AQUACULTURE AND FISH GENETICS RESEARCH PROGRAMME

FINAL TECHNICAL REPORT

Resource, market development and poverty targeting issues associated with emerging Peri-urban and Urban Aquaculture in Sub-Saharan Africa

DFID Project R 8287

March 2006

Date Completed: 31st of March 2006

Reporting period: FROM   March 2003   TO   March 2006

Authors: Principal investigators: Dr Simon Heck, WorldFish Centre, Cairo, Egypt; Dr Krishen Rana, Institute of Aquaculture, University of Stirling, UK. Report compiled by Giorgia Monti, AFGRP Research Assistant, Institute of Aquaculture, University of Stirling, UK.

Programme: AFGRP

Programme Manager/Institution: Professor James Muir / Institute of Aquaculture, University of Stirling, UK.

<u>Acknowledgements</u>

Table of Contents

<u>Acronyms</u>

AFGRP   Aquaculture and Fish Genetics Research Programme
ARDC   Aquaculture Research and Development Centre
DFID   UK Department for International Development
FAO   Food and Agricultural Organisation
FIRRI   Fisheries Resources Research Institute
GDP   Gross Domestic Product
IITA   The International Institute of Tropical Agriculture
NARO   National Agricultural Research Organisation
NGO   Non-Governmental Organization
NIOMR   Nigerian Institute for Oceanography and Marine Research
SSA   Sub-Saharan Africa
TAFRI   Tanzania Fisheries Research Institute
WFC   The WorldFish Center (formerly ICLARM)

LIST OF FIGURES

LIST OF TABLE

<u>Executive Summary</u>

In many African countries fish consumption is an important source of animal protein, contributing 22% of overall protein intake. However, between 1973-1997 annual per caput fish consumption has declined from 9kg to around 6.6kg, much of this attributed to dwindling supplies from capture fisheries and rise in population. Fish remains widely popular, however, and demand is predicted to grow. Though aquaculture has been often identified as the means of closing the supply gap, growth has been limited and intermittent. Though reported aquaculture production in Africa has risen sharply from 95,000 tonnes in 1994 to 531,000 in 2003, much of this can be attributed to Egypt, which in 2003 accounted for 84% of regional production.

However, domestic markets, particularly around urban and periurban zones, may now provide the impetus for change, with urbanization, due to population growth and rural-urban migration growing at some 7-10%/yr, aquaculture might address local demand and diversify household income, possibly also using waste resources or by-products from one farming enterprise to supplement another.

To explore the nature of change in aquaculture, its growth in urban and peri-urban areas, and the implications for addressing regional development goals, this DFID AFGRP project carried out a series of studies during 2004-05, together with partners research teams in Nigeria, Uganda, Tanzania, South Africa, Cameroon and Malawi.

In urban (U) and peri-urban (PU) African centres, such as Dar es Salaam, Lagos, Kampala or Cape Town, there is evidence of emerging aquaculture activity using various systems and environments. In these and other conurbations, planners, entrepreneurs and workers alike have recognised the potential of aquaculture to serve expanding markets. As shown in this work partnering the DFID Programme with WorldFish, this change is essentially market-driven rather than the result of traditional forms of technical promotion, which have rarely succeeded in stimulating growth. Subject to conducive investment conditions, knowledge of local resources and markets, the prospect of growth in aquatic food across sub-Saharan Africa might now become more realistic, with positive impacts on employment and income for producers and food access for consumers. There are particular implications in addressing poverty issues, with potential to produce long-term opportunities for poor U and PU communities.

1. <u>Background to the Project</u>

In a context of rapid urbanisation in Africa (7-10%/yr), accelerating urban migration of the poor, major health challenges and poverty, unemployment and food insecurity in urban (U) and periurban (PU) zones and declining fish supplies are a source of major concern for local and national governments in the region (FAO, 2000; Lawrence et al.; 1999, Smith and Olaloku; 1998, Sawio, 1993 and Mvena, 1991). These trends proceed against a backdrop of changing forces in food markets, and austere urban economic structural reforms causing significant proportions of U and PU poorer communities to engage in farming as a livelihood and household food security option (Drechsel et al., 2001; Dongus, 2000; FAO, 2000; and Sawio, 1998). Aquaculture is uniquely placed to reverse declining supplies from capture fisheries (mean caput fish availability in Africa declined 20% between 1990-96 and has declined further), and has notable potential for new livelihood opportunities, providing the mechanism for lower priced fish, enhanced nutritional security and employment for poor communities by servicing urban markets (Jagger and Pender, 2001)**.** For example, in Tanzania peri-urban agriculture is the second largest employer (Mougeot, 2000). Aquaculture may also provide an important opportunity to recycle wastes generated by the zero grazing and other agriculture practices increasingly common in the region's U and PU zones, contributing positively to growing urban waste disposal issues, and adding value to scarce water resources (Asomani-Boateng and Haight, 1999). Failure to engage in such opportunities would increase social costs and environmental risks, and worsen trade balances. Though the potential of aquaculture in the region, and the changing impacts of urbanisation are noted, the lack of a realistic knowledge base to inform policy and planning processes is a severe constraint (Preston and Rodriguez, 1999 and Gregory, 1999).

Different culture systems have emerged in many U and PU centres such as Dar es Salaam, Kampala, Jinja and Accra. However, the extent of uptake, scope for livelihood gain through employment, supply and price impact, and food security, implications for resources and wastes, and the wider issues of market chains, knowledge transfer, and institutional capacity and linkages are poorly understood. Research is required to assess lessons to be learned from existing aquaculture initiatives and to evaluate potential opportunities and constraints to broadening long-term options for poor U and PU communities. In addition, since poor rural migrants in urban fringes are probably landless (Sawio, 1988; Dongus, 2000), the impact of recent reforms in land and water tenure (Okali et al., 2001; Lerise et al., 2001) on the adoption process need to be evaluated, taking into account complementarities and externalities imposed by multiple uses of land and water.

Although similarities in human and institutional capital exist with agriculture, there are notable differences for aquaculture concerning policy and processes, its potential role in food supply, resource-use and poverty reduction. There is growing consensus at local government level, that U and PU aquaculture is expanding in an ad-hoc manner and therefore knowledge of production system typology and urban-rural spatial distribution in relation to the natural resource base, is urgently required to inform policy and planning. Research will be carried out in Nigeria, Tanzania and S. Africa. To foster sustainable livelihoods more broadly, and complete the linkages between urban and rural context, lessons from complementary small-scale rural farming projects in Cameroon and Malawi (ICLARM) and Uganda (DFID) will also be explored through joint workshops and networks, and a better perspective developed of the emerging interactions.

Through collaborative research with partners and other ICLARM projects in the region this project addresses national need to generate new adaptive knowledge for evaluating the adoption processes and the role emerging aquaculture can play in U and PU zones and fringes to alleviate poverty, stabilise fish supplies, human nutrition and health while managing bludgeoning organic waste generated by U and PU agriculture. This need is identified by national partners as one pathway for addressing key development problems and issues arising from accelerating rates of urbanisation and associated rise in poverty, and declining nutritional status and parallel changes in forces influencing food supply such as fish.

2. <u>Project Purpose</u>

To promote effective aquaculture development in SSA based on sound knowledge of resource access, market development and poverty targeting issues associated with emerging Urban (U) and Peri-urban (PU) aquaculture.

3. <u>Research Activities:</u>

3.1 Research partners

Research coordinators:

<u>Institute of Aquaculture, University of Stirling, UK</u>
Dr Krishen Rana (co-PI)

<u>WorldFish Center, Abassa, Egypt</u>
Dr Simon Heck (co-PI)

Table 1: Linking institutions – regional project teams

Institution	Location	Collaborative linkages and outputs
The International Institute of Tropical Agriculture (IITA)	Cameroon	Findings from DFID Aquaculture Development Project in Cameroon (NRE9800 605/522/003) adapted for use by this project.
World Fish Center.	Malawi	Research collaborator; participatory field studies, disseminate findings, developing intra-national networks
Nigerian Institute for Oceanography and Marine Research (NIOMR), Lagos	Nigeria	Research collaborator; interacting in design and implementation socio-economic survey; participatory field studies, disseminate findings, developing intra-national networks
Tanzania Fisheries Research Institute (TAFRI), Dar es Salaam (1st phase) Faculty of Aquatic Science and Technology, University of Dar es Salaam (2nd phase)	Tanzania	Research collaborator; interacting in design and implementation socio-economic survey; disseminate findings, developing intra-national networks. Delays in workplan implementation in Tanzania led to change of national partners in February 2005
Division of Aquaculture Stellenbosch University, Stellenbosch	South Africa	Research collaborator; interacting in design and implementation socio-economic survey; disseminate findings, developing intra-national networks
Centre for Rural Development Systems, University of Natal, Scottsville	South Africa	Research collaborator; interacting in design and implementation socio-economic survey; disseminate findings, developing intra-national networks
National Agricultural Research Organisation (NARO) Fisheries Resources Research Institute (FIRRI) Aquaculture Research and Development Centre (ARDC), Kajjansi	Uganda	Research collaborator; implementation field surveys

3.2 Overview of Activities

Table2: Summary of Achievements and Deliverables

Outputs	Achievements	Deliverables
1. Situation analysis of current status of Urban and Peri-Urban aquaculture and related farming activities in the target countries, including identification of principal stakeholders and institutional framework.	Situation analysis of macro-level trends completed; Workshop hold and findings presented	National situational reports; Project workshop report;
2. Analysis and characterization of fish supply chains in Urban and Peri-urban areas in the target countries, including documentation of how these are working and the interactions between trade in wild caught fish, and fish from aquaculture and imports.	Surveys of fish producers, traders and markets completed and findings analysed; workshop held to discuss outputs.	National reports on markets and fish supply chains; Project workshop proceedings; electronic and print publication
3. Assessment of the emerging trends in fish production and marketing in the target countries, and the influence of national and regional level policy arenas such as PRSPs, RECs and NEPAD.	Production and market trends assessed, and policy environment analysed;	National reports on policy environment
4. Analysis of the current and potential future implications of these emerging markets for investment in fish farming and capture fisheries, including by enhancing value through improved processing.		Implications for future investments in fish production/processing
5. Detailed proposals for further research on the development of markets for fish and fish products in sub-Saharan Africa with a focus on the target countries.	Proposals for further R&D developed; dissemination of findings	Project proposals

Table 3: Synthesis of planned activities with methodology

Activity	Methods
Output 1 1.1 Establish core teams and confirm working protocols with principal stakeholders in collaborating countries.	1.1 Planning workshop; exchange of protocols
1.2 Orientate partners on project approach and core methods to be used.	1.2 Planning workshop; regular communication between partners
1.3 Collate information on macro level forces affecting U and PU aquaculture development including macroeconomic trends; policy, legal and administration frameworks; household-level poverty trends, and food supply and consumption.	1.3 Secondary data and literature review; key informants
Output 2 2.1 Analysis and characterization of fish supply chains in Urban and Peri-urban areas in the target countries.	2.1 Piloting questionnaires
2.2 Analysis of the markets.	2.2 Traders Survey
2.3 Analysis of consumer preference for fish and demand structure for aquatic products.	2.3 Markets/consumers Survey
Output 3 3.1 Assess aquaculture production trends in PU areas	3.1 Producers Survey
3.2 Assess the economic viability and scope for expansion of U and PU aquaculture sector.	3.2 Comparison analysis of Rural and PU systems
3.3 Analyse of the national and regional level policy	3.3 Review of policy and planning documents
Output 4	4.1 workshop and analysing of funding from outputs 2 and 3; triangulation with secondary data
Output5 5.1 Develop recommendations for future support to develop aquaculture within the context of poverty alleviation in SSA.	5.1 Analysis of findings from the projects
5.2 Disseminate findings and recommendations through workshops and institutional networks.	5.2 Consultative workshop with key stakeholders
	5.3 Electronic media, workshops, technical publications and press

Table 4: Overview of research activities carried out

Field based activities						Theoretical Activities
Cameroon	**Malawi**	**South Africa**	**Nigeria**	**Tanzania**	**Uganda**	**UK/WFC**
General Situation analysis						Results review
Producer survey						Finalised questionnaires/ Results review/ Workshop
Trade survey						
Markets survey						
	Follow-up: consumer survey planned					

3.3 Overview of countries and study areas

The research was conducted in urban and peri-urban centres in six countries in Sub-Saharan Africa (SSA), whose study may be broadly applicable to U and PU aquaculture development in other African countries. At the beginning the activities were planned in Tanzania, Nigeria and South Africa, considered to study situation trends due to their high demographic pressure, increasing urbanisation process and high poverty levels. In a second phase of the project Uganda and Malawi were added, with the collaboration of WFC local teams, and findings from DFID Aquaculture Development Project in Cameroon (NRE9800 605/522/003) adapted for use by this project.

The project focused on predefined locations. Field activities for the survey research were carried on aquaculture producers, fish traders and markets in Lagos (Nigeria), Cape Town (South Africa), Blantyre (Malawi), Kampala (Uganda) and Yaoundé (Cameroon) areas. Those cities were chosen for being among the major commercial cities of the countries to provide the case study of the fish-marketing situation in majority of the nation's urban areas. Delays in workplan implementation in Tanzania led to change of national partners to Faculty of Aquatic Science and Technology, University of Dar es Salaam in February 2005.

Review/desk research was undertaken in the UK at the Institute of Aquaculture, Stirling, as well as in WFC, Abassa, Egypt; in NIOMR, Lagos, Nigeria; TAFRI, Dar es Salaam, Tanzania; Faculty of Aquatic Science and Technology, University of Dar es Salaam, Dar es Salaam, Tanzania; Division of Aquaculture, University of Stellenbosch, SA; Aquaculture Research and Development Centre, Kajjansi, Uganda; and WFC, Malawi. Workshops were hold at the main collaborating national institutions in Tanzania, SA, Malawi and Uganda. A regional workshop was held with WFC, at Abbassa, Egypt. Writing and reporting related to fieldwork and workshops took place initially in the countries object of the study with editing and collation in the UK.

3.4   Field surveys

Methodology

Data collection used primary source through interviews. Three separate surveys for producers, traders and markets were designed and carried out using structured questionnaires (see Annex I & II) in order to allow for comparative analysis across the countries (for Calendar see Table 5). The questionnaires were pre designed by regional collaborators of the survey. However, consultations were made where possible in order to adapt it to the local situation without losing its context. The questionnaires were then pre tested in selected areas before the survey.

Additional information that was deemed necessary to augment the findings, but were not covered within the scope of the structured questionnaire surveys was solicited through semi-structured and focus group discussions, and complemented with on the spots observation. Secondary data from numerous studies done in capture fisheries were also used to capture relevant information from the lake.

Enumerators were trained in sampling methodology and the use of survey questionnaires. These enumerators included team of multidisciplinary researchers and field extension officers, and in some countries as in Malawi they worked closely with Fisheries Department field staff.

Table 5: Calendar of the surveys

Country	2003 II semester	2004 I semester	2004 II semester	2005 I semester	2005 II semester	2006 I semester
Nigeria				▓	▓	
South Africa				▓		
Tanzania						
Malawi			▓			
Uganda			▓	▓		
Cameroon	▓	▓				

Description of the study area in each country:

Nigeria:
The survey was carried out in Lagos state (Figure 1). Lagos state is the most populous state in Nigeria. With a total area of about 4000km^2, the smallest in the country, the state's population density is high, around 1,590 persons per square kilometre. A 1998 estimate indicates that the population of Lagos State had been growing at an annual rate of 8 percent in the urban areas and 3 percent in the rural areas.

The state experiences two rainfall peaks in the year and the annual precipitation ranges from 1312mm to 1726mm. The ambient temperature is fairly high (32^{0}C) though moderated by the cool coastal wind. The relative humidity is on the average, over 60% throughout the year.

The topography that is undulating plain in its northern area is interspersed with swamps in the flood plains of the rivers that run through the state. The coastal belt of sandy ridges is interspersed by lagoons and creeks. This makes the state rich in water resources for fishing and aquaculture activities.

Figure 1: Administrative map of Lagos State, Nigeria showing the Study area.
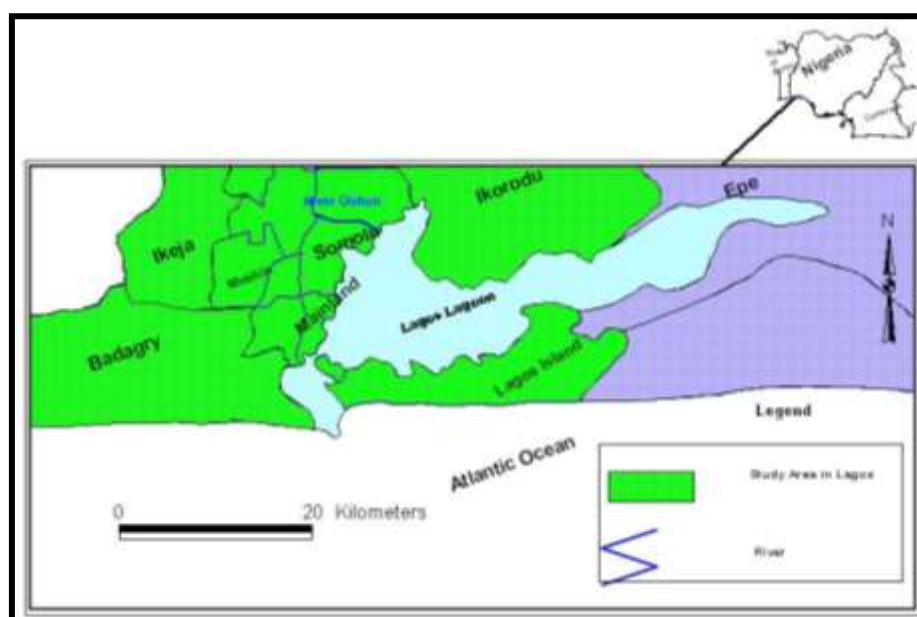
South Africa

The present surveys were limited to the Western Cape Province (WCP), with Cape Town as the metropolitan city and urban centre. The administrative boundary for Cape Town municipality has a radius of approximately 50 km from the city centre. The decision to delimit the survey to Cape Town Urban and peri-urban was based on the limited time frame and resources for the project. In any case, the WCP forms the hub for both the capture and the aquaculture industries in South Africa. Conducting the survey in Cape Town and its surroundings therefore provided a good indication of the future potential and the context of evolvement of the aquaculture industry using the trading and marketing infrastructure of the exiting capture fisheries industry.

Malawi

The study was conducted in Blantyre City. There are mainly four major urban centers in Malawi namely Lilongwe (Capital City), Blantyre, Zomba and Mzuzu (table1). City of Blantyre was chosen for the study for several reasons. City of Blantyre is the nation's major commercial city. Its population density of 2,282 persons per km2 is one of densely populated cities in Malawi. Urbanization rate of 3.7% is one of the fastest in the nation. The poverty level is high affecting 60% of the city's population. In this regard findings from survey would in general, provide the case study of the fish-marketing situation in majority of the nation's urban areas.

Uganda

The field surveys were carried out in the districts of Kampala and Wakiso (See Annex 3). In Kampala, all the five divisions were included in the survey. In Wakiso, three (Makindye-Ssabagabo, Nangabo and Wakiso) out of the five sub-counties that boarder Kampala district were randomly selected and included in the survey. However, time did not allow the team to complete field work in Nangabo sub-county.

Cameroon

Project activities were implemented in three localities—Obala, Akono and peri-urban Yaoundé—of the Center Province of Cameroon, that were deliberately chosen to represent different development domains with potentially differing implications for aquaculture development. The domains were identified *a priori* for the HFEB as part of the International Institute of Tropical Agriculture ecoregional research efforts (Gockowski et al. 2001). The Obala domain, area of degraded forest, is characterized by high population pressures (80 to 240 inhabitants per km^2 depending on the village) and somewhat limited access to the Yaoundé market. The Akono domain south of Yaoundé is characterized by lower population pressures (30 to 50 inhabitants per km^2) and more limited market. The peri-urban Yaoundé domain is densely populated and with good market access to Yaoundé, the capital of Cameroon and its second largest city, with over 1.5 million inhabitants.

Tanzania

Delays experienced during the project with performing the field surveys made it impossible for a study to be conducted in Tanzania. Hence there was no data collected for the Tanzania study, with the exception of those generated by the preliminary appraisal at the beginning of the project.

Data Collection

Nigeria

Lagos was stratified into 2 zones East and West by Lagos State Agricultural Development Authority (LSADA) along ecological, old administrative and divisional boundaries and is about the same size land-wise (Fig. 1). For the purpose of administrative convenience, the two zones were further stratified into sixteen blocks each. Each block is being managed by a block extension Agent (BEA). For each block, a comprehensive inventory of fish producers, marketers and traders was obtained. Data on geographical knowledge of aquaculture and related farming activities were generated using

structured and unstructured questionnaires. Satellite mapping was carried out with the use of eTrex Vista (GARMIN) GPS.

South Africa

In the case South Africa, the trader and market surveys extended to those developed under capture fisheries due to the lack of dedicated traders and markets for aquaculture products. With the increasing realization within government and private sector that aquaculture and Marine aquaculture might represent new areas of growth, the logic is that, new markets and traders will evolve from the existing networks for the capture fisheries' industry to serve the aquaculture industry. Assessing the workings and bottlenecks of these capture fisheries trade systems and marketing channels thus makes sense. It is within this context that an assessment was conducted to evaluate the dynamics associated fish markets and traders in both capture fisheries and aquaculture.

Malawi

Consumer survey was designed in such a way as to cover all income classes. However it was difficult to identify fish consumers of distinct different income classes and when found their willingness to respond to the questionnaire was a problem.

Traders interviewed during the survey were selected at random but it was emphasized that sample should include traders of all fish types found at the market including market leaders. One questionnaire at each market was administered to one of these people to gather market information. Market survey was to include departmental stores. However, efforts to gather information from these departmental stores met some resistance.

The other component of the survey targeted fish producers. Lakes Malawi, Malombe, Chilwa and Lower Shire River are the main sources of fish traded in urban areas. However, in the context of the study, fish farmers in urban as well as peri-urban areas were visited in order to generate some insights in the marketing environment and factors affecting their participation in urban markets.

Uganda

Producer survey-Lists of all fish farmers in both districts were obtained from the District Fisheries Officers. It was then decided that since the number was not big; all the farmers should be included in the study.

Trader survey-It was not possible to obtain a list of all traders from which to select a sample. Markets and fish landing sites were visited and respondents were selected randomly from those found buying fish for sale and those selling fish.

Market survey-Information obtained prior to selection of the markets indicated that the main sources of fish were landing sites and two markets in Kampala city namely Katwe and Shauriyako.

Cameroon

The study was part of the action research agenda of DFID Aquaculture Development Project in Cameroon (NRE9800 605/522/003) implemented by The WorldFish Center. The objective in undertaking this study was to suggest improved marketing strategies following analysis of the current marketing arrangements for cultured fish in southern Cameroon. The study population was stratified by market access into two groups, peri-urban and rural, as determined by their position relative to a 30 minutes travel boundary to the Yaoundé city limits. Following the data collection interviews, a meeting with representatives of the farmer organizations was held to verify, validate and discuss the findings.

3.5 Data Analyses

The data from all the three surveys were entered into the Statistical Package for Social Sciences (SPSS) Version 10.0 and analysed. The parameters determined included frequencies, cross tabulation and descriptive statistics (mean & standard deviations). Correlations were done on selected variables. The use of SPSS by all the participating countries was expected to allow for comparative analysis of the country specific findings across the countries.

3.6 Dissemination activities

The activities of the project included national and regional workshops. Regional workshop facilitated disseminate outputs to users outwith the partner countries. To ensure broader capacity building process these workshops were attended by a wide range of service providers including technical specialists, government officials, farmers and other stakeholders who served as conduits for disseminating outputs to their own institutions and wider public.

Peer reviewed papers were published to inform international academics scientists of project's outputs. Other non-peer reviewed publications, internal and workshops' reports were produced (see Publications and other outputs).

Finding from the projects were disseminated by oral presentations and publications at regional and international meetings/conferences. A Session on "Fair market development for African Aquaculture" was held during the 7th Conference of the Aquaculture Association of Southern Africa, 12 -15 of September 2005, Grahamstown, South Africa, to point up Aquaculture as an opportunity for poverty alleviation, both through production and consumption, and to disseminate preliminary results from the project through the private sector, research institutes and governmental agencies present at the conference

Mass media such as radio and TV in South Africa, Cameroon, Tanzania and Malawi were contacted to make the broader public aware of the outputs and to promote U and PU aquaculture.

Project outputs and findings in Cameroon were disseminated by a network of NGOs to increase the range of collaborative interactions and expand project impacts beyond the target villages.

Dissemination of project finding was also complemented by personal contacts, discussion groups, internal reports and training.

4. Institutional Linkages

5. Research Outputs

5.1 Situation Analysis

Trends underline the enormous internal demand for fish in many African countries as Uganda, where fish is a major source of animal protein for the population. In many African countries fish is contributing 22% of the protein intake. In recent years however, fish consumption has declined sharply. Between 1973-1997 per caput consumption has declined form 9kg/yr to around 6.6kg/yr and much of this has been attributed to limited availability arising from dwindling fish supplies from capture fisheries. Furthermore the demand for fish and fisheries products is estimated to continue growing with increasing population growth: in Nigeria, the population is growing at a rate between 3 and 5% per annum. Data from the last two populations census in 1976 and 1987, indicate that the population of Yaoundé grew at over 7.5% annually, which means that its food demand doubled in only 10 years. The reported fish deficit is met by importation at a great cost in foreign exchange to the countries. In 2000 in Nigeria, a sum of US$ 409 million was expended on the importation of 552,000 metric tons of fish into the country. This evident widening gap between supply and demand for fish in most domestic markets in Africa offers new opportunities for aquaculture development, and for small holders willing to invest in aquaculture technologies to capitalise on fish prices that are likely to increase in the short to medium term.

The urgent need for promoting aquaculture especially in Urban and Peri-Urban (U and PU) areas in Africa has become even more relevant with the increasing urbanisation (7-10%/yr). Some urban settlements in the region are a recent phenomenon, as in Uganda, while other, like Dar-Es-Salaam and Mombasa, are over 500 years old. But common to all of them is an accelerating rural-urban migration. This process is highly linked with problem of urban poverty, food insecurity and disease. To supplement household food consumption U and PU agriculture has recently emerged stimulated by the proximity of a growing urban market for food and non-food products. Urban and peri urban agriculture is a fairly recent trend, which has taken root in town areas to supplement household food consumption and is viewed as survival strategy, although in more urbanized areas activities are increasingly becoming market oriented. In these contexts aquaculture can faster develop with expectations of meeting local demand for fish and diversifying household income, exploring the use of waste resources or by-products from one farming enterprise to supplement another. Its potential for positive impact on fish food supply and poverty alleviation in Africa has been recognized at international level from Institution as FAO, WFC, and recently from NEPAD.

5.2 Field surveys

The current status of urban and peri-urban aquaculture production

During recent years reported aquaculture production in Africa has risen sharply from 95,000 metric tonnes in 1994 to 531,000 in 2003. Much of this reported rises however has been attributed to Egypt, which in 2003 accounted for 84% of the African production.

This recent research funded by the UK Department for International Development (DFID), through the University of Stirling, United Kingdom, and the World Fish Center (WFC), suggests emerging aquaculture activity in U and PU areas in countries such as Nigeria, Uganda, Tanzania, South Africa, Cameroon and Malawi.
Fish is one of the main traded commodities in many cities such as Kampala, Dar es Salaam or Lagos, and the surrounding PU areas. But currently most of the fish comes from the capture fisheries, while aquaculture is still responsible for a small proportion of total fish production. Around urban settlements, like Dar es Salaam, small scale fish farming activities are combined with recreational to supplement income generation. The production which is mainly for subsistence is generally low (10kg/100m2/yr in Kampala district), and only a small portion of the farmed fish is sold at the pond

side, mostly to neighbours/friends. New market opportunities in the last few years however, have stimulated the development of small scale fish farms in periurban and urban zones, where farmers have begun to exploit the retail markets. In Nigeria, for example where small-scale fish farming accounts for over 70% of the fish culture production, aquaculture is evolving from traditional to semi–intensive production farming systems. Preliminary analysis and visual observation showed an ever-increasing number of producers in states like Lagos, due to apparent elastic demand for fish and increasing awareness of fish profitability. In Cameroon productivity of small-scale aquaculture in the target areas increased over the project period from 498 kg/ha to 2525 kg/ha, and the number of active fish farmers in the target areas more then doubled. Fish are in part consumed by the farm family, but mostly produced for the Yaoundé market, increasing farmers' cash returns.

Figure 2: Earthen pond systems in Daar es Salaam area, Tanzania.

In urban areas various cultural practices were observed ranging from the homestead, extensive, semi-intensive earthen pond systems with Tilapia sp. (mostly *Oreochromis niloticus,* or *Heterotis niloticus*) in polyculture (Figure 2) to intensive ones, where more common was African catfish (*Clarias gariepinus*) in monoculture. With growing market prices for fish and government intervention, farmers are beginning to adopt concrete/fibre tanks with flow through or water recirculation system (WRS), and new techniques with low inputs and simple technology are expanding, as seen in Lagos area with recirculation system using lava stones and Coca –cola and Beer crates as filter media system (Figure 3). Other opportunities are done both for U and PU population, by the use of integrated farming techniques that include the most common fish cum poultry, adding value to scarce water and land resources. Farming systems diversification through the integration of aquaculture significantly increased the productivity, intensity of production and profitability of small-scale farms in periurban areas around Yaoundé, but not in rural areas. Completely different is the situation of the Western Cape Province in South Africa where an intensive commercial aquaculture sector specialised in high value species as abalone or trout, has been developed mostly focusing to the export market and only recently is looking at local market opportunity.

Figure 3: WRS under construction using Crates/lava stones as bio-filter. Lagos state, Nigeria.

Traders and markets

As aquaculture is a relatively young industry, the trading systems and marketing channels are the same as those for capture fisheries'. Fish trade is one of the main daily businesses carried out within many urban and peri-urban areas, as Kampala or Cape Town district, which provides income to sustain local livelihoods. The main sources for traders of fish are landing sites or wholesalers, rarely markets. A survey of markets revealed that among the high number of fish species traded none were from fish farms. Only in South Africa fish markets were found selling shellfish sourced from aquaculture farms, or less common farmed trout and salmon. The reasons given during a survey in Lagos state for not trading in aquaculture products ranged from not being aware of aquaculture products to that their consumers did not want to eat freshwater ("dam") fish. However, among the informal traders there were some optimism about the potential for trading in aquaculture products, expressing the willingness to include farmed fish and products in their business portfolios as fishery supply presented problems of shortage and seasonality.

In Lagos as well as in Kampala or Dar es Salaam districts fish trading and marketing are concentrated: the trader/marketers sell fish at fixed stalls in designated points or markets that are the main sources of all day-to-day food items for urban dwellers (Figure 4). Other times the channel has one or more intermediaries and traders sell to retailers or even to other traders, or deliver fish to hotels and restaurants on a routine basis. In general in every settlement, most especially PU, there are usually fish traders even when there are no markets and every day most common are informal itinerant traders, as in the Western Cape Province. These are characterized by "street side vendors", that provide fresh fish on a daily basis to the vast majority of the low-income consumers especially in townships and middle-income suburbs.

Figure 4: Designated points for trading activity in Lagos state, Nigeria.

Most market areas are not specialised for sale of fish only, with the fish section comprising a small segment of the major market. In the Cape Town district the situation is different; South Africa does not have typical fish markets as the fishing companies developed the infrastructure where sell their products while other fish markets were set up by small-scale fishers and informal traders. Among the different area studied the trading places generally lacked legislative control and basic trading amenities such as water supply and cold storage facilities. To encourage the growing economic activity, improved sanitary conditions and better structures for distribution and sale of fish should be built by local governments. Positive examples have been seen in some local municipalities e.g. Grabouw, in South Africa, where new facilities for fish trade have been set up.

The most popular product form is whole (with head), gutted or filleted fish. Usually, fish is fresh, or smoked, but can be found in markets fried, sun dried or salted. Only in South Africa most of fish products traded in markets were frozen form because the markets had cold storage facilities.

5.3 National and regional level policy Analysis

The current policy environment is generally favourable for aquaculture development; over the last years aquaculture has been identified as a priority sector for economic development in several countries of the African Region. Although in many countries specific guidelines are not in place, mandates at local government level contradictory, and financial investment required to implement these policies are lacking. In South Africa the government is now in the process of finalizing the national policy document that should provide strategy and direction of aquaculture development in the country.

There is an urgent need to sensitise local and national governmental on the necessity of developing guidelines and policies that create a positive aquaculture investment climate, and among small and large-scale private investors on the opportunities that this activity represents in African urban area. Investors need to work closely with researchers to develop serviceable fish culture facilities and techniques that are most suitable for the local environment, and outcomes from best management practices arising from such research can contribute to national planning. As well there is a need of water resource management policies development to encourage multiple use of irrigation water, investigate ways of utilizing grey water, promote sustainable systems and preserve natural resources.

5.4   Key results and recommendations

- Increasing local urban demand for live and fresh fish is generating renewed interest in aquaculture in many African countries.

- The market environment as well as, elastic supply of fish from aquaculture and the increasing opportunity to maintain quality during transport to markets provides opportunities for small holders in surrounding urban areas willing to invest in appropriate aquaculture technologies.

- The significant impacts of market incentives on the scale and intensity of aquaculture demonstrated from the research suggest that extending those incentives beyond the peri-urban domain will be critical to the takeoff of aquaculture and improving the welfare of rural producers as well. The study recommends future strategies not focusing aquaculture development efforts only within the peri-urban domain, but as well in those areas with a comparative advantage in production, facilitating the access of small producers to urban markets.

- If aquaculture is to meet local demand, producers will have to consider the comparative advantage of what they might produce, and engage a strategy for marketing and promoting public acceptance of aquaculture products, as well as reduce the current high production costs in the current market environment where wild caught fish may be cheaper. Given the shortfalls in supply however, the price of fish is likely to increase in the short to medium term in areas close to growing urban markets thus offering an opportunity for farmed fish, to compete.

- In the medium to long term increased production may also lower prices thus making fish more affordable to poorer communities.

- In the medium to long term, to compete effectively aquaculture operations will need to reduce production costs of key input items such as aqua feed and fingerlings. Instead of state-owned fish hatcheries supplying fingerlings to producers, governments and donors are now looking to promote the private sector in such activities.

- Governments have a crucial role to play in creating the enabling environment for the development of a commercially oriented demand driven industry. This includes supportive policies and appropriate legal frameworks.

- Research and extension services will have a key role in production and diffusion of innovations for aquaculture development. More specifically, research and extension efforts should not only focus on production questions but should also consider marketing and post harvest innovations.

6. <u>Contribution of these Outputs to Developmental Impact</u>

I*mportant to highlight both Direct and Indirect impacts, on both target beneficiaries and any partner institutions with some indication of numbers impacted, both presently and in the future. Perhaps summarise in table form.*

Through collaborative research with partners and other WFC projects in the region this project addressed national need to generate new adaptive knowledge for evaluating the adoption processes and the role emerging aquaculture can play in U and PU zones to stabilise fish supplies, human nutrition and health.

The generated knowledge on benefits and constraints of local production systems, fish supply chains, market trends and socio-economic climate associated with emerging U and PU aquaculture contributed to better inform government and non-governmental professionals and farming practitioners guiding future developments for improving livelihoods of all U and PU communities, especially women, youth and the unemployed. In Cameroon to increase the range of collaborative interactions and expand project impacts beyond the target villages, a network of NGOs was created to disseminate information and a Research Committee was established to manage 32 ancillary research projects through a competitive grants facility. In terms of policy, in Cameroon the project worked with local and international agencies to define, describe and institutionalise a Strategic Framework for Aquaculture Development. The model was first applied in Cameroon, but through collaboration with FAO is now being adapted to a number of other countries within the region.

The project contributed to identifying opportunities and constraints to inform national, international and donor communities on better targeting of future research and sustainable development activities

6.1   Areas for further research/activities

Following pilot trials under the project, an NGO-led effort to facilitate market access and the development of a sustainable rural fish marketing business plan is continuing in Cameroon.

To assess the fish consumption patterns and need in low-income households, as well consumers' preferences, two follow-up research proposals were developed during the last phase of the project, for Malawi and South Africa:

 - Concept Document and Terms of Reference for Nutrition Research on Low-Income Households within Malawi, Africa.

- Concept Document and Terms of Reference for Market Research in the Western Cape Province of South Africa.

7. Publications and other outputs

7.1 Peer-reviews:

Brummett, R.E., J. Gockowski, J. Bakwowi & A. D. Etaba. 2004. Analysis of aquaculture investments in periurban Yaoundé, Cameroon. Aquaculture Economics & Management 8(5/6):1-10.

Giorgia Monti, Krishen Rana, Simon Heck, (2005). New opportunities? Aquaculture for developing urban African markets. New Agriculturist on-line, 1st of November 2005.

Krishen Rana, Jide Anyla, Khalid Salie, Charles Mahika, Simon Heck, Jimmy Joung, (2005). The role of aqua farming in feeding African Cities. Urban Agriculture Magazine, Number 14, pp.36-38.

Krishen Rana, Jide Anyla, Khalid Salie, Charles Mahika, Simon Heck, Jimmy Joung, (2005). Aquafarming in urban and peri-urban zones in Sub Saharan Africa. Aquaculture News, Number 32, IoA, University of Stirling, Scotland. pp. 6-8.

Soua, N., J. Gockowski, R. Brummett, V. Pouomogne & J. Bakwowi. Urban markets and the commercialization of smallholder aquaculture in sub-Saharan Africa: lessons from Southern Cameroon. Food Policy. (Submitted)

7.2 Internal reports:

A Preliminary Investigation on the Development of Aquaculture in Metropolitan and Peripheral Zones of Dar Es Salaam City, Tanzania. Progress Report No. 1. By Charles Gaspar Mahika & ☐ P.O.J. Bwathondi, Aquaculture Research Unit (ARU), Tanzania Fisheries Research Institute, Dar es Salaam, Tanzania. February 2003

Situation analysis of macro-level trends. South Africa. Draft Report. 2005

Aquaculture and Urbanisation in Sub-Saharan Africa: Resource, market development and poverty targeting issues associated with emerging Peri-urban and Urban Aquaculture in SSA. DRAFT REPORT. University of of Stellenbosch, Stellenbosch, South Africa. 2005

Aquaculture and Urbanization in SSA: Resource utilization, market development and poverty targeting issues associated with emerging Peri-urban (PU) and Urban (U) Aquaculture in Nigeria. Situational Analysis (Output 1) Nigerian Institute for Oceanography and Marine Research, Lagos, Nigeria. April 2005.

Progress report on resource utilisation, market development and poverty targeting issues associated with emerging aquaculture in urban (u) and peri urban (pu) zones in Nigeria. April 2005

Aquaculture and urbanisation in Sub Sahara Africa – Malawi. Fish marketing survey report. April 2005.

Peri-urban Aquaculture study in Uganda. Draft Final Report. National Agricultural Research Organisation (NARO), Fisheries Resources Research Institute (FIRRI) & Aquaculture Research and Development Centre (ARDC), Kajjansi. April 2005.

Aquaculture and Urbanisation in Sub-Saharan Africa. Uganda Country Report by National Agricultural Research Organisation. Fisheries Resources Research Institute. Aquaculture Research and Development Centre, Kajjansi. DRAFT FINAL REPORT. May 2005.

Aquaculture and urbanisation in Sub Sahara Africa. Aquaculture development and its contribution to urban /periurban initiatives in Malawi. Situation analysis. Prepared by: WorldFish Center, Malawi Office, May 2005.

Participatory Research, Markets & Aquaculture in Cameroon. R.E. Brummett, J. Gockowski & V. Pouomogne.

Plan d'affaire cooperative de pisciculteurs avec point operationnel sur le marche de Yaounde, Cameroon. Soua Mboo Nelly Nicaise. Draft : May 2005.

Aquaculture adoption process & Policy environment in South Africa. Samara Velthuysen & Khalid Salie. February 2006.

7.3 Non-peer reviewed publications

Rana, K, Jide Anyila, Khalid Salie, Charles Mahika and Simon Heck Aquafarming in Urban and periurban zones in Sub Saharan Africa, RUAF Magazine (Resource Centre on Urban Agriculture and Forestry) February 2005

Rana K, Jide Anyla, Khalid Salie, Charles Mahika, Simon Heck, Jimmy Joung, Giorgia Monti (2005). Aquafarming in Urban and Periurban zones in Sub-Saharan Africa. Presentation at 7th Bi-annual Conference of the Aquaculture Association of Southern Africa, 12-16 September 2005, Grahamstown, South Africa. Book of abstract: pp. 35.

Salie K, Krishen Rana & Samara Velthuysen, (2005). An evaluation of the feasibility of urban aquaculture in the Western Cape Province, South Africa. Presentation at 7th Bi-annual Conference of the Aquaculutre Association of Southern Africa, 12-16 September 2005, Grahamstown, South Africa. Book of Abstract: pp.72.

7.4 Workshops

Draft report on the Planning workshop at Abbassa: Resource, market development and poverty targeting issues associated with emerging peri-urban and urban aquaculture in Sub-Saharan Africa (DFID Project No. R8287), WorldFish Centre, Abbassa, Egypt 29 September – 1 October 2003

Atukunda, Gertrude et al. Proceedings of the National Stakeholder Workshop on Peri-urban Aquaculture in the Kampala-Entebbe-Jinja Region, Uganda. Jinja, Uganda, Fisheries Resources Research Institute, 9 March 2005.

Nagoli, Joseph et al. Proceedings of the National Stakeholder Workshop on Peri-urban Aquaculture around Blantyre, Malawi. Zomba, Malawi: The WorldFish Center. 9 March 2005.

7.5 Conferences

Session on "Fair market development for African Aquaculture" held during the 7th Conference of the Aquaculture Association of Southern Africa, 12 -15 of September 2005, Grahamstown, South Africa, to point up Aquaculture as an opportunity for poverty alleviation, both through production and consumption, and to disseminate preliminary results from the project through the private sector, research institutes and governmental agencies present at the conference.

8. Appendices