A Macdonald-Laurier Institute Publication

MLI

True North In Canadian Public Policy

Commentary

April 2013

Hungry For Change Series

The Blue Revolution:

Why Canada Needs to Do Better at Farming the Seas

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Introduction

The amount of food that will be consumed in the next 50 years will exceed all the food eaten in the rest of human history. World demand is on the upswing, driven by rising population, urbanisation, and rising global incomes.

Yet the world's doubtful ability to respond to that growing demand is ringing alarm bells everywhere. After a half century during which the Green Revolution produced a huge spurt in food production, the rate of population growth is overtaking the rate of growth in food production. Follow these two trends to their logical conclusion: if we do not find ways as a planet to rise to this challenge, major food shortages and humanitarian disasters are just a few short years away.

As a result, food prices are rising across the world, and those able to feed the world's teeming billions will not only do a service to humanity, but will make a good living doing so. In agriculture and food, including aquaculture, it will be not only possible but imperative to do good by doing well.

Canada has everything needed to fill a major share of the gap in the world's supply of food. We have vast tracts of agricultural land and our soil is in much better shape than many other major food producing nations. Our climate is clement and climate change is likely to make it even more so. Our supply of fresh water, a major constraint on other farming powers, is the envy of the world. We have one of the longest coastlines in the world with which to develop aquaculture, as well as huge numbers of bodies of freshwater. And we have clever, educated, and experienced people in every part of the sector: farmers, technologists, researchers, managers, processors, manufacturers, and more.

Yet despite the scale and scope of the opportunity, Canada is not merely failing to take advantage of these propitious circumstances – our share of world food markets is declining and our food productivity is falling far behind that of our peers, such as the US and Australia.

The Four Factors of Prosperity

To understand prosperity for the food industry, including aquaculture, we need to take a step back for a moment and ask, what it is that creates prosperity wherever it is to be found, including in aquaculture? There are four things that, when brought together in just the right proportions, cause economic progress, whether in aquaculture or mining or manufacturing or any other field. These four things are:

- Human intelligence and energy;
- properly functioning rules and institutions;
- capital; and
- opportunity.

Canada is full of bright, energetic, innovative, hard working, creative people. But in some cases we have equipped them with the other three factors of prosperity, or economic progress, and in others we have not. This Commentary will describe the difference between when we got it right and when we got it wrong. Aquaculture is one of those places where we have got it wrong.

CAPITAL

Capital unlocks opportunity. The world's supply of oil is not limited chiefly by the amount of oil in the earth's crust. It is limited by the amount of capital we deploy to seek and develop that resource. The supply of oil in the world is a direct function of capital investment. The supply of food falls into the same category. The supply of food will respond in exactly the same way to the intelligent application of scarce capital as the supply of other products such as oil, automobiles, computers, and televisions.

While capital is certainly not unlimited, there is a huge amount of it sloshing about in the world looking for reasonable returns. The amount of investment capital in the global fund management industry increased 10 percent in 2010 (the latest data point) to reach a record $79.3 trillion.[1] So this global pool of capital increases by roughly $7 trillion to $8 trillion a year. As a point of comparison, the capital intensive oil sands need a microscopic 0.14 percent of that annually to continue their development. The oil sands will get that money because there is a decent return to be made in bringing bitumen to a world hungry for energy.

Yet aquaculture and many parts of the agri-food industry cannot attract the capital to unlock the value the industry could create. In fact, in food processing, capital investment in recent years has been less than depreciation. In other words, we are not merely not increasing our investment, we are actively pulling our capital out. By 2012, investment in our fishing industry had fallen below $100 million for the first time since 1985.[2] That is not because there is a shortage of capital; but because we have not created the conditions in which it is worthwhile to invest that capital in aquaculture.

OPPORTUNITY

So if the problem is not human energy and creativity, which we have in abundance, and not a shortage of capital available in the world, there must be a problem with one of the two other factors needed to create prosperity: either the opportunity must be lacking, or there must be something wrong with the rules and institutions under which we are operating.

Focus first on the real opportunities we face. Of the 7 billion people in the world, only about half now live in cities. By 2050, according to the UN, the world's population will have increased by 2.3 billion, whereas the population of the

world's cities will increase by 2.6 billion. So all the world's population increase over the next 40 years will take place in cities, and another 300 million people will move from rural areas to the cities.

The effect of urbanisation on workers' incomes in the developing world is startling. Workers in cities earn 33 percent more than their nonurban counterparts. Every time you add another million people to a city's population, you increase the wage level of everyone living there by 15 percent, so the growth is self-reinforcing.

Look no further than this for the explanation of the explosive growth of cities throughout the world and especially in the developing world. This is why places like Manila, Shanghai, Mumbai, Buenos Aires, Mexico City, and Cairo will have 20 or 30 or 40 million people each in them and why Paul Romer says that any city of less than 10 million will be a global backwater.[3]

Not only is urbanisation driving rising global prosperity, but rich city dwellers eat differently – and usually better – than their rural counterparts. Dollar for dollar, city dwellers eat more food, and especially more processed foods, than their country cousins. They also tend to be richer and able to afford pricier food, such as meat, fish, and seafood. So protein demand will rise strongly.

In other words, rising global incomes and population will increase demand for food and the composition of the average person's diet, but the entirety of the population increase will take place in cities where these new populations will be unable to supply much of their food themselves. Food demand will increase, but there will be fewer people in the countryside.

These trends help to explain rising food prices and declining stocks of food relative to demand, leaving the world's food system more vulnerable to shocks, because the buffer stocks on hand are lower. We are leaving an era of food surpluses and entering a world of food shortages with massive implications for humanity and the planet.

There is, therefore, a huge challenge to improve our ability to produce food.

So far, though, the discussion of the challenge of feeding our teeming billions has focused on the land. Nothing could be further from the truth. Already in 1973 Jacques Cousteau proclaimed we must farm the sea as we farm the land. The reasons are clear. A little simple math: food from the sea (both animals and plants) accounts for a tiny 1.5 percent of humanity's food supply. And yet water covers seven-tenths of the earth and, with a little coaxing from human effort and ingenuity, those waters can and should be a source of much greater plenty for humanity.

The analogy with land based farming is strong: if we depended solely on the unorganized bounty of nature to feed us, humanity would be a shrivelled shadow of its current self. Imagine if instead of raising millions of cows on the prairie through organised human effort, we were limited to the protein we could get from hunting a declining wild buffalo herd.

The planet only supports so many billions of people because we learned how to make land super-productive, and with an ever smaller ecological footprint.

The Blue Revolution

The so-called Blue Revolution, taking food production off the land and into the waters of the globe, is already well advanced. Aquaculture is the fastest growing source of food in the world at the moment. We stand astride the moment when aquaculture production is finally overtaking the "wild fishery" as the largest source of protein from the sea, just as in the distant past animal husbandry eventually overtook hunting as the primary source of meat and other animal products.

This has created a worldwide industry that is struggling mightily to satisfy a powerful human need. Global demand for seafood is increasing by almost 10 percent a year. A fifth of humanity finds its main source of protein in fish, and those people are concentrated disproportionately in the developing world. By 2020 the UN's Food and Agriculture Organization (FAO) foresees a shortfall of 50 million metric tonnes in our ability to supply the world's demand for food from the sea.[4]

Improving the way we raise animals for human consumption (including aquaculture, which is clearly not fishing but a form of livestock farming) is every bit as important as improving crop farming because of protein's growing share in the world's diet.

Since the 1980s livestock production has far outstripped that of cereals. World meat output more than doubled between 1980 and 2007. Production of eggs rose even more. We expect aquaculture to be supplying half the fish and seafood protein consumed in the world in a few short years.

Much of this increase is due to changes in the way we raise animals. For sheer efficiency, there is little question that industrial approaches to raising livestock do a better job than traditional methods. A free-range hen scratching around might lay one or two eggs a week. Feeding her costs nothing, giving a net gain of 50-100 eggs a year. A battery chicken will lay six eggs a week. She might cost the equivalent of 150 eggs to feed, producing an annual net gain of 150 eggs. Selective breeding has made her more economic to keep. Battery chickens used to need 4 kg of feed for 1 kg of eggs; now they need only 2 kg of feed.

Moreover, it is almost impossible to scale up a farmyard operation: there are only so many insects to eat, and only so many hens one family can look after. And to breed the most productive hens, which convert their feed most efficiently into eggs and are most resistant to disease, you need large flocks.

Beyond these advantages, genetic science is improving breeding dramatically. It allows breeders to select traits more precisely and thus speeds up breeding by reducing generational intervals: if you know which genetic traits an animal has, there is no need to wait several generations to see what breeding produces.

Returning to aquaculture, according to the FAO it is the fastest growing animal protein producing sector, with per capita supply increasing at an average annual growth rate of 6.6 percent. Total global aquaculture production reached 73 million tonnes in 2009, up more than 600 percent from 9.9 million tonnes in 1984.

Between 1970 and 2008, the worldwide production of food fish from aquaculture increased at an average annual rate of nearly 10 percent, while the world population grew at an average of less than 2 percent per year.

So in the context of our narrative about looming food shortages and the world's declining ability to feed itself, aquaculture is a good news story. And yet for the last decade in Canada the industry has at best just marked time, while other producers in New Zealand and Norway and Scotland and Chile have raced ahead. Why?

Rules and Institutions

The opportunity that is driving our natural resource boom is exactly the same opportunity that we do not seem able to capitalize on in the agri-food sector, especially but not exclusively in aquaculture. To return to the four factors of prosperity, we have no shortage of human energy, there is no shortage of capital to match to good opportunities in the world, and there could hardly be a better opportunity facing us and our productive capacities than the need to feed an increasingly numerous and ravenous humanity.

That only leaves one factor that might explain our lack of progress: the rules and institutions under which we operate. To explain why that is the right answer, this Commentary returns to what explains the huge success of our

natural resource economy and contrast that with the rules and institutions that hobble aquaculture's development to this day.

Many people say that Canada is a lucky place. Why? Because of its fantastic endowment of natural resources, including coastline, water, and agricultural land as well as minerals, oil, and gas.

But the **real** reason Canada is lucky, and the reason why the world beats a path to our resources, is not chiefly due to the resources themselves. What makes that endowment almost uniquely valuable in the world is that it exists within another vastly more important endowment of rules, institutions, and behaviours in Canada.

Consider that many of the world's wealthiest societies, be it Switzerland or Japan or Singapore or Taiwan or many others, have few natural resources to speak of.

On the other hand, economists often talk about the curse of natural resource wealth because many of the societies that are blessed with such wealth do not know how to manage it. Like many a lottery winner, they are ruined by their good fortune. Just think of Nigeria, Venezuela, Indonesia, Angola, Algeria, Russia, or Saudi Arabia and ask yourself if you would trade living where you are to live there. Surely most people would answer no.

The natural resource curse is not limited to the developing world. Louisiana has one of the best natural resource endowments in the United States, yet consistently ranks near the bottom of all the states on most measures of social and economic progress. On the other hand many of the wealthiest states in the union, such as Massachusetts, Connecticut, and Florida have no natural resources to speak of.

What makes the difference? It is mostly due to the endowment of institutions and behaviours. In Canada, we generally have the full set of institutions and behaviours that, as a matter of empirical and historical fact, confer economic success. Many of these Harvard historian Niall Ferguson summed up in his recent book *Civilization*[5] as the six killer apps of western democracies.

These entail: the rule of law, independent judges and reasonably speedy and reliable resolution of disputes, the enforcement of contracts, the absence of corruption among government officials and the police, respect of private property, moderate, predictable, and stable taxation and regulatory burdens, public policy based predominantly on reason over emotion, a stable currency that keeps its value, responsible public finances, freedom to trade both domestically and internationally, a well developed work ethic, and a refusal to resort to violence to resolve political disagreements. These are the greatest endowments that we have.

Note that many (although not all) are conditions that are created by public officials, through law, regulation, and standards of public behaviour. These are powerful tools we possess to create the conditions in which wealth can be generated.

Consider the idea of nesting a rich natural resource endowment inside the endowment of rules, institutions, and behaviours just described. Companies can invest billions of dollars to unlock opportunities, such as the oil sands, reasonably secure in the knowledge that they know the fiscal, regulatory, and contractual conditions they will face over a period of years sufficient to recoup their investment and make some money. They know they will not be extorted by megalomaniacal presidents or state sanctioned gangs of thieves. They know their investment will not be nationalized overnight on a change of regime. They know that they are not in competition with favoured state corporations who will take a share of their business with no compensation, or who will be given access to opportunities on more favourable conditions than foreign investors. They know they can sell their product wherever they can get the best price and they can repatriate their profits in real hard currency.

Contrast this with Venezuela, Russia, Iran, or Argentina, to pick only a few examples.

This may all help you to understand why, while it costs about $20 to extract a barrel of oil in Saudi Arabia and about $80 to extract one from the oil sands, oil companies from around the world are vying for the opportunity to invest and develop that resource here. Its institutional context makes it more valuable.

But this institutional and behavioural endowment is not settled, immutable, and final. On the contrary, it is constantly evolving, sometimes for the better, sometimes for the worse. It evolved for the worse, for instance, when the Alberta government decided to change the rules for many companies in the middle of the game, after billions had been invested on the basis of what companies thought were stable and clear regulatory and tax conditions. This relatively small adjustment in the rules drove companies to invest next door in Saskatchewan's oil patch, where then Alberta premier Ed Stelmach quickly became known as the best economic development minister Saskatchewan had ever had.

By contrast, the rules have been changed for the better recently, with the federal government's announcement of a streamlining of environmental and regulatory rules for the approval of major natural resource infrastructure projects. They have grasped, at long last, the perishable nature of the opportunity afforded by the resource boom and decided that it was indispensable that the regulatory framework should respond at the speed of real life.

INSTITUTIONAL OBSTACLES TO THE GROWTH OF AQUACULTURE

It is precisely the absence of several aspects of the institutional endowment just described that make our aquaculture resources highly undesirable as a place to invest.

Secure property rights and stability of the regulatory regime were key in unlocking the long-term capital investment that has created such wealth elsewhere for Canada in natural resources. This is exactly what is lacking in aquaculture.

Aquaculture should be every bit as synonymous with Canada as wheat or beef, given the enormous length of this country's coastline and the world-class expertise in fish farming that exists here. Instead, we are literally treading water.

The Canadian aquaculture industry has stagnated in recent years, with production varying only slightly between 155,000 and 175,000 tonnes over the past decade. If anything, total production was slightly lower in 2010-2011 than in 2000-2001. While average annual rates of growth in the industry for the rest of the world continue to be 6 percent or more, Canada's output has fallen outright. So this is a clear case of Canada failing to live up to the natural and human endowment we enjoy.

Perhaps the most important obstacle to changing this state of affairs in aquaculture is an antiquated system of property rights that makes little distinction between wild fish that are gathered in the open ocean and those that are farmed. The result is that fish farming is overseen by the same federal government department, Fisheries and Oceans (DFO), that also governs the wild fishery, instead of by a department such as Agriculture or Industry, where it more properly belongs. As one critic put it, the government's oversight of aquaculture is analogous to "a chicken farm being managed by the Migratory Birds Act."[6] An example of the issues arising from this situation is the aquaculturists who have been penalized for harvesting their stocks outside the season prescribed for the wild fishery, even though the domesticated stocks existed not because of nature but because of the efforts of human beings.

The second obstacle to the growth of aquaculture is the nature of government in Canada. The minister in charge of the department that oversees aquaculture is, like all politicians, highly motivated by political concerns – particularly the desire to be re-elected. Accordingly, he or she is vulnerable to pressure from special interest groups who do not necessarily have the interests of the aquaculture industry at heart, including some conservationists, environmental groups, commercial fishermen, Aboriginal peoples, recreation and tourism interests, and waterfront property owners. Indeed, such groups may be actively hostile to fish farming, and the campaigns they wage against it have a harmful effect on aquaculture policy.

Again, in this there is little that separates aquaculture from the rest of the agri-food business. One can make the case that had we not invented agriculture in humanity's ancient past but were seeking to do so today, we would not be allowed to invent it. Moreover, there are parts of the environmental movement that are essentially opposed to the use of animals to feed people, and they consider any and all tactics to be permitted in what they consider a moral crusade. The loftier moral crusade, however, is the one required to maintain, let alone improve, our ability to feed the 9 billion plus people we will have living on the planet in less than 40 years.

In the case of aquaculture, no matter what fish farmers do to keep their stocks healthy and which responsible methods they use to increase production and reduce the ecological footprint of fish farming, environmental activists point to their use of veterinary drugs, or to genetic modification, or to the presence of miniscule amounts of pollutants to charge that farmed fish are dangerous.

Securing Aquaculture's Future in Canada

The solution to the problems that Canadian aquaculture faces involves five strategies, in my view. First, establish the same private property rights in aquaculture that exist in agriculture. That means giving the fish farmer ownership of the means of production and exclusive rights to the profit gained from his or her use of those means. If outright ownership is not possible, the alternative should be to issue high-quality leases and licences for a sufficient length of time to encourage investment in water quality, equipment, and fish health.

Remember that in natural resources in Canada, as a general rule, companies do not own the resource until they have pulled it out of the ground and paid a royalty to the resource's owner, the province. Companies still invest for the long term, rather than the "dig and run" mentality that prevails in many developing countries where companies are always a target for rapacious politicians and aggrieved minorities. Our experience proves that not owning the productive resources outright need not be an obstacle to success, as long as security of tenure and tradeable long-term access on a non-discretionary and non-arbitrary basis are available.

In concert with establishing those secure tradeable property rights, the government needs to apply to aquaculture (and economic opportunity more generally) the lesson it has learned from other resources about the perishable nature of opportunity. Capital does not wait indefinitely to find out if you want to deploy it. Opportunities do not wait on the whims of bureaucrats. Time is money, and regulatory uncertainty is one of the worst ways in which a society's endowment of institutions can let down the search for prosperity rather than supporting it. In aquaculture, for example, that means clear objective rules about site approvals and a tight deadline for decision-making.

Second, we must separate government oversight of aquaculture from that of the wild fishery. Ideally, this would involve creating a separate, fully competent, independent government agency to regulate and support aquaculture. A less comprehensive alternative would be to create an independent unit within the Department of Agriculture.

Third, we must replace politicized decision-making with objective cost-benefit analysis in disputes concerning aquaculture. Bureaucrats and politicians, under pressure from environmental activists, apply the precautionary principle to the point of paralysing decision-making within DFO. Instead, an institutionalized, economics based process, independent of any competing special interest, should objectively analyse and inform both the bureaucracy and the courts about the development effects of their decisions with respect to fish farming.

Fourth, we must reform the regulatory approach to food in general and aquaculture in particular. Canada's regulatory system is slow, cumbersome, and inefficient. It discourages the adoption of new technologies at the farm level and in food processing. It discourages food companies from developing new products that can provide health and other benefits to consumers. It is, in a word, an oppressive blanket on innovation in the food sector that not only discourages investment, but drives it out of the country and it removes any opportunity for Canada to be an early adopter of technology in this area. It should be the subject for immediate and substantial reform aimed at

simultaneously providing healthy products to Canadians and encouraging innovation and efficiency in the food supply system.

Finally, Canada suffers from serious tariff and non-tariff barriers in reaching markets that demand Canadian products. In other words, there are markets where consumers demand products made in Canada but trade barriers stand in our way. Nothing illustrates the importance of market access better than the Canadian pork industry. Millions of dollars in public funds were invested in a money losing industry during the past five years that declined by about 14 percent, even as worldwide demand for its products was dramatically increasing. Despite being a low-cost producer, we cannot sell our high-quality product in Asian markets where high prices indicate unsatisfied demand.

Expanded and secure market access is the solution for not only Canada's pork industry but the entirety of the agriculture, aquaculture, and agri-food sector. But we need to reform our own thinking about food and agricultural trade to achieve this. We need to stop giving up so much of our international trade negotiating power to protect a few small supply-managed sectors that serve only a tiny domestic market, and instead use our negotiating power to open up the international opportunities in foreign markets. Our grain farmers recently won this freedom. It is imperative that we not stop there, but integrate all of our food producers into that web of international rules and institutions that are part of the institutional endowment that confers success in Canada.

If we were to achieve all, or even just a major part, of this ambitious programme, Canada would be well on its way to being the world food superpower it is capable of being. We would begin to wring from the waters the same bounty of food and of prosperity that our land has yielded for generations. Canada also would make a disproportionate contribution to solving the urgent conundrum of how to keep mass hunger from again stalking humanity.

This Commentary is adapted from keynote speeches given by Brian Lee Crowley to the Aquaculture Association of Canada's annual conference on May 28, 2012, in Charlottetown, PEI and the Canadian Aquaculture Industry Alliance's 2012 National Forum on November 20, 2012 in Ottawa, Ontario.

Endnotes

1 See "Size of the global fund management industry" under "Investment management" on Wikipedia.com. Available at http://en.wikipedia.org/wiki/Investment_management#Size_of_the_global_fund_management_industry.

2 Statistics Canada. 2012. Table 031-0002 – *Flows and stocks of fixed non-residential capital, by North American Industry Classification System (NAICS) and asset, Canada, provinces and territories, annual (dollars)*, CANSIM (database).

3 Paul Romer. 2012. "Charter Cities as a Model for Growth and Governance" (lecture, Ottawa Economics Association in partnership with the Macdonald-Laurier Institute, April 25).

4 Food and Agriculture Organization of the United Nations. 2010. *The State of World Fisheries and Aquaculture 2010*. United Nations. Available at http://www.fao.org/docrep/013/i1820e/i1820e00.htm.

5 Niall Ferguson. 2011. *Civilization: The West and the Rest.* New York: Penguin Press.

6 Brad Hicks. 2001. "Fish Farming is Farming not Fishing." *Northern Aquaculture*, August.

About the Author

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