

(1) \$2 per pound domestically produced seafood; A Grand Challenge for the 21st Century Bioeconomy in the areas of health, the environment, and agriculture:

When is the last time you bought seafood in the grocery store? Where did it come from? How much did it cost?

Although the health benefits of a diet high in seafood are well known, American consumers continue to eat far less seafood than other forms of meat. This year new dietary guidelines (published by the U.S. Department of Agriculture and U.S. Department of Health and Human Services) call for Americans to double their seafood consumption. However, even at current levels of consumption, the U.S. produces very little of its own seafood supply and other forms of meat are available to consumers at much lower prices. This is not due to any inherent inefficiency in seafood production. Seafood can be produced in low energy culture systems and cultured seafood species normally have more favorable feed conversion ratios than terrestrial species. The lack of affordable domestic product is due to the relatively new and underdeveloped nature of the domestic industry.

Looking forward, finite wild seafood stocks combined with increased domestic and global demand (fueled by both population growth and increased per capita consumption) is likely to result in even higher prices and less availability of quality seafood for the U.S. consumer.

On a global scale, the shortage of wild seafood has been met by explosive growth in the agricultural production of aquatic organisms – herein referred to as aquaculture. Commercial aquaculture production currently makes up greater than half of the global seafood supply. However, the United States has lagged behind other nations in the development of this emerging form of agriculture. U.S. consumers have access to quality, safe, and affordable sources of red meat and poultry, raised in the U.S., under U.S. food safety and environmental regulations, yet only 5% of the seafood consumed in the U.S. is a product of domestic aquaculture. The U.S. represents one of the world's largest seafood markets (second only to Japan), but 86% of that market is supplied by imports, approximately half of which are foreign aquaculture products, contributing to a national seafood trade deficit which recently surpassed \$10 billion per year.

Aside from issues of availability and price, U.S. consumers may avoid seafood due to concerns regarding the source, safety, and sustainability of seafood products. Although most of the seafood available to U.S. consumers is safe, there are valid concerns associated with seafood that has been harvested or farmed under less than adequate regulatory oversight. Such concerns would be addressed by the domestic production of seafood, under U.S. environmental and food safety oversight.

Any plan for building a 21st Century Bioeconomy should include the development of a sustainable domestic aquaculture industry that will be large enough to reduce the nation's seafood deficit, add jobs to the U.S. economy, and provide consumers with a quality, safe, and affordable supply of healthful seafood.

In 1980, the passage of the National Aquaculture Act made it this nation's policy to support the development of domestic aquaculture. However, 31 years after the passage of the act, the U.S. has made important contributions to aquaculture innovation, technology, and environmental management; but has failed to take a leading role in production. A modest domestic aquaculture industry has emerged, but not on a scale that can successfully compete with the lower cost of foreign production.

The U.S. demand for seafood is likely to continue to grow, and it is in the best interest of public health and the national economy to produce a greater proportion of that seafood domestically as part of the emerging 21st Century Bioeconomy.

A large scale domestic aquaculture industry will provide the following benefits:

- Benefits to the American consumer – Nutritious and affordable seafood. Clear understanding of the source, security, quality, and safety of U.S. farm-raised seafood.
- Benefits to the U.S. economy – A domestic aquaculture industry on the scale of other meat production industries in the U.S. would provide thousands of jobs in production, support, and scientific discovery. Such development would also be consistent with the objectives of the White House Rural Council to strengthen rural communities and promote economic development
[<http://www.whitehouse.gov/administration/eop/rural-council>]
- Benefits to the environment – One of the world's largest seafood markets would become significantly less dependent on faltering wild fish stocks and on under-regulated foreign aquaculture. Additionally, many forms of aquaculture produce positive ecosystem effects (e.g., Oyster culture can restore degraded habitat and remove excess nutrients from the water column). Furthermore, a successful, competitive U.S. aquaculture industry would set the best practices standards for the rest of the world to follow.

Many of the funding sources that currently support domestic aquaculture development have been, or are likely to be, dramatically reduced in the current budgetary climate. The development of a large scale, competitive aquaculture industry in the U.S. will require commitment and decisive action by the Federal government, companies, academic institutions, non-profit organizations, and others, in the following specific areas:

Seafood species selection and development: The animals used in terrestrial agriculture today have undergone centuries of selective breeding, making them more efficient and productive. Because large-scale aquaculture is a relatively recent form of agriculture, there is still the opportunity to select and develop the most appropriate species for culture. Federal research in the area of selective breeding should be funded at higher levels because genetic improvement of aquaculture species has the potential to dramatically increase productivity, and there are few commercial operations that have the resources to maintain a selective breeding program.

Feed research: Feed comprises a large portion of production cost for any animal species. The same is true for aquatic species. Currently aquatic animal feed relies heavily on fish meal, harvested from wild fish populations, as a key feed ingredient. Since the amount of fish meal available from the wild is a finite and is dependent on fluctuations associated with wild populations, the cost of fish meal is a potential limiting factor for aquaculture production. Additionally, if increased aquaculture is to realize its potential to reduce pressure on faltering wild stocks of fish, alternatives to fish meal need to be developed for use in aquatic animal feeds. Terrestrial plants such as soybeans have shown promise as a partial replacement for fish meal, especially for some species of fish. Perhaps even more promising is the use of aquatic algae – the natural source of fish nutrition, in synergy with biofuel production. Every new feed ingredient needs to be approved by the Food and Drug Administration. The process for this approval requires substantial resources that are often beyond what is practical to spend on an approval for the relatively small U.S. aquaculture feeds market. Federal research should be focused on identifying, testing, and approving fish meal replacements for aquaculture feeds. The National Oceanographic and Atmospheric Administration and U.S. Department of Agriculture recently produced a draft document that outlines potential steps to address this issue. [<http://aquaculture.noaa.gov/news/feeds.html>]

Aquatic Animal Health: Aside from feed, another major cost associated with intensive animal production is the prevention and cure of infectious disease. Because aquatic animal husbandry is relatively new when compared to traditional agriculture, there is still a lot to learn with regard to aquatic disease agents and host species biology that might impact the productivity of domestic aquaculture. Developing the necessary diagnostic tools, drugs, and vaccines is an expensive proposition that is not justified by the current size of the U.S. industry. Federal effort should focus on developing the tools, knowledge base, and infrastructure needed to monitor, mitigate, treat, and control aquatic animal diseases.

Regulations: Adequate regulation of domestic aquaculture is critically important. A domestic industry would be of little value if consumers can not be certain that the product is of high quality and was produced in a manner that is safe for human consumption and for the environment. In many cases inefficient, confusing, overlapping, and/or undeveloped regulations are a hindrance to the expansion of U.S. aquaculture. The Federal government should make it a priority to critically evaluate its regulations regarding aquaculture, and address regulatory inefficiencies. States should be encouraged to do the same. Such an effort would be consistent with the January 18, 2011, Executive Order regarding Improving Regulation and Regulatory Review [<http://www.whitehouse.gov/the-press-office/2011/01/18/improving-regulation-and-regulatory-review-executive-order>].

Statistics: It is difficult to understand past, current, and future directions of the domestic aquaculture industry without accurate production and market numbers. The Federal government should track and publish this information through its National Agricultural

Statistics Service. Recent cuts in the census of U.S. aquaculture are inconsistent with the nation's aquaculture policy.

Financing: Due in part to the lack of a clear regulatory climate and the difficulties associated with defining the market, aquaculture startups can have trouble obtaining financing. The Federal government should consider ways to make funding more readily available for properly vetted aquaculture projects.

Information: The U.S. consumer is exposed to many conflicting messages regarding the safety and sustainability of wild, farmed, foreign, and domestic seafood. The result seems to be general confusion and apprehension regarding seafood consumption. The Federal government should provide a source of clear and unbiased information for the consumer. Especially as it pertains to specific consumer concerns (e.g., mercury content, PCBs, and overfishing).

An interagency aquaculture coordinating group, under the Office of Science and Technology Policy, meets on a quarterly basis to better coordinate on aquaculture issues. The group is composed of members of federal agencies with roles in the development and regulation of aquaculture, and is currently proposing a Research and Development Strategic Plan to address these and other issues associated with U.S. aquaculture. Federal support of the Research Plan would be an important initial step toward meeting the proposed challenge.

Meeting this grand challenge - \$2 per pound domestically produced seafood - would be a monumental achievement and would dramatically affect the way Americans eat. It would give the U.S. consumer the option to consume seafood in the same way that they now consume chicken breast- or ground beef, and could have important public health benefits. Importantly, it would also be a sign that U.S. aquaculture production is a large and thriving part of the nation's economy, and that the U.S. is a world leader in the industry. It would mean that one of the major seafood markets of the world is no longer dependent on the harvest of imperiled wild seafood stocks or on the low cost production methods of developing countries. As long as high regulatory standards are maintained, it would mean that safe, high quality seafood can be produced in a sustainable manner, without sacrificing the health and function of the environment. This is an attainable challenge. However, the benefits of success would be incremental. If the effort results in the domestic production of \$4 per pound, or even \$6 per pound seafood, this is still a significant win for the U.S. consumer, the U.S. economy, and the environment.