

# Small-Scale, On-Farm Fish Processing

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Small farms are prominent in the aquaculture industry. The U.S. Economic Research Service classifies small family farms as those with gross annual sales of less than \$250,000. During the 1970s, aquaculture in the U.S. was characterized by the explosion of catfish production, with the top producing states being Mississippi, Alabama, Arkansas, and Louisiana. At the peak of production, those states produced about 660 million pounds (299,371 mt) of catfish annually. Over time the industry has come under pressure from higher production costs, competition from lower priced imports, and recent price surges in commodity feed ingredients being used for other consumable goods such as bio-fuels. In some areas of the U.S., the economy of scale is strengthened by the contraction in the industry that promotes large-scale production, while in other areas, which lack established infrastructure for feed and processing, small-scale producers need marketing venues outside the traditional channels.

Over the past 10 to 15 years, several small farms and urban areas in the U.S. have diversified to include some aquaculture and aquaponics into the farming and community portfolio. These often include non-traditional species such as tilapia, freshwater prawn, bass, and even paddlefish where water bodies can support them. With growing concerns about food security, the safety of imported seafood, interest in local foods, and the identification of “food deserts” by community leaders, consumers, chefs, restaurants, and food services are demanding more locally grown, sustainably harvested and processed products. Small-scale producers can be perfectly poised to market locally grown, value-added products directly to these consumers. Small-scale, on-farm processing enables producers to market a value-added commodity or specialty product directly to consumers through

farmers’ markets, small-scale wholesale or retail buyers such as restaurants and food services, groceries, and/or Community Supported Agriculture (CSA) subscriptions. This shortened product chain can potentially result in increased profits for these producers.

Although direct retail sales can be more profitable, farmers must address several important considerations before establishing their own processing facilities.

1. Are there niche market opportunities in your area?
2. Can you service these markets fully, consistently, and in a timely way?
3. Do you have the labor resources to carry out these requirements?
4. Can the quality of your products and service compete with lower priced products?

If a small farmer can answer “yes” to these questions, on-farm processing and direct retail marketing could be a profitable option.

Since 2005, several states have initiated local marketing campaigns to help small farmers market their agricultural products. Consumers are very aware of issues related to the carbon foot print and sustainability of food production and are demanding more locally grown products. This publication focuses on two species—freshwater prawns and catfish—but other aquatic species could be processed in a small, on-farm facility.

## Processing facility requirements and design

On-farm processing, as illustrated here, is meant to be a low-cost, manual fish processing operation using family and farm labor to produce limited quantities of product. There are several options for facility design, though there are requirements that must be met before processed products can be sold legally into retail markets.

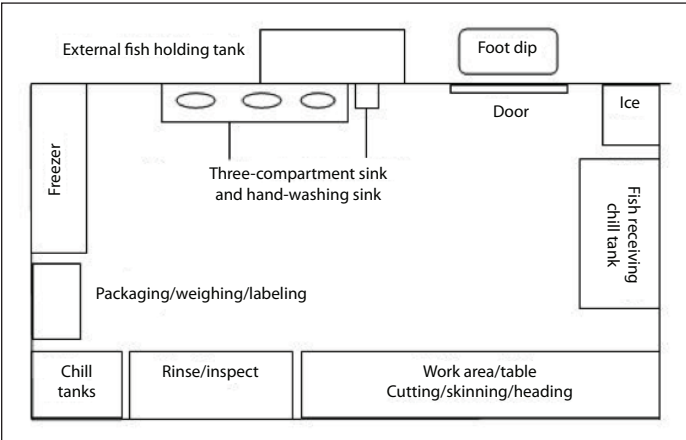
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Small-scale processing facilities must follow all local, state, and federal requirements for seafood processing and safety. All seafood and fisheries products must follow an approved Hazard Analysis Critical Control Point (HACCP) plan that is specific to the processing facility (See SRAC Publication No. 4900, *The HACCP Seafood Program and Aquaculture*). These plans can be developed by a trained and certified HACCP person. Online HACCP training programs can provide the bulk of the information, but to complete the class most states require that the processor spend a day with FDA staff to write a practical plan. HACCP consultants are trained to identify potential hazards within the processing facility and are available to write plans. It is best to confirm all requirements with your state and local health department.

Each HACCP plan will contain a flow chart of the process for each product, any potential hazards, how each hazard is mitigated, and any corrective action needed to ensure that safe, un-adulterated products are entering the market. Each Critical Control Point (CCP) identified will have a corresponding documentation that the CCP will not be causing a hazard. All HACCP plans must be accompanied by the Standard Operating Procedure (SOP) and the Standard Sanitation Operating Procedure (SSOP) documents. The SOP details all steps and procedures that will take place during the processing. The SSOP documents all the steps in cleaning before and after processing.

All products must be labeled with a list of all ingredients/allergens, weight, safe handling and storage instructions, the location where the product was processed, and contact information. The interior of processing facilities must have impermeable walls, a floor draining into a septic system or sewer, covered lights, a three-compartment sink deep enough to submerge the largest utensil, and a hand-washing sink. (This may vary slightly by state.) All



**Figure 1.** A floor plan for a small processing room.

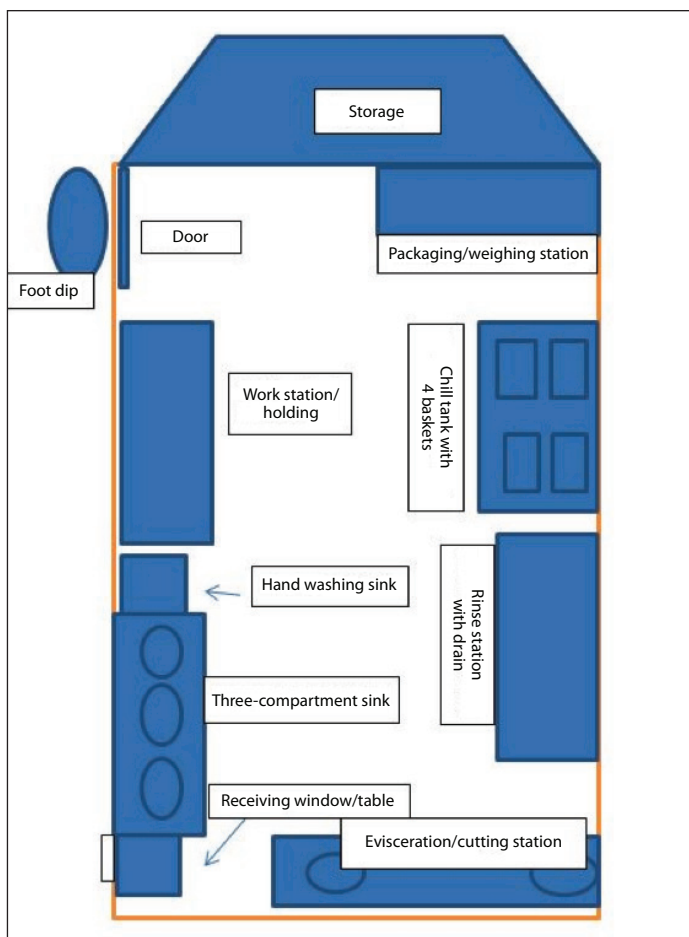
surface areas, including work tables, walls, floors, and ceiling, must be able to be sanitized. All utensils must be food grade. There must be easy access for products to enter the facility and every precaution must be taken to minimize contamination. Restroom facilities must be available, but may not be required to be in the same building.

A simple example of a floor plan is shown in Figure 1. This facility can process approximately 500 pounds (226.8 kg) of live fish per day and approximately 750 pounds (340.19 kg) of whole freshwater prawns. The area is compact, simple in design, and can be installed in existing buildings. An example of cost is shown in Table 1. Costs will vary depending upon what work farmers can do themselves and what equipment they already have.

Kentucky has developed a mobile processing unit (MPU) in a third wheel trailer refitted to include all the required equipment. It is used to process products on the pond bank, with processing water being disposed of at the farm. Several other states have MPUs for use in the poultry and aquaculture industry. Producers should contact their Cooperative Extension Service or state department of health or agriculture to determine whether such mobile units are available and legal to use. (Poultry, meat, and catfish processing is regulated under the USDA. Please reference the *USDA FSIS Mobile Slaughter Compliance Guide 2010*.)

In some states farmers who process and hold products in refrigerated or frozen storage may be considered

Table 1. Example of facility equipment and infrastructure requirements (built in an existing building).	
Item	Cost
Concrete floor and walls	\$2,600
Window air conditioner	300
Door	200
Suspended ceiling and covered lighting	500
Plumbing and electrical	1,200
Fish holding tank	600
Three-compartment stainless sink and hand sink	600
Fish processing table	600
Chiller tanks	250
400 lb/day ice machine (optional)	3,000
25-cubic-foot freezer	700
Supplies*	500
<b>Total</b>	<b>\$11,050</b>
*Supplies include knives, buckets, totes, shelving, cleaning equipment, etc.	



**Figure 2.** The layout of the Kentucky Mobile Processing Unit (MPU).

to be “warehousing,” which may require that their storage unit(s) be inspected and that they have permits. In storage, processed products need to be kept with similar products (i.e., fish with fish, etc.) and not co-mingled with non-similar products. Packaged products should be packaged, boxed, and kept separate from other processed products. No personal consumables should be stored in the same refrigerator or freezer as processed products stored for wholesale or retail sale.

## Operational guidelines

The basic procedure for processing catfish in a small, on-farm facility is as follows:

1. Test fish for off-flavor before harvest. Off-flavor fish should not be allowed to enter the marketplace.
2. Once fish are deemed acceptable, withhold feed for 2 to 3 days before harvest.
3. Transfer harvested fish into a purge tank (de-chlorinated water with aeration) outside the processing room. Process as soon after harvesting as possible to minimize loss.

4. Chill-stun fish by submerging them in ice water. This tank can be outside or inside the facility.
5. Skin catfish using manual pliers (an electric floor or tabletop skinner can be used). Remove the head and offal and place in a designated container. For other finfish fillets or steaks, cut with the skin on and remove skin after fillets are cut.
6. Place rinsed, processed fish into a chill tank (water and ice) to reach the required temperature set in the HACCP plan.
7. Pack fish on drained ice for fresh sale or package fish in containers for fresh or frozen sales. All packages should be labeled with the required information.
8. All products must be kept at the proper temperature for fresh or frozen storage.

To process freshwater prawns:

1. Harvest the prawns from a drained pond.
2. Place them in a rinse tank to de-mud.
3. Place prawns in a tub of ice slush to chill-kill.
4. Transfer prawns to the work table and remove the heads from the tails and rinse and inspect the tails. Discard heads in a designated container.
5. Place all tails in ice water to reach the temperature required in the HACCP plan. Document all temperatures.
6. Pack tails on drained ice for fresh sale or package in containers for fresh or frozen sales. When freezing, cover tails with potable water and freeze. Use plastic containers to avoid bag punctures and leakage. All packages should be labeled with the required information.
7. All products must be kept at the proper temperature for fresh or frozen storage.

Offal (head, skin, viscera, and scales) can be handled in several ways. It can be transported to municipal landfills, picked up by contracted disposal companies, or composted following local or state composting guidelines. Or, the offal can be rendered. If quantities are significant, offal can be frozen for pick up by established rendering companies. Check with regulatory agencies for proper handling of offal.

## Cost considerations

A sample of the processing results and operating budget for 500 pounds (226 kg) of catfish and 750 pounds (340 kg) of freshwater prawns are presented in Tables 2 and 3. The per pound cost of processing dressed fish and tails equals the total cost minus live fish costs divided by the total dress-out weight. The break-even prices stated

are estimates of all costs associated with processing fish and prawns and operating the facility. These figures will change depending on a farmer's experience and skill. Each farmer should calculate his or her unique costs of processing and break-even price. It is calculated by dividing total cost by the number of dressed pounds. These will vary depending on fish species, size, farmer experience, and market price when processing.

It is assumed that the estimated investment cost in construction is borrowed and all fixed costs are based on 100 days of operation per year with finfish and other uses with freshwater prawns. It is important for the producer to know the value of marketing cost, delivery, packaging, and time when determining the sale price of products processed in a small-scale, on-farm facility. These

**Table 2.** Processing results for 500 pounds (226 kg) of catfish (1.5 pounds [680 g] average weight) and 750 pounds (340 kg) of freshwater prawns.

Item	Catfish value	Freshwater prawn value
Labor	12.5 hours	12.5 hours
Dress-out percentage	53%	45%
Dress-out weight	265 pounds (120 kg)	337.5 pounds (152 kg)
Water usage	1500 gallons	1500 gallons

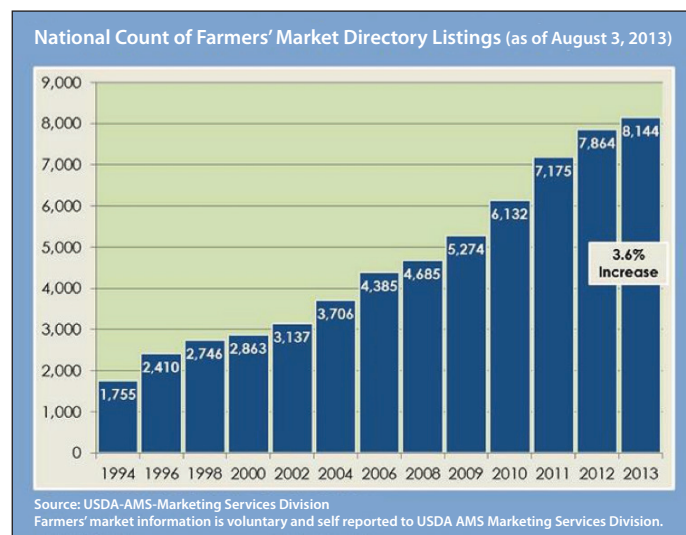
**Table 3.** Sample daily operating budget for a small-scale, on-farm facility processing 500 pounds of catfish (1.5-pound average weight) and 750 pounds of freshwater prawns.

Item	Catfish			Freshwater prawns		
	Unit (lbs)	Unit cost direct	Total cost (\$)	Unit (lbs)	Unit cost direct	Total cost (\$)
Live fish	500	\$1.20	\$600.00	750	\$7.50	\$5625.00
Labor	12	\$8.00	\$96.00	12	\$8.00	\$96.00
Electricity			\$5.00			\$5.00
Water	1500		\$12.00	1500		\$12.00
Misc.			\$25.00			\$25.00
Supplies			\$50.00			\$105.00
<b>Total cost</b>			<b>\$788.00</b>			<b>\$5868.00</b>
				<b>Catfish</b>	<b>Prawns</b>	
<b>Processing cost per pound (dressed weight)</b>				<b>\$0.71</b>	<b>\$0.72</b>	
(Total cost - live fish cost) ÷ (live fish weight × % yield)						
<b>Break-even price per pound (dressed weight)</b>				<b>\$2.97</b>	<b>\$17.36</b>	
(Total cost ÷ (live fish weight × % yield))						

estimates will vary with species, size of fish, amount of fish available, cost of inputs, labor efficiency in attaining high dress-out weight, and facility costs. The local selling price of processed fish must be greater than the calculated break-even price and must include the cost of marketing, advertising, telephone, delivery, packaging, storage, maintaining accounts, permits, etc., which could add significantly to the break-even price. Every farmer must calculate the break-even price for his or her individual enterprise.

As evident in Tables 2 and 3, the break-even prices for both products are considerably higher than those of large processors because of the economy of scale. Therefore, direct, local marketing is desirable for small producers willing to deliver a value-added processed product, which demands a higher price for quality and service. Freshwater prawn producers can be most profitable selling fresh, whole product without any expense of processing. Prices received (depending on the area and demographics) for whole fresh prawns have ranged from \$6.00 to \$12.00 per pound. However, because of the seasonality of the product and having to harvest the entire crop in one day, an alternative method of processing and later marketing is desirable for any product not sold on harvest day.

The growth of farmers' markets in the U.S. from 1994 through 2013 is presented in Figure 3. Many farmers' markets are interested in selling more protein products and are suitable venues for fish producers to sell small quantities with higher profit margins. There is also a surge in CSA. In this enterprise, shares of farm production are sold at the beginning of the season and the recipient is guaranteed a basket of available produce from the farm weekly. CSA participants would also like to incorporate meat and fish products into their weekly deliveries.



**Figure 3.** Growth of farmers' markets in the U.S.



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Restaurant chefs are using more local, high-quality farm products than in the past, which creates another profitable outlet for farmers.

On-farm, small-scale or mobile processing facilities could be used by other growers who might pay a “fee for service” to use these facilities. Or, others might be willing to pay for use of these facilities to process non-traditional species for personal consumption only. It is best to check with local and state health officials to see what regulations apply to these arrangements.

## Summary

On-farm processing, with a relatively low investment cost, may provide an affordable marketing edge for small fish farmers who have identified niche markets. The facility can be designed to operate at different capacities to process different fish at different times and at differing quantities and market demands. Supplying local retail markets directly can provide a higher return than selling to traditional processors. Also, rural farms with little or no access to established (and usually distant) processors could sell a larger volume of product.

Farmers must identify local and state regulations and permits that pertain to on-farm processing. The labor and time required to maintain accounts, deliver products, and adhere to regulatory issues need to be evaluated when considering on-farm processing. Close proximity to retail markets is recommended to minimize the time and

expense of delivery. Local farmers’ markets, restaurants, and CSA weekly delivery offer marketing options to small farmers. Scheduling processing for consistent availability of products to customers is essential and a major challenge for small farms. With careful planning, on-farm processing is a way for small farms and groups of farms to access higher profit retail markets.

## Suggested readings

SRAC Publication No. 183, *Processing Channel Catfish*.

SRAC Publication No. 184, *Processing Catfish: Product Forms, Packaging, Yields and Product Mix*.

SRAC Publication No. 185, *Processed Catfish: Product Quality and Control*.

SRAC Publication No. 350, *Small-Scale Marketing of Aquaculture Products*.

SRAC Publication No. 431, *Testing Flavor Quality of Pre-harvest Channel Catfish*.

SRAC Publication No. 483, *Economics of Freshwater Prawn Farming in the United States*.

SRAC Publication No. 1800, *Cost of Small-Scale Catfish Production*.

SRAC Publication No. 3000, *Hybrid Striped Bass Production in Ponds: Enterprise Budget*.

SRAC Publication No. 4900, *The HACCP Seafood Program and Aquaculture*.

USDA. *Mobile Slaughter Unit Compliance Guide*. [www.fsis.usda.gov/Significant\\_Guidance/index.asp](http://www.fsis.usda.gov/Significant_Guidance/index.asp).

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