regulations:

- obligations for the public to be informed, consulted or given the opportunity to participate;
- cost recovery by the national authority in the form of fees;
- access to the information provided in EIAs.

From all this detailed information it is clear that aquaculture is now subject to extensive obligations under EIA regulations right across the continent. To some extent this is a situation that the sector itself has yet to fully take on board, and aquaculture departments will need to adapt to it as the national environmental authorities gain experience and move to more effective compliance.

Adapting EIA processes to the small-scale farmer

The language of the statutes and in many cases the detailed obligations involved in acquiring the various "environmental" approvals would seem to be particularly daunting for a small-scale farmer or business. As indicated above and in Table 2, some legislation specifically excludes small installations, while others theoretically include all sizes within the scope of EIA. The tendency of some frameworks to insist on "polluter pays" principles could also be a potential obstacle for poorer categories of farmer, particularly if environmental advice is not made available as a public service.

Three reasons can be advanced for including the small-scale farmer to some degree in environmental assessment processes. Firstly, there is always a potential for an aggregation of small farmers to collectively create unexpected environmental impact. Secondly, this category of farmer would benefit from some formal protection from negative impacts on their resources as a result of other external activities. Thirdly, environmental issues are often a key part of the message working towards "best aquaculture practice" (for example in sustaining good water quality). Some support to small-scale farmers can be provided as part of institutional outreach activities, possibly in the form of a simple checklist approach, which informs the farmer/extension personnel of the best management options for aquaculture and draws attention to acceptable or unacceptable practices.

Multiple or overlapping legislation governing aquaculture

The legislation governing aquaculture is dispersed among a number of sectoral laws in most countries, very few countries having specific aquaculture legislation to cover all requirements. These include such sectors as fisheries, agriculture, forestry, environment, water and land to name just the principal sectors involved. This has two potential consequences to note.

Environment, a relatively "young" sector, can encounter difficulties in the efficient implementation of its EIA regulations when it is seen as a junior partner by more "senior" departments or ministries. Mainstreaming environmental concerns across public institutions, including for instance aquaculture or fisheries departments, make the regulations easier to apply consistently.

The other consequence of multiple legislation is that in order to comply with all the requirements, proponents of aquaculture have to acquire a number of permits and authorizations, each of which demands expense, time and effort. This is the case for example for farmers in South Africa and Egypt, where long established land and water management institutions retain effective control of their sectors, including interaction with aquaculture.

Single window or one-stop-shop approach

The idea of a single window approach to gaining regulatory approval for an aquaculture investment is an attractive one (Percy and Hishamunda, 2001) but not necessarily simple to achieve unless cooperation can overcome competition between relevant authorities. It is of interest however, that farmers surveyed in South Africa thought the better solution would be to improve the efficiency of the current institutions rather than attempt to create a new one-stop structure.

Dynamic approach to hard/soft law

Both the environment and aquaculture sectors in Africa are expected to evolve quickly over the coming years, so it is important that initial versions of these regulations do not become "set in stone". There should be opportunities for the aquaculture sector and the environment institutions and stakeholders to review whether current rules are really appropriate, and to revise them later in the light of mutual experiences.

Guidelines are often published to assist in understanding, interpreting and implementing the formal regulations. It is common to have general guidelines for the interpretation of the EIA regulations, which are legal texts that are not always easy to comprehend. Some countries provide sectoral guidance to aid project proponents to prepare and present the various documents that are required over the length of the assessment cycle. South Africa, in particular has produced a wide range of guidelines covering a variety of situations. Three countries – Seychelles, South Africa, Madagascar – have published specific guidance documents for aquaculture which are aimed at assisting aquaculture investors to interpret the EA laws; other countries have similar guidelines in preparation. The African Development Bank also has guidelines for aquaculture which are combined with capture fisheries, as part of the forestry guidelines (AfDB, 2003).

Guidelines, however, are not always seen as the answer, and run the risk of leading to a mechanistic and rigid approach to carrying out an EIA, when a freer more intuitive and pragmatic approach to individual projects might lead to better assessment of impact and real risk in a complex environment (Spooner, 1998).

STAGES OF A STANDARD EIA PROCESS

National regulations specify the procedures for conducting an EIA. These are expressed as a number of distinct steps generally similar to the generic outline for the EIA process (see generalized EIA process flow chart in Appendix 3 of this publication). There are many minor variations and vocabulary differences but the principles are broadly similar.

Screening

This is the stage at which applications are filtered by the environmental authority and a decision is made on whether or not a particular project is liable to carry out an EIA.

A project can also be rejected at this point as environmentally unsustainable. It is an important stage, and in the context of aquaculture there are choices to be considered over the liability of small-scale farmers, farm intensification and the risks of eventual impacts. The decisions taken can be decisive for the future of a proposal including the eventual cost to the investor, should extensive studies be required by the agency.

Half of the national regulations of the African countries studied specify some of the criteria to be used in screening aquaculture projects (see Box 2 and Table 2 above). In the other cases aquaculture would be screened as potentially an activity that requires an EIA "if the project would have significant (unspecified) impact". The specified screening criteria in a few cases makes EIA mandatory for all aquaculture, but in most cases there is a minimum threshold defined by physical size or production output. Only in one country is all aquaculture excluded from the EIA regulations. A possible difficulty with a number of the regulations is that they are worded in an inclusive way, with no clear way of dealing with the very small-scale farmer, such as those with a fish pond or small-scale seaweed culture rack. Some situations like this require that the supervising authority be able to apply pragmatic decisions, exempting low risk proposals at screening.

Some of the regulatory procedures have a feature that seems to adapt well to the situation for African aquaculture. This is a two speed assessment, with a third option of total exemption. The applications which carry the most risk (large scale, most intensive culture methods or location in a sensitive area) are liable to a full in-depth EIA. The smallest farm ponds would be exempted, while in between these are small-scale enterprises that would have to undergo a limited assessment before being given environmental approval. The aim of this option is to verify that the applicant has already made an effort in the project planning to integrate environmental concerns into the siting and methods to be used. These reduced requirements go under various names, which indicate some of the philosophical differences between them. Ghana can request a "Preliminary Environmental Report" (sometimes referred to as a PEA), which can lead to approval and the issue of an environmental permit without recourse to a full EIA (Ghana, 1999). Madagascar requires that all aquaculture projects prepare at least a PREE, which can be sufficient for approval without EIA (O.N.E., 2006b). The PREE consists of a "commitment by the project promoter to take certain measures to reduce the impact of his activity on the environment, as well as measures to eventually rehabilitate the project site" (Madagascar, 2004).

This two-speed approach can recognize that many aquaculture producers do not cause significant negative impacts, and can avoid imposing the cost and effort required by EIA where it is not essential. It will also be effective in "educating" all applicants to introduce environmental concerns into the planning phase of their projects.

Scoping

If screening identifies the need for EIA, most national procedures undertake "scoping" often with interaction between the promoter and the environmental agency, or even other stakeholders (see Box 9). The scoping process identifies the issues that are likely to be of most importance during the EIA and eliminates those that are of little concern. In this way, EIA studies are focused on the significant effects so that time and money are not wasted on unnecessary attention to minor impacts. Once the scoping is completed, terms of reference for the EIA studies are agreed upon. Public consultation is best initiated at this stage so that the concerns and priorities of the local communities are taken on board as early as possible.

EIA studies: investigations and evaluation of potential impacts identified in the terms of reference

This stage forms the heart of the EIA process and involves a detailed assessment and analysis of all the important potential impacts identified during the scoping stage. The

BOX 9

Approaches for assessing the significance of impacts

Impacts can be grouped into two categories, depending on how their significance is assessed:

1. Impacts for which there are published standard criteria, regulations or for which levels of acceptability have been determined. Few countries have published clear criteria for acceptable environmental impact (Environmental Quality Objectives - EQOs); research is urgently needed in most African situations to address this issue.
2. Impacts for which the assessment has to be based on the qualitative judgment of various stakeholders:
   (i) opinions of qualified decision makers in municipalities, or ministerial departments based on the government's national and sectoral development policies;
   (ii) opinions of specialists (e.g. environmentalists, ecologists, hydrologists, geographers, agronomists, sociologists, urban planners);
   (iii) past documented experience of similar projects;
   (iv) surveys of public opinion as to acceptability of impacts.

studies are normally the responsibility of the farmer/promoter and he may often hire specialists especially for the larger projects. In fact in some cases, such as South Africa, the regulations state that independent approved consultants must be used. The end product is an EIA report (or Environmental Impact Statement (EIS) which forms the basis for institutional review and the decisions on the final approval for the project.

Identification and prediction of the magnitude of eventual impacts needs to be undertaken against an environmental baseline, and where this baseline information does not already exist, the necessary data must be obtained as part of the EIA. It is also necessary to determine the acceptable level of impact of the new activity. For technical parameters these can be published by the national agency, for instance for water quality (e.g. Biological Oxygen Demand (BOD) in water effluent, chemical pollutant concentrations) or water consumption. These standards have yet to be determined in most African countries. As a short-term measure some environmental standards may be adopted from developed nations or even international banks, although this is not ideal (Wood, 2003), provided careful consideration is given to their suitability for application in Africa. Factors such as climate, ecology, population density and social demands are all likely to vary from country to country and region to region and will influence the level at which the thresholds are set. Gauging the acceptable levels of impact for those things that require qualitative judgement should be done at both local and national level, and requires experience and meaningful stakeholder consultation.

Given the limited experience of commercial aquaculture, many EIA studies will have to obtain original data and information. Accumulating a national database (of non-commercially sensitive) information from these studies and keeping it accessible in the public domain is essential to improving the process and to promoting aquaculture development in Africa.

Consideration of alternatives

A comprehensive EIA is required to assess the relative environmental costs and benefits in making choices between say aquaculture, and other alternative uses of resources. Equally, consideration should be given to alternative aquaculture methods and technologies to be used by the project, and/or alternative sites, with a view to identifying those which can mitigate some of the potential impact. Local community

preferences will play a part in some of these decisions and as a consequence are likely to be subject to various social and political influences.

Consideration of alternatives, as well as the identification of mitigation measures, is a process that starts at the screening of the project and intensifies until the production of the environment impact report and could even be raised again after a period of environmental monitoring.

Mitigation planning

One of the key aspects of the EIA process, recognising that impacts will inevitably occur, is the identification of ways of reducing eventual negative consequences of introducing a new activity. These mitigation measures may take many forms, from changes to infrastructure design, specification of certain management measures, monitoring/feedback programmes with the involvement of public institutions and permanent community consultation. EIA obliges the promoter to include this reflection before approval can be given. There is no reason to conclude that this will necessarily lead to higher costs, rather it should improve general sector practice.

As the aquaculture sector (both public and private elements) becomes more experienced, some of the mitigation measures initially adopted as the result of EIA studies and monitoring for some pioneering projects, will be adopted by future projects and successfully integrated early in the project cycle before the screening process. This will reduce the amount of work needed for an EIA and consequently reduce the cost of the study.

Final approval process

This stage depends on the individual arrangements of each country system, and usually there are appeals procedures associated with it. It needs to be transparent and open to public scrutiny by all stakeholders, public and private. The review has to be conducted by technically competent officers, or there will be a risk that the approval process becomes reduced to a bureaucratic rubber-stamp exercise for a fee.

Public participation in EIA process

This is a challenging facet of environmental assessment in Africa. Public participation in project decisions is not an exercise that is commonly used and government and national agencies are more accustomed to a top-down approach to decision-making. While this may be appropriate for the more technical impacts that confront a project and the environmental agency, there are many other impacts that may occur and involve others, and which may not have been considered previously before the use of EIA. Those who may be affected, generally called "stakeholders" or "the public" in the regulations, include other businesses – such as suppliers to aquaculture – upstream and downstream activities even distant from the project, local communities, other sectoral authorities responsible for health and education provision and infrastructure providers, as well as various economic factors at a national level. While there are decentralised government institutions, such as rural councils, which provide local representation, it is a fact in many parts of Africa that, regardless of their legal status, it is traditional frameworks that play a major role in many decisions for local communities, and these include key aspects for aquaculture such as land access and use, water access and rights of way. African communities are not homogeneous and have their own various ways of engaging citizens in decision-making. Finding inclusive ways of carrying out public consultation should be a priority where large scale projects are proposed (Motsamai, 2003).

Monitoring

The final phase of a full EIA is the follow-up provided by the farmer and the appropriate institutions, to ensure compliance and to detect any impacts that might

arise later. In view of the early stage of development of African aquaculture, and that there is often a lack of hard data from the region, this is probably the most important phase of EIA in the short-term.

EIA as a single compliance event is of limited use unless it is combined with sustained monitoring. Normally EIA regulations require the promoter to prepare an environmental management plan (EMP) that is reviewed as part of the EIA report before project approval is given. In fact the two steps of EIA and monitoring are inseparable, and insofar as we are not often sure of the extent of future impact of aquaculture – impacts which can be long term and not immediate – monitoring is really even more important. It is the monitoring that can indicate whether or not the original decisions made during the EIA are having the expected results, and it is essential to feed back potential improvements into the screening and scoping stages as well as improving the search for mitigation solutions.

All EIA regulations appear to require the use of EMPs or something similar, although not all give any details on how monitoring should be carried out, by whom and with what frequency. Most reviews of EIA in Africa identify this stage as weakness in the system, primarily because the environmental agencies do not, or are not able to provide the necessary follow up to ensure that the EMP is being carried out, nor to appraise the results of the monitoring. Most of the monitoring activities are expected to be carried out by the producers themselves, but there are other parameters affecting the wider environment and various national interests that will need input from the environmental agency or other public sector institutions.

Essentially, this weakness in professional capacity seems to be linked to the availability of resources (CLEAA, 2007b; IUCN *et al.*, 2007), as well as to political will and commitment. Capacity within the main environmental agencies is already generally considered inadequate to administer, guide and review the basic EIA process, so there is little capacity left to carry out one of the most difficult tasks, to monitor and follow up EMPs.

However, in this situation of constraint on resources, some special priority should be given to the monitoring phase of EIA. Given that most of the aquaculture methods used presently in Africa do not present a significant risk of long-term environmental harm, more will be achieved by allowing acceptable projects to go ahead, while insisting on a comprehensive monitoring of the project's interaction with the environment. Data and measurement should be part of this, and the fisheries/environmental/private sector institutions should work together to assemble databases of relevant information with widespread access. This information is needed to inform EIA related decisions and is knowledge that will contribute to making aquaculture projects more sustainable and profitable.

ROLE OF EIA IN AQUACULTURE DEVELOPMENT IN AFRICA

Building an industry with positive engagement with environmental concerns

Control or education

EIAs could be said to have two roles – legal enforcement and education.

The legal role is quite straight forward: to ensure that development projects such as a shrimp farm, a road or a new open cast mine comply with standards that aim to minimize impacts on the environment throughout their entire "lifecycle" – i.e. during design, construction, operation, maintenance and demolition. For many of these categories of development, it is a focus on mitigation of the expected inevitable negative impacts that they will cause.

The educational role is equally important – and should really precede the enforcement role – and aims to raise the awareness of everyone involved of the potential for impacts of any development that will eventually and cumulatively affect

the surrounding environment. The EIA process is designed to introduce opportunities early in project planning phases to consider choices and make decisions that will simply avoid the environmental pitfalls that might otherwise have occurred. This role of informing/educating the principal actors is of particular importance to aquaculture in Africa, because the opportunity is there, at this early stage in the growth of this sector, to develop the industry in an environmentally responsible manner, avoiding some of the setbacks that have been encountered in the past elsewhere. Some of these setbacks occurred through ignorance, but there is now a lot more knowledge about "best practice" options, such as those promoted by the Consortium on shrimp farming and the environment (FAO/NACA/UNEP/WB/WWF, 2006).

Given that resources are generally stretched in Africa, and that creating the institutional capacity to implement the EA regulations effectively presents a challenge, there is an argument in aquaculture for consciously allocating resources to this "educational" role as a priority. This would be about providing information to farmers about "best practice", but also going further and acquiring knowledge of potential impacts relevant to aquaculture and the sustainable options that could be made available to avoid or mitigate these. The sector should set itself ambitious objectives to develop environmentally favourable management options, providing farmers with the information to avoid or mitigate some of the industry's more intractable problems such the reliance on (imported) fish meal in fish feed.

Success in integrating "environmentally sustainable thinking" into sectoral and individual planning of aquaculture developments should lead to EIA processes becoming less onerous for the investor who is able to meet most standards at the screening stage of the process.

Added value from EIA: virtues of the best environmental credentials

A strong argument for gaining the support of farmers and investors for investing in the environmental dimension of operating an aquaculture business is the prospect of adding value by so doing. Even if the benefits would mostly only be felt in the long term, these could include more sustainable enterprises, with reduced risks of failure in the medium to long term.

A more immediate motive can come from access to premium markets that favour environmentally-friendly production methods and the price advantage these markets can offer. That African aquaculture can tap into these has been amply demonstrated by producers of shrimp, abalone and tilapia in Madagascar, Mozambique, South Africa and Zimbabwe.

Adherence to EIA and wider EA principles is a means of demonstrating high standards to potential customers. There is no reason why these qualities should not be recognized by domestic markets as well as the export markets that are the primary focus today. Furthermore, it is not an unreasonable objective to aim for virtually all aquaculture in Africa to be kept within the limits of international standards for certifiable aquaculture. The major local markets for fish will be urban and it can only be an advantage to have a positive image to project, and this would compare well with the widely held disparaging popular opinions of intensive poultry rearing, for instance.

Individual producers or groups of producers can go further and capture important niche markets by using ecocertification or eco-labelling schemes, similar to that being pioneered in Madagascar for *P. monodon* production with the support of the WWF and the Consortium on shrimp farming and the environment. This approach may be quite costly and not easy to achieve, but rewarding over the medium term.

STRETCHING BOUNDARIES OF EA FOR AQUACULTURE

Defining the boundaries for EIA

Since the advent of EIA as a project-level assessment, there has been a progressively more widely held conviction that the interactions between an activity like aquaculture and its environment go much further than the production site. This has seen the extension of impact concerns further out into the natural ecosystem and into the social and economic spheres. EAA (Ecosystem Approach to Aquaculture) is an alternative system boundary for analysing a sustainable aquaculture production sector (FAO, 2006; Soto, Aguilar-Manjarrez and Hishamunda, 2008).

One of the extensions to the boundary that needs to be considered for EIA is the inclusion of the additional impacts that will be generated not by the aquaculture producer itself, but the other businesses that grow to supply a producer or more likely a number of producers making up a successful aquaculture sector. These cumulative impacts could be substantial in the case of aquaculture becoming particularly successful in an area, despite the environmental performance of individual producers being quite acceptable as measured by project-level EIAs.

Perhaps the most intractable example of these "distant" impacts is that of the feed required for intensive aquaculture production. In many commercial systems large quantities of fish feed are required, including fish meal, which may have to be imported. There is of course potentially a significant impact at the site of production of the feed ingredients that may be outside of the producers' ecosystem, country or even continent, plus any long distance transport impact. At present EIA cannot really deal with these issues, although local feed production could be easier to include. One study made an estimation of the "ecological footprint" of tilapia cage culture on Lake Kariba (Berg *et al.*, 1996). Assuming that all the requirements were sourced locally including the fishmeal (based on kapenta), this study suggested that each 1 m^2 of cage production would be needed to be supported by the capacity of about 20 000 m^2 of lake surface. While these figures should be treated with care as they contain many assumptions and do not refer to real impact measurements, they do illustrate the scale of the problem that might occur. In Africa, as elsewhere, this puts the spotlight on the real impact of intensive aquaculture beyond the project site, bringing up both potential positives (agricultural opportunities, jobs) and potential negatives (agriculture market disruption, exceeding land production capacity).

Including assessment of these more extensive parameters is not practical in most cases for a project-level EIA with its limited objectives and short timescale. One option available is to use a wider perspective and employ a process called Strategic Environmental Assessment (SEA). This process is capable of seeing a "bigger" picture beyond individual projects and is a tool for including environmental considerations into policies, plans and programmes at the earliest stages of decision making, and which within certain limits could be a useful complement to environmental assessment in the context of aquaculture development.

Greater use of broad application of EA principles, such as SEA

Stategic Environmental Assessment or SEA could have a role to play in African aquaculture development, both at the level of preparation of sectoral policies as well as acquiring environmental data that would assist in project-level assessment. Some of the characteristics of SEA as compared with EIA are presented in Table 7, alongside suggestions of how this might apply to the aquaculture sector in Africa.

The main advantages are two-fold. Firstly, it would contribute to moving the whole sector forwards on a sound environmental level by improving strategy and sector policies that at present do not include sufficient attention to environmental impact (to satisfy even new national regulations). A strategic study is able to pro-actively identify

TABLE 7
Opportunity for use of Strategic Environmental Assessment for the aquaculture sector in Africa

EIA	SEA	Aquaculture SEA
Is usually reactive to a development proposal	Is pro-active and informs development proposals.	Looks ahead as aquaculture develops from a low initial level.
Assesses the effect of a proposed development on the environment.	Assesses the effect of a policy, plan or programme on the environment, or the effect of the environment on development needs and opportunities.	Ambitious policies for aquaculture need to be better informed of the risks and benefits attached to different options, and SEA could provide the data that is missing.
Addresses a specific project.	Addresses areas, regions or sectors of development.	Addresses countries, regions, waterbodies, catchments, wetlands, estuaries, mangroves, coastlines zonation of activities; estimates ecosystem carrying capacities;
Has a well-defined beginning and end.	Is a continuing process aimed at providing information at the right time.	Aquaculture is developing fast; attitudes and knowledge will change with time, and national strategies need to keep pace.
Assesses direct impacts and benefits.	Assesses cumulative impacts and identifies implications and issues for sustainable development	Provide baseline assessment for the sustainable growth of both commercial and small-scale producers. Aggregated impacts from concentrations of small operations needs management, especially out-grower schemes. Identifies cooperative solutions with other sectors competing for the same resources.
Focuses on the mitigation of impacts.	Focuses on maintaining a chosen level of environmental quality.	Environmental quality is high in Africa, which is attractive to aquaculture. SEA would set the environmental standards to be maintained
Has a narrow perspective and a high level of detail.	Has a wider perspective and a lower level of detail to provide a vision and overall framework.	Transfers some of the load from project level EIA by dealing with aquaculture in a wider regional or ecosystem context
Focuses on project-specific impacts.	Creates a framework against which impacts and benefits can be measured.	Creates a baseline of data on pertinent parameters against which future aquaculture impact can be measured. Identifies risk factors and potential benefits of aquaculture within the system being studied
Cost to individual investors/farmers	Investment for sector as a whole, either public or public/ private funding	Possibly a better option for using scarce resources and expertise in Africa to maintain environmental standards with regard to aquaculture development. Aims to facilitate project specific EIA studies, making them quicker, more focussed and less costly

Source: adapted from Brownlie, Walmsley and Tarr, 2006; ECA, 2005.

opportunities within the legal, environmental and political constraints that may exist in a given area, region or coastline. Policies would benefit if SEA is able to include information, within the above constraints, on such aspects as the aquaculture "carrying capacity" of the region, options for optimal zonation that take into consideration other potential users, and the possible impact of other infrastructure that would be required. This would present an "enabling" insight to potential investors, large or small, and hopefully remove some of the apparent risk and uncertainty due to the fact there is little existing aquaculture to inspire and inform new entrants.

Secondly, the SEA can provide a platform of information and data that can make the outcome of an EIA easier to predict, thus lowering a possible barrier of entry for new investors. The present lack of baseline information means that a comprehensive EIA needs to acquire a lot of original data (physical, biological, social, economic) if it is going to seriously analyse potential impacts and their alternatives/mitigation. This is costly and for some time to come in Africa may be beyond the capacities of the expertise available to small and medium investors. The benefits of a SEA, implemented with these issues in mind, could include:

- a strategic framework to promote sustainable aquaculture;
- providing baseline environmental data and proposing minimum quality standards to be maintained;
- estimating carrying capacity of promising areas, zonation proposals;
- providing fundamental understanding of issues of "co-habitation" with existing activities;
- providing clearer interpretation of the EIA regulations such as criteria for the screening stage of EIA.

SEA is also potentially an easier process to use to look for broad win/win solutions between "opposing" stakeholders – promoters of different economic activities, conservationists or traditional community users of the resources. EIA, which is conducted for individual projects, usually for individual sites, has a tendency to become a battleground between opponents with fixed opinions.

Funding of strategic studies would be an issue, but if the above advantages can be realized this would seem to be a more productive and cost-effective way to use some of the scarce resources available in Africa. It would, however, be difficult to count on private "polluter pays" sources of finance which the current EIA system relies on at the moment. If SEA can be an effective contributing precursor to the establishment of an active commercial aquaculture sector, it is not unreasonable that this could be an action financed by public institutions or international development banks, and justified by the subsequent commercial activity of the aquaculture producers.

Using SEA procedures should not be about just adding another "layer" of institutional interference to economic aquaculture development. The objective should be to reduce the reliance on project level EIA and to provide comprehensive answers to the questions of environmental impact that are required by the legislation, thereby reducing the resources needed and cost of individual EIAs.

Zoning

Whether or not a SEA process is used, zonation could be a useful tool in promoting and managing aquaculture investment and growth in certain areas (Halwart and Moehl, 2004). Zonation is much more than a site identification exercise. It ensures a physical space for competing land/water users, and identifies areas which are suitable for aquaculture, where the impacts (particularly environmental impacts) of aquaculture development are acceptable within the limits that the SEA would determine. It removes potential conflict with other users, avoids unnecessary "sprawl" of development, and because many of the most attractive sites for aquaculture are also in or close to sensitive habitats, it can determine protected areas where development would not be permitted. EIA in such a context is rendered easier, and less off-putting to investors as the SEA removes a lot of the uncertainty of project planning. Establishing priority zones is also one route for the state to provide, by legislation or other means, for improved long-term access to resources such as land and water.

Zonation is a step that might help in launching a higher level of commercial investment, because apart from reassuring investors by identifying areas that are suitable, it could encourage some clustering of production, within the limits of local environmental carrying capacity, which brings with it opportunities for specialising professional roles such as in fry production, feed manufacture, or product processing. It may also be easier to provide infrastructure such as transport links, access to utilities and other links of a supply chain and marketing infrastructure. Egypt, with all its pressures on land and water, effectively operates a degree of zonation for agriculture/aquaculture/industrial users. Efforts are underway in South Africa studying how this might be done, but elsewhere this is an initiative that could stimulate interest in the sector from investors.

RISKS TO ACHIEVING EFFECTIVE EIA

Cost issues

Introducing the EA process has inevitably resulted in an "upfront" cost for a project, even if the long-term intention is to reduce cost to the environment and national economies by guiding developments towards sustainable options. This is an important issue in the context of aquaculture which is a new sector needing investment, which may well be difficult to come by in Africa where resources are generally stretched.

The extra costs are felt at several levels – the cost to the investor (under the "polluter pays" principle) of conducting the EIA, the cost to the oversight institutions (usually government authorities), and the cost to other stakeholders who want to participate in the EIA consultations. This applies not only to the initial studies, but also to the long term monitoring and audit that logically follow on from the initial study and approval. The principal costs are direct finance and the need to deploy trained personnel particularly within oversight institutions.

If the overall objective is to increase investment in the sector, there are questions that can be asked in the context of aquaculture in Africa. Firstly, can the sector as a whole, as well as individual projects, afford EIA and, second, does the prospect of paying that cost act as a dissuasive factor for investors?

EIA is a cost item that is just beginning to be included in African projects and even a few years ago this would not have been a part of the budget of a planned investment. Even now it does not apply to aquaculture in all countries, and in many it only applies to the largest projects. As to its affordability, this is difficult to judge. Two of the most significant investments in aquaculture to date which have conducted large EIA studies – Madagascar shrimp farms and Lake Kariba tilapia cage culture – have both used the fact of their attention to environmental concerns as a means to access premium export markets, effectively paying for their "investment" in EIA (among other environmental initiatives) with higher prices. It remains to be seen whether the impact of EIA costs on efforts to scale up the production of cheap food fish for local consumption will be a more significant constraint.

Cost will always be something of a barrier, and care must be taken by the sector that this is kept to the minimum necessary. Local investors in particular might not have easy access to finance and may well intend to build up the aquaculture production progressively, using revenue to finance incremental growth. In cases like this the prospect of a major "upfront" cost that does not immediately contribute to production could well be a "deal-breaker". The argument that in the long term the cost/benefit comparison will be favourable, and that the successful adoption of sustainable methods will make the EIA investment worthwhile eventually, has to be demonstrated by those promoting the sector and understood by potential investors. If this perception is not achieved, the result will be investors adopting other activities for which EIA is either seen as worthwhile or not required in the legislation at all.

It is not just the amount that an EIA study might cost that could be dissuasive, but also the level of uncertainty associated with the process. Initiating an EIA study is no guarantee of approval of the project and such variables as unpredictable stakeholder participation and influence, local politics, unpredictable study results, or conflicts arising that are beyond the scope of an aquaculture project (such as land tenure politics) can all lead to the failure of the proposal and consequent monetary loss. It is not possible – or desirable – for the proponents of a project to retain complete control of the consultation process once it is underway, and although such risks and their cost implications can be minimized, they can never be entirely eliminated. The proponents must be convinced that the risks are balanced by the fact that, overall, the process is likely to enhance the project's long-term sustainability (World Bank, 1999b). The Rufiji shrimp project incurred major costs in the approval process, including environmental

assessments, and once the proposal had been blocked the local fishing company involved met with financial problems and had many of its assets seized. Although there are many factors involved here other than EIA, there is a link to the failure to complete the approval process and the potential risks are clear.

How should the EIA process be paid for? In most national regulations, particularly the most recent, the "polluter pays" principle is clearly stated. This means that generally the proponent pays for the application and EIA study itself, with varying investment required into organising public participation in the review of the proposal. The same applies for regular monitoring. However, there is more variation in the approach for financing the oversight activities by the national authority (UNEP/UNDP, 1999). In one option this is seen as a public service and the expense is ultimately met out of the public purse. In those cases there is often just a fairly inexpensive one off payment to have the initial application accepted and possibly a second one off payment to acquire the final environmental approval. The second option requires that the proponent pays fees, which can be substantial, to defray some of the expenses of the designated authority.

CLEAA, an African regional network representing environmental professionals, recommends two-part fee systems: (1) a processing fee, which supports the regulatory agency in the execution of its screening, scoping and EIA review responsibilities; and (2) a permit or license fee, which supports the regulatory agency in the execution of monitoring of the implementation of Environmental Monitoring Plans. Fees should scale to the size and complexity of the project (IUCN *et al.*, 2007). This is a model that a number of countries have adopted for all types of project subject to EIAs and three examples are given in Table 8 (the ranges indicated in the table have been calculated from the stepped thresholds used in the regulations for different levels of fees). It is possible that these levels of fees are more appropriate to major industrial projects such as mining, rather than for lower risk food production projects such as aquaculture. This could be reviewed and adjusted if necessary.

In fixing fees in this way there is a need to strike a balance between being realistic in terms of resources available to African investors in aquaculture and the desire of EA authorities and practitioners to secure finance for their work. At the same time without a minimum of resources for oversight, the EIA process will not really serve any useful purpose.

How can cost be reduced? Part of the answer to this question is to reduce the obligations for EIA/monitoring by demonstrating that aquaculture is not inherently a high risk to the environment, provided that the issues are understood by farmers/investors (education) and the choices for better and more sustainable options are taken early in the project cycle:

- by using SEA in appropriate situations to provide overall guidance in environmental issues and standards;
- by ensuring that the preliminary screening process eliminates the EIA as obligation wherever it is not really necessary, by using where possible a minimum threshold and a reduced assessment for recognized categories;

TABLE 8
Calculated examples of fees charged on a sliding scale as percentage of total project cost

	Madagascar	Zambia	Uganda
US$ project budget:	%	%	%
$30 000	0.5	7.2	0.5
$30 000 to $100 000	0.5	7.2–2.1	1.0–0.45
$100 000 to $500 000	0.5	10.8–2.1	0.45–0.15
$500 000 to $1 000 000	0.5	5.4–2.7	0.15–0.12
$1 000 000 to $10 000 000	0.5–0.3	5.4–0.54	0.12–0.1
1 US$	*1845 ariary*	*3860 kwacha*	*1750 shilling*

Source: EIA regulations of Madagascar, Uganda and Zambia.

- by a policy of openness with environmental data;
- in cases where full EIA study is required, to ensure that the scoping phase is used to carefully focus on key impacts rather than expecting a wide ranging "textbook" study.

Cost of environmental assessment and monitoring is therefore an issue that policy makers from both the aquaculture sector (as far as it is possible to negotiate a sectoral viewpoint) and environmental authorities should agree to monitor, in order to achieve a compatible arrangement that encourages the right kind of investment in sustainable aquaculture. Efforts should be made to avoid imposing unnecessary costs that would deter investors from entering this sector of great promise for Africa.

Issues of public participation

The environmental debate is evolving fast in Africa, and may well become a platform that populations and civil society will use to engage with government and business in tackling local, national or regional development. Most EIA regulations stipulate some kind of public consultation or participation in the decision-making process. The requirements vary widely and for some countries there may be just a brief mention of "public consultation" being required, while others are very prescriptive and specify at which stages this must be done, using designated methods and imposing a timescale and quality standards for information provided. Public participation is important to all effective EIA, not solely for aquaculture, and this an issue to be addressed by government authorities who so far have little experience of making it work. Aquaculture seems to have some issues that are commonly raised at the level of public consultation – notably around access to the key resources of land and water, and how this can be managed with minimum disruption. It is also likely that the communities affected will ask how they can participate in aquaculture at the same time, and projects might well benefit in being prepared to offer solutions to this before consulting the public. One option is to offer some local participation in a project, such as through an outgrower scheme linked to the principal farm, as has been proposed by the S.O.N. tilapia project in Uganda. In the case of Madagascar, however, the uncontrolled participation of small growers was not seen as desirable in the short term, due among other things to environmental risks and disease control, and the projects have taken particular care to consult regularly with the community and to offer other benefits.

Who is consulted during EIA activities, when, how and by whom will vary considerably from project to project, depending on project needs, but there are a number of reasons why this consultation is important, as outlined below in EIA guidelines from Malawi (Malawi/SDNP, 2007). To have the greatest chance of success, consultation needs to begin at an early stage, while critical project design decisions are still amenable to change (World Bank, 1999b). Effective public participation has a number of potential advantages for the project promoter:

- A project creates change which is unsettling but proposals are more readily accepted by people and government authorities if they are well informed.
- When people are informed, they are better able to appreciate the opportunities a project will have for them such as a job or a market for their goods and services.
- People in a project area have a wealth of knowledge and information about local conditions and consultation can help avoid EIA omissions and mistakes, and minimize adverse impacts on the community and their environment.
- In democratic societies people expect to be consulted about activities which will affect them and failure to consult them can result in problems for government and delays for project developers.

Information and communication are important to this part of the process and should be both comprehensive and in accessible language and form for the lay public, which for aquaculture means rural communities sometimes with low literacy. The

importance of information in relation to public participation is demonstrated in the events surrounding the Rufiji shrimp project (Lissu, 1999). In this case the information to the public was initially provided late in the planning cycle of the project, although it had been debated and encouraged at high government level. Later, after the project had effectively been designed, considerable information was provided and a lively debate ensued in hearings, the media and eventually the High Court. Possibly early public consultation could have produced a different outcome. Although this experience has sensitized professionals, NGOs, the media and some communities to the utility of consultation in environmental decision-making, it is possible that the authorities – and in particular those responsible for major development investment – have not learned the lessons of this. More recent proposals for shrimp farming on Mafia Island, where much of the coastline has protected status, have been approved after EIA studies, although the local communities affected do not feel that they have been adequately consulted and that obvious risks of environmental impact have not been seriously considered.

Political will is an important ingredient in seeking sustainable solutions through the EIA process, particularly in the use of wide consultation of "stakeholders", and without it there is a risk that EIA becomes ineffective. There is political support for increasing investment in aquaculture in many countries, but this doesn't have to be incompatible with the EIA process, something that can be resolved by cooperation between sectoral authorities with aquaculture and environment responsibilities.

Land issues

Land tenure is important to aquaculture on at least two levels. Firstly, security of tenure is necessary to attract major investment into the sector. Secondly, the installation of a project in a rural community, where tenure is not a simple matter of buying private property, has to deal with finding solutions to disruption to existing access to land and water resources. This is often subject to unclear national legal frameworks and contradictions between state law and accepted traditional practice. Once opened up to public participatory debate there is a risk that it becomes a "make/break" issue for EIA (possibly independent of the potential benefits of an aquaculture project).

Land tenure arrangements in Africa are very variable, often with overlapping public/communal approaches and sometimes very controversial. They include private ownership, public/state "ownership" or "guardianship" and traditional tenure arrangements. It is common for the state to have a preponderant position as the final arbiter of land ownership especially outside urban areas, although land is often left to be used and exploited in a traditional manner by the local occupants. In some cases governments are accustomed to making major decisions about developments that affect land without considering local stakeholder positions. A fixed long-term investment like aquaculture (whether private or public) can then acquire land by application to state institutions. These can seem quite arbitrary top-down decisions to the existing traditional users of the land. This affects the EIA process, as the experience of the Rufiji Delta aquaculture proposals demonstrated. Public consultation is mandatory in most EIA rules and when it is implemented there is a risk of the forum becoming an opportunity for general land grievances to be aired to the detriment of reasoned consideration of the project situation. Where this happens it is possible that institutional stakeholders and investors become reluctant to allow EIA to become an open process, perceiving it as more of an unnecessary obstacle to progress.

The issue of land is not limited to private investment in commercial aquaculture, and it also affects the development of small-scale farming. In many places where land use is traditionally organized on a communal basis, fish ponds can disturb established modes of land occupation. The permanent nature of the pond infrastructure is very different to the normal cultivation/husbandry practice and building ponds can be used by individuals as a way of permanently "claiming" land previously perceived as

communal. This can lead to conflict and loss of resources to the rest of the community. In the end this runs counter to sustainability and can lead to abandonment of the activity.

Risks of EIA becoming reduced to a paper based bureaucratic obstacle

A commonly cited risk in analyses of EIA systems is the tendency in Africa for these to lose the focus on mitigation of environmental impact and to become just another permit to be paid for. There may be several reasons for this, including the lack of institutional capacity to maintain a sufficient review and monitoring service, the lack of political will to use EIA properly, or simply that there is a generally poor understanding by applicants and administrators of the role of EIAs in the overall development project life cycle (Weaver and Sibisi, 2006). This concern applies equally to aquaculture, except that as mentioned above there is certainly the prospect that the industry can be persuaded of the self-interest in adopting sustainable environmentally friendly approaches. One factor in the aquaculture situation is that in many countries the sector is regulated by many sectoral laws (e.g. water, land) rather than by a specific "aquaculture" law. Where these sectoral laws are well established, such as in Egypt or South Africa, EIA approval might tend to be regarded by applicants as a relatively minor additional permitting process.

EIA, like many other authorization processes, also presents a risk of becoming just another delaying, costly and inefficient "rubber-stamping" exercise, poorly and bureaucratically managed by an under-resourced government department. It can only be hoped that recognition of this risk can lead to the public and private sectors working together to avoid it and keep the positive thrust of the EIA process on track.

Overlapping legislation and institutional roles

As has been noted in several of the case studies it can be difficult for a new environment agency to implement the environmental laws, in particular the EIA regulations, when individual sectors retain their own statutes governing approvals for projects falling within their sector (Adegoroye, 1996). Not all these sectoral statutes are inclusive of environmental concerns, and the introduction of the environmental agency into the "mix" becomes interpreted as unnecessary interference. This can lead to competition with line ministries for control of the legislation and of enforcement, or it may simply be a case of the sectoral line ministries having long-standing arrangements in place and there being resistance to change on the ground. In the end, the approach of the environmental agency must be "inter-sectoral" in nature and convincing them of the benefits of EA and working closely with line ministries is probably the only solution.

Access to environmental information

Information is a key ingredient of the EIA process, and is an issue on at least two levels for aquaculture in Africa – acquisition of the required information/knowledge, and wider access to that information.

There is relatively little information available about the environmental impacts of aquaculture in African countries, even for basic vital parameters such as water quality. Seeking and accumulating such knowledge into national and regional environmental databases will be an important step towards being able to improve sector planning and strategy, as well as sustainable implementation of individual projects. A strategic assessment approach can contribute to this, but sharing of information within the sector by both public and private sectors will be crucial and a vital role both for fisheries/aquaculture departments and private sector associations.

Clear policies to make this information easily available would be a positive step towards aquaculture development, and this includes clarifying whether or not the baseline data included in EIA studies, or preliminary assessment, should be made

available. Several of the national frameworks include articles that specifically put this information in the public domain, in some cases with the proviso that confidential proprietary information be protected[11]. The latter condition should not be an obstacle to releasing most information relative to aquaculture projects. Despite these clauses it is still relatively difficult to obtain actual EIA documents, which project developers who have financed their preparation are perhaps unsurprisingly reluctant to reveal. Given that the documents are legally in the public domain, the environmental authority or aquaculture departments should try to take steps to make the information accessible, perhaps through Web sites, and in so doing contribute both to the confidence of potential investors and in fulfilling the obligations for public information contained in EIA legislation.

Implications of business applicants having control of EIA

Under the principle that the "polluter pays", most of the EIA regulations in Africa specify that the implementation and resourcing of the EIA study is the responsibility of the applicant. The EIS produced in this way are used as the basis for the approval decision to be made by the environmental authority, and this raises some important questions.

There is a real risk that the EIA study will be, or become perceived to be, partial and effectively promoting the applicants interests, rather than being an objective attempt to identify potential negative impacts and the mitigation measures that need to be taken. This could then slip through the approval process if there is not sufficiently sophisticated scrutiny (Katima, 2000). This is not a concern unique to Africa, and it is an accusation made against EIA in other situations. Given the commercial stakes for the businesses conducting these studies, this tendency should not be unexpected. The antidote to this is strong national institutions with the responsibility for oversight of each stage of the EIA process. However, most reviews of the EA in Africa at present indicate that the institutional capacity of environmental authorities still leaves much to be desired in terms of the resources, training and competence available. This is a deficiency that must be quickly addressed if EIA is to remain credible to the wider public.

A part of the solution to this is to ensure that adequately trained professional consultants (environmental assessment practitioners) are used to carry out the EIA study, and several national regulations make this mandatory[12]. This provides a motive to set up a recognized national register of practitioners who are available for promoters preparing a study. In some cases these national registers already exist and have a statutory basis, in other cases they are largely voluntary self-regulating bodies. There have also been efforts to organise the profession on regional and subregional

[11] For instance: PART VIII. ACCESS TO ENVIRONMENTAL IMPACT STATEMENTS AND INFORMATION (United Republic of Tanzania, 2005)
Art. 39.-(1) Subject to the freedom of access to environmental information, any project brief, environmental impact statement, terms of reference, public comments, report of a person presiding at a public hearing, environmental impact assessment statement, decision letter or any other information submitted to the Council under these Regulations, shall be public documents.
(2) The Council shall, grant any person who desires to consult any document referred to in sub-regulation (1), access to that document on such terms and conditions as the Council considers necessary.
Art. 40.-(1) A person submitting information to the Council may at anytime apply to exclude the information or parts thereof from being made available to the public on the basis of commercial confidentiality or national security.

[12] For instance: Appointment of EAPs to manage applications (South Africa, 2006b)
Art. 17. (1) Before applying for environmental authorization of an activity, an applicant must appoint an EAP at own cost to manage the application.
General requirements for EAPs
Art. 18. An EAP appointed in terms of regulation 17(1) must –
(a) be independent;
(b) have expertise in conducting environmental impact assessments, including knowledge of the Act, these Regulations and any guidelines that have relevance to the proposed activity;

bases; see further below for these sub-regional groupings including EAAIA, SAEIA, WAAEA, SADC (CLEAA, 2004). Oversight and quality control will also need to be a preoccupation of the registration bodies, to avoid any perception that the "self-interest" of professional practitioners will influence their conclusions in favour of their employers" view and financial interests.

BIODIVERSITY ISSUES

Of all the topics surrounding the environmental impact of aquaculture in Africa, the most hotly debated is that of biodiversity. This can be affected by the introduction of alien species into aquatic ecosystems, the development of improved domestic strains of indigenous species through genetic selection, or eventually the creation of genetically modified organisms. Each of these potential threats needs to be looked at separately. "Introduction of alien species" can be taken to include translocation out of an area of natural distribution, even if that is within a country or sub-region of Africa[13]. Already these movements have had very significant impact on river basins, lakes and other waterbodies (Hecht *et al.*, 2006)

This is very relevant to EIA for most aquaculture projects, which so often rely on the translocation or importation of culture species. Not only would EIA almost certainly be evoked by the basic clauses of the regulations which make assessment necessary for "developments which are likely to have significant environmental impact", but in at least 16 countries the introduction of alien species or of GMOs is specifically listed as requiring EIA on its own merit. In one country (Comoros) the introduction of exotic species is simply banned.

What may not be clear is exactly how an EIA study can satisfactorily produce evidence in favour of an introduction, except in some unusual cases which are "exceptions that prove the rule". Three examples of these possible "exceptions" are:

- the introduction of a specialized species into a new man-made environment with no prospect of it spreading, and where there is no indigenous species available. The introduction of *Limnothrissa* into Lake Kariba is an example;
- the introduction of an alien species which is presumed not to be able to breed in local conditions if it does escape from aquaculture. Culture of grass carp, *Ctenopharyngodon*, as used for vegetation control in canals in Egypt either in areas where reproduction cannot occur or because sterile triploid fish are available;
- the introduction of an alien species by an aquaculture project situated in a catchment/ecosystem where it has already been introduced (illegally?) and become established in the wild. The use of *O. niloticus* in cage culture in Lake Kariba is an example of this.

The argument used to support this last case – that there is no prospect of eradicating the alien once it is established widely in the wild, and so no further harm can be done – is also an illustration of a fundamental argument against introduction in the first place – that introduction is usually irreversible, and ordinary "precaution" is no guarantee of avoiding this.

What are the issues facing project level EIA for introduction of an alien species?

- uncertainty is high about the impact should the species escape to the wild;
- there is no total mitigation to offer; total control of escape is not realistic except in high-tech bio-security infrastructure (hardly a sustainable option);
- EIA can suggest alternatives: this could be to use an indigenous species (most catchments/ecosystems in Africa have a large number of fish species) with the disadvantage that few of these have been tried/tested in aquaculture; in any case,

[13] The term "Alien genotype" has often been used to indicate an organism is the same species as a local species, but contains genetic resources that differ from the local population. These differences can arise from genetic manipulation in a farm or from transferring genetically differentiated populations from other locations within the species' range..

genetic improvement of local species would lead to creation of "alien genotype" and there would be risks.
- a release/escape will in many cases have transboundary consequences in Africa, which under international conventions will require that other countries must participate in a decision (African Union, 2003);
- even if a project can demonstrate immediate economic returns from introducing a species, what price can the EIA put on the long term impacts on biodiversity in comparison?

In many cases national law and international treaties make a presumption that any introduction would be an extreme exception, although most leave some discretion presumably for those cases where there is assumed to be an urgent economic reason to do so. International guidelines such as the FAO CCRF and supporting Technical Guidelines on genetic resource management (FAO, 1995; 2008), or the ICES codes of practice (ICES, 2004) argue for the application of the precautionary approach and appropriate ecological risk assessment and management, taking the view that these introductions should be examined *a priori*, evaluated by EIA or other assessment and controlled.

The South African regulations provide a clear statement of the true implications of the "polluter pays" principle (South Africa, 2004):
"Should an alien species establish itself in nature as an invasive species because of the actions of a specific person, a competent authority may hold that person liable for any costs incurred in the control and eradication of that species"

This presents the decision to import a species as a clear business risk, and the downside is that eradication (even partial control) would almost certainly cost "millions". Reports from South Africa suggest that farmers there, once eager to import many exotic species, are already viewing this with much more circumspection and are now more likely to consider conducting research into local species.

Meanwhile, the African Convention on the Conservation of Nature and Natural Resources (African Union, 2003) also goes further than some international guidelines and contains articles that oblige signatories to strictly control not only the introduction of aliens but also the export from their own country "out of normal range" to another country. It also creates an obligation for states to eradicate alien species that are a threat to indigenous biodiversity.

Malawi illustrates the need to face up to difficult EA decisions in relation to this issue of biodiversity. The laws require EIA for introductions, but given the unique and extraordinary biodiversity of the fish in and around Lake Malawi, it is almost unthinkable that any fish introduction would be entertained. In fact in the past investors have proposed the farming of *O. niloticus*; this has been discarded for the alternative of *O. karongae* - a species indigenous to Malawi, despite this incurring extra cost in R&D for the investor.

The use of improved strains of indigenous fish is a quite different case. Aquaculture operations will inevitably, whether intentionally or not, lead to genetic changes in the domestic stocks. Deliberate selection for desirable characteristics is going to occur on farms, to the benefit of the sector. There are risks that can be identified in cases where the population or gene pool of the wild populations are small, but in the case of common species like the tilapia the likely impact of occasional escapes of conspecifics that mix with the wild population will be very small (Moehl, Brummet and Panzoni, 2006). Caution should be applied in any EIA analysis concerning the use of significantly altered strains, but the risk assessment study should be able to provide the information necessary for the decision to be made sensibly.

The case of GMO introductions is at present mostly theoretical, and unlikely to be acceptable given the current socio-political reluctance in Africa to allow introductions of any organisms in this category.

HUMAN RESOURCES AND INSTITUTIONAL CAPACITY

The capacity to carry out all the tasks that are required in implementing any environmental assessment has been widely identified as a key constraint to current EIA efficacy in Africa (Bekhechi and Mercier, 2002; EAAIA, 2007; Wood, 2003). This is reflected in a broad requirement for higher levels of staffing and competence covering both the public sector (the national environmental authority charged with oversight) and the private sector professionals who have the task of providing impartial expertise during the impact assessment process.

It is also important that the aquaculture institutions, most of which are in the public sector, should give a higher priority than at present to acquiring knowledge and expertise in environmental assessment as a useful asset for developing sectoral strategies and policies (Tekeu, 2004) and providing general assistance to aquaculture farmers. It would also enable them to better understand the processes and to be more effective in promoting better sustainable practice among farmers. At present aquaculture specialists tend to be quite unfamiliar with the requirements of EIA even in countries where aquaculture is a listed category that must be assessed. Interaction between investors and aquaculture agency/department professionals who are aware of the environmental issues, at an early stage of the project planning process will bring benefits to the sustainable qualities of the project as well as facilitate a more focused and efficient approach to the subsequent EIA process.

Training is available at many universities across the continent, as well as through initiatives such as CLEAA (Capacity Development and Linkages for Environmental Assessment in Africa) as well as UNEP (Sadler and McCabe, 2002) and the United Nations University (UNU[14]). CLEAA is a pan African network facilitating EA development across the continent (CLEAA, 2007a). They offer courses in project level EIA, SEA, follow up and post-implementation monitoring, EA and public participation, integrating HIV/AIDS in EA processes, integrating biodiversity issues, managing EA processes and quality control (reviewing) of EAs, although there is no specialist training directed towards aquaculture.

The total requirements for trained personnel will fluctuate with the EIA workload that is generated by economic development, but it has been pointed out that state trained personnel, already too few in number, have a tendency to leave public service where the private consultancy opportunities are more attractive.

Quality control of environmental assessment practitioners would also need to be built into the system, and already some countries, such as Uganda and South Africa, have screening and registration processes for private consultants who are approved by the environmental agency for work on EIA.

INTERNATIONAL LINKS ACROSS AFRICA

International links between African countries provide a number of benefits, enabling the region to share experiences in the broad field of environmental assessment, whether they are positive or negative. The use of EIA, including for aquaculture, is being introduced across the continent and there are opportunities for mutual exchange at several levels including of technical data, law, enforcement, expertise and training.

The political will to address the problems of the environment facing the continent are already being addressed in a number of fora such as the African Union (through the New Partnership for Africa's Development – NEPAD), and the African Ministerial Conference on the Environment (AMCEN). There are also treaties such as the African Convention on the Conservation of Nature and Natural Resources, which deal with several transboundary issues relevant to EIA – see below.

[14] EIA Open Educational Resource - http://eia.unu.edu/

Specific networks have been established to develop and improve the implementation of EA in Africa, most notably those under the umbrella of CLEAA (Capacity Development and Linkages for Environmental Assessment in Africa, CLEAA, 2007a), which includes the following sub-regional groupings:

- Southern African Institute for Environmental Assessment (**SAIEA**);
- Eastern Africa Association for Impact Assessment (**EAAIA**);
- West African Association for Environmental Assessment (**WAAEA**);
- Indian Ocean Islands Association for Environmental Assessment (**IOAEA**);
- Secretariat for the Environmental Assessment in Central Africa (**SEACA**);
- Community Based Impact Assessment Network for Eastern Africa (**CIANEA**);
- Tunis International Centre for Environmental Technologies (**CITET**) for North Africa**.**

There are also similar networks dedicated to regional cooperation in aquaculture, such as the **CIFAA** (Committee for Inland Fisheries and Aquaculture in Africa) and **ANAF** (Aquaculture Network for Africa), which also provide a forum for the discussion of environmental issues (Aguilar-Manjarrez, 2008; Barg *et al.*, 2008).

International (regional) harmonization of legal approach – African Convention on the Conservation of Nature and Natural Resources

There are clearly important international dimensions to the management of the environment in Africa and many aquaculture initiatives could have far reaching transboundary impacts, e.g. the shared aquatic resources of the Great Lakes of eastern and southern Africa (cages, water pollution, alien introductions) or the major river basins (UNEP/UNDP, 1999).

In a step to harmonize the approach of all countries to these transboundary issues forty-four African countries are party to the African Convention on the Conservation of Nature and Natural Resources under the auspices of the African Union (2003). This treaty provides for cooperation and statutory coordination across the continent. Summarized below are some of the relevant clauses that require countries to make provision for EIA and SEA type approaches in managing their environment:
"Art.XIV.b.…ensure that policies, plans, programmes, strategies, projects and activities likely to affect natural resources, ecosystems and the environment in general are the subject of adequate impact assessment at the earliest possible stage and that regular environmental monitoring and audit are conducted" (African Union 2003);

The treaty also calls for strict controls on alien introductions:
"Art XI.2.h. …strictly control the intentional and, in as far as possible, accidental introduction, in any area, of species which are not native to that area, including modified organisms…"

But goes further by calling for states to:
"…endeavour to eradicate those already introduced where the consequences are detrimental to native species or to the environment in general";

As well as creating an obligation to control exports of alien and GMO organisms:
"Art XX.f …the Parties shall, prior to the export of… alien or modified organisms, undertake to secure the prior informed consent of the importing, and where appropriate, transit States";

This is an interesting extension to internal state responsibilities, although there are no records of this clause being invoked in the transfer of fish species whether for aquaculture or not.

EVOLVING INTERACTION OF AQUACULTURE WITH EIA AND ENVIRONMENTAL MANAGEMENT

This document has discussed some of the issues relating to the use of EIA for aquaculture in Africa, but it is only a snapshot in a dynamic situation. Looking at current events it is clear that activities, regulations and institutions within both sectors – aquaculture and environmental management – are undergoing change all the time.

If the high expectations for the development of aquaculture in the African region do become reality, we can expect the rate of change in these matters to accelerate as production sites increase in size and number. The widely enacted EIA regulations will come into their own as a management tool once there is real experience of the consequences of environmental impact as a result of the success of the sector.

In the short term, there is scope for environmental management agencies to put greater priority into the implementation of those aspects of the regulations that provide for monitoring and audit of aquaculture projects once they have been approved and put into operation, and so acquire the data to assess the real environmental costs and benefits of aquacultural activities.

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