

Extensive or intensive fish farming?

The debate continues on whether to recommend intensive or extensive fish farming to farmers in sub-Saharan Africa

Extensive fish farming usually refers to fish farming conducted in medium- to large-sized ponds or water bodies; the fish production relies merely on the natural productivity of the water which is only slightly or moderately enhanced. Externally supplied inputs are limited; costs are kept low; capital investment is restricted; the quantity of fish produced per unit area is low. In brief, the control over the production factors is kept low. The return on labour is high.

Intensive fish farming, on the other hand, implies that the quantity of fish produced per unit of rearing area is great. To intensify the culture, production factors, such as feed, quality of water and quality of stocked fingerlings, are controlled to improve the production conditions. There is steady monitoring during the production cycle.

It goes without saying that all these controls entail high-tech practices and capital-intensive investments, which add to the production costs. The returns must justify increased production costs. The contribution of natural productivity into fish production is low or negligible. Besides this, intensive fish farming carries with it high costs or threats to the environment.

Apart from these two forms of fish farming, some speak about semi-intensive fish farming, referring to intermediate practices, taking elements of both forms. This is, however, ill-defined.

Before suggesting which of these forms is to be recommended, one should look at the context under which fish farming is practised. What are the farmer's objectives? The first objective is to ensure food security/livelihood for his household. This can be secured, firstly, by

growing food crops, and then by diversifying the farmer's activities over a range of agriculture and non-agriculture ventures in pursuit of his income generating strategies. The rationale behind this is to manage risk (*ex ante*) and to cope with loss (*ex post*).

The strategies devised will have to take into account his assets (resources, human capital, know-how) and his investment capacities. To carry out his strategies and best achieve his objectives, enabling market conditions need to be present. These are essentially a market system for agricultural and non-agricultural factors and products. For instance, food or labour scarcities can alter performance of the markets and prevent the farmer from achieving his objectives.

In support of his strategies, the farmer aims at optimizing the use of resources in his reach, putting to use unused or underused resources. The objective reason for going into fish farming is, therefore, the expected return to be made from fish farming. The choice of income-generating activities, amongst several options available, is made on the grounds of their expected returns and risks involved.

Farmers can be largely divided into three categories:

- those with little resources and land, no cash, short of labour, who are risk-prone and try to diversify their production in spreading risks, but who have little manoeuvring range;
- those with more resources, on-farm and off-farm; and
- the rich ones.

The first group of farmers will practise fish farming as a complementary or supplementary activity, while the two other groups can envisage fish farming as an income-generating activity on its own.

This means that, for the first group, fish farming needs to be integrated into a whole farm system, while, in the other two cases, it could stand on its own and develop into a primary economic activity.

The greater the role fish production plays in the generation of income, the larger the market needs to be to absorb the produced supply. The less fish is produced, the greater will be the home consumption of the fish produced.

Many smallholder farmers, except for the poorest ones, have off-farm incomes (trading activities, handicraft production,

basket weaving, herbalist activities, wine or beer production, and so on). These incomes are often quite important, as they are part of the risk-spreading strategy to secure a living.

In cases of failure of agricultural production due to climatic or other reasons, farmers will increasingly rely on off-farm income to tide over the critical period, though, in some cases, as in rural Mozambique, off-farm income has no discernible effect on calorie availability.

A possible explanation might be that off-farm activities are primarily accessible to men, while women are mostly responsible for the supply of food.

Non-farm income-generating activities are also important to provide means to pay for hired labour in agriculture; women will have to depend more on

mobilizing inter- and intra-household linkages to provide for extra labour.

Cash incomes are also important for the purchase of planting material or fish seed and farm inputs, as formal credit facilities from banking institutions are not available. Incomes generated through off-farm work, sales of cash and food crops contribute to the emergence of food and non-food markets with effective demands. With the monetisation of the economy, reliance on non-market relations, such as informal or exchange labour, is regressing; hired labour to be paid for in cash and kind is increasing. For instance, in Nigeria, traditional patterns of gender role in agriculture are changing, resulting in increased participation of Igbo women in agricultural production due to greater male participation in non-farm activities and in wage employment.

Alternative productive activities with little requirements for capital will be favoured. These offer a rapid return on investment, which can incorporate marginal labour force (children or the elderly).

Any move into fish farming will be supported by an assessment of the required conditions, i.e. suitable land (water-logged soil or proximity to a water stream), availability of water and inputs (agricultural by-products and manure), the anticipated returns from the available resources, and whether these are greater than those (expected or real) generated by other uses of the same resources (production of rice in marsh areas, compared to that of fish), and expected marketing facilities for the fish produced.

The benefits generated by fish farming are:

- a homestead pond has multiple purposes and contributes to increasing overall farm productivity;
- fish is an important ingredient in human nutrition, as a source of animal protein, as a tasty relish and as a prestige food;

- fish production has proved to provide excellent returns to land and labour and is, therefore, a profitable production; and
- fish is a high-value commodity.

On the negative side, several constraints restraining the adoption of fish farming must be considered. These, mainly, are:

- the ability to master the know-how of the new technology;
- the security of land tenure, which justifies the setting up of a costly investment (the construction of the pond); and
- the access to fish seed, to stock the pond, and to a market, to sell the fish.

In certain countries, access to wetland areas can be more difficult, as they are a common property resource, as in Malawi. Secure land tenure should not be understood in its formal sense since, as such, it is not a necessary condition for investments on land.

Social and cultural institutions, which assure individuals that they are part of a stable, equitable, well-adapted set of rights and duties, give the tenure arrangements meaning. Also, security of land tenure is less important if the investment pay-back period is short.

The various types of fish farming accessible to farmers in rural or pen-urban areas in developing countries are, essentially, fish farming in earthen ponds, irrigated rice fields, dams and reservoirs, and in pen or cages.

Irrigation

The ponds are either drainable, i.e. fed from an irrigation canal or rainfed, or non-drainable, dug in the water table. Existing irrigated rice fields can be used.

This is done by stocking them with fish and shrimps. Fisheries production in dams, reservoirs and natural water bodies can be enhanced by stocking fish in them. Further, pens and cages can be set up in dams, reservoirs and lakes to rear fish.

The bulk of fish produced in sub-Saharan Africa by fish farming comes from ponds and irrigated rice fields. What should be the level of intensity of fish farming? Before recommending anything, it should be remembered that fish farming can only be envisaged as an economic activity and, therefore, there is a need to investigate the prerequisites for the establishment of a healthy farmed-fish market. Amongst these, successful fish farming is one prerequisite.

To be successful, the technology should be feasible, productive and profitable. This means that fish farming should be within the capacity of the farmer—understood as the farmer's household and not as the male or female heading the farming household, i.e. compatible within his/her indigenous knowledge system; be easily accommodated within his/her time or labour availability, cash or capital availabilities, resources or resource base.

Further, fish farming should be productive; though, if the homestead pond is considered for under its pivotal role of supporting numerous on-farm activities, it can not be assessed from the mere perspective of the amount of fish produced, as the benefits include an improved overall farm performance. These multipurpose ponds provide water for domestic use, for watering vegetables, livestock, trapping wild fish, serving as bioreactors to dispose wastes, and so on.

Also, the amounts of fish harvested from a pond are differently assessed, according to expectations. For poor farmers, a few small fish harvested from a pond erratically fed can be a definite improvement to a diet; the marginal benefits of this production are substantial. 'Productive' is, therefore, a relative and not an absolute term.

Finally, the profitability of fish farming can be assessed in comparison to other productions. To be profitable, costs should be kept at bay, meaning that the inputs should be drawn, as much as possible, out of the farmer's resources base, making best use of underused by-products of farm activities. Labour requirements must be, as far as possible, accommodated within the available

labour force, and the use of hired labour must be minimized.

Once these conditions are met and fish farming is adopted by the farmers, the fish produced can be self-consumed and thus contribute to the household food security. However, sustainability of fish farming will be enhanced if there is an excess of farmed-fish production, a fair outlet for marketing the fish and the establishment of a farmed fish market.

To this effect, there must be a demand for farmed-fish; the cumulative offer of farmed-fish produced by the fish farmers must meet a certain number of criteria: the supply must be regular, the quality of supply must be adequate and the fish must fetch a fair price. The market requires that enough cash be in circulation, or at the disposal of the customers, to enable transactions to take place easily.

Intensification of fish farming can only occur if there is a discrepancy between the demand and supply. An increase in the supply of farmed fish can be met with an increase in the area under production, i.e. an increase of the number of producers or, alternatively, an increase in the average area of the fish farmer.

Another way to raise production is to resort to intensification. This can be realized by improved fish feed, by improving the size and quality of the fish, and by increasing the water quality. Compounding and pelleting feed to reduce wastage and to meet the nutritional requirements of the fish is, for instance, an improvement over the use of domestic wastes as feed

Different strains

Strains selected for faster growth, late maturity, male monosex fish, diploid and triploid fish, association with a predator, association of fish with various feeding regimes, artificial aeration of the water to improve the dissolved oxygen to enable higher stocking densities, and veterinary control to prevent health and disease problems, are all technological improvements to raise output.

Intensification will call for specialization in the various stages (feed preparation,

seed production) of production, which entails [he transfer of technology, the establishment of production units of the specialized sub-products (feed, seed) for intensified fish farming. This requires capital and investment, but also the market to sustain these operations at a large enough scale to be profitable.

Side effects, in terms of environmental damages, for instance, polluted water emissions from farms, destruction of ecological buffer zones such as marshes and mangroves, destruction of biodiversity in these habitats, release of genetically transformed fish species and the introduction of exotic species in natural waters result from fish farming. These effects tend to increase as fish farming gets intensified.

Further, preparation of commercial feed relies heavily on fishmeal, made of small pelagics fished at sea. This is not the most sensible way to make use of fish protein, nor is it the most economical way to produce fish.

In brief, intensification of fish farming tends to be an increasingly market-oriented production, often a monoculture, with poor waste management. It is oriented towards short-term economic benefit and profit, mostly at the cost of the environment. Intensification of production leads to an

autonomy of fish farming activities, since, soon, on-farm resources alone are not enough to support the increased production requirements, and inputs have to be provided from outside the farm, with all the attendant consequences.

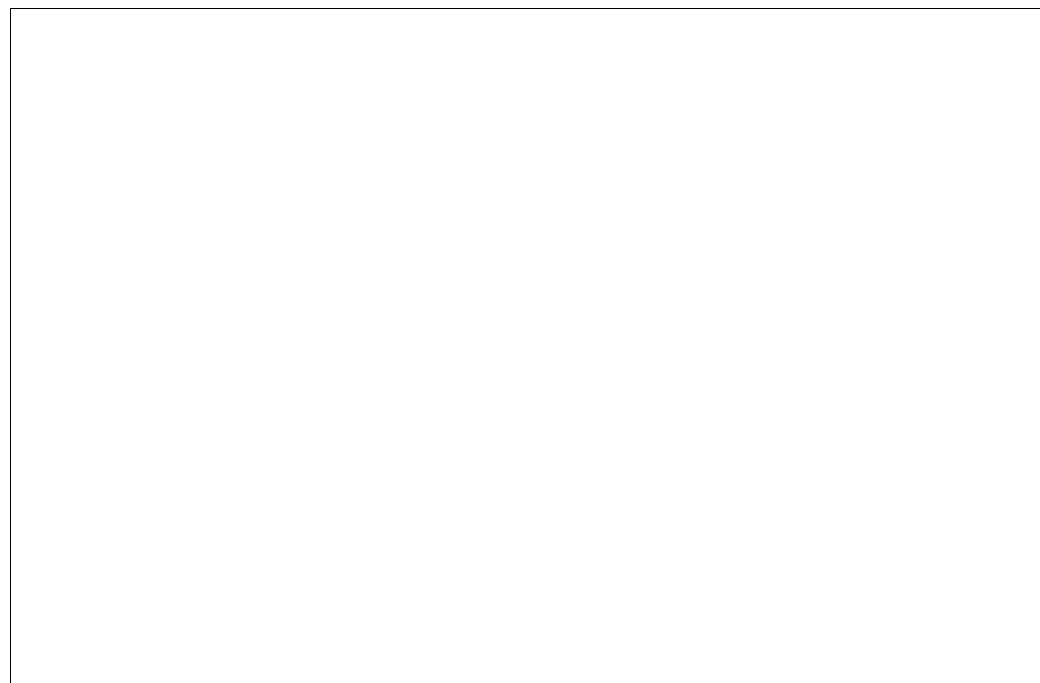
In many sub-Saharan African countries, fish farming production is low and could potentially contribute much more to rural economies. The first priority is to promote the adoption of fish farming on a wider scale, either for home consumption or for income generation.

The technological options so far extended have not been sufficiently integrated within indigenous knowledge systems to establish a solid and consistent farmed-fish production base.

Overdependence

The reasons for this failure stem from too much dependence on inputs (fish seed, feed) provided from outside, which could not be provided reliably or which needed cash to be procured, and a lack or inadequate integration of the activities within the whole farm system.

Once locally adapted and sustainable forms of fish farming have developed and begin expanding, then the supply and, concomitantly, the demand can be expected to steadily increase. With the adoption of fish farming production as an economic activity, a factor and product



market will be established. An increase of the area under production will be followed by a move towards an increase in quantity and improvements in quality. The existing situation of many rural economies suffers from a vicious circle.

The production of smallholder farmers is low, just enough to survive but below the level where it could generate some income-enabling investments; the production is poor because inputs (fertilizers and improved seeds) are not used since there is no cash (or credit) to purchase them; due to shortage of agricultural and non-agricultural incomes, there is shortage of agricultural labour during the peak demand (for clearing, weeding, ridging), leading to low yields.

Smallholder farmers produce essentially the same range of food crops, which are all harvested at the same time, flood the local market and fetch very low prices when the seasonal demand is low. In many cases, there are no facilities to collect the goods and bring them to markets where there is a demand.

If the surplus production is collected, the bulk of the profits goes to the middlemen. There is no incentive to increase agricultural production. Goods are not available in the local markets because of insufficient effective demand; such demand will not emerge unless smallholders can generate increased cash incomes through off-farm work or greater sales of cash or food crops.

Within this environment, the production of a highly perishable commodity, such as fish, can not be advocated without due consideration for its marketing. The conditions for establishment of a market with an effective demand for food crops, including fish, are found in the vicinity of urban areas.

It is in those areas that sustainable forms of semi-artisanal fish farming have appeared in many sub-Saharan African countries. The process of intensification of fish farming has concentrated on

labour-intensive, and not capital-intensive, production factors. Fish are selected and associated with predator

species to produce uniform, large-size specimens. Feeding and maintenance of the ponds are done with bulky, cheap agricultural by-products, available locally.

Fish farming development in rural areas must find its own, domestically adapted production technology, integrated in the local context. There is no "blueprint" technology that could be recommended; the technology must be developed by farmers, possibly with the assistance of scientists. If fish farming as an economic production is expected to take off, it should be offered adequate markets.

Intensification of fish farming appears where there is a greater demand for farmed fish, i.e. in the vicinity of towns and cities. This intensification is not meant to please the promoters of fish farming nor is it the result of development efforts. It is the result of the existence of an effective market.

Effective market

The intensification carried out is mainly labour-intensive, not capital-intensive. Specialization in sub-products of the production process, such as the pegging and construction of the pond, and the production of fingerlings for stocking have also occurred.

This article is by Guy Delince, an independent fisheries planning advisor from Belgium