

Sustainable Alternative Livelihoods in Madre de Dios

A Pilot Study on the Valuation of Artisanal Mining, Brazil Nut
Harvesting, and Fish Farming Livelihoods

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A report led by

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About the Authors

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TABLE OF CONTENTS

Introduction..... 2
Methods 4
Results 6
Artisanal, informal and small-scale gold mining:..... 6
Brazil Nuts:..... 8
Organic Certification:..... 11
Fair Trade Certification:..... 12
Fish Farming: 13
Exploring Micro-Credit for Fish Farms: 17
Discussion 17
Conclusion 20
Works Cited 21



INTRODUCTION

The southwest Amazon, located in the Tropical Andes Biodiversity Hotspot (Myers et al., 2000), remains a relatively intact wilderness that hosts some of the world's highest levels of terrestrial species endemism and diversity (Critical Ecosystem Partnership Fund, 2000), important cultural diversity including over 40 ethnic groups as well as indigenous peoples in voluntary isolation (Bennett and Mulongoy, 2006), and globally important stocks of carbon. Many of these critically important resources are located in Madre de Dios, Peru, and the Peruvian government has established several protected areas to safeguard these resources. However, weak governance, rapid and unchecked migration of people to the area, unsustainable resource use, and inadequate funding drive and amplify threats and pressures faced by protected areas across the Peruvian Amazon. This results in high value protected areas with important vulnerability to external threats and encroachment, such as mining and road construction, with low capacity to respond and effectively manage these immense areas of contiguous forest. Lands adjacent to the protected areas, or buffer zones, are even more complex, with many overlapping and conflicting land-use rights, little-to-nonexistent law enforcement, and lack of land-use planning.

In Madre de Dios, and particularly in the Tambopata National Reserve and its Buffer Zone, illegal gold mining is the principal threat to intact forested

landscapes, followed by illegal logging, agricultural expansion, and road construction. The drastic increase in the price of gold during the first two decades of this century has caused a boom in small-scale illegal and informal alluvial gold mining that has remained rampant (Webster, 2012). Population growth, migration for gold mining, and lack of proper land-use planning has driven expansion of poorly-planned settlement in the Tambopata National Reserve buffer zone. According to Peru's National Institute for Statistical Information, the population of migrants in the region has more than doubled in the past 30 years (INEI 2014). These new populations hold different cultural and economic ties to the area than the indigenous populations, resulting in rapid and dramatic changes to the mosaic of economic uses of land in the area, and the introduction and expansion of a cash-based economy.

In this context, communities – both migrant and indigenous alike – face the dilemma of how to generate income from natural resources in the area, as well as who should have access to which resources and where. From both a conservation perspective and a sustainable development perspective, a second dilemma in the area is how to incentivize sustainable economic activities when the informal economy (illegal gold mining and illegal logging) offer comparatively lucrative returns on seemingly modest investment. The natural question that follows is whether and how

alternatives to those activities might be able to provide equivalent returns in cashflow and income, or some other set of returns (economic stability, mitigation of natural hazards, provision or safeguarding of ecosystem services, etc.) that can outweigh the incentives of unsustainable resource use.

The answer to those questions is important for the landscape as a whole, as well as for protected areas in the region whose purpose is to safeguard ecological integrity. While unsustainable livelihoods drive much of the forest loss in the landscape, they also have deleterious indirect impacts. In addition to the forest fragmentation that has resulted from the economic and demographic changes in the region, a political narrative has developed that views protected areas as barriers to economic growth, a belief reinforced by anti-conservation rhetoric employed by several in the regional political class. At the same time, many indigenous communities and some of the more recent migrants embrace a conservation ethic. The result of these changes is that current land uses include reforestation concessions, Brazil nut concessions, ecotourism concessions, indigenous community territories, and smallholder agriculture, alluvial and small-scale mining, logging, and non-timber forest product harvesting.

While many of these land uses are compatible with a sustainable and intact forest landscape, others are not. Outside of mining and logging, the most profitable economic activities in Madre de Dios,

particularly in the buffer zone of the Tambopata National Reserve, are agroforestry-based cacao production, brazil nut harvesting and fish farms. Strong potential markets exist for each, but these have yet to achieve their full potential and face strong obstacles. For instance, a major challenge is to prevent agroforestry-based cacao from transforming from a sustainable economic activity on degraded lands into a driver of deforestation. The main economic barrier for fish farming is the high price of fish food, which is imported from Lima, and obtaining ongoing technical support. A major obstacle to further expansion of conservation-friendly economic activities in Madre de Dios is the lack of political voice and participation for small farmers and producers' associations as a major economic force in the region. Achieving a higher profile for these endeavors as viable, valuable economic activities could generate more interest from other people and communities seeking economic alternatives to destructive activities such as mining, logging, and unsustainable agriculture.

Unfortunately, the actual livelihoods and economic returns from any of these activities are poorly understood by stakeholders in the area including policy makers, civil society organizations, and local residents themselves, with actors operating on assumptions that may or may not be accurate. One of the most widely held assumptions is that mining offers the highest returns with relatively low investment compared with other activities.

However, little work has been done to calculate the actual wages and cashflow associated with various economic activities and their value chains. It is therefore difficult to know whether alternative livelihoods can in fact be as lucrative, viable, or attractive as unsustainable activities for the average resident of Madre de Dios. Understanding the economic aspect of these various activities is essential in order to uncover ways to promote the ecological health of the landscape while guaranteeing economic stability and achievement of the Sustainable Development Goals for the local populations.

In order to explore these issues, we undertook a pilot study of livelihoods associated with three of the predominant economic activities in the buffer zone of Tambopata National Reserve: artisanal gold mining, brazil nut harvesting, and fish farming. We did not examine in detail larger and more mechanized small-scale gold mining or other activities including logging, industrial agriculture, or agroforestry. The question we ask in this study is whether the two potentially sustainable land uses can provide economic returns that can match or exceed the returns from mining. In order to address our research question, we explore the following hypotheses:

H₀ – Small scale and artisanal or informal mining provides higher wages than either fish farming or brazil nut harvesting as individual activities for the average person

H₁ – Fish farming and brazil nut harvesting practices can be modified sufficiently to equal or surpass wages from artisanal or informal mining, either as individual activities or as components of a mosaic of livelihood choices

While this study is intended only as an initial pilot experiment and not an exhaustive and thorough assessment, it demonstrates a useful approach to understanding how alternative livelihoods should be conceptualized in order to make them more attractive to populations that may or may not be inherently conservation oriented.

METHODS

We used a multi-method approach to assess the viability of alternative livelihoods that both leveraged intact forests and were economically comparable to artisanal, informal, small-scale and illegal gold mining (collectively referred to as ASGM) in the Madre De Dios (MDD) region of Peru. We began with a desk study, which included a comprehensive review of the literature as well as an analytical re-assessment of existing data. We used findings from the desk study to create an interview guide for subsequent qualitative interviews with experts and field work (focus groups and site visits) with practitioners. This allowed us to corroborate and triangulate all data used in our final analysis.

The first phase of the desk study reviewed existing primary and secondary sources of data that examined the current livelihoods in MDD, particularly in the Buffer Zone area. ASGM was the most commonly cited livelihood. Of all others that allowed for or required intact forests (brazil nut harvesting, fish farming, agroforestry, logging, eco-tourism, and cash crops such as cacao), brazil nut harvesting and fish farming were determined to have comparable economic returns to ASGM. The second phase of the desk study focused on obtaining primary and secondary data to quantify the cost structure, supply chain, and the size of the markets for livelihoods of a brazil nut harvester and fish farmer. Our goal was to qualitatively and quantitatively compare inputs, returns, and impacts of all three livelihoods.

The desk study was followed by qualitative interviews with experts at the United Nations Development Program (UNDP) in Lima, US Consulate in Lima, SERNAP (Servicio Nacional de Áreas Naturales Protegidas) at the Ministry of Environment in Lima, and project and program managers at ACCA (Asociación para la Conservación de la Cuenca Amazónica) in MDD. Interviews with experts were conducted in their respective offices, either in Lima or in MDD, in English or Spanish, whichever language was most comfortable for the expert. When the language of the interviews was Spanish, native speakers translated to ensure all researchers understood the content.

Our goal for interviews with experts was three-fold: First, we sought to confirm the validity of the economic data and trends obtained from our desk study. Second, we sought a deeper understanding of the local socio-economic and environmental context in which to ground our focus groups and site visits. Finally, we wanted to understand the economic incentives as well as the environmental and social consequences of choosing to informally mine (or not mine) as a livelihood. Our interview with UNDP helped us corroborate the potential environmental contamination caused by mining, specifically from the use of mercury, and the implications for sustainable national growth. Similarly, ACCA helped us understand the socio-economic tradeoffs, local norms and expectations. SERNAP officials clarified issues of land usage and rights, challenges to enforcement of legal rights, and barriers to entry and some market size data for alternative livelihoods. Mining permit and labor related data, as well as some cost data gathered during the desk study phase was verified with economic and country experts at the US Consulate.

Field work consisted of focus groups, site visits, and qualitative interviews with brazil nut harvesters and fish farmers. Focus groups and interviews were conducted at the ACCA offices while site visits occurred on the premises of the practitioners. Due to issues of safety, we were unable to speak with informal miners directly. We obtained IRB permission for the focus groups, which were conducted in Spanish,

the primary language of the practitioners. Native speakers simultaneously translated the conversations, which were also recorded (without any identifying features and with permission). Recordings were translated by native speakers for use by researchers. To ensure consistency between interviews two interview guides were developed – one for fish farmers and the other for brazil nut harvesters and their associations. The interview guides are attached as appendices and can be used as templates for future endeavors like this.

Our field work had three main goals: First, to map the supply chain for each of the two alternative livelihoods considered in the desk study. Second, to gather practitioner level-data, including costs of inputs, prices and profits sufficient for an evaluation of the alternative livelihoods as economically viable options for informal mining. Third, understand the barriers to entry and other factors that prevented the alternative livelihoods from being more prevalent in the MDD area. Field interviews also gave a firsthand account of the impact of ASGM on the local environment as well as the local socio-economic context. Focus groups helped us understand the experience of local populations who had chosen an alternative livelihood, including threats to their economic security. Site visits were essential to observe operational conditions and constraints, supply chain issues, and explore options for enhancement of the livelihood.

RESULTS

ARTISANAL, INFORMAL AND SMALL-SCALE GOLD MINING:

Using publicly available data from the Ministry of Mining, global reports from the World Bank, and academic literature, we estimate that Peru produces 6.8% of the world's gold, making it the 6th largest producer globally (Wang, 2016). Of the 212 tons of gold mined in Peru in 2015, over one-quarter is mined informally by individuals or small groups of 2 to 5 people (Wang, 2016). We distinguish between mining that is small-scale (organized with 10 or more individuals who mine, usually legally, on an area of between 1,000 and 2,000 hectares), artisanal (individual or small group of 2 to 5 people who legally mine on land totaling less than 1,000 hectares), and informal (individual or very small groups mining on small tracts of land typically without a full permit). Our review of publicly available data and literature identified that there is little to no formal or legal artisanal mining in MDD – all artisanal mining in the province is therefore informal. We use both artisanal and informal interchangeably throughout this text, much as the terms are used in MDD.

We focus on the informal mining in MDD, which totals nearly 45% of the total informal mining in Peru, and may, by some estimates, employ as many as 180,000 to 280,000 miners (Swenson, Carter, Domec

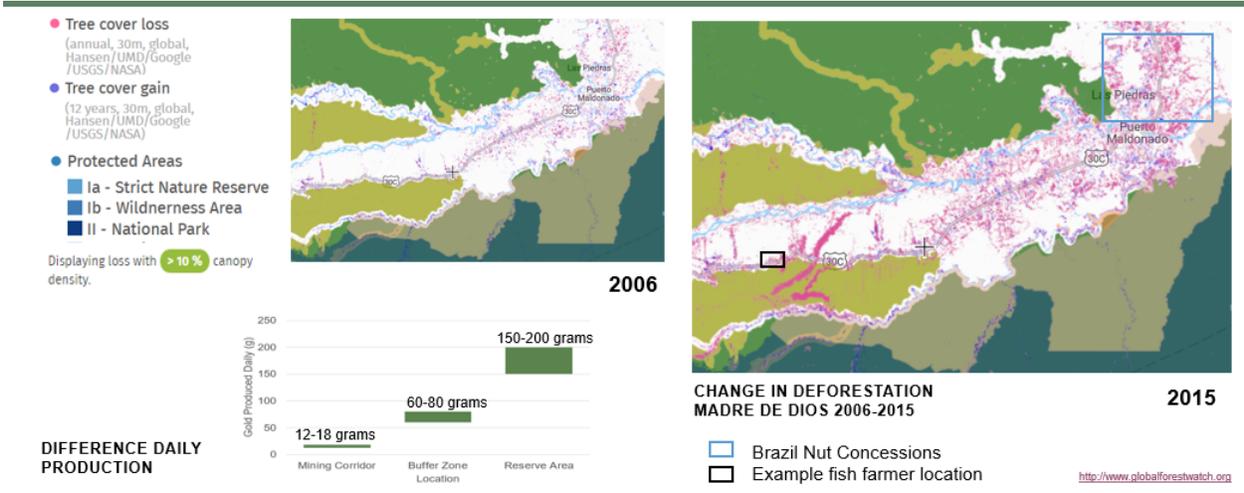


Figure 1. Environmental Dangers of ASGM

& Delgado, 2011), accounting for nearly 45% of the local economy¹.

Not only does informal mining provide considerable economic returns, according to the experts we interviewed, it is the livelihood of choice for migrants and unskilled workers as it has few barriers to entry, and legal restrictions are not strictly enforced. Though returns on mining are declining in the designated mining corridor, where miners typically obtain 12 to 18 grams of gold per day, the average amounts of gold mined per day in the buffer zone (60 to 80 grams) and the Tambopata National Reserve (150 to 200 grams) are substantially higher. Thus, it is common to see informal mining outside of the mining corridor in MDD, which has resulted in substantial deforestation (See Figure 1) as well as increased levels of mercury contamination in the local water supply. A potential solution explored by the Peruvian government is the

legalization of informal mining with a hope of reducing mercury contamination. Of the 5,500 miners who filed papers of intent stating their wish to become legal miners, nearly 74% are unable to complete the process as they do not have clear access to a land concession. Another 25% have access to land that is otherwise deemed unsuitable for some reason, such as, proximity to a large natural water source². Thus, the economic incentives to mine along with lack of enforcement and the difficulty in obtaining legal permissions has established a strong informal artisanal mining culture in the MDD area (See Figure 2).

The average annual wage in the MDD area is approximately \$3,500 a year, while annual income from artisanal mining can be as much as \$8,400-\$10,800. Any alternative livelihoods would need to be at least as lucrative on an economic basis.

¹ Verbal interviews with Experts in Lima

² *ibid*

Figure 3 presents the alternatives currently available in MDD. Of these, we chose to focus on brazil nuts harvesting and fish farming as both are economically comparable to artisanal mining with local as well as regional/national markets. Environmentally, both livelihoods are considerably more sustainable than artisanal mining, and there exists a local social culture for both products.

BRAZIL NUTS:

Brazil Nut harvesting was identified as a potential alternative sustainable livelihood to ASGM. Based on literature review and interviews, we determined the

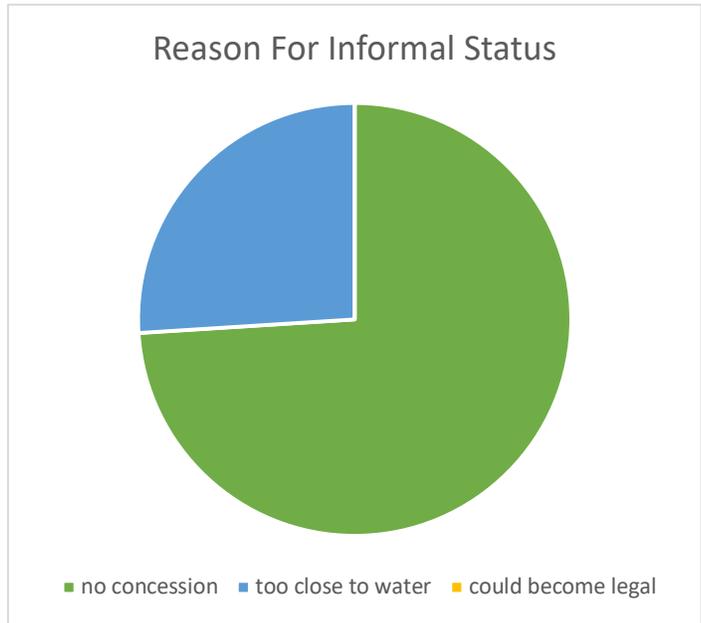


Figure 2. Reasons for Informal Status of gold miners in MDD

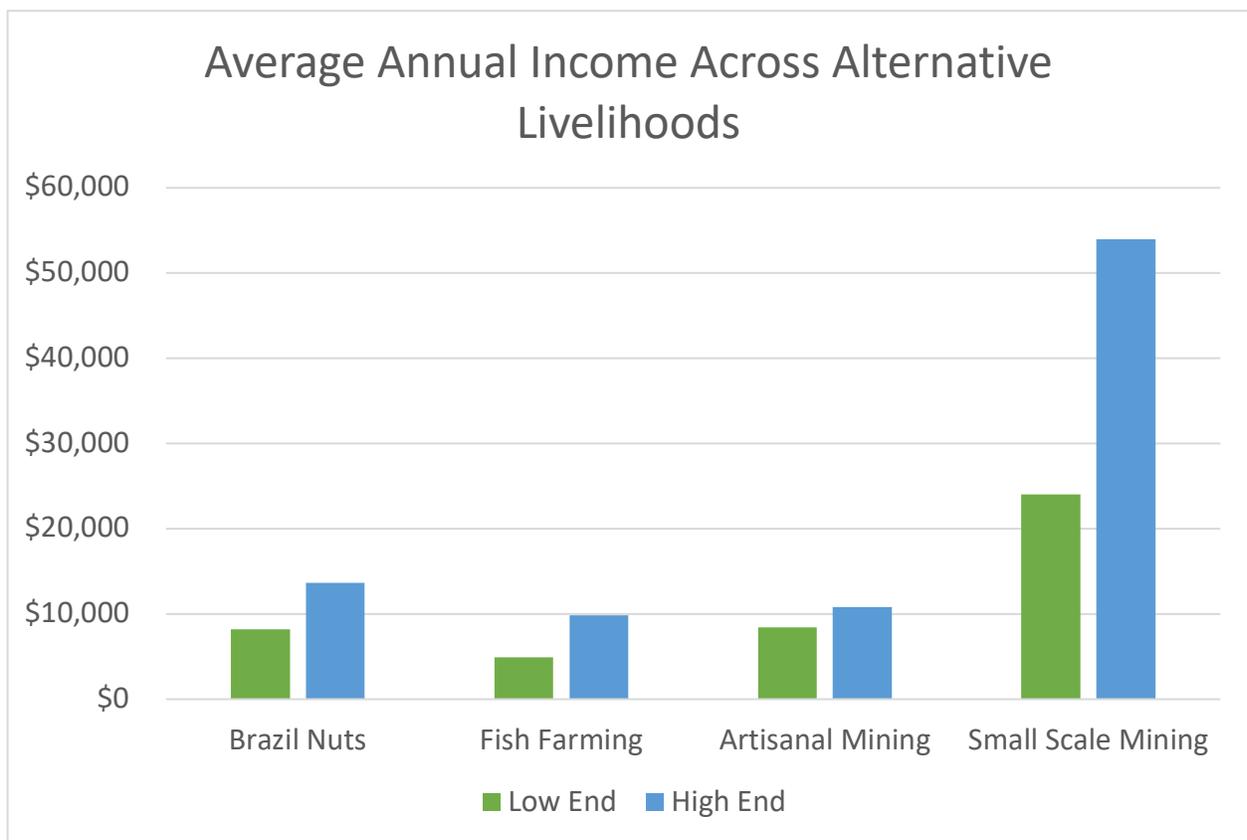


Figure 3. Income Across Livelihood Options

average production per hectare of a Brazil Nut concession to be 15Kg of nuts, and the average size of a Brazil Nut concession to be 600-1000 hectares, resulting in an average annual household income for Brazil nut producers in the range of US\$8,209-\$13,682 (Nunes, Soares-Filho, Giudice, Rodrigues, Bowman, Silvestrini & Mendoza, 2011). After harvest, producers can sell their nuts in one of two forms: shelled or unshelled. The supply chain (Figure 4) consists of harvesting the nut, transporting some of the nuts to a local drying and shelling facility and selling the rest unshelled. Shelled nuts are then packed and sold as such. Nuts determined to be rotten or too bruised and spoiled for human consumption are sold as fish food

to local fish farmers. Shelling the nuts requires an addition step thereby increasing cost of production, but it can also increase the selling price by as much as 500% (Collinson, Burnett & Agreda, 2000) (Figure 5). Most farmers, as confirmed by our field interviews, would like to sell their nuts shelled, but sell more unshelled instead due to a number of reasons including, lack of access to the equipment for shelling, inability to afford the upfront payment required for shelling, or the need for immediate cash flow.

Producers of Brazil nuts have grouped together to form several membership-based associations that provide a series of

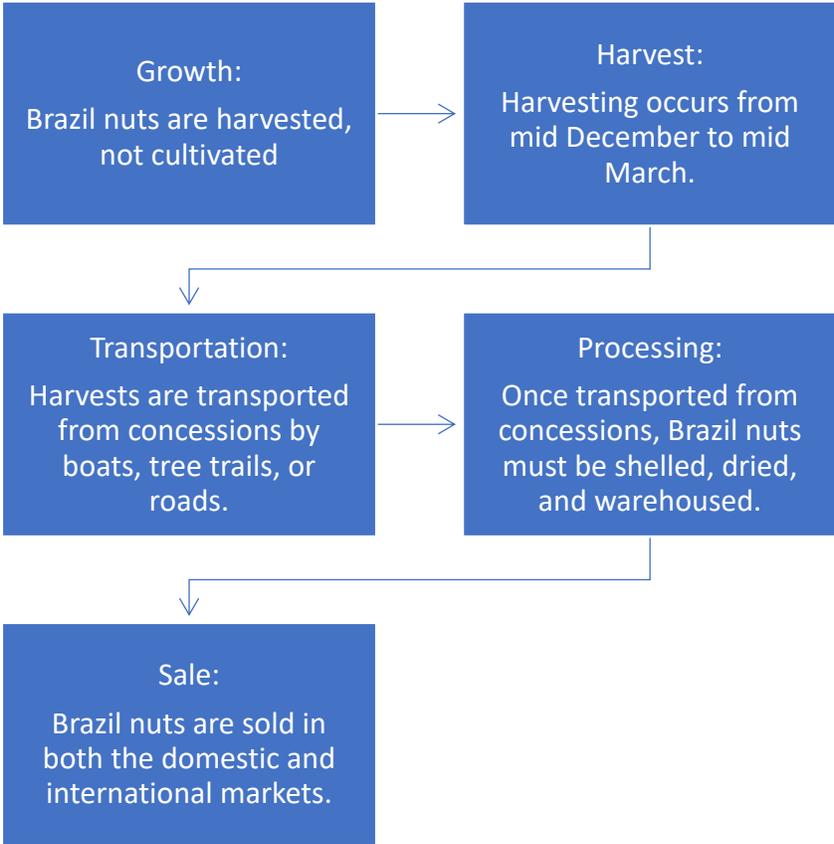


Figure 4. Value Chain of Brazil Nuts

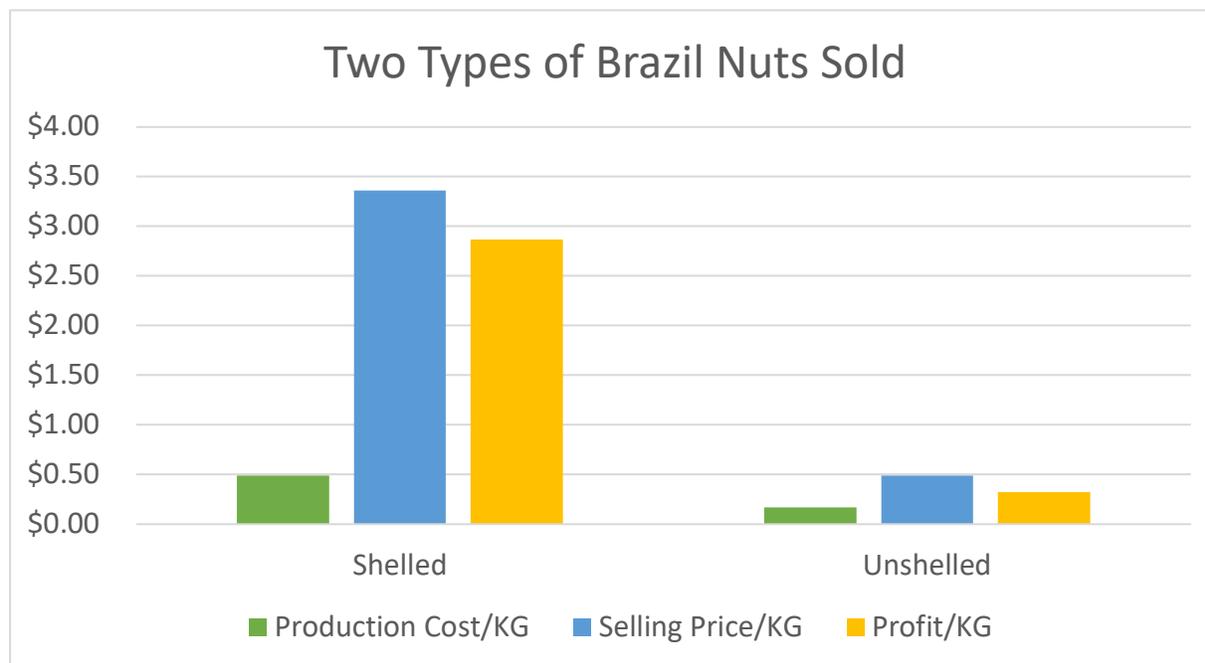


Figure 5. Value of Shelled vs. Unshelled Brazil Nuts

enefits ranging from harvesting assistance to shelling and sales assistance. We visited the Brazil nut association ASCART's shelling facility where nuts are stored, dried and shelled. The shelling facility provides a stable source of income to many locals, at least 88% of whom are women. The facility allows for flexible working arrangements to suit the needs of women who may have school-age children. ASCART facilities have the capacity to shell 12,000KG of Brazil Nuts per year giving their members, but is currently functioning only at about one-third (4,000 KG) capacity. Thus, members could shell a larger portion of their harvest without needing additional investment in equipment, obtaining a higher sales price and higher net profits. A rough estimation of the production by ASCART current members suggests that full shelling capacity would only be utilized if all

members were to shell their entire harvest. Thus, *shelling is a relatively easy way to create value for harvesters and increase their annual income without any additional capital investment or skills training.* ASCART also sells the Brazil Nuts deemed unfit for sale as fish food for local fish farms. The damaged nuts substitute for costly fish food, and many locals believe fish fed local ingredients taste better. *We suggest exploring this option to increase percentage of nuts shelled locally further to fully understand its impact and potential.*

We also met with AFIMAD, another Brazil nut association whose members from indigenous communities. The association has interest in obtaining Fair Trade and Organic certifications for their nuts. These certifications are another way to raise the selling price and obtain direct access to international markets. Candela Peru

(Comercio Alternativo de Productos No Tradicionales y el Desarrollo para Latino América Perú) sells organic and fair trade brazil nuts and other associated products. There are also at least two North American retailers of Candela’s Brazil nut products. One World Projects (www.oneworldprojects.net), sells Brazil nuts, Brazil nut oil, Brazil nut candles, and chocolate bars with Brazil nuts. Also, Ten Thousand Villages in Canada (<https://www.tenthousandvillages.ca>) sells organic and fair trade certified Brazil Nuts. Thus, Candela Peru has gone through both processes – evidence that they can be reasonably obtained.

ORGANIC CERTIFICATION:

Data from AFIMAD, which we confirmed with various certification agencies, estimates the cost for organic certification at approximately \$2,300 per year. The certification is quite valuable as it increases profits by an around \$0.13/KG of nuts sold (Figure 6). The process is fully outlined on multiple websites, including the United States Department of Agriculture (<https://www.ams.usda.gov/services/organic-certification>) and many smaller certifying bodies, and is a possibility for the local producers. Some preliminary analysis showed that the potential increase in profit due to organic certification is considerable as it increases the price of unshelled nuts by nearly 25% and the price

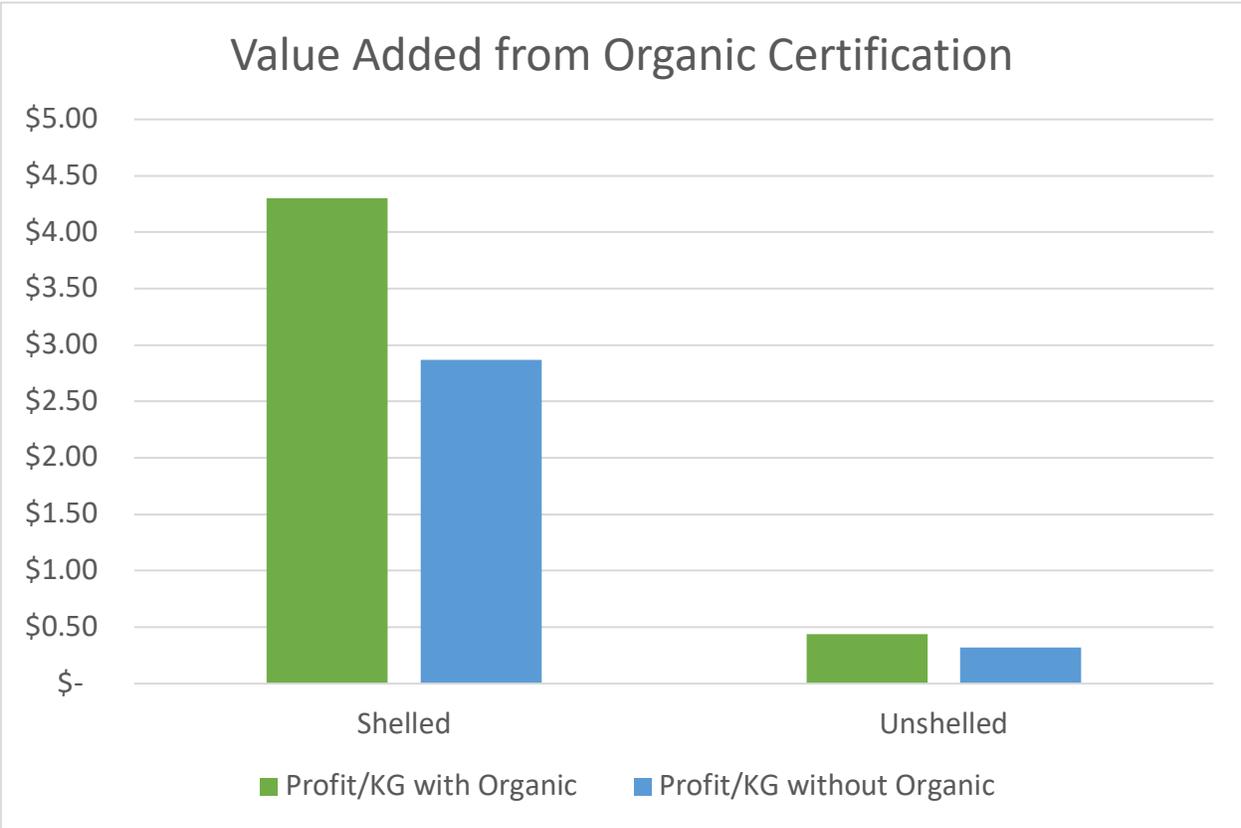


Figure 6. Value added from Organic Certification

of shelled nuts by 5%. Since Brazil nuts are not cultivated but rather harvested from naturally growing trees with little to no human interference or day-to-day management, there is little to no cost to maintain their natural “organic” state. The only caveat would be when trees are in areas that may have contamination due to mining. *We suggest exploring this certification further to fully understand its impact and potential.*

FAIR TRADE CERTIFICATION:

Fair Trade certification is harder to obtain as it is based on a definition of relationships rather than how the product is produced and handled. We were unable to identify the true price increase from a Fair Trade certification for the same reason - it is relationship based and thus difficult to quantify. Fair Trade was defined in 1998 as “a trading partnership, based on dialogue, transparency and respect, that seeks greater equity in international trade. It contributes to sustainable development by offering better trading conditions to, and securing the rights of, marginalized producers and workers – especially in the South” (Krier, 2001). Major certifiers for Fair Trade include the Fairtrade Labelling Organization (FLO) which certifies commodities and the World Fair Trade Organization (WFTO) which certifies handicrafts, Fair For Life and Fair Trade USA are another two that cover additional products and producers. However, all of these groups subscribe to a similar set of principles that include a living wage, decent working conditions, democratic

decision making, access to capital, ongoing relationships, and sustainable practices. The primary benefits of fair trade for the brazil nut harvesters is the long-term relationships and stronger commitments that the certification requires. Fair trade wholesalers and retailers in the developed countries tend to form multi-year partnerships, and often engage in capacity building projects with the producer/artisans.

In most cases, both the producer/artisan and the retailer must be certified in order to carry the fair-trade label on the product, and the process can be quite intense. Trade businesses, such as Candela Peru, must have been in business for two years before applying for full membership (newer businesses are invited to apply for Associate Membership, with more limited benefits). The application process for membership requires documentation (Mission Statement, Annual Report, and two years of Financial Statements) and three references, one of which must already be a WFTO member. Once approved as a Provisional Member, the business must pay an annual membership fee, based on sales and region, must submit a self-assessment report and undergo a Peer Visit and/or Monitoring Audit within one year. Fees for 2017 ranged from €400 to €2,600 for producer/exporter members, in addition to the €50 fee for Latin America (WFTO, 2017). Only after these fees, reports, and audits are satisfactorily completed is full membership granted, and only then is the member allowed to use the WFTO

certification symbol when selling their products. Once a full member, the organization must continue to pay annual fees, and must also implement an improvement plan and submit to a monitoring schedule set by the WFTO. *We suggest exploring this certification further to fully understand its impact and potential.*

FISH FARMING:

Fish farming was also considered as a viable alternative sustainable livelihood to informal mining. We calculated the

average annual income for a fish farmer by making certain assumptions that were based upon our review of the literature and were verified through our field work. Fish farmers aim to have 5 to 10 ponds, each with approximately 2,500 cubic meters of water producing 450 to 550 Kilos of fish. The local price of fish in Madre de Dios is approximately \$3.50/Kg. It takes around 7 months for the fish to grow to a cost per kilo of fish is nearly \$2.26/Kg³. As shown in (Figure 8), this results in an average annual income of US\$4,925 to US\$9,850 for Fish farmers with 5-10

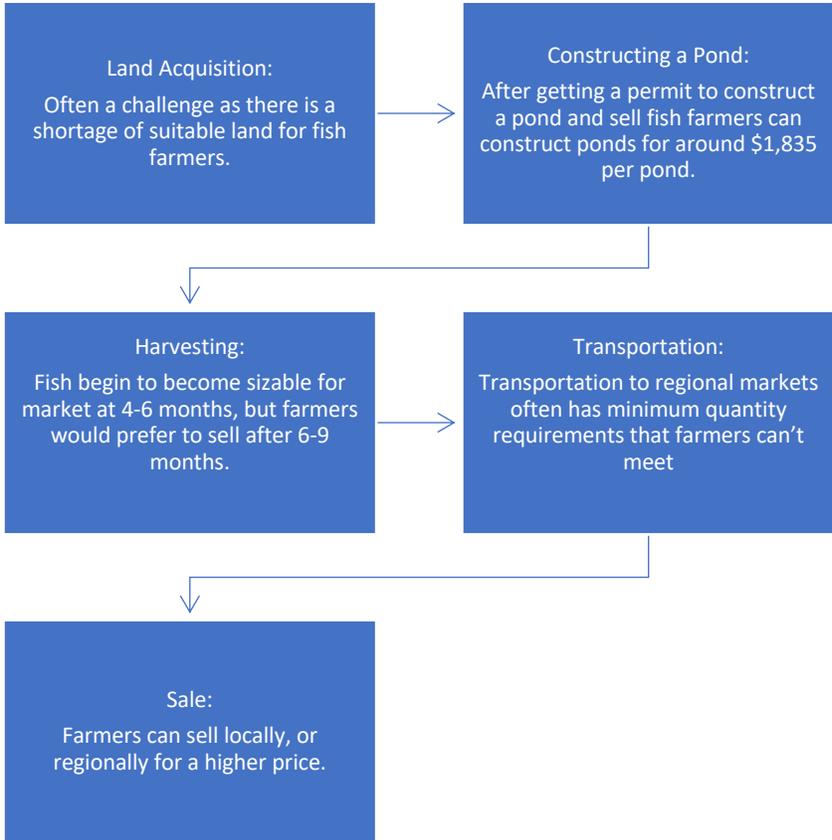


Figure 7. Value Chain for Fish Farming

³ Ministerio del Produccion: www.produce.gob.pe

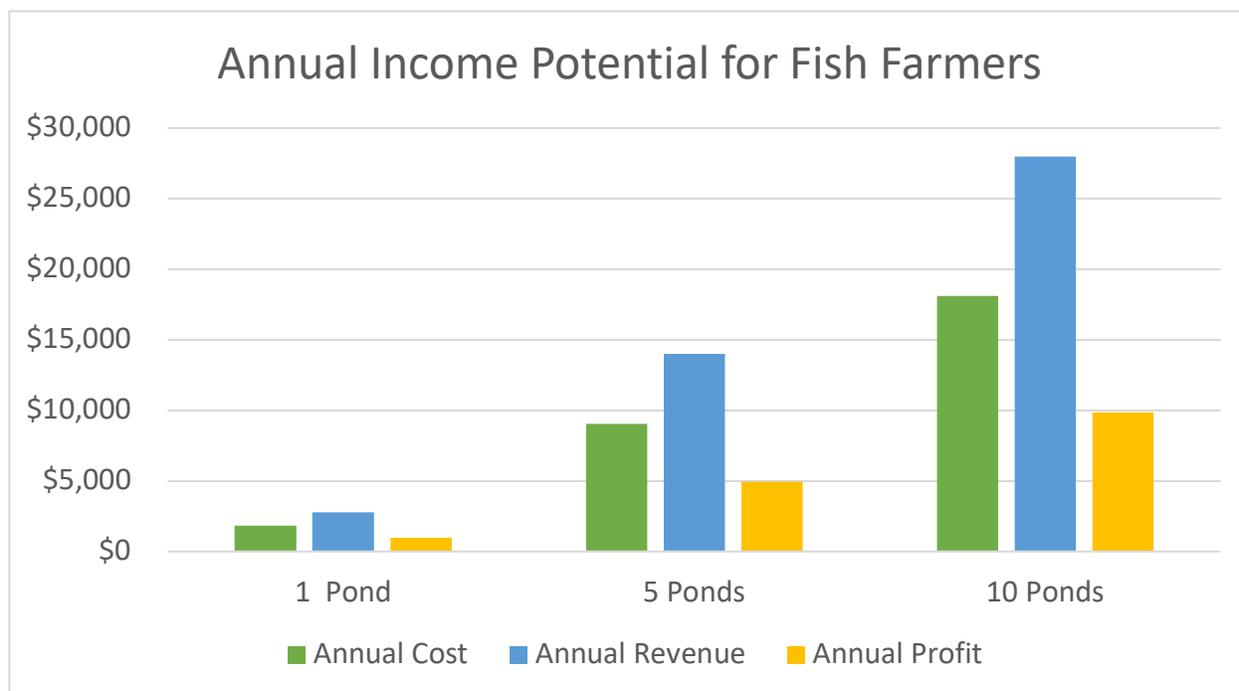


Figure 8. Annual Income from Potential Fish Farms

ponds. Beyond being economically comparable to ASGM, fish farming also has potential aid in restoration of the natural environment.

Interviews with fish farmers highlighted two sets of barriers – cost of permits, setting up the initial pond on suitable land, and access to clean water as barriers to entry, and the cost of building new ponds and maintaining current ponds, cost of fish larvae, cost of food for the fish and distribution to fish markets beyond MDD that have higher demand and prices (such as Cusco) as barriers to successfully operating the business. Understanding barriers to entry requires a deeper look into issues of land access and reform, access to clean water, water taxes and credit for initial setup expenses. These were beyond the scope of our interviews

and desk study, but would be worth exploring in a future project.

We discuss here some barriers to the success of current operations. As shown in Figure 9, based on what was learned in interviews with practitioners and corroborated by IIAP, the cost of building a new pond is approximately \$1,835. This size of one kilo, which is considered a good size to take to market (Figure 7). The results in a breakeven time of nearly two years on each pond. In order to achieve a wage comparable to those obtained from ASGM, fish farmers need 10 ponds, requiring them to have sufficient cash flow to be able to build new ponds and maintain them while breaking even.

Exploring reducing costs associated with building new ponds and providing micro-credit to support expansion of the number

of ponds are logical next steps. Fish farmers explained in interviews that not only was digging a pond expensive, they often had to wait months for someone to come with a bulldozer to dig the new pond. If enough farmers coordinated digging, they could either rent or even buy the equipment necessary to dig ponds. One mechanism for achieving economies of scale is for farmers to come together in associations that are membership based and offer services that require scale.

Distribution is another major issue for fish farmers, in our interviews with local practitioners they mentioned shipping and transportation being huge barriers to reaching local and regional markets. In order to reach regional markets (like Cusco) that command a higher sales price per kilo of fish (\$5.15 in Cusco compared with \$3.50 in MDD), farmers need larger

quantities of fish and refrigerated trucks. On average, a full truck load requires between 700 and 1,000 kilos of fish. This amount is beyond the reach of any single producer, but could be achieved if multiple farmers were to pool their total fish available for sale. Here too, we suggest exploring membership-based associations that can help manage logistics across all members to capture benefits of economies of scale.

Since we did not have actual transportation costs, we conducted a sensitivity analysis (see Figure 10) based on price per kilo and found that selling regionally in Cusco would be profitable as long as transportation costs did not exceed \$0.0037 per kilogram per kilometer, or \$1.665 per Kilo for the distance between Pt Maldonado and Cusco. Figure 11 presents a comparison of

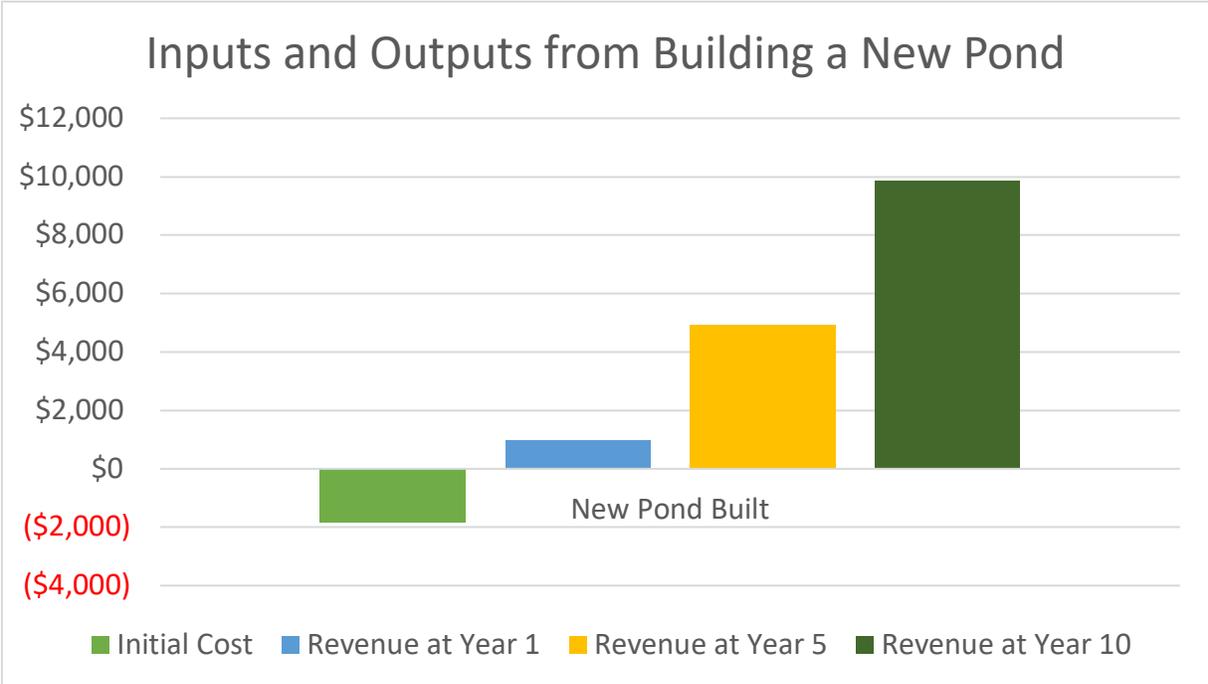


Figure 9. Inputs Required for New Ponds

profits obtained from selling the total production from one, five and 10 ponds locally in MDD, regionally in Cusco, or 50% in each location. Achieving the 10-pond size and being able to sell at least some part of the fish produced regionally would substantially increase income potential for fish farmers.

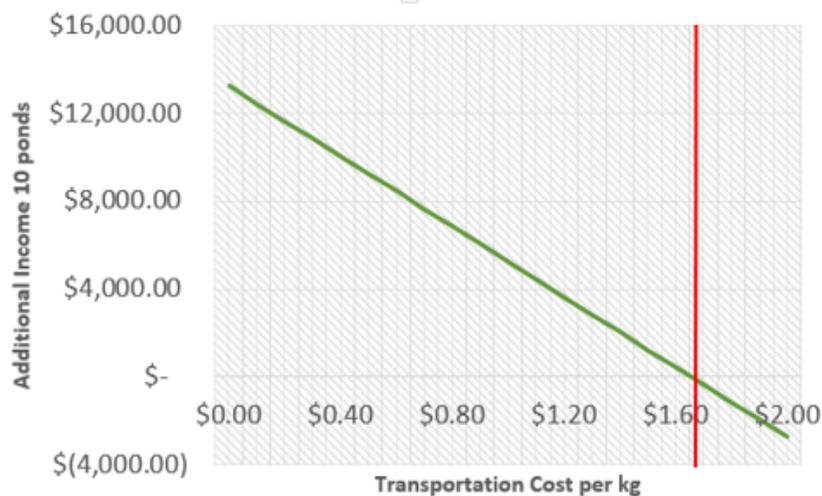
Polluted water is always a threat to farmers who want to ensure their fish are growing in clean water and not water that may have been contaminated with mercury run off. Thus, testing of water would be a prudent future step. Similarly, algal blooms were observed in the fish ponds we visited. Algal blooms are caused by excess nitrate runoff, often from fertilizers, pesticides, detergents and soaps, which makes the algae in the pond grow exponentially blocking the oxygen from getting into the pond. A known solution to algal blooms is

to circulate the water within the pond so that fresh oxygen can enter the system. When visiting the research facility IIAP we noticed they had a pipe pouring new water into their fish ponds, and unlike the fish farms we visited, no algal blooms. The reduction of algal blooms is not only good for the ecosystem, but a safer pond will be more profitable as well.

A final cost is purchase of larvae to start a new crop. IIAP appears to have programs that provide larvae at no or minimal cost. We suggest exploring such programs to fully leverage them. Purchase of food for feeding the fish is another cost that can be managed by linking with brazil nut producers to purchase nuts unsuitable for human consumption to feed the fish.

Additionally, some of the farmers interviewed grew fruits (bananas,

TRANSPORTATION COST



Distance Puerto Maldonado-Cusco: 450km
 Profitable up to 1.66\$ per kg or \$0.0037 per kg per km.
 Challenges: Transportation, missing refrigeration, increased competition (Brazil, sea fish)
 => Regional market is profitable but support and coordination is needed

Figure 10. Estimates in Transportation Cost

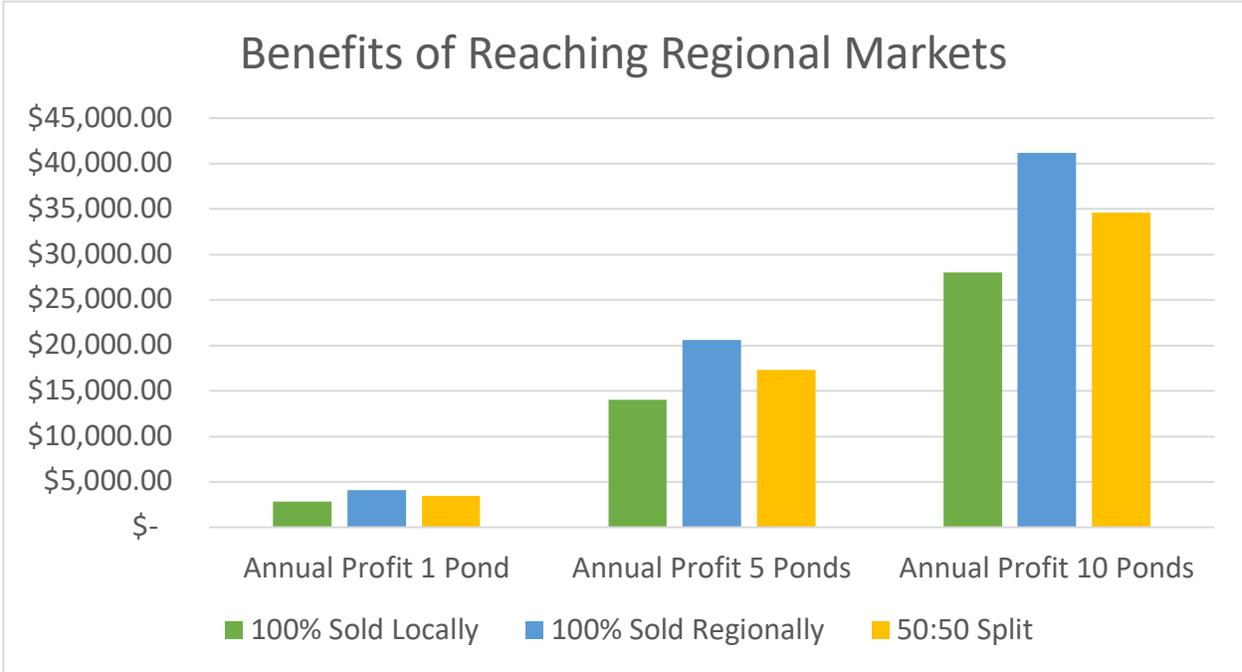


Figure 11. Benefits of Reaching Regional Markets

pineapples) and crops (cacao) that could be sold for income but the leftovers of which could also be used to feed fish.

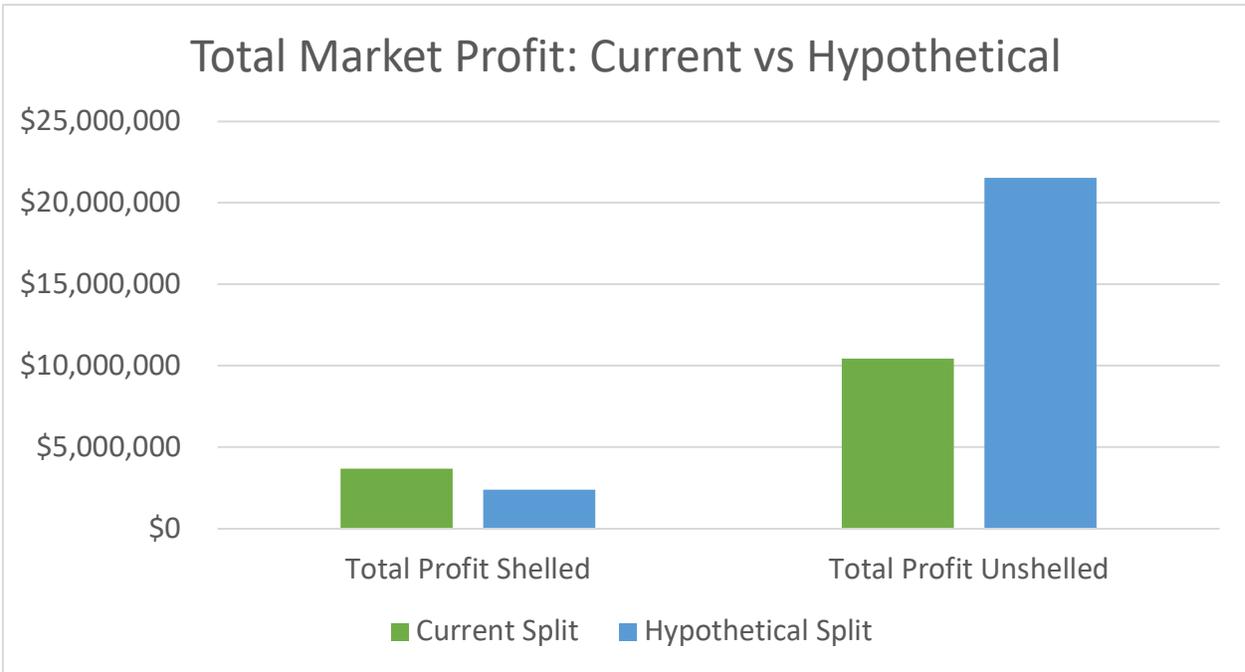
EXPLORING MICRO-CREDIT FOR FISH FARMS:

It has been suggested that individual fish farmers should expand to at least ten ponds, but the capital requirements, at \$1,835 per pond, are beyond the means of local farmers. Microloans seem to be a possible solution, with a series of smaller loans to individual farmers, until each is at a sustainable level of production. First, we need to understand the local lending market: are small business loans available at local bank branches in MDD? Are there microfinance institutions operating in Puerto Maldonado or in similar market sizes elsewhere in Peru? If not, would any of the existing MFIs in Cusco be interested

in expanding? Further, suggestions will depend on the current regulatory environment in Peru. If legally possible, a “village banking” model might be appropriate, whereby the association acts as the lender. As a loan is retired, a new loan can be made to the same farmer or other farmers in the association.

DISCUSSION

We set out to test the validity of two hypotheses – (i) H0: mining offers higher wages than other livelihoods for the average resident in Madre de Dios, and (ii) H1: modifications to other livelihood activities could raise the wages and economic gains sufficient to make them as attractive or more than mining. We find that the potential wages from small scale



Hypothetical Production	Unshelled	Shelled
Hypothetical Production (Kg)	7,500,000	7,500,000
Profit at This Level	\$2,400,000	\$21,525,000
Difference from Previous Value	(\$1,280,000)	\$11,480,000
Current Production	Unshelled	Shelled
Annual Production Volume (Kg)	11,500,000	3,500,000
Total Revenue (USD)	\$5,635,000	\$11,760,000
Total Cost Before Transportation (USD)	\$1,955,000	\$1,715,000
Total Profit (USD)	\$3,680,000	\$10,045,000
Profit Per Kg (USD)	\$0.32	\$2.87

Figure 12. Total Market Profit for Current and Hypothetical Scenarios

mining are substantially higher than more environmentally sustainable activities, but that small scale mining is not a viable livelihood option for the average resident due to the barriers to entry discussed earlier, namely land tenure, initial investments, etc. As a result, artisanal mining in the form of informal mining is the viable alternative, and our results demonstrate that the wages and returns are nearly equivalent to other livelihood options in the area and may actually be

lower for the average resident. Therefore, we find evidence to reject parts of the first hypothesis that mining is the most lucrative livelihood in the area. We find that this is not always accurate, particularly for informal mining, and may lead to sub-optimal livelihood choices.

With regard to the second hypothesis, we find that using production techniques commonly employed in the area, brazil nut harvesting and fish farming are nearly

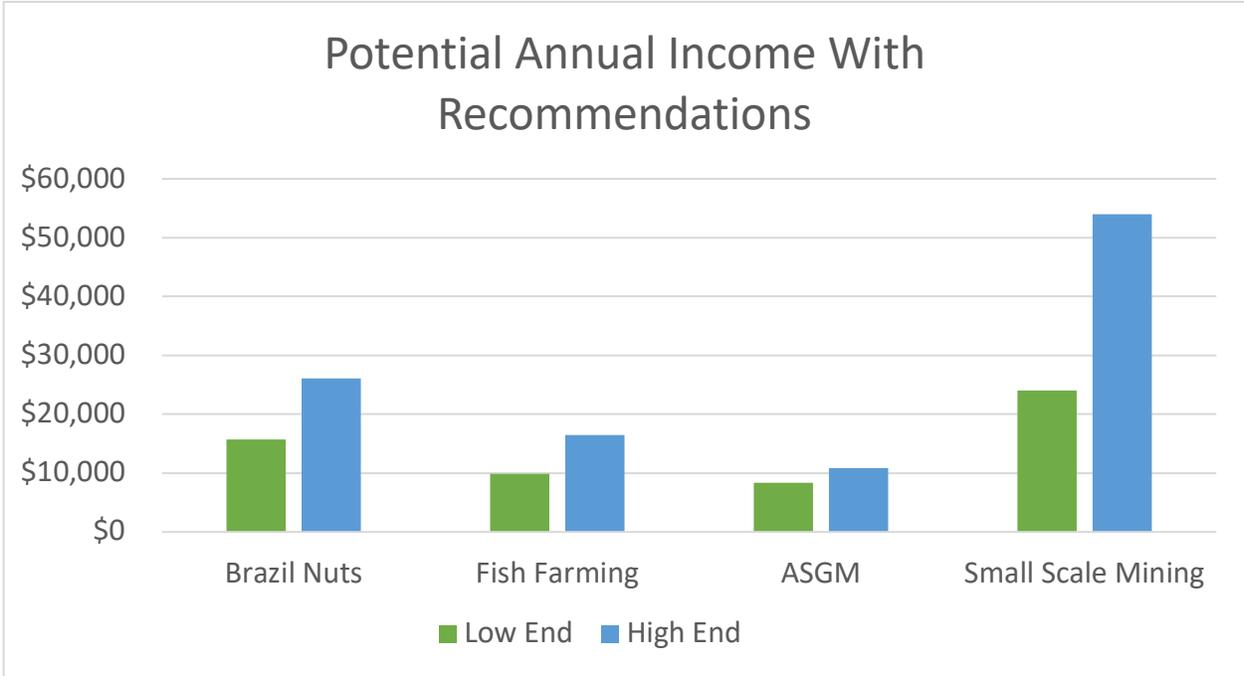


Figure 13. What Income Could Look Like with Recommendations

equivalent in their returns. However, we demonstrate that with sometimes minimal investment or modification to production and distribution techniques, the potential income that could be generated from sustainable livelihoods can quickly surpass that of artisanal mining, without the indirect deleterious impacts to other ecosystem services. For instance, with regard to brazil nuts, we suggest shelling a larger quantity of nuts locally in Madre de Dios, detailed in Figure 12, obtaining organic certification, and exploring the fair-trade certification further to fully understand its impact and potential. Increased level of shelling is not difficult to achieve and may not require additional cash investment immediately, given current excess capacity in the area.

Current cash reserves of the associations may be an issue however, in obtaining

certifications – this is an area where microcredit and/or technical assistance from local NGOs would be highly beneficial. This is particularly true for organic certification that requires an upfront payment and maintenance of organic status for the brazil nut concession area. Fair Trade certification, although harder to obtain, may be easier to manage as relationships built with retailers will provide has the potential to provide access to operational cash as well as technical knowledge.

Similarly, for fish farming we suggest pooling of resources by farmers through an association to create economies of scale for digging additional ponds and transporting fish to regional markets with higher sales prices. We also suggest better water management to contain algal bloom. Coordination with local agencies

like IIAP to obtain larvae at no to low cost and local brazil nut producers as well as food producers to obtain rejects as food for fish is suggested as a way to contain operational costs. Finally, examining the potential of microcredit/microfinance in funding essentials like bulldozing equipment or refrigerated trucks would be a vital next step. These recommendations do not address barriers to entry as we believe that requires further independent study.

In summary, and as shown in Figure 13, implementation of our recommendations for brazil nuts as well as fish farms can increase the income potential for both livelihoods to beyond the levels of ASGM, while maintaining sustainability and intact forest cover.

CONCLUSION

While the study presented here is a pilot investigation into the viability of alternative livelihoods in Madre de Dios, Peru, we find evidence to at least partially reject the assumption that mining is the most lucrative economic choice in the area. Further, we find evidence to support the second hypothesis that modest changes in investment or production and transportation can increase the viability and attractiveness of alternative livelihoods over that of mining.

In order to realize the potential of these other, more sustainable livelihoods, more detailed assessment of value chains, transportation infrastructure, viability of various certification schemes, and the availability of credit and financing is required. We have demonstrated that there is tremendous growth potential in both brazil nut harvesting and fish farming, however a more thorough analysis is required to tailor investments to achieve that potential. Likewise, a fuller assessment of the unintended consequences of modifying current practices and livelihood patterns is required to understand how further economic changes will impact forest integrity and livelihoods in the region.

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