



Value Chain Analysis of Great Lakes Fish Byproduct for 100% Utilization

Submitted To:

Conference of Great Lakes St. Lawrence Governors and Premiers

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Introduction

TriNav Fisheries Consultants, Inc. has been retained by the Conference of Great lakes St. Lawrence Governors and Premiers (GSGP) as part of the 100% Great Lakes fish initiative to conduct a comprehensive analysis of potential value chains for producing compost, pet food, liquid fertilizer, and fish meal oil using fish byproduct sourced from the Great Lakes region in the US and Canada. The goal of the project is to showcase how 100% of commercially and recreationally caught fish, aquaculture fish from the Great Lakes region, and sport fish cleaning stations can be utilized to maximize the economic benefit within the region. A similar project has been done to utilize 100% fish byproduct in Iceland, which inspired this project and is referenced throughout the report.

A 100% Great Lakes fish strategy presents significant opportunities for the Great Lakes St. Lawrence region to fully optimize fish utilization, boost economic returns, create jobs, and support the growth of rural economies. This report is a value chain analysis that discusses opportunities to collaborate with existing producers both inside and outside the Great Lakes region, identifies any barriers such as transportation costs, explores engagement with regional companies not currently involved in fish-related ventures but active in adjacent markets, as well as fills in any value chain gaps that may have not previously been known. Note that this report is one part of a much broader effort to establish a 100% Fish initiative in the Great Lakes region, and further analyses will be conducted in the coming months.

Background

The Great Lakes fisheries are managed by provincial, state, and tribal agencies and represent a significant economic pillar for the region. The Great Lakes commercial, recreational, and tribal fisheries are valued at more than USD \$7 billion annually and support more than 75,000 jobs (according to the Great Lakes Fishery Commission). Each year roughly 35 million lbs of fish are harvested as part of the commercial fishery in these lakes. Of the 35 million lbs caught, only approximately 40% of the fish is sold in the market, while the other 50-60% has little to no demand and is either discarded at a financial loss, given away at a breakeven level, or rarely sold at a marginal revenue. This means that when accounting for species markets and utilization approximately 17.9 million lbs of the catch is currently being disposed of without realizing any substantial economic return. The main species for this report are lake whitefish, yellow perch, walleye, lake trout, and sucker, however the value chains can also be optimized for other fish in the Great Lakes, such as smelt, cisco, or others.

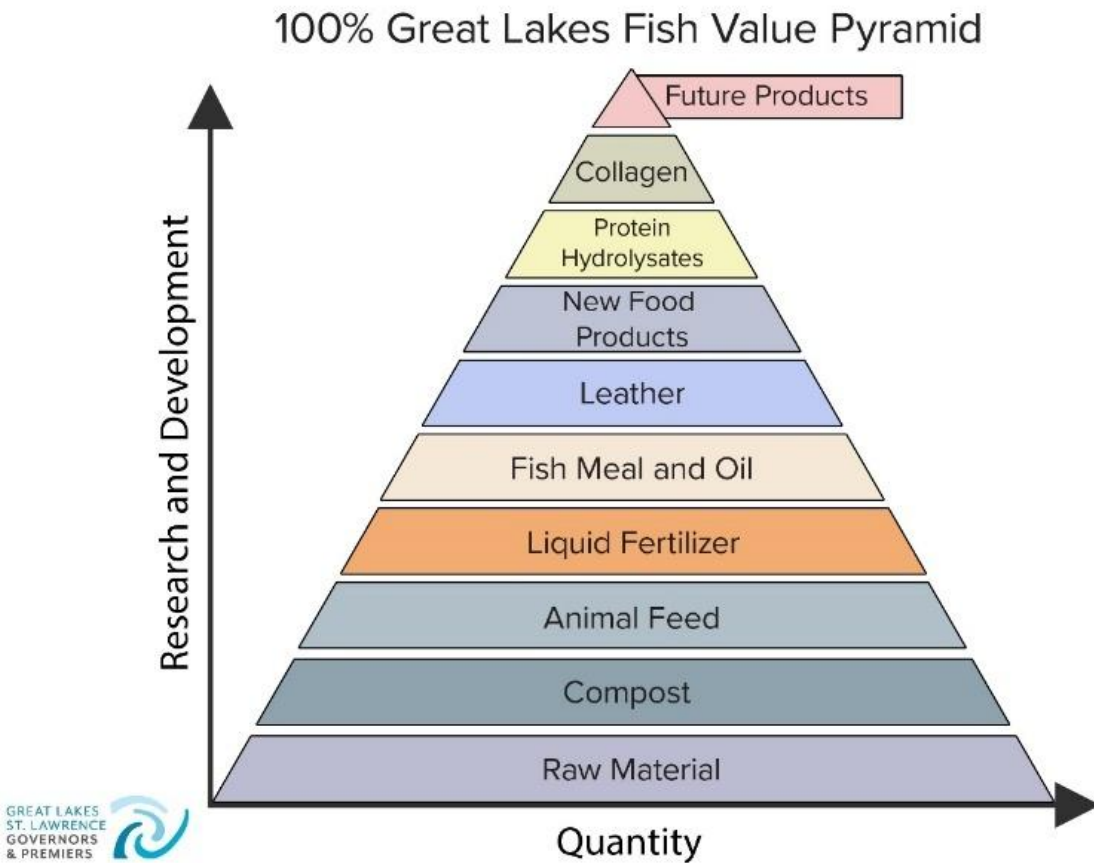
GSGP connects the 10 states and provinces that share the Great Lakes St. Lawrence region--Ontario, Québec, Wisconsin, Pennsylvania, Ohio, New York, Minnesota, Michigan, Indiana, and Illinois (Figure 1). GSGP has recognized that opportunities to increase the economic opportunities for this previously underutilized fish byproduct exist. In 2023, GSGP undertook a study for 100% fish utilization following the blueprint that was implemented through the findings of the Icelandic Ocean Cluster. Iceland, much like the Great Lakes, once discarded 60% of its fish byproduct. Today more than 90% of the cod is being used with the average product value increasing from US \$12 to over US \$5,000 per fish.

Figure 1. Map showing Lake Superior, Lake Huron, Lake Michigan, Lake Erie, Lake Ontario, St. Lawrence River as well as the surrounding states, and provinces.



This report builds on findings from the Icelandic Ocean cluster and discusses potential uses for revenue-generating industries for fish byproduct. A comprehensive analysis of potential value chains for producing compost, pet food, and liquid fertilizer has been completed to understand what opportunities exist currently for the participants in the region, and organized from least to most profitable (Figure 2, following page).

Figure 2. Fish Value Pyramid from least profitable (bottom) to most profitable (top).



Moreover, opportunities to collaborate with existing producers inside or outside the region, identification of any barriers (e.g., transportation costs), engagement with regional companies not currently involved in fish-related ventures but active in adjacent markets (e.g., bovine or porcine meal and oil), and need for new entities to fill value chain gaps were reviewed.

Potential Partner Industries

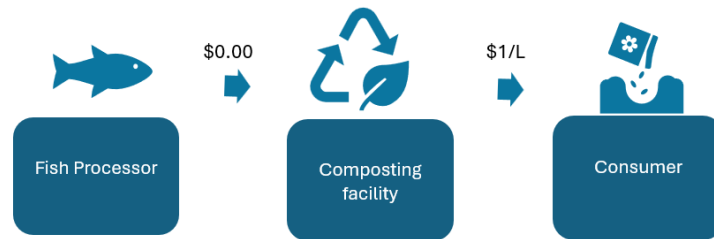
Biological material that is high in fat, protein, and nutrients is increasingly in demand in a variety of industries. The agricultural industry has a long history of utilizing byproduct products to create fertilizers and composts to improve crop yields. Animal feed for both livestock and pets has historically utilized cheap and easily available ingredients, however consumers are increasingly demanding high quality, nutritious ingredients in the food for their pets. Fish-based pet foods are well regarded by consumers for their healthy nutritional profiles, and environmentally conscious consumers are drawn to pet feed products that have sustainability certifications from the Marine Stewardship Council (MSC), Aquaculture Stewardship Council (ASC), and others.

These industries each have the potential to utilize significant amounts of the raw byproduct material produced by the Great Lakes fish processing industry, recreational fishery, and aquaculture industry. Crucially, these industries are set up to handle this material immediately, while other more complicated industries may require significant time and resources to develop the necessary infrastructure, receive the proper certifications, etc. The following section will describe three of these industries as it pertains to the potential usage of fish byproduct, providing a high-level overview of the opportunities and challenges each industry presents.

Compost

Composting is a sustainable and cost-effective utilization strategy for fish byproduct that offers environmental and economic benefits. Composting can be undertaken at any volume, if there is suitable room for the byproduct to be buried. There are two main approaches: static aerobic and anaerobic composting. Static aerobic composting involves mixing fish byproduct with wood or sawdust to create a nutrient-rich fertilizer suitable for crop growth. This is the most common type of compost, and the easiest to implement today. Based on our research, this process typically takes about nine months and boasts a 90% success rate, with the remaining 10% often compromised by contamination, such as garbage. To mitigate this issue, intermediaries can be implemented with metal detection and sorting procedures prior to composting, though this introduces additional costs to an already low-margin industry. Despite these challenges, composting is a straightforward way to repurpose fish byproduct and offset disposal costs, though it generally results in a break-even outcome at best rather than generating revenue, and in some cases may require a fee. Facilities like Derouin Composting can process large quantities of byproduct rapidly, providing an effective solution for short-notice disposal needs. Generally, the product is given to the composting facility, which also acts as the retailer to be sold to the consumer (Figure 3).

Figure 3. Supply chain overview for compost industry



While this industry is relatively easy to access, there are several barriers that exist within this value chain. The most pressing issue is the extremely small to non-existent revenue potential. Similar to fertilizer, transportation is an issue due to costs and logistics such as whether the processors or intermediaries are responsible for the cost. There is also concern with spoilage if the fish is exposed to too much moisture or not handled properly in transit. Seasonal variability is also a concern, as the winters in North America can delay starting of new composting, as well as interrupt ongoing composting. A lack of year-round supply also limits the output of composting products consistently, limiting profits and the process in the colder months. Odor and environmental concerns also exist, particularly with static composting near larger communities or public areas.

The development of re-processing facilities to decontaminate and prepare fish byproducts for composting would help to eliminate any byproduct material deemed not proper for compost or capable of being recycled for utilization. These facilities could also help to extract extra byproducts such as omega-3 oils to maximize profitability. This allows any leftover nutrients from composting to be used for pharmaceuticals or fish oils. The cost savings from composting versus byproduct disposal fees indicate composting is a cost-reducing solution in the short-term, but not a profitable long-term solution to the issue of fish byproduct. A summary of the compost industry is included in Table 1 on the following page.

Table 1. Summary of Compost industry

Product	Acceptable Raw Materials	Handling Requirements	Supply Chain Structure	Volume Capacity	Health, safety, monitoring requirements	Logistics	Players in Great Lakes region	Achievable Price (Processor to buyer)	Misc
Compost	Heads, frames, bones, skin, viscera.	Not as strict on metal detection as other potential uses, but any garbage or non-compostable material could spoil composting process. Fresher product is preferred but not a strict requirement.	Fish processor -> Composting facility -> Carbon products such as wood or wood chips are added to mixture -> Compost product after roughly 9 months	Very High Capacity Global industry utilizes hundreds of millions of pounds of raw material.	Can have a strong odour in public/residential areas. Needs to be turned consistently	Transport logistics are inconsistent and vary between free delivery, and charging for pickup. A third party for transport may need to be introduced to be profitable. May be issues with composting in the winter months.	Grand Traverse Band of Ottawa and Chippewa Indians County/municipal services Dairy Doo Morgan Composting Inc. Greener Bay Compost	Composters generally unwilling to pay anything for raw material, sometimes charge to take material.	Very limited profit potential. Comparatively easier to access in terms of handling. In some areas, funding may be available to divert byproduct from landfills toward uses such as compost.

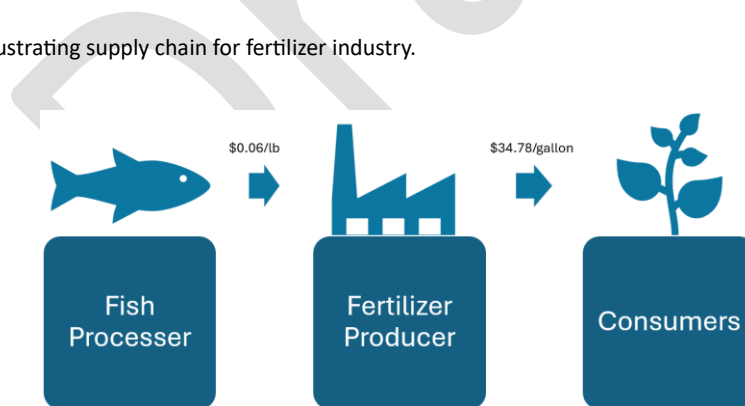
Fertilizers

Fertilizers derived from fish byproduct can come in solid or liquid forms, each possessing different quality and properties. Generally, they come in the form of emulsions or hydrolysates. Hydrolysates are produced by enzymatically cold-pressing fish, preserving the oils, amino acids, vitamins, hormones, and enzymes within the final product. This process results in a nutrient-rich concentrate with trace minerals, ideal for plant growth. Fish emulsions are typically produced using high-temperature processes that either kill or separate these beneficial compounds, leading to a lower-quality product with a lower nutrient content.

Fish fertilizers have gained popularity in recent years due to their proven ability to enhance crop output. Studies show significant improvements in parameters such as stem diameter, shoot dry weight, fruit yield, and overall quality. Both home gardeners and large-scale agricultural operations benefit from these fertilizers, which can be packaged into small containers or mass-produced for broader use.

Raw material is usually collected for a fee or no cost by the fertilizer producer or rarely by an intermediary. Once the process is finished and significant value has been added to the raw material, fertilizer can be sold for up to for \$34.78/gallon (Figure 4). A raw material intermediate within this value chain would not be feasible due to the relatively low cap on the acquisition of the material, and therefore was not included in the value chain.

Figure 4. Flowchart illustrating supply chain for fertilizer industry.



Processors often provide the fish byproduct to fertilizer companies at no cost rather than paying for it to be removed or sending it to a landfill. Although this causes issues with revenue generation, there is potential to sell the byproduct for small amounts to generate small amounts of revenue rather than paying for disposal or giving the product away. In sum, utilizing the fertilizer industry for collection is a convenient way to remove fish byproduct with minimal handling and monitoring concerns. The downside is that there is only marginal revenue potential from selling byproducts for fertilizer. Table 2 on the following page includes a summary of the fertilizer industry and its potential usage of fish byproduct.

Table 2. Summary of Fertilizer Industry

Product	Acceptable Raw Materials	Handling Requirements	Supply Chain Structure	Volume Capacity	Health, safety, monitoring requirements	Logistics	Players in Great Lakes region	Achievable Price (Processor to buyer)	Misc
Fertilizer	Heads, frames, bones, skin. Viscera.	Product should undergo metal detection before grinding. Fresher product is preferred but not a strict requirement.	Fish processor -> Fertilizer Producer -> Farms or garden supply stores	Very High Capacity 10 lbs of fish offal creates 1 liter of fertilizer. Global industry utilizes hundreds of millions of pounds of raw material.	Generally fresh product works best compared to frozen. Fresh product can spoil quickly so transportation and liquidation speed is essential	Transportation is currently an issue. There is large inconsistency with who delivers/picks up material, as well as who pays for it. Large industry players active in the region (The Andersons) Due to low achievable revenues, the cost to ship the byproduct to the fertilizer companies can become unprofitable beyond a short distance.	The Andersons AgroLiquid Hyper-Grow Fertilizer Lakeshore Ag Dramm Liquid Fertilizer	Maximum price industry is currently willing to pay for raw material from processors is approximately \$0.06/lb.	Fertilizer companies get significant amount of material for free or very low cost. Huge source of volume from chicken, cow, other livestock industries. Potential collaboration with bovine and poultry industry for the off-seasons, or for higher NPK values.

Pet Food and Treats

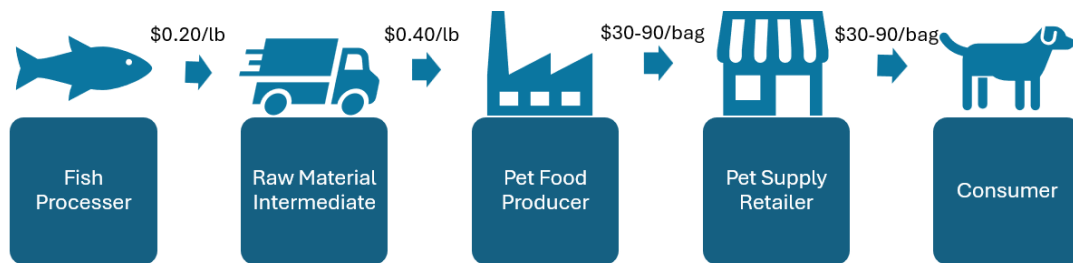
One product stream that can utilize all byproducts from fish processing is the pet food industry. Viscera, bones, skin, and heads can all be ground into a product suitable for pet consumption, typically in the form of a wet food. Currently, the most demanded species for this type of food are salmon and lake trout, as they provide a nutritional product as well as a preferred red coloration. There are also significant amounts of salmon and trout being cleaned at the various cleaning stations, and the large average size of the species results in a higher amount of byproduct being created. There is limited information regarding whether large scale pet food producers would be interested in utilizing other species from the Great Lakes, though pet treat producers have expressed potential interest.

There are several important factors to consider when sending byproduct to the pet food industry. The processing required is relatively straightforward but has several components that increase the cost of production. Grinders are utilized to turn the heads, skins, viscera, and frames into a blended material, which is then frozen in blocks. It is preferred that the product is washed to remove blood and other substances that could negatively impact freshness and shelf life. Additionally, washed product has more pleasing color, which consumers prefer over darker red, potentially blood-stained product. Only fresh or freshly frozen product is accepted, meaning that the byproduct must be frozen or refrigerated very shortly after landing. The ground material must also undergo a metal detection test prior to grinding to ensure there are no hooks or metal debris that could damage the grinders and cause injury to the animals consuming the eventual feed product. Some producers prefer to remove viscera as it can cause spoilage and coloration issues. Product with viscera has a much shorter shelf life, down to approximately 9 months. For frozen raw product this is not a major issue, however the market for raw pet food is not nearly as large and there are concerns around the safety of this product.

The supply chain for pet food is more extensive compared to fertilizer and compost. Pet food manufacturers typically purchase fish material from intermediaries that are capable of cleaning, blending/grinding, and transporting the material to the pet food manufacturing plants. This allows for the pet food producers to purchase from a single source, rather than dealing with many unrelated processors with different handling strategies, species, volumes, etc.

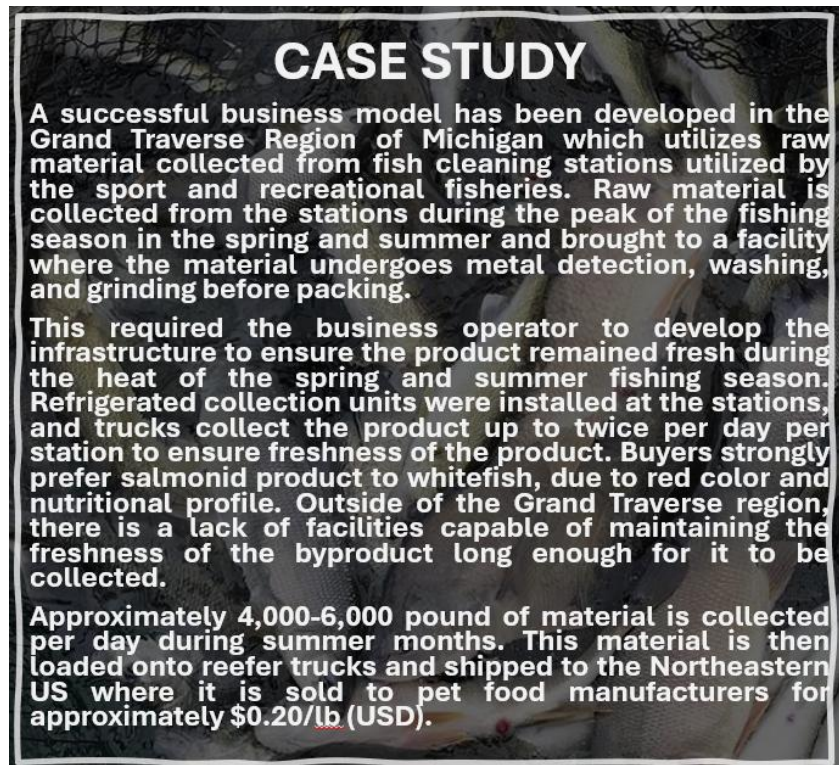
The pet food industry is relatively low margin, which constrains the upper limit of what a pet food producer is willing to pay for raw material. Comparatively, however, it represents a higher revenue generating potential compared to fertilizer and compost. Consistent, year-round volume supply of raw material is highly preferred by pet food manufacturers. Currently the maximum price that the intermediaries are willing to pay to the fish processors is \$0.20/lb (USD) for material that has been washed and cleared of metal and debris. Pet food producers will purchase for approximately \$0.40/lb (USD) from the intermediaries (Figure 5).

Figure 5. Supply chain overview for pet food industry



Consumers are increasingly interested in sustainability for their pet food products. Accreditation from the Marine Stewardship Council, the Aquaculture Stewardship Council, Oceanwise, and others is increasingly important to pet owners. Fish byproduct would appeal to the environmentally conscious consumer and may command a price premium compared to less sustainable sources of input. Producers are also increasingly interested in sustainability labeling as it appeals to their customers. Labeling indicating the location and species of the product, such as “Lake Erie Perch”, would represent a significant value add over non-descript pet food products.

Many large pet food producers such as Champion Foods have strict requirements for their ingredient sources. These companies require information on the exact origin of the raw material, including coordinates, species, etc. Some may also have concerns over bioterrorism. In general, large producers require substantial and consistent volumes from their supplies. For salmon, one company utilizes 126 million pounds on an annual basis.



CASE STUDY

A successful business model has been developed in the Grand Traverse Region of Michigan which utilizes raw material collected from fish cleaning stations utilized by the sport and recreational fisheries. Raw material is collected from the stations during the peak of the fishing season in the spring and summer and brought to a facility where the material undergoes metal detection, washing, and grinding before packing.

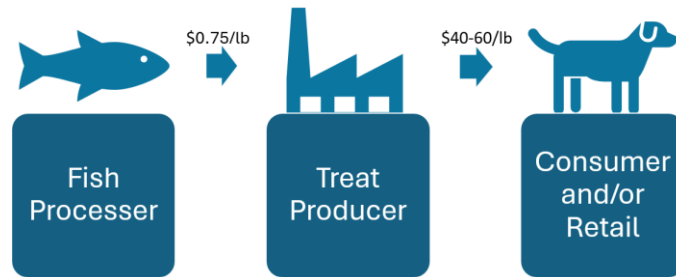
This required the business operator to develop the infrastructure to ensure the product remained fresh during the heat of the spring and summer fishing season. Refrigerated collection units were installed at the stations, and trucks collect the product up to twice per day per station to ensure freshness of the product. Buyers strongly prefer salmonid product to whitefish, due to red color and nutritional profile. Outside of the Grand Traverse region, there is a lack of facilities capable of maintaining the freshness of the byproduct long enough for it to be collected.

Approximately 4,000-6,000 pound of material is collected per day during summer months. This material is then loaded onto reefer trucks and shipped to the Northeastern US where it is sold to pet food manufacturers for approximately \$0.20/lb (USD).

An alternative product stream in the pet food industry is high quality treats and raw food. These products command a much higher price compared to canned wet food and kibble, and producers are willing to pay a significantly higher price.

Some treat producers have utilized fish material extensively to create pet treats and purchase raw material from fish processors for \$0.75-1.00/lb (CAD) freight-on-board (FOB). The product forms include ground, mixed species patties, dehydrated salmon tails, whole capelin and sardines, haddock skins, and more. These products can sell for more than \$10.00 per 100g, or approximately \$40-60/lb, representing a significant source of value to pet retailers. These high consumer prices increase the price they are willing to pay providers of raw material, but it is paramount that the raw material is in fresh condition or immediately frozen to prevent health issues in order to command a premium price. Unlike the larger wet food and kibble sector, treat producers do not purchase through intermediaries, as their operations are typically smaller (Figure 6, following page).

Figure 6. Supply chain overview for pet treat industry.



Larger scale treat operations may utilize intermediaries. Volumes for the treat industry are considerably smaller, however TFC's market research indicated that regional treat companies can utilize over 50,000 lbs of fish material on an annual basis.

While there may be insufficient demand to sell the entirety of the Great Lakes byproduct to the treat industry, even relatively smaller volumes could generate significant revenues due to the higher margins that can be achieved. For comparison, each pound of raw material sold to the treat industry is over 15 times more valuable than each pound sold for fertilizer. This represents a highly profitable supplementary source of demand to compliment the industries that have higher volume requirements.



Example of dried fish pet treat.

Case Study



A producer of premium pet food products in Nova Scotia has had success purchasing byproduct from fish processing plants in the province. This company purchases from aquaculture and wild capture seafood operations. They sell this product in a variety of forms, including whole capelin, mackerel and sardines, a seafood patty made of blended species, haddock skins, dehydrated salmon tails, and more. These products are in high demand from sustainability minded and health conscious pet owners.



This company produces over 50,000 pounds of seafood-based pet treats on an annual basis. Prices for these products are significantly higher than canned wet food or kibble, often reaching \$50.00/lb or more. These more regional producers are also less likely to utilize intermediaries, and do the metal detecting, grinding, and washing of the product themselves. As a result, the producer is willing to pay more for the byproduct, with the company in this example paying between \$0.75-1.00/lb FOB for raw material.

Refrigerated road transport is essential to keep fish products high-quality and enables the products to be transported longer distances. Transport generally consists of small, converted vans, rigid vehicles, or articulated vehicles such as semi trucks. The temperature of chilled products must be as close as possible to 0C/32F. Whether the vehicle is fully or partially loaded can affect the quality of the product throughout transportation. Type of material may also influence the effectiveness of cooling. This could affect how much product is delivered to particular value chains, and the quality of the overall product once it arrives. The higher value potential of the pet food industry means that transport costs are not as prohibitive relative to revenues compared to the fertilizer or compost industries.

Sustainability certification is highly preferred in the pet food industry, as environmentally conscious consumers are becoming increasingly concerned with traceability and sustainability of the pet feed product they purchase. These accreditation labels on products can command a price premium compared to uncertified products. The MSC and ASC labelling programs are well known and products with this labelling often command a price premium compared to uncertified products. A summary of the pet food and treat industry is included in Table 3 on the following page.

Table 3. Summary of pet food and treats industry

Product	Acceptable Raw Materials	Handling Requirements	Supply Chain Structure	Volume Capacity	Health, safety, monitoring requirements	Logistics	Players in Great Lakes region	Achievable Price (Processor to buyer)	Misc
Wet Pet Food	Heads, frames, bones, skin. Viscera optional but not preferred.	Product must undergo metal detection, visual inspection, and be filtered for debris. Product must be fresh (1-3 days refrigerated) or frozen.	Fish processor -> Intermediary Raw material processor -> Pet Food producer -> Pet Supply Retailer -> End user	Very high capacity Global industry utilizes hundreds of millions of pounds of raw material. Over 100 million pounds of salmon material utilized by one company alone annually, for example.	Variable. Large companies require extensive precautions and safety measures due to massive customer base and concerns over bioterrorism. Large producers require exact information on where product was harvested, what it is composed of, etc. Approval can take over a year. Smaller regional producers much less stringent, though safety is still important.	Intermediary companies handle transportation of product, metal detecting, visual inspection, sorting, grinding, freezing, etc. Large number of companies in the Great Lakes region, transportation should not be major concern. Business can remain profitable for intermediaries even when travelling distance. Transport raw material via refrigerated trucks.	Huron Tackle BHJ Pet Food Alltech The Peterson Company	Maximum price industry is willing to pay fish processors for raw material is approximately \$0.20/lb	Possible price premium for products labelled "Great Lake Fish", "Lake Erie Perch", etc. Preferred by environmental and health-conscious pet owners.
Pet Food Treats	Heads, frames, bones, skin, viscera	Product must undergo metal detection, visual inspection, and be filtered for debris. Product must be fresh (1-3 days refrigerated) or frozen.	Fish processor -> Pet Treat producer -> Pet Supply Retailer -> End user	Moderate capacity Regional companies can use 50,000+ lbs of fish product annually, potentially more as market is further developed	Producers prefer to know exactly where product originates. Safety is important. Producers prefer buying from trusted processors that provide clean and debris-free product.	Producers buy direct from processing plants, less likely to utilize intermediaries. Regional players more sensitive to logistical challenges, particularly small-scale operations. Transport raw material primarily via refrigerated trucks	Treats de Cuisine Great Lakes Pet Food Totally Raw (in NS, sells treats to stores in Ontario, indicated interest in Great Lakes byproduct)	Producers willing to pay processors \$0.75-1.00/lb freight on board for raw material.	High value end product generates higher margins compared to standard pet food industry. This gives treat producers more flexibility over purchase price.

Summary

Fish byproducts originating from the Great Lakes commercial fishery have only partially been utilized in an economically efficient manner up to this point. The majority of fish processors pay to have their byproduct collected, and a substantial portion is destined for landfill or compost. With the recent success of the 100% Fish initiative in Iceland, it has become apparent that fish byproduct represents a source of unrealized revenues. There is a significant opportunity to utilize fish byproducts from the Great Lakes region for revenue generating activity. Currently, there are four major industries with capacity to receive fish byproducts in the Great Lakes region. Certain industries represent higher value potential than others, while lower value industries may provide ease of access for immediate usage or be more appealing for other reasons.

Additionally, there is a supplementary source of raw material available from recreational and sport fishing cleaning stations, however there are significant infrastructure developments that will need to be made before this material can be utilized on a large scale.

Processors will need to consider these industries on a case-by-case basis depending on their own needs, location, regulation and monitoring requirements, and the species of fish being processed. Table 4 on the following page provides an overview of the advantages and disadvantages associated with partnering with each industry type to utilize fish byproducts. There are a number of companies in these industries active in the Great Lakes region, primarily located within Michigan, illustrated in Figure 7 on page 20.

Table 4. Advantages and disadvantages of each industry as a potential collector of fish byproduct.

Industry	Advantages	Disadvantages
Pet Food	<p>Comparatively high willingness to pay</p> <p>High capacity</p> <p>Intermediaries handle logistics and bulk of handling</p> <p>Wide variety of intermediaries in Great Lakes region</p>	<p>Onerous process for approval to become supplier to large pet food brands.</p> <p>Product preferred to be sorted so that viscera is removed.</p> <p>Product must be sold fresh or fresh-frozen.</p> <p>Higher risk, safety paramount.</p> <p>Sustainability labelling is highly demanded, often meaning single species raw material is preferred.</p>
Pet Treats	<p>High willingness to pay</p> <p>Take a variety of byproduct forms</p> <p>High volumes not required to be profitable</p>	<p>Significantly lower capacity.</p> <p>Handling safety extremely important.</p> <p>Limited number of players in the Great Lakes region.</p>
Liquid Fertilizer	<p>Limited safety concerns</p> <p>Will take all byproducts</p> <p>Can utilize product that is not fresh</p>	<p>Low willingness to pay</p> <p>Competing with extremely inexpensive (often free) sources of raw material.</p> <p>Regional producers reluctant to travel far to collect.</p> <p>Large scale agriculture suppliers may require higher volumes than can be provided.</p>
Compost	<p>Will take all byproduct materials</p> <p>Freshness is not a major concern</p> <p>Sorting & handling not a major concern</p> <p>Ease of access</p>	<p>Low or non-existent profit potential. Composters are often receiving raw material for free, sometimes they are even paid by producers to take material. Unlikely to pay for raw material from producers. Needs debris removed.</p> <p>Likely unwilling to travel beyond short distances to collect, so transportation burden may fall on fish processor</p>

Figure 7. Location of various companies of each industry type in the Great Lakes region. Note that this map is not exhaustive.

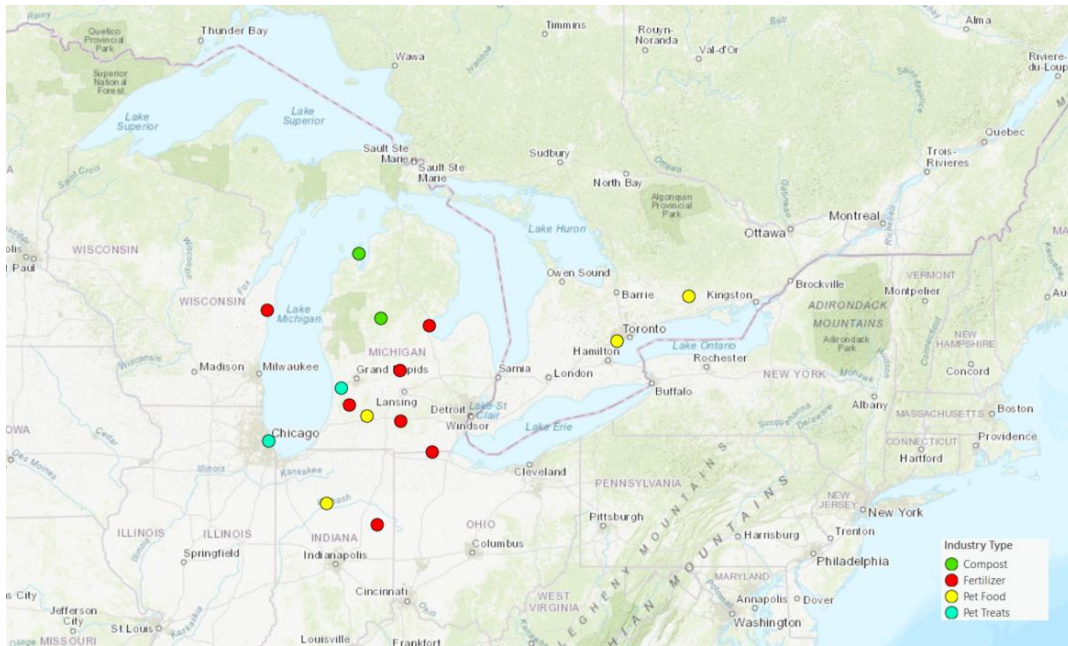


Table 5 provides a summary of the revenue and utilization potential from each industry included in this report.

Table 5. Revenue and utilization potential of fish byproduct for each industry type.

Industry	Currently achievable price received by processors (\$/lb USD)	Revenue at 10% utilization (8.9 million lbs)	Revenue at 50% utilization (8.9 million lbs)	Revenue at 100% utilization (17.9 million lbs)	Capacity for full utilization?
Fertilizer	*0.06	\$110,000	\$550,000	\$1,100,000	Yes
Compost	0.00	0	0	0	Partial
Pet Food	0.20	\$360,000	\$1,800,000	\$3,600,000	Yes
Pet Treat	0.75	\$1,340,000	\$6,700,000	**13,400,000	Partial

*This is considered to be the best-case scenario for fertilizer, and the actual achievable price is likely lower.

**Due to the significantly lower capacity of the treat industry, full utilization of the total of Great Lakes fish byproducts is not possible. This figure is meant to illustrate the high value of the product on a per pound basis and should be pursued as a supplementary source of revenue to compliment income from lower margin, higher capacity industries such as fertilizer and pet food.

On a per pound basis, the treat industry is the most valuable due to the high margins that can be achieved for premium pet treats. However, this industry is not large enough to support the nearly 18 million pounds of fish byproduct produced by the Great Lakes commercial fishery on an annual basis. The pet food industry which creates less-premium products has a much higher capacity and still offers reasonable revenue potential. These two industries should be the primary target to approach about selling byproducts. The fertilizer industry may offer a marginal amount of revenue, but \$0.06/lb (USD) for raw material is considered to be a very optimistic number, and the achievable price is likely lower than this at this time. The compost industry offers essentially no revenue potential and would likely charge processors for collection. Regardless, it may be an attractive option for selected producers.

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Appendix 1: Theoretical Map

Map of Theoretical Byproduct Data from 3-year Average of Port Landings

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