Aquaculture as a Tool for Economic Development in North America's Great Lake Basin

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Wild-caught ocean fisheries are being drained worldwide and the global demand for seafood is increasing. At the same time, domestic commercial aquaculture is underdeveloped in the Great Lakes region despite its central location within the North American market. A state like Indiana, where the state motto is the "Crossroads of America," is situated centrally in American transportation networks while also having the abundant freshwater resources of the Great Lakes basin available on its northwestern shoreline. This is a lost opportunity both in terms of economic opportunity for wealth and diversification. This research paper details how the development of an aquaculture industry in the Great Lakes basin of North America can diversify food production and increase food security in the Midwest region by examining the several stakeholders that would play a role in the industry's success.

Research Question and Methods

This report details how the development of an aquaculture industry in the Great Lakes basin of North America can diversify food production and increase food security in the Midwest region of the United States. The report answers how aquaculture can be economically viable in the Midwest and why creating a thriving aquaculture industry in the Great Lakes Basin would be advantageous for the region by increasing economic activity and food security. Research was conducted by reading trade studies, economic studies, journal articles on the aquaculture industry, scientific articles, various state and federal economic incentive programs that have an agricultural focus, as well as any proposals, studies or plans for building an aquaculture industry anywhere in North America. Some keywords that guided the research conducted include 'aquaculture,' 'agriculture,' 'Midwest,' 'food security,' 'seafood,' 'Great Lakes,' 'incentives,' and 'subsidies.' Please note that some searches combine several or more keywords into one

search or use variants or subcategories of a word. For example, some searches use ‘Lake Michigan’ versus ‘Great Lakes.’ These keywords are important because they ensure a diverse, but related, range of literature topics to factor into the analysis. These research methodologies fully complement the research question because it ensures the inclusion of a diverse range of possible articles that are related to the report. The remainder of the report synthesizes conclusions drawn from the research to create a detailed report on aquaculture being used as a tool for economic development and sustainment, as well as how that topic relates to wider trends regarding society and technology.

Background

According to the National Fisheries Service, “marine aquaculture refers to the breeding, rearing, and harvesting of aquatic plants and animals. It can take place in the ocean, or on land in tanks and ponds. U.S. marine aquaculture produces primarily oysters, clams, mussels, shrimp, salmon, and other marine fish” (NMFS, 2022). Aquaculture is incredibly flexible in how and where it is conducted. This leads to aquaculture being more environmentally friendly, logistically straight forward, and even has the possibility of being cheaper than regular fishing techniques or other ranch and farm-based animal rearing.

From a food systems perspective, consumption of meat is only projected to increase. However, an abundance of research has shown that consistent world-wide meat consumption, especially from terrestrial sources, exacerbates climate change (Carrington, 2018). Seafood is expected to play a greater role in meeting the demand for meat across the world. The National Oceanic and Atmospheric Administration expects “aquaculture to grow exponentially due to the high demand for seafood and the decline in the amount of captured wild fish each year” (NOAA, 2022) until at least 2035. Aquacultural products do not have the same high carbon costs per gram

compared to beef and pork and some other terrestrial sources of meat. Seafood can be a greener alternative at a time when some societies are looking to reduce their meat consumption due to the perceived negative environmental effects (Carrington, 2018). Worldwide traditional fisheries are decreasing in total yield due to a variety of factors that include overfishing and poor management practices. The total amount of fish produced has increased despite fish caught from the wild decreasing. Aquaculture production makes up the difference between these two categories because it has proven to be able to complement production from wild fisheries as well as provide a consistent domestic supply of seafood that is both environmentally and economically sustainable (NFS, 2022). Overall, the aquaculture industry is projected to grow for decades to come as it is a highly versatile practice. Aquaculture is a highly versatile practice and can support the production of many different types of fish (trout, catfish, salmon, tilapia, etc.), shellfish (crustaceans, mollusks, etc.) as well as some sea-based plants such as seaweed (APHIS, 2022).

Many Great Lake states are a part of the American 'Rust Belt' – a region that was once a center for industry, manufacturing, and innovation is now partly destitute due many jobs moving overseas. While the region has seen decades of economic decline it still has a proud and practical legacy of industrial agricultural success. Aquaculture can be economically viable in the Midwest and why creating a thriving aquaculture industry in the Midwest would be advantageous for the region by increasing economic activity and food security. The region's legacy can be channeled towards a new industry and provides thousands of jobs for those living in the region. With the goal of improving the access and reliability of agricultural products in different communities both in the Midwest and around the country, increased aquaculture production has a chance of success in a non-traditional area of our nation.

STS Framework

Buy-in from government and private stakeholders is essential for aquaculture development to succeed in new regions where it traditionally has not been a major industry. Success will require government and private stakeholders, government policies, private investment, general public approval, and the acquisition of several stakeholder artifacts. Some physical artifacts include seafood, aquaculture equipment, fish food, electricity, as well as general infrastructure. The only relevant non-physical artifacts include the capital that would be invested in the industry as well as the government policies, subsidies, and incentive programs that would encourage the development of the industry.

The development of a seafood industry in the American Midwest is a good example of technological momentum. According to our class's presentation, technological momentum "infers that social development shapes and is shaped by technology" (Seabrook, 2022). Furthermore, Hughes describes technological momentum as, "A technological system can be both a cause and an effect; it can shape or be shaped by society. As they grow larger and more complex, systems tend to be shaped more by society and less shaped by it" (Hughes, 1994). Technological momentum's applicability to Midwest aquaculture lies in its ability to help analyze how aquaculture technology has the potential to positively impact social and economic systems in the Great Lakes region. One critique of using the technological momentum lens is the assumption that technology (aquaculture in this case) must change the social and economic systems and will do so naturally. However, any change that would be implemented would almost certainly have a positive effect – bringing wealth and employment to an economically destitute area. Furthermore, it is unlikely that the aquaculture industry would become so dominant that it arms other industries (like the oil industry in Venezuela). While, if widely implemented, it can

drive entire careers and could become the predominant industry in a specific town, the industry as a whole would remain to be a relatively small part of the total Midwest economy.

Actor network theory specifically focuses on the different stakeholders, what interest they have in the input and outcome of the development of the industry, as well as how they can interrelate to one another (Cresswell et al., 2010). The several positive factors that would come from an expansion of the aquaculture industry around the Great Lakes is specifically related to the network component of actor network theory. There are a variety of different variables (such as government and private stakeholders, government policies, private investment) that would play into the success or decline of the industry (Tatnall & Gilding, 1999) whose side effects can best be viewed through the lens of ANT and a systems approach, where the consideration the goal of the initiative takes center view. For instance, aquaculture has been proven to be a successful tool for improving food security in Nigeria (Abiodun, 2019). In order to improve regional food security, Nigeria has subsidized and incentivized the development of land-based aquaculture fisheries in several provinces. The industry has a relatively low impact on the environment while providing an affordable, locally produced, high-quality food staple. The fisheries themselves are able to provide decent employment opportunities for undereducated men as well as creating employment for women and children through the sales of fish and other aquatic products in rural and urban markets. The improvement of aquaculture technology has made the industry affordable (with government subsidies) as well as attainable due to the educational level of many locals. Since systems are composed of people, policy, and technology ANT can be used to analyze how people and technology specialize in certain tasks as well as the relationships amongst other people and technologies.

Results

Aquaculture has tremendous potential to serve a tool for positive economic growth in developed nations. Due to advancement of aquaculture technology, communities in developed nations that have the requisite infrastructure and financial backing will be able to set up operations to farm a variety of different seafood species. The root issue that this report addresses is that communities across the American Midwest have been in economic decline over the past several decades due to a loss in manufacturing jobs from changing global markets. Aquaculture attempts to reverse this trend as it is a manufacturing-adjacent industry that requires existing infrastructure and a knowledgeable workforce (both of which the Midwest has) while providing an in-demand good. The report shows the current market is undersaturated and would possibly be a prudent time to invest in an industry in the sector. An aquaculture industry would only be able to succeed if the several stakeholders that would contribute a regional sector are able to mobilize and work with other stakeholders in a manner that benefits both parties. A lack of one of the stakeholders described below could result in a market performing at a less-than-efficient level.

Viewing Aquaculture as a Technological Fix

According to the National Fisheries Service, "marine aquaculture refers to the breeding, rearing, and harvesting of aquatic plants and animals. It can take place in the ocean, or on land in tanks and ponds. U.S. marine aquaculture produces primarily oysters, clams, mussels, shrimp, salmon, and other marine fish (NFS, 2022)." From a food systems perspective, consumption of meat is only projected to increase, as seen from Figure 1, where the meat supply between 1961 and 2009 increased at a much faster rate than the population. However, an abundance of research has shown that consistent world-wide meat consumption, especially from terrestrial sources,

exacerbates climate change (Carrington, 2018). As the climate changes, seafood is expected to play a greater role in meeting the demands for meat across the world. Furthermore, fisheries worldwide are decreasing in total yield due to a variety of factors that include overfishing and poor management practices. As seen in Figure 2, the total amount of fish produced has increased despite fish caught from the wild (the ocean) decreasing. Aquaculture production makes up the difference between these two categories. Aquaculture has proven to be able to complement production from wild fisheries as well as provide a consistent domestic supply of seafood that is both environmentally and economically sustainable. Aquaculture can support the production of many different types of fish (trout, catfish, salmon, tilapia, etc.), shellfish (crustaceans, mollusks, etc.) as well as some sea-based plants such as seaweed (APHIS, 2022). The diversity in the products produced by the aquaculture industry is projected to only increase in following decades.

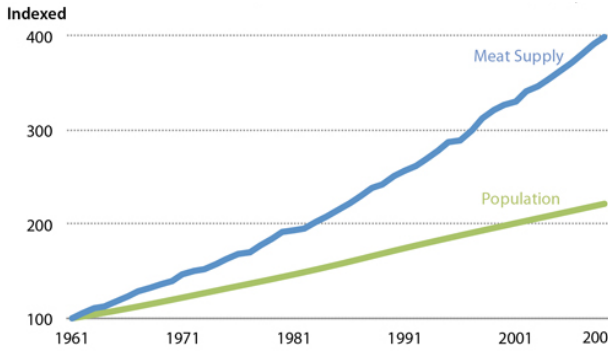

Figure 1: Growth of Population and Meat Supply (UNEP, 2022)

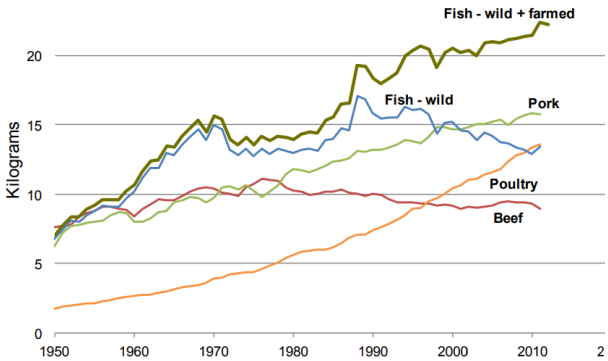

Figure 2: World Animal Protein Production, per person (Earth Policy, 2022)

According to the National Fisheries Service (NFS, 2022), there are several aquaculture techniques including:

- Hatcheries — most aquaculture fish begin their lives in a hatchery. In fact, the populations of many fish caught by traditional fishing are augmented in hatcheries, then released.
- Pond culture — one or many earthen ponds are used to culture some marine species.

- Cage culture — enclosed cages are submerged in aquatic environments. Careful protocols and monitoring help to minimize potential interactions with the environment.
- Recirculating systems — fish, shellfish, and or plant-life are raised in "closed-loop" production systems that continuously filter and recycle water and waste.
- Integrated Multi-Trophic Aquaculture — several species are raised together in a way that allows one species' by-products to be recycled as feed for another.

Figure 3: Cage Culture Aquaculture (Texas A&M, 2021)

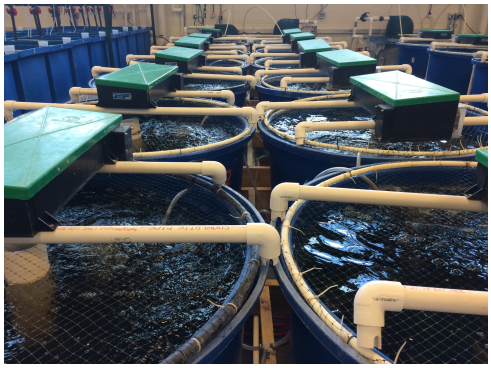

Figure 4: Recirculating System Aquaculture (Texas A&M, 2021)

Any of the aforementioned aquaculture techniques could be successfully implemented in the American Great Lakes basin if correctly operated and integrated into necessary markets. That being said, cage culture aquaculture as well as a recirculating system form of aquaculture has the most potential to achieve large scale production to ensure a profit (Masser, 2008). Cage culture aquaculture would take place in the water in any of the Great Lakes, directly adjacent to land. The most common seafood grown in a cage setting are shellfish or fish. The cage would be a rigid frame enclosed with some sort of mesh. According to Texas A&M, “the mesh retains the fish, making it easier to feed, observe and harvest them. The mesh also allows the water to pass freely between the fish and surrounding water, maintaining good water quality and removing wastes” (Texas A&M, 2021). The cage is a mostly static structure that would stay in one geographic location within the lake. A recirculating system is a land-based system that could operate directly adjacent to a body of water or dozens of miles away from the water, as long as

there is a consistent supply of water. A recirculating system consists of several large tanks of water that usually only contain fish. The fish would typically be moved from a hatchery into a recirculating system to live their entire adult lives. Both the recirculating system as well as the cage culture setups have engineered methods for processing fish waste in an environmentally sustainable manner. These relatively recently developed processes allow for aquaculture production to take place on a greater scale, enabling for an entire industry in a town or a large industrial operation at a single site. Since these advancements are relatively new, very few enterprises have begun to invest in the aquaculture industry in the Great Lakes Region. A new sector in the region would, relatively speaking, not have much competition from peer companies as compared to other regions like the Pacific Northwest, New England, or the U.S.' Gulf of Mexico coast. Technology could have a massive impact on the development of a seafood industry in the American Midwest because without modern technology it would be impossible to do aquaculture sustainability on a large scale. What drives home the technological momentum argument is the irony that a state like Indiana could become home to a massive seafood industry, with the majority of the base being located dozens of miles away from a major source of water. Indiana, or any other state, would only be able to achieve a level of success because of technological progress.

How this technological fix has worked elsewhere

Aquaculture technology has been proven to be a tool of economic revitalization and growth has been successfully implemented in several other countries around the world. Turkey is a nation determined to grow aquaculture in order to capture opportunity presented by both the current market and future anticipated demand in the Mediterranean market. In the past few decades, through sound government policy (targeted tax incentives), straightforward market

objectives (job growth above regional median salaries and an export-focused model), and scientific investment (leveraging salmon genetics and production technologies from Norway and North America), Turkey has invested in the growing aquaculture industry. Turkey targeted its aquaculture industry growth in the eastern portion of the country, where the lowest GDP per capita regions are located. Targeting a less economically vibrant region allows for the greatest return on investment from dollars invested into the industry in terms of positive and stable economic growth in the eastern portion of the country. Furthermore, a significant amount of fresh water is needed to sustain conventional land-based aquaculture operations. Eastern Turkey is flushed with fresh water sources. The Tigiris, Coruh, and Euphrates rivers all originate (and receive the majority of their intake volume) in Turkey. Turkey's natural resources ensure that the country will not only be able to sustain current investments but grow the industry for years to come. Today the sector now provides 63,000 jobs in Turkey (FAO, 2021), with the sector being further targeted, and increasing the total economic input by 1.4% annually for the next twenty years. Closer to home, the Canadian province of Ontario has advanced its aquaculture production (especially rainbow trout) primarily using cage culture in the near-shore waters of Lake Huron (Drost, 2013). Collectively this sector is contributing approximately $194 million in sales and supports 1107 full time jobs. As the sector grew, it shifted from all land based to open-water cage culture to grow out because it offers greater economic returns while also ensuring social, environmental, economical sustainably. From an environmental point of view, farms located in oligotrophic waters, have contributed to the revitalization of native species including lake trout. Ontario shows that former industrial zones also have the potential to be redeveloped for that aquaculture industry. In the Parry Sound region, water is now being revitalized from a wasteland as a result of the iron ore and steel sector production and shipping

of the early 20th century. Lake trout populations that numbered in the hundreds in the 1970s are now counted in the 100Ks, to the extent that population surveys are no longer conducted on the restored ecosystem or the populations that it hosts.

The development of an aquaculture industry in the Great Lakes would be similar to what has happened with the vitalization of the automobile industry in the Midwest. There has been dramatic growth of car plants in the region over the past five years from several different foreign and domestic companies. Many of these returning and new factories bring with them a significant number of jobs for the community. The Washington Post reported in 2022 that "Illinois, a longtime manufacturer of autos and parts, has scored some early wins in the EV race by attracting Rivian and electric school-bus and truck manufacturer Lion Electric, which is setting up a factory in Joliet that could employ up to 1,400 people" (Whalen, 2022). However, one former constant that across the board is not returning are plentiful low-skilled jobs. Instead, these factories that create new models for non-native brands are home to robots and workers who either supervise the robots of the process or conduct tasks that robots are not yet skilled enough to do reasonably efficiently. The Washington Post goes on to state "The old Rust Belt manufacturing is going to be around for quite a while, but that is not where the significant growth is going to be. It's going to be in advanced manufacturing and high-skilled labor and robotics" (Whalen, 2022). Aquaculture, in many ways, is similar to the trends with the automobile industry. Both industries require the balance of capital, resources, and the proper workforce to succeed in producing an in-demand consumable. The return of automobile manufacturing in the Midwest is proof that there is room for a well funded, well-run, and well grounded industrial sector to thrive. A major hurdle, however, for the aquaculture industry is coordinating between the multiple stakeholders of the industry. Advances in technology create

the potential to lift communities that invest in a new age of industrial agriculture to produce wealth for both the owner, the workers, and the community alike.

Actor Network Theory as Applied to Great Lakes Aquaculture

Outside investors, owners, governments, research and innovation centers, consumers, as well as the communities where the fish farms are located all play an important role in the development, operation and success of a potential industry. Each stakeholder, or actor, is linked to other stakeholders through their interests, opportunity for success, and risks assumed. These links are laid out in Figure 5: Stakeholder Network. Each actor would shape the potential industry in a way that is beneficial to themselves and to the industry. In return, the industry has the potential to shape how the social structures within communities are shaped and further developed by the industry.

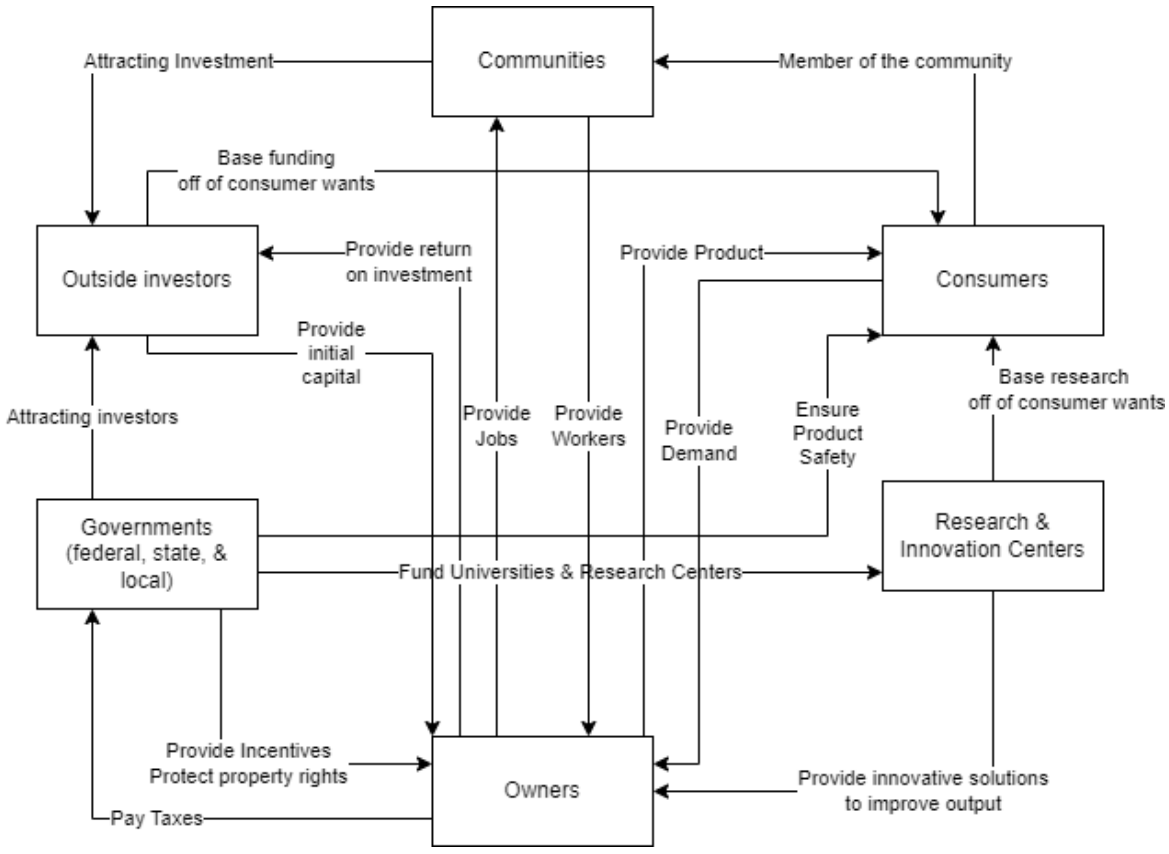

Figure 5: Stakeholder Network (Sprincis, 2023)

Outside investors would support the industry, individuals, and communities by supporting workforce development, with a commitment to a local communities' needs, interests, and capacities. This investment may include expanding partnerships, creating associated training programs and apprenticeships (that are accessible to the population that would apply for them), or stakeholder-based internships to provide relevant skills to support industry. Investors would support the viability and expansion of existing operations, as well as encourage new entrants and connect aquaculture producers, including small and medium start-up enterprises – with federal and state government programs to enhance access to investments – lending programs, insurance programs, extension services, and grants for research and development. Investors would have the resources and skills to effectively explore innovative approaches for fostering growth of early stage aquaculture companies (like private-public partnerships), new technologies for enhancing aquaculture production, and development of new products and customers (innovation incubators or accelerator programs). Investors will be incentivized to develop innovative ways to finance new ventures while still being attractive for other stakeholders like the operators of aquaculture companies, research institutions, and the local communities that fish farms are a part of.

The owners and operators of aquaculture companies and farms would work internally to attract, recruit, hire, and retain talented and diverse employees, and promote efforts for similar practices to be followed by the aquaculture industry. The prime driver to sector expansion must be commercial business committed to aquaculture or related support businesses. Support business, such as transportation and processing will need to be developed as well. While current local business could pivot to meet the fish processing needs to handle short-term growth, there will be a need for processing and input suppliers to support the sector. Firms not native to the region (either an international firm or one from the Atlatic or Pacific coasts) would likely make

up a large portion of the initial market due to their experience in aquaculture. Due to the wide variability in the products and services that a company can provide in the industry, enterprises will need to identify market segments for their area of focus. However, scholars predict that the most lucrative sub-sector will be the actual production – increasing the seafood output to meet the existing growing demand. The owners and operators are the least stable stakeholder in the network. The core production of aquaculture products and operation of the farms is the responsibility of the owners. Without the owners, many of the other stakeholders in the network become largely obsolete as their purpose is severely diminished.

The public sector in the form of legislative bodies and the executive authorities that carry out laws and regulations will play a major role in the success or failure of the economic development from an aquaculture industry. Regulations should be put in place to form a legal framework for secure investment with reduced risk. There is an argument to be made that regulations are overly restrictive, impeding aquaculture development. The U.S. Regulatory Commission describes the situation as an "increasing concern that the U.S. regulatory environment, as compared to that of international competitors, may also have contributed to the decline. More than 1,300 laws apply to U.S. aquaculture and even though the majority has been issued by individual states and apply only to specific types of aquaculture businesses in that state, the cumulative regulatory burden has increased over time" (Engle & Stone, 2013). Several organizations like the U.S. EPA and the Wisconsin Sea Grant have developed compliance manuals (EPA, 2023). A major condition of the Wisconsin manual is that any open water system would have to meet at a minimum level of expectations placed on other public natural resource utilizations like commercial timber, energy extraction, and mining operations. Permit agreements would include compensation to the public for resource utilization. Any regulation on the

aquaculture industry would be a combination of local, state and federal policies, with each enforcing laws for different parts of the industry and different areas of the region having different regulations. The opportunity exists to create regulations in the context of developing the industry. One example includes designating certain water bodies or areas for aquaculture, while other areas as preserves. Regulation is a required framework for compliance - to demonstrate and assure the proper stewardship and food safety. Fair regulations could be established by governmental agencies through partnering in various ways with industry. Making the Great Lakes a sustainable medium for aquaculture is essential for positive future economic growth. A collaborative undertaking is essential for a company based out of any state since the Great Lakes waters are shared with Canada and other U.S. states. A regional approach in support of developing a thriving, economically and environmentally sustainable industry provides a benefit to everyone involved. Federal programs surrounding the development of the aquaculture industry will likely be handled through the U.S Department of Agriculture's Rural Development agency. The mission of Rural Development is to foster opportunity and economic security for people and communities in rural America through a broad range of investments. Rural Development has already invested millions into researching aquaculture investments and the benefit those investments would have on those communities. Finally, state and local governments could utilize the success of a local aquaculture company as a marketing tool to boost further investment. The public relations impact of a rust belt state championing a sustainable industry could be positive for the state's overall image, helping to attract further investment that is both related and unrelated to aquaculture.

Centers of innovation such as engineering companies, universities, as well as some public advocacy groups will play an important role in troubleshooting technical issues of the

aquaculture industry but also researching ways to increase efficiency, and advocate for better public policy. Research investment priority should be placed on the production/supply side of the industry. Examples of research can include innovation in fish genetics (such as finding ways to incorporate other species into aquaculture or the adaptation and enhancement of species already being used for aquaculture purposes), industrial processing of seafood products, transportation of seafood and aquatic products, and better utilizing energy sources for aquaculture. A part of this endorsement could include directing state universities to conduct research projects to improve the economic viability of aquaculture in Indiana. For example, Purdue University, a major American land-grant university located in Indiana, is perfectly poised to conduct research to improve the potential of success of the aquaculture industry in northwestern Indiana. Purdue has a reputation of completing a wide variety of projects (Purdue, 2022) in support of Indiana's agriculture industry and it can be expected that they could adapt to research ways to better bring the aquaculture industry to Indiana.

Nationwide, per capita consumption of seafood is 15.8 pounds per year, far below the US Department of Agriculture's dietary recommendations of 26 pounds per year (Weeks, 2012). People in the Midwest are the least likely to consume fish, particularly fresh fish and shellfish with frozen and canned fish consumption not being fundamentally different from other regions of the country (Masters, 2011). Compared to other parts of the country, Midwesterners have less access to truly fresh fish. There could be pent up demand for fresh seafood products, and markets such as Chicago, Milwaukee, Indianapolis, and Minnestsota's Twin Cities having special potential due to their size and location. It should be noted that there is less potential in the plains and 'Western Corn Belt' where there is less of a culture of eating seafood. To overcome this trend there will need to be a period of consumers building trust with land-based or shore-based

fishing. Trust can be gained in three ways: strong branding to capture the value of aquaculture seafood and ensure ongoing reinvestment. A solid regulatory framework – one that is clear and simple – further builds trust on behalf of society. Furthermore, there is a role for a third party verification to provide market-based certification of best practices, ideally limiting the need for reliance on government regulatory agencies like the USDA.

Owners of fish farms achieving a local community's trust is paramount to the success of an operation. Earning trust involves activities to build confidence in the sector as well as the individual operator level. Community participation and buy-in is critical for initial growth and sustained success. Local communities directly interact with state and local authorities via electing representatives as well as providing the workers to provide labor for the aquaculture farms. Communities, along with more established universities and individual employers, will also be responsible for ensuring that an area's population possess the necessary skills to work in the aquaculture industry. The purpose of the technical training would be to teach the skills and knowledge of the aquaculture profession. Technical training can only be accomplished by either learning in a classroom and lab setting, by placing the students in an organization to conduct supervised practical training in the industry sector for a period of time, or a combination of the two. The training would likely need to be completed before people are allowed to work and operate on their own. Most training could likely be conducted on the job-site or at a local community center or community college. Finally, it is primarily the responsibility of communities, but also individuals and companies, to find a way to insure their economic vitality during recession. Aquaculture industries other places have been known to produce boom and bust cycles or even sector collapses. These cycles can be caused by disease outbreaks, food safety recalls, or natural disasters. Even boom cycles have negative side effects with the rapid

growth of commercial aquaculture impacting communities by leading to increased levels of debt. Disturbances in societal resilience and reduction in social capital can be associated with shifts toward high-capital intensive aquaculture.

Similar to any other government program or business venture, the research described above is not airtight, there are likely details that were not considered and assumptions that turn out to be wrong. Due to this, some information and suggestions described in the above section is likely to be incorrect. While this report went lengths to provide an accurate analysis, all future information cannot be anticipated, predicted and accounted for. The system as a whole is relatively stable, with the owner being the least stable stakeholder since they are the cornerstone of production. The stability of the system lies in both how businesses are run and protected within the United States but also due to the vast single market that is the U.S. economy. If one or more stakeholders fail the system should continue to function, albeit less efficiently. Instability of the system would only likely occur if there were mass failures of several stakeholders simultaneously to the event that surviving stakeholders were unable to sufficiently adapt. Furthermore, domestic programs run by USDA's Officer of Rural Development and foreign programs administered by the U.S. Agency for International Development shows that there is not typically a single fix-all to solve economic problems, growing and sustaining a region's wealth. Instead, sustained economic growth often takes time to mature and oftentimes is not as overwhelming as anticipated. I would like to continue this research to understand how the introduction of an aquaculture industry in the developing world (like Tanzania, for example) and the near developed world (like Bulgaria) would be beneficial for those economies. I think that just like domestic economic development, there is tremendous potential to use aquaculture as a tool of international economic development and wealth creation.

Conclusion

There is strong evidence to support the success of an aquaculture industry in the Great Lakes region of North America. The demand for buying seafood is present, the region has an industrial culture and existing infrastructure that can quickly adapt to new industrial sectors, and the region continues to have strong civic institutions to protect investment and economic success. In the long run, the significance of this project lies in its ability to improve the lives of people in the communities with an active aquaculture sector. Many areas of the Great Lakes region have been heavily affected by globalization and industrial jobs moving overseas. The scheme detailed above hopes to restore some of those jobs and return some dignity, economic independence, and vitality to the American Midwest.

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