Final Report and Recommendations

Regenerating Ecologies and Economies for Livelihoods (REEL)

Centro de Innovación Científica Amazónica (CINCIA)

Notre Dame Team Members

Beverly Ndifoin
Lydia Knoll
Mark Giesey
Maria Camila Salamandra
Valentina Munoz
Cesar Bertinetti
Ozioma Nwachukwu
Mauricio Carrizalez Mora

Notre Dame Faculty

Richard “Drew” Marcantonio

Notre Dame Advisors

Alix Underwood
Nadine Hashem

CINCIA Team

France Cabanillas
Marta Torres

Notre Dame Scientific Advisors

2025

TABLE OF CONTENTS

Acknowledgements **2**
Glossary **3**
Executive Summary **4**
1.0. Introduction **7**
2.0. Importance of Income Diversification for Miners **8**
3.0. Business Framework **11**
4.0. Floating Cage Fish Farming in Post-Mining Ponds **16**
5.0. Other Supplemental Activities **26**
5.1. Produce 26
5.2. Ecotourism 30
5.3. Livestock 35
6.0. Summary of Women's Responses from the Workshop **40**
7.0. Conclusion **45**
Appendix **46**
Methodology 46
Bibliography 53

Acknowledgements

The team appreciates the support of everyone who made this research possible. This includes the CINCIA staff in Madre de Dios, The Red de Mujeres MAPE, local organizations, Notre Dame faculty, and advisors for the Regenerating Ecologies and Economies for Livelihoods program and the Mendoza College of Business.

Partner Support: The team is grateful for the support of CINCIA team members, including France Cabanillas and Marta Torres, who guided the development of our research questions and methodology. They also coordinated logistical support and facilitated the engagement of community members before and during field visits for data collection. The team equally appreciates the resources CINCIA made available to support the workshop and interviews with local actors. We thank CINCIA, MAPE women, and local actors who generously offered their time and shared meaningful knowledge and experiences through our interviews and workshop. We are deeply appreciative of their willingness to share their experiences and stories with us.

Regenerating Ecologies and Economies for Livelihoods (REEL) Program Support: The team is grateful to Richard "Drew" Marcantonio, faculty advisor; Alix Underwood and Nadine Hashem, Notre Dame advisors; Cesar Bertinetti, Ozioma Nwachukwu and Mauricio Carrizalez Mora, Notre Dame scientific advisors who provided technical guidance throughout the project life cycle. Additionally, the team appreciates Jessica Parson, who provided logistical support for team travel to and from Peru. The team acknowledges the Mendoza College of Business and the Keough School of Global Affairs for financial support for this project.

Centro de Innovación Científica Amazónica (CINCIA) is the main partner for this project. It is a leading research and innovation institution in the Amazon, which generates scientific capacity and knowledge, integrating them into productive and environmental management initiatives to promote sustainable development.

Glossary

ACA	Amazon Conservation Association
AFIMAD	Asociación Forestal Indígena de Madre de Dios (Indigenous Forestry Association of Madre de Dios)
ASM	Artisanal and Small-Scale Mining
CINCIA	Centro de Innovación Científica Amazónica (Amazonian Scientific Innovation Center)
CITE	Centro de Innovación Productiva y Transferencia Tecnológica Productiva (Productive Innovation and Technology Transfer Center)
DIRCETUR	Dirección Regional de Comercio Exterior y Turismo de Madre de Dios (Regional Directorate of Foreign Trade and Tourism of Madre de Dios)
GOREMAD	Gobierno Regional de Madre de Dios (Regional Government of Madre de Dios)
INIA	Instituto Nacional de Innovación Agraria (National Agricultural Innovation Institute)
MAPE	National Network of Women in Artisanal and Small-Scale Mining
PEN	Peruvian Nuevo Sol (currency unit)
REEL	Re-ecologizing Economies for Livelihoods Program
SERFOR	Servicio Nacional Forestal y de Fauna Silvestre (National Forest and Wildlife Service)
SPDA	Sociedad Peruana de Derecho Ambiental (Peruvian Society of Environmental Law)
UNDP	United Nations Development Programme
WWF	World Wildlife Fund
IDRC	International Development Research Centre

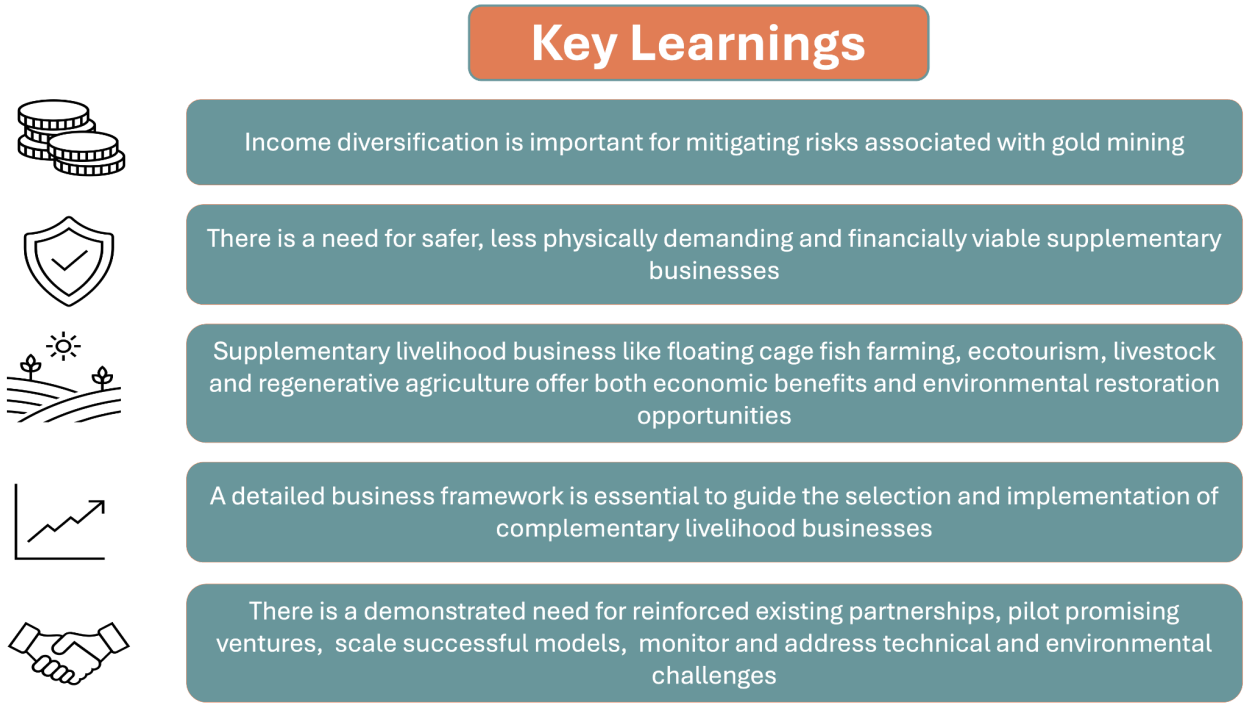


Figure 1. Key Learnings

Executive Summary

In Madre de Dios, Perú, where mining communities face conflicts, social unrests and environmental degradation, diversifying income is not just an option but essential. This report shows how additional income sources such as floating cage fish farming, ecotourism, and regenerative agriculture could support miners in earning a steady income even during mine suspensions or violent unrests. By regenerating degraded lands through reforestation and using available resources like abandoned mining ponds for fish farming, communities can reduce reliance on mining while protecting pristine areas. These activities are not only an economic buffer but also foster environmental restoration and social security for seniors, offering safer, less physically demanding jobs for older miners and new opportunities for youth. Embracing a circular economy through these diverse ventures creates a pathway to a sustainable future for people and the planet.

Supplementary businesses are possible pathways to reduce dependency on gold mining

Gold mining in Madre de Dios faces economic instability due to mining conflicts, its unsustainable finite resource extraction and the expansion of illegal gold mining in response to global gold price increase. Environmental costs include deforestation and mercury contamination which have been estimated to cause significant economic losses impacting agriculture, tourism

and public health. Supplementary livelihood activities offer a possible pathway to reduce dependency on mining while restoring degraded lands. See **Figure 2** for the importance of income diversification.

Figure 2: Infographic on Importance of Income Diversification

Supplementary businesses need to be economically and environmentally sustainable

The business framework developed in this study serves as a roadmap to assess, select and implement viable supplementary livelihoods. It consists of a series of steps evaluating personal capacity, identifying local resource availability, analyzing market demands and estimating startup and recurring costs. This structured approach is important for ensuring that chosen activities not only generate income but also align with environmental best practices. **See Figure 3.** for the economic and environmental benefits of different supplementary livelihood activities

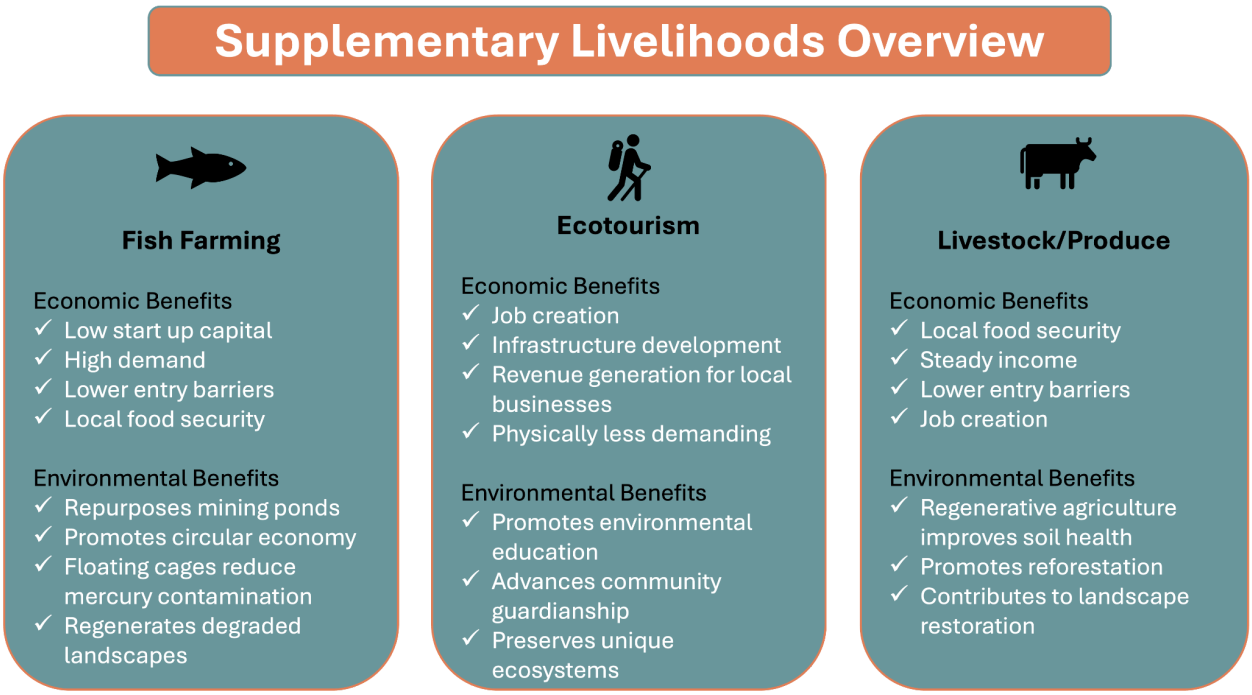


Figure 3. Supplementary Livelihoods Overview

Workshop Overview

The participatory workshop with the Red de Mujeres network members revealed key priorities among women miners through the use of a participatory worksheet (see Appendix Figure 2) . Financial constraints, safety concerns and need for technical support were their top hurdles. However, the women demonstrated a strong interest in investing in supplemental activities that offer flexibility, decent return on investment and reduced physical labor, particularly fish farming. These insights suggest that lower risk ventures can potentially build financial resiliency during mining conflicts or government interdictions.

Recommendations and Next Steps

- **Adopt a Phased Implementation Strategy:** Begin with promising pilot projects such as fish farming in select abandoned mines to test the viability of supplementary activities on a small scale. Use floating cages to reduce mercury contamination. Monitor economic returns and environmental impacts. Successful models can then be gradually scaled.
- **Strengthen Partnerships and Access to Technical Support:** Collaborate with different organizations, government agencies and cooperatives to secure access to technical training, financial support and market access for miners.
- **Promote Business Planning and Capacity Building:** Encourage miners to participate in workshops that focus on business planning, resource management and land rights.
- **Integrate Environmental Safeguards:** Ensure that supplementary livelihood initiatives incorporate best environmental practices through regular monitoring.

1.0. Introduction

The Amazon is one of the most biodiverse regions in the world, playing a critical role in regulating climate, sustaining water cycles, and supporting both wildlife and local communities[1]. In Peru, the Amazon covers around 60% of the national territory[2]. Madre de Dios, a department located in the Peruvian Amazon, has always been rich in natural resources as it is home to part of the Amazonian rain forest. However, the region has experienced deforestation, mercury pollution due to illegal mining activities, and complex socio-environmental challenges as a consequence of gold mining.[3] To combat this problem, local, regional and international institutions and NGOs have tried different approaches.

One of the key organizations working in this context is the Amazonian Scientific Innovation Center / Centro de Innovación Científica Amazónica (CINCIA, by its acronym in Spanish, hereafter CINCIA), which has been actively involved in research and addressing environmental issues in the region. CINCIA has focused on the contamination caused by mercury from ilegal gold mining, conducting studies to better understand its impact on local ecosystems. Additionally, they have supported reforestation efforts in areas impacted by mining activities. Part of their work includes a social strategy that seeks to strengthen community engagement with environmental issues, as is the case of the Regional Network of Women in ASM (Artisanal and Small-Scale Mining) / Red Nacional de Mujeres MAPE (MAPE Women hereafter). Through their collaboration with CINCIA, MAPE Women have started to shift to better practices that helped to reduce the negative environmental impacts of mining activities in the region.

This report is the result of a collaboration between the Regenerating Ecologies and Economies for Livelihoods (REEL hereafter) program at the University of Notre Dame and CINCIA. Within the framework of this partnership, our primary goal is to support the economic stability and sustainability of the MAPE Women, by providing CINCIA with recommendations on potential supplementary livelihood options based on local economic conditions, contextual learning, and community dynamics. The objective of these findings is to contribute to a broader vision in which miners can become sources of inspiration for more sustainable livelihood practices while strengthening the partnership between CINCIA and MAPE Women.

[1] Deutsche Welle. "The Amazon: Vital for Our Planet." DW, August 27, 2019. https://www.dw.com/en/the-amazon-vital-for-our-planet/a-50170004.
[2] BBC. "Amazonia: Un tesoro en peligro." *BBC Mundo*. Accessed April 6, 2025. https://www.bbc.co.uk/spanish/specials/1330_amazon/page8.shtml.
[3] United States Agency for International Development (USAID). 2020. *Case Study: Artisanal and Small-Scale Mining in Madre de Dios, Peru*. October.

2.0. Importance of Income Diversification for Miners

Safety During Mining Conflicts and Suspensions

Mining areas in Madre de Dios frequently experience conflicts, including violent confrontations among mining groups or with authorities. These conflicts often lead to significant financial losses and project delays when miners are forced to abandon projects. Therefore, diversifying income can increase resiliency against these challenges. Triscritti[4] mentions two notable examples in Peru's Cajamarca region that underscore the need for miners to diversify income. Firstly, the Yanacocha mine got its license revoked by the Ministry of Energy and Mines after publicly stating that it underestimated the concerns of local people. This was after weeks of violent confrontations between the police and protesters. Similarly, the La Zanja mine experienced a serious conflict that quickly escalated to hundreds of locals occupying the company's premises and destroying its exploration camp and vehicles. Notably, the Peruvian Ombudsman's office reported a rise in social conflicts with over 40% mining-related. These conflicts have continued to grow from 73 incidents per month to 215.

In addition, miners tend to be affected by social unrests and protests such as the 2023 protests reported by La Republica[5], highlighting the need to diversify income sources. During these protests, roads were blocked and the region became isolated, and those solely dependent on mining faced economic vulnerability as the blockades prevented miners from accessing work sites or selling gold. These periodic disruptions inevitably create economic instability. By developing supplementary income sources, miners could build resilience and reduce vulnerability to conflict-related shutdowns.

Economic, Environmental and Social Sustainability

The economic analysis of artisanal and small scale mining in Madre de Dios speaks to the precarious nature of depending only on gold extraction. Although mining directly employs about 30,000 people[6] and indirectly supports local commerce, its unsustainable dependency on finite resources exposes communities to economic instability. Environmental degradation further compounds these challenges, with deforestation and mercury contamination costing the region an

[4] Triscritti, Fiorella. "Mining, development and corporate–community conflicts in Peru." *Community development journal* 48, no. 3 (2013): 437-450.
[5] La República. "Protestas en Perú, Madre de Dios: ¿Cómo va situación paro en región aislada, bloqueos?" January 24, 2023. https://larepublica.pe/sociedad/2023/01/24/protestas-en-peru-madre-dios-como-va-situacion-paro-en-region-aislada-bloqueos-64508
[6] Yard, Ellen E., Jane Horton, Joshua G. Schier, Kathleen Caldwell, Carlos Sanchez, Lauren Lewis, and Carmen Gastañaga. "Mercury exposure among artisanal gold miners in Madre de Dios, Peru: a cross-sectional study." *Journal of Medical Toxicology* 8 (2012): 441-448.

estimated $593.8 million[7] annually in economic losses due to impacts on agriculture, tourism and public health.

Senora Lucila in front of her fish pond. Photo courtesy of Beverly Ndifoin

However, gold miners can significantly benefit from diversifying their income through supplementary businesses like fish farming, creating a more sustainable circular economy. As demonstrated by the Paco fish farming initiative in former mining ponds, these abandoned water bodies get transformed into productive aquaculture sites yielding profitable harvests within six to eight months. Insights from a fish farming expert suggest that repurposing mining ponds into fish ponds offers several advantages: it provides steady income (approximately 8,000 soles or $2,200 revenue per 400-fish cycle of a single floating cage) during periods when mining may be less viable; it creates a healthier food alternative to imported canned fish with potentially high mercury levels; and it rehabilitates mining landscapes that would otherwise remain abandoned and unproductive. Importantly, this model doesn't require miners to abandon their primary activity but instead encourages them to utilize their existing resources, their mining ponds, more efficiently. This complementary business approach creates financial resilience for miners while simultaneously addressing environmental concerns and food security, demonstrating how resource extraction can evolve into a more sustainable circular economic model.

Furthermore, most miners do not have critical labor benefits such as social security[8], pensions or other retirement measures, leaving them financially unprotected in old age. Considering how physically demanding mining is, less demanding complementary or supplementary activities could ease the physical burden at old age.

[7] Mongabay. "In Peru's Madre de Dios, Deforestation from Mining Brings Huge Economic Losses." *Mongabay News*, June 2024. Accessed April 11, 2025. https://news.mongabay.com/2024/06/in-perus-madre-de-dios-deforestation-from-mining-brings-huge-economic-losses/.

[8] Jaramillo Lizana, Jorkaef. "Economic and Social Impact of Informal Mining in Madre de Dios: A Critical Assessment and Proposals for a Sustainable Future." *Available at SSRN 5019990* (2022).

In other parts of the world like Myanmar[9], research has shown that complementary livelihood options are necessary for miners as these help to meet different livelihood needs. Agriculture and mining have been identified as complementary, operating in different seasons and meeting different needs. Therefore, diversifying income sources is essential to address multifaceted needs and also ensures that interventions are effective in controlling illegal gold mining.

Diversifying income sources through other livelihood activities mitigates financial insecurity and aligns with broader goals of environmental restoration. This shift will enhance resiliency, reduce dependency on mining and create a more balanced sustainable economic framework.

3.0. Business Framework

When considering supplementary sources of income to mining, there are a few steps that can help determine what type of activity is best fit and how to begin pursuing that activity as a business. Refer to Figure 2 in the Appendix to walk through these steps with a worksheet. The following steps provide a framework for women of Red de Mujeres MAPE when considering supplemental activities to their mining operations.

First, the feasibility of a complementary business activity must be assessed. The following questions can guide this reflection:

- Do I have the time and flexibility to work on something other than mining?
- If I worked less hours at the mine, what would I want to do to make money instead?

To explore activities that may suit a particular community, consider the following:

- What is a product or service I wish I had closer to home?

[9] Prescott, G. W., A. C. Maung, Z. Aung, L. R. Carrasco, J. D. T. De Alban, A. N. Diment, A. K. Ko et al. *Gold, farms, and forests: Enforcement and alternative livelihoods are unlikely to disincentivize informal gold mining. Conservation Science and Practice, 2: e142*. 2020.

- Are there others in my nearby community who also want that product or service?
- Is there a central location to provide that product or service?

If the interest and willingness to pursue a supplementary business exist, then the level of investment required must be considered. Different business activities demand varying levels of investment. Once a business opportunity has been identified, the necessary resources for starting that business can be evaluated. Key considerations include:

- What materials are required to make the product or offer the service?
- What equipment or technical support is necessary before beginning?
- How much time and labor will be required to begin production?
- What sort of licenses, permits, and/or certifications are required for this line of work?

At this stage, it is also important to assess what resources are already available—such as land, employees, vehicles, or equipment. If the necessary resources are unclear, it may be helpful to research similar businesses in the area or reach out to local regulatory bodies or NGOs that support new enterprises and can offer guidance. Examples are provided later in this text.

Creating a comprehensive list of startup needs—including estimated costs for each item—will form the foundation of a startup budget for the business.

When considering monthly expenses and current income, it is essential to ensure the startup cost is reasonable for the individual's financial situation. A few strategies to consider include:

- Starting small: What are the smallest steps you could take toward this business that don't require a lot of time or investment? This often looks like producing goods for subsistence, whether that's growing produce, raising livestock, or stocking fish ponds. Start small and grow the business slowly.
- Local Context: Is there something unique about doing this type of business in your neighborhood or with your community? A specific, unique need? Easy access to a critical resource? Strict regulations that make it difficult?

The next step is developing a business plan. A simplified business plan requires three parts.

1. Costs: The money spent toward a business
2. Revenue: The money made from a business
3. Markets: Where products or services are sold and/or where customers are located

Costs

The “startup” cost or initial level of investment was estimated in the previous steps, so the next costs to consider are the recurring expenses, such as lease payments, wages, and utility bills. These are most easily assessed on a regular time interval, such as monthly.

Additional costs to account for include larger, less frequent expenses—such as equipment purchases that may last 5–10 years but require a substantial investment when first purchased or replaced. Some examples of this type of expense include a new vehicle to transport goods or machinery needed to maintain land. Preparing for these major expenses in advance can reduce the financial burden when it becomes necessary to replace machinery or repair infrastructure.

One effective strategy is to allocate these large expenses over time—for example, by dividing the total cost into monthly installments over five years and setting aside those amounts into savings. By breaking the larger expense into smaller, manageable portions, it becomes easier to understand the business’s true monthly operating costs and, eventually, to calculate unit costs—how much it costs to produce a single unit of the product or service.

Revenue

Revenue can come from many different sources, even within the same industry. For example, as described in later sections, Ecotourism may involve working as a tour guide, providing transportation for tours, or operating an ecolodge. Livestock offers another example—revenue can be earned by breeding and selling the animals themselves or by selling a variety of products such as dairy, meat, wool, eggs, and more.

These represent different revenue streams within the same general “activity,” so it is important to clearly define what will be sold in order to generate income. Based on an understanding of the chosen activity, one should estimate the amount of money each product or service could reasonably be sold for. It is essential that each product or service is priced above the cost of producing a single unit in order to maintain profitability.

Markets

Finally, identifying the markets for goods or services can be the deciding factor between a successful and an unsuccessful business. Consider the following:

- Do I want to sell directly to end consumers, such as other community members, who will use the product/service themselves?
    - This option allows full control over how the product appears at the point of sale but may be limited by the size and accessibility of the local customer base.
- Do I want to sell to other businesses who then sell my product elsewhere?
    - This route provides access to a larger customer base and the opportunity to sell higher quantities, but it also reduces control over the product after the sale and may result in lower prices per unit.

Once it is clear whether the sale will be direct to consumers or to businesses, the next step is to identify and reach the appropriate buyers. Options might include selling at a local market or supplying restaurants and hotels. Successfully connecting the product with the right consumers—and bringing the product to where those consumers are—is essential.

Overcoming Barriers to Success

Launching a new business often comes with obstacles that can slow down or hinder progress. It is important to consider potential challenges in advance. Common barriers include:

- Money
- Time
- Security
- Formalization
- Technical Knowledge

Planning in advance for how to overcome these challenges can increase the likelihood of success. The following section highlights several organizations that provide support in these areas.

Seek Training, Funding and Support

With a business plan in place, it becomes possible to seek support from external sources to begin operations. Depending on the chosen business activity, there may be a range of NGOs, cooperatives, government ministries, or training programs available to provide assistance.

Training

Examples of training that may be available include World Wildlife Fund's (WWF) training on how to grow and harvest Brazil nuts. The Asociación Forestal Indígena de Madre de Dios, AFIMAD, offers a similar training rooted in traditional indigenous practices. They also provide a market to sell the nuts.

INIA provides group training on how to regenerate soil with seedlings. Through a cooperation with CINCIA, they provide seedlings to landowners and teach them how to properly care for their land over long periods of time. This type of regeneration is important for livestock, produce growth, and the environment.

An organization called Productive Innovation and Technology Transfer Center / Centro de Innovación Productiva y Transferencia Tecnológica Productiva (CITE by its Spanish acronym, CITE hereafter) supports individuals with growing hydroponic plants and establishing aquaculture pools on their property. Their work aims to ensure healthy ecosystems that can support plants and animals at once, while increasing the long-term sustainability of the system.

Funding

Small-scale entrepreneurs in Madre de Dios have access to a range of funding options to help launch or grow their businesses. Local microfinance institutions, such as MiBanco and Caja Arequipa, offer small loans tailored to entrepreneurs with limited credit history and preferential to businesses that benefit the environment and their local communities across Peru. MiBanco is particularly interested in investing in sustainable fishing,[10] which is applicable to Floating Cage Fish Farming discussed later in this document. Larger credit options include services like Tienda Pago or Mercado Pago, that provide small business loans to qualifying applicants.

Government programs through the Fondo de Cooperación para el Desarrollo Social (FONCODES) and the Ministry of Production (PRODUCE) also provide financial support, grants, and training for individuals starting businesses in rural or underserved regions. Additionally, NGOs operating in the Amazon region—such as Caritas del Perú and PRISMA—often offer seed funding, technical assistance, and business development workshops for women and indigenous entrepreneurs. An introduction to Caritas can be made by the Notre Dame team if that's of interest.

Cooperative models and savings groups are another common option, allowing community members to pool resources and access small loans with low risk. These diverse funding channels help reduce barriers to entry and support sustainable, supplemental economic activities to mining.

Support

Additional forms of support can be provided to help entrepreneurs navigate the business development journey. Cooperative models like Coopsur bring multiple entrepreneurs together to sell their products at a larger scale. This model promotes the sharing of best practices and resources in a collaborative way that benefits all members. It also strengthens entrepreneurs' bargaining power when selling to other businesses by increasing collective control over the regional supply. Joining a cooperative aligned with the chosen business activity can offer valuable opportunities to support the launch and growth of a new venture.

Additionally, the women of Red Mujeres MAPE form a strong support network. Each member brings her own experiences with different business activities, and by sharing those experiences, all women in the group benefit and grow together.

Monitor and Adapt

[10] Mibanco recognizes the most innovative solutions with the 2024 Spiral Innovation Award." 2024. Corresponsables. https://www.corresponsables.com/per/actualidad/mibanco-reconoce-las-soluciones-mas-innovadoras-con-el-premio-espiral-de-innovacion-2024/.

After a business begins generating income, the final step toward ensuring long-term sustainability is monitoring progress and continually seeking improvement. Tracking costs and income is critical to understanding the business's financial performance and determining whether there is sufficient budget to scale operations. If applicable to the business activity, environmental monitoring is also important to maintain the health of the land involved. This may include water and soil quality testing, as well as tracking plant growth. For those engaged in livestock or fish farming, animal health management is essential. Regular monitoring of animal health, with support from veterinary professionals, helps prevent the spread of disease and reduces the risk of other health-related issues. Potential issues can be caught early on if proper monitoring is done, allowing ample time to address the problem and prevent significant losses.

By adopting consistent monitoring practices early on, new farmers can build more resilient, sustainable operations that protect both their livelihoods and the surrounding environment.

4.0. Floating Cage Fish Farming in Post-Mining Ponds

Source: Institut de recherche pour le développement

Livelihood Opportunity

Floating cage aquaculture in mining ponds represents a possible solution to the dual challenges of livelihood diversification and environmental recovery in Madre de Dios. The local market demand for *paco* (also called *red-bellied pacu*), a culturally preferred native fish, is high in the region, especially during holidays like Christmas and Holy Week. Prices range from 20 PEN ($5.35 USD) per kilogram to 25 PEN ($6.70 USD) per kilogram during special events, with each individual fish weighing about a kilogram[11]. Despite the presence of mercury contamination due to extensive artisanal gold mining practices, consumers continue to rely heavily on fish as a dietary staple. However, recent studies reveal that mercury levels in *wild-caught* carnivorous fish

[11] Giesey, M. (2025, March). Field *Notes on Floating Cage Aquaculture in Post-Mining Ponds, Madre de Dios, Peru* [Unpublished Document]. University of Notre Dame.

often exceed international safety thresholds, making clean, farm-raised fish an attractive alternative[12].

Fish raised in floating cages have a distinct market advantage. Since they do not interact with contaminated sediment—the primary location of methylmercury formation—they are significantly less likely to accumulate harmful levels of mercury[13]. Additionally, consumer confidence can be reinforced through water and fish tissue testing, which is already being carried out through labs in Puerto Maldonado and Lima. Having an existing pipeline for this type of testing presents an opportunity for producers to position their product as a "clean" alternative in both local and regional markets. This could include remote mining communities that are willing to pay a premium for safe, protein-rich food, like La Pampa[14].

Source: Roger Stevens

Minimum Requirements

The start-up requirements for this model are relatively low. A single floating cage costs approximately 10,000 PEN ($2,675 USD) and can support up to 400 *paco* juveniles, though best

[12] Martinez, G., McCord, S. A., Driscoll, C. T., Todorova, S., Wu, S., Araújo, J. F., Vega, C. M., & Fernandez, L. E. (2018). Mercury contamination in riverine sediments and fish associated with artisanal and small-scale gold mining in Madre de Dios, Peru. *International Journal of Environmental Research and Public Health, 15*(1584).
[13] Martinez, G., McCord, S. A., Driscoll, C. T., Todorova, S., Wu, S., Araújo, J. F., Vega, C. M., & Fernandez, L. E. (2018). Mercury contamination in riverine sediments and fish associated with artisanal and small-scale gold mining in Madre de Dios, Peru. *International Journal of Environmental Research and Public Health, 15*(1584).
[14] Diringer, S. E., Feingold, B. J., Ortiz, E. J., Gallis, J. A., Araújo-Flores, J. M., Berky, A., Pan, W. K. Y., & Hsu-Kim, H. (2015). River transport of mercury from artisanal and small-scale gold mining and risks for dietary Mercury exposure in Madre de Dios, Peru. *Environmental Science: Processes & Impacts, 17*(2), 478–487.

practice often limits this to 160 fish per cycle to ensure growth and reduce stress. Juvenile fish cost around 5,000 PEN ($1,337 USD) per batch, and operational expenses including fish food and labor average about 300 PEN ($80 USD) per month (costs outlined in **Table 1** below). For operations that raise 160 *paco* per cycle, initial break-even occurs after the first full production cycle of six to eight months, after which operations can become profitable. Floating cages are sourced from Brazil, where producers have already accounted for local risks—designing the cages to withstand caimans and giant otters, which are common in the Amazon[15].

Importantly, site selection must prioritize water quality, security, and logistical access. While traditional aquaculture ponds may reach only 1.5 meters in depth, deeper mining ponds and slow-flowing tributaries offer better oxygenation and water circulation, reducing the risk of ammonia buildup. In addition to physical infrastructure, operations require committed labor—typically either the landowner or a trusted partner from the mining community who can provide security and manage daily care for the fish. Because post-mining ponds often exist within existing concession zones, identifying and building alliances with miners or landholders who support the transition to aquaculture is critical[16].

Prior to beginning operations, it is critical to conduct water and soil testing to determine the suitability of post-mining ponds for fish propagation. Baseline testing ensures that parameters such as dissolved oxygen, pH, ammonia, nitrites, and temperature fall within optimal ranges for fish health. Poor water quality can lead to fish stress, disease outbreaks, or mass die-offs, particularly during the dry season when oxygen crashes are common[17]. Additionally, sediment testing is vital to detect residual mercury or heavy metals in the pond bed, which, while less of a risk in floating cage systems, may still pose indirect threats through waterborne exposure or bioaccumulation in feed sources.

Structured monitoring protocols, potentially supported by organizations like CINCIA or INIA, could provide farmers with actionable insights to manage risk and maintain environmental safety. Integrating soil and water diagnostics not only promotes fish health, but also opens pathways for potential certification (IE, “mercury-free” branding) that could enhance consumer trust and price premiums in regional markets.

Market Viability

[15] Giesey, M. (2025, March). Field *Notes on Floating Cage Aquaculture in Post-Mining Ponds, Madre de Dios, Peru* [Unpublished Document]. University of Notre Dame.
[16] Giesey, M. (2025, March). Field *Notes on Floating Cage Aquaculture in Post-Mining Ponds, Madre de Dios, Peru* [Unpublished Document]. University of Notre Dame.
[17] Diringer, S. E., Berky, A. J., Marani, M., Ortiz, E. J., Karatum, O., Plata, D. L., Pan, W. K., & Hsu-Kim, H. (2020). Deforestation due to artisanal and small-scale gold mining exacerbates soil and mercury mobilization in Madre de Dios, Peru. *Environmental Science & Technology, 54*(1), 286–296.

The consumer base in Madre de Dios is fish-dependent, and supply consistently falls short of demand[18]. While tilapia (*Oreochromis niloticus*) has been considered in other contexts, it is invasive and less suitable for floating cage aquaculture in this region[19]. Although Peru has general aquaculture regulations, there is no evidence of a specific national framework dedicated to managing the ecological risks of Nile tilapia, despite its known invasive potential and widespread use in tropical aquaculture[20].

By contrast, *paco* is robust, well adapted to local conditions, and familiar with local consumers. Local sales are strongest when fish reach 0.5 to 1 kilogram, which can be achieved within six months. Retail prices remain stable, with higher returns possible when selling directly in mining zones. A kilo of *paco* can command upwards of 25 PEN ($6.70 USD), and clean, certified fish could potentially fetch even higher prices due to growing awareness of mercury-related health concerns. Additionally, fish sold in illegal mining centers such as La Pampa could command even higher prices due to price inflation in that area[21].

Surveys and laboratory studies of wild fish in the area confirm that methylmercury contamination is widespread and largely invisible to the naked eye or standard water testing kits[22]. Consequently, consumer education and formal certification would be essential tools in building trust and securing market differentiation. Floating cage aquaculture could offer the rare chance to supply mercury-safe protein that is traceable, locally grown, and aligned with public health goals.

Resources Required

Total estimated startup costs range from 15,000 to 18,000 PEN ($4,000–$4,800 USD) per cage[23]. This includes the cost of infrastructure, juvenile fish, feed, and initial water quality testing. Access to technical knowledge—such as monitoring dissolved oxygen levels, understanding cage positioning, and measuring water ammonia—is increasingly available through local

[18] Diringer, S. E., Feingold, B. J., Ortiz, E. J., Gallis, J. A., Araújo-Flores, J. M., Berky, A., Pan, W. K. Y., & Hsu-Kim, H. (2015). River transport of mercury from artisanal and small-scale gold mining and risks for dietary mercury exposure in Madre de Dios, Peru. *Environmental Science: Processes & Impacts, 17*(2), 478–487.
[19] Zambrano, Luis, et al. "Invasive Potential of Common Carp (*Cyprinus carpio*) and Nile Tilapia (*Oreochromis niloticus*) in American Freshwater Systems." *Canadian Journal of Fisheries and Aquatic Sciences*, vol. 63, no. 9, 2006, pp. 1903–1910.
[20] Zambrano, Luis, et al. "Invasive Potential of Common Carp (*Cyprinus carpio*) and Nile Tilapia (*Oreochromis niloticus*) in American Freshwater Systems." *Canadian Journal of Fisheries and Aquatic Sciences*, vol. 63, no. 9, 2006, pp. 1903–1910.
[21] Giesey, M. (2025, March). Field *Notes on Floating Cage Aquaculture in Post-Mining Ponds, Madre de Dios, Peru* [Unpublished Document]. University of Notre Dame.
[22] Diringer, S. E., Berky, A. J., Marani, M., Ortiz, E. J., Karatum, O., Plata, D. L., Pan, W. K., & Hsu-Kim, H. (2020). Deforestation due to artisanal and small-scale gold mining exacerbates soil and mercury mobilization in Madre de Dios, Peru. *Environmental Science & Technology, 54*(1), 286–296.
[23] Giesey, M. (2025, March). Field *Notes on Floating Cage Aquaculture in Post-Mining Ponds, Madre de Dios, Peru* [Unpublished Document]. University of Notre Dame.

initiatives and institutions like CINCIA. Supportive government agencies and NGOs are already collaborating on sustainable development efforts in Madre de Dios, and fish farming is emerging as one of the few activities with both economic and ecological justification[24].

Boats are often used to scout for pond depth and water flow conditions, ensuring that cages are deployed where sediment interaction and stagnant water will be minimized. A medium-sized boat will cost around 9,000 PEN ($2,407 USD) but would greatly assist in transporting products to the marketplace[25]. Additional investments in transport for juvenile fish and secure food storage may be necessary depending on the location of the operation. See **Table 1** below for a full list of costs.

Table 1: Startup & Operational Costs

Stage	Description	Estimated Cost	Timeframe
Stocking	Purchase and transport of juvenile *paco* (approx. 160 fish per cage) Secure floating cage and setup site	● Cage: 10,000 PEN ($2,675 USD) ● Fish: 5,000 PEN ($1,337 USD) ● Transport: 500–800 PEN ($133-$214 USD)	● Initial setup: 1 week ● Stocking: 1–2 days
Feeding & Monitoring	Daily feeding, water testing, cage cleaning, and fish health observation	● Feed: 300 PEN ($80 USD)/month ● Optional: testing kits, labor (if hired)	● 6–8 months (entire growth cycle)
Harvesting	Capture mature fish (~0.5–1.0 kg), clean, and prepare for sale or delivery	● Labor (optional) ● Equipment (nets, storage)	● 1–2 weeks per cycle
Marketing & Sales	Sell in local markets, mining camps, or direct to households Highlight "mercury-free"	● Transport: 200–500 PEN ($53-$133 USD)	● Ongoing after harvest; peak demand Dec–May

[24] Duff, P. M., & Downs, T. J. (2019). Frontline narratives on sustainable development challenges/opportunities in the 'illegal' gold mining region of Madre de Dios, Peru: Informing an integrative collaborative response. *The Extractive Industries and Society, 6*(2), 552–561.
[25] Giesey, M. (2025, March). Field *Notes on Floating Cage Aquaculture in Post-Mining Ponds, Madre de Dios, Peru* [Unpublished Document]. University of Notre Dame.

	certification if available	• Lab test (if used): ~100–200 PEN/sample	

Total startup costs: 15,800 PEN; total operational costs (monthly): 1,000-1,500 PEN

Regulatory Considerations

In Peru, land is classified as either public or private, with natural resources, such as water, fish, minerals, and forests, belonging exclusively to the state regardless of land ownership. Individuals and companies can occupy land under various legal roles: as owners with full rights, as possessors who act like owners without formal title, or as holders who occupy land with permission but without ownership claims. Possessors, even without official documentation, may legally pursue ownership if the original owner has long abandoned the land. Importantly, a person does not need to own the land to apply for permission to use the natural resources on it. However, they must typically demonstrate legitimate access, such as a lease or informal agreement, to obtain such authorization.

However, it is important to note that landholding in Peru often exists without formal title, especially in communities where informal possession and joint community rights predominate. In such settings, individuals frequently manage and harvest land based on practical access and community legitimacy rather than state-recognized ownership[26]. These informal norms can function as strong substitutes for legal regulation, particularly where formal governance is weak or inaccessible. This legal flexibility can provide a practical framework for implementing small-scale aquaculture in Madre de Dios, where many mining ponds lie on land held informally or communally.

Officially, when it comes to conducting activities on land where natural resource use is involved, both land access and state authorization are required. On public land, the state must authorize both land use and resource extraction. On private land, the landowner's consent is needed for physical access, while the state remains responsible for authorizing the use of natural resources. If the land belongs to an Indigenous community, both the community and the state must provide authorization, with additional protections under international law.

For projects like fish farming, these distinctions are crucial: if the pond is on land the miner owns or has legitimate possession of, fewer legal barriers exist. In contrast, if the activity is on someone else's land, the miner must secure permission from the landholder. This framework provides a flexible legal basis for miners to engage in alternative livelihoods like aquaculture without requiring full ownership of the land, so long as proper access arrangements and authorizations are in place.

[26] Braaten, Devin. "Land Rights and Community Cooperation: Public Goods Experiments from Peru." *World Development*, vol. 61, 2014, pp. 127–141.

Formalization of mining pool fish farming enterprises in Madre de Dios is currently not a prerequisite, provided there is clear support from local concession holders and community leaders[27]. Numerous studies highlight the challenges of formal regulation in the region, often complicated by overlapping concession uses (mining, tourism, forestry) and limited state capacity[28]. However, successful aquaculture projects operate informally but with strong local legitimacy, often through arrangements where landowners or miners take responsibility for site security, fish feeding, and access agreements[29].

That said, alignment with national mercury reduction goals (I.E. under the Minamata Convention) and emerging conservation strategies offers opportunities for future support, especially for projects that demonstrate ecological restoration or carbon offset potential[30]. Formal partnerships with organizations conducting environmental monitoring may also support scalability and grant funding eligibility for even small-scale fish farming operations.

Required Permits

- Phase 1 (0–6 months): Identify and secure 1–2 suitable ponds in collaboration with local concession holders. Install floating cages and begin stocking with juvenile *paco*. Train caretakers in feeding and water quality management.
- It is necessary to request a water use permit from the National Water Authority (ANA) for aquaculture activities in bodies of water, including post-mining ponds[31].
- If the pond is located within an active mining concession, it is necessary to coordinate with the Mining Authority to obtain the corresponding authorizations that allow both activities to coexist.
- Depending on the scale of the aquaculture project and the characteristics of the body of water, it may be necessary to submit a Declaration of Environmental Impact (DIA) to the Mining Authority in order to assess potential impacts and establish mitigation measures.

Seek legal assistance for obtaining the required permits, since legal requirements may vary in each case depending on the location of the mining concession, property rights over the concession, and the size of the ponds.

---

[27] Giesey, M. (2025, March). Field *Notes on Floating Cage Aquaculture in Post-Mining Ponds, Madre de Dios, Peru* [Unpublished Document]. University of Notre Dame.

[28] Espin, J., & Perz, S. (2021). Environmental crimes in extractive activities: Explanations for low enforcement effectiveness in the case of illegal gold mining in Madre de Dios, Peru. *The Extractive Industries and Society, 8*(1), 331–339.

[29] Giesey, M. (2025, March). Field *Notes on Floating Cage Aquaculture in Post-Mining Ponds, Madre de Dios, Peru* [Unpublished Document]. University of Notre Dame.

[30] Diringer, S. E., Berky, A. J., Marani, M., Ortiz, E. J., Karatum, O., Plata, D. L., Pan, W. K., & Hsu-Kim, H. (2020). Deforestation due to artisanal and small-scale gold mining exacerbates soil and mercury mobilization in Madre de Dios, Peru. *Environmental Science & Technology, 54*(1), 286–296.

[31] Gobierno del Perú. "Solicitar Permiso de Uso de Agua para Actividades Acuícolas en las Categorías Productivas AREL y AMYPE." *Gob.pe*, Gobierno del Perú, https://www.gob.pe/55144-solicitar-permiso-de-uso-de-agua-para-actividades-acuicolas-en-las-categorias-productivas-arel-y-amype. Accessed 26 Apr. 2025.

Ecological Impacts

One of the strongest arguments for floating cage aquaculture in mining ponds is its alignment with circular economy principles. These ponds, which are often seen as ecological dead zones, are being naturally recolonized by aquatic biodiversity—including fish, amphibians, and aquatic plants[32]. This rewilding creates an opportunity to integrate fish farming with restoration, water management, and even educational tourism. Floating cages also prevent direct contact with contaminated sediments, thereby reducing the likelihood of mercury bioaccumulation. Moreover, they eliminate the need to clear additional forest or disturb intact ecosystems for new infrastructure.

Environmental Monitoring

Several studies indicate that some post-mining ponds in Madre de Dios have lower sediment-bound mercury levels than pristine oxbow lakes, likely due to reduced erosion and minimal organic inputs[33]. While this supports the use of water-column-based aquaculture, it does not eliminate the need for active environmental vigilance. To ensure both ecological and public health safety, fish farming initiatives should incorporate a structured environmental monitoring plan that aligns with existing regulatory standards while adding safeguards specific to the region's risks.

Baseline water testing, already required by regulation before the start of aquaculture operations[34], should include parameters such as temperature, pH, dissolved oxygen, ammonia, and nitrites. However, because drought-related oxygen crashes are a major hazard in Madre de Dios,[35] farmers should adopt weekly or semi-automated monitoring systems for oxygen and temperature levels. Real-time sensors or affordable analog tools could provide early warnings to prevent fish kills during dry periods.

Fish stocking density should also be monitored closely, as overcrowding can lead to poor water quality, slow growth, and heightened disease transmission[36]. While optimal densities vary by species, organizations like CITE have developed guidelines for maximizing yield while maintaining fish health, particularly for native species like *paco*. Adherence to these recommendations is essential for both environmental balance and economic performance.

---

[32] Araújo-Flores, J. M., Santa-Maria, M. C., Timana-Mendoza, C., Reyes-Calderon, A., & Venail, P. (2024). *Assessing fish diversity in abandoned mining ponds in Madre de Dios, Peru, using environmental DNA*. Environmental DNA, 6, e520.

[33] Diringer, S. E., Berky, A. J., Marani, M., Ortiz, E. J., Karatum, O., Plata, D. L., Pan, W. K., & Hsu-Kim, H. (2020). Deforestation due to artisanal and small-scale gold mining exacerbates soil and mercury mobilization in Madre de Dios, Peru. *Environmental Science & Technology, 54*(1), 286–296.

[34] Chávez Michaelsen, A., et al. "The Effects of Climate Change Variability on Rural Livelihoods in Madre de Dios, Peru." *Regional Environmental Change*, vol. 20, 2020, article 70.

[35] Timaná-Mendoza, Claudia, et al. "Assessing Fish Diversity in Abandoned Mining Ponds in Madre de Dios, Peru, Using Environmental DNA." *Environmental DNA*, 2024.

[36] Timaná-Mendoza, Claudia, et al. "Assessing Fish Diversity in Abandoned Mining Ponds in Madre de Dios, Peru, Using Environmental DNA." *Environmental DNA*, 2024.

Mercury monitoring presents a unique challenge. Although floating cages minimize direct sediment contact, environmental exposure can still occur through waterborne pathways and feed. Farmers should avoid commercial feeds containing fish meal or animal protein, as these may introduce mercury or other heavy metals[37]. Ideally, each harvest-ready batch of fish should undergo testing for methylmercury (MeHg) through a partnership with a scientific institution such as CINCIA or a regional laboratory. Alternatively, regular random sampling—perhaps monthly—could provide a more continuous picture of mercury risk over time.

Finally, water samples should be tested at least annually for other heavy metals (e.g., arsenic, cadmium, lead), which, while often overlooked, can accumulate in fish tissue and pose toxicological risks to both fish and consumers. Establishing a simple but reliable testing protocol for these contaminants will not only protect the health of the local population but also position fish farmers to meet future certification standards, potentially unlocking access to premium markets[38].

Recommendations

Based on the market dynamics, environmental conditions, and social structures of Madre de Dios, floating cage aquaculture using *paco* emerges as one of the most viable complementary livelihood activities in the region. It addresses a major public health concern (mercury in fish), leverages existing post-mining infrastructure, and taps into local cultural preferences for native fish. The model is simple enough for miners or landowners with minimal training to adopt, and robust enough to scale with proper oversight.

Efforts should focus on building partnerships with local miners who have capital and land but lack direction or diversified income streams. Pilot sites should be selected based on security, water quality, and local buy-in. Certification processes (e.g., mercury-free fish) can enhance market positioning and serve as a gateway to broader environmental goals.

Implementation Strategy

- Phase 1 (0–6 months): Identify and secure 1–2 suitable ponds in collaboration with local concession holders. Install floating cages and begin stocking with juvenile *paco*. Train caretakers in feeding and water quality management.
- Phase 2 (6–12 months): Conduct mercury testing and water quality monitoring in collaboration with institutions like CINCIA. Begin harvesting and selling fish during high-demand periods. Use revenues to fund further cycles and test cage durability.
- Phase 3 (12–24 months): Expand the number of cages, explore additional sites, and train new farmer-partners. Establish an informal cooperative or buyer network to aggregate supply and

[37] Diringer, S. E., Berky, A. J., Marani, M., Ortiz, E. J., Karatum, O., Plata, D. L., Pan, W. K., & Hsu-Kim, H. (2020). Deforestation due to artisanal and small-scale gold mining exacerbates soil and mercury mobilization in Madre de Dios, Peru. *Environmental Science & Technology, 54*(1), 286–296.

[38] Timaná-Mendoza, Claudia, et al. "Assessing Fish Diversity in Abandoned Mining Ponds in Madre de Dios, Peru, Using Environmental DNA." *Environmental DNA*, 2024.

share best practices. Integrate restoration goals and explore funding from sustainability or conservation programs.

Table 2: Livelihood Challenges & Opportunities

Category	Challenges	Opportunities
Economic Viability	● Upfront costs (I.E. cages, fingerlings, feed) may be a barrier without initial capital or credit access ● Inconsistent market access in remote areas	● Fish farming offers steady income with lower health or environmental risks than mining; high local demand for *paco*, especially during holidays, ensures a ready market ● Potential to break even after first cycle; sustainable income long-term
Technical Knowledge	● Limited aquaculture training in rural areas. Farmers may lack experience in water quality management and disease prevention	● Simple systems (e.g., floating cages) are easy to learn and manage with basic support ● Support available through CINCIA, government partnerships, and NGOs
Environmental Conditions	● Mercury contamination in mining areas is a risk ● Shallow or stagnant ponds can reduce water quality	● Floating cages keep fish off sediment, reducing mercury exposure ● Many abandoned mining ponds are deep enough and reconnect with rivers, aiding water flow and oxygenation
Legal & Land Access	● Complex concession rights; unclear or overlapping land/resource claims	● Fish farming can be set up informally with miner/landowner buy-in—no need for full formalization.

	● Risk of operating in informally controlled areas	● Aligns with government and international goals to reduce illegal mining and support sustainable development
Community Perception	● Skepticism around using mining ponds for fish ● Preference for quick cash from gold may deter some from trying aquaculture	● Strong interest once benefits are demonstrated ● Farmers can work with neighbors and former miners, creating a network of support
Security	● Theft of fish or equipment if ponds are near roads or unprotected	● Hiring trusted locals or working with miner-concession owners creates built-in protection ● Sites off-road are naturally more secure
Health & Safety	● Risk of mercury exposure if farming methods are poor ● Lack of awareness about safe aquaculture practices	● Certified mercury-free fish can be promoted as healthier than wild-caught alternatives. ● Better working conditions than the dangerous, exploitative gold mining environment.
Scalability	● Expansion requires more cages, inputs, and labor ● Some sites are hard to reach or manage at scale	● Modular nature of floating cages makes it easy to expand gradually. ● Potential for cooperatives or associations to share resources and reach new markets.
Environmental Impact	● Poorly managed farms can pollute water (e.g., excess feed or waste buildup)	● Fish farming reuses degraded land and supports local biodiversity.

		• Can integrate with restoration or eco-certification programs.

5.0. Other Supplemental Activities

In addition to floating cage fish farming, several other supplemental economic activities are commonly practiced in the Madre de Dios region, each varying in terms of implementation complexity and potential for scalability. This research also explored activities such as reforestation through agricultural production, ecotourism, and livestock farming. While not an exhaustive list, these examples represent a selection of viable options that may be considered for income diversification in the region. The following sections provide an overview of each activity with resources to seek additional information as needed.

5.1. Produce

RECOMMENDATIONS:

- Check the viability of the project in terms of land use
- Use agroforestry systems that mimic natural forest structures
- Conduct thorough soil and water testing
- Prioritize organic and regenerative agriculture
- Implement bioremediation techniques

RESOURCES NEEDED:

- Land: Areas that can be rehabilitated and/or clear areas.
- Financial Resources: For land acquisition or leasing, seedlings, organic fertilizers, sustainable equipment, and fair wages for labor.
- Technical Expertise: Agronomists specializing in tropical agroforestry, soil remediation experts, and community development facilitators.
- Labor: Skilled and trained local workers, with fair compensation and safe working conditions.
- Equipment: farming tools, water testing equipment

The Amazon, one of the most biodiverse ecosystems in the world, offers a variety of products such as castañas, copoazu, arazá, camu camu, avocado, citrus fruits, coconut, chontaduro, guaba, papaya, and pineapple, among others like soursop, guarana, cashew, uvilla, and pitaya. Some products' uniqueness enhances their appeal in international markets and increases their potential for export.

Agriculture, livestock, hunting, and forestry are the four main economic activities in the region, and agricultural products are the third most exported goods.[39] Although crops vary throughout the year, the Ministry of Agrarian Development and Irrigation indicates that the most cultivated

[39] Banco Central de Reserva del Perú. Madre de Dios: Síntesis de Actividad Económica. January 2020

products include brachiaria grass, plantain, cassava, cacao, papaya, pineapple, yellow corn, and paddy rice.[40]

Sustainable agroforestry systems offer a valuable approach to balancing economic development with environmental preservation in the Tambopata region. By integrating the production of crops with potential economic value to the restoration of degraded lands, these systems could promote land preservation and support environmental management plans for mining sites. Techniques such as intercropping, cover cropping, and natural pest control are essential components, with a focus on local ecosystem recovery. However, it is crucial to recognize that the expansion of the agricultural frontier poses a potential threat to the landscape and native ecosystems. Therefore, it is essential to have the necessary technical guidance for minimizing the negative impacts and maximizing the potential of reforestation.

Additionally, one concern expressed by different NGOs is the lack of studies on potential mercury contamination in produced goods cultivated nearby mining areas. To address these challenges, collaboration with local partners is essential, some of the organizations identified are:

- CINCIA (Centro de Innovación Científica Amazónica): For their crucial scientific research on the impacts of gold mining and deforestation in the Amazon, as well as their work on developing innovative solutions for environmental restoration.
- CITE productivo Madre de Dios
- Wyss Academy
- The Nature Conservancy: For their expertise in land management and ecological restoration.
- Amazon Conservation Association (ACA)
- Servicio Nacional Forestal y de Fauna Silvestre (SERFOR): The Peruvian national service for forest and wildlife, providing regulatory oversight and technical assistance.

As resources allow, supplemental production of consumer goods outside of mining sites could be a viable diversification option. One successful example currently being implemented in the region is the cacao cooperatives, such as Coopsur and Agrobosque, which integrate small and medium-scale producers, encourage the adoption of agroecological techniques to increase production, and enable producers to access larger markets and obtain technical assistance for certifications that enhance product value and expand market reach.

Best practices for implementing activity

Growing sustainable agroforestry systems can be approached in many ways; however, some good practices to keep in mind from an environmental perspective include conducting thorough

[40] ITP produccion, Dinamica agricola. Accessible at: https://data-peru.itp.gob.pe/profile/geo/tambopata-170101?monthsAvailableAgricola=2020-03&topCultivos=1-10

soil and water testing to determine soil properties and contamination levels—especially near mining sites. It is important to be aware of potential mercury contamination and consider this when selecting suitable crops. Another key practice is to employ agroforestry systems that mimic natural forest structures, avoiding the introduction of non-native species that could negatively interact with local ecosystems. Prioritizing organic and regenerative agriculture can also be beneficial, not only for the environment but also for accessing niche markets and certifications. Finally, implementing bioremediation techniques can help reduce mercury contamination and support long-term land recovery.

Challenges and possibilities

The below table summarizes predictable challenges and opportunities when considering agricultural products as a supplemental source of income.

Category	Challenges	Opportunities
Environmental	- Potential mercury contamination in soil/water from nearby mining areas - Deforestation from expanding agricultural frontiers - Risk of introducing invasive species or unsuitable crops	- Rehabilitate degraded land through agroforestry - Implement bioremediation and regenerative practices - Mimic natural forest systems - Prioritize native species with high value (e.g., Brazil nuts, copoazú, guarana) - Strengthen local biodiversity
Technical Capacity	- Lack of technical knowledge in soil remediation, agroforestry design, or organic methods	- Collaboration with CINCIA, SERFOR, and ACA for training - Use of proven methods: intercropping, cover crops, natural pest control

Economic	- Initial investment costs for land rehabilitation and farming infrastructure - Market access barriers	- High market value for niche Amazonian products (e.g., cacao, copoazú) - Certification opportunities (organic, fair trade) to raise value
Social & Labor	-- Trained personnel availability	- Job creation with fair wages in agroecology - Capacity-building and collaboration
Health & Safety	- Lack of studies on long-term exposure to mercury in agricultural produce	- Soil/water monitoring and testing before production - Potential support from NGOs for contamination studies
Regulatory/Institutional	- Bureaucracy and weak enforcement of environmental laws	- Engagement of local governments for technical and logistical support
Market Development	- Informal markets and poor infrastructure	- Existing successful models (e.g., Coopsur, Agrobosque) - Support from NGOs for value chain development

5.2. Ecotourism

RECOMMENDATIONS

- Start small with essential resources like a boat, and expand only if income allows.
- Follow environmental principles strictly to protect nature and attract tourists with interest in the environment.
- Collaborate with local organizations like the Tambopata Management Committee for guidance and permits.
- Invest in basic quality improvements like hot water and waste management to enhance guest experience.
- Get legal support and training to meet national tourism requirements and run your business properly.

RESOURCES NEEDED

- Natural Resources and access to their administration.
- Infrastructure: Potable water supply systems, hot water, roads, means of transportation and waste management system. Some infrastructure (such as means of transportation) can be provided by the private sector, which can be an investment opportunity.
- Knowledge about the environment and local Natural Resources if interested in educating tourists.
- Second language if interested in working as a tour guide or having direct communication with tourists.

In general terms, all tourism is situated in an environmental, social, and economic world.[41] What makes ecotourism different is its key principles: Conservation, community benefits, environmental education and awareness, and low impact. In addition to minimizing environmental harm, ecotourism actively promotes sustainable practices, encourages meaningful engagement with local cultures, and fosters a deeper understanding of natural ecosystems. Considering this, one could say that ecotourism, from a business perspective, is the offering of goods and services to tourists guided by ethical and philosophical principles of environmental conservation, respect for life, and the natural habitat of living beings within their own social, environmental, and economic context. It implies a responsible management that prevents mass tourism's negative effects while ensuring long-term benefits for both local communities and biodiversity. This means that the ethical considerations of environmental impact are going to have equal or perhaps more value than the economic considerations of revenue. However, to make it a sustainable business, revenue should be enough to maintain the livelihoods of the communities that depend on it.

Having ecotourism as a business implies a normative commitment to the environment and sustainability, and this normative commitment is going to influence all economic decisions. Taking that into consideration ecotourism can look less attractive as a business model, however,

[41] Wearing, Stephen, and Schweinsberg, Stephen. 2019. *Ecotourism : Transitioning to the 22nd Century*. Third edition.. Abingdon, Oxon ; New York, NY: Routledge.

researches have shown that, for instance “through economic incentives and revenues, ecotourism has provided local guardianship by communities or villagers, while encouraging effective resource management”[42].

Reserva Nacional Tambopata. Source: Camila Salamandra

Resources needed

Starting an ecotourism business in Madre de Dios, Perú requires access to natural resources, adequate infrastructure, technical knowledge and some legal authorizations depending on the specific activities involved. These resources can be managed or accessed through the support of institutions present in the region. Startup costs range from 14,000 PEN (around 4,000 USD), which corresponds to the initial cost of purchasing a boat to offer river transportation services, to up to 100,000 PEN (approximately 26,700 USD) for high-investment ventures such as building hotels, hostels, or ecolodges[43].

Natural resources are the first and most essential asset, as they are the main reason tourists are attracted to the region. This is one of Madre de Dios’s greatest strengths: located in the heart of the Peruvian Amazon, the region offers direct access to landscapes, diverse wildlife, and protected areas such as the Tambopata National Reserve. For those interested in starting a business that involves the Reserve, a good starting point is to engage with The Management Committee of the Tambopata National Reserve[44], which includes local organizations like *AMATAF* and/or *Los Tambopatas*[45]. There are also opportunities for ecotourism outside of protected areas, depending on property rights and whether the land is public and accessible to local communities. Greenhouse Tambopata[46] is another key actor in the region that can help identify which zones are suitable, and which are not, for ecotourism development.

In terms of infrastructure and basic services, the region shows mixed conditions. There are eco-lodges and examples of sustainable accommodations. For instance, Rainforest Expeditions[47] stands out as a successful example in the area. However, the lack of standardized quality measures may negatively influence the experience of some tourists. One example is the lack of access to hot water, which from an optimistic point of view represents an opportunity for

[42] Ramírez, Fernando, and Santana, Josefina. 2019. *Environmental Education and Ecotourism*. Cham, Switzerland: Springer.
[43] Information obtained from an expert in tourism in the region.
[44] Original name in Spanish: Comité de Gestión de la Reserva Nacional Tambopata.
[45] Los TamboPatas, "Los TamboPatas," accessed April 5, 2025, https://www.tambopatas.org/.
[46] Green House Tambopata, "Green House Tambopata," accessed April 5, 2025, https://greenhousetambopata.com/.
[47] Rainforest Expeditions, "Peru Amazon Tours," accessed April 5, 2025, https://www.rainforestexpeditions.com/peru-amazon-tours/.

investment and improvement. Clean water is available mostly in bottles, as there is no general potable water supply system. Waste management systems exist but are not yet environmentally friendly enough. On the other hand, transportation infrastructure is present since there are air, river, and land routes which create an opportunity to invest in cars, vans, or boats that can meet the demand of transportation for tourists and tourism companies.

While the structural conditions of infrastructure require significant participation from the public sector and do not depend as much on the willingness of the private sector, the private sector can engage in conversations with public institutions to advance infrastructure plans. For example, the Ministry of Environment[48] is investing in infrastructure to improve tourism in regions like Madre de Dios through the *"Con Punche Perú Turismo"* plan[49], showing clear state interest in boosting the sector and supporting its development. These types of government initiatives represent an opportunity for the ecotourism sector, along with NGOs and environmental organizations, to make requests and suggestions on how infrastructure investment should be done in the region according to market demands.

Environmental knowledge is available through both institutional and local sources. However, there is a limited presence of language training institutions, and overall language skills in the region are low, which could pose a challenge for international tourism. Key institutions for obtaining knowledge in either language training or environmental information include the National Amazonic University[50] of Madre de Dios, the National System of State-Protected Natural Areas[51], and NGOs such as Amazon Ecology[52], which have provided support and guidance to ecotourism projects in the past[53].

Regarding legal and educational requirements, the Peruvian government mandates a tourism diploma to work as a certified tour guide. In order to operate a hotel in the region, establishments must have at least six rooms and hot water. Eco-lodges must also meet environmental sustainability standards. A relevant institution overseeing these requirements is the Regional Directorate of Foreign Trade and Tourism[54] of Madre de Dios. An institution that can help with guidance for these requirements is the Peruvian Society of Environmental Law[55] Although they

[48] Original name in Spanish: Ministerio de medio ambiente
[49]Ministry of the Environment of Peru, "Madre de Dios: New Infrastructure for Safe Solid Waste Disposal in Tambopata Province," published October 20, 2023, https://www.gob.pe/institucion/minam/noticias/854009-madre-de-dios-inauguran-moderna-infraestructura-para-disposicion-segura-de-residuos-solidos-en-provincia-de-tambopata.
[50] Original name in Spanish: Universidad Nacional Amazónica de Madre de Dios
[51] Original name in Spanish: Sistema Nacional de Áreas Protegidas
[52] Amazon Ecology, "About," accessed April 5, 2025, https://amazonecology.org/pages/about.
[53] **Herrera, Jessica.** 2006. *Lessons from the Equator Initiative: The Casa Matsiguenka Community-Based Ecotourism Lodge Enterprise in Manu National Park, Peru.* Joint Project with the International Development Research Centre (IDRC) and the United Nations Development Programme (UNDP) Equator Initiative. Winnipeg: University of Manitoba. More info: https://idl-bnc-idrc.dspacedirect.org/bitstreams/d27e32c1-3c14-46a4-9176-1b3ace3e634f/download
[54] Original name in Spanish: Dirección Regional de Comercio Exterior y Turismo de Madre de Dios (DIRCETUR)
[55] Original name in Spanish: Sociedad Peruana de Derecho Ambiental (SPDA)

focus on the promotion and implementation of environmental policies, they have a strong interest in supporting the actions that civil society takes for environmental protection. It is possible to request legal advice on the grounds that this is an economic activity that helps in the protection and conservation of the environment while maintaining the livelihoods of the people.

Best practices for implementing activity

A person can be involved in the ecotourism business through various activities such as tour guiding, the provision of transportation or food services, and other related offerings. Additionally, an individual may serve as a provider of natural resources, particularly if they own land that could be developed into a tourist attraction. Another avenue is to invest in the construction of hotels and eco-lodges. The decision regarding which ecotourism goods and services to invest in depend on several factors, including the financial capacity available at the time of investment, the level of expertise in the field, and the personal skills acquired through education or life experiences, among other considerations.

Environmental Impact

In general terms, ecotourism tries to minimize its negative environmental impact and maximize conservation efforts that are useful for the environment. To ensure that ecotourism activities maximize their benefit to the environment, a holistic, mindful approach needs to be taken across all aspects of the operation. First, eco-lodges and accommodations should be designed with sustainability in mind, utilizing - if possible - renewable energy sources, energy-efficient systems, and/or water-saving technologies. Waste management is another important aspect, with a focus on minimizing plastic use and promoting recycling. Tourism activities, such as nature tours, should prioritize low-impact methods of exploration, such as walking tours or small boats that do not disturb local ecosystems. When offering transportation services, businesses should aim to use electric or hybrid vehicles when possible to reduce carbon emissions. Additionally, food services should source locally grown, organic products to minimize the ecological footprint and support local communities.

However there are some negative environmental impacts that can come with the construction of new infrastructure and the interaction with humans and the environment. Best practices are meant to decrease the level of negative impact and increase the level of positive environmental impact in local communities.

Challenges and opportunities

The below table summarizes predictable challenges and opportunities when considering ecotourism as a supplemental source of income.

Category	Challenges	Opportunities
Environmental	- If this activity is not done with best environmental practices, it may lead to "greenwashing" or practices that harm the environment while misleading the public into thinking they are eco-friendly.	- This economic activity tends to be great for the environment and conservation efforts.
Technical Capacity	- Tour guiding requires a degree, certifications, and knowledge of English.	- There is a strong support network in the area for this type of initiative.
Economic	- In the case of investing in eco-lodges or hotels, the initial investment may take some time before generating a return. - Initial investment in general is high. No less than 14.000 PEN	- Initial investment can be made in one of the supporting businesses, such as food or transportation services, which tend to be less expensive and offer quicker economic benefits - There are institutions like Profonanpe[56] that offer financial support for business proposals in ecotourism.
Regulatory/Institutional	- Eco-lodges or hotels require permits, as well as tour guiding, so the initial investment to obtain all necessary authorizations can be high.	- There are already successful examples of eco-lodges, hotels and tour guides in the area that can serve as models for starting a business. Additionally, some institutions provide guidance on how to start an ecotourism business
Market Development	- The infrastructure of the region is still inadequate, which affects the quality of service that can be offered to tourists.	- Because the existing services in the region are not of the highest quality, a new business could offer a better experience and position itself as the best in the area

[56] Profonanpe, *Allies for the Conservation of Nature*, accessed April 11, 2025, https://profonanpe.org.pe/en/.

5.3. Livestock

RECOMMENDATIONS

- Start small, scale slowly
- Communicate early with potential buyers to gauge interest
- Rotate grazing pastures to ensure time for land to regenerate
- Compost organic waste or use as chicken feed if applicable
- Provide tree cover to provide shade, support healthy soil, and increase biodiversity
- Connect with local agencies, cooperatives, and NGO's with technical support

RESOURCES NEEDED

- Cleared, legally titled land
- Fertile soil, regenerated if using post-mining land
- Fertilizer: can be sourced with the help of organizations like CINCIA
- Fencing: wooden posts, concrete, wire
- Water troughs and rain catchments
- Shade infrastructure
- Feed storage
- Livestock: cattle, chicken, sheep

Raising livestock as a supplemental income source requires up-front investment and continued labor but comes with the potential for considerable revenue. Different livestock options are feasible in the Madre de Dios region of Peru including cattle, chickens, and sheep. Cattle can be used for meat or dairy products, chickens produce meat and eggs, and sheep produce wool. When considering livestock as an income source, the level of product processing should be taken into consideration, as processing meat requires far more resources than selling the cow to a processor but also generates greater profit margins. The product and scale of operations depends largely on the level of investment. Livestock production requires daily maintenance and regular environmental management, likely demanding more time, labor, and resources than the other previously discussed activities, but the Peruvian government offers several avenues of support for small-scale farmers.

Resources Needed

Livestock such as cattle, chickens, or sheep in the Madre de Dios region of Peru requires a combination of infrastructure, environmental management, and access to technical knowledge. First and foremost, adequate land is essential—cleared and legally titled land that avoids infringing on protected rainforest areas or indigenous territories. Peru's Agroforestry Concessions System through their Forest Law supports farmers in identifying and accessing naturally-cleared land. To avoid the health and environmental risks of mercury contamination it's best to use non-mining land, but there are some potential ways to raise livestock on mined-land if one has the land rights to do so.

Second, the soil in Madre de Dios, while fertile in some areas, often lacks key nutrients and may require supplementation or rotation systems to sustain grazing animals like cattle or sheep. This is particularly true if the land was mined, which in that case the top soil would first have to undergo a reforestation process. This would take multiple years before the ground may have enough plant life to contribute to the cows diet. This would also pose a risk to mercury contamination, even if the land was reforested. For this reason, land that is owned for purposes other than mining are best suited for raising cattle or sheep. In order to confirm what nutrients are available in the soil, technical expertise from the Ministry of Agrarian Development and Irrigation (MIDAGRI) and the Instituto Nacional Innovación Agraria (INIA) teams can be leveraged for proper soil testing. After testing, these organizations can help create or source fertilizer mixes with the necessary nutrients.

Source: Lydia Knoll

In addition to healthy soil, fencing, water access (such as wells, rainwater catchment, or small-scale irrigation systems), and shade structures are critical infrastructure elements for raising livestock, especially given the intense heat and high rainfall typical of the region. Fencing is commonly made from wooden posts and electrical wire and can be reinforced with concrete to last longer, as seen in the image above.

To reduce costs and strain on water sources, a rainwater catchment system is a solution that collects rainwater to be used by the livestock. Simple systems can be built using common construction supplies like large trash containers or industrial-sized drums. Shade structures are necessary to protect the animals in the hot summer months from heat-related illnesses. Trees can be used for shade if large and dense enough and are a great way to support soil health. Without proper tree coverage, livestock need an alternative barn structure to protect them. Chickens require coops that provide protection from predators and high humidity, along with feed storage areas and reliable sources of water. Chicken coops can be built by hand with wood and wire mesh. For cattle and sheep, access to pasture and feed and proper drainage to avoid hoof diseases in the wet environment are also necessary.

Logistically, raising livestock in Madre de Dios poses challenges due to the remoteness of many areas and limited access to veterinary services, quality feed, and agricultural supplies. Start-up

operations need access to transport for animals and feed, either by river or limited road networks, as well as cold storage or processing infrastructure if the goal is meat or dairy production. Road infrastructure and vehicles will support transport of products to local markets or nearby buyers.

Best Practices

Starting a small livestock business in Madre de Dios as a supplemental income source requires careful planning and sustainable practices suited to the region's tropical rainforest environment. Entrepreneurs should begin by first determining how much land is available to them for livestock and which animal(s) the land is best suited for. Select livestock well-adapted to the local climate, such as tropical breeds of chickens, cattle, or hair sheep. Communicate early with potential buyers to gauge local demand for different products. It is important to start small, using available land and resources efficiently while ensuring proper shelter, clean water access, and basic veterinary care. Increasing the number of animals slowly over time ensures the daily operations remain manageable without significant increases in labor required.

Best practices for maintaining the land include rotational grazing to protect soil health, using organic waste for compost, and maintaining or increasing tree cover to encourage biodiversity and provide the animals shade. Connecting with local agricultural agencies, cooperatives, or NGOs can provide valuable training and support to build a business that is both profitable and environmentally responsible. **Table 2** in the Appendix provides a list of organizations.

Environmental Impact

The environmental sustainability of raising and selling livestock is as critical as the economic sustainability. Environmental degradation harms the immediate health of the land which in turn harms the long term health of the animals, creating costly challenges in the future.

Torres Jara de Garcia and Durand-Chavez[57] developed a sustainability evaluation with key indicators across environmental, economic, and social sustainability. Examples of the environmental indicators that measure soil quality include depth of the arable layer of the soil, microbiological activity, presence of invertebrates, and level of erosion. Pasture health is measured by weeds presence, trees presence, vegetation diversity, pasture growth and others. The last environmental criteria is animal quality which looks at calving per year, animal performance, and selling weight to give a few examples. Economic factors consider the quantity and quality of resources available such as water supply, sanitation facilities, housing quality, tools and equipment, vehicle access, additional staff, bank credit and income levels. In the paper, these indicators are rated on a 1-10 scale to provide a "sustainability score." This thorough analysis is

[57] Torres Jara de García, Giovanna P., and Luz M. Durand-Chávez. 2023. "Sustainability of livestock farms: The case of the district of Moyobamba, Peru." Heliyon 9, no. 2 (February). https://doi.org/10.1016/j.heliyon.2023.e13153.

perhaps unnecessary for a single livestock owner, but it's recommended that all of these indicators are considered and monitored to ensure the long term productivity of the operation.

Livestock traditionally poses a threat to the environment. The Peruvian Ministry of Environment published their most recent biennial update report for the UN Framework Convention on Climate Change in 2023 which analyzes the country's greenhouse gas emissions. In the report, they find that methane produced by digestion of ruminants like cattle and sheep contributed 14.7% of emissions of the entire agriculture sector from 2000-2019[58]. The Peruvian government is taking measures to address the negative environmental impacts. Regulation regarding the environmental policies governing livestock and agriculture in Madre de Dios are in Table 1 of the Appendix. With this regulatory landscape in mind, there are ways to protect and improve the environment while raising livestock.

The government believes that the use of natural pastures will provide the greatest reduction to emissions. To support this, Peru has designated funding for farmers in its budgetary programme to help them secure natural pastures[59]. More details are needed to understand how to gain access to this funding, so it's recommended to contact government agencies such as INIA and GOREMAD.

Other ways to decrease the environmental impact of farming include the implementation of "circular" systems. Circular systems repurpose waste into useful products. A few examples include repurposing cattle manure as fertilizer for the plants, catching rainwater to provide to the animals, and feeding food scraps to the chickens. Additionally, caring for the plants on the land will support the livestock while also replenishing the soil with the nutrients it needs and promoting biodiversity. By planting and growing large trees, livestock have more shade and by tilling empty pastures, plants return to the soil as fertilizer increasing the growth of the next years' grasses[60].

Challenges and Possibilities

The below table summarizes predictable challenges and opportunities when considering livestock as a supplemental source of income.

Category	Challenges	Opportunities

[58] Technical analysis of the third biennial update report of Peru." 2024. United Nations Framework Convention on Climate Change. http://unfccc.int/sites/default/files/resource/tasr2023_PER.pdf.

[59] "

[60] reforestACTION. 2024. "Land restoration and agroforestry systems implementation in the region of San Martín." https://www.reforestaction.com/en/magazine/agroforestry-peru-lamas.

Environmental	- Potential mercury contamination in soil/water from nearby mining areas - Deforestation from expanding pasture lands - Methane emissions from cattle contributing to greenhouse gases	- Reforest degraded land to produce more pasture - Work with local government to identify “natural pastures” - Use strictly non-forested lands - Diversify animal types to include sheep, chicken, etc.
Technical Capacity	- Lack of technical knowledge in soil remediation or animal care	- Collaboration with Tropical Forest Alliance, WWF, CINCIA, INIA, SENASA, GOREMAD, MINAM (see appendix)
Economic	- Initial investment costs for land rehabilitation, farming infrastructure, animals, and their care - Market access barriers	- High demand for livestock - Certification opportunities (organic, fair trade) to raise value
Social & Labor	- Trained personnel availability - Requires daily maintenance and ongoing labor to operate	- Job creation with fair wages in livestock - Capacity-building and collaboration

Health & Safety	- Risk of high mercury levels in cattle as seen in research studies[61]	- Soil/water monitoring and testing before use as livestock feed - Increased safety compared to mining operations - Potential support from NGOs for contamination studies
Regulatory/Institutional	- High number of regulations on livestock operations - Bureaucracy and weak enforcement of environmental laws	- Engagement of local governments for technical and logistical support
Market Development	- Higher demand for processed products which require more investment and management	- Existing market for livestock with opportunities for being part of cooperatives - International demand for livestock products

[61] Basri, and Masayuki Sakakibara. 2017. "Mercury Contamination of Cattle in Artisanal and Small-Scale Gold Mining in Bombana, Southeast Sulawesi, Indonesia." Urban Environmental and Medical Geochemistry 7, no. 4 (December): 133. https://doi.org/10.3390/geosciences7040133

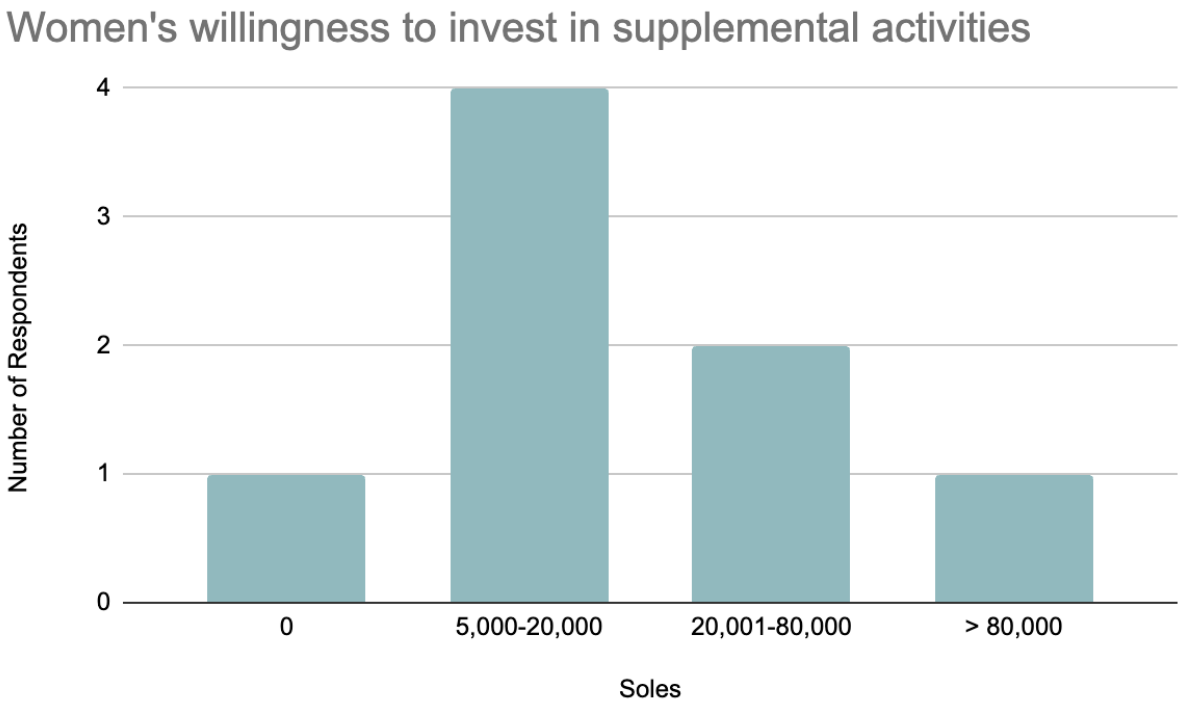
6.0. Summary of Women's Responses from the Workshop

The final report is based on the economic activities commonly practiced in the Madre de Dios region, which were thoroughly investigated. However, through the workshop facilitated on March 14th, 2025, with the MAPE women's network, it became clear that the women are interested in a broader range of business opportunities. Information was gathered on their willingness to invest, as well as their fears, dreams, and hopes for the future.

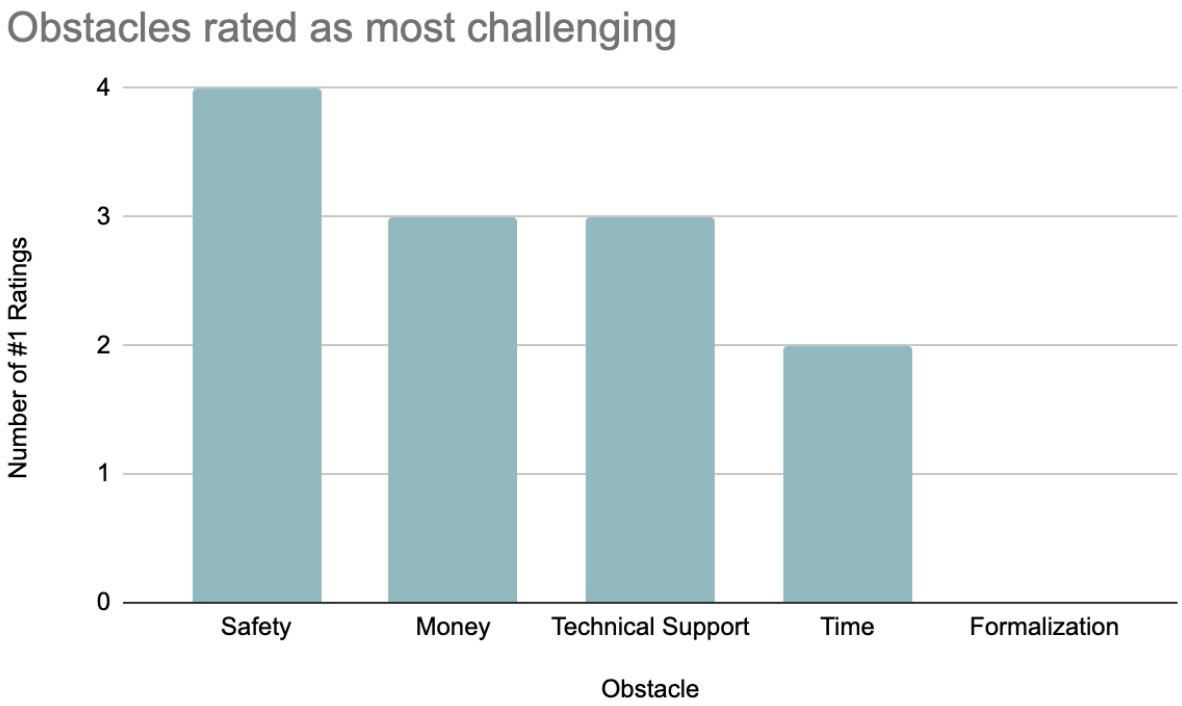
Out of the 15 women who are part of the network, 9 attended the workshop, representing 60% of the members, and answered all or most of the questions asked. They expressed interest in businesses such as jewelry, grocery stores, a restaurant offering Peruvian food, a bookstore, a hardware store, a coffee shop, livestock and fish farming, a meat shop, a pharmacy, and farming. Some of these businesses already exist, while others are ventures they would like to start. Additionally, some of the businesses mentioned align with those explored in the final report, while others do not.

When asked about what to sell, who to sell it to, and where to sell, the women provided a range of responses. Customers, the general public, families, and institutions were identified as potential clients. Some mentioned the importance of advertising their businesses through social media to reach a wider audience. As for where to sell their products, the answers varied from setting up a small shop in the market for groceries to finding a strategic and appealing location for their brick and mortar businesses. Many emphasized the need for quality control, eye-catching designs, and ensuring that products, such as food, were clean, tasty, and appealing to customers. In terms of support, they suggested hiring people to help with selling and seeking professional assistance from accountants or administrators, some even relying on family members for additional help. Overall, they recognized the need for financial management and assistance in formalizing their businesses to ensure their success.

When asked about the willingness to invest in a new business, 8 out of the 9 respondents answered. Of the respondents, 50% (4 people) are willing to invest between 5,000 and 20,000 PEN (1,300-5,300 USD), 25% (2 people) are willing to invest between 20,001 and 80,000 PEN (5,301- 21,300 USD), 12.5% (1 person) is willing to invest 80,000 PEN (21,300 USD) or more in a new business. One person is not willing to invest in a new supplementary activity.



When discussing possible obstacles or fears they have about starting a new business, 8 out of the 9 respondents answered. The women were asked to rate the following obstacles: money, time, safety, formalization, technical support, and other. A rating of one meant the obstacle was perceived as the hardest and a rating of five meant the obstacle was perceived as the least hard of the options. Among those who responded, the most significant obstacle was safety, ranked as the number one hardest obstacle by four people. The second most challenging obstacles were money and technical support, each rated as the most challenging by three people. Only two people rated time as the most challenging obstacle and no one selected formalization. Some miners ranked more than one option as a number one obstacle, which explains why there are more than 9 responses.



To overcome the obstacles, the miners suggested a variety of approaches. Some proposed seeking support from public or private institutions that could assist them in overcoming financial challenges. Others considered taking out loans to increase capital, mentioning that although they had enough money for certain investments, like a motorcycle, they still needed more to purchase merchandise for their businesses. Ensuring the reliability of workers was also mentioned as a crucial factor in overcoming obstacles. Additionally, some participants highlighted the importance of delegating tasks and organizing time efficiently to address issues related to workload and time management. Finally, credits and partnerships were seen as potential solutions to secure the necessary resources for their businesses.

Finally, when asked about their expected earnings from the investment, the women indicated various amounts. Some mentioned they hoped to earn from 9,000 to 10,000 PEN ($2,400 - 2,600 USD); they did not specify if monthly, weekly, or any timeframe, while others estimated a monthly income of 3,500 PEN ($935 USD). One participant shared a more detailed breakdown, stating an initial investment of 10,000 PEN ($2,600 USD), with monthly expenses of 1,000 PEN (267 USD) and an estimated weekly revenue of 800 PEN ($213 USD). The detailed thought put into the exercise reaffirms the women's interest in exploring supplemental activities to their mining operations.

7.0. Conclusion

In conclusion, diversifying income through supplemental livelihood activities is a promising pathway for mining communities in Madre de Dios. Exploring opportunities such as floating cage fish farming, ecotourism and sustainable agriculture can reduce the Red de Mujeres MAPE women's reliance on gold mining, attain steady financial benefits and foster environmental restoration through practices that mitigate mercury contamination and promote land regeneration. These initiatives supported by robust business frameworks and strengthened partnerships hold potential to not only build economic and social resilience, but also preserve the region's rich ecological heritage, offering a promising, sustainable future.

Appendix

Methodology

Our research used a multi-phase, participatory approach designed to identify viable complementary livelihood options for MAPE women engaged in artisanal and small-scale mining in Madre de Dios, Peru. Our methodology combined desk research with observation, key informant interviews and a focus group workshop to ensure women miners' perspectives remained central throughout the investigation.

Phase 1: CINCIA Discussions & Systems Mapping

We began with initial consultation with CINCIA to determine the direction of the study that would be most beneficial to target beneficiaries. We conducted a comprehensive desk review to identify existing supplementary livelihood options implemented by miners in the region. Our initial selection of activities for indepth research was guided by CINCIA's input. This initial exploration allowed us to map promising activities and stakeholders involved in the mining sector. Our developed map of the system (Figure 1 in Appendix) within which mining is done positioned the Red de Mujeres women network at the center, with CINCIA as a key partner, and various other stakeholders operating within the system. To complement our literature review and deepen our preliminary understanding, we conducted virtual interviews with CINCIA recommended members of the Red de Mujeres network. These conversations provided crucial insights into their practices and perspectives on supplemental income sources, their preferences and potential constraints. This engagement was crucial to set the foundation for a long term relationship and trust before our field visits. It also ensured that subsequent field research would be grounded in the realities and aspirations of the women.

Phase 2: Field visits & Direct Observation

The second phase involved field visits to a mining concession, one gold processing site, one cacao processing cooperative, one mercury lab and three supplementary activity sites. These visits offered first-hand observations of the mining operations and the supplementary activities already being implemented by MAPE women. We documented the promising supplementary livelihood activities including reforestation projects, cattle farming operations and innovative fish farming utilizing abandoned mining ponds. These observations allowed us to understand not just the technical aspects of the activities, but also how they are integrated with or isolated from mining activities.

Phase 3: Stakeholder & Expert Engagement

Building on our growing understanding, we conducted a series of key informant interviews with multiple stakeholders. These included representatives from local NGOs active in the region who work with miners as well as subject matter experts in specific supplementary activities such as

fish farming and cacao processing. They shared technical knowledge and market insights essential for evaluating the viability of these businesses. These interviews were helpful in mapping the existing support system for miners and identifying both resources available and gaps in assistance that could potentially support livelihood diversification for miners.

Phase 4: Participatory Workshop

Our data collection process culminated in an interactive workshop with participants from the Red de Mujeres MAPE. The aim of this collaborative exercise was to explore the key steps, resources, and decisions involved in starting or strengthening a supplemental activity to their mining operation. In collaboration with CINCIA, we developed a practical worksheet that guided participants through a structured decision-making process for selecting an appropriate additional income-generating activity, see Figure 2 in the Appendix. Some of the key things covered in this participatory exercise included:

- Financial capacity and willingness to invest in a complementary activity
- Interest levels in various livelihood options
- Anticipated implementation challenges
- Required support mechanisms
- Timeline considerations for implementation and return on investment for income and the environment.

This workshop created a space to further build trust and collectively brainstorm on what opportunities are available and interesting to the women. Also, CINCIA rounded out input from this workshop by providing an ecological perspective. After careful considerations based on all learnings and consultations with CINCIA, fish farming stood out as an activity of interest for most women in the Red de Mujeres MAPE network. Hence, this report focuses heavily on fish farming, although other supplementary activities are explored.

Figure 1. Systems Map

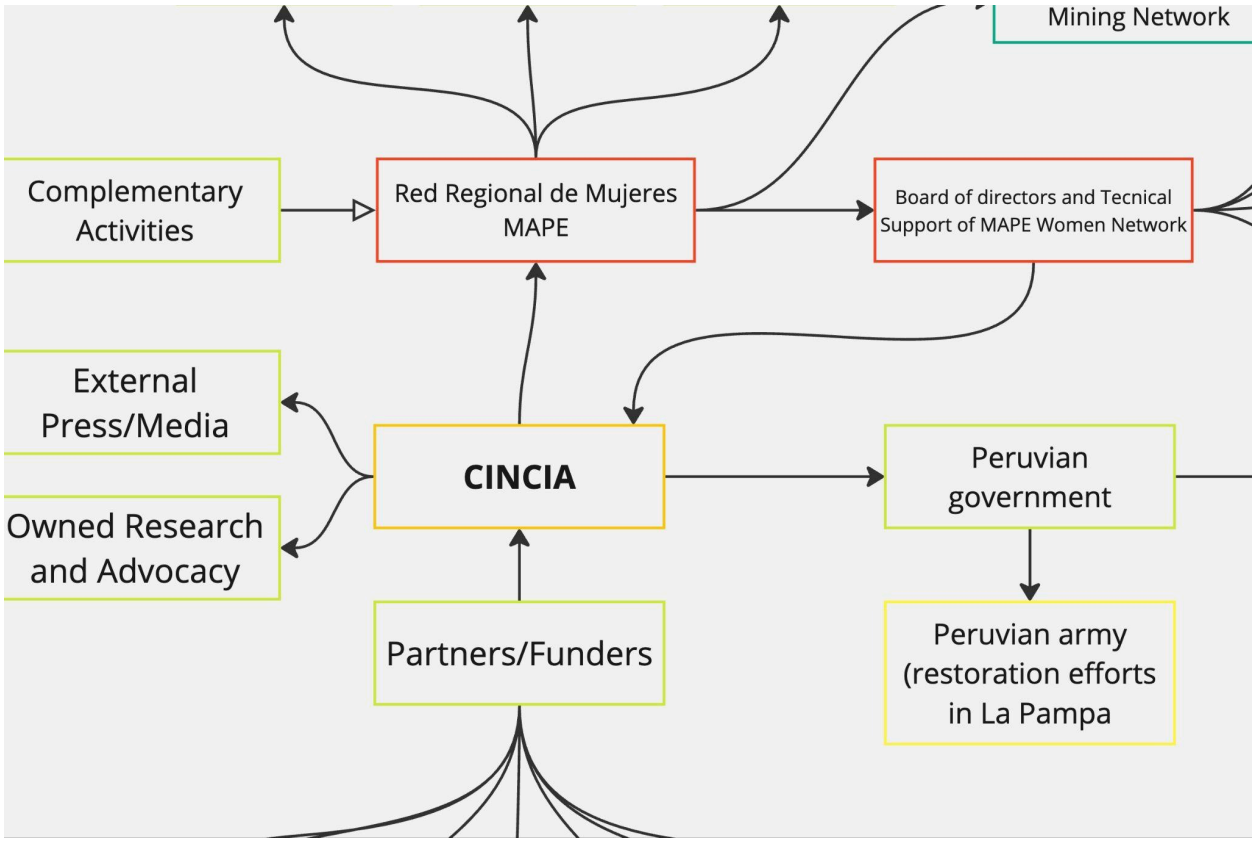


Figure 2. Women's Workshop Worksheet

Actividades complementarias

¿Qué me gustaría hacer?

¿Qué actividad complementaria tienes o te gustaría iniciar?_____

¿Quiénes son mis clientes?_____

¿Dónde y cómo venderé mis productos?_____

¿Quién podría ayudarme? _____

¿Qué necesito para empezar?

¿Cuánto dinero está dispuesto a invertir en su actividad complementaria?
☐ 5.000-20.000 Soles
☐ 20.001-80.000 Soles
☐ 80,000 + Soles
☐ Por ahora, no estoy dispuesta a invertir en un negocio complementario
☐ Por ahora no puedo

Estimación de los costos iniciales

Recurso	**Costos Mensuales**

¿Cuánto calculo que necesito para iniciar mi negocio?

4. Posibles obstáculos

¿Se le ocurre algún obstáculo para acceder a los recursos que necesita? (Enumere todo lo que corresponda)

	Dinero
	Tiempo
	Seguridad
	Formalización
	Apoyo técnico

Otro: _____

¿Cómo podría superar estos obstáculos? (Instituciones, recursos, ONGs, etc.)

_____

_____

_____

Después de pagar todos sus costos, ¿cuánto dinero le gustaría que le quedara?

Beneficio mensual (existente o deseado)

Table 1. National Regulations on Livestock and Agriculture

Regulation Name	Description
Forest and Wildlife Law	Forested lands may not be used for agriculture or livestock production because they are public lands. The Agroforestry Concessions System supports farmers in identifying and accessing naturally-cleared land or utilizing forest land for agroforestry.
Animal Protection and Welfare Law	Prohibits slaughtering of animals in public places and requires sanitary conditions for raising and transporting livestock.
Environmental Management Regulations for the Agricultural and Irrigation Sector	Livestock farming operations must obtain an Environmental Management Instrument (IGA) which can be obtained from the Environmental Adequacy and Management Program (PAMA). There is a threshold for projects that require this. A new operation that doesn't require the IGA must submit an Environmental Technical Form (Ficha Técnica Ambiental — FTA) to the Ministry of Agrarian Development and Irrigation (MIDAGRI).
Peru National Livestock Development Plan 2017 – 2027	A strategic initiative by the Ministry of Agrarian Development and Irrigation (MIDAGRI) aimed at enhancing the competitiveness and sustainability of the livestock sector, with a particular focus on supporting small and medium-scale producers.
Madre de Dios “guidelines” with Ministry of Agrarian Development and Irrigation and GOREMAD	Aims to transform cattle ranching practices to reduce deforestation and greenhouse gas emissions while enhancing productivity.

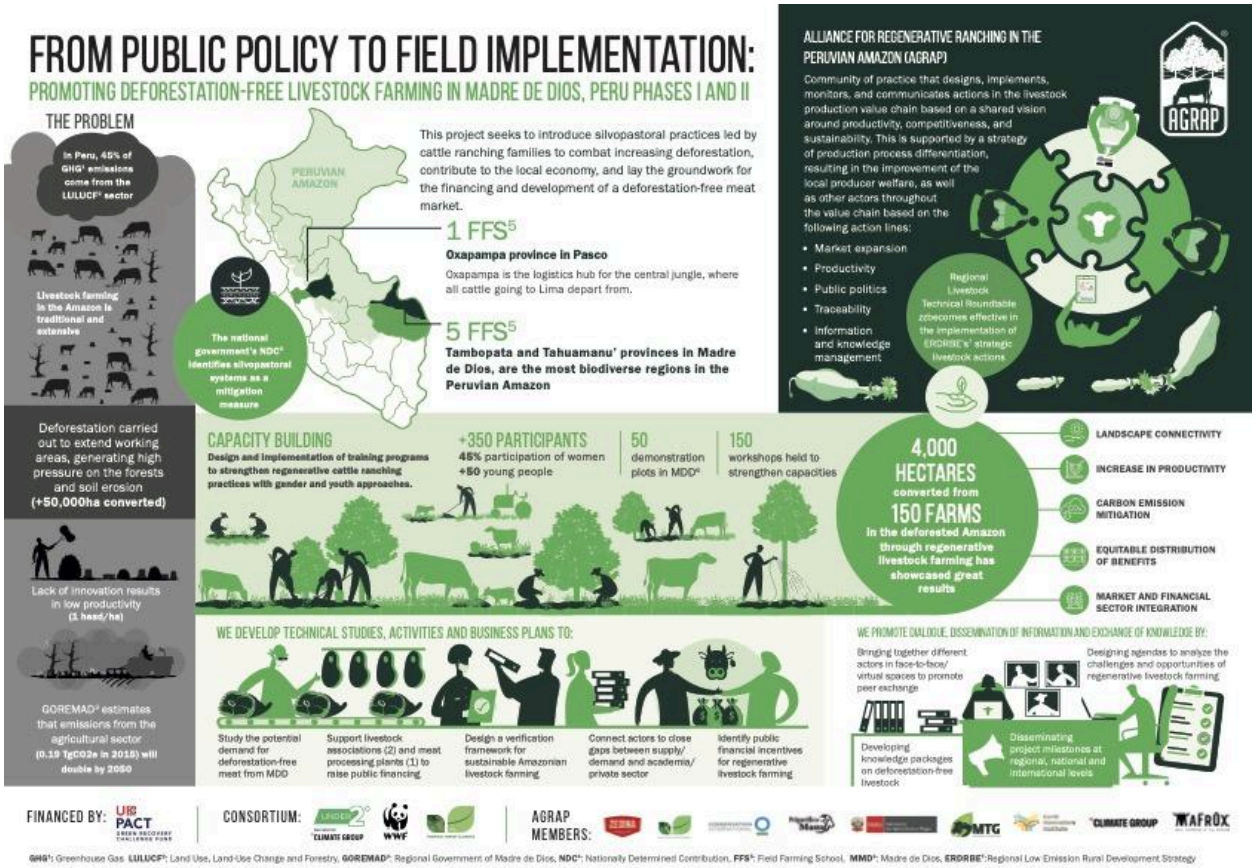
Low Emission Rural Development Strategy	Peru national framework designed to promote sustainable economic growth in rural areas while reducing greenhouse gas emissions, particularly from deforestation and land-use change. This strategy emphasizes the integration of environmental conservation with rural development by encouraging sustainable agricultural practices, enhancing forest governance, and supporting low-carbon supply chains.

Table 2. Organizations

Organization	**Opportunity**
Tropical Forest Alliance	Offered Deforestation Free Livestock Working Group in 2021, could have similar training/workshops in the future
INIA	Cattle artificial insemination, genetic modification/testing; Technical assistance, workshops
Ministry of Agrarian Development and Irrigation (MIDAGRI)	Supports efforts aligned to their strategies, detailed above, and supports small-scale farmers in identifying naturally-cleared land
Regional Government of MDD (GOREMAD)	Supports small-scale farmers by facilitating access to technical assistance, resources, and market opportunities
WWF	Offers "field school" to farmers in Madre de Dios to improve livestock production and recover degraded lands
National Agrarian Health Service (SENASA)	Enforces sanitary standards and health regulations
Coalición por Producción Sostenible	Supports sustainable production in collaboration with businesses, civil society organizations, and government
AFIMAD	Offers a Brazil-nut production training rooted in traditional indigenous practices and provides a market to sell the nuts.

Ministry of Environment	Provides training and support for sustainable Amazon nut collection and distribution. Is also investing in infrastructure to improve tourism in regions like Madre de Dios through the *"Con Punche Perú Turismo"* plan.
Re:wild	Brings together Indigenous peoples, local communities, influential leaders, nongovernmental organizations, governments, companies, and the public to protect and rewild nature. Conducts training and funds conservation programs.
The Management Committee of the Tambopata National Reserve (Some members are The Tambopatas or Amataf)	The committee has information about the requirements needed to offer ecotourism activities within the Tambopata National Reserve
Rainforest Expeditions	A successful example of ecotourism business in Madre de Dios
National Amazonic University	The University runs an ecotourism program for those interested in becoming tour guides. It also offers English classes, and programs in Finances and International Business.
National System of State-Protected Natural Areas	Provides support and guidance to ecotourism projects.
Amazon Ecology	Provides support and guidance to ecotourism projects.
Regional Director of Foreign Trade and Tourism of Madre de Dios	In charge of the legal regulations of ecotourism.
Peruvian Society of Environmental Law	Offer legal support for environmental issues.
Profonape	Offer financial support for business proposals in ecotourism.

Figure 3. Deforestation-Free Livestock Infographic


FROM PUBLIC POLICY TO FIELD IMPLEMENTATION:
PROMOTING DEFORESTATION-FREE LIVESTOCK FARMING IN MADRE DE DIOS, PERU PHASES I AND II
THE PROBLEM
In Peru, 45% of GHG[1] emissions come from the LULUCF[2] sector
Livestock farming in the Amazon is traditional and extensive
Deforestation carried out to extend working areas, generating high pressure on the forests and soil erosion (+50,000ha converted)
Lack of innovation results in low productivity (1 head/ha)
GOREMAD[3] estimates that emissions from the agricultural sector (0.19 TgCO2e in 2015) will double by 2050
PERUVIAN AMAZON
The national government's NDC[4] identifies silvopastoral systems as a mitigation measure
This project seeks to introduce silvopastoral practices led by cattle ranching families to combat increasing deforestation, contribute to the local economy, and lay the groundwork for the financing and development of a deforestation-free meat market.
1 FFS[5]
Oxapampa province in Pasco
Oxapampa is the logistics hub for the central jungle, where all cattle going to Lima depart from.
5 FFS[5]
Tambopata and Tahuamanu' provinces in Madre de Dios, are the most biodiverse regions in the Peruvian Amazon
ALLIANCE FOR REGENERATIVE RANCHING IN THE PERUVIAN AMAZON (AGRAP)
Community of practice that designs, implements, monitors, and communicates actions in the livestock production value chain based on a shared vision around productivity, competitiveness, and sustainability. This is supported by a strategy of production process differentiation, resulting in the improvement of the local producer welfare, as well as other actors throughout the value chain based on the following action lines:
• Market expansion
• Productivity
• Public politics
• Traceability
• Information and knowledge management
Regional Livestock Technical Roundtable becomes effective in the implementation of ERDRBE's[6] strategic livestock actions
AGRAP
CAPACITY BUILDING
Design and implementation of training programs to strengthen regenerative cattle ranching practices with gender and youth approaches.
+350 PARTICIPANTS
45% participation of women
+50 young people
50
demonstration plots in MDD[6]
150
workshops held to strengthen capacities
4,000 HECTARES
converted from
150 FARMS
In the deforested Amazon through regenerative livestock farming has showcased great results
LANDSCAPE CONNECTIVITY
INCREASE IN PRODUCTIVITY
CARBON EMISSION MITIGATION
EQUITABLE DISTRIBUTION OF BENEFITS
MARKET AND FINANCIAL SECTOR INTEGRATION
WE DEVELOP TECHNICAL STUDIES, ACTIVITIES AND BUSINESS PLANS TO:
Study the potential demand for deforestation-free meat from MDD
Support livestock associations (2) and meat processing plants (1) to raise public financing
Design a verification framework for sustainable Amazonian livestock farming
Connect actors to close gaps between supply/demand and academia/private sector
Identify public financial incentives for regenerative livestock farming
WE PROMOTE DIALOGUE, DISSEMINATION OF INFORMATION AND EXCHANGE OF KNOWLEDGE BY:
Bringing together different actors in face-to-face/virtual spaces to promote peer exchange
Designing agendas to analyze the challenges and opportunities of regenerative livestock farming
Developing knowledge packages on deforestation-free livestock
Disseminating project milestones at regional, national and international levels
FINANCED BY: UKRI PACT GREEN RECOVERY CHALLENGE FUND
CONSORTIUM: UNDP2 CLIMATE GROUP, WWF
AGRAP MEMBERS: MTG, CLIMATE GROUP, AFRÓX
GHG[1]: Greenhouse Gas LULUCF[2]: Land Use, Land-Use Change and Forestry, GOREMAD[3]: Regional Government of Madre de Dios, NDC[4]: Nationally Determined Contribution, FFS[5]: Field Farming School, MMD[6]: Madre de Dios, ERDRBE[7]: Regional Low Emission Rural Development Strategy

Bibliography

Amazon Conservation Association. n.d. "MAAP #104: Major Reduction in Illegal Gold Mining from Peru's Operation Mercury." Accessed April 11, 2025. https://www.amazonconservation.org/maap-104-major-reduction-in-illegal-gold-mining-from-perus-operation-mercury/.

Araújo-Flores, J. M., M. C. Santa-Maria, C. Timaná-Mendoza, A. Reyes-Calderon, and P. Venail. 2024. "Assessing Fish Diversity in Abandoned Mining Ponds in Madre de Dios, Peru, Using Environmental DNA." *Environmental DNA* 6: e520.

Basri, and Masayuki Sakakibara. 2017. "Mercury Contamination of Cattle in Artisanal and Small-Scale Gold Mining in Bombana, Southeast Sulawesi, Indonesia." *Urban Environmental and Medical Geochemistry* 7 (4): 133. https://doi.org/10.3390/geosciences7040133.

Banco Central de Reserva del Perú. 2020. *Madre de Dios: Síntesis de Actividad Económica*. January.

BBC. n.d. "Amazonia: Un tesoro en peligro." *BBC Mundo*. Accessed April 6, 2025. https://www.bbc.co.uk/spanish/specials/1330_amazon/page8.shtml.

Braaten, Devin. 2014. "Land Rights and Community Cooperation: Public Goods Experiments from Peru." *World Development* 61: 127–141.

Chávez Michaelsen, A., et al. 2020. "The Effects of Climate Change Variability on Rural Livelihoods in Madre de Dios, Peru." *Regional Environmental Change* 20: Article 70.

Deutsche Welle. 2019. "The Amazon: Vital for Our Planet." *DW*, August 27. https://www.dw.com/en/the-amazon-vital-for-our-planet/a-50170004.

Diringer, S. E., B. J. Feingold, E. J. Ortiz, J. A. Gallis, J. M. Araújo-Flores, A. Berky, W. K. Y. Pan, and H. Hsu-Kim. 2015. "River Transport of Mercury from Artisanal and Small-Scale Gold Mining and Risks for Dietary Mercury Exposure in Madre de Dios, Peru." *Environmental Science: Processes & Impacts* 17 (2): 478–487.

Diringer, S. E., A. J. Berky, M. Marani, E. J. Ortiz, O. Karatum, D. L. Plata, W. K. Pan, and H. Hsu-Kim. 2020. "Deforestation Due to Artisanal and Small-Scale Gold Mining Exacerbates Soil and Mercury Mobilization in Madre de Dios, Peru." *Environmental Science & Technology* 54 (1): 286–296.

Duff, P. M., and T. J. Downs. 2019. "Frontline Narratives on Sustainable Development Challenges/Opportunities in the 'Illegal' Gold Mining Region of Madre de Dios, Peru: Informing an Integrative Collaborative Response." *The Extractive Industries and Society* 6 (2): 552–561.

Espin, J., and S. Perz. 2021. "Environmental Crimes in Extractive Activities: Explanations for Low Enforcement Effectiveness in the Case of Illegal Gold Mining in Madre de Dios, Peru." *The Extractive Industries and Society* 8 (1): 331–339.

Giesey, M. 2025. *Field Notes on Floating Cage Aquaculture in Post-Mining Ponds, Madre de Dios, Peru*. Unpublished document, University of Notre Dame.

Herrera, Jessica. 2006. *Lessons from the Equator Initiative: The Casa Matsiguenka Community-Based Ecotourism Lodge Enterprise in Manu National Park, Peru*. Winnipeg: University of Manitoba. https://idl-bnc-idrc.dspacedirect.org/bitstreams/d27e32c1-3c14-46a4-9176-1b3ace3e634f/download.

Jaramillo Lizana, Jorkaef. 2022. "Economic and Social Impact of Informal Mining in Madre de Dios: A Critical Assessment and Proposals for a Sustainable Future." Available at SSRN 5019990.

Martinez, G., S. A. McCord, C. T. Driscoll, S. Todorova, S. Wu, J. F. Araújo, C. M. Vega, and L. E. Fernandez. 2018. "Mercury Contamination in Riverine Sediments and Fish Associated with Artisanal and Small-Scale Gold Mining in Madre de Dios, Peru." *International Journal of Environmental Research and Public Health* 15 (1584).

Mibanco. 2024. "Mibanco Recognizes the Most Innovative Solutions with the 2024 Spiral Innovation Award." *Corresponsables*. https://www.corresponsables.com/per/actualidad/mibanco-reconoce-las-soluciones-mas-innovadoras-con-el-premio-espiral-de-innovacion-2024/.

Ministry of the Environment of Peru. 2023. "Madre de Dios: New Infrastructure for Safe Solid Waste Disposal in Tambopata Province." Published October 20. https://www.gob.pe/institucion/minam/noticias/854009-madre-de-dios-inauguran-moderna-infraestructura-para-disposicion-segura-de-residuos-solidos-en-provincia-de-tambopata.

Mongabay. 2024. "In Peru's Madre de Dios, Deforestation from Mining Brings Huge Economic Losses." *Mongabay News*, June. Accessed April 11, 2025. https://news.mongabay.com/2024/06/in-perus-madre-de-dios-deforestation-from-mining-brings-huge-economic-losses/.

Prescott, G. W., A. C. Maung, Z. Aung, et al. 2020. "Gold, Farms, and Forests: Enforcement and Alternative Livelihoods Are Unlikely to Disincentivize Informal Gold Mining." *Conservation Science and Practice* 2: e142.

Ramírez, Fernando, and Josefina Santana. 2019. *Environmental Education and Ecotourism*. Cham, Switzerland: Springer.

Torres Jara de García, Giovanna P., and Luz M. Durand-Chávez. 2023. "Sustainability of Livestock Farms: The Case of the District of Moyobamba, Peru." *Heliyon* 9 (2). https://doi.org/10.1016/j.heliyon.2023.e13153.

Triscritti, Fiorella. 2013. "Mining, Development and Corporate–Community Conflicts in Peru." *Community Development Journal* 48 (3): 437–450.

United States Agency for International Development (USAID). 2020. *Case Study: Artisanal and Small-Scale Mining in Madre de Dios, Peru*. October.

Wearing, Stephen, and Stephen Schweinsberg. 2019. *Ecotourism: Transitioning to the 22nd Century*. 3rd ed. Abingdon, Oxon; New York: Routledge.

Yard, Ellen E., Jane Horton, Joshua G. Schier, et al. 2012. "Mercury Exposure Among Artisanal Gold Miners in Madre de Dios, Peru: A Cross-Sectional Study." *Journal of Medical Toxicology* 8: 441–448.

Zambrano, Luis, et al. 2006. "Invasive Potential of Common Carp (Cyprinus carpio) and Nile Tilapia (Oreochromis niloticus) in American Freshwater Systems." *Canadian Journal of Fisheries and Aquatic Sciences* 63 (9): 1903–1910.