7.10 Freshwater fish seed resources in Ghana

Patricia Safo
Crystal Lake Fish Ltd
Accra-North, Ghana
safardirect@yahoo.com; oliviasafo@yahoo.com

Safo, P. 2007. Freshwater fish seed resources in Ghana, pp. 257–266. In: M.G. Bondad-Reantaso (ed.). Assessment of freshwater fish seed resources for sustainable aquaculture. FAO *Fisheries Technical Paper.* No. 501. Rome, FAO. 2007. 628p.

ABSTRACT

The present study has provided an evaluation of a basic and important requirement of the industry: hatcheries to produce fingerlings for farmers. The information presented in this paper consists of different aspects of the freshwater fish seed sector in Ghana such as resources and supply, production facilities and technology, management, quality, marketing, certification, economics and a brief description of the seed industry, legal and policy frameworks, support services and stakeholders.

A well-planned and coordinated action is required to solve the major constraints in the sector so that an orderly and rapid progress can be achieved. Among the recommendations include: (i) contract with some private companies with the capability to produce seed for the industry to be given incentives and contracts drawn up against the government and the farmers, (ii) there should be a re-focusing of research and training programmes at all levels to cater for the emerging needs, (iii) development of stocks better suited for local conditions and management to maintain genetic integrity in the light of potential fish transfers, (iv) efforts to ensure all-year round supply of quality fish seed, (v) inclusion of aquaculture objectives in national and international agricultural seed development funding programmes or projects and (vi) strengthening of technical manpower, provision of equipment and other logistics to facilitate hatchery production and delivery of fingerlings to farmers.

The study concluded that while it has become evident that producing seed is not a major problem, good management of the entire process will be a major challenge. The country needs to be updated with some of the latest technology in order to ensure that Ghana remains competitive and is able to produce the fast growing fish required in commercial aquaculture – and also to provide enough protein through aquaculture to meet the needs of the people.

INTRODUCTION

Aquaculture was introduced to much of the African continent five decades ago as an innovation that would improve the economic and nutritional well-being of producers. Fish ponds were foreseen as an ideal component of integrated farming systems, a fish crop grown using by-products from the home and farm. Indeed, from Kenya to Sierra Leone thousands of ponds were built, many only to be abandoned after a few years of meagre production.

Ghana is fairly well-endowed with a bountiful supply of water resources, but there is a high variability in the amount of available water within the year and over several years. The resources include rivers, streams, lakes, underground waters, lagoons, ponds and marshes. All these are dependent on precipitation.

The country is drained by three main surface water systems and the wetlands. The surface water systems are the Volta, Southwestern and Coastal systems. About 70 percent of the total land area of Ghana is drained by the Volta river system, which flows directly into the sea. The Volta Lake covers approximately 8 482 km^2 while the tributaries, which are seasonally flooded, total 1 684 km.

The areas outside the Volta drainage basin are the southwestern and the southern coastal basins, which are drained by a number of rivers and streams flowing directly into the sea. These cover 22 percent and 8 percent, respectively of the total areas of Ghana.

The wetlands (lagoons, salt marshes and mangrove swamps) are important components of the estuarine and coastal water systems in Ghana. There are about 89 coastal lagoons representing about 0.15 percent of the total land area of Ghana. They form an ecologically important unit providing feeding, roosting and nesting sites for thousands of migratory and resident birds. They also provide nesting and breeding sites for marine turtles and some marine fishes.

The water resources of Ghana are utilized for drinking water, fishing, irrigation agriculture, industrial, transport, power generation, livestock watering, salt production, recreation and for waste disposal purposes.

Ghana's freshwater fish fauna includes 28 families, 73 genera and 157 species. Of the species, 121 have been recorded from the Volta river system (Ghana portion) which drains more than two-thirds of the country. The Volta system in Ghana includes the Volta River, the Volta Lake and their tributaries such as rivers Oti, Pra, White Volta, Black Volta and Asukawkaw.

Outside the Volta system, the major inland water system includes the Densu, Ayensu, Okye, Kakum, Pra, Ankobra, Tano and Bia river basins and Lake Bosumtwi.

Nine species, namely: *Barbus subinensis* (Cyprinidae), *Irvinea voltae* (Schilbeidae), *Chrysichthys walkeri* (Claroteidae), *Synodontis arnoulti*, *S. macrophthalmus, S. velifer* (Mochokidae), *Limbachromis robertsi*, *Steatocranus irvinea* (Cichlidae) and *Aethiomastacembelus praensis* (Mastacembelidae) are endemic to freshwater systems of Ghana (Dankwa, Abban and Teugels, 1999).

According to Dankwa, Abban and Teugels (1999), 81 species are economically, of food importance and the species of culture importance include: *Heterotis niloticus* (Osteoglossidae), *Clarias gariepinus*, *Heterobranchus longifilis* (Claridae), *Chrysichthys nigrodigitatus* (Claroteidae), *Oreochromis niloticus* (Cichlidae) and *Lates niloticus* (Centropomidae).

Although a wide variety of fish have been tried in culture environments, the most common pond-raised fish in Ghana are tilapias (i.e. various fish from the genera *Oreochromis* and *Tilapia*) and catfishes (i.e. *Clarias, Heterobranchus* or their hybrid). Initially the catfish was a victim of the scarcity syndrome by requiring extraordinary hatchery techniques. Fortunately, today it is now possible to produce *Clarias* seed using farmer-friendly techniques in most farms.

In spite of this, tilapia remains the most frequently cultured fish and the fish about which more complaints are made with respect to small harvest size, stunting, etc. To attempt to address this problem, a variety of techniques have been used in Ghana to raise all-male tilapia which grow to a larger size (than females). Hand-sexing to obtain an all-male stock is the most user-friendly method. At some sites sex-reversal using methyltestosterone is employed, but this requires access to the hormone and slightly higher technology.

Other aquaculturists have sought to improve tilapia systems by improving the fish, either by identifying a new culture species or by genetically improving existing culture species.

SEED RESOURCES AND SUPPLY

Currently, there are about 2 000 fish farms throughout the country with over 1 000 fish farmers. These are made up of private farms, government fish farms and parastatal fish farms. These farms rely mostly on three sources for their fish seed, i.e. (a) from the wild where the farmers buy the fingerlings from fishermen, (b) some of these farms produce their own fingerlings, while (c) others rely on specialized farms for their stock of the fingerlings.

Local fishermen usually scoop up "clouds" of fry as they school in the shallows (wild) or remove young fry from their mother's mouth and sell to the farmers who in turn transfer them to some type of rearing container and feed them.

Majority of farmers use mixed-sex tilapia systems to generate their seed. That is, they use the customary techniques where the fish is harvested in the pond after six months, selling or eating the larger fish and keeping the smaller individuals for restocking. However, since extreme care is not taken, the individuals that are used for restocking are usually already sexually mature and begin reproducing almost immediately after stocking.

Another alternative method used is to hold broodfish in a net enclosure (*hapa)* where their spawning is closely monitored. In this way, the age of the fingerlings are well known and the risk of stocking sexually mature individuals is eliminated. The *hapas* are usually placed in the farmer's grow-out ponds. Now, some farmers are specializing in seed production where *in lieu* of *hapas*, small earthen ponds are being used.

Regardless of the technology chosen, it can be concluded that on-farm (private) production of fish seed is now feasible for the most common culture species. The most suitable culture fishes in Ghana should continue to be *O. niloticus*, *C. gariepinus* and *H. longifilis.*

SEED PRODUCTION FACILITIES AND SEED TECHNOLOGY

A major constraint to successful aquaculture among producers is the poor and erratic quality of fish seed available for stocking. Local infrastructure, for aquaculture development and to support the primary beneficiaries, is limited in the country. Two major factors influence the cost of fish seed in the country. These are the high cost of production from government breeding centres and insufficient supply. Pilot fish hatcheries were established in Accra, Akosombo and Kumasi to make available to farmers seed fish species that are relatively easy to handle. The Accra Centre started operating in 1993 with a target of 180 000/yr but by 1999, it was producing a paltry 40 000. The Akosombo Centre started operating in 1996 with a target of 100 000 seed/ yr. In 1999, it was producing 100 000 seed/ year and this success was attributed to the fact that it was being operated by a research institute with special interest in aquaculture. The Kumasi Centre became operational in 1997 with a target of 100 000 seed/yr and by 1999 it was producing only 4 000 seed/yr. The shortfalls in the production targets were attributed to predation, cannibalism, theft and storms killing brooders. Though the fish seed prices are subsidized by governments as they are produced at public facilities, the costs remains high and constitute a major operating cost for aquaculture development in the country.

In all these facilities, the fish of choice for production were *O. niloticus* and *C. gariepinus.* Others include the tilapias and *H. longifilis.*

However, if the seed production is contracted to private companies it will ensure more continuity in the seed production in Ghana. Large commercial farms like Crystal Lake Fish that have excess capacity to produce seed are being under utilized. They already have the infrastructure in place to produce over three million fry a month.

There is a need for dialogue by the government to put in place some sort of contract between the private sector and the government.

PLATE 7.10.1
Aquaculture facilities at Crystal Lake in Ghana

SEED PRODUCTION FACILITIES AND SEED TECHNOLOGY

A major constraint to successful aquaculture among producers is the poor and erratic quality of fish seed available for stocking. Local infrastructure, for aquaculture development and to support the primary beneficiaries, is limited in the country. Two major factors influence the cost of fish seed in the country. These are the high cost of production from government breeding centres and insufficient supply. Pilot fish hatcheries were established in Accra, Akosombo and Kumasi to make available to farmers seed fish species that are relatively easy to handle. The Accra Centre started operating in 1993 with a target of 180 000/yr but by 1999, it was producing a paltry 40 000. The Akosombo Centre started operating in 1996 with a target of 100 000 seed/ year. In 1999, it was producing 100 000 seed/ year and this success was attributed to the fact that it was being operated by a research institute with special interest in aquaculture. The Kumasi Centre became operational in 1997 with a target of 100 000 seed/yr and by 1999 it was producing only 4 000 seed/yr. The shortfalls in the production targets were attributed to predation, cannibalism, theft and storms killing brooders. Though the fish seed prices are subsidized by governments as they are produced at public facilities, the costs remains high and constitute a major operating cost for aquaculture development in the country.

In all these facilities, the fish of choice for production were *O. niloticus* and *C. gariepinus.* Others include the tilapias and *H. longifilis.*

However, if the seed production is contracted to private companies it will ensure more continuity in the seed production in Ghana. Large commercial farms like Crystal Lake Fish that have excess capacity to produce seed are being under utilized. They already have the infrastructure in place to produce over three million fry a month.

There is a need for dialogue by the government to put in place some sort of contract between the private sector and the government.

SEED MANAGEMENT

The development of fish farming like all other ventures requires an appreciable investment in basic supporting services (Pillay, 1987). In this regard, while it is essential that centres be established to produce adequate and quality seed for timely delivery to farmers, the resources used in the process become specialized and complex. Therefore, economic, commercial and financial considerations are required to directly optimize investments in the sub-sector to the most efficient levels. In a study conducted in 1999 on the economic indicators for catfish hatcheries in Accra, Akosombo and Kumasi centres, the sensitivity analyses revealed that it was only the Akosombo Centre that gave a positive net present value (NPV) while the Accra and Kumasi centres gave negative NPV values which is indicative that the projects had low prospects of being viable. The poor economic indicators for the catfish hatcheries could be attributed mainly to:

1. the use of imported brine shrimp *Artemia* as the sole feed for the larval stages of the catfish;
2. the lack of appropriate equipment and facilities;
3. inadequate experience on the part of the hatchery operators in hatchery management practices.

Thus, while demonstrating the ability to adapt the techniques, the incorporation of additional distinct resources required in managing and putting the techniques to productive uses were not given due consideration. These resources include among others institutional structures and linkages, expertise and experience.

SEED QUALITY

The quality of fish seed, or young fish, is a vital element for successful aquaculture production. Simple pond fish culture by small-scale farmers is an activity often encouraged by national fisheries programmes or non-governmental organizations (NGOs). Such projects are intended to provide an additional source of food or income to the farm household. However, despite good intentions, such projects can often fail because, even on a very small scale, there is a great deal more involved than simply digging a hole and filling it with water and fish. Water quality is an essential consideration but the siting and shape of the pond are also important. But even if these factors are satisfactory, poor stock will result in poor yields.

Private companies that have established facilities can be given contracts to supply quality seed to would-be farmers.

One way of ensuring seed quality in the country is the proper management of aquatic animal diseases. Healthy seed ensure healthy stocks, hence, there is the need for more equipment and more clinics which can provide diagnostic facilities for farmers; good husbandry practices and continuous research on developing new methods which can help in the development of rapid diagnostic facilities.

Solving the problems of environmental impacts and sustainability of aquaculture farms require improved culture technologies and systems, good fish nutrition coupled with fish disease control and prevention. Also the genetic improvement of fish stock, maintenance of quality of seed and brooders and the improvement of the quality of fishery products are all husbandry practices that ensure the seed quality.

Already established farms with adequate resources can be given incentives to provide these services as they have the infrastructure in place.

SEED MARKETING

Seed marketing in any aquaculture venture is an important aspect of the enterprise. Seed produced must be sold to prospective farmers so that the business flows. In this regard, aggressive marketing strategies must be evolved by the seed producers to ensure that whatever investment they have made is recouped after the sales. In this regard, hatchery

managers would have to strengthen linkages with their clients (farmers) and formulate realistic arrangements that would programme activities on both sides, such that pond harvesting and restocking are done on a regular basis. The channel of communication between the hatchery managers and the farmers must not be broken. This requires massive investment in infrastructure in the fields of roads and telecommunication which are currently lacking on most farms.

Hatchery workers should, in addition, have to recognize the fact that farmers occasionally encounter obstacles that pose difficulties to the marketing of food-size fish. One report indicated that when such obstacles are ameliorated and a reduction in the gap between fingerling availability and stocking periods is attained, the socio-economic viability of the hatchery output could easily be proven, thus, raising farmers' confidence in the hatchery activities and the acceptance of the output emphasize the need for the integration of financial, economic and social aspects of the venture.

SEED INDUSTRY

The fish seed industry is at the heart of the aquaculture development as a whole since it is a multidisciplinary science that includes biology, engineering, nutrition, feed technology, genetics and economics among others.

Much biotechnological research has been undertaken in Ghana in the field of aquaculture which aims at improving productivity per unit area of water, e.g. the sex reversal in the Nile tilapia *O. niloticus* using hormones to produce all-male tilapia fingerlings which grow faster and bigger that the female tilapias.

There is an urgent need to develop improved genetic seed, e.g. through advance selection and super-male breeding programmes.

The development of super-male production would have to be a government initiative.

Also, different techniques have been introduced into seed production of the various fishes farmed in the country. All these are aimed at increasing production of cultured fish.

Several training courses have been organized by scientists from the CSIR Water Research Institute's Aquaculture Research and Development Centre in Akosombo, the Fisheries Directorate and the FAO for fish farmers, extension officers, hatchery managers both in the public and government farms. These training sessions are helping to improve the seed base of the aquaculture industry in the country. Unfortunately, these initiatives are not up-to-date with the latest technology.

SUPPORT SERVICES

In the context of extension services, their organization and efficiency in most of the countries in the region are similar. Aquaculture and capture fisheries are placed in a single administration, usually the Department of Fisheries, which is within the Ministry of Agriculture, Rural Development, or Animal Production. However, in Ghana, aquaculture is directly under the Ministry of Fisheries.

The smooth and orderly development of fish farming in Ghana is hampered by a number of problems which include:

- weak extension services;
- inadequate supply of good quality fingerlings;
- lack of knowledge of fish pond management;
- high cost of pond construction;
- inadequate access to transport and equipment;
- lack of funds.

It is important to note that commercial fish farming is not very common in West Africa. The farmers have taken the risk to establish farms and have successfully established farms should be given incentives to act as advisors to new comers hoping to establish fish farms.

However, aquaculture is now considered an integral part of development activities that fall under the agriculture sector and a proposed Aquaculture Policy focusing on:

1. increased private sector productivity of all types of farm inputs (i.e. improved seed, breeding stocks, farm labour and management);
2. diversification of range of products and services; and
3. increased farm yields and improved access to marketing with a view to increasing farm incomes, contributing to poverty reduction and creating the image of aquaculture as a viable economic activity.

Due to the stratification of extension services staff, most of the work in the field is being undertaken by personnel with little training themselves. In Ghana, extension agents are recruited and trained on-the-job. On-the-job training is appropriate when facilities exist and are operational and also where senior staff or colleagues have the possibilities to perform their duties. At present, however, in the country, these conditions are lacking or are inadequate. Most extension services in Ghana are overstaffed relative to their present needs. This may be due to a concentration on the Training and Visit (T and V) System as the method to provide training and advice to farmers on their own farms.

Extension agents, particularly field workers, have limited opportunities for career advancement. This is due to the lack of training institutions in the country and to the lack of basic qualifications to pursue training outside the country. Even those who have the opportunity to train externally, such as the trainees of the UNDP/FAO project at Arac fail to further their career advancement because of the lack of follow-up by the institutions concerned, e.g. the failure to issue to the trainees with transcripts of their results and diplomas or certificates of qualification.

Three levels of core personnel required for aquaculture have been identified as senior aquaculturists, technicians and extension workers by UNDP and FAO. However, in Ghana, all three levels of trained personnel are lacking. In cases where senior aquaculturists exist their efficiency and work performance as supervisors of extension workers, who include technicians as well, are constrained by insufficient managerial and technical experience due to minimum exposure to the industry.

FAO organizes specialized in-region or in-country training courses through bilateral or international arrangements. In 1987, the Commonwealth Secretariat ran a 6-week fish culture course in Ghana for 20 technical officers. It also ran a Workshop on Aquaculture for Commonwealth Countries in the region in 1985 at Freetown, Sierra Leone.

SEED CERTIFICATION

This is a very important aspect of fish farming. Seed certification is critical to ensure healthy farms are established in the country. Unfortunately this does not exist in Ghana.

LEGAL AND POLICY FRAMEWORKS

The development of fisheries policy in Ghana has followed the development of the fishing industry. The legal basis for fisheries management in Ghana evolved from ordinances into laws and regulations. The law was continuously reformed to:

- contract with some private companies with the capability to produce seed for the industry to be given incentives and contracts drawn up against the government and the farmers;
- sustain and regulate the exploitation of national fishery resources;
- improve Ghana's access to international markets within the domain of the international fish trade;
- obtain optimum benefits for Ghanaians as owners of fish-related enterprises, as employers of the fishing industry, as consumers of fish products and as beneficiaries of foreign exchange earnings from fish trade;

- enhance investment in a private sector-driven industry; and
- improve the fishery management system.

Currently, the law on fisheries in Ghana has been consolidated into the Fisheries Act of 2002 (Act 625).

With regard to fish production, it is noteworthy to observe that the current Fisheries Act (2000) conforms to the relevant sections of the FAO Code of Conduct for Responsible Fisheries with particular emphasis on gear selectivity and an effective institutional framework. The Fisheries Act also gives legislative backing to the recently established Monitoring, Control and Surveillance Division of the Fisheries Directorate with clearly defined legal powers to regulate fishing operations. The Division draws strength from the inclusion of a number of security agencies, especially the Ghana Navy, in its surveillance operations.

The Directorate of Fisheries under the Ministry of Fisheries has also elaborated fishery management plans for marine and Lake Volta fisheries. A new set of fisheries regulations to give effect to the Fisheries Act 625 (2002) is under preparation.

ECONOMICS

There are both public and private fish breeding centres, in the country supposedly ostensibly to produce fingerlings and particularly for the tilapias. There are about 2000 fish farms/breeding centres in the country. However, due to lack of funds for operation and maintenance and adequately trained management, the production from many centres is extremely low.

This accounts for the irregular supply and high cost of fingerlings in the country. Also some of the fish ponds were not properly constructed hence they dry up in the dry seasons and only bounce back in the rainy season. Demands for fingerlings therefore fluctuate with the seasons and those farmers that rely on sales of fingerlings for their livelihood tend to lose income at certain times of the year. The fish seed sector has therefore been unable to prove its economic viability and is plagued with insufficient seed supply, inadequate management and lack of technical support.

Many farmers are also not able to prepare viable and bankable dossiers and local banks do not have adequate expertise to evaluate loans in the sector. In some cases, due to the weakness of the extension services, farmers are unaware of the existence of credit facilities.

INFORMATION OR KNOWLEDGE GAPS

There is also an associated need to strengthen institutional capacity to manage the fish seed sector and to expand the knowledge base in order to enable sustainable development policies and plans. There is a general recognition of the need for interdisciplinary and intersectoral approaches to development and resource management in aquaculture. Moreover, it is becoming increasingly clear that sustainable aquaculture development cannot be regulated solely by governments but they must also involve many interest groups at the national, regional and international levels, including new institutional arrangements and partnerships (consultative frameworks). This is being highlighted by ongoing structural change, namely privatization and the contraction of governments' role in development.

STAKEHOLDER

The various stakeholders involved in fish seed production includes government fish farms (Afife fish ponds and the Libga fish ponds), parastatal fish farms (WRI-Aquaculture Research and Development Centre, Akosombo and the Institute of Renewable Natural Resources fish farm, Kumasi) and private fish farms (Crystal Lake Fish Limited and Pacific Farms Ltd.).

The Council for Scientific and Industrial Research (CSIR) Water Research Institute (WRI) organized courses for NGO's (Ghana Rural Reconstruction Movement and the

African Centre for Human Development) involved in fish farming and cooperative fish farming groups from the Akwapim North and the Kadjebi Districts to disseminate the practice of all-male tilapia culture in ponds. There were lessons in the rudiments of fish farming, pond preparation, stocking, fertilization, feeding and harvesting.

Private fish farms in all the regions in the country are now upgrading their knowledge in fish seed production in order to meet the demands for fingerlings on their farms and for sale to smaller farms.

Larger hatcheries such as the WRI-Aquaculture Research and Development Centre at Akosombo develop and produce new varieties and strains of fish seed for sale and distribution to other farms.

Fish Farmers Associations are now springing up in the districts and in the regions but these splinter groups are yet to come under one umbrella to champion the cause of fish farmers in the country.

The WRI-Aquaculture Research and Development Centre, Akosombo, the Institute of Renewable Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi, The Fisheries Department of the Ministry of Fisheries and other research Institutes are collaborating to provide the legal and policy framework for the fish farming and seed industry and thereby eliminate all bottlenecks that hamper the smooth functioning of the sector.

Several donor agencies have been collaborating with research institutions in Ghana. Notable among them are FAO, German Development Organization (GTZ), International Centre for Living Aquatic Resources Management (ICLARM), Danida, International Development Research Center (IDRC) and many others. The fields of collaboration include organizing workshops for both scientists and farmers, field demonstrations, funding of research activities and provision of grants for training.

FUTURE PROSPECTS AND RECOMMENDATIONS

The development of aquaculture in Ghana rests on a well planned and co-ordinated action to solve the major constraints to the orderly and rapid progress of the industry. Although the technical aspects of aquaculture have been and continue to be discussed by experts, planning of the industry in the country has not received more than a cursory attention.

The present study has provided an evaluation of a basic and important requirement of the industry: hatcheries to produce fingerlings for farmers. It has been shown that, in all except one, the activities of pilot hatcheries were not viable.

To redirect the fish seed industry in Ghana, the following recommendations are provided:

- contract with some private companies with the capability to produce seed for the industry to be given incentives and contracts drawn up against the government and the farmers
- there should be a re-focusing of research and training programmes at all levels to cater for the emerging needs
- development of stocks better suited for local conditions and management to maintain genetic integrity in the light of potential fish transfers
- efforts to ensure all-year round supply of quality fish seed
- inclusion of aquaculture objectives in national and international agricultural seed development funding programmes or projects and
- strengthening of technical manpower, provision of equipment and other logistics to facilitate hatchery production and delivery of fingerlings to farmers.

CONCLUSIONS

It has become evident that producing seed is not a major problem in Ghana but good management of the entire process has become very challenging. There is a need for the

country to become up-to-date with some of the latest technology. This will in the long run ensure that Ghana remains competitive and is able to produce the fast growing fish required in commercial aquaculture – and also provide enough protein through aquaculture to meet the needs of the people.

REFERENCES

Dankwa, H.R., Abban, E. K., & Teugels, G.G. 1999. *Freshwater fishes of Ghana: Identification, Distribution, Ecological and Economic importance*. Ann. Sci. Zool. Vol. 283.. Musee Royale de I'Afrique Centrale. Terveren. Belgium. 53 pp.

Pillay, T. V. R. 1987. *Planning of Aquaculture Development: An introductory guide*. Farnham, Surrey, England. 69 pp.