Aquafarming in urban and peri-urban zones in Sub Saharan Africa

Can urban and peri-urban aquafarming in Africa play a role in feeding the cities?

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In a context of rapid urbanisation in Africa (7-10%/yr), the combination of urban migration of the poor with unemployment, food insecurity in urban (U) and periurban (PU) zones and declining fish supplies is raising major concerns 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 and trade patterns in national and international food markets, 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).

Urban and peri-urban agriculture contributes to employment, food security and income generation in cities (Smit, 1996), but although this research related to production in Africa, it excluded aquaculture. Consequently, the significance of aquafarming in and around African cities is largely unknown but ad hoc information, especially in Nigeria, suggests it's a growing phenomenon.

Aquaculture is regarded as being uniquely placed to reverse declining supplies from capture fisheries (mean per capita fish availability in Africa declined 20% between 1990-96 and has declined further), and the activity 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 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.

Fish Production

Figure 1 highlights the growth in exports of fish products from Sub-Saharan Africa (SSA), taking fish away from local consumption, and the ongoing reliance upon imported fish

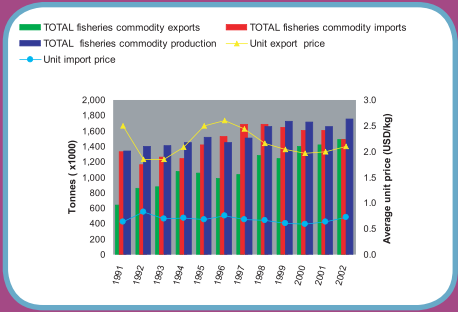

Figure 1. Trade and unit prices in fisheries commodities in SSA

products to supplement indigenous supplies. Although 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, Gregory, 1999).

One of the challenges facing local and national planners is provision of the infrastructure and services to facilitate and secure food supplies for the burgeoning cities. In assessing the potential role of aquaculture to supply these open markets we need to be realistic, taking into consideration current fish supplies, prices and products demanded. Fisheries production in SSA

Figure 2. Large catfish farmed near Ibadan, Nigeria fetch premium prices in city markets

reached 5.3 million tonnes in 2002 with five countries accounting for 50% of production (South Africa, Namibia, Nigeria, Senegal and Ghana) but a significant proportion was for non-human consumption. As shown in Figure 1, SSA countries are exporting higher unit value commodities and are importing lower unit value products, especially cheaper frozen fish, to meet demand. Average unit prices of exports varied between USD 2-2.5/kg while fish imported were only around 20-25% of this price.

If aquaculture is to meet local U and PU demands, producers will have to consider the comparative advantage of what they might produce, not least its competitive price position. Frozen herring and mackerel and other frozen fish dominate the imports, accounting for around 60-75% of total imports in 2002. One explanation for their popularity is their low price (USD 0.4-0.6/kg), a price level which may well influence the cost ceiling of any aquaculture activity and certainly if it is aimed at mass markets.

The above provides a basic backdrop against which national policy for aquaculture development may need to be defined, taking into consideration macro economic policies that are likely to drive distribution of scarce national resources.

It is highly likely that as long as these conditions prevail, aquaculture producers in U and PU zones will not be able to compete with these cheap imports and therefore fish farmers may have to focus on niche markets for large, live or fresh fish taking into account productivity, market preferences and investment risks of their time and money.

Current initiatives towards evaluating role of aquaculture in U and PU zones

In several African countries the potential of (peri-)urban aquaculture for employment, income generation and food security is being increasingly recognised but the markets for aqua products, economic viability, typology and locations of these activities are largely undocumented. Recently, the DFID Aquaculture and Fish Genetics Research Programme funded a project to establish the potential role of aquaculture in selected U and PU zones in SSA. This project is being conducted jointly between the Institute of Aquaculture (IOA) and World Fish Centre (WFC) in Egypt with partners from Nigeria, Cameroon, Uganda, Tanzania, Malawi and South Africa. The primary focus of this collaboration is to (i) understand the macro and micro economic and social environment in urban centres of demand for aquatic

Figure 3. Youth trained in aquaculture beside a simple but effective filter tower of recirculating system for catfish rearing in Lagos, Nigeria

products, (ii) assess the market structure and aquatic products to establish the current conduciveness of U and PU zones for aquafarming and (iii) establish if aquafarmed products can compete in the market place. As part of this initiative the role of local institutions is being appraised, with particular regard to the policy and planning process relating to aquaculture.

In Nigeria, the culture of large catfish in urban and periurban zones is one example of such a development where local residents, including civil servants, teachers, engineers, and trained unemployed youth, have developed home-grown tank and other technologies to farm catfish, semi-intensively and intensively, in small land areas in and around cities such as Lagos (Figures 3 & 4). Interestingly, many of these entrepreneurs are women with no previous knowledge of aquaculture, but an enthusiasm to learn and be trained.

In these cities catfish are mainly cultured in tanks of varying sizes ranging from 1-50 m^3,

Figure 4. Simple backyard tank for catfish in Lagos, Nigeria.

which are linked to recirculating systems of varying degrees of sophistication (Figures 3 & 4) and in earthen ponds. Since catfish are air-breathing fish they can be stocked at high densities, and these were observed

Table 1. Characterisation of aquaculture activities by municipality in the city of Dar es Salaam, Tanzania*.

District	Number of farmers**	No. of fish ponds	Total area of ponds (M^2)	Average area (M^2) per pond (range)
Kinondoni	14	18	24,315	135 (10-10,000)
Ilala	5	6	3,530	294 (80-2,400)
Temeke	13	24	21,100	879 (65-10,000)
Total	32	48	48,945	
Average	102	101	15,365	1,653

*Data are based on a field survey conducted from the 20th to 30th June 2002.
** Farming groups are considered as one entity.

to range from 10-100kg/m^3. A further cost advantage is that fish are commonly fed on farm-based feeds using local ingredients and equipment (Figure 5) although the lack of a viable commercial feed industry has

Figure 5. Simple equipment for home made aquafeed, Lagos.

forced some operators to use imported feeds. Although catfish are also produced in ponds in PU zones the problem of theft and high land cost has constrained some uptake in U and PU zones. Development of recirculating systems over the last decade and growing market demand has generated considerable interest even though initial capital costs are relatively high.

Aquaculture in Dar es Salaam, Tanzania, is not as well developed as Nigeria and differs in that tilapia is the predominant species of culture in U and PU areas. This may be attributable to the scarcity of and limited access to land within the metropolitan areas and lack of cost-efficient tank systems and technical know-how. A preliminary survey in three geo-political municipalities of the city of Dar Es Salaam (Kinondoni, Ilala and Temeke) suggests that around than 50 ha of land is used for fish farming activities. Pond size ranges from about 10 m^2 to 10,000 m^2.

In the periphery of Dar es Salaam city aquaculture is growing fast, albeit in a novel form. Peri-urban fish culture is combined with commercial interests with a passion for aestheticism. More than half (55%) of fish farmers interviewed considered rearing fish in ponds as a social status activity as well as providing tangible rewards (through selling fish) to supplement their income. These farmers were mostly senior government and military officials (retired or not), business personnel and elite individual farmers. This category of farmers considered fish culture as a small-scale income generating activity but not necessarily an important livelihood option. Local pub owners, however, believed that if they established fishponds nearby they could supply fresh fish to their customers for immediate consumption.

Although aquaculture development in South Africa is in its infancy many city municipalities have recognised the potential role of aquaculture as a livelihood option. Several cities, such as Durban, have formulated an urban agricultural policy that includes aquaculture as an economic activity. Ornamental fish rearing is considered a possibility and trout farms are being established by disadvantaged groups in periurban zones (Figure 6). In view

Figure 6. Trout processing facility near Cape Town , SA

of its rich marine resourses South Africa has a well-established formal and informal marketing structure. To encourage economic activity, improve sanitary conditions and encourage the distribution and sale of fish, many municipalities have constructed fish marketing sites. Recent surveys indicated that

Figure 7. Informal markets selling locally produced smoked trout near Cape Town, SA

these traders are receptive to aquaculture products provided quality and price expectations are met (Figure 7).
A problem identified in most cities is the quality and suitability of available water for fish farming. In the case of Dar es Salaam some water bodies may be contaminated with heavy metals such as lead and cadmium and therefore all sites may not be suitable. In addition, in most of these zones city bylaws are not conductive for both aquaculture and agriculture. Efforts will have to be focused on local institutions to create an enabling environment to encourage ordered expansion of aquafarming to meet the rising demands from cities.

Conclusion

The above case studies of urban and periurban aquaculture show that it is already playing an important role within the markets of SSA. Evidence suggests that there is quite diverse recognition and interest in the potential contribution of aquaculture to local food supplies, especially targeting market segments with comparatively few alternative competitors. Whilst the wider availability of imported frozen low unit-value pelagic species is likely to remain a serious constraint to expansion of high volume, low cost-focussed production systems, their very presence may well provide the financial incentive and stimulus for future expansion of current activities.

For more information on this project, a detailed list of references from this article or to discuss general issues of aquaculture development around cities in Africa please contact the authors via this e-mail address: afgrp@stir.ac.uk.

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Thesis List

MSc Aquatic Pathobiology

Pearce, M. W. Comparison of an ELISA kit and PCR for the detection of koi herpes virus

Tautenhahn J. Antibiotic resistance in *Flavobacterium psychrophilum*, causative agent of rainbow trout fry syndrome (RTFS)

MSc Aquatic Veterinary Studies

Cervellione, F. Detection of aquatic *Mycobacterium* spp using single and duplex polymerase chain reaction. (PCR)

Colina, A. O. Effects of iron availability on growth and phagocytosis of *Renibacterium salmoninarum*

De La Cuesta, S. Transmission dynamics of *Gyrodactylus gasterostei* (Glaser,1974) and *Gyrodactylus bychowsky* (Monogenea, Gyrodactylidae)

Ingles, A. G. Morphological aspects of red mark syndrome in rainbow trout, *Onchorynchus mykiss* (Walbum) in Scotland

Montuliu, B. G. Identification of common epitopes on fish IGM using monoclonal antibodies

Del Pozo, J. Studies on monoclonal antibodies characterization and immunohistochemical detection of *Lactococcus garvieae*

Rizgalla, G. An investigation of the involvement of *Flavobacterium psychrophilum* in the pathogenesis of gravel rash syndrome

MSc Aquaculture

Alvarez, V. M. P. Design and evaluation of a field training manual for aquaculture technology transfer in Michoacan, Mexico

Blanco, A. I. The influence of dietary arachidonic acid on egg and milt quality in Atlantic cod (*Gadus morhua*) brood stock

Fenjul, C. L. Prelimary analysis on growth and feed conversion indices for Atlantic cod (*Gadus morhua* L.)

Fletcher, R. C. Larval rearing protocols for the Atlantic cod, *Gadus morhua*; towards the reduction or replacement of the live feed artemia with commercially available micro particulate diet

Garcia, A. A. Development of an aquaculture plan for pescado blanco *Chirostoma estor estor* and other species based on the Convention on Biodiverstiy

Gatward, I. C. M. Ecological impacts of fisheries in central Scotland on receiving water bodies

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Malme, M. The effect of net changes on the copper content of sediments underlying an Atlantic salmon (*Salmo salar*) cage farm

Orriols, J. M. Development of new technology for counting rotifers (*Brachinus plicarus*) using image analysis

Murray, J. The effects of spectral composition and light intensity on Atlantic cod, *Gadus morhua*, egg and larval performances and quality traits

Smith, R. G. Development of a GIS-based wave climate model for the Western Isles

PhD

Zuleica de Garcia e Costa, J. B-cell epitopes in fish nodavavirus

Davie, A. Effects of photoperiod manipulation on growth and reproduction in Atlantic cod (*Gadus morhua* L)

Williams, P. M. Feeding behavior of *Lumbriculus variegatus* as an ecological indicator of in situ sediment contamination