Fish farming development in Africa: the end of the bottleneck ?

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All the projects aiming at developing fish farming for self-consumption (subsistence aquaculture) have failed in Africa, mostly because the technological models proposed did not permit to make it an attractive activity for farmers. Practising fish farming requires a lot of inputs and at least manpower to dig and manure the pond, or stock and feed the fish with available by-products etc… But the models proposed were generally operated at a very low technical level: stocking fish -mainly tilapias- without regard to the species, without control of the wild fish entering the pond and no sexing or control of overpopulation using a police fish. The result is very poor in quality and quantity so that, in such a context, the opportunity cost of manpower is usually not in favour of fish culture (insufficient work productivity in terms of time and space). In fact, most African fish culture development projects have been developed on a very large geographical scale, aiming at promoting a high quantity of farmers rather than at developing efficient culture systems among a few number of operators, at least at a first stage. Moreover, funding agencies were pushing forwards for quick and spectacular results, whatever can happen after the project. Some had a slogan saying: "fish culture is everyone's business", whereas nowhere else in the world every farmer is doing aquaculture (except perhaps in some parts of Asia with backyard ponds). The result is that after the end of each project nobody was doing fish culture anymore in the country… until new projects start.

Fish farming should be considered as a profession, even and perhaps particularly in Africa, and should therefore be practised at least at a minimum level of skill. Farmers are ready to learn new techniques, especially for diversifying their productions in order to minimize the risks. In such a context, suitable fish farming technology packages should be elaborated, each one corresponding to every context where fish farming is intended to be developed, considering the agricultural, social, anthropological and economical environment. Taking into account all the constraints (water and land availability, feed/manure, farmer's or worker's manpower, market including type of fish required -small, medium, large- and corresponding prices...), the most suitable fish production system for a given context of a given country can be found among the several models developed by R&D projects.

Although there is most probably not a universal production system to be developed in Africa but dozens of them, **three main categories** can be listed. For 30 years, economical operators have made attempts to invest in **industrial** fish farms in Africa (Ivory Coast, Nigeria, Kenya, Zimbabwe...) but without meeting the expected success, although this situation seems to be changing due to the development of an international market for tilapia. The question remains to know if such industrial units could be a driving-force or competitor for small scale aquaculture. That is where the government policies could play a key role by enhancing synergies. These are characterized by large production units and justified by the possibility to engage in economies of scale. Their objective is strictly economic and financial, and differ from this point of view from the other two models which social component is of much more importance. However, this does not mean that their economical component is not as important as it is in the case of the industrial farms, as they must not only be profitable to be adopted by the farmers, but they also must be more attractive than other locally available economical (agricultural or not) activities. For example in Ivory Coast, the labor economic efficiency of efficient fish culture models is higher than for irrigated rice (3000 F CFA working day for fish farming, 1000 F CFA/working day). Similar results in favour of fish culture are recorded for land economic efficiency (20 000 F CFA/100 m2 for fish farming and 5000 F CFA/100 m2 for rice culture). In both environments, the promotion of models that make use of production factors accessible and available under conditions allowing production at a competitive cost price is highly advisable. For this, production inputs that are locally available for possible use must be inventoried. The model must not be capital intensive, i.e., it must encourage the use of the most abundant production factors as opposed to the most scarce ones. In African environment, the most rare production factor is capital. Yet, the most efficient systems are those making intensive use of the most abounding production inputs, in this case, labor. The chosen systems must therefore rely on productive combinations that take into account the limitations in production (financial, labor, land and marketing constraints). Regarding financial constraints, models requiring an important working capital are not suited for rural development.

Periurban areas are characterized by their proximity to the fish and input markets, so that several technical models could be considered. Table 1 gives the net profit of seven of them. It shows clearly that the most efficient in terms of profitability is not the one which uses the most performing feed. Moreover, it shows that

the only models having a positive profit are the ones which are using an all-male stocking (hand sexing with police-fish). Heavy extension support is required, probably on a long term basis.

Table 1: Net profit for different fish culture models developed in Ivory Coast (Koffi *et al*., 1996)

	Net profit (F CFA as of 1996, 1 US $ = 600 F CFA)
All male tilapia + Heavy extension support + Low quality feed (rice bran) + Pig manure fertilisation	22 009
All male tilapia + Heavy extension support + Commercial feed	14 189
All male tilapia + Heavy extension support + Low quality feed (rice bran)	13 604
All male tilapia + Light extension support + Commercial feed	4 084
All male tilapia + Light extension support + Low quality feed (rice bran)	2 630
Mixed tilapia + Light extension support + Commercial feed	-72
Mixed tilapia + Light extension support + Low quality feed (rice bran)	-447

On the other hand, **rural** areas are characterized by a difficult access to the urban market for fish and production inputs, and by a still more acute scarcity of capital in particular in the African rain forest countries. On the other hand, land is often the most abundant production factor, in particular in countries like Ivory Coast where agricultural development has historically been based on the culture of coffee and cocoa on high lands whereas low lands where systematically unused. Thus, technical models must be based on no- or very low- input, so that the most frequent fish culture models are generally characterized by a low density stocking (<1 fish/m2) and a large pond size (>5000 m2)

Both systems require a good level of skill for stocking the right species of tilapia, doing hand sexing with high ratio of males and using the right species of police-fish and at the right size. Monosexing techniques such as SRT (sex reversed tilapias) or GMT (genetically male tilapias) for small-scale fish farming do not appear to be applicable in most African places, and most hatcheries implemented in the framework of development projects have stopped after the external fundings have dried up. On-farm production of tilapia fry should be encouraged. There has been often suggestion of producing cheap high biomasses by growing large quantities of small fishes, starting from a mixed-sex tilapia stock for feeding low income populations. This does not appear as a realistic alternative for both main reasons: in low input conditions, low stocking density (<1/m2) seems to take better profit of the pond productivity ; in higher input conditions, using raw by-product and manure, the best net profit is provided by producing large fish in many areas of Africa. The right combination of species must be applied, as polyculture is another characteristic of African ponds that permits a better exploitation of all aquatic food resources.

Reference:

Koffi, C., M. Oswald and J. Lazard. 1996. Rural development of tilapia culture in Africa: from myth to reality. Pp 505-514. *In*: R.S V. Pullin, J. Lazard, M. Legendre, J. B. Amon Kothias and D. Pauly, editors. The third international symposium on tilapia in aquaculture. ICLARM Conf. Proc. 41, Manila, Philippines