ENVIRONMENTAL MANAGEMENT AND ENVIRONMENTAL IMPACT ASSESSMENT IN AQUACULTURE
Training Workshop for Aquaculture Managers
Entebbe - Uganda
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Environmental management and
Environmental Impact Assessment in
Aquaculture

Training Workshop for Aquaculture Managers

Entebbe
Uganda

GCP/RAF/466/EC SmartFish Project
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Acknowledgements

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Executive Summary

The overall objective of the SmartFish programme is to contribute to an increased level of social, economic and environmental development and deeper regional integration in the Eastern-Southern Africa and Indian Ocean Region (ESA-IO), through the sustainable exploitation of fisheries resources. The programme is funded by the European Union under the 10th European Development Fund and is implemented under the overall responsibility of the Indian Ocean Commission.

Within the framework of SmartFish Result 5, Output 5M3.1, improved Environmental Management and Environmental Impact Assessment in Aquaculture (EIAA) was identified as a means by which sustainable benefits from aquaculture can be ensured. The regional training workshop was organized for SmartFish beneficiary countries with the objective of enabling them to improve country application and compliance of environmental impact assessment and environmental management of aquaculture, which would in turn help them foster sustainable development. All SmartFish member countries participated in the organization of the workshop, from the assessment of training needs, to the design of the training programme, through to the training itself.

Based on the findings from the initial needs assessment exercise, the workshop targeted national aquaculture managers. Findings from the needs assessment suggested focusing on improving practical knowledge and skills to address the following topics:

- Aquaculture inputs and resources;
- Aquaculture outputs and impacts;
- Why undertake environmental management;
- Site selection and estimating capacity;
- Modeling aquaculture impact;
- Environmental regulations and their application;
- EIAA components and process;
- Environmental Management planning;
- Environmental monitoring;
- Strategic Environmental Assessment.

The training sessions involved active discussions and practical exercises, which included field tours and case studies. In the case studies, participants evaluated pond and cage based aquaculture investments within the context of EIAA. They took into account the technical aspects, as well as the socio-economic and ecosystem requirements and impacts likely to arise from aquaculture. The evaluation of case studies followed steps based on recommended best practices from EIAA and Environmental Management Procedures (EMP).
The steps below show how participants undertook the review of their case studies:

- Evaluation of the business plan;
- EIAA screening process;
- Identification of main issues likely to arise, including identification of key stakeholders, stakeholder consultation exercises (done during field visit) and risk analysis of the main issues;
- Identification of data requirements for analysis, evaluation and monitoring;
- Identification of mitigation measures;
- Presentation of findings that were outlined as EIAA and EMP to the departments of Environment and Aquaculture\(^1\) for final evaluation, approval and licensing.

At the end of the workshop, participants expressed the value of working together with all relevant stakeholders. Aquaculture as an enterprise is cross-cutting and EIAA and EMPs cannot be implemented effectively by primary departments alone. Moreover, participants were able to identify the key issues in their respective countries, and the appropriate practical steps needed to be put in place, which would enable them to become more effective in EIAA considering both their national and local conditions.

The following were identified by participants as being the gaps for which additional support would be required in order to improve levels of effective implementation of EIAA in the region:

- Specialized training that targets managers (both in aquaculture and environmental institutions), practitioners and the general public, focusing on building skills and improving levels of public awareness.
- Building the capacity of the various public institutions and the private sector, through building Public-Private-Partnerships, in order to implement EIAA and better manage the general environmental issues of aquaculture. The following proposals were put forward: the development and production of user manuals for the different audiences; the provision of field and laboratory equipment; undertaking Strategic Environmental Assessments; setting up specialized EIAA units within departments; and, establishing effective functional linkages between key departments, notably the National Environmental Management Agencies and Fisheries aquaculture institutions. Information management systems should also be looked at.
- Development and/or improvement of general and specific national policies, regulations, strategies and guidelines, including their implementation.
- Adoption of environmentally friendly systems and practices at all times.

\(^1\) Represented by a group of participants in a role playing game
Résumé exécutif

L'objectif global du programme SmartFish est de contribuer à hausser le niveau du développement social, économique et environnemental ainsi que permettre une intégration régionale plus profonde dans la région de l'Afrique orientale et australe et l'océan Indien (AfOA-OI), à travers une exploitation durable des ressources halieutiques. Le programme est financé par l'Union européenne au titre du 10e Fonds européen de développement et il est mis en œuvre sous la responsabilité générale de la Commission de l'Océan Indien.

Dans le cadre de SmartFish Résultat 5, extrant 5M3.1, l'amélioration de la gestion environnementale et l'évaluation des incidences de l'aquaculture sur l'environnement (EIAE) ont été identifiées comme un moyen pouvant assurer les avantages durables de l'aquaculture. L'atelier de formation régional a été organisé pour les pays bénéficiaires de SmartFish dans le but de leur permettre d'améliorer la mise en application et le respect au niveau pays de l'évaluation des incidences sur l'environnement et de la gestion environnementale de l'aquaculture, ce qui les aiderait à favoriser à leur tour le développement durable. Tous les pays membres de SmartFish ont participé à l'organisation de l'atelier, de l'évaluation des besoins en formation à la conception du programme de formation, en passant par la formation elle-même.

Sur la base des conclusions de l'exercice initial d'évaluation des besoins, l'atelier a ciblé les gestionnaires nationaux d'aquaculture. Les résultats de l'évaluation des besoins ont montré qu'il faut se concentrer sur l'amélioration des connaissances et des compétences pratiques en vue d'aborder les thèmes suivants :

- Les intrants et les ressources de l’aquaculture ;
- Les extrants de l’aquaculture et les incidences ;
- Pourquoi entreprendre une gestion de l’environnement ;
- Choix du site et capacité d’estimation ;
- Modélisation des incidences de l’aquaculture ;
- Les règlements pour l’environnement et leur mise en pratique ;
- Les composants et le processus EIAE ;
- La planification de la gestion de l’environnement ;
- La surveillance environnementale ;
- L’évaluation environnementale stratégique.

Des discussions actives et des exercices pratiques comprenant des visites de terrain et des études de cas faisaient partie des sessions de formation. Dans les études de cas, les participants ont évalué les investissements pour l’aquaculture en étang et en cage dans le cadre de l'EIAE. Ils ont pris en compte les aspects techniques, ainsi que les besoins socio-économiques et éco systémiques de même que les incidences qui pourraient résulter de l’aquaculture. L’évaluation des études de cas a suivi les étapes basées sur les meilleures pratiques recommandées de l'EIAE et les procédures de gestion environnementale (PGE).
Les étapes suivantes montrent comment les participants ont entrepris l'examen de leurs études de cas :

- L’évaluation du plan d’activité ;
- Le processus de l’examen préalable de l’EIAE ;
- L’identification des principaux problèmes susceptibles de se poser, y compris l’identification des principales parties prenantes, des exercices de consultation des parties prenantes (réalisés lors de la visite sur le terrain) et l’analyse des risques des éléments essentiels ;
- L’identification des besoins en données destinées à l’analyse, l’évaluation et le suivi ;
- L’identification des mesures d’atténuation ;
- La présentation des conclusions qui ont été décrites comme EIAE et PGE pour les services de l’environnement et de l’aquaculture en vue de l’évaluation finale, l’approbation et l’octroi des permis.

À la fin de l’atelier, les participants ont exprimé l’importance de travailler en collaboration avec toutes les parties prenantes. En tant qu’entreprise, l’aquaculture est transversale et l’EIA et le PGE ne peuvent être mises en œuvre de manière efficace par les services primaires seuls. En outre, les participants ont pu identifier les questions clés dans leurs pays respectifs, et les mesures pratiques nécessaires qui doivent être prises, ce qui leur permettra de devenir plus efficaces en matière d’EIAE en tenant compte de leurs conditions nationales et locales.

Les participants ont identifié les éléments suivants comme étant les écarts pour lesquels davantage de soutien serait nécessaire afin d’améliorer les niveaux de mise en pratique de l’EIAE dans la région :

- Une formation spécialisée qui cible les cadres (des institutions de l’aquaculture et de l’environnement), les exécutants et le grand public, l’accent étant mis sur le renforcement des compétences et l’amélioration des niveaux de conscientisation du public.
- Le renforcement des capacités des différentes institutions publiques et du secteur privé à travers la l’établissement de partenariats public-privé, afin de mettre en œuvre l’EIAE et de mieux gérer les questions environnementales d’ordre général de l’aquaculture. Les propositions suivantes ont été formulées : le développement et la production de manuels de l’utilisateur destinés à différents publics ; la fourniture d’équipements de terrain et de laboratoire ; la réalisation d’évaluations stratégiques sur l’environnement ; la mise en place d’unités EIAE spécialisées au sein des services ; et l’établissement de liens fonctionnels efficaces entre les services clés, notamment les agences nationales de gestion de l’environnement et les institutions des pêcheries pour l’aquaculture. Les systèmes de gestion de l’information devraient également être examinés.
- Le développement et / ou l’amélioration des politiques nationales, des règlements, stratégies et directives, générales et spécifiques, ainsi que leur mise en œuvre.
- L’adoption, en tout temps, de systèmes et de pratiques favorables à l’environnement.

2 Représentés par un groupe de participants lors d’un jeu de rôle.
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### Acronyms and abbreviations

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<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCRF</td>
<td>Code of Conduct for Responsible Fisheries</td>
</tr>
<tr>
<td>CAADP</td>
<td>Comprehensive Africa Agricultural Development Programme</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EAA</td>
<td>Ecosystem Approach to Aquaculture</td>
</tr>
<tr>
<td>EIAA</td>
<td>Environmental Impact Assessment for Aquaculture</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>ESA-IO</td>
<td>Eastern-Southern Africa and Indian Ocean</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>FCR</td>
<td>Food Conversion Ratio</td>
</tr>
<tr>
<td>LVHD</td>
<td>Low Volume, High Density</td>
</tr>
<tr>
<td>MAAIF</td>
<td>Ministry of Agriculture, Animal Industry and Fisheries, Uganda</td>
</tr>
<tr>
<td>NaFIRRI</td>
<td>National Agricultural Fisheries Resources Research Institute, Uganda</td>
</tr>
<tr>
<td>NEPAD</td>
<td>New Partnership for Africa’s Development</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non-Governmental Organizations</td>
</tr>
<tr>
<td>SON</td>
<td>Source of the Nile Fish Farm, Jinja, Uganda</td>
</tr>
</tbody>
</table>
1. **Background**

The SmartFish Programme aims to contribute to an increased level of social, economic and environmental development and deeper regional integration in the Eastern-Southern Africa and Indian Ocean Region (ESA-IO), through the sustainable exploitation of fisheries resources. The Programme is funded by the European Union under the 10th European Development Fund and is implemented under the overall responsibility of the Indian Ocean Commission.

Within the framework of SmartFish Result 5, Output 5M3.1, the project carried out a regional training workshop on Environmental Management and Environmental Impact Assessment in Aquaculture (EIAA).

2. **Objectives of the training workshop**

The objective of this training was to provide both theoretical and practical workshops to key staff in the Aquaculture Departments of the participating member countries. Training included best practice for Environmental Impact Assessments for aquaculture projects that risk causing significant impact to the environment; and improving the application and compliance of environmental management procedures (EMP) in the practice of aquaculture in a manner that fosters the development of a sustainable sector at all levels of production.

2.1 **Overall objectives**

The overall objectives were to:

- Equip participants with the skills that would enhance their ability to develop, improve and apply EIAA appropriately;
- Provide participants with adequate information, building their capacity to disseminate the information and pass on the skills obtained to other stakeholders.

2.2 **Specific objectives**

The specific objectives were to provide appropriate practical knowledge and skills in the following areas:

- The basic elements of environmental planning and management in aquaculture;
- The aquaculture production process in relation to environmental management, with special emphasis on associated risks and areas under local production conditions and practices;
- The EIAA content, process and steps;
- Strategic Environmental Assessment;
The national (and international) environmental regulations relevant to aquaculture and to the application of EIAA.

3. **Training needs assessment**

Prior to the workshop, a questionnaire was used to assess participants’ needs, as well as any gaps and challenges that were affecting EIAA implementation in beneficiary states. The findings of this assessment suggested that the initial target audience for the workshop would be national aquaculture managers. The assessment also recommended that emphasis be placed on the practical skills required to implement EIAA for the various production systems practiced in the region.

Table 1 summarizes what participants viewed as the most important course needs in the needs assessment questionnaire.

### Table 1: Summary of the needs assessment consultation prior to the course

<table>
<thead>
<tr>
<th>Themes</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on large scale industrial aquaculture</td>
<td>23</td>
</tr>
<tr>
<td>Cover all aquaculture regardless of the scale</td>
<td>33</td>
</tr>
<tr>
<td>Focus on general principles and concepts of environmental management in aquaculture</td>
<td>40</td>
</tr>
<tr>
<td>Provide more detailed information and discussion on the full aquaculture production process and associated environmental risks and hotspots with emphasis on local cases</td>
<td>35</td>
</tr>
<tr>
<td>Pond culture</td>
<td>34</td>
</tr>
<tr>
<td>Cage culture</td>
<td>37</td>
</tr>
<tr>
<td>Aquaculture systems and environments for different species</td>
<td>36</td>
</tr>
<tr>
<td>Focus on the implementation of national (and international) environmental regulations relevant to aquaculture</td>
<td>36</td>
</tr>
<tr>
<td>Provide information on strategic environmental assessment</td>
<td>38</td>
</tr>
<tr>
<td>Have a session to share experiences: review status of EIAA application in beneficiary countries</td>
<td>34</td>
</tr>
</tbody>
</table>
4. **Organization of the training workshop**

4.1 *Training Methodology*

The emphasis of the training was on building the capacity of stakeholders to apply and disseminate EIAA. The needs assessment survey identified that the training should cover the basic principles and practices of EIAA, with a focus on local aquaculture conditions and potential development. The needs assessment survey also highlighted the need for participants to identify the resources required locally for EIAA implementation.

In addition to lectures, open discussion among participants was also encouraged. Group assignments were included during which members evaluated selected case scenarios within the framework of EIAA implementation.

The proposed case studies were fictional, made-up within certain conditions by the participants themselves as a way to enhance the practical aspects of EIAA application and evaluation, and to improve their understanding.

The workshop included site visits based on the following criteria:

- Operations that provided examples of EIAA implementation, good or less than optimal;
- Different production system options, for example cage, pond or other mechanisms.

Structure of sessions: Sessions were divided into morning (9-12) and afternoon (2-5), with a break in between. Every session was initiated with a background presentation, followed by a participatory activity.

5. **Programme, venue and participants**

The participants comprised aquaculture managers from beneficiary states (see Annex A) with diverse professional backgrounds and varying levels of exposure to EIAA. None however, had any practical experience with the application of EIAA.

The contents of the programme (Annex 2) were based mostly upon the findings of the needs assessment. Trends in aquaculture development, resources required for the various forms and scales of aquaculture and potential effects on the environment were discussed. The EIAA objectives, process and requirements for aquaculture were introduced. The case studies and field tours enabled participants to critically articulate this information, while comparing the status of EIAA practice and environmental management in their countries. Details of the workshop agenda can be found in Annex 2.

The workshop was residential, based at Laico Lake Victoria Hotel, Entebbe. Field visits were undertaken at the cage farming pilot site of NaFIRRI, Jinja and at the Source of Nile (SON) Fish Farm, Njeru.
These provided participants with an opportunity to compare the environmental implications of a government run establishment with a private commercial establishment. At SON they were given opportunities to assess the potential implications of cage versus pond operations, as well as grow-out and hatchery/nursery operations. Issues of the use and effect on environmental resources was well illustrated. Both sites are located within the Napoleon Gulf of Lake Victoria and there are several other users of the natural resources, for example urban settlements, industry, water-transport, tourism and agriculture. The side on which Jinja is situated is more urbanized, while Njeru is more rural. Having both sites in close proximity provided an excellent learning opportunity. There was a wide range of variables that directly impacted on the implementation of EIAA and environmental management. These included different objectives, community uses and needs, and the status of natural resources – all of which had different mitigation needs.

6. Introduction to the training workshop

Participants were provided with an overview of world aquaculture and the current situation of the sector in Africa. Some of the main elements are outlined below.

Amid some fluctuations, world fish production generally started to level off in the 1990’s. In 2011, aquaculture contributed to 40 percent of the world’s total fish production with a total biomass of 62.7 million tons (plants excluded). It was estimated to be at 42 percent in 2012 and projected to be 44 percent by the end of 2013.

Aquaculture is rapidly growing in Africa. Production levels reached 1.4 tons in 2011, representing 2.2 percent of global production. Despite the fact that one country (Egypt) leads production, most countries in sub-Saharan Africa have aquaculture as one of their most rapidly growing food sectors.

Africa is also home to some of the largest aquatic biodiversity in the world, especially freshwater, and it is a region of both great opportunities and needs. It is important to make sure that aquaculture grows in such a way that it will promote socio-economic development and food security. It is essential that it does not pose a threat to the conservation of natural resources for the needs of neither immediate users of these ecosystems nor those of future generations.

Governments need to strengthen their capacities and broaden their knowledge and understanding of environmental and social issues around aquaculture. In so doing, they will be able to improve regulations and assist the private sector to develop sustainably. Africa still has rich and diverse water resources and quality, and these assets will be even more valuable in the near future.
7. **Background on the present status of environmental management in Africa**

Most African States are aware of the need for an EIAA and have taken steps to adopt its principles. Such commitment is further enshrined in the international and regional developmental goals, in the fisheries and environmental frameworks and in regulations that they are signatory to. Most notable amongst these are the Millennium Development Goals (MDG), the FAO’s Code of Conduct for Responsible Fisheries and the New Partnership for Africa’s Development (NEPAD).

However, while most countries have EIAA procedures and regulations in place, many also face challenges regarding their implementation. Aquaculture is in a phase of transition from largely smallholder subsistence fish farming to commercial companies.

Most of the appropriate developmental and regulatory frameworks guiding this have not yet ‘matured’. There is a lack of information on the resource needs of potential aquaculture systems based on local experience.

Table 2 below summarizes the status of EIAA country implementation among participating States at the workshop.

**Table 2: Summary of EIAA country implementation status**

<table>
<thead>
<tr>
<th>Country</th>
<th>Kenya</th>
<th>Tanzania</th>
<th>Uganda</th>
<th>DRC</th>
<th>Comoros</th>
<th>Eritrea</th>
<th>Zambia</th>
<th>Malawi</th>
<th>Sudan</th>
<th>S. Sudan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EIAA framework in place</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No: under formulation</td>
</tr>
<tr>
<td><strong>EIAA implementation</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Not good</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>General EIA regulations</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Application of EIAA</strong></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Small holder</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Large holders</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

* More detail is given in the summary of EIA implementation by countries in section 11.
8. Training content and process

Doris Soto provided an overview of a typical EIAA pathway as described by the FAO (2009)\(^3\) in a publication. It provides a global perspective of EIAA use and the main challenges faced both globally and by region. A general background was provided to explain the reasoning behind the main components and steps in the EIAA process. This was related to the outline of the training and to the needs assessment in the African countries involved in this workshop.

The following sections detail the content of the main lectures.

8.1 Aquaculture inputs and resource use

(Prepared by Patrick White and Nelly Isyagi)

The presentation gave an introduction to the aquaculture production chain and aquaculture stakeholders. It covered the use of resources by aquaculture: water, land, seeds, feeds, energy, labor, equipment and infrastructure.

Aquaculture continues to be the fastest growing animal food-producing sector. Total aquaculture production from both inland and marine waters contributes 42 percent of the total supply of fish products (including plants and non-food products), and more than 40 percent of all seafood\(^4\) produced for human consumption.

FAO estimates that another 40 million tonnes of seafood worldwide per year will be needed by 2030 just to meet current consumption rates. Whilst world aquaculture production is expected to continue to grow over the coming decade, the rate of increase is expected to slow down.

Due to an increase in the number of farms, farmed areas and intensification of these, there has been a rapid increase in global aquaculture production. This has led to a call for more responsible management, due to concerns for the use of natural resources within their ecosystems for both inputs and outputs of the production process.

In terms of potential impact there is a great difference between fed (adding nutrients) and unfed aquaculture.

Fed aquaculture has been criticized as a net resource waste in terms of nutrient and/or wild fish used. Approximately one-third of all farmed food fish production (20 million tonnes) is currently achieved without external feeding, as is the case, for example, of bivalves and filter-feeding carps.


\(^4\) Here seafood means aquatic foods (i.e. it could also come from freshwater environments)
The aquaculture production and consumption chain can be divided into five steps:

- Production;
- Harvesting;
- Processing (and packing);
- Marketing;
- Consumption.

The aquaculture value chain often includes:

- Upstream inputs – the supplies and raw materials required for the production operation, such as feed, seed, fertilizer, veterinary medicines and other chemicals;
- Production – the process of transforming inputs into marketable products and services, normally involving the provision of infrastructure holding systems, energy, feeding and caring in general;
- Private service providers – providing the inputs and services to the producer to assist them, such as farm design, farm constructions, health services, environmental monitoring, etc.;
- Downstream outputs – the processing, packaging, marketing and distribution of finished goods.

Aquaculture stakeholders comprise primary stakeholders who are directly involved – positively or negatively – and secondary stakeholders who are indirectly involved. Secondary stakeholders include those who have technical expertise and/or links to primary stakeholders. These can be non-governmental organizations (NGOs) and local communities in the areas where aquaculture is taking place, various intermediary or representative organizations and technical and professional bodies. They often represent the interests of the general public.

The main natural resources required by aquaculture and competing claims on those resources include:

- Sufficient clean water supply;
- Sufficient space (land, sea or lake) that is not competing with other coastal users;
- Sufficient supply of seeds (eggs, larvae);
- Sustainable supply of fish meal, fish oil and other ingredients for fish feed;
- Energy supply.

Human resources, capital and infrastructure should also be included as necessary inputs. Sometimes there are competing claims in the use of these too.
In general, use of coastal zones and ‘common property’ of aquatic habitats involves potential interference with natural food webs, for example aquatic birds and other ecosystem components; potential interference with coastal artisanal fisheries and sport fishing; and other recreational uses.

8.2 Aquaculture outputs and impacts
(Prepared by Doris Soto)

The main negative environmental impacts, interactions and consequences of the outputs of aquaculture production involve, amongst others:

- **Feeding process** – this may involve fed versus non-fed aquaculture and intensive versus extensive aquaculture. In the case of fed and intensive aquaculture the non-eaten feeds and fish wastes release excess nutrients and organic matter to the environment that could cause eutrophication;
- **Escapes** – there are important risks to escaped fish. They have the potential for the introduction of exotic species and genes, and the spread of diseases affecting wild stocks and biodiversity;
- **Treatment of diseases** in intensive aquaculture involving the use of chemicals such as antibiotics, pesticides and other products.

There are a number of mitigation solutions including:

- Avoid farming in sensitive areas, for example on coral reefs and reproductive areas for native species;
- Aquaculture in semi-closed and closed systems with water re-circulation are probably the best solution and are presently feasible for salmon smolt production, for shrimp production and for other species. Re-circulation technology can retain more than 80 percent of organic matter and recycle up to 90 percent of water. However it can be too expensive for most aquaculture species and involves high energy use;
- Reduction of feed conversion factors by using better feeds, feeding detection systems, better training, and using more efficient farmed strains;
- Careful selection of individual sites and ensuring that the production is within the ecosystem carrying capacities;
- Having proper biosecurity frameworks in place, preventing diseases and avoiding the use of chemicals and other treatments;
- Appropriate monitoring and follow up. In many countries this is covered by government regulations such as the EIA. There are also other types of monitoring such as the integrated monitoring programmes covering whole areas and monitoring systems connected to Clean Production Agreements, traceability programmes or to certification systems.
One of the main issues of evaluating aquaculture impacts relates to the key response variables or indicators of significant environmental impacts:

- Easy to measure;
- Low cost – very important for small activities;
- Easy to check and verify by authorities;
- Convenient to use for regulation and mitigation.

What is most important however is to account for impacts on biodiversity and ecosystem processes. In this case local effects are perhaps less relevant and what is important is to understand the greater ecosystem responses and biodiversity recovery beyond local impacts.

**8.3 Why undertake environmental management?**

(Prepared by Patrick White)

All food systems, agriculture and livestock production have impacts just as aquaculture production does. However, the most important factor is the capacity of the environment to be able to cope with the impact and not be overwhelmed by it. “Environmental capacity is the ability of the environment to accommodate a particular activity or rate of an activity…without unacceptable impact.” Every environment can only handle a certain amount of input, for example nutrients, or output, for example harvest, for it to remain healthy. Therefore there are environmental limits on the scale and type of aquaculture systems that can sustainably operate in a certain ecosystem, which could be a water body, a lake, an inlet etc. It requires us to address the cumulative impacts of whole sectors and activities, and ideally all economic activities on the ecosystem within a specified area.

Whilst the ecosystem has some resilience or resistance to change, in general, ecosystems recover easily from small disturbances. The resilience of an ecosystem sets the amount of disturbance it can accept without damage to its prospects for rapid and full recovery. Many elements determine the resilience of an ecosystem, including its physical and biotic aspects.

Human disturbance of ecosystems fall into at least four key types:

- Addition of natural materials (for example organic waste, nutrients, exotic species) for which the ecosystem has a natural, but finite assimilative capacity, or removal capacity (such as oxygen, phytoplankton), which defines the carrying capacity of the ecosystem for that use;

- Addition of synthetic materials (such as PCBs) for which the ecosystem has no natural breakdown pathways and no assimilative capacity. If they are toxic they constitute a growing risk to wild and farmed organisms and humans;
• Extraction of natural components, for example through overfishing of larvae/seeds for aquaculture production, water abstraction etc.;

• Physical perturbation, for example changing the causeway of a river, building a dam, placing fish cages in an area where they interfere with natural movement or migration of species.

It is necessary to identify what are acceptable environmental impacts and what are not acceptable. It is necessary to determine what impacts and magnitudes are acceptable and whether the impact is reversible or whether the ecosystem is able to assimilate it. Impacts involving permanent damage have to be considered more carefully than those that can be reversed by natural recovery or remedial action.

The acceptable impacts of aquaculture can differ from country to country and are on a sliding scale of acceptability. More developed countries can afford stronger restrictions on aquaculture impact, such as Scotland, Norway and Canada. Less developed countries have different priorities, particularly in the short term. They may be more concerned with hunger and poverty alleviation than environmental impacts and be willing to accept higher impacts.

However there should be some overriding limits as to what are acceptable impacts and what are unacceptable.

Unacceptable aquaculture impacts are those that:

• Cause irreversible effects in general;
• Cause changes in water quality that could harm human health or the safety of human beings;
• Jeopardize the future productive base for short term economic benefit;
• Adversely affect essential ecological processes (for example oxygen availability);
• Adversely affect biodiversity or sensitive habitats;
• Utilize fish, larvae, fishmeal or fish oil from heavily exploited fisheries stocks.

The level of environmental management practiced by producers is a result of the following factors:

• What the laws and regulations are;
• What the regulators enforce;
• What the producers know and do;
• Economic costs – e.g. funding of studies and monitoring;
• Economic benefits – e.g. reducing overfeeding;
• Voluntary will – e.g. prevention of self-pollution and prevention of diseases;
• Peer pressure – e.g. producer codes of conduct;
• What other users of the aquatic resource demand e.g. tourism;
• What the markets impose e.g. certification schemes.
Improving environmental management can involve all the above factors, but some of them are more relevant and sustainable, such as improving the knowledge and technical capacity of the farmers and improving the capacity of the State to enforce environmental management.

It is important to clarify that even though we talk about ‘environmental management’ in general we cannot ‘manage the environment.’ Rather we manage human behavior and actions that have an impact on the environment.

Improving environmental management requires the social, economic and governance elements. The ecosystem approach to aquaculture, the EAA\(^{5}\), is a strategy for the integration of the activity within the wider ecosystem such that it promotes sustainable development, equity and resilience of interlinked socio-ecological systems. The EAA provides a planning and management framework whereby parts of the aquaculture sector can be effectively integrated into local planning. It affords clear mechanisms for engaging with producers and government for effective sustainable management of aquaculture by taking into account the environmental, the socio-economic and governance objectives. The EAA can facilitate the adoption of both international and national policies and regulations at any geographical or administrative scale. In many countries the EIA systems follow a similar process to the one described here for the EAA. In general however, they do not address the full range of social and governance issues. Strategic environmental impact assessments (SEIA), implemented in few countries, have a more Eco systemic view that could cover the added impact of many small farms. This type of EIA has more similarity to the EAA.

### 8.4 Environmental regulations and their application

(Prepared by Patrick White and Nelly Isyagi)

Aquaculture is normally governed both locally and internationally by different policies and frameworks from which the appropriate regulations are derived.

There are a number of international conventions that guide sustainable and responsible aquaculture development. In Africa the most relevant include:

- The Millennium Development Goals – currently most countries have signed and use these as guiding development principles;
- International regulations and non-binding agreements more widely followed are:
  - Convention of Biological Diversity (CBD);
  - FAO Code of Conduct for Responsible Fisheries;

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Sustainable aquaculture starts at the planning stage. This must include some essential elements from the environmental and social perspective: the zoning of aquaculture to reduce conflicts with other users of aquatic resources and minimizing environmental and negative social impacts; the estimation of the safe carrying capacity for aquaculture in the area; and undertaking some form of EIA or risk assessment as appropriate.

Sustainable aquaculture also needs good management and control. Management and control can be forced by regulators requiring regular environmental surveys; be they voluntary in the form of Codes of Best Practice; or certification schemes that require either a higher price or more stable market demand. Sustainable aquaculture management also benefits from a holistic approach in the form of ecosystem based management and co-management of production.

Permanent monitoring and control of aquaculture is required to ensure that it remains sustainable and in many countries this is strictly enforced by government regulators. Larger aquaculture farms are required to undertake regular monitoring surveys to ensure that impacts are within the limits described in: the EIA framework; any government water quality standards; and to control whether impacts are stable or getting worse.

There may be regional policies and regulations in place, guided by international regulations that are adapted to suit local regional conditions and developmental goals. Most are frameworks that enable regions and states to operate national and international guidelines/regulations.

In Africa there are regional policies created by NEPAD – Comprehensive Africa Agricultural Development Programme (CAADP). These are:

- Pillar 1: Sustainable land and water management;
- Pillar 2: Market access;
- Pillar 3: Food supply and hunger;
- Pillar 4: Agricultural research.

At a national level, aquaculture is controlled by legislation and regulations. The objectives are to promote the long-term growth of the aquaculture industry within the frameworks of sustainable and responsible development of the sector. Strong and fair regulations permit the growth of a healthy aquaculture industry capable of competing in the global market, while at the same time protecting the industry from threats such as disease, chemical contamination, over-capacity and environmental harm. The Licensing and Control Regulations should not create undue burdens on the investor, but all regulations must be enforced. The State must have the capacity to do so otherwise such regulations become no more than just ‘paper.’
Each country should have a national aquaculture policy, strategy and action plan. An aquaculture policy consists of a broad vision for the sector, reflecting priorities and development goals at various levels including provincial, national, regional and international. An aquaculture strategy represents a roadmap for the implementation of a policy and contains specific objectives, targets and instruments to address issues that might stimulate or impede the comparative advantage of the sector and obstruct its development. An aquaculture action plan represents a roadmap for the implementation of a strategy to achieve its objectives and implement strategy models. It is time-bound, contains specific programmes and activities, and details resources required to achieve them.

8.5 Site selection and carrying capacity estimation
(Prepared by Doris Soto and Jose Aguilar)

One key factor for minimizing negative impacts and unsustainable aquaculture development is the selection of appropriate spatial location for its undertaking.

In general, the specific site selection process can be simple when there is not much information and in places, regions and countries where aquaculture is a new sector it has often been based on trial and error. Once farmers acquire some experience they can start judging the benefits and drawbacks of a specific site in the absence of regulations or limitations beyond their own capacity to farm and produce.

The provision of adequate spatial planning for the sector is one of the key priority actions by governments in order to ensure sustainable aquaculture development.

Spatial planning, within an ecosystem approach to aquaculture, starts with an aquaculture zoning process and takes into consideration physical, ecological, productive and social carrying capacity. This could be done at a national, provincial or local level and can generate maps of suitable aquaculture areas or areas available for aquaculture. Elements to consider in this mapping may include size of the water bodies, water availability, temperatures, depths, conservation areas, distance from inputs and market distribution of local communities.

The concept of carrying capacity is born from the realization that profitable production reaches a maximum biomass within a certain area or volume of water, beyond which there is often a sharp decline in quality and yield, and losses are observed. In general terms, the carrying capacity for any sector can be defined as ‘the level of resource use both by humans or animals that can be sustained over the long term by the natural regenerative power of the environment.’
The selection of an area for aquaculture must consider at least four types of carrying capacity:

- The **physical carrying capacity** is the potential of an area/site to sustain aquaculture in that it has the appropriate physical characteristics (including minimal infrastructure and access). This is the primary selection criterion for an aquaculture activity and for aquaculture zoning and site selection.

- The **production carrying capacity** is the maximum yield that can be produced in the selected water body. This estimates maximum aquaculture production given the source of food and is typically considered at the farm level but should go beyond this. It is especially relevant when farming extractive species.

- The **ecological carrying capacity** can be described as ‘the population or biomass of a species that a specific habitat can permanently sustain without damaging the ecosystem from which it depends.’ It is the magnitude of aquaculture production that can be supported by the environment.

- The **social carrying capacity** can be defined as the amount/type of aquaculture (total production, number and density of farms, species and systems) that a social system can take without incurring in significant negative social changes. This is often the most difficult to address.

These four types of carrying capacity must be considered in the final decision. The selected area or site should be that where these four overlap.

### 8.6 Predictive modeling of environmental impacts

(Prepared by Patrick White and Doris Soto)

During the planning stage and before aquaculture is established in a certain area the potential impact on the environment should be assessed. One of the ways of predicting the impacts and effects is to use models or modeling that can predict the environmental impact of aquaculture together with representative observational data from the area. Once aquaculture has been established, regular environmental monitoring may show whether or not actual impacts are within the acceptable limits, if the impact is stable or is increasing over time.
There are at least three types of models:

- **Mass balance model**: this models the pathway and potential impacts of dissolved nutrients on water quality. Mass balance equation models can be used for many different parameters but is most widely used to model nitrogen and phosphorus concentrations in the water. For example, the use of a mass balance model for predicting water quality impact in Bolinao and Anda Bay in the Philippines in 2006. Here, over production from aquaculture led to very high nutrient levels leading to re-occurring fish kills in the farming systems.

- **Depositional model** (particle tracking): this models the pathway of particulate nutrients and predicts the severity and extent of impact on sediment quality. Depositional models predict particulate outputs from fish cage aquaculture (quantity and location) and can be used to predict the organic footprint and impact on sediment and sensitive demersal flora and fauna. These models use hydrodynamic data (current speed, direction and dispersion) to predict organic flux from cage culture to the seabed. They can be used to predict sustainable aquaculture yields, local impacts of fish farming on sediment and water quality. An example of the TROPOMOD model was given to show how impacts were minimized and fish production was optimized at Panabo Mariculture Park, Philippines.

- **Dynamic model**: this model predicts impact change in the environment over time.

### 8.7 EIA components and process

(Prepared by Patrick White and Nelly Isyagi)

Many related environmental instruments, regulations and codes exist. Some of the acronyms and definitions are listed as follows:

- 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.
Environmental regulations recognize that any new activity can impact on the environmental and social systems. Often they recognize that some of the key impacts of developments are found away from the project site. This can be either elsewhere in the ecosystem, outside in the community, or linked to parallel developments in the supply chain.

An Environmental Impact Assessment (EIA) is defined as, ‘the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals, prior to major decisions being taken and commitments made.’

An EIA serves three main purposes:

- To inform a consenting or licensing decision;
- To identify mitigation measures that will minimize any possible environmental impact, and often social impact;
- To generate a monitoring system and follow up mechanisms.

The EIA has been developed and widely used for other sectors, but has been adapted for aquaculture more recently. The requirements and implementation of aquaculture EIAs vary from country to country. The need will depend on the technology and systems applied – intensive production often has the potential to cause larger impacts. Most countries require some form of EIA for aquaculture.

An EIA is most commonly applied to intensive, marine, fin-fish culture (especially salmon culture) and for large-scale shrimp farm developments. However, some countries with significant large-scale aquaculture industries (including Japan, Thailand and parts of Europe) do not apply EIA to aquaculture development, but rather rely on a range of alternative environmental management procedures.

A full EIA is not applied to the bulk of global aquaculture production. This is because most production is small scale, and in many cases is a traditional activity. There are less rigorous forms of environmental assessment, for example environmental declarations and initial environmental assessments, that are increasingly applied as part of the permitting or licensing procedure for small-scale aquaculture developments.

According to a recent review produced by the FAO on this topic the typical EIA process follows a number of steps that were described in the training.

**Screening**

The first step is usually the screening stage. Applications are filtered by the Environmental Authority and a decision is made as to whether a full EIA must be undertaken, to what level, or if indeed no EIA is required. Most countries apply thresholds that may include area, production level, intensity, technology or species. In some cases, an EIA is triggered by specific characteristics, such as the introduction of alien species.
A project can also be rejected at this point as environmentally unsustainable. Decisions taken can be important for the future of a proposal as to whether or not the project can go ahead and the cost to undertake the study to the investor.

Projects that carry the most risk – usually large-scale, with intensive culture methods or located in a sensitive area – are usually liable to undertake a full in-depth EIA. Smaller pond farms are usually exempt. Medium-scale enterprises may have to undergo limited assessments 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 phase to integrate environmental concerns into the siting and methods to be used.

**Scoping**

If the screening identifies the need for an EIA, most national procedures require a second phase – scoping – to determine the most important issues during the EIA and to eliminate those that are of little concern. The use of risk assessments at this stage is required to allow the EIA to focus on the impacts that might have the highest risk. In this way, EIAs are focused on the potentially significant effects so that time and money are not wasted on minor impacts.

**Public consultation**

Once scoping is completed, the terms of reference for the EIA are agreed upon. Public consultation can be planned and initiated at this stage so that concerns and priorities of the local communities and relevant stakeholders are taken on board as early as possible. Public consultation is not always usual in practice, but is highly recommended.

**EIA and report**

The EIA involves investigations and evaluation of potential impacts identified in the terms of reference prepared after the screening phase. This stage forms the heart of the EIA process. It involves a detailed assessment and analysis of all the important potential impacts identified during the scoping stage. The study is normally the responsibility of the farmer and he may often hire technical experts, especially for larger projects. Often the EIA will use models or graphics tools to predict impacts and effects. In order to prepare the EIA the full technical and business plan of the proposed activity must be available. The end product is an EIA report – or an Environmental Impact Statement (EIS) – that forms the basis for institutional review and the decisions on the final approval for the project.

**Environmental baseline**

The identification and prediction of the magnitude of eventual impacts needs to be undertaken against an environmental baseline. Where this baseline information does not already exist, the necessary data must be obtained as part of the EIA.
Acceptable limits

It is necessary to determine the acceptable level of impacts of new activities with some known or agreed standards and critical values. These can be published by the national agency e.g. water quality criteria or standards, such as the Biological Oxygen Demand (BOD) in water effluent and chemical pollutant concentrations; or water consumption levels. These standards have yet to be determined in many African countries.

Possible alternatives

The EIA must consider possible production and management alternatives. A comprehensive EIA is required to assess the relative environmental costs and benefits in making choices between aquaculture and other alternative uses of resources. 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 could mitigate some of the potential impacts.

8.8 Environmental Management Plan

The purpose of an Environmental Management Plan (EMP) is to identify management measures aimed at preventing or minimizing potential adverse environmental impacts. Impacts arise from construction and installation, operation of the aquaculture farm and decommissioning. The EIA should minimize impacts on sensitive habitats and species and ensure the maintenance of good water quality. It should also ensure nutrient inputs are within safe levels for both humans and marine communities. The EMP will ensure compliance with environmental regulatory requirements.

The content of an EMP should include the structure and responsibility of the implementing person or team with emergency contact details, data collection and analysis and reporting requirements for the activities. The EMP should also contain an environmental training plan, activities for key personnel and complaints handling protocols for local communities and other stakeholders.

The EMP should have a number of environmental management sub-plans to provide guidelines for the operation of the farm. These could include:

- Emergency Response Plan;
- Waste Management Plan;
- Work Health and Safety Management Plan;
- Traffic Management Plan;
- Marine Fauna Interaction Management Plan;
- Disease, Parasite and Pest Management Plan;
- Escape Management Plan.
8.9 Environmental monitoring

(Prepared by Patrick White and Nelly Isyagi)

Environmental monitoring is undertaken to assess, and more often to estimate, the actual impact on the environment and ecosystems and to detect improvements or degradation in environmental quality. In the context of an EIA, monitoring provides an understanding of the development conditions before the project has started, gives feedback on the actual environmental impacts of the project and assesses the effectiveness of mitigation measures applied.

Monitoring the implementation of mitigation measures and the quality of the local environment also varies between countries. Some countries conduct random checks on farms that have been through the EIA process. There is a need for good analysis of monitoring information and feedback for better farm and sector management.

Monitoring programmes should have a number of objectives:

- Document baseline conditions;
- Predict potential impacts;
- Ensure that the Environmental Management Plan is being followed and is effective;
- Monitor compliance with agreed conditions;
- Identify trends in impacts;
- Assess the effectiveness of environmental protection measures;
- Review activities and/or mitigation measures;
- Prevent disasters and emergencies.

Baseline monitoring

Baseline monitoring is undertaken before a project starts or before a major expansion of an authorized project, in order to establish existing environmental conditions and provide background data for future comparisons.

The purpose of baseline monitoring is to gather information on the environment that is potentially at risk from a proposed aquaculture project or activity. It should identify sensitive ecosystems or habitats in the proposed location and assess potential threats. Information gathered on existing conditions provides a baseline to subsequently assess post-development changes. Baseline monitoring typically examines the physical, chemical and biological variables in an ecosystem. It can also be used for social components and assessments.
Monitoring survey

A monitoring survey collects data during farm operations and provides information on actual impacts in relation to baseline data. The results may be used directly for management decisions by both fish farmers and environmental regulators by ensuring adherence to standards and acceptable zones of effect.

The monitoring survey design should take into consideration:

- The key variables to be measured/evaluated;
- Frequency of sampling;
- Position of sampling stations;
- Method of sampling water or sediments;
- The need to have replicated samples to account for natural variability and must consider reference or control points;
- Method of analysis of the samples taken to measure chosen parameters.

Sampling should be cost effective to maximize data collection per expended effort, it should also be easy to perform and amenable to replication and verification.

8.10 Strategic Environmental Assessment

(Prepared by Patrick White and Nelly Isyagi)

A Strategic Environmental Assessment (SEA) is defined as, ‘a formalized, systematic and comprehensive process for evaluating the environmental effects of a policy, plan or program and its alternatives.’ A SEA considers all the different impacts generated by different human activities on a defined common ecosystem or water body.

A SEA therefore encompasses procedures such as programmatic environmental assessments (EA), regional EAs and sector EAs.

The core idea is that the collection of information relating to many actual or possible developments is used to inform higher level strategic decisions in terms of management and mitigation measures for the sector, for a particular area or in relation to a government programme. The level at which an SEA is undertaken is a key issue for more effective management of aquaculture development, especially when there are many small-scale aquaculture activities that could have significant added and synergic effects on the ecosystem.

The strategic component of a SEA refers to the set of objectives, principles and policies that give shape to the vision and development intentions incorporated in a policy, plan or programme. SEAs deal with concepts and goals, not with particular activities.
The distinction between SEAs and project-level EIAs are that the SEA is broader in scope and is used as a strategic planning tool for development. Project-level EIAs address specific issues and impacts at specific locations. SEAs do not replace project-level EIAs.

SEAs promote sustainable development by enhancing the integration of environmental concerns in policy and planning processes. They address the limitations of project-level EIAs that look at individual projects and do not fully take into account cumulative effects of a number of farms in the watershed or water body.

SEAs can be applied to various sectors (e.g. aquaculture, tourism, etc.); geographic areas (e.g. land use or development plans at various scales - local, regional, national, international and global etc.); and actions that do not give rise to projects but that may result in significant environmental impacts (e.g. new technologies, new aquaculture practices, etc.).

SEAs are considerably more complex than project-level EIAs because the policy, plan or programmes involve multiple activities. SEAs are likely to have greater and more diverse impacts over a larger area, be subject to more legislation and policies and open to a wider range of alternatives. However, SEAs follow similar steps for their undertaking, such as screening, scoping, baseline survey, etc.

9. Site visits

Site visits were made to the National Agricultural Fisheries Resources Research Institute, Uganda (NaFIRRI) and the Source of the Nile Fish Farm.

9.1 NaFIRRI

Dr. Balirwa, the Director of NaFIRRI, welcomed the group to the Institute and explained the new development of Aquaculture Parks in Uganda. Dr. Balirwa gave a detailed description of the cage culture system and management.
Source of the Nile Fish Farm

Mr. Robert Osinde, the Manager of the Source of the Nile (SON) Fish Farm based in Jinja, gave the participants an overview of the private sector experience in developing an aquaculture business. He outlined the environmental management measures that SON has taken and Allen Kusasira gave details on the production process.

The ponds at SON are used for breeding and seed production. The farm has its own breeding programme from which broodstock are obtained for seed production. Spawning is done in open ponds. Swim-up fry are then collected, graded and sex-reversed in hapas. They are reared in nursery hapas until they are about 0.25 grams, and are then transferred for on-growing into open nursery ponds until they are 1 gram. These are raised on the farm as seed for the cages and some are sold to grow-out farmers. Production for grow-out farmers is done on demand.
Low-volume high-density (LVHD) cages are used as nursery and grow-out cages. Juvenile cages stock fish at 1 gram and are harvested after about a month at 3-5 grams. The fish are then stocked in ‘double’ production cages from which fish of 350-500 grams are harvested. These ‘double’ cages have an inner cage of finer mesh that is removed as the fish get older. Fish are fed extruded pellets from TFL, Mauritius (45 percent and 35 percent CP) and Ugachick Poultry Breeders Limited, Uganda (30 percent and 25 percent CP). The former feed is used largely during the early juvenile stages and in the last phase of production to boost growth. About 80 percent of the feed comes from Ugachick. Locally made demand feeders are used to feed cages. Average growth rates of 1.5 gram per day and feed conversions of 1.6 are achieved in the cages. Survival rates range from 80-95 percent and the standing crop at harvest on average is about 65 kg/m$^3$.

The participants were informed of the aquaculture and environmental permits that were required before the farm could start. They were informed of current environmental management procedures at the farm and how the farm is integrated with the local community. The participants were informed of the fish production process and visited the broodstock, fry and nursery ponds onshore as well as cages in the lake.

**Figure 2: Participants visiting SON broodstock, fry and fingerling ponds.**

**Figure 3: Participants visiting SON LVHD cages.**
Box 1: SON Fish Farm list of permits and licenses required.

<table>
<thead>
<tr>
<th>Permit/License</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland use permit</td>
</tr>
<tr>
<td>Waste water discharge</td>
</tr>
<tr>
<td>Surface water abstraction</td>
</tr>
<tr>
<td>Operational license</td>
</tr>
<tr>
<td>Trading license</td>
</tr>
<tr>
<td>EIA certificate</td>
</tr>
<tr>
<td>Aquaculture establishment permit</td>
</tr>
<tr>
<td>Aquaculture seed production permit</td>
</tr>
<tr>
<td>Fish movement permit</td>
</tr>
<tr>
<td>Fish export permit</td>
</tr>
<tr>
<td>Hormone use and importation license</td>
</tr>
</tbody>
</table>

10 Case studies

After the visit participants discussed what they had seen and what they thought were the most important social and environmental issues.

As a continuation of the training, the participants undertook a practical case study exercise. The participants were divided into two groups. Participants from the same country were put into different groups.

Each group of participants were asked to undertake the following:

- **Prepare a business plan**: the participants were asked to develop a business plan for a commercial farm with a budget of US $500,000. They were asked to calculate the size of the farm’s growing facilities, the number of staff and possible impact issues. Group A was requested to do it for a cage farming activity and Group B for a pond activity.

- **Present the plan for EIA screening**: one of the participants was asked to present the business study to the other group for pre-screening. The other group played the role of the government institutions that are in charge of the EIA process. Group B listened and reviewed Group A’s presentation and decided whether the project proposal required a full EIA, a partial simplified EIA or would be exempt from an EIA. They exchanged roles and then each group continued with the following steps.
- **Identify the main issues:** the participants were asked to identify the main issues from the point of view of a range of stakeholders. The stakeholders were as follows:
  - Representative from the Aquaculture Department;
  - Representative from the Environment Department;
  - Representative from the local mayor’s office;
  - Leader of the local community;
  - Leader of the fishermen’s association;
  - NGO for environment and wildlife;
  - Local policeman;
  - Local agriculture farmer.

- **Prioritize the issues:** the participants were asked to prioritize the issues that were identified using a simple qualitative form of a risk assessment.

- **Identify data:** the participants were asked to identify the data required to evaluate the risks and undertake the baseline survey. They were also asked to identify if this information would be locally available or would need to be collected.

- **Identify mitigation measures:** the participants were asked to identify mitigation measures for the key issues that would form part of the Environmental Management Plan.

- **Present their findings:** finally the participants were asked to present their outline EIA and EMP to the Department of Environment for EIA approval and to the Aquaculture Department for a license to operate.
The two case studies are outlined below.

**Figure 4: Participants identifying and prioritizing issues.**

10.1 Cage farm

The business plan that was developed for the cage farm was for 100 LVHD nursery and grow-out cages measuring 2.5 m x 2.5 m x 2.5 m deep, producing 300 tonnes per annum in two cycles. All male Tilapia fry would be bought from local hatcheries. The location of the farm would be in relatively shallow water in a semi-enclosed bay, near a medium sized town. The farm would employ 50 people for its operation and management.

Table 3 below summarizes the potential issues that were identified and their priority based upon the likelihood of occurrence and potential consequences.
Table 3: Summary of issues likely to arise from the establishment of a cage farm.

<table>
<thead>
<tr>
<th>Main concerns</th>
<th>Specific areas of concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Socio-economic</td>
<td>Labor issues (4) – may have foreign people as labor and expensive labor. Use of space (6) – jetties or landing sites may occupy land owned by local community and there may be conflict for resources between cage owner and hotel owners. Market Competition (12) – local fish supply likely to increase making prices to fall, increased competition against alternative sources of protein, for example beef; investor may import all materials, including what is locally available, from outside. Services (15) – increase in demand for local services notably accommodation, waste disposal, security, water and power.</td>
</tr>
<tr>
<td>2. Ecosystem health</td>
<td>Changes in biodiversity (20) – arising from the introduction of exotic species, fish escaping from cages into main water body and cages may attract birds and other pests from other areas. Also interference with breeding grounds. Pollution (12) – arising from waste from farm operations being washed onto beaches as well as mixing with the water, increased domestic waste due to an increase in local population and habitat degradation. Animal welfare (2) – issues arising from stress, disease that may be passed on among wild fish populations as well as other wild animals. Food safety (9).</td>
</tr>
<tr>
<td>3. Governance</td>
<td>Increase in conflicts – arising from access to resources. Increase in insecurity. (Both were collectively ranked under competition for resources)</td>
</tr>
</tbody>
</table>

*Numbers in brackets are scores from risk assessment matrix.*
Table 4 below lists the recommended mitigation measures:

**Table 4: Mitigation measures for a cage culture establishment.**

<table>
<thead>
<tr>
<th>Concerns</th>
<th>Recommended mitigation measures</th>
</tr>
</thead>
</table>
| Biodiversity            | Stock endemic species  
                          | Cover cages  
                          | Use strong net material and cage framework  
                          | Capacity building  |
| Fish health             | Regular health monitoring  
                          | Use fingerlings from disease free areas/approved hatcheries  
                          | Use proper stocking density  
                          | Regular cleaning of nets, cages, etc.  
                          | Discourage birds from perching  |
| Pollution               | Avoid use of chemicals – only use appropriate chemicals, for example drugs, sex-reversal hormones etc. based on recommended guidelines  
                          | Maintain proper carrying capacities  
                          | Avoid disease break-outs  
                          | Avoid spillages of engine fuels, feeds, etc.  |
| Services                | Additional investment into service delivery to support increased population  
                          | Give incentives to service providers  
                          | Use of local materials as much as possible  
                          | Use of local community to supply labor  |
| Market competition      | Sell fish outside the locality, for example produce for export  
                          | Market promotion  
                          | Grade fish and add value for different markets, for instance domestic and export markets  |
| Food safety             | Sensitization – capacity building on food safety and hygiene  
                          | Fish inspection – issuance of Health Certificates  
                          | Cleaning – use of clean nets and other fish handling equipment and facilities  
                          | Appropriate fish preservation methods, for example cold stores, coolers etc.  |
| Use of space            | Zoning – define operational areas to avoid conflicts with other natural resource users  
                          | Maximize use of spaces, for instance optimum stocking densities, higher efficiencies etc.  
                          | Licensing  |
Table 5 shows the parameters that participants recommended for EIAA monitoring and evaluation:

**Table 5: Data requirements for monitoring a cage farm.**

<table>
<thead>
<tr>
<th>Area of concern</th>
<th>Data requirements</th>
<th>Source of data (A = Available / C = Collect)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity</td>
<td>Local fish species and stocks</td>
<td>A/C</td>
</tr>
<tr>
<td></td>
<td>Birds found locally</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Local flora and fauna</td>
<td>C</td>
</tr>
<tr>
<td>Health issues</td>
<td>Understand the common fish diseases and their control</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Need to know which diseases can be spread by birds and their causative agents</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Effect of the disease on fish, humans and their associated economic loss</td>
<td>A</td>
</tr>
<tr>
<td>Services</td>
<td>Number of people to be employed (labor force)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Facilities and infrastructure required for water harnessing and waste disposal</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Local population statistics</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Number of fish farmers, fishers and traders</td>
<td>A</td>
</tr>
<tr>
<td>Market</td>
<td>Current price of fish</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Amount of fish produced</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Species of fish available in the market</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Market survey for fish supply and demand</td>
<td>A/C</td>
</tr>
<tr>
<td>Pollution</td>
<td>Type and form of waste – for example excreta or fish feed</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Nutrients released – notably nitrogen and phosphorus</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Ways of waste treatment</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Fish biomass</td>
<td>A</td>
</tr>
<tr>
<td>Food safety</td>
<td>Fish handling techniques</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Fish products</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Methods of fish preservation and grading</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Chemicals used in the production process – for instance antibiotics, hormones etc.</td>
<td>A</td>
</tr>
</tbody>
</table>
10.2 Pond farm

The farm was located 14 km away from a lake-shore town, close to a permanent small river, which was its water source. The following is an outline of the pond farm case study:

**Box 2: Business plan for the pond farm.**

<table>
<thead>
<tr>
<th>Tilapia aquaculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production system: Intensive, semi-water reuse system, stocking rates 8 fish/m²</td>
</tr>
<tr>
<td>Farm size: 10 ha total water surface area comprising 20 ponds, each 1,000 m²</td>
</tr>
<tr>
<td>Targeted levels of production: 10 tons per ha</td>
</tr>
</tbody>
</table>

Table 6 shows the main issues that the group felt were likely to arise from such an enterprise:

**Table 6: Summary of concerns likely to arise from the establishment of a pond farm.**

<table>
<thead>
<tr>
<th>Major concern</th>
<th>Specific area of concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-economic</td>
<td>Competition for resources (6) – local fishermen denied a livelihood because of reduced catches arising from reduced water levels as a result of increased levels of water abstraction from local river. On the other hand, there would be reduced fishing pressure on the natural water body.</td>
</tr>
<tr>
<td></td>
<td>Marketing (16) – loss of market for fishermen’s fish.</td>
</tr>
<tr>
<td></td>
<td>Land Use (15) – changes in land use; changes in tourism sites.</td>
</tr>
<tr>
<td></td>
<td>Community Service (9) – there may be an increase in crime and conflict arising from competition for local resources; extra demand on policing and other services from the town council. Additional pressure on local infrastructure. Community benefits from the project, such as jobs.</td>
</tr>
<tr>
<td>Ecosystem Health</td>
<td>Pollution (9) – an increase in local population arising from personnel, their families and service enterprises that may arise or expand. More effluent discharge into lake.</td>
</tr>
<tr>
<td></td>
<td>Biodiversity (10) – positive and negative impacts on biodiversity. Changes in fish biodiversity arising due to escapes from ponds, effect of water abstraction on breeding grounds and possible interference of establishment on wildlife migration routes etc.</td>
</tr>
<tr>
<td>Governance</td>
<td>Conflict resolution – policing</td>
</tr>
</tbody>
</table>

*Numbers in brackets are a risk analysis scores.*
The following were the recommended mitigation measures from the pond case study (Table 7):

**Table 7: Mitigation measures for pond culture establishment.**

<table>
<thead>
<tr>
<th>Concerns</th>
<th>Recommended mitigation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>Sell fish in local markets during the season when the lake is closed</td>
</tr>
<tr>
<td>Land use</td>
<td>Plant trees in the watershed</td>
</tr>
<tr>
<td></td>
<td>Employ local community</td>
</tr>
<tr>
<td></td>
<td>Seek alternative livelihoods for the people who previously used the land on which the farm is now located</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Seek to enhance biodiversity, for instance by creating refuges, protecting breeding grounds etc.</td>
</tr>
<tr>
<td></td>
<td>Screen all inlets and outlets from farm</td>
</tr>
<tr>
<td>Pollution</td>
<td>Install suitable infrastructure to handle and biodegrade all waste before it is released into the environment, for example bio filters etc.</td>
</tr>
<tr>
<td>Services</td>
<td>Collaboration with local administrative and law enforcement agencies</td>
</tr>
<tr>
<td></td>
<td>Incorporation of all stakeholders in project management</td>
</tr>
<tr>
<td>Competition for resources</td>
<td>Use water only when needed and leave river flow intact</td>
</tr>
<tr>
<td></td>
<td>Construct a water reservoir on the farm and integrate project with other projects</td>
</tr>
</tbody>
</table>
Table 8 shows the data requirements participants suggested for monitoring the pond farm:

**Table 8: Data requirements for monitoring pond farm.**

<table>
<thead>
<tr>
<th>Area of Concern</th>
<th>Data Requirements</th>
<th>Source of Data (A = Available / C = Collect)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity</td>
<td>Status of existing flora and fauna</td>
<td>A/C</td>
</tr>
<tr>
<td>Pollution</td>
<td>Limnology</td>
<td>A/C</td>
</tr>
<tr>
<td></td>
<td>Hydrology</td>
<td>A/C</td>
</tr>
<tr>
<td></td>
<td>Effects of discharge on river and lake biodiversity</td>
<td>A/C</td>
</tr>
<tr>
<td>Market</td>
<td>Quantity of fish in the market</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>The number of fishermen</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>The price of fish</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>The species in the market</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Trends of fish supply and demand</td>
<td>C</td>
</tr>
<tr>
<td>Land use</td>
<td>Land ownership</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Demography</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Current land use</td>
<td>A/C</td>
</tr>
</tbody>
</table>

**10.3 Overall evaluation of the case study exercise**

The participants benefitted from this exercise as it allowed them to follow the steps to undertake an EIA. It also gave them the ability to understand the different viewpoints of the aquaculture developer and the environmental and social concerns of stakeholders, and the environmental data collection and analysis that need to be undertaken by the service providers doing the EIA. Finally it gave them an opportunity to understand the evaluation of the EIA application by the government authorities.
11. National critical evaluation of the current EIAA implementation status and conclusions

Following the presentations detailing the best environmental management practices and the case studies, each participant was asked to identify the gaps in their country’s environmental planning and management of aquaculture. They discussed how those gaps could be addressed and who should address these gaps. Finally they were asked what outside technical assistance they would require.

11.1 Individual country gaps in environmental management for aquaculture.

The following outlines the participants’ views of the major gaps in EIAA implementation in their respective countries.

Sudan
EIAA is not implemented in aquaculture in Sudan because it has not yet grown into a significant sector. This provides the chance to develop aquaculture with EIAA principles in mind, involving all the necessary steps, including certification, permits, monitoring and evaluation.

South Sudan
Aquaculture strategic plans for South Sudan have not yet been developed. The absence of an EIAA policy framework has delayed implementation. EIAA regulations and application have not been developed and no EIAA guidelines and manuals are in place.

Kenya
- In Kenya there is no policy on cage culture;
- There is a lack of proper mitigation measures, particularly in terms of effluent discharge in pond culture;
- The Annual Environmental Audit is not properly followed;
- There is a lack of specific guidelines for EIAs in the aquaculture – general guidelines are applied.

Zambia
- In Zambia there is inadequate technical knowledge of EIA procedures amongst aquaculture staff;
- There is a lack of enforcement of environmental regulations for small-scale aquaculture entrepreneurs;
- There is a lack of systems to certify fish seed producers;
- There are inadequate systems for the control of fish imports.
Democratic Republic of Congo

Current provisions in DRC are general and focus on preventing threats in the future and making good use of aquaculture land. Aquaculture in DRC is still practiced in marshy valleys that cannot be used for other agricultural practices.

Comoros

There is no aquaculture development in Comoros, so there is no EIA framework. The Department of the Environment oversees environmental management in the country in collaboration with the relevant departments. This is done with the collaboration of the Aquaculture and Fishing Department.

Malawi

- There are no guidelines for investment in aquaculture in Malawi;
- As a result there are no guidelines for EIAs specific to aquaculture;
- There is no provision for EIA in the fisheries legislation;
- There are no experts in EIA in the Department of Fisheries, Department of Environmental Affairs and other agencies that need to do EIAs;
- There is no Environmental Strategic Plan;
- There is poor coordination of sectoral stakeholders in environmental issues;
- Environmental issues are handled by another governmental department;
- Unavailability of environmentally friendly production technologies both in pond and cage culture systems;
- Limited knowledge of EIA by investors in aquaculture.

Tanzania

- There are different policies and regulations between environmental and aquaculture departments in Tanzania;
- Cage culture is not well developed in the country;
- EIAs have not yet been implemented for any aquaculture projects;
- Not all people are aware of EIA principles.

11.2 Synthesis of the gaps in environmental management for aquaculture found in the region

There was a wide range of gaps identified by the different countries depending on the level of aquaculture development. Some counties had no aquaculture and therefore did not have EIAs or environmental management measures in place. Other countries with well-developed aquaculture had substantial measures in place.
There were three main gaps:

1. Environmental management process and measures;
2. Environmental management governance and implementation;
3. Environmentally friendly culture systems and practices;

Environmental management process and measures

The main gaps included the:

- Lack of site selection criteria and methodology;
- Lack of knowledge on the EIA pre-screening scope, process and evaluation;
- Lack of knowledge and experience on the EIA evaluation process;
- Lack of knowledge on the EMP scope and mitigation measures;
- Lack of knowledge on the environmental monitoring requirement and evaluation;
- Lack of awareness of and appreciation for EIA.

Environmental management governance and implementation

Some very common issues were identified, these included:

- Differences in policy for environmental planning and management of aquaculture;
- The lack of coordination between the aquaculture department and the environmental department in environmental planning and management of aquaculture.

Other common gaps identified included:

- The lack of an EIA framework and regulations for aquaculture in countries where it had not yet started or where the industry was still small and based on small-scale producers;
- The lack of technical knowledge and capacity within the aquaculture department and the environmental department to develop and implement an EIA for aquaculture;
- Haphazard application and lack of enforcement (especially for small-scale producers) of any EIA or environmental regulation measure for aquaculture;
- Lack of environmental monitoring during farm operations;
- Lack of laboratory capacity for undertaking analysis of samples from baseline and monitoring surveys.
Environmentally friendly culture systems and practice

In many countries there was a lack of knowledge about environmentally friendly culture systems and practices. Examples were given including low impact cage culture systems, highly digestible feeds and good feeding practices, and effluent settlement ponds for land-based fish production.

12. Recommendations and the way forward

The measures that are required to address gaps were identified and grouped into four main areas:

- Improved governance;
- Training requirements;
- Capacity building;
- Environmentally friendly culture systems.

Governance

- Development of appropriate aquaculture specific EIA policies and guidelines including new technologies, such as cage culture;
- Develop an Environmental Strategic Plan for aquaculture – technical assistance required;
- Establish functional linkages between key government departments, notably environment, water, and land, in the implementation and management of EIAA;
- Establish an EIA section for aquaculture by the department of fisheries;
- Create a conducive environment for the establishment of consultative aquaculture EIA firms.

Capacity building and training requirements

- Capacity building of fisheries officers and other stakeholders in the principles, implementation, and management of EIAA;
- Training of trainers for both fisheries and environmental officers that includes training tools kits and manuals that can be used to disseminate the information down to small-scale communities and the private sector;
- Sensitization and advocacy of EIAA to farming communities and relevant stakeholders;
- Development of EIAA training and operational manuals for both managers and operators of establishments based on best practice and local requirements;
- Establish technical capacity to implement and manage EIAA. This would involve staff training, establishment of laboratory capacity, equipping departments with appropriate tools and equipment, support to extension services and finance;
- Exposure to best practice operations for relevant key government departments and other stakeholders.
Environmentally friendly culture systems

As a way forward it was agreed that:

- Countries adopt and implement the principles of EIAA according to best practices;
- Specific national EIAA policies, strategies and programmes be developed and incorporated in current aquaculture and environmental guidelines;
- Financial and technical assistance should be looked for to build the capacity of countries to implement and manage EIAA;
- Capacity building would include: improving levels of public awareness; conducting training of trainers; establishing technical capacity to execute EIAA in terms of providing local personnel with relevant skills; providing appropriate specialized equipment; improving functional linkages between stakeholders (both public and private sector); establishing EIAA units in relevant departments; and developing, producing and distributing training and operational guidelines and manuals;
- Adopt environmentally friendly production systems.
13. Workshop training evaluation survey

Seventy five percent of participants filled in the evaluation form (see Annex C-1). The majority of respondents found the training very useful and mentioned that they had learnt a lot. They were satisfied with the quality of training given. In addition, most respondents felt the duration of the course was correct and that enough information had been provided.

The participants would recommend the training to other stakeholders and suggested future workshops should additionally target a broader spectrum of stakeholders in the aquaculture sub-sector, such as field environmental officers, aquaculture field personnel, producers and personnel from environmental management agencies.

Trainer of trainers programmes need to be considered if the practice of EIAA is to be implemented effectively in the respective countries. It was recommended that more time be allocated to practical exercises in the field, and that field activities be representative of the existing production systems to enhance the quality of training. Only a public research facility and large commercial farm were visited during this programme, yet aquaculture in the respective region is characterized by small-scale fish farmers.

In the ensuing trainings, more consideration needs to be given to participants’ lingua franca and, where necessary, translation services should be provided. The French speakers were unable to fully participate and felt they missed out on a lot of useful information during the workshop. The workshop was run in English.
## Annex 1. List of Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Tel.</th>
<th>Email address</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comoros</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
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<tr>
<td><strong>Malawi</strong></td>
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<td><a href="mailto:ofumu@hotmail.com">ofumu@hotmail.com</a></td>
</tr>
<tr>
<td>Mussa Alsi Makame</td>
<td>Project Officer</td>
<td>+255 773189963</td>
<td><a href="mailto:kijijini19@yahoo.co.uk">kijijini19@yahoo.co.uk</a></td>
</tr>
<tr>
<td><strong>South Sudan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Workshop for environmental management and environmental impact assessment in aquaculture</strong></td>
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<tr>
<td><strong>Uganda</strong></td>
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</tr>
<tr>
<td>Sarafino Aloma Francis</td>
<td>Director General Fisheries and Aquaculture Development</td>
<td>+211 955187673</td>
<td><a href="mailto:sarafinoaloma@ymail.com">sarafinoaloma@ymail.com</a></td>
</tr>
<tr>
<td>Daisy Olyel Aciro</td>
<td>Senior Fisheries Inspector</td>
<td>+256 772636438</td>
<td><a href="mailto:daisyolyel@yahoo.com">daisyolyel@yahoo.com</a></td>
</tr>
<tr>
<td>Francis Mukalazi</td>
<td>Senior Fisheries Officer</td>
<td>+256 312290287</td>
<td><a href="mailto:mukalazif@yahoo.com">mukalazif@yahoo.com</a></td>
</tr>
<tr>
<td>Elizabeth Claire</td>
<td>Fisheries Inspector</td>
<td>+256 753126966</td>
<td><a href="mailto:liz11claire@yahoo.co.uk">liz11claire@yahoo.co.uk</a></td>
</tr>
<tr>
<td>Alio Andrew</td>
<td>Assistant Commissioner - Aquaculture Management</td>
<td>+256 772567189</td>
<td><a href="mailto:andrewalio@gmail.com">andrewalio@gmail.com</a></td>
</tr>
<tr>
<td><strong>Sudan</strong></td>
<td></td>
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</tr>
<tr>
<td>Nadia Eldirdiry Omer Karoum</td>
<td>Director General Fisheries and Aquaculture Development</td>
<td>+249 111253422</td>
<td><a href="mailto:nadiakaroum@yahoo.com">nadiakaroum@yahoo.com</a></td>
</tr>
<tr>
<td>Abdelhalim Ahmed Elsyed</td>
<td>Director General of Fisheries - North State</td>
<td>+249 912352867</td>
<td></td>
</tr>
<tr>
<td><strong>FAO</strong></td>
<td></td>
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</tr>
<tr>
<td>Doris Soto</td>
<td></td>
<td></td>
<td><a href="mailto:doris.soto@fao.org">doris.soto@fao.org</a></td>
</tr>
<tr>
<td><strong>Consultants</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patrick White</td>
<td></td>
<td></td>
<td><a href="mailto:patrick.white@wanadoo.fr">patrick.white@wanadoo.fr</a></td>
</tr>
<tr>
<td>Nelly Isyagi</td>
<td>Aquaculture Management Consultants Limited</td>
<td>+256 782728028 +44 7435341518</td>
<td><a href="mailto:nisyagi18@gmail.com">nisyagi18@gmail.com</a> <a href="mailto:a.m.consult.ltd@gmail.com">a.m.consult.ltd@gmail.com</a></td>
</tr>
<tr>
<td><strong>Private Sector</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robert Osinde</td>
<td>Farm Manager, Source of Nile Fish Farm, Uganda.</td>
<td>+256 332276348 +256 772207216</td>
<td><a href="mailto:rosined@lakeharvest.com">rosined@lakeharvest.com</a></td>
</tr>
</tbody>
</table>
## Annex 2. Workshop agenda

<table>
<thead>
<tr>
<th>Monday 30 September, 2013</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8.3</td>
<td>Registration</td>
</tr>
<tr>
<td>9:00</td>
<td>Introductory remarks and house-keeping</td>
</tr>
<tr>
<td>9:15</td>
<td>Aquaculture inputs and resource use</td>
</tr>
<tr>
<td>9:45</td>
<td>Aquaculture outputs and impacts</td>
</tr>
<tr>
<td>10:15</td>
<td>Session discussion</td>
</tr>
<tr>
<td>10:45</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>11:00</td>
<td>Why Environmental Management?</td>
</tr>
<tr>
<td>11:45</td>
<td>Overview of International and National Environmental Regulations and their application</td>
</tr>
<tr>
<td>12.3</td>
<td>Session discussion</td>
</tr>
<tr>
<td>13:00</td>
<td><strong>Lunch</strong></td>
</tr>
<tr>
<td>14:00</td>
<td>EIA components and process</td>
</tr>
<tr>
<td>15:00</td>
<td>Session discussion</td>
</tr>
<tr>
<td>15:15</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>15:30</td>
<td>National Environmental Regulations and their application in Africa</td>
</tr>
<tr>
<td></td>
<td>Individual presentations on EIA practice in beneficiary States</td>
</tr>
<tr>
<td>Tuesday 1 October, 2013</td>
<td></td>
</tr>
<tr>
<td>9:00</td>
<td>National presentations</td>
</tr>
<tr>
<td>9:45</td>
<td>Summary of EIAA situation in Africa</td>
</tr>
<tr>
<td>10:15</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>10:30</td>
<td>Site selection and carrying capacity estimation</td>
</tr>
<tr>
<td>11:00</td>
<td>Modeling environmental impacts</td>
</tr>
<tr>
<td>11:30</td>
<td>Strategic Environmental Impact Assessment</td>
</tr>
<tr>
<td>12.3</td>
<td>Session discussion</td>
</tr>
<tr>
<td>13:00</td>
<td><strong>Lunch</strong></td>
</tr>
<tr>
<td>14:00</td>
<td>Group case studies: Developing an Environmental Management Plan and Monitoring Program in the context of national EIA system</td>
</tr>
<tr>
<td>16:00</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>16:30</td>
<td>Group case studies: Developing an Environmental Management Plan and Monitoring Program in the context of national EIA system</td>
</tr>
<tr>
<td></td>
<td>Objectives of field trips</td>
</tr>
<tr>
<td>Wednesday, 2nd October, 2013</td>
<td></td>
</tr>
<tr>
<td>6:00</td>
<td>Departure Entebbe</td>
</tr>
<tr>
<td>9:15</td>
<td>Field trips – NaFIRRI pilot cages</td>
</tr>
<tr>
<td>11:00</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>11:30</td>
<td>Field trip – Source of the Nile Fish Farm</td>
</tr>
<tr>
<td>14:00</td>
<td><strong>Lunch</strong></td>
</tr>
<tr>
<td>14:45</td>
<td>Evaluation of site visit</td>
</tr>
<tr>
<td>15:30</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>15:45</td>
<td>Group presentations and general discussion</td>
</tr>
<tr>
<td>16.3</td>
<td>Departure for Entebbe</td>
</tr>
<tr>
<td>Time</td>
<td>Activity</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Thursday 3 October 2013</strong></td>
<td></td>
</tr>
<tr>
<td>9:00</td>
<td>Group assignments: Case studies (identifying issues from the view of stakeholders)</td>
</tr>
<tr>
<td></td>
<td>Group 1 – Case study: fish cages</td>
</tr>
<tr>
<td></td>
<td>Group 2 – Case study: fish ponds</td>
</tr>
<tr>
<td>11:00</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>11:15</td>
<td>Group assignments: Case studies (prioritizing issues using a risk assessment)</td>
</tr>
<tr>
<td></td>
<td>Group 1 – Case study: fish cages</td>
</tr>
<tr>
<td></td>
<td>Group 2 – Case study: fish ponds</td>
</tr>
<tr>
<td>13:00</td>
<td><strong>Lunch</strong></td>
</tr>
<tr>
<td>14:00</td>
<td>Group assignments: Case studies (development of an Environmental Management Plan)</td>
</tr>
<tr>
<td></td>
<td>Group 1 – Case study: fish cages</td>
</tr>
<tr>
<td></td>
<td>Group 2 – Case study: fish ponds</td>
</tr>
<tr>
<td>16:00</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>16:30</td>
<td>Presentation of EIA and Environmental Management Plan for assessment</td>
</tr>
<tr>
<td></td>
<td>Introduction to Friday’s exercise</td>
</tr>
<tr>
<td><strong>Friday 4 October 2013</strong></td>
<td></td>
</tr>
<tr>
<td>9:00</td>
<td>Critical review: Presentations by participants on country EIA systems – implementation status, main gaps and ways forward</td>
</tr>
<tr>
<td>11:00</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>11:15</td>
<td>Continuation of presentations</td>
</tr>
<tr>
<td>12:30</td>
<td><strong>Lunch</strong></td>
</tr>
<tr>
<td>13:30</td>
<td>Lessons learned and the way forward for the region</td>
</tr>
<tr>
<td>15:00</td>
<td>Wrap-up</td>
</tr>
<tr>
<td>15:30</td>
<td><strong>Coffee/tea break</strong></td>
</tr>
<tr>
<td>16:30</td>
<td>Official closure</td>
</tr>
</tbody>
</table>
## Annex 3. Workshop/training evaluation

### 3.1: Evaluation Form

**Regional Workshop on Environmental Management and Environmental Impact Assessment in Aquaculture (EIAA)**

**Entebbe, Uganda**

**30 September to 4 October 2013**

**Pre-learning Questionnaire**

**Participants’ evaluation of workshop**

1. How would you rate the usefulness of the training?

<table>
<thead>
<tr>
<th>Level</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not useful</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Very useful</td>
<td></td>
</tr>
</tbody>
</table>

2. How much was learnt from the workshop?

<table>
<thead>
<tr>
<th>Level</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not much</td>
<td></td>
</tr>
<tr>
<td>Much</td>
<td></td>
</tr>
<tr>
<td>Very much</td>
<td></td>
</tr>
</tbody>
</table>

3. Rate the quality of the training

<table>
<thead>
<tr>
<th>Level</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somehow satisfied</td>
<td>Satisfied</td>
</tr>
<tr>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>Very satisfied</td>
<td></td>
</tr>
</tbody>
</table>

4. Was there enough information given?

<table>
<thead>
<tr>
<th>Level</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not enough</td>
<td></td>
</tr>
<tr>
<td>Enough</td>
<td></td>
</tr>
<tr>
<td>Too much</td>
<td></td>
</tr>
</tbody>
</table>

5. Was the length of training correct?

<table>
<thead>
<tr>
<th>Level</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too short</td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td></td>
</tr>
<tr>
<td>Too long</td>
<td></td>
</tr>
</tbody>
</table>

6. Would recommend this training to others?

<table>
<thead>
<tr>
<th>Level</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Maybe</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

7. Suggestions for how the training could be improved

<table>
<thead>
<tr>
<th>Space for input</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
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</table>
### 3.2: Summary of Responses to Evaluation Form

<table>
<thead>
<tr>
<th>Question</th>
<th>Total number of respondents (15)</th>
<th>Proportion of respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How would you rate the usefulness of the training?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not useful</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Good</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Very useful</td>
<td>11</td>
<td>73</td>
</tr>
<tr>
<td>2. How much was learnt from the workshop?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not much</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Much</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Very much</td>
<td>12</td>
<td>80</td>
</tr>
<tr>
<td>3. Rate the quality of the training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somehow satisfied</td>
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<td></td>
</tr>
<tr>
<td>Satisfied</td>
<td>9</td>
<td>60</td>
</tr>
<tr>
<td>Very satisfied</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>4. Was there enough information given?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not enough</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Enough</td>
<td>8</td>
<td>53</td>
</tr>
<tr>
<td>Too much</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>5. Was the length of training correct?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Too short</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Correct</td>
<td>11</td>
<td>79</td>
</tr>
<tr>
<td>Too long</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>6. Would recommend this training to others?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maybe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>7. Suggestions for how the training could be improved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of participation by other stakeholders, not just aquaculture personnel needs to be improved.</td>
<td>7</td>
<td>47</td>
</tr>
<tr>
<td>The training should be done in the other countries to also target their individual needs.</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Increase the duration of training including considering making it a one-month training course for TOTs.</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Have more field visits.</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Be more representative of production systems in field visits. In this case the workshop should have included a small scale farming system not just government, large and commercial.</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Have translation services to ensure all participants fully participate.</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>
SmartFish is a regional fisheries programme managed by the Indian Ocean Commission, funded by the European Union and co-implemented by the Food and Agriculture Organization of the United Nations. SmartFish, which operates in 20 countries throughout the East and Southern Africa - Indian Ocean region, focuses on fisheries governance, management, monitoring, control and surveillance, trade, and food security.

This report documents the proceedings of the regional training workshop that was organized for SmartFish beneficiary countries to enable them to improve country application and compliance of environmental impact assessment and environmental management of aquaculture projects.

The workshop included several field visits and practical case studies in order that participants fully understand the necessary steps involved in undertaking an environmental impact assessment and to see for themselves the importance of mitigating and monitoring environmental impacts across all levels.