

# Package 100, Item 1

Type: Issue pack

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**Aquaculture: The value chain**

1. **Introduction and how to use this issue pack**

This issue pack is designed to provide radio broadcasters with the information they need to create effective and entertaining radio programs on the value chain for fish farming, or aquaculture. Activities in the aquaculture value chain include raising, processing and marketing farmed fish.

The issue pack focuses on aquaculture in Malawi, but the information here can be easily adapted to other sub-Saharan African countries where aquaculture is practiced.

The issue pack begins with this introduction, then Section 2 presents two true stories of fish farmers in Mali and Ghana.

Section 3 presents factual background information on activities in the aquaculture value chain. Please see Resource Pack 95, Item 9 – *An introduction to value chains* – for a definition of “value chain,” and for a better understanding of why value chains are important for both broadcasters and farmers.

In the final section, section 4, we list sources for further information on the aquaculture value chain. This includes resource organizations, online radio programs, online videos, and online documents.

You might use the information in this issue pack in several ways. For example:

* You could use the stories in section 2 as a starting point for creating your own local stories. Interview aquaculture producers, traders, and others.
* You can use section 3 as background information for any program on aquaculture.
* You could contact one or more of the organizations listed in section 4 for information, or to interview experts.
* You could use the audio and video resources and online documents in section 4 to help create programs on aquaculture.
1. **Aquaculture story #1**

**Mohamed Farota** is a Malian farmer whogrows paddy rice and raises carp and catfish in the same field ─ at the same time. He farms in Baguineda, about 35 kilometres from Mali’s capital city of Bamako. Mr. Farota was introduced to integrated rice-fish culture in 2007. He creates special ditches for his fish at the ends of his paddy fields. Since he introduced fish to his fields, his rice yields have increased and he has made a great living selling fresh carp and smoked catfish.

You can hear more about Mr. Farota’s integrated rice and fish farming operation in Item 5 of this Resource Pack.

**Aquaculture story #2**

**Peter Opoku** is a fish farmer in the Ashanti Region of central Ghana. He has five fish ponds on his 20-acre farm.He started raising fish after a friend convinced him that his often waterlogged, rain-soaked farm might be perfect for fish farming. Though he didn’t make much money the first season, he fed his family well and was “hooked” on aquaculture. Five years later,he is doing well. He practices mixed crop and fish farming, has developed a successful fish feed mixture, and still finds fish farming both rewarding and fascinating. You can read more about Peter Opoku in Item 4 of this Pack.

1. **Background information on aquaculture activities in Malawi**

**Why farm fish?**

There are many reasons that small-scale farmers might want to add a fish pond to their farm:

* Fish grow quickly and give a quick return on investment. Fingerlings – newly hatched fish weighing between 5 and 20 grams – are ready to market or eat in 6-8 months and can fetch around US$3-4 per kilo. This selling price is 25 times greater than the cost involved in feeding and caring for the fish and bringing it to market.
* There is a ready market for farmed fish.
* By careful planning, it is possible to meet demand in a timely and efficient manner, and avoid wastage by harvesting only what you can sell.
* Unlike other types of livestock, fish rarely suffer from diseases.
* Land that is not suitable for other uses – even small plots – can be used for fish farming.
* Once established, fish farms are easy to maintain. This leaves you with extra time for other tasks.
* Fish are a good source of high-quality protein and other essential nutrients, and provide nutrients which are especially important for mothers and children.
* Fish farming saves water because, unlike farm crops, fish do not consume water. Therefore, the same water can be used to irrigate crops or vegetables grown near the fish pond. This is especially important when climate change is reducing the amount of water available for farmers.

**What equipment do you need?**

To establish and operate a small fish farm, you need: machetes, hoes, shovels, pickaxes, wheelbarrows, measuring tapes, wooden pegs, string, agricultural lime, fingerlings, fertilizer, a weigh scale and scoop nets. And, of course, land and labour.

### Scale of fish farming

### *Small-scale fish farming*

Over 90% of African fish farmers are *small-scale* fish farmers. These farmers have one or a few earthen ponds of less than 500 square metres in surface area, which are built and operated with family labour. The ponds typically produce between 300 and 1000 kilos per hectare once a year, and the timing of the harvest is connected to fingerling availability, water supply and local demand. On small fish farms, about half of the fish are eaten by the family and half are sold or traded to neighbours. Fish boost the nutritional status of the family.

Fish ponds help small-scale farmers generate a small amount of cash for emergencies, school fees, and other needs. Small-scale fish farmers do not buy many inputs. Yield is based almost entirely on composts, manures and other organic materials found on the farm and recycled through the pond.

In Malawi, the best yields in artisanal fish farms are about 1500 kilos per hectare per year, mostly of small tilapias. The fish pond is usually integrated with other food production, including vegetable gardens and livestock. The ponds can provide emergency irrigation water. Also, livestock and crop by-products and waste can be added to the pond, thus turning low-quality waste materials into valuable fish at minimal cost. (See below for integrated fish-crop and fish-livestock farming.)

Research shows that, in Malawi, farms with integrated fish ponds generate almost six times the cash earned by the typical small-scale farmer. There are similar artisanal fish farms throughout Africa, producing thousands of tonnes of fish annually for rural families.

### *Small and medium-scale fish-farming enterprises (SMEs)*

Some African farmers have diversified their cash cropping by shifting some effort and capital towards aquaculture. These farmers tend to build more ponds than small-scale fish farmers, use more expensive technology, employ hired labour, and purchase fingerlings and other inputs, especially feeds and fertilizers. They typically transport their fish to a local town or city where wealthier consumers pay cash. The main difference between these farmers and small-scale fish farmers is that small-scale fish farmers mainly seek food security, farm diversity, and a little income, while SME farmers seek cash, sometimes at the expense of diversity and sustainability.

Like small-scale fish farmers, SME farmers are faced with challenges, including high transportation costs (for farmers distant from wealthier urban markets), and the lack of marketing infrastructure, especially ice plants and clean facilities. Because fish start to spoil by the end of the harvesting day, these challenges limit SME farmers’ ability to negotiate decent prices. This, of course, is also true for small-scale fish farmers.

South Africa and Nigeria have relatively well-developed SME aquaculture sectors and these sectors are growing in Cameroon, Ghana, Uganda, Angola, the DRC, Zambia and Kenya.

**Raising farmed fish**

The fish species which are most often raised in Malawi ─ with their Chichewa names in brackets ─ are the three tilapia species, *Tilapia rendalli* (chilunguni), *Oreochromis shiranus (makumba), Oreochromis karongae* (chambo), and the catfish species, *Clarias gariepinus (mlamba).* Some of these species are popular in fish farming in other African countries. Check with extension agents to find out which species are most popular and suitable for your country and area.

*Please contact local extension agents, the resource organizations listed below, or other experts if you need more information on any of the background information provided below.*

*Choosing a site for a pond*

* Choose gently sloping land, large enough to build a pond of at least 10 metres by 10 metres.
* The pond should be in full sun and not surrounded by trees. Trees can house predators such as fish-eating birds.
* The soil should not allow water to seep away. Soils with a lot of clay make the best sites for fish ponds. You can check by digging a test hole about four feet deep, filling it with water and returning the next day to see whether the water has seeped away. It is a good idea to dig test holes in several sites.
* You need a reliable and convenient source of clean, unpolluted water because water should continuously flow through the pond. Sources include underground springs, streams, and river diversions. Borehole or piped water is likely unaffordable. Chlorinated water is poisonous to fish.

*Building the pond*

* Clear the site of vegetation.
* Measure and mark out the pond size with sticks and string before you build it.
* Ponds should be rectangular or square rather than circular. Bigger ponds, up to 50 metres by 100 metres, are easier to manage. The sides of the pond should slope outwards.
* The pond should be half a metre deep at the shallow end where the water enters, and slope down to one and a half metres at the deep end where the water leaves. This slant in the pond bottom helps proper drainage of the pond through the drainage pipe.
* Dig out the pond and pile the soil around the pond to form a dyke. Add a thin layer of agricultural lime to the bottom of the pond. This will help to eliminate pests like leeches, and help the growth of tiny animals and plants on which the fish will feed. If there is water in the pond already, mix the lime with water and spread the mixture evenly over the surface of the water.
* Fill the pond with water.
* Fence the pond 24 hours after liming.

*Inlet, outlet and drainage pipes*

Fish ponds have an *inlet pipe*, which allows water into the pond, an *overflow pipe*, which prevents overflow from the pond if the inlet pipe is accidentally left open, and a *drainage pipe*, which allows farmers to remove water from the pond and cleaning of the pond from time to time. Both the overflow and drainage pipes are at the deep end of the pond.

The inlet pipe should be smaller in diameter than the overflow pipe, and at least 20 centimetres above the water surface to prevent fish from escaping. It must be properly screened to prevent fish from entering the pond from the outside.

Pond outlets should have an *anti-seep collar* and an *anchor-collar*. The anti-seep collar prevents water seepage from the “joint” where the outlet pipe and the soil meet. Without an anti-seep collar, most ponds leak.

When not in use, the drainage pipe is full of air, which means that the pipe tends to float. If the pipe is not fastened securely at the bottom of the pond, it can be knocked out of place at the bend or leaks can develop. Having an anchor-collar just after the pipe bend prevents this by holding down the drain pipe and the bend.

*Fertilizing the pond*

Fertilizing a pond encourages the growth of tiny plants and animals such as algae and plankton that are natural food for your fish. An added advantage is that algae turn the water green, which makes it harder for predators such as birds and snakes to see and catch the fish. You can use either animal manure or chemical fertilizers. Add fertilizers every two weeks, or when you see that the water is becoming clear. The following table shows how much fertilizer to use for every 100 square metres of pond (a 10 metre by 10 metre pond is 100 square metres).

|  |  |
| --- | --- |
| **Fertilizer** | **Amount per 100 square metres of pond**  |
| Cow, goat or sheep dung | 6 kilograms |
| Chicken, duck or goose droppings | 2.5 kilograms |
| Chemical urea | 1 kilogram |
| DAP (diammonium phosphate) | 1 kilogram |
| TSP (triple superphosphate)  | 1 kilogram |

For best results, mix the animal manure or fertilizer well with pond water and distribute it evenly over the entire surface of the pond.

*Stocking the pond*

* Purchase fingerlings from an established fish farm in your area.
* Wait four days after fertilization before stocking the pond.
* Transfer the fingerlings to the fish pond as soon as possible (within six hours).
* Add three tilapia fingerlings for each square metre of pond area, or two catfish fingerlings per square metre. Thus, a 10 metre by 10 metre pond with an area of 100 square metres would be stocked with 300 tilapia fingerlings or 200 catfish fingerlings.
* Place fingerlings in a bucket of fresh water.
* Gently lower the bucket containing the fingerlings into the shallow end of the pond.
* Gradually tip the bucket to allow the fingerlings to swim into the pond.
* *Important*: If fingerlings are not introduced into the pond gently, they may die from shock.

*Supplementary feeding*

* For the first month, the young fingerlings will eat the natural food (algae, plankton, etc.) in the pond.
* After the first month, feed the fingerlings twice daily.
* Good feeds include soybean meal, rice, maize or wheat bran. The amount of feed depends on the size and number of fish in the pond. Fish are normally fed 3% of their body weight daily. Fish should be sampled and weighed every month to adjust the feeding rate.
* Supplementary feeds include:
	+ sliced kale or chopped sweet potato vines
	+ termites and ants
	+ small lake shrimps (not available in Malawi)
	+ small leftover fish caught by fishermen
	+ local fishmeal

*Monitoring the fish*

* Check on your fish regularly and weigh them monthly, using a seine net. This will also help farmers adjust the feeding rate, depending on the size and number of fish in the pond.
* The fingerlings should increase in weight by at least 10 grams in the first month. They should continue to grow steadily each month.

*Maintaining the pond*

* Keep the area around the pond weed-free.
* Fence the pond to keep out children, animals, and thieves.
* Maintain water levels at between half a metre and one and a half metres deep.
* Remove some water and pump in fresh water to aerate the pond periodically. This ensures that there is enough oxygen in the water for the fish. This is especially important during the dry season.
* Drain the pond completely after a full harvest to remove mud and re-lime. Crush the mud and use the nutritious mud to fertilize crop fields.

*Harvesting*

* About six months after stocking, fish of marketable size can be harvested or partially harvested (leaving fingerlings in the pond to grow), or all fish can be harvested and the pond cleaned.
* Lower a large seine net into the pond at the deep end. Ideally, two people on either side of the pond will hold the net.
* Press the net to the bottom of the pond to catch all the fish. This can best be done by having at least three people in the pond.
* Gradually pull the net towards the shallow end.
* Gather the net towards one corner, making sure you retain all the fish you capture.
* Pull the net out of the water.
* Place the fish in a container of clean water.
* Sort the fish. Return any underweight fish to the pond.
* Depending on demand, market all fish or return some to the pond.

*Keeping records*

* Keep records of all costs and sales income. This allows you to calculate whether your fish farming business is profitable. It also helps farmers track the major activities undertaken from the start of a fish farming business.

**Integrated aquaculture-agriculture**

The basic principle of integrated aquaculture-agriculture is to grow fish in water bodies that are closely integrated with the farm. The goals of integrated aquaculture-agriculture are:

* to convert agricultural waste and manure into high quality fish protein;
* to use the nutrients generated in the pond (fish waste) as fertilizer for growing crops;
* to reduce the need to purchase off-farm inputs; and
* to grow vegetables around the pond by using it as an on-farm water reservoir, with the option of growing vegetables, maize and rice in the moisture of the pond bottom in times of drought.

Item 5 in Resource Pack 100 tells the story of a farmer who practices integrated rice and fish farming. Integrated livestock-fish farming can pair fish ponds with many types of livestock ─ cattle, sheep, goats, poultry, pigs or rabbits. It allows wastes from one system (the pond or the field) to be used as inputs in the other system.

Integrating fish ponds into a small farm can increase the farm’s sustainability, both economically and ecologically. In Malawi, a serious drought from 1991 through 1995 had a major negative impact on small-scale agriculture. But even as staple crops failed and farmers lost money, integrated fish ponds sustained farms. By retaining water on the land, ponds enabled farmers to continue food production and balance their losses on cropland.

**Figure 1** below shows a poultry house on stilts at the edge of a fish pond. The chicken manure falls or is fed into the fish pond, thus acting as fertilizer for the plants and animals in the pond, which in turn act as food for the fish.

Methods and yields for integrated fish-livestock farming or integrated fish-rice farming depend on local conditions. Farmers in Malawi adjust their integrated plant-fish system every year according to the amount of rainfall. In dry years, farmers might grow vegetables on the pond bottom because there is not enough water to raise fish. The vegetables grow well on the fertile soil at the bottom of the pond, and suffer less from the drought.



**Figure 1: Poultry house on stilts at edge of fish pond** (Image from IIRR, 1996, *Environmentally Sound Technologies for Women in Agriculture*. <http://collections.infocollections.org/ukedu/uk/d/Jii01ee/>)

**Post-harvest fish farming activities**

***Storage***

Fresh fish spoil very quickly, within 12 hours after harvest. To prevent spoilage, either the bacteria present in fish must be killed, or you must suppress their growth. There are various methods to process fish and suppress bacterial growth.

After harvesting, immediately cut the fish open along the underside and pull out the guts. You can dry the guts and mix them with bran, and then feed them to livestock, including chickens. Then wash the fish with clean water and place them in cooler boxes.

Sell or cook and eat fresh fish as soon as possible. Otherwise, you can preserve fish by salting, sun-drying, smoking or other means.

*Salting*

This is an inexpensive method when salt is cheap because no electricity is required and you can store the fish at room temperature. The quality and nutritional value of the fish are reasonable after salting, and salted fish have a long storage life.

*Drying*

Drying is inexpensive because no electricity and little equipment are needed. You need dry and/or airtight storage. The quality and nutritional value of the fish are reasonable if storage is good.

*Smoking*

Smoking is inexpensive because little equipment or energy are needed, but fuel must be available. Quality and nutritional value are reasonable.

*Fermentation*

Fermentation is often inexpensive, but the taste and odour of the fish are completely changed. Storage life for fermented fish varies, depending on the product. Nutritional value is often high.

*Cooling and freezing*

Cooling and freezing fish is a very expensive method of preservation because it uses a lot of energy and equipment. Quality and nutritional value are good, and storage life is long. In Malawi, unfortunately, there is no ice making equipment available for small-scale fish farmers.

***Processing***

Fish processing for pond-grown fish in Malawi includes smoking species like *chambo* and catfish.

Less often, fish is frozen or iced to enable fish traders to transport it to distant rural and urban markets. There is a fish marketing and distribution network throughout Malawi, supplying fish to both rural and urban markets. Fish are transported by bicycle, lake steamer, public bus, and truck.

Other processing techniques in Malawi include using dug-out smoking ovens and drying racks made of reeds and mats. Salt is usually not used in fish processing because it is very expensive.

While 50% of fish from lakes and rivers are sun-dried and 30% smoked, pond fish are usually sold fresh. Because most pond-raised fish are sold locally, there is little interest in or need for ice. But recent improvements in access to ice may make a difference for larger-scale fish farmers who want to transport tilapia to cities.

***Marketing***

In the rainy season, fish catches in Lake Malawi are abundant. But most fish traders are farming at this time and do not visit the lakeshore. Also, trying to preserve fish in the rainy season is difficult. Thus, there is poor access to fish during the rainy season. The rainy season is also the period when people experience the greatest shortage of food and cash. This probably explains why prices drop for several fish species during the rainy season, and why price increases occur almost solely during dry months, when buyers have more disposable income.

Demand for tilapia is so great all year-round that pond-reared fish rarely reach urban markets and few fish farmers transport their fish over any significant distance. Rather, they sell most of their fish either at the farmgate or directly at the pond and frequently sell their fish the day before the harvest is actually conducted. Usually, fish farmers inform the community about an upcoming harvest, and customers arrive on the appointed day.

Some farmers have built kiosks or conduct sales from their house in order to have greater control over sales and to avoid damage to the pond bank. Some more commercially-oriented farmers are trying to improve their income by capturing niche markets, for example for fried tilapia snacks at roadside markets, bus stations, primary schools and hospitals. Others sell fresh fish to local secondary schools and hospital canteens and for use in school biology class experiments.

In many areas, the potential for increased earnings from fish farming is limited by the condition of local infrastructure. Trade in many rural areas is limited by roads that may be impassable during the rainy season.

The output from commercial fish farms is sold in urban areas such as Blantyre, Lilongwe, Zomba and Mzuzu through department stores and selected food shops.

1. **Further resources on the aquaculture value chain in Malawi and sub-Saharan Africa**

***Resource organizations***

These are some of the organizations that are involved with aquaculture in Malawi.

1. Department of Fisheries. Dr. Friday Njaya, fnjaya@gmail.com
2. NEPAD Fish Node. Professor Emmanuel Kaunda, ekaunda@yahoo.com
3. National Aquaculture Center. Mr. Brino Chirwa, brinobchirwa@gmail.com
4. Bunda College of Agriculture. Dr. Wilson Jere, lazarojere@yahoo.co.uk
5. WorldFish Centre. Joseph Nagolij, nagoli@cgiar.org
6. Innovative Fish Farmers’ Network. Mrs. Laness Chavula, lanesschavula@gmail.com

***Videos***

1. Akpos Yemi Ejumudo, 2008. *ABC of Fish Farming: Fish farming in Nigeria using earthen ponds.* <http://www.youtube.com/watch?v=zZCmSs2yh0A> (31 minutes)
2. Wilson Munala, undated. Fish Pond Management 1: What you need to know. <http://www.youtube.com/watch?v=EpuCvFByVzk> (8 minutes)

***Audio programs***

1. AGFAX, 2011. *Knowledge and input costs: aquaculture’s bottlenecks*. Audio and transcript available at <http://www.agfax.net/radio/detail.php?i=471>
2. AGFAX, 2010. *Fast growing fish for farming*. Audio and transcript available at <http://www.agfax.net/radio/detail.php?i=332>

***Documents***

1. ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA), 2007. *Make a Living through Fish Farming*. CTA Practical Guide Series, No. 9. 414 KB. <http://teca.fao.org/sites/default/files/technology_files/009_Make_Money_With_Fish_Farming_A4.pdf>
2. *Anonymous. Aquaculture: A bright future for Africa. Spore, No. 166, October-November 2013.* [*http://spore.cta.int/en/component/content/article?id=7839:aquaculture*](http://spore.cta.int/en/component/content/article?id=7839:aquaculture) *.*
3. *Brummett, R.E. and Noble R., 2001, Aquaculture for African Smallholders. ICLARM Tech. Rep. 46, 69 p.* [*http://ageconsearch.umn.edu/bitstream/44729/2/9789718709665.pdf*](http://ageconsearch.umn.edu/bitstream/44729/2/9789718709665.pdf) *(3.5 MB)*
4. *Carballo et al, 2008. Small-scale freshwater fish farming. Agrodok 15. CTA.* [*http://journeytoforever.org/farm\_library/AD15.pdf*](http://journeytoforever.org/farm_library/AD15.pdf) *(688KB).*
5. *FAO Farm Management and Production Economics Service; FAO Inland Water Resources and Aquaculture Service. Small ponds make a big difference. Integrating fish with crop and livestock farming. Rome, FAO. 30p.* *ftp://ftp.fao.org/docrep/fao/003/x7156e/x7156e01.pdf* *(561 KB)*
6. *Hilbrands, A. and C. Yzerman, 2004. On-farm fish culture. Agrodok No. 21. CTA.* [*http://journeytoforever.org/farm\_library/AD21.pdf*](http://journeytoforever.org/farm_library/AD21.pdf) *(583 KB).*
7. *Isyagi, N.A. et al, 2009. Manual for the Commercial Pond Production of the African Catfish in Uganda. USAID, 222 pages.* [*http://www.ag.auburn.edu/fish/international/uganda/docs/Catfish%20ManualEntire.pdf*](http://www.ag.auburn.edu/fish/international/uganda/docs/Catfish%20ManualEntire.pdf) *(10.5 MB)*
8. *Russell AJM, Grötz PA, Kriesemer SK and Pemsl DE, 2008. Recommendation Domains for Pond Aquaculture. Country Case Study: Development and Status of Freshwater Aquaculture in Malawi. WorldFish Center Studies and Reviews No. 1869. The WorldFish Center, Penang, Malaysia. 52 pages.* [*http://www.worldfishcenter.org/resource\_centre/WF\_1102.pdf*](http://www.worldfishcenter.org/resource_centre/WF_1102.pdf) *(1.15 MB)*

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