



# POLICY BRIEF

## CAN FISH DRIVE DEVELOPMENT OF THE AMAZON BIOECONOMY?

*Expanding Amazon fish production can greatly reduce pressure from cattle-driven deforestation, while providing a healthy, land-sparing, low-carbon source of protein to regional and international consumers. It gives cattle producers and communities a way to diversify income and secure food supplies. Production of fish through aquaculture also requires 30 times less land and emits just 3-5% of the carbon released through an equivalent volume of beef. Fish is deeply embedded in the culinary traditions of the Amazon, and it is the dominant form of animal protein traded globally, with demand growing more rapidly than beef. Current fish production (8% of beef production) has already reduced the demand for 38,000 km<sup>2</sup> of new deforestation— and could be far larger if the right measures are taken now.*

**AUTHORS** McGrath, D. G.<sup>i,ii</sup>,  
L. Castello<sup>iii</sup>, M. Brabo<sup>iv</sup>, D. Nepstad<sup>i</sup>,  
S. da Gama<sup>v</sup>, B. Forsberg<sup>vi</sup>, E. Mendoza<sup>i</sup>,  
G. Estupinan<sup>vii</sup>, A. Ribeiro<sup>i</sup>, O. T. Almeida<sup>viii</sup>,  
A. J. Bentes<sup>ix</sup>, C. Chan<sup>i</sup>

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- <sup>i.</sup> Earth Innovation Institute, 98 Battery Street, Suite 250, San Francisco, CA
- <sup>ii.</sup> Federal University of Western Pará, Santarém, PA, Brazil
- <sup>iii.</sup> Virginia Tech, Dpt. of Fish and Wildlife Conservation, Blacksburg, VA
- <sup>iv.</sup> Federal University of Pará, Bragança, Instituto de Estudos Costeiros, Pará, Brazil
- <sup>v.</sup> Federal University of Western Pará, Santarém, Pará, Brazil
- <sup>vi.</sup> Vermont Department of Environmental Conservation, Montpelier, VT
- <sup>vii.</sup> Wildlife Conservation Society, Brazil
- <sup>viii.</sup> Federal University of Western Pará, Santarém, Pará, Brazil
- <sup>ix.</sup> Sociedade para a Pesquisa e Proteção do Meio Ambiente, Santarém, PA, Brazil





## EXECUTIVE SUMMARY

- Cattle production is the main driver of Amazon deforestation; beef and chicken have displaced wild-caught fish as the main source of protein for the Amazon population beginning in the 1980's.
- Fish is now making a come-back and could become a pillar of the region's bioeconomic development path, greatly reducing the demand for new deforestation.
- A fish-based bioeconomy is also a socially inclusive economy; Indigenous peoples, traditional communities, smallholders and corporate producers are already participating.
- Amazon aquaculture production is now equivalent to about 8% of the region's beef production, with a much smaller land and carbon footprint; the annual production of a ton of beef requires 16 hectares of pastureland, 32 times more than the annual production of a ton of fish.
- The sustainable management of Amazon floodplain lakes by Indigenous and traditional communities have also seen major increases in production. Also, fisheries productivity increases with forest cover. More forest, more fish.
- Global demand for fish is far greater than the demand for beef, and is growing more rapidly, representing an important market opportunity for Amazon farmers and communities.
- *Challenges:* While the potential of aquaculture and managed fisheries is enormous, there are substantial obstacles to overcome, including: 1) low quality and limited availability of data on the sector, 2) the low productivity of Amazonian aquaculture varieties and production systems relative to non-native species (e.g. tilapia), 3) regulatory bottlenecks, and 4) rudimentary supply chain infrastructure.
- *Opportunities:* These challenges can be overcome through public and private investment in breeding programs for native Amazon species, marketing strategies, regulatory reform, contract farming arrangements, and formalization of fish supply chains. There are also significant opportunities to integrate robust, user friendly tech-based solutions to overcome Amazon logistics.
- *Conclusion:* The transition to a diversified, forest-friendly Amazon bioeconomy can be achieved through a long-term strategy to build a modern fish sector that is driven by regional and global market forces. This transition is feasible through collaborations between producers, researchers, companies, investors, government policymakers and civil society organizations.



## 1. INTRODUCTION

Since work began on the Trans-Amazon highway in the early 1970s, Amazon deforestation and its impacts on biodiversity and climate have been a central concern of conservationists and governments the world over (1). Despite enormous effort and billions of dollars, deforestation driven by beef production continues its relentless advance across the Amazon basin. Nearly fifty years on, 17% of the Brazilian Amazon forest has been cleared (788,516 million km<sup>2</sup>) with an equivalent area degraded through fire and logging, releasing 0.5 billion tons of CO<sub>2</sub>eq to the atmosphere (1% of global total) each year (2).

Frustrated with the endless struggle to maintain deforestation on a declining trend, there is growing interest in alternative land use strategies with minimal impacts on tropical forests. Aquaculture offers a credible alternative to beef and already has the potential to offset Amazon deforestation. Aquaculture and managed fisheries are far more efficient than Amazon beef production with comparably lower greenhouse gas (GHG) emissions (Fig. 1). Furthermore, fish is the dominant form of animal protein traded globally, and global trade in fish is growing more rapidly than beef (3). Rather than punitive measures that merely seek to constrain the expansion of beef production, a fish-based development strategy can harness Amazon farmers' enormous potential to drive aquaculture development, providing a critical complementary strategy to the command-and-control strategies that have been the focus in recent years.

Here we present the case for a long-term strategy that seeks to shift Amazon production towards a more diversified rural economy in which fish play a progressively larger role. This process is already underway. Brazil is developing a dynamic, modern aquaculture sector that is expanding across the Amazon,



driven by soy and beef producers and other farmers interested in diversifying their production strategies (4), and by locally managed fisheries that integrate scientific and local knowledge to increase the productivity of the Amazon's floodplain fisheries (5). Together, fish from managed fisheries and aquaculture could play a central role in developing the diversified, forest conserving bioeconomy of the future (6).

## 2. POTENTIAL OF FISH AS A LOW EMISSION ALTERNATIVE

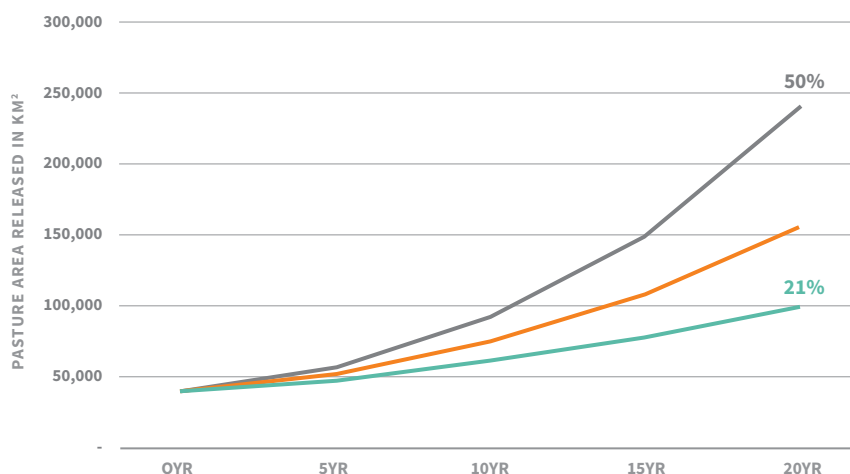
There are three main benefits of a fish-based regional development strategy.

**2.1 GHG Emissions and the hydrological cycle:** The reduction in demand for land associated with a transition to fish would reduce GHG emissions to only 3-5% those of conventional beef production (7). Production of an amount of fish equivalent to total 2017 Brazilian Amazon beef production could help to conserve biodiversity, expand Amazon forest cover and increase forest evapotranspiration, ensuring the functional integrity of the hydrological cycle that sustains the Amazon ecosystem (8).

**2.2 Land use efficiency:** In terms of land use, aquaculture is far more efficient than beef. Production of one ton of beef requires 16ha on conventional, extensive pasture and 4ha for semi-intensive beef, while conventional Amazon aquaculture requires only half a hectare (Fig. 1). Shifting production from beef to fish could release up to 90% of the area in pasture for reforestation and tree based production systems.

**Figure 1.** Area needed to produce one ton of beef or fish with today's prevalent production systems





**Figure 2.** Three Scenarios for 2017 Amazon Pasture Area Released for Reforestation as Amazon Aquaculture Develops: 2020-2039

Data Labels: Percent of total 2017 pasture area released by aquaculture production after 20 years

#### AQUACULTURE GROWTH RATE

- 10%
- 7.5%
- 5%



A comparison of the total area in aquaculture today with the amount of land required to produce an equivalent amount of beef illustrates how incremental increases in aquaculture can have significant impacts on deforestation and forest cover. For example, total aquaculture production of the Legal Amazon today is about 8% that of beef (9). The area required for this level of fish production, is approximately 38,000km<sup>2</sup> smaller than that required for the same amount of beef. This is equivalent to total Amazon deforestation over the last five years (2019-2015). Figure 2 shows hypothetical trends in the area of pasture released by the development of Amazon aquaculture based on growth rates of 5%, 7.5% and 10%. Here, depending on the level of investment and government support, aquaculture development over a 20-year period could release between 21% and 50% of the area in pasture in 2017 for forest-friendly land use alternatives.

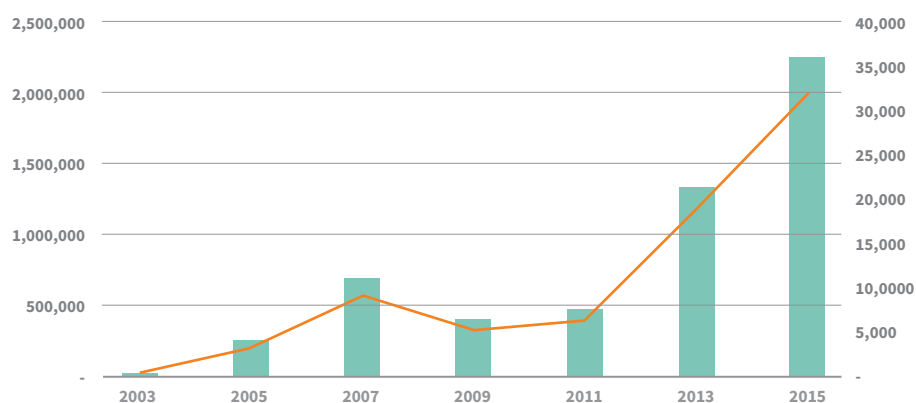
**2.3. Fish as a driver of change in the Amazon rural economy.** Fish, especially aquaculture, has the potential to drive a bioeconomic development strategy. While Amazon deforestation is driven primarily by beef, fish is more important in global markets and is growing more rapidly (FAO database). Increasing meat consumption as global incomes rise, combined with rising consumer interest in healthier, more sustainable sources of animal protein add to this positive outlook for fish (10).

Aquaculture is growing steadily in Brazil and in some regions is developing modern, vertically integrated aquaculture clusters that are increasingly able to compete in global markets (11). Rondônia is one of the top three aquaculture producers in the country and most other Amazon states are investing in aquaculture as a driver of rural development (12). The state of Amazonas leads in the sustainable development of its fisheries. Combining scientific and local knowledge, managed fisheries here are reaching scale, led by growth in the sustainable management of the pirarucu (*Arapaima spp.*), an important, high value commercial fish species (Fig 3). More generally, comparative studies show that with effective management and government enforcement, annual harvests from the Amazon's floodplain fisheries could be many times higher and more valuable than current unmanaged harvest levels would indicate (13).

### 3. FISH, SMALLHOLDERS, TRADITIONAL COMMUNITIES AND INDIGENOUS PEOPLES

Fish could be the basis for an inclusive bioeconomic development strategy that embraces smallholders as well as traditional communities and Indigenous people. Well-organized, small-scale producers are leading aquaculture development in some of the highest producing aquaculture states in Brazil, including Paraná and the Amazon state of Rondônia (4). Aquaculture has





**Figure 3.** Growth in managed pirarucu production Amazonas State: 2003-2015.

(Sources: IBAMA Amazonas: Managed Pirarucu Database)

been widely promoted in the Amazon as an economic alternative for smallholders. Results have been variable due mainly to inadequate program design, rudimentary supply chain infrastructure and deficient government support. Contract farming arrangements in which companies provide high quality inputs, technical support and market access is a promising strategy that can provide the reliable, market oriented technical assistance that small-scale producers need and governments rarely provide.

Traditional and Indigenous communities, supported by science-based NGOs and research institutions, are leading the development of sustainably managed fisheries throughout the Amazon (14). The growth of managed pirarucu production in traditional and Indigenous communities in Amazonas state is the result of this partnership. The vast Amazon floodplain has enormous potential for sustainably managed wild fisheries. With effective government support and equitable producer company partnerships the sustainable management of floodplain fisheries could be expanded throughout the Amazon floodplain. Furthermore, by taking advantage of the positive relationship between forest cover and fishing productivity (15), local management organizations can develop both managed fisheries and managed forests, “fish orchards”, producing fruits and nuts for fish, as well as fast growing Amazon timber species for local markets, improving the incomes and livelihoods of hundreds of thousands of families in traditional and Indigenous communities throughout the Amazon (16).

#### 4. TRANSITION TO FISH

A study of aquaculture in Mato Grosso found that an important factor in farmers’ decision to invest in aquaculture was interest in diversifying farm production (17). The study found that farms that invested in aquaculture were 15% less reliant on beef production. This suggests that an effective strategy for promoting the transition to aquaculture is to offer incentives to encourage commercial and small-scale farmers to invest in aquaculture. As these farmers gain experience



in commercial aquaculture production and become increasingly competitive in national markets, they will be well positioned to expand aquaculture operations under favorable market conditions.

A core aspect of the incremental expansion of aquaculture as a strategy for reducing and mitigating Amazon deforestation is that rather than coercing farmers to stop clearing forest and forgo the income from new pasture, aquaculture provides strong incentives for farmers to shift from beef to fish on already cleared land. The high productivity of land use under aquaculture enables producers to comply with Brazil’s Forest Code and meet market sustainability demands, while diversifying production and increasing farm income. Through this process, aquaculture can harness the enormous productive capacity of the Amazon’s commercial and small-scale farmers to progressively reduce the total area in pasture while expanding aquaculture production and forest-based production systems.

## 5. CHALLENGES TO DEVELOPING A FISH-BASED STRATEGY

While the potential of aquaculture and managed fisheries is enormous, so are the challenges that must be addressed to develop this potential (11). These include: 1) Low quality and limited availability of the data needed for fisheries and aquaculture policy and investment decision-making, 2) The lower productivity of Amazonian aquaculture varieties and production systems compared to producers elsewhere in Brazil who farm higher productivity exotic species such as Tilapia, 3) Regulatory bottlenecks that contribute to low compliance and high rates of informality, and 4) Rudimentary supply chain infrastructure that increases costs and reduces the quality of fish delivered to markets (18).

## 6. INVESTMENT OPPORTUNITIES

Many of these challenges also represent potential investment opportunities for private sector involvement in developing a fish-based strategy. Both managed fisheries and aquaculture offer investors the opportunity to simultaneously contribute to the Amazon's development, conservation and social objectives, generating employment and improving livelihoods while conserving Amazon forests. There are significant opportunities for developing modern tech-based solutions that are robust and user friendly to overcome the challenges of Amazon production and transport logistics.

**Aquaculture:** Aquaculture has been widely disseminated in the Amazon, especially in colonist settlements, mostly without the technical assistance and supply chain infrastructure needed to produce efficiently and access national markets. Here there are opportunities for private sector investment in fish processing and transport logistics, and in companies that develop contract farming arrangements with producer groups. With such support, colonists can invest in fish production and reduce reliance on low productivity cattle ranching, the main driver of smallholder deforestation.

**Improved varieties for aquaculture:** A top priority is the development of high productivity domestic varieties of Amazon fish species. There is a number of promising candidates for domestication, and investment is urgently needed to fund research to develop high productivity varieties of these native species, as well as the feed and production systems they will require. Through such investments in the modernization of Amazon aquaculture, producers will become increasingly competitive and better able to harness growth in demand for Amazon fish to drive aquaculture development.

**Managed fisheries:** Private sector investment in contract farming could play a strategic role in developing the

potential of the Amazon's floodplain fisheries. Encourage Capital's investment strategy is an example of such an approach (19). Through investment in companies buying fish from local management organizations and in modernizing local processing capacity and supply chain infrastructure, investors can contribute directly to lowering pressure on forests while developing the productive potential of Amazon fisheries to drive the development of the Amazon bioeconomy.

**Fish & Carbon Finance:** Aquaculture and managed fisheries provide important opportunities for carbon finance mechanisms. As an animal protein with a very small carbon footprint and high scalability, fish produced through aquaculture and managed fisheries could figure prominently in the low-emission rural development strategies that will soon be verified through the California Tropical Forest Standard.

**Marketing Strategies for Amazon Fish:** There is huge marketing potential for Amazon fish, especially with climate-conscious consumer groups. Marketing strategies aimed at national and international consumers can highlight the role Amazon fish play in conserving forests while supporting traditional communities and Indigenous peoples.

## 7. CONCLUSIONS

The growth of aquaculture and sustainably managed wild fisheries opens up new possibilities for Amazon development that are far better suited to the agro-ecological potential of the basin than the cattle-based production systems that now dominate the region. The transition from beef to fish will depend on a long-term strategy that starts by building the foundations for the development of a modern fish sector capable of engaging global market forces to drive development of Amazon fish production. As shown earlier, incremental increases in Amazon aquaculture production can play a critical role in reversing the loss of forest cover and averting an Amazon "tipping point".

It should be remembered that the future of Amazon beef production was not at all guaranteed in the 1970s when large-scale, government subsidized expansion of cattle ranching began (20). The current beef sector is a product of decades of collaboration between producers, researchers, companies, investors, government policymakers and civil society organizations. Through these kinds of collaborations, formal and informal, we can create conditions that support a large-scale transition from beef to a diversified, forest-friendly Amazon bioeconomy, in which fish play an increasingly important role in driving rural development. Through this process, the Amazon can cease to be a major threat to the earth's climate and biodiversity and become an increasingly important part of the solution.

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