Project Title: A Comprehensive Study of Processing Fish in Local Facilities for Local Food Systems [Termination Report]

Total Funds Committed: $201,834
Initial Project Schedule: September 1. 2021-August 31, 2022 [Extended to August 31,2023]
Current Project Year: September 1, 2022-August 31, 2023
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Extension Liaison: Kwamena Quagrainie (Purdue University)
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Project Objectives

1. Conduct an in-depth study of the business models for shared-use commercial kitchens and butcher shop-type facilities.
2. Assess the feasibility for fish processing in shared-use commercial kitchens and butcher shop-type facilities, and the supply of processed aquaculture products in the local food system.
3. Address food safety issues associated with implementing Objective #2 including product safety and safety of direct selling operations.
4. Develop economically viable business models and strategic pathways for fish farmers / aquaculture businesses to engage with local food actors.
5. Disseminate research results identifying optimal products, safety indicators for products and direct sales, business models, and strategic pathways for engaging local food systems

Project Summary

The project explored processing fish in shared-use commercial kitchens and on-farm processing facilities in local communities. We provided five fish farmers with free HACCP. We also hosted a free seafood processing and food safety workshop at University of Illinois, Champaign, Illinois that covered topics such as food safety basics, HACCP regulation, value-added products, financial feasibility of processing, facility inspections, and more. There were 25 participants at the workshop. We collected information and data from seven shared-use commercial kitchen owners and two on-farm fish processing kitchen owners on their operations to construct business models, costs, regulations, etc. as case studies. The information and data collected were used to develop enterprise budgets and financial measures to assist fish farmers/aquaculture businesses that plan to engage in fish processing. We also documented all the information collected from this project into a handbook as a guide for small-scale fish farmers who want to start processing their fish. The handbook outlines various aspects of the process including knowing the regulations, required training, requirements for renting a commercial kitchen and what it takes to own an on-farm facility. Fish farmers interested in processing their fish can now use the handbook to decide if processing is a feasible pathway to add to the fish production business or simply getting into fish processing using any of the local facilities.

Anticipated Benefits

This project is a comprehensive study of utilizing shared-use commercial kitchen facilities for the feasibility of processing aquaculture products by fish farmers. Results will provide answers to the research question: "What would it take to process fish and other aquaculture products in shared-use commercial kitchen facilities to supply local clients?

Project Progress
Method

Analysis employed (1) Political-Economic-Social-Technological (PEST) analysis, a concept in marketing research that companies use as a tool to track their operating environment or the environment they are planning to launch a new product or service as well as (2) Financial analysis as case studies to characterize potential local processing for local food systems. The project approach involved various activities:

1. Seafood Hazard Analysis and Critical Control Point (HACCP) training for fish producers.
2. Interviewing commercial kitchen owners/operators.
3. Interviewing on-farm fish processing facility owners.
4. Conducting a workshop on fish processing and food safety.

The information and data for analysis were obtained from interviewing seven commercial kitchens and two local on-farm kitchens, as well as information from regulatory agencies and a previous pilot project. To determine what questions to ask the commercial kitchen owners and fish farmers who own a processing facility, we brainstormed questions that a fish processor may have when thinking about renting or building a facility. We did basic preliminary research on commercial kitchens and on-farm fish processing facilities using various internet sources. We finished with 30 questions for commercial kitchen owners and 24 questions for on-farm fish processors. To find commercial kitchens, we searched the website 'The Kitchen Door' for commercial kitchens throughout Illinois, Indiana, and Ohio (The Kitchen Door, 2022). We used the information provided on the site to find the kitchen names, addresses, contact information. Of the 49 commercial kitchens that were listed on the site in Illinois, Indiana and Ohio, 37 were in operation. Of these 37 kitchens, we contacted 26 kitchens by email or phone number listed on their website. The other 11 kitchens were not contacted because their contact information was not easily available. Out of the 26 kitchens contacted, we received responses from 19 kitchens, and out of the 19, seven agreed to be interviewed (27% response rate). Respondents included three kitchen owners from Indiana, three kitchen owners from Ohio, and one kitchen owner from Illinois. We also interviewed one on-farm fish processor from Ohio and one on-farm fish processor from Illinois.

Results

Hazard Analysis and Critical Control Point (HACCP) training

HACCP training is required by the FDA if a person wants to process seafood for commercial operations. HACCP training teaches about hazards, how to identify hazards, risk analysis, critical points, and controls for critical points during processing. HACCP training typically happens in two parts: an online course and a one-day in-person or virtual training session. The farmers are now one crucial step closer to being able to process fish in any local certified and inspected kitchen facility. We also hosted a free seafood processing and food safety workshop that covered topics such as food safety basics, HACCP regulation, value-added products, financial feasibility of processing, facility inspections, and more. There were 25 participants at the workshop.

PEST Analysis

Political Factors

Rules and regulations that were identified as being relevant to fish processing included:

- ✓ 21 CFR 101: This code covers food labeling, 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. 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 products 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. 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.
- ✓ 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.
- ✓ 21 CFR 1, 87 FR 70910: A rule establishing additional recordkeeping for seafood processors relating to traceability.

Training programs that were identified for fish producers planning to process fish included:

- ✓ Seafood Hazard Analysis and Critical Control Point (HACCP). HACCP training is a requirement to process seafood, including farmed fish and fishery products (FDA seafood HACCP regulation 21 CFR 123).
- ✓ Current Good Manufacturing Practices (CGMPs). CGMPs are regulations outlined by the FDA to help ensure the safety of food.
- ✓ ServSafe Food Handler, a training that provides a sanitation certification credential for anyone producing food for sale.
- ✓ Sanitation Control Procedures (SCPs). For businesses required to develop a HACCP plan, the SCPs training program is highly recommended. It provides the background needed to develop foundational SCPs to support a HACCP plan.

Economic Factors

Commercial kitchens: Renters typically pay an hourly fee for kitchen usage as the primary cost. Some commercial kitchens mandate that renters commit to a minimum amount of usage or spending, often on a monthly basis, and require renters to sign a contract outlining their intended kitchen usage. A cloud-based software called "*Food Corridor*" is commonly employed to manage shared kitchen usage, handle renters' requests, and schedule kitchen usage times. The hourly rental fee for kitchen space varies across the United States; however, in Illinois, Indiana, and Ohio, it typically ranges from $14 to $25. To accommodate renters who anticipate frequent kitchen usage, some commercial kitchens offer tiered pricing packages that offer a discounted rate compared to the standard hourly fee. Commercial kitchens vary in the types of professional training they offer to their clients. While some may provide business, accounting, and legal training, others may only provide instruction in sanitation and cleanliness. Commercial kitchens operators interviewed indicated that, renters may process any type of food during their scheduled time, and there are no fees based on the amount of food processed. In some instances, commercial kitchens may also require renters to pay yearly or monthly membership fees, as well as first-time user application fees, which may be partially refundable. In the NCR, commercial kitchens are generally categorized as small-scale or large-scale shared kitchens and vary in size from 1,500 to 6,000 square feet.

On-farm kitchens: On-farm kitchens are significantly smaller, with typical sizes ranging from 200 to 400 square feet. There are no rental costs associated with on-farm kitchens since farmers use their own kitchens. However, farmers face regular expenses related to labor, packaging, and cleaning supplies. On-farm kitchens operators are responsible for covering all the utility costs

associated with the operation process. On-farm kitchens require an initial financial investment that includes the cost of the building, septic system, equipment, and kitchen equipment and tools, all of which have a lifespan and annual depreciation. The expense for on-farm kitchens varies from $15,000 to $50,000, depending on size and equipment.

Social factors

Social factors are very relevant when a fish farmer wants to sell directly to customers in the state. The information provides valuable demographic information about potential consumers. Therefore, a summary of the demographic situation in the states of Illinois, Indiana, and Ohio are presented here. Data from the U.S. Census Bureau database (2021) indicates that the median household income in the United States from 2017-2021 (in 2021 dollars) is $69,021. Specifically, the median household income for Illinois is $72,563, for Indiana is $61,944, and for Ohio is $61,938. It is worth noting that Illinois has a median household income that is 5.1% higher than the national average, while Indiana and Ohio are 10.3% lower. The population of Illinois, Indiana, and Ohio are 12,671,469; 6,805,985; and 11,780,017 respectively, accounting for 3.89%, 2.0%, and 3.56% of the total population in the U.S. Ohio has the largest elderly population among the three states, with a percentage of 17.8% of individuals over 65 years old in the population. This is higher than the national percentage of 16.8%, while Illinois and Indiana have percentages of 16.6% and 16.4%, respectively. In terms of gender distribution, the populations of Illinois, Indiana, and Ohio are relatively balanced, with female population percentages close to the national average of 50.5%. Therefore, these states have slightly larger female populations than male populations. The racial composition of the states of Illinois, Indiana, and Ohio is characterized differently. The percentage of the White population in these states is higher than the national average of 75.8%, ranging from 81.2% to 84.2%. Conversely, the American Indian, Alaska Native, Native Hawaiian, and Hispanic populations in the three states have lower percentages than the national average, ranging from 0.2% to 14.7%. Additionally, Indiana and Ohio have lower percentages of African American and Asian populations. In terms of education, while the percentages of high school graduates in Illinois, Indiana, and Ohio are 89.9%, 89.8%, and 91.1%, respectively, which are higher than the national average of 88.9%, the percentages of bachelor's degree and higher in Indiana and Ohio are 29.7% and 27.8%, respectively, which are 0.8% and 2% lower than the corresponding national average of 33.7%.

Technological factors

The commercial kitchens in the NCR region rarely rely on advertising tools and instead utilize basic and inexpensive means for advertising, such as monthly newsletters. Many commercial kitchen owners do not advertise as they consider it to be ineffective and inefficient. On the contrary, local community networking events like presentations, forums, association talks, and vendor shows are more effective in helping commercial kitchens connect with their targeted clients. Regarding information technology access, commercial kitchens generally create their communication channels. Some have internal communication departments within the market, while others have business websites that enable virtual tours, multiple social media accounts such as Facebook, Instagram, and LinkedIn, email and text messaging for regular contact, and utilize Food Corridor for scheduling and billing. Consistent contact with clients is vital for the smooth operation of the business; therefore, commercial kitchens often use a combination of the aforementioned methods to ensure access to consumers.

Financial Analysis

To establish the framework of profitability analysis, several assumptions were made.

1. We considered two types of facilities in our scenarios; shared-used commercial kitchen and on-farm kitchen facility.
2. We chose two common fish market species - tilapia and rainbow trout to examine the scenarios.
3. Processing yields for tilapia and rainbow trout are assumed to be 32% and 53% respectively.
4. We created three small-scale processing production levels: Scale I (processing 2,500 pounds a year), Scale II (processing 5,000 pounds a year), and Scale III (processing 10,000 pounds a year). It should be noted that fish processed represents only a portion of the farmer's total fish production, as they also engage in selling live fish. This profitability analysis focuses on exploring processing a portion of a farmer's total fish production on their own for local markets.
5. Two selling prices were considered in this analysis, with a markup percentage of 10% and 15%.
6. We assumed that a fish farmer visits a local processing facility twice a month, or once every two weeks.
7. The productivity of labor processing fish is filleting 2 pounds of fish in 4 minutes, either through hired or self-labor. Labor cost is fixed at $15.00/hr.

Processing Tilapia

Table 1 presents a summary of the profitability associated with utilizing commercial and on-farm kitchens for processing tilapia in Scale I, Scale II, and Scale III. In the case of using commercial kitchens to process tilapia, the profitability of fish farmers is contingent on the selling price, regardless of the processing production level. For example, in the scenario where a 15% markup is applied, Scale I farmers must sell their processed tilapia at $24.43 /lb., Scale II farmers must sell at $19.57 /lb., and Scale III farmers must sell at $17.26 /lb. to achieve profitability. Notably, the value of profitability indexes for all production scales is 1.15, indicating profitability. A profitability index of 1.0 indicates that the present value of the cash inflows is equal to the initial investment, and a value greater than 1.0 implies profitability. Similarly, for the scenario where a 10% markup is applied, Scale I farmers must sell their processed tilapia at $23.38 /lb., Scale II farmers at $18.72 /lb., and Scale III farmers at $16.51 /lb. to achieve profitability. The value of profitability indexes for all production scales is 1.10, also indicating a profitable processing venture. A key factor that farmers need to determine is whether local buyers are willing to pay those prices, which then will inform their decision to process tilapia.

When fish farmers opt to utilize on-farm kitchens to process tilapia, their profitability is subject to variation based on the quantity processed and selling price. For Scale I production, a 15% markup requires farmers to sell their processed tilapia at $19.35 /lb., resulting in a profitability index of 0.73 and a negative net present value, indicating an unprofitable venture. In this scenario, farmers would require at least 10.6 years to recover their initial investment. Similarly, a 10% markup requires farmers to sell their processed tilapia at $18.51 /lb., resulting in a profitability index of 0.62 and a negative net present value, also indicating an unprofitable venture. In this scenario, farmers would require at least 12.4 years to recover their initial investment.

For Scale II production, a 15% markup requires farmers to sell their processed tilapia at $16.48 /lb., resulting in a profitability index of 0.95 and a negative net present value, indicating an unprofitable venture. In this scenario, farmers would require at least 8.1 years to recover their initial investment. Similarly, a 10% markup requires farmers to sell their processed tilapia at $15.76 /lb., resulting in a profitability index of 0.78 and a negative net present value, also indicating an unprofitable venture. In this scenario, farmers would require at least 10.0 years to recover their initial investment.

For Scale III production, a 15% markup requires farmers to sell their processed tilapia at $14.88 /lb., resulting in a profitability index of 1.39 and a positive net present value, indicating profitability. In this scenario, farmers can recover their initial investment in 5.6 years. Similarly, a 10% markup requires farmers to sell their processed tilapia at $14.24 /lb., resulting in a profitability index of 1.07 and a positive net present value, indicating profitability. In this scenario, farmers would require 7.3 years to recover their initial investment. The results show that as farmers' profitability increases, payback years decrease, and net present value increases as they expand their production level and raise their markup percentage.

Processing Rainbow Trout

Table 2 presents the profitability analysis of using commercial and on-farm kitchens to process rainbow trout. In the scenario where a 15% markup is applied, profitability can be achieved by Scale I farmers by selling their processed rainbow trout at $16.94 /lb., Scale II farmers at $14.01 /lb., and Scale III farmers at $12.61 /lb. The value of profitability indexes for all production scales are 1.15, indicating profitability. Where a 10% markup is applied, Scale I farmers must sell their processed rainbow trout at $16.20 /lb., Scale II farmers at $13.40 /lb., and Scale III farmers at $12.06 /lb. to achieve profitability. The value of profitability indexes for all production scales are 1.10, also indicating a profitable venture.

For on-farm kitchen processing at Scale I production, a 15% markup requires farmers to sell their processed rainbow trout at $13.88 /lb, resulting in a profitability index of 0.79 and a negative net present value, indicating an unprofitable venture. In this scenario, farmers would require at least 9.8 years to recover their initial investment. Similarly, a 10% markup requires farmers to sell their processed rainbow trout at $13.28 /lb., resulting in a profitability index of 0.66 and a negative net present value, also indicating an unprofitable venture. In this scenario, farmers would require at least 11.6 years to recover their initial investment.

For Scale II production, a 15% markup requires farmers to sell their processed rainbow trout at $12.14 /lb., resulting in a profitability index of 1.07 and a positive net present value, indicating profitability. In this scenario, farmers would require at least 7.2 years to recover their initial investment. Similarly, a 10% markup requires farmers to sell their processed rainbow trout at $11.61 /lb., resulting in a profitability index of 0.86 and a negative net present value, also indicating an unprofitable venture. In this scenario, farmers would require at least 9.0 years to recover their initial investment.

For Scale III production, a 15% markup requires farmers to sell their processed rainbow trout at $11.18 /lb., resulting in a profitability index of 1.64 and a positive net present value, indicating profitability. In this scenario, farmers can recover their initial investment in 4.7 years. Similarly, a 10% markup requires farmers to sell their processed rainbow trout at $10.69 /lb., resulting in a profitability index of 1.23 and a positive net present value, indicating profitability. In this scenario, farmers would require 6.3 years to recover their initial investment.

These results suggest that profitability increases, payback years decrease, and net present value increases as farmers expand their production level and raise their markup percentage. Additionally, utilizing on-farm kitchens to process rainbow trout yields higher profits than processing tilapia, while using commercial kitchens to process rainbow trout results in the same profitability as processing tilapia with economies of scale.

References

The Kitchen Door (2022). Find licensed, commercial kitchens to take your food business to the next level! Available at: https://www.thekitchendoor.com/

Outreach Overview

Current and potential aquaculture producers will have all the relevant information about seafood processing opportunities in the region.

Targeted Audience
Current and potential aquaculture producers interested in exploring processing opportunities to diversify their markets.

Outputs/Impacts

- Conducted an in-depth study of the business models for shared-use commercial kitchens and butcher shop-type facilities
    - Interviewed two on-farm processing facility owners and seven commercial kitchen owners from Illinois, Indiana, and Ohio

- Assessed the feasibility for fish processing in shared-use commercial kitchens and butcher shop-type facilities and the supply of processed aquaculture products to the local food system
    - Fish processing is much more feasible in shared-use commercial kitchens than in on-farm fish processing/butcher shop-type facilities at a small-scale level.
    - Produced "*Handbook on Processing for Small-Scale Fish Farmers*"

- Addressed food safety issues associated with implementing Objective #2, including product safety and safety of direct selling operations
    - There are many rules and regulations involving food safety and fish processing. HACCP certification is the main requirement. We conducted free HACCP training for five fish producers and food safety training / fish processing training for 25 workshop participants.
    - Facilitated in six fish farmers obtaining HACCP certification

- Developed economically viable business models and strategic pathways for fish farmers/aquaculture businesses to engage with local food actors
    - Drafted document on "Comparative Case Study of Small-Scale Fish Processing for Local Seafood Supply"
    - Produced "*Handbook on Processing Fish for Small-Scale Fish Farmers*" which includes financial models

- Disseminated research results identifying optimal products, safety indicators for products and direct sales, business models, and strategic pathways for engaging local food systems
    - Produced "*Handbook on Processing for Small-Scale Fish Farmers*"
    - Presented at 2023 North Central Regional Aquaculture Conference, Eau Claire, WI
    - Presented at Aquaculture America 2023 in New Orleans, LA

- Increased the number of HACCP certified farmers/business in the NCR
- Produced "Handbook on Processing Fish for Small-Scale Fish Farmers"
- Increased awareness regarding food safety basics, HACCP regulation, value-added products, financial feasibility of processing, and facility inspections for the 25 NCR farmers who attended a free workshop and aquaponics facility tour

- Increased awareness of processing opportunities in the NCR and costs associated to renting kitchen space and processing on-farm through presentations at professional conferences, extension publications and peer-reviewed journal article
- Provided workforce/professional development opportunities to one staff member and one graduate student

Recommended Follow-Up Activities

We recommend a follow-up activity to follow the methodology and procedures taken in writing the "Handbook on Processing Fish for Small-Scale Fish Farmers" and *Comparative Case Study of Small-Scale Fish Processing for Local Seafood Supply* but to focus on other forms of products such as value-added products like smoked fish, fish dips, etc. This could be done by interviewing fish processors who produce various value-added products and using their answers to further investigate the feasibility of producing value-added products. A financial analysis modeled after the one we completed would be necessary to fully investigate the feasibility of value-added processing.

Impact Summary

Relevance. — Fish farmers have long expressed interest in processing fish for local markets, but the marketplace situation created by the Covid-19 pandemic intensified the need for processing to expand market opportunities.

Response. — The study explores processing fish and other aquaculture products in commercial kitchen facilities in local communities for the growing local food systems.

Results. — Ongoing research

Recap. — What would it take to process fish and other aquaculture products in shared-use commercial kitchen and butcher shop-type facilities to supply local clients?

Publications, Manuscripts, Workshops, and Conferences

Publications in Print

- ***Brochure:***

Quagrainie, K.K., Bradford, T.L., Tao, J., and Shambach, A.M. (2023). "Handbook on Processing Fish for Small-Scale Fish Farmers." Illinois-Indiana Sea Grant Report IISG23-SFA-BRC-044. Available at: https://iiseagrant.org/publications/handbook-on-processing-fish-for-small-scale-fish-farmers

- ***Thesis***

Tao, JingJing. (pending 2024). Comparative Case Study of Small-Scale Fish Processing for Local Seafood Supply. Purdue University MS Thesis, unpublished.

- ***Manuscripts***

Tao, J., Quagrainie, K.K., and Bradford, T.L. (draft). Comparative Case Study of Small-Scale Fish Processing for Local Seafood Supply

Papers Presented

- The Feasibility of Processing Fish in Local Facilities for Local Food Systems by Jingjing (Tina) Tao, Kwamena K. Quagrainie, Taylor L. Bradford at Aquaculture America 2023 in New Orleans, Louisiana on February 24, 2023
- Thinking About Small-Scale Fish Processing in the Midwest? Things to Know by Taylor Bradford, Kwamena Quagrainie, Jingjing (Tina) Tao at Aquaculture America 2023 in New Orleans, Louisiana on February 23-26, 2023
- Comprehensive Study of Processing Fish in Local Facilities for Local Food Systems – PROJECT UPDATE. Presented at 2023 North Central Regional Aquaculture Conference February 17, 2023, Eau Claire, WI.

Table 1. Financial Metrics for Processing Tilapia Using Local Facilities

Kitchen Type	Scale I	Scale II	Scale III
Commercial Kitchen			
Selling Price (15% markup)	$24.43	$19.57	$17.26
Profitability Index	1.15	1.15	1.15
Selling Price (10% markup)	$23.38	$18.72	$16.51
Profitability Index	1.10	1.10	1.10
On-farm kitchen			
Selling Price (15% markup)	$19.35	$16.48	$14.88
Profitability Index	0.73	0.95	1.39
Payback Years	10.6	8.1	5.6
Net Present Value	($12,488.71)	($2,255.37)	$17,943.91
Selling Price (10% markup)	$18.51	$15.76	$14.24
Profitability Index	0.62	0.78	1.07
Payback Years	12.4	10.0	7.3
Net Present Value	($17,238.99)	($10,283.07)	$3,316.82

Table 2. Financial Metrics for Processing Rainbow Trout Using Local Facilities

	Scale I	Scale II	Scale III
Commercial Kitchen			
Selling Price (15% markup)	$16.94	$14.01	$12.61
Profitability Index	1.15	1.15	1.15
Selling Price (10% markup)	$16.20	$13.40	$12.06
Profitability Index	1.10	1.10	1.10
On-farm kitchen			
Selling Price (15% markup)	$13.88	$12.14	$11.18
Profitability Index	0.79	1.07	1.64
Payback Years	9.8	7.2	4.7
Net Present Value	($9,703.37)	$3,315.31	$29,085.28
Selling Price (10% markup)	$13.28	$11.61	$10.69
Profitability Index	0.66	0.86	1.23
Payback Years	11.6	9.0	6.3
Net Present Value	($15,382.10)	($6,569.28)	$10,744.39