Handbook on Processing Fish for Small-Scale Fish Farmers



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Introduction

he aquaculture industry in the Midwest region of the United States has limited or no access to economically feasible seafood processing infrastructure for farmed seafood products, leaving producers to rely on live ethnic fish and recreational markets. However, local kitchens, such as shared-use commercial kitchens and licensed on-farm kitchens, can provide resources for fish farming entrepreneurs interested in adding some form of value to their fish, by allowing them to diversify their market. These shared-use commercial kitchens can be found in many communities and are rented by food producers, local food entrepreneurs, and caterers to prepare and process their food products for consumer markets. Using local facilities for processing fish and developing aquaculture products could diversify marketing opportunities for small-scale fish farmers and have a positive impact on farm profitability. A diversified market also reduces market risks for fish farmers.

Embarking on processing is an additional investment for a fish farmer and requires resources. This handbook provides some information and resources for fish farmers interested in using licensed kitchen facilities for fish processing or setting up their own on-farm processing kitchen. This handbook highlights the necessary elements of processing fish to guide any interested fish farmer or entrepreneur. As you are reading, take note of the *Footnotes*, which provide relevant links to additional resources on information provided in the handbook.

Why Process Fish?

For small fish farmers, processing fish has its advantages the resulting product adds to the mix of options that they can offer to the market. For some aquaculture producers, small-scale fish processing could provide an opening to maintain business viability, increase revenues, and enhance economic opportunities.

With processing, fish farmers can:

- 1. Explore value added product offerings.
- 2. Supply processed fish products.
- 3. Stimulate new fish product development.
- 4. Improve the diversity of local aquaculture products.
- 5. Increase sales of local aquaculture products.
- 6. Increase awareness of supply and access to local aquaculture products.
- 7. Increase access to and consumption of local aquaculture products.

For example, a fish producer may want to use a commercial kitchen facility to develop a new fish product and/or enhance an existing one. If a producer has identified their customers for a particular product, the facility can be used to prepare these specific products for these clients, in addition to preparing a general product for the consumer market.



Regulations

You must first understand and comply with federal, state, and local rules and regulations for legality and food safety. Many regulations, permits, licenses, inspections, rules, laws, and taxes apply to food processing and vary locally and by state. States, counties, and cities have regulations that are not federally required, but nonetheless must also be understood and followed. Be sure to extensively research your local and state regulations to ensure that you are aware of all that are applicable to processing fish. A common regulation enforced by state and local governments is ServSafe certification.

Some federal regulation codes that apply to fish processing are:

- 21 CFR 101: This code covers food labeling,¹ which addresses how to label foods, nutrition labeling requirements, health claim requirements, etc.
- 21 CFR 117: This relates to current good manufacturing practice, hazard analysis, and risk-based preventative controls for human food.² The code considers appropriate personal hygienic practices, facility sanitation, design and construction of a food plant, maintenance of a food plant, sanitary operations, and controls during food production.
- 21 CFR 123: This code regulates fish and fishery products³ in terms of Hazard Analysis Critical Control Point (HACCP), definitions of fish and fishery products, record keeping, training, sanitation control procedures, smoked fish products, and raw shellfish.



- 21 CFR 1240: Focuses on the control of communicable diseases.⁴ This regulation addresses issues related to Public Health Service Act guidelines to prevent the introduction, transmission, or spread of communicable diseases from one state into another and regulations designed to control the spread of communicable diseases.
- 21 USC 331: This is a provision in the Food, Drug, and Cosmetics Act that prohibits adulteration and misbranding of any food in interstate commerce.⁵
- 21 CFR 1, 11, 81 FR 20091: A code that requires those engaged in the transportation of food to use sanitary transportation practices to ensure the safety of the food they transport.⁶
- 21 CFR 1, 87 FR 70910: A rule establishing additional recordkeeping for seafood processors relating to traceability.⁷

¹ eCFR :: 21 CFR Part 101 -- Food Labeling https://www.ecfr.gov/current/title-21/chapter-l/subchapter-B/part-101

² eCFR :: 21 CFR Part 117 -- Current Good Manufacturing Practice, Hazard Analysis, and Risk-Based Preventive Controls for Human Food https://www.ecfr.gov/ current/title-21/part-117

³ eCFR :: 21 CFR Part 123 -- Fish and Fishery Products (https://www.ecfr.gov/current/title-21/chapter-l/subchapter-B/part-123)

⁴ eCFR :: 21 CFR Part 1240 -- Control of Communicable Diseases (https://www.ecfr.gov/current/title-21/chapter-l/subchapter-L/part-1240)

^{5 21} U.S. Code § 331 - Prohibited acts (https://www.law.cornell.edu/uscode/text/21/331)

^{6 21} CFR 1, 11, 81 FR 20091: Sanitary Transportation of Human and Animal Food (https://www.federalregister.gov/documents/2016/04/06/2016-07330/sanitary-transportation-of-human-and-animal-food)

^{7 21} CFR 1, 87 FR 70910: (https://www.federalregister.gov/documents/2022/11/21/2022-24417/requirements-for-additional-traceability-records-for-certain-foods)

How to Get Started in the Process of Processing Seafood

Planning

For fish farmers, processing provides another stage of investment, in addition to producing and marketing fish the traditional way. Planning should involve engaging in a series of steps as well as determining the resources needed to complete each step.

Here is some guidance on each step:

Establish your vision for processing fish. Clarify what is to be achieved and the necessary resources. Ask questions such as: What is my motivation to process fish? What is my goal for processing fish? Why do I want to take on the added stage of processing? Your answers will help clarify your purpose and ultimate goal of investing in fish processing.



- Have a good understanding of the market you are getting into. This will help you understand who your customers are, what their needs and wants are, whether there is adequate demand for a processed fish product, what form of a processed product is needed, product prices, consumers' willingness to pay for local processed fish, and where to sell them.
- ⊘ Potential markets include direct sales to consumers, local restaurants, local grocers, and food caterers. Each of these market channels has its own unique characteristics that must be understood: Gather insight into customer profiles, their choice of product types, quantities they demand, how often supply is needed, etc.
- ⊘ Determine the type of processed fish to produce. Processed finfish products in the market include non-value added products such as whole-dressed (scaled, gutted, eviscerated, and de-gilled), drawn fish (whole dressed fish with head on), headed and gutted (whole dressed fish with head removed), fish steaks or chunks (cross-section slices), and fillets with skin-on or no skin. Value-added products could include smoked, breaded, etc.
- ⊘ Determine the price of the processed fish product. The key drivers of processed fish prices are the cost of raw unprocessed fish and the yield/recovery percentage from processing (See Financial Analysis section). The yield from processing also depends on a number of factors including the fish's anatomy, physiological condition, size, and quality, as well as processing conditions, processor skills in handling fresh fish (such as filleting), type of processed product, etc.⁸
- O Determine the required federal, state, and local policies and regulations and what training is needed. While some training is required, such as HACCP, others are optional. Note that some commercial kitchen facilities require additional training for renters.
- O Determine cost and requirements to process in local shared-use kitchen facilities. These types of facilities may have additional requirements that are not required by federal, state, and local regulatory authorities.

⁸ Chef's Resources – Finfish Butchering Yield % to Fillets and Loins (https://www.chefs-resources.com/seafood/seafood-yields/)



Training

Both federal and state policies and regulations govern fish processing and the sale of fish and fishery products.⁹ Some counties and communities may have additional regulations that need to be followed as well. The underlying reasons for policies and regulations are ensuring food safety and protecting public health. The U.S. Food and Drug Administration (FDA) regulates fish and fishery products, except catfish, that enter interstate commerce while relevant state agencies (such as the Department of Health) regulate in state commerce of fish and fishery products. The regulatory authority for catfish is USDA's Food Safety and Inspection Service (FSIS).¹⁰ FDA regulated seafoods must comply with the seafood HACCP regulation 21 CFR Part 123. USDA regulated catfish must comply with the USDA HACCP Systems regulations 9 CFR Part 41711.¹¹ These products must meet the requirements of the seafood HACCP regulation. It is important that fish handling, processing, storage, and distribution activities be carefully executed at all points along the food chain-from the time of harvest to the point of sale-by following government and industry requirements and recommended guidelines. The following trainings are essential for any fish farmer thinking of processing their fish.



Seafood Hazard Analysis and Critical Control Point

HACCP training is a requirement to process seafood, including farmed fish and fishery products (FDA seafood HACCP regulation 21 CFR 123). Seafood HACCP is a systematic approach that guides food businesses dealing with seafood to conduct a hazard analysis to determine significant food safety hazards that could occur with respect to the processed fish and fishery products and to identify preventive measures to control those hazards. Food safety hazards could come from internal and external environments of the processing phase, including food safety hazards that can occur before, during, and after fish harvest.

When developing a Seafood HACCP plan, producers start by conducting a hazard analysis to identify potential food safety hazards associated with their product(s), determine which, if any, are significant, and identify necessary controls to prevent such hazards. Upon completion of the hazard analysis, processors will develop a HACCP plan by identifying an appropriate control strategy and devising appropriate critical limits, monitoring, corrective action, verification, and record keeping procedures that will be implemented to control significant hazards. The Seafood HACCP Alliance (SHA) standardized training curriculum is designed to walk participants through this process and navigate available resources to effectively develop Seafood HACCP plans for their facilities.

Aquaculture producers who process their seafood products are required to have HACCP plans. The training consists of two segments. Segment 1 is completed as an online course through training programs by qualified trainers of the SHA curriculum.¹² This part must be completed before you can start Segment 2. You need to register for the Segment 2 training directly with the instructor. Segment 2 is typically a one-day training. There is also a 3 day in person course that encompasses both of these Segments. You can inquire about participating in a training by contacting the Association of Food and Drug Officials (AFDO) and SHA.You will receive an AFDO certificate upon full completion of the training.

10 https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/meat/catfish-farm-table

⁹ U.S. Food & Drug Administration - Seafood Guidance Documents & Regulatory Information (https://www.fda.gov/food/guidance-documents-regulatoryinformation-topic-food-and-dietary-supplements/seafood-guidance-documents-regulatory-information)

¹¹ USDA Guidebook for the Preparation of HACCP Plans - https://www.fsis.usda.gov/sites/default/files/media_file/2021-01/Guidebook-for-the-Preparation-of-HACCP-Plans.pdf

¹² Seafood HACCP Alliance (www.afdo.org/training/sha/seafood-haccp/)

Good Manufacturing Practices

Current good manufacturing practices (CGMPs)¹³ are regulations outlined by the FDA to help ensure the safety of food. CGMPs are established in the Code of Federal Regulations (CFR) in 21 CFR Part 117 Subpart B. These regulations address matters related to hygienic practices, sanitary operations, facility sanitation, controls during food production, and more. They set standards for quality assurance, record keeping throughout the manufacturing process, standards for cleanliness and safety, qualifications of manufacturing personnel, product testing, production, and process controls. In particular, food handlers should be well trained and gualified to handle the food manufacturing equipment and processes, and this includes having the required training and skills to handle fresh fish.

ServSafe Food Handler

This training provides a sanitation certification credential for anyone producing food for sale.¹⁴ It is an educational program for anyone seeking knowledge of basic safe food handling and safety procedures. It is administered by the National Restaurant Association. This can be a local requirement and is also required by many shareduse commercial kitchens.

Sanitation Control Procedures¹⁵

For businesses required to develop a HACCP plan, the Sanitation Control Procedures training program is highly recommended. It provides the background needed to develop foundational sanitation control procedures (SCPs) to support a HACCP plan. This training program is not required but is valuable for developing and implementing SCPs. It covers sanitation methods, crosscontamination prevention, proper handling of toxic compounds, protecting food from adulterants and pests, hand washing, and employee health. Training books are available whether you participate in formal training or are self-taught.





¹³ FDA - Current Good Manufacturing Practices (CGMPs) for Food and Dietary Supplements (https://www.fda.gov/food/guidance-regulation-food-and-dietarysupplements/current-good-manufacturing-practices-cgmps-food-and-dietary-supplements)

¹⁴ ServSafe® - Food Handler, Manager and Responsible Alcohol Training (https://www.servsafe.com/)

¹⁵ Protocol-SHA-Virtual-SCP (https://www.afdo.org/wp-content/uploads/2020/12/Protocol-SHA-Virtual-SCP-Protocol-Agenda-Reg-10.20.2020.pdf)

Fish Processing Skills

According to CGMPs, training on how to safely handle and operate equipment is needed to ensure fish are processed safely and correctly. Anyone involved in processing fish should be trained in workspace cleanliness and safety and in safe usage, storage, and cleaning of all materials used. They should have a sufficient understanding of the HACCP plan to meet regulatory compliance.

Waste Disposal

Processing fish creates solid and liquid waste. Follow your local government policy and guidelines for disposing of waste.¹⁶ Check with your local health department to ensure that your choice of waste disposal is approved and legal.¹⁷ Some fish processors create compost out of their waste which can be sold to add value to their businesses.

Cleaning and Sanitization

All utensils and materials used must be cleaned then sanitized. To clean utensils, wash and scrub them with soap and water. You can make a simple sanitization solution to disinfect utensils by mixing five tablespoons of unscented bleach with a gallon of clean water. Immerse your utensils in this solution for at least one minute to sanitize.¹⁸ All utensils, tables, and food contact surfaces must be sanitized after each use and after any interruption of operations as contamination may have occurred. All equipment and food contact surfaces must be cleaned and sanitized at a minimum of every four hours.¹⁹



You can make a simple sanitization solution to disinfect utensils by mixing five tablespoons of unscented bleach with a gallon of clean water.

¹⁶ US EPA - Hazardous Waste Permitting (https://www.epa.gov/hwpermitting)

¹⁷ US EPA - Solid Wastes (https://www.ecfr.gov/current/title-40/chapter-I/subchapter-I)

¹⁸ CDC - Cleaning and Disinfecting With Bleach (https://www.cdc.gov/hygiene/cleaning/disinfecting-bleach.html)

¹⁹ NFSEM_wk3_Actvy-Clean-Sanitize.pdf (servsafe.com) (https://www.servsafe.com/ServSafe/media/ServSafe/Documents/NFSEM_wk3_Actvy-Clean-Sanitize.pdf)



Processing Facilities Shared-Use Commercial Kitchen

Local commercial kitchens, which are available for shared-use,²⁰ provide an option for processing fish. To rent space in a kitchen, you typically need to fill out an application and pay any fees. Commercial kitchen owners often charge an initial setup fee as well as hourly rental rates. Some charge for the use of storage, refrigerator, and freezer space as well.

Common Questions about a Shared-Use Commercial Kitchen:

Q.	What is the average hourly cost to rent?	Α.	In the Midwest, the average hourly cost to rent is between \$15–25. Many different factors can affect the cost including how much time, space, and equipment you use.
Q.	Are there monthly, membership, or application fees?	Α.	Whether you will need to pay a monthly, membership, or application fee varies. Typically, larger facilities require more of these fees while smaller facilities do not.
Q.	Do kitchens offer labor?	Α.	Kitchens do not offer labor.
Q.	Do kitchens charge per pound of food processed?	Α.	Kitchens do not charge for the amount of food processed.
Q.	Do kitchens charge for dry, refrigerated, or freezer storage?	Α.	All kitchens charge for dry, refrigerated, and freezer storage. Some kitchens give one shelf of dry storage for free.
Q.	What is basic kitchen equipment?	Α.	Basic equipment found in kitchens includes ranges, ovens, mixers, griddles, sinks, and deep fryers. Some kitchens have more specialized equipment such as freeze dryers, pizza ovens, vacuum packers, and proofing cabinets. Some kitchens require renters to bring their own cutting boards and kitchen small wares.
Q.	What are the requirements to rent?	Α.	Most kitchens require that renters have a registered limited liability company, insurance, be ServSafe certified, and have approval from the state Department of Health.

20 Shared Kitchens - Local Food Economics (https://localfoodeconomics.com/shared-kitchens/)

Starting an On-Farm Fish Processing Facility

The steps listed below are ordered to be most helpful in starting your own on-farm fish processing facility. While this list is not exhaustive, it includes pertinent information that you need for your planning and research. It is based on responses obtained from fish farmers with on-farm processing facilities in the Midwest. Be aware of local, state, and federal guidelines, rules, and laws pertaining to your fish processing facility.

Think about these steps and plan, research, and analyze all the factors before making a final decision to build your own fish processing facility.

- 1. Define your goals: Why do you want to start a fish processing facility? What is your financial objective?
 - a. Realize that fish processing is challenging and your processed products will compete with imported ones as well as domestically raised products from other regions. Know how you will tackle these challenges.
 - b. Comply with local, state, and federal regulations.
 - i. Determine what local, state, and federal permits or licenses you will need.
 - ii. Determine what local, state, and federal inspections will occur.
 - c. Determine local, state, and federal taxes.
- 2. Plan your products and market: What are you selling? Who are you selling to? What are the prices you are likely to sell for? Who are your competitors? How much product are you selling?
 - a. Market research is absolutely necessary.
 - b. Base your plan on market trends and competitive pricing.
- 3. Plan logistics
 - a. Plan to have a good quality product.
 - b. Plan how your customers will receive your fish.
 - i. Determine whether you can ship your products at a reasonable cost, which includes what types of transportation and packaging you will offer.
 - ii. Type of transportation will determine how likely your fish will arrive in good condition.
 - iii. Determine the proper handling and chilling conditions for delivery.
 - iv. Plan how you will use technology to trace the shipping process of your fish after a purchase.
 - v. Plan when your fish facility will be operating—which days of the week, months of the year, hours in the day, etc.
- 4. Plan for needed equipment and supplies.
 - a. Determine cost of stainless-steel surfaces and equipment and where to purchase them.
 - b. Determine maintenance protocols for equipment.
 - c. Determine supplies needed for daily production and their costs.
- 5. Plan processing yields.
 - a. Determine what processing yields you expect and strive for the upper end of yield.
 - b. Determine potential uses of waste if necessary or desired.
- 6. Plan the building.
 - a. Check with your state and local governments for minimum facility requirements and necessary approvals related to the facility size, flooring type, wall type, etc.

- b. Determine the production capacity of your facility and secure needed equipment.
- c. Design the building based on storage and processing space, packaging and supply storage, restroom, utilities, office space, etc.
- d. Ensure that the building is designed so fish move smoothly and efficiently through the facility.
- 7. Plan the building location.
 - a. Decide the location to build the facility or to repurpose or renovate an existing building or room based on the facility design.
- 8. Plan for utilities.
 - a. Determine the amount and types of utilities you will need and the associated costs.
 - b. Determine how much waste you will produce, how to dispose of it, and how much disposal will cost.
- 9. Plan your labor needs and costs.
 - a. Determine your expected labor requirements. Will you be using your labor or hired labor?
 - b. Determine the workers' needed skills. Note that fish processing skills are important to realizing maximum fish yields.
- 10. Plan your overhead costs.
 - a. Determine all your overhead costs and estimates.
 - b. Determine how much fish you need to process to afford your overhead costs.
- 11. Analyze your finances based on planned pricing from market research.
 - a. Identify relevant record keeping.
 - b. Create profit and loss analysis and cash flow analysis.
 - c. Determine how often you will review and analyze your financials (quarterly, bi-annually, annually).
- 12. Determine your tax bracket and breaks.
 - a. Determine what taxes a food processing facility in your city, county, and state pays.
 - b. Determine if you receive any local, state, or federal tax incentives.
- 13. Determine your insurance and liability needs.
 - a. Determine the types of insurance you need, such as general liability, food liability, property, business income, commercial auto and fleet, commercial umbrella liability, crime, workers' compensation, and product recall.
 - b. Determine which insurance company is best for your needs.



You don't need all the fancy gadgets of high-end commercial kitchens, but you should plan for needed equipment and supplies such as stainless steel tables, bay sinks, and food grade pans as well as cutting boards, processing knives, and a freezer.

- 14. Determine your facility financing.
 - a. Determine your source of money to start the facility.
 - b. Determine whether grants are an option.
 - c. Determine whether loans are an option.
 - d. Determine your facility's return on investment.
- 15. Develop employee training.

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- a. Determine necessary training for all employees.
- b. Determine necessary and specific training for each position.
- c. Determine when, where, and by whom your employees will be trained.
- d. Determine the cost of training.

Common Questions about Fish Processing through an On-Farm Kitchen Facility:

Q.	What amount of insurance is needed?	Α.	The common dollar amount of insurance needed for a small-scale fish processor is \$1 million liability insurance.
Q.	How often are inspections?	Α.	Inspections happen 2–3 times a year and are random. They are the responsibility of the county health or agriculture department. Federal inspections are totally random.
Q.	What kind of knives are commonly used?	Α.	Fillet knives and electric knives are commonly used. Some have found that fillet knives yield better results than electric knives, but they are slower.
Q.	What equipment is needed?	Α.	A basic small-scale fish processing facility needs a 30-inch x 72-inch stainless-steel processing table, three bay stainless-steel sinks, fillet knives between 6–12 inches, a refrigerator or walk-in cooler, and a freezer or chest freezer.
Q.	What is the initial financial investment?	Α.	The initial financial investment varies depending on the size of the processing facility. Plan for 200–400 square feet.
Q.	What is the monthly operating cost?	Α.	The monthly operating cost varies widely depending on size and usage—a larger facility will cost more than a small facility. Some factors that go into this cost are electricity, water, heat, and air conditioning.

Selling Processed Fish

There are many ways to sell processed fish. Some options include farmers markets, online, direct-tocustomer, local grocers, and local restaurants. Local grocers and restaurants usually require a regular supply of processed fish. Online and direct-to-consumer selling and marketing depend on your location and community, but this is usually a more manageable way to sell processed fish for small-scale fish processors. Farmers markets are great ways to sell fish, but one has to take into account many factors such as travel and set-up time, post-market teardown, cleanup, restock time, fish storage and temperature, and the cost to rent a market space to know whether selling at the market is worth it.

Case Study Financial Analysis

The following example is a case study of financial analysis incorporating financial measures, which can help inform your decision about processing fish. The analysis is a case study that focused primarily on two types of facilities—a shared- use commercial kitchen and an on-farm processing facility for rainbow trout. The analysis explores processing a portion of a farmer's total fish production on their own for local markets.

Assumptions for this example include:

- Three levels of processing production: 2,500 pounds per year, 5,000 pounds per year, and 10,000 pounds per year.
- The cost of raw product for rainbow trout is \$4.00/lb.
- Selling price is a 10% markup over cost.
- Processing occurs twice a month, or once every two weeks.
- Processing productivity is two pounds of fish filleted in four minutes.
- Processing yields for rainbow trout is 53%.

Other per year assumptions include six hours for prep work before processing, four hours for packaging, and a 6-hour timeframe for cleanup after processing. For transportation, a round-trip distance of 200 miles is assumed at a mileage rate of \$0.50/mile. A biweekly schedule entails an annual travel distance of 4,800 miles. Annual fixed costs include security deposit, insurance cost, and management cost. All commercial kitchens require renters to have a minimum of one million dollar liability insurance, which is estimated to cost \$1,440 annually. The management cost is calculated as an opportunity cost for 1% of the total annual variable cost. Information on costs associated with setting up a 400 sq ft on-farm kitchen that assumes no salvage value for the items after the useful years are presented in Table 1.

The constructed yearly enterprise budgets contain the expected annual costs and revenues associated with processing rainbow trout. Table 2 presents a budget for using a shared-use commercial kitchen and Table 3 is a budget for using an on-farm facility. Tables 2 and 3 specify the yearly cost for each item for the three production levels. The breakeven price is that which exactly covers the cost of processing fish. The profitability index is the ratio between the present value of cash inflows and the present value of cash outflows. A profitability index of 1.0 indicates that the present value of the cash inflows is equal to the initial investment, which means a value greater than 1.0 implies profitability.

Note that profitability depends on the selling price, therefore you need to do some market research to establish if local buyers are willing to pay the necessary price. That should inform your processing decision. The breakeven prices for processing 2,500, 5,000, and 10,000 pounds in a shared-use commercial kitchen are respectively, \$14.73, \$12.18, and \$10.97 per pound. With a 10% markup scenario, the profitability index for each scale of processing is 1.1, indicating profitability (Table 2).

Table 3 provides an overview of the yearly enterprise budget for processing rainbow trout in an on-farm kitchen facility. The variable costs include raw product, processing, packaging, as well as utilities and supplies. Variable costs depend on the amount of rainbow trout processed. Fixed costs comprise facility setup, insurance, and management.

The net present value (NPV) is the present value of all expected cash flows; "net" includes both positive and negative cash flows. A positive NPV means that the investment is profitable. A negative NPV value implies the return cannot cover the cost of investment. A zero NPV means that the future return just equals the investment cost. The payback years is a measure of time needed in years to recover an investment, or how long it takes to get your money back. You can use it as a measure of your investment risk.

In Table 3, assuming a 10% markup, the profitability index is 0.66, 0.86 and 1.23, respectively, for processing 2,500, 5,000, and 10,000 pounds of rainbow trout in own on-farm facility. The NPV is negative for processing 2,500 and 5,000 pounds, indicating negative profitability. It would take 11.6, 9.0, and 6.3 years, respectively, to recover the initial investment for processing 2,500, 5,000, and 10,000 pounds.

These results suggest that economy of scale is important; that is, profitability increases, payback years decrease, and net present value increases as farmers expand the quantity of fish to process.

Facility Setup Item	Total Cost (\$)	Useful Years (years)	Annual Depreciation (\$/year)
Building	\$40,000	20	\$2,000
Septic System	\$5,000	20	\$250
Table – 2 @ \$200	\$400	20	\$20
Stainless Bay Sink	\$400	20	\$20
Chest Freezer	\$300	10	\$30
Ice Machine	\$700	10	\$70
AC unit	\$800	10	\$80
Pressure Washer	\$300	10	\$30
Scale, Knife & Plastic Tray	\$180	5	\$36
Total Initial Investment	\$48,080		
Total Annual Setup Cost			\$2,536

Table 1. Facility Setup Items for a 400 sqft On-farm Kitchen.

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		2,500 lbs/year			5,000 lbs/year			10,000 lbs/year	
	Unit Price	Quantity	Value	Unit Price	Quantity	Value	Unit Price	Quantity	Value
Revenue									
Rainbow Trout (10% markup)	\$16.21/lb	1,325 lbs	\$21,478	\$13.40/lb	2,650 lbs	\$35,510	\$12.06/lb	5,300 lbs	\$63,918
Variable Cost (VC)									
Facility Rental	\$19.00/hr	99.32 hrs	\$1,887	\$19.00/hr	99.32 hrs ^a	\$1,887	\$19.00/hr	127.11 hrs	\$2,415
Raw Product	\$4.00/lb	2,500 lbs	\$10,000	\$4.00/lb	5,000 lbs	\$20,000	\$4.00/lb	10,000 lbs	\$40,000
Transportation	\$0.50/mile	4,800 miles	\$2,400	\$0.50/mile	4,800 miles	\$2,400	\$0.50/mile	4,800 miles	\$2,400
Labor – Preparation & Cleaning	\$15.00/hr	12 hrs	\$180	\$15.00/hr	24 hrs	\$360	\$15.00/hr	36 hrs	\$540
Labor – Processing	\$15.00/hr	83.33 hrs	\$1,250	\$15.00/hr	166.66 hrs	\$2,500	\$15.00/hr	333.33 hrs	\$5,000
Ice	\$1,000/unit	1 unit	\$1,000	\$1,000	2 units	\$2,000	\$1,000	4 units	4,000
Packaging Materials	\$0.78/unit	250 units	\$195	\$0.78/unit	500 units	\$390	\$0.78/unit	1,000 units	\$780
Subtotal			\$16,912			\$29,537			\$55,135
Fixed Cost (FC)									
Security Deposit		1 unit	\$1,000		1 unit	\$1,000		1 unit	\$1,000
Insurance		1 unit	\$1,440		1 unit	\$1,440		1 unit	\$1,440
Management		1 unit	\$169		1 unit	\$295		1 unit	\$551
Subtotal			\$2,609			\$2,735			\$2,991
Total Cost (TC)			\$19,521			\$32,273			\$58,126
Breakeven Price (BEP)									
BEP/VC			\$12.76			\$11.15			\$10.40
BEP/TC			\$14.73			\$12.18			\$10.97
Profitability Index			1.10			1.10			1.10

^aSame rental space hours for 1 person processing 2,500 lb and 2 people processing 5,000 lb of fish.

		2,500 lbs/yea1		2	,000 lbs/yean		I	0,000 lbs/yea	
	Unit Price	Quantity	Value	Unit Price	Quantity	Value	Unit Price	Quantity	Value
Rainbow Trout (10% markup)	\$13.27/lb	1,325 lbs	\$17,583	\$11.61/lb	2,650 lbs	\$30,767	\$10.69/lb	5,300 lbs	\$56,657
Variable Cost (VC)									
Raw Product	\$4.00/lb	2,500 lbs	\$10,000	\$4.00/lb	5,000 lb	\$20,000	\$4.00/lb	10,000 lbs	\$40,000
Labor – Preparation & Cleaning	\$15.00/hr	12 hrs	\$180	\$15.00/hr	24 hrs	\$360	\$15.00/hr	48 hrs	\$540
Labor - Processing	\$15.00/hr	83.33 hrs	\$1,250	\$15.00/hr	166.66 hrs	\$2,500	\$15.00/hr	333.33 hrs	\$5,000
Packaging Materials	\$0.78/unit	250 units	\$195	\$0.78/unit	500 units	\$390	\$0.78/unit	1000 units	\$780
Utilities/Supplies			\$1,200			\$1,440			\$1,680
Subtotal			\$12,825			\$24,690			\$48,000
Fixed Cost (FC)									
Facility Setup		1 unit	\$2,536		1 unit	\$2,536		1 unit	\$2,536
Insurance		1 unit	\$500		1 unit	\$500		1 unit	\$500
Management		1 unit	\$128		1 unit	\$247		1 unit	\$480
Subtotal			\$3,174			\$3,303			\$3,516
Total Cost (TC)			\$15,989			\$27,973			\$51,516
Breakeven Price (BEP)									
BEP/VC			\$9.68			\$9.32			\$9.06
BEP/TC			\$12.07			\$10.56			\$9.72
Economic Metric									
Profitability Index			0.66			0.86			1.23
Payback Years			11.63			9.02			6.25
Net Present Value			(\$15,382)			(\$6,569)			\$10,744

Table 3. Yearly Enterprise Budget for Processing Rainbow Trout in On-farm Processing Facility

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