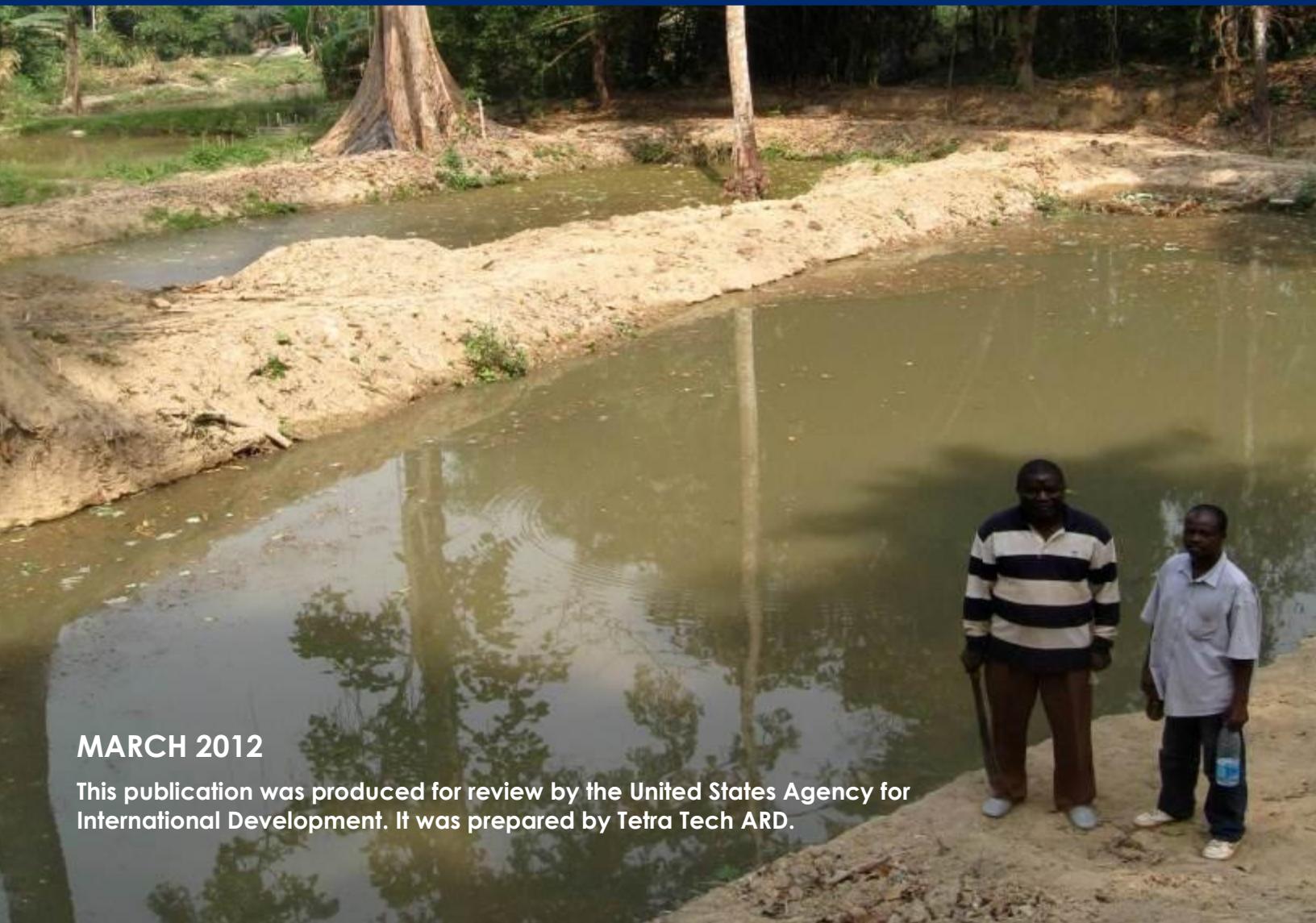




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PROPERTY RIGHTS AND ARTISANAL DIAMOND DEVELOPMENT (PRADD)

ENVIRONMENTAL REHABILITATION AND ARTISANAL
DIAMOND MINING: A CASE STUDY OF LAND AND
LIVELIHOODS IN THE CENTRAL AFRICAN REPUBLIC



MARCH 2012

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Authors: Terah U. DeJong

Implemented by:

Tetra Tech ARD
P.O. Box 1397
Burlington, VT 05402

Contact Information:

Melissa Hall
Project Manager
Melissa.Hall@tetrtech.com

Dr. Stephen Snook
Senior Technical Advisor/Manager
Stephen.Snook@tetrtech.com

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ACRONYMS AND ABBREVIATIONS

AFL	<i>Artisan Facilitateur Local</i> (local field mobilizer)
ASDM	Artisanal and Small-scale Diamond Mining
ASM	Artisanal and Small-scale Mining
CAR	Central African Republic
CASM	Communities and Small-Scale Mining
DDI	Diamond Development Initiative
EGAT	Bureau of Economic Growth, Agriculture and Trade
FESS	Foundation for Environmental Security and Sustainability
GIS	Geographic Information System
GoCAR	Government of CAR
IIED	International Institute for Environment and Development
KPCS	Kimberley Process Certification Scheme
MMSD	Mining, Minerals, and Sustainable Development
POMIGER	Post-Mining Income-Generating Environmental Rehabilitation
PSRP	Poverty Reduction Strategy Papers
PRADD	Property Rights and Artisanal Diamond Development
RRA	Rapid Rural Appraisal
TNS	Sangha Tri-National Landscape
UCP	<i>Unité de Production Commerciale</i> (commercial production unit)
UNDESA	United Nations Department of Economic and Social Affairs
USAID	United States Agency for International Development
WRI	World Resources Institute
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

The Post-Mining Income-Generating Environmental Rehabilitation (POMIGER) is a path-breaking initiative that combines behavior change communication, technical training, clarification of land rights, economic incentives, and environmental rehabilitation. Conceived as part of the USAID Property Rights and Artisanal Diamond Development (PRADD) project in the Central African Republic (CAR), POMIGER aims to address both poverty and environmental degradation by converting old mining pits into fish ponds, vegetable gardens, or fruit orchards. Since its launch in 2010, the program has grown exponentially, and currently counts at least 381 rehabilitated sites, representing at least 19.1 hectares of previously degraded land.

Of all activities, aquaculture has seen the most explosive growth, especially in the village of Loppo, home to at least 209 fishponds. Vegetable farming is more technically challenging and is not year-round, although it benefits women and alleviates acute food insecurity during the dry season. Agroforestry is the most profitable on paper but its long time horizon is a key barrier. Overall, enthusiasm for POMIGER is due in no small part to the severe crisis in the diamond economy that began in 2008, which has pushed people back toward an agrarian economy. In addition, food insecurity has worsened, in part because local fish populations have been decimated by environmental destruction related to mining and the use of toxins. PRADD's improved property rights have played an indirect role in POMIGER mainly by giving the land value, and there is empirical evidence that the certificates of customary tenure have increased confidence and contributed to creating a nascent land market, including for mined-out sites. However, there is concern that the certificates in their current form might not apply to POMIGER, and that ambiguity could weaken trust in the future.

There is also evidence that POMIGER activities, especially aquaculture, have increased many people's incomes, some at levels on par with or surpassing diamond mining. However, with some exceptions, earnings are unlikely to be sufficient to completely supplant external financing for mining. In addition, there is evidence that POMIGER is a preferred route for those, such as men past their prime, who are looking for a less backbreaking way to ensure their retirement. Overall, the diversification trend will likely continue, even if the crisis in the diamond economy subsides. POMIGER's ecological impact has also been significant and positive, especially with respect to water damage and land degradation, although it is not a silver bullet, since the scale of adoption has natural limits of distance from settlements and site suitability. This has implications for the model's application elsewhere. In addition, aquaculture has potential negative environmental impacts, and there is evidence of water-sharing becoming an issue. A revitalization of PRADD's initial land use planning approach could be an appropriate response.

The recently adopted commercial model shows excellent potential, and is in many ways a continuation of POMIGER's philosophy, which has resisted handouts and encouraged initiative and investment. Although it is too early to evaluate fully, the commercial model's strengths include entrepreneurs with strong business experience and a preexisting customer base that has already demonstrated a willingness to pay. Weaknesses include insufficient attention paid to the nuts and bolts of the business model, including how to overcome transportation hurdles and how to prepare for possible demand saturation. Numerous opportunities exist to strengthen the approach, including integrating technical experts and diversification.

Finally, POMIGER has benefitted from strong staff and a sophisticated communication strategy. Among its strategies: integrating sensitization with practical training, encouraging word-of-mouth and opinion leaders, creating incentives for field agents to invest heavily in one-on-one relationships, and allowing space for both individual and communal modes of organization. POMIGER has also played a decisive role in enabling the success of other PRADD activities, including the certification process, due to the goodwill and trust engendered by tangible benefits. These experiences with implementation should not be overlooked when examining how the model's principles and practices could be adapted to other contexts.

1.0 OVERVIEW

1.1 INTRODUCTION AND BACKGROUND

The Property Rights and Artisanal Diamond Development project (PRADD) has been active in the Central African Republic (CAR) since April 2007. Managed by USAID/Bureau of Economic Growth, Agriculture and Trade's (EGAT) Land Tenure Unit, in cooperation with the US Department of State, PRADD forms part of the application of the Clean Diamond Trade Act of 2003. The Act is the vehicle through which the United States implements the Kimberley Process Certification Scheme (KPCS), a voluntary agreement among governments, civil society, and the diamond industry committing members, including 75 countries, to only trade diamonds certified as originating from conflict-free areas. As authorized under Section 9 of the Act, PRADD offers technical assistance to the Government of CAR (GoCAR) to help implement the scheme.

PRADD's multipronged approach focuses on improving property rights in the artisanal and small-scale mining (ASM) sector. In its current phase, PRADD has five objectives: (1) to identify, clarify, and formally recognize the customary land and natural resource rights in target areas; (2) to strengthen GoCAR's system for reliable tracking of production and initial sale information of diamonds; (3) to increase benefits of mining activities in local communities, including diversifying and intensifying food production; (4) to strengthen the capacity to prevent and mitigate environmental impacts of ASM; and (5) to increase access and availability of information on artisanal diamond mining to stakeholders.

In the second quarter of 2010, PRADD launched the Post-Mining Income-Generating Environmental Rehabilitation program (POMIGER) that combines income diversification, food security strengthening, and environmental rehabilitation. POMIGER aims to convert exhausted mining sites into three types of productive agricultural units: fish farming ponds, vegetable gardens, and agroforestry (mainly fruit trees). Data from the field has shown exponential growth: from 18 sites in late 2010 to 381 sites by February 2012. This has led USAID to reflect upon whether the POMIGER model is commercially and ecologically sustainable.

The present report aims to explore this question by offering an in-depth case study of POMIGER's implementation in CAR. As established in the consultant's scope of work, five key questions guide the analysis:

1. Is POMIGER an ecologically sound model to mitigate the environmental impact of artisanal diamond mining?
2. Is POMIGER an economically sound model to allow artisanal mining households to diversify their income and reduce their livelihood dependency on diamond traders?
3. Is POMIGER truly sustainable under the recently implemented commercial model?
4. Which if any core components of POMIGER can be highlighted for a replicable model?
5. What role, if any, has the PRADD clarification of land rights and related PRADD certificate played in increasing land tenure security and incentivizing POMIGER activities?

The report is organized as follows: in the remainder of this chapter, after presenting the study's mixed-methods methodology, a literature review synthesizes academic studies and technical assistance reports related to artisanal diamond mining, land tenure, sustainable livelihoods, and environmental impact mitigation. In Chapter 2, POMIGER activities will be examined descriptively and empirically, including its conceptual foundations, the current extent of adoption, and the contextual factors motivating its growth.

Chapter 3 then takes a step back and examines the project's economic and environmental impact and viability, in addition to the replication potential of the model's principles and practices.

The report presents key empirical findings and analysis, but is also interspersed with numerous profiles, stories, and anecdotes from the field. The goal is to offer a textured, detailed, and accurate analysis that will critically bring to life both the small and larger picture of the program.

1.2 METHODOLOGY

The study employed a mixed-methods approach that was designed in several phases. First, a preliminary concept note was prepared to flesh out the five key questions identified in the scope of work. Based on feedback on this concept note, a full research protocol was developed in consultation with rapid rural appraisal specialist Karen Freudenberger. The methods and sequencing follow.

1.2.1 FIELD STUDY

Field research in the CAR took place from January 2 to 20, 2012, and consisted of the following activities:

Date	Location	Activities
January 2-5	Bangui	<ul style="list-style-type: none">Orientation and planningSemi-structured interviews PRADD staffReview of data and unpublished reportsInterviews with representatives from the water and forests ministry, and the WWF country director
January 5	Boda	<ul style="list-style-type: none">Focus group discussion with staff from the Lobaye province PRADD team
January 6	Nola, Ngoulo	<ul style="list-style-type: none">Focus group discussion with staff from the Sangha-Mbaeré province PRADD teamOpening protocol with village leaders in Ngoulo
January 7-10	Ngoulo	<ul style="list-style-type: none">Rapid rural appraisal (RRA) activitiesInterview and visit to the fish farming commercial production unit (UCP)Visit to active mining site
January 11-12	Bayanga, Beya	<ul style="list-style-type: none">Interview with WWF technical advisor and park conservator on mining activities near the parkSynthesis and preliminary analysis of RRA findingsSite visit to a dozen fish ponds and one vegetable garden in Beya
January 13	Loppo, Balego	<ul style="list-style-type: none">Group meeting and participatory exercises in LoppoSite visits to about 20 fish ponds on 2 water coursesVisit to restored stream in Balego, followed by meeting with village leaders
January 14	Berberati	<ul style="list-style-type: none">Focus group discussion with Mambéré-Kadeï province PRADD staffSite visit to aquaculture UCP and early adopters of new fish ponds
January 15-16	Ngotto, Bokumba, Bossouï	<ul style="list-style-type: none">Site visits and semi-structured interviews at agroforestry plot, aquaculture UCP, vegetable garden UCP, 5 community fish ponds, and multiple individual fish ponds and vegetable gardens
January 17	Boda	<ul style="list-style-type: none">Visit to agroforestry UCP, site visit to large-scale artisanal mining site

January 18-20	Bangui	<ul style="list-style-type: none">• Design and testing of quantitative survey questionnaire• Finalization of sampling frame, training of survey enumerators, gathering of GIS data
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The different tools used in the field included:

Rapid Rural Appraisal. Because the study sought to uncover the motivations and factors behind land reclamation practices, it was deemed essential to understand the broader socioeconomic context of the region. Therefore, the first several days of the study were spent in a single village in Sangha-Mbaéré province. The village of Ngoulo was chosen in part because RRA activities had not been conducted there previously, and after extensive discussion of different options, it was determined to be representative of PRADD's areas of intervention. In addition, it was accessible both logically and in terms of the quality of relationships between PRADD staff and local stakeholders. The following activities were carried out:

- *Participatory territorial mapping* with open participation from a broad cross-section of the village;
- *Development of a seasonal calendar* with 10 participants, including three women, purposefully chosen in consultation with the local community agent (AFL) to represent the full range of economic activities practiced, including agriculture, diamond mining, fishing, and cattle-herding;
- *Wealth ranking exercise* with eight separate purposefully chosen participants, including two women selected for their ability to speak about overall conditions in the village; other participants included a priest, school teacher, the land chief, and other long-term residents;
- *Three in-depth household interviews* were conducted with households randomly selected from each of the three wealth groups identified in the wealth ranking exercise;¹
- *Development of a conflict matrix* with the combined group from the wealth ranking and seasonal calendar exercises; and
- *Development of a historical matrix* with participation open to all, announced by the land chief's village crier, immediately followed by a presentation of key findings and a closing protocol with local leaders.

In total, six nights and four full days were spent in Ngoulo. Several activities originally planned, including the economic activity matrix, were not carried because of travel delays and limited availability of participants on a Sunday. Elements of the economic activities matrix were integrated into the in-depth household interviews and the seasonal calendar exercises. A formal transect walk was not included, although several informal walks were conducted with local leaders and field staff, including a visit to a water spring. In addition, the number of participatory activities was reduced because time was needed to visit the fish production unit and an active mining site, in addition to conducting numerous informal interviews in the evenings.

Activities were led by the consultant in close collaboration with Aleck Soupene, PRADD's Director of Sustainable Development, the division that implements POMIGER, who accompanied the consultant throughout the fieldwork. Translation from Sango to French was conducted by the AFL, although several one-on-one interviews were conducted in French by the consultant. There were initially issues with translation neutrality and the need to provide full translation rather than paraphrasing, but these problems were identified quickly and mostly resolved. Debriefings were held at least once a day, which included reviewing notes, entering them into a computer, and planning subsequent activities.

The present report does not include a full account of RRA findings, since its purpose was to inform and contextualize the subsequent focused research on POMIGER, although highlights will be presented throughout. Key findings were triangulated both in Ngoulo and during subsequent site visits elsewhere. For

¹ Random selection proceeded as follows: participants in the wealth ranking exercise each wrote down one household name from each of the three wealth groups they defined, and then one name from each group was randomly drawn from a plastic bag. In one case, lack of availability of one selected household led a second draw from that wealth group.

example, findings regarding livelihood diversification trends in the last decade were confirmed in at least five subsequent semi-structured interviews elsewhere. In addition, the RRA was an essential step to prepare the quantitative survey, including testing key questions and identifying the wealth indicator goods used in the wealth index, described below.

Semi-structured interviews. After Ngoulo, semi-structured interviews with key informants, often coupled with site visits, were the key data collection instrument. Interview checklists and questions prepared in the research protocol were consulted during interviews. In addition, where possible, checklists were prepared and customized for individual interviews, both ahead of and during interviews. Notes from the semi-structured interviews were transcribed onto a computer either the same or following day to reduce the likelihood of information loss due to incomplete notes.

Focus group discussions and site visits. Focus group discussions lasting about two hours were held with the staff from each of the three field offices. Since focus group discussions are good at eliciting dialogue and shared opinions, discussion focused on why POMIGER appeared to be successful, what the challenges were, what strategies and thinking were behind overcoming them, and staff perspectives on risks and opportunities moving forward. Since these field workers spend a lot of time in villages (on average two nights a week), their opinions and knowledge were invaluable.

In general, large group meetings were avoided because they tend to be *protocolaire*, meaning they are formal, almost exclusively involving male village elites, and tending toward discussion of donor wish lists. In addition, the unpredictable travel conditions meant that participants in formal group meetings could be forced to wait for delayed arrival. While these meetings were sometimes necessary to establish relationships, they were avoided as venues to gather information. Instead, the team focused on integrating interviews with site visits.

Restrained group meetings were useful in some contexts, however. For example, in Loppo, an initial group meeting enabled the identification of opinion leaders and all those who had bought or sold fish ponds, and these people were then targeted for individual interviews later on. In addition, participatory methods (such as the bean methodology) were used to examine the mining status of POMIGER participants, the proportion of fish sold locally versus in Nola, etc. Other “snowballing” methods were used, such as asking the association that runs the commercial production unit in Berberati to introduce us to miners who are spontaneously converting their sites to fish ponds, resulting in a profile included later in this report. However, to reduce potential selection bias, the consultant also explicitly asked local staff to identify and set up interviews with certain categories of people, such as the key stakeholders in the land dispute in Beya.

Quantitative survey development. The quantitative survey questionnaire was developed in the field, mainly during the last three days in Bangui. The questionnaire included demographic and socioeconomic information, mining activity information, fish farming practices and questions on motivations and attitudes. Some questions were tested during the qualitative research, but most were developed based on a review of field notes. The questionnaire was written in French and questions were asked in local languages by the two enumerators, both of whom had previous experience conducting household surveys for PRADD. Questions regarding attitudes were translated into Sango to ensure the wording was consistent. Question wording and sequencing was reviewed and revised based on discussion with several PRADD staff members and the two enumerators during a daylong work session. During this work session, the enumerators did several test runs in the presence of the POMIGER director, including entering the data into Excel to ensure the codebook was clear.

A key challenge was determining the sampling frame and unit of analysis. Because men and women have differing knowledge and attitudes about earnings, the household was chosen as the unit of analysis, and interviews were conducted with both men and women present where possible. After extensive deliberation, a census of fish farmers in the village of Loppo, rather than a random sample of all POMIGER participants, was the chosen sampling frame for both methodological and practical reasons. First, lack of an accurate list of

POMIGER participants at the time of the survey² made drawing a random sample impossible. Second, time and budget constraints meant that covering numerous sites was not feasible. Third, because Loppo represents over half of all fishponds across three provinces, any random sample would be heavily skewed. Finally, a random sample of POMIGER participants would not allow unbiased generalization about adoption behavior, since PRADD staff played an active role in selecting initial participants.

1.2.2 DESK REVIEW AND ANALYSIS

Literature Review. The following databases were consulted: Science Direct, Environment Complete (EBSCO), Persée, Cairn, PAIS International, JSTOR, Google Scholar, USAID Land Tenure Portal, and World Bank documents. Keywords and topics included academic studies on the linkages between ASM, poverty and rural livelihood strategies, reports on trends in artisanal and small-scale diamond mining (ASDM), reports on artisanal mining in general, environmental impact assessments and mitigation projects, land tenure in the CAR, and documents from the PRADD project and other projects.

Survey Data Analysis. Data entry of the individual survey question ($n=104$) was put into Excel spreadsheets prepared by the consultant while in CAR. These were then transferred into Stata (Version 10, IC) and recoded where necessary. Besides basic descriptive statistics, analytical techniques included Pearson pairwise correlations, Student t-tests, factor analysis, reliability analysis, linear regression with robust standard errors, and logistic regressions with odds ratios. More details on the specific methods will be described when presented at various points in this report.

Spatial Analysis. A limited amount of GIS analysis was conducted using data provided by PRADD's GIS expert and shape files created by the World Resources Institute (WRI) as part of its interactive forest atlas and made available on its website under a Creative Commons license.³ PRADD's database of georeferenced mining sites, consisting of five Excel spreadsheets, were first analyzed and combined into a database in MS Access. All entries without geographic coordinates were removed, as were duplicates (determined by multiplying X and Y coordinates to obtain unique identifiers). The total number of georeferenced sites imported in ArcGIS Version 10 that were included using this method was 1,717. In addition, the February 2012 registry of 264 active POMIGER beneficiaries was linked to the georeferenced sites database via the unique site ID for those who possess certificates. Site IDs were available and/or matched for only 60 sites. These data were then projected and some basic summary statistics were calculated, including average point distance from the sites to the nearest village, and comparisons of the average amount of square meters identified as being exhausted.

1.3 LITERATURE REVIEW

The reviewed literature touched upon the following themes: ASM in sub-Saharan Africa and in general, the environmental impacts of ASM, strategies for environmental impact mitigation, the relationship between ASM and sustainable livelihoods, and issues related to land tenure.

A key finding was the overall paucity of academic literature on artisanal mining in the CAR, even in francophone journals. The only two articles with significant mention of CAR were Ingram et al. (2011) and Schure et al. (2011), both results of the same study on artisanal gold and diamond miners operating in protected areas of the Sangha Tri-National landscape (TNS) of the Congo Basin Forest Partnership, straddling CAR, Cameroon, and the Republic of Congo. These studies found that artisanal mining offers income to 5% of the landscape's population, that the average daily earnings from diamond mining is US \$3.08, and that mining accounts for 65% of their income.

² A "registry" of all active POMIGER participants has since been completed, and data from this list have been incorporated into this report in later chapters.

³ The forest atlas can be accessed on <http://www.wri.org/publication/interactive-forest-atlas-central-african-republic>. According to WRI's permissions policy, "[f]or original data files published on this site under a Creative Commons license, you may use the data to produce your own charts or other data visualizations." See <http://www.wri.org/publications/permissions>.

In general, while literature on ASM has increased in the last two decades, it remains an understudied area, especially in sub-Saharan Africa. A key report, “Social and Labour Issues in Small-Scale Mines,” published in 1999 by the International Labor Organization, offered the oft-cited figure that 13 million people worldwide work in the sector, and accounts for 15 to 20% of the world’s non-fuel mineral production. The report also criticized the “scant heed being paid to the underlying economic, labour and social problems” of artisanal miners (cited in Hilson, 2007).

Several trends in how ASM has been treated by international development actors were identified. Hentschel (2002) argued that the 1970s focused on definitional debates on what constitutes ASM, the 1980s focused on technical issues related to production, the 1990s on legislation and the relationships between industrial mining and ASM, and the 2000s on sustainable livelihoods. These trends were linked to different lenses through which ASM is viewed. In the 1980s, the “get rich quick” narrative dominated, which viewed miners as entrepreneurs motivated by the possibility of making quick money, and hence programs focused on increasing their technical capacity (Hentschel and Prieste, 2003).

Headway in broadening the perspective was made with the World Bank hosted the International Roundtable on Artisanal Mining in 1995, and subsequent research and advocacy frameworks have been put into place, such as the Bank-initiated umbrella framework Communities and Small-Scale Mining (CASM). Other efforts include the Diamond Development Initiative (DDI) of 2005, an alliance of industry, government, and civil society. More recently the Mining, Minerals, and Sustainable Development project (MMSD) headed by the International Institute for Environment and Development (IIED), has commissioned 12 case studies (Hentschel and Prieste, 2003).

1.3.1 ENVIRONMENTAL IMPACTS

The environmental impacts of artisanal diamond mining are often mentioned in a general sense, though only one rigorous study was found regarding water quality published by the South Africa Water Research Commission (Heath et al., 2004). This study examined multiple types of mining and used several indices to assess the impact of ASM, especially on water resources. It noted numerous impacts, including suspended sediments (increased turbidity) as a result of accelerated erosion, instability of riverbanks increasing flooding likelihood, alteration of river flows, excavation of sediments exposing them to oxidation and release of toxic metal ions, acid mine drainage, mercury toxicity, wind-blown dusts from unprotected tailings, destruction of spawning habitat of fish and macro-invertebrates, soil erosion of arable land, leaks of oils and chemicals from equipment and large tracts of land becoming a safety hazard for people and livestock. Naidoo-Vermaak (2009) also noted aesthetics and floodplain ponding as issues in South Africa’s artisanal mining sector.

Strategies to address these impacts varied. Hilson (2010) suggested that the key is improved regulation, increased education and improved technological dissemination. Looking at the case of Ghana, he suggested environmental impact assessments, dissemination of improved technology (such as mercury retorts for gold mining), and improved access to resources. Ghana’s “reclamation bond” approach was also highlighted, whereby the government restores land using a percentage of mining revenues. Aryee et al. (2003) noted that Ghana has had limited success with a regulatory approach, and suggested that alternative livelihoods and local economic development are good ways to mitigate impact by encouraging less people to take up mining in the first place.

In the consultancy report that shaped the POMIGER model, Mazalto (2009) examined several pilot initiatives in Sierra Leone. Like Ghana, the country keeps some funds aside from license fees—about \$75,000 per year—to fund rehabilitation. Four pilot projects were highlighted. First, the USAID Integrated Diamond Management Program (lasting from 1999 to 2005) worked with five cooperatives to restore and cultivate land. In addition, the Sierra Leone government has paid people to refill and cultivate four pilot sites. The Canadian NGO One Sky, financed by the Canadian government and working with other partners, has worked with existing cooperatives, financing the labor needed to fill in the holes (14 acres as of 2009), and helping widows have a source of income from agriculture. Finally, the Foundation for Environmental Security and Sustainability (FESS), financed by the Tiffany Foundation and USAID, rehabilitated around 45

acres⁴ by working with cooperatives that signed leases with the government, received technical training, and worked on both community pilot sites and applied their knowledge in individual fields (Mazalto, 2009). Both FESS and One Sky were part of the DDI, with whom Baxter (2009) is affiliated.

Numerous challenges were highlighted with these projects, the main one being lack of technical accompaniment by field agents (Mazalto, 2009) and land tenure issues. Mazalto noted that the FESS project involved government land, not customary land, which often has ambiguous status post-mining. Baxter, similarly, noted in the fourth lesson learned from the FESS project that “workers who reclaim and cultivate the land need longer-term rights.” The review yielded no other examples of non-regulatory rehabilitation projects, although such an approach was mentioned as a best practice by Hentschel (2002), noting that “interventions should be focused on incentives and training rather than on the traditional monitoring and enforcement systems” (p. 14).

1.3.2 SUSTAINABLE LIVELIHOODS

As noted above, a sustainable livelihoods approach, adopting the Department for International Development’s (DFID’s) original formulation, became common in the late 1990s and 2000s. A key paradigm shift was simply including ASM as a livelihood activity in the first place, an omission that is still prevalent in the burgeoning livelihood literature today (Hilson, 2011). The United Nations Department of Economic and Social Affairs (UNDESA) led a pilot program from 2000 to 2003 leading to a Yaoundé Vision Statement that recommended, *inter alia*, to integrate ASM into country Poverty Reduction Strategy Papers (PSRP) and to use ASM as a catalyst for broader economic development (UNDESA, 2003).

More recently, attention in academia has examined the links between ASM and rural livelihoods, especially agriculture. The journal *Resources Policy* published a special issue in 2009, and the *Journal of International Development* published a special issue in late 2011 on artisanal mining and livelihoods in sub-Saharan Africa, the outcome of a 2010 conference. This collection offered a step toward treating ASM in relation to the rural economic context as a whole.

These studies and others identified several ways of examining the relationship between ASM and livelihoods. Hentschel and Prieste (2003) noted that livelihoods linkages should be distinguished by the type of artisanal mining under consideration, whether it is a “rush,” temporary (fueled by recession), isolated and remote, seasonal with agricultural, or year-round. Some communities will need livelihood stabilization, while others will have opportunities to use ASM for long-term growth, and others will need different activities to increase resilience to external shocks. For his part, Hilson (2009) distinguishes the “demand-push” and “distress-push” schools. The “demand-push” evokes the “get rich quick” lens popular in the 1980s: people are generally doing fine, but they want to earn more money, so they rush to a new opportunity. The “distress-push” model—a result of the paradigm shift in the 1990s that fully considered poverty—views mining in relation to economic crises.

Within “distress-push,” there is debate about the relationship with agriculture: some view a permanent shift away from agriculture (so-called “de-agrarianization”) as a trend stemming from the fact that ASM is a viable strategy to rapidly escape from poverty. “This school contends that those who have diversified into artisanal mining from farming now view the former as their principal means of livelihood, and engage in the latter solely for subsistence purposes” (Hilson, 2009, p. 3). The implication here is that people are unlikely to adopt donor-driven alternative livelihoods because these are less attractive economically, and this is what has happened with several initiatives in Ghana (Tschakert, 2009; Hilson and Banchirigah, 2010).

Others view the shift to mining as not permanent, but a temporary result of an economic shock, and Hilson describes a case of farmers turning to mining in Ghana faced problems in the farming economy (2010). Policymakers point to the potential of ASM revenue to spark other investment (Hentschel, 2002). The pitfalls

⁴ According to the project report, http://www.fess-global.org/Publications/Other/Reclaiming_the_Land_After_Mining.pdf

of relying too heavily on ASM, since it can increase vulnerability to shocks, are noted in one case study of Sierra Leone that is particularly relevant to CAR:

On the one hand, the analysis suggests that income derived from ASM provides valuable investment funds for reviving the agrarian institutions and social networks that are vital to the post-war rural economy. However, on the other hand, diminishing returns from diamond mining operations coupled with the institutional and policy challenges of the mining sector may also be responsible for persuading some individuals to abandon ASM and encouraging them to reorientate their livelihoods more exclusively around farming. (Maconachie 2011, p. 1054).

Articles strongly recommend that future interventions take into account this nuanced understanding of the linkages: “Future development strategies must be based on a detailed understanding of relationships between the agricultural and mining sectors if meaningful rural development is to be achieved among desperately poor communities” (Maconachie and Binns, 2007b, p. 367). The majority of donor interventions so far have not done this, according to Hilson (2007), mainly because of out-of-touch consultants and a “refusal to adopt bottom-up, community-driven approaches toward ASM research and policy implementation” (p. 239).

1.3.3 LAND TENURE

The specifics of land tenure in CAR, and the complex interactions between the customary and the statutory systems, were explored in several documents commissioned by PRADD (Sende, 2011; Azou-Passonda, 2011). These will not be summarized here, but they were consulted as background material, and will be cited later in this report when the role of improved property rights in incentivizing POMIGER is explored.

The more general links between property rights, ASM, and environmental protection in Africa received much less attention compared with livelihoods. Botchway (1998) argues that “proprietorship” in Ghana is a prerequisite for environment mitigation, although his argument comes from a regulatory point of view: it is easier to hold people accountable in court if they own land. No other studies were found that make these claims. PRADD and POMIGER appear to be without precedent in combining property rights clarification with environmental rehabilitation and livelihood diversification.

2.0 POMIGER ACTIVITIES

2.1 TIMELINE AND CONCEPTUAL FOUNDATION

While POMIGER did not begin until the second quarter of 2010, its origins go back to the beginning of PRADD's intervention in CAR in early 2007. During the first 18 months of the pilot project, the main focus was on the establishment of an artisanal mining claims registry and a production and sales database (Mazalto, 2009). The environmental component of this period focused on land use planning: consultative platforms were established to guide zoning decisions about opening up new lands for diamond mining. This preventative strategy received less emphasis during the second phase. Direct restoration activities were deemed challenging because of a lack of interest and difficulties in finding the most cost-effective ways to intervene.⁵

The conceptual foundations for POMIGER are evident in the final report by Marie Mazalto in collaboration with Jean-Michel Sarraih, published in June 2009. In the English executive summary, the global economic crisis was cited as a reason why “diamond development projects can help communities convert to more sustainable agricultural livelihoods” and also reduce “dependence on diamond mining activities.” However, from the start POMIGER was never conceived as promoting an “alternative livelihood,” but rather as a “complementary livelihood,” and this principle was a key message in the early sensitization efforts.⁶

Another key element of POMIGER’s conceptual foundation was distinguishing between restoration, rehabilitation, and reclamation.⁷ Whereas restoration attempts to reconstitute original habitat and reclamation is a conversion of degraded land to human uses, rehabilitation is an intermediate step that attempts to restore elements of the original ecosystem while also putting the land to productive use. POMIGER retained elements of all of these types, although the Mazalto document proposed primarily rehabilitation followed by rapid reallocation. In this sense, the approach emphasizes the restoration of ecosystem services rather than ecosystems *per se*.

The three POMIGER activities—vegetable farming, agroforestry, and aquaculture—were also identified in the report, and were proposed based on experiences in Sierra Leone, RRAs conducted in CAR, as well as site visits and interviews with communities. As will be explored later on, CAR already has a rich experience with aquaculture, and the report highlighted this fact. Seven pilot sites were identified in Lobaye province. In contrast to Sierra Leone, where projects worked through cooperatives, Mazalto noted that CAR mining communities tended to be more individual and focused on making quick money. Therefore, Mazalto proposed compensation for aspects of the rehabilitation, whereas the reclamation (conversion) would be based on a cost-share model, where labor by communities would be exchanged for training, expertise, and inputs (p. 73). This emphasis on equipment and training was also a fundamental principle and component of the model.

POMIGER began in the second quarter of 2010, and by September, 18 fish ponds were completed and 32 ponds were constructed. POMIGER’s lead, the Director of Sustainable Development, liaised with team leaders in each of the two provincial offices (Lobaye and Sangha-Mbaeré), who in turn supervised two

⁵ From the Terms of Reference for Mazalto (2009).

⁶ From the report: “Un autre principe consiste surtout à ne pas opposer les activités minières et les activités agricoles mais, au contraire, à sensibiliser les populations à leur indéniable complémentarité. Dans le contexte actuel de crise, ce constat est d'autant plus urgent à poser.”

⁷ *Réallocation* in French.

community agents, who were full-time PRADD staff, in each province. These community agents worked closely with each village's *artisan facilitateur local* (AFL), or several for large villages, who were competitively selected based on a written and oral examination. These AFLs were paid by the project. In addition, the community agents were incentivized to spend as much time in the field as possible by paying them per diems.

In Bangui, PRADD's Communication Director, in collaboration with POMIGER's Director, developed the first communication tools and training materials. These consisted of detailed technical guides in each of the three activities, in addition to communication toolboxes for the community agents and AFLs to use during trainings, consisting of laminated "cheat sheets" with key sensitization messages and a clear sequence for carrying out training exercises. All of these materials were approached by the mining and environment ministries respectively. In total, five formal training sessions were held: one training for each province in aquaculture was first, followed by two trainings for vegetable farming, and a training for the community agents in agroforestry. By December 2010, the number of sites had risen to 90, including four fish multiplication ponds. In all, 50 kilos of *tilapia nilotica* were delivered to Boda, and 30 kilos to Ngotto. In addition, 19 people declared their interest in agroforestry and 70 in vegetable farming.

This growth continued through the first half of 2011: by March, the surface area of reclaimed land jumped to 8,984 hectares, overwhelmingly due to agroforestry plots and vegetable gardens. By June, there were a total of 425 sites reported. Also in June, PRADD and POMIGER expanded to the province of Mambéré-Kadeï. As a result, several community agents were promoted to become team leaders at the provincial level, and a new batch of community agents—three per province, instead of two—were recruited and hired. By September 2011, the number of sites had risen to 456, showing somewhat of a plateau, although the surface area of restored areas continued to rise. One reason cited in the quarterly report was the shift to a new model: instead of distributing fingerlings to beneficiaries, a transition was underway to support nine entrepreneurs who would sell the inputs to customers. Figures from December 2011 showed another spike, up to 580 sites, a figure that was finalized during fieldwork for this report.⁸

2.2 OVERVIEW OF ACTIVITIES

2.2.1 THE EXTENT OF ADOPTION

Of the 580 converted sites included in the latest reporting figures, there are 350 fishponds, 54 agroforestry plots and 176 vegetable gardens. For the six quarters with data available, the exponential quarterly growth rate of the number of sites converted to all three types of uses was 65 percent.⁹ The quarterly report also notes that these figures are likely to be much higher since numbers have surpassed field staff's ability to keep count, especially in the two original zones of intervention.¹⁰ For aquaculture, the case of Loppo is especially impressive: a handwritten list provided to the consultant by a local AFL identified 157 fishponds, but he estimated that the actual number was about 250. (A more recent census of active sites from February 2012 found 209 individual ponds in Loppo, belonging to 137 people.)

While there is little doubt about the spontaneous and impressive growth, especially with fishponds, the numbers need to be interpreted with certain caveats. First, due to data and time constraints, the consultant was unable to verify these figures.¹¹ Indeed, an exploration of the data reporting system revealed the

⁸ Data taken from a draft prior to submission on January 20, 2012.

⁹ The cumulative total has risen from 18 sites in the third quarter of 2010 to 580 sites in the fourth quarter of 2011. When an exponential trend line is applied to all six quarters of data, the quarterly growth rate is 65 percent.

¹⁰ p. 23

¹¹ Due to a hard drive failure in December 2011, the master list of sites maintained by the director of POMIGER was irretrievably lost. In addition, despite attempts to include more agroforestry plots in the site visits, only 1 was visited, since according to PRADD staff, the majority of sites are located quite far away from villages.

possibility of inaccuracies.¹² In addition, the fact that figures are cumulative means that there are likely sites, especially vegetable gardens from last year, which were included in the figures but are no longer active.¹³ Because of these reasons, PRADD staff recently conducted a census of all active sites, completed in February 2012, which is summarized in the table below.

Number of active individual sites	381 (25 gardens, 25 agroforestry, 331 fish ponds)
Number of unique beneficiaries	264
Total area	48.28 hectares
Number of individual sites on former mining pits	163 (43%)
Number of individual sites on land with PRADD certificates of customary land tenure	114 (30%)
Number of sites by province	Sangha-Mbaeré (313), Lobaye (51), Mambéré-Kadeï (15)
Number of active association sites	29 (20 fish ponds and 9 gardens run by 25 separate groups; 76% on former mining pits)
Total area	2.15 hectares

The above figures do not take into account inactive rehabilitated sites, if there are any such sites. The table also reveals another caveat that must be made when interpreting these numbers: they do not necessarily refer to the number of *unique* mining sites identified in the PRADD census process that have been *completely* rehabilitated. This is an important nuance for several reasons. First, while the original POMIGER sites were deliberately selected from exhausted mining sites, the spontaneous expansion has included non-mining sites as well. Hence, according to these figures, 43% are located on former pits. (The quantitative survey of Loppo found exactly the same proportion.) In addition, since there can be multiple fishponds per mining site, the number of POMIGER sites doesn't necessarily refer to the number of unique mining sites that have been reclaimed. Finally, the entire mined-out portion of the site is not necessarily rehabilitated, only as much as is needed for the new activity.

These qualifications are needed because it would be misleading to compare the figure of 580 or 381 to the total number of registered sites, which currently stands at 3,871.¹⁴ Despite these caveats, the basic trend of fast growth is clear, especially with fish farming. Indeed, the socioeconomic surveys conducted by PRADD periodically with the exact same random sample show this growth dramatically: the proportion of households

¹² The data on new POMIGER activities is gathered by the AFL, then transmitted to the AC, who informs the EC. Normally, these figures are included in weekly reports sent to the POMIGER director in Bangui, who then enters the information into a master list. However, an examination of all completed weekly reports from October to December 2011 for Lobaye and Sangha-Mbaeré provinces showed no new sites reported whatsoever. It was explained that quarterly figures are not always derived from weekly reports, in part due to technical issues (one regional office has been without Internet for several months). This means that the data on new sites is orally transmitted by the AFL to the community agents to the EC and then to Bangui, and this fact leaves open the possibility of inaccuracies, especially since the AFL is no longer compensated. It is important to note, however, that because of the loss of the master list in the hard drive failure, it was not possible for the consultant to fully assess the accuracy of the current figures. In addition, it bears mentioning that given very limited time and staff numbers on the ground, ensuring 100 percent accuracy of figures, especially given current growth, would involve a trade-off with other programmatic work.

¹³ Vegetable gardens are primarily a dry season (January to March) activity, since most plants would rot in the rainy season. It is possible that some gardens planted last year, especially in old intervention zones, will not be repeated this year due to lack of seed availability. For those that fit this category, the sites can still be counted as rehabilitated though inactive.

¹⁴ According to the annual report. A previous annual report (cite from notes) did compare the total number of POMIGER sites to the total number of georeferenced sites, but this was not continued in subsequent reports.

with one or more fish pond in Lobaye and Sangha-Mbaéré provinces has risen from 18.8 percent in late 2009 to 35.9 percent in December 2011.¹⁵

When looking at the ecological impact of POMIGER's sites, it is perhaps more useful to look at the surface area totals. Accurate measurement is difficult, but one clear trend is an increasing surface area of fish ponds per family: the same surveys just cited show that average fish pond size rising from 1.39 acres in November 2009 to 6.53 acres in December 2011. As for total amounts, figures vary from 211 hectares¹⁶ to 50.43 hectares.¹⁷ Regardless, the quantity of reclaimed land is more than anything achieved in similar projects, at least those identified as part of the literature review. The figures will be further contextualized from an ecological perspective in Part 3 of this report.

2.2.2 OVERVIEW OF EACH ACTIVITY TYPE

Fish farming has been the most successful POMIGER activity in terms of the number of sites, the amount of revenue generated, and the level of spontaneous expansion. Rapid returns are a key reason for its popularity: people have seen with their own eyes how much money can be earned in mere months. In Loppo, for example, one man reportedly earned 700,000 CFA (\$1,400) from his last fish harvest, wagering with another farmer about who will reach a million francs first.¹⁸

The rapid expansion of fish farming is not just limited to Loppo. In the newest province of intervention, word-of-mouth has led to spontaneous preparation of many ponds even before trainings. For example, one man handed the consultant's team a note declaring that his three ponds were completed and he wanted to place an order for fish. Even in the old provinces, there is expansion: in Ngotto, former AFL Ben Eudes recently received a request for fish from a village chief from Mbangali, 18 kilometers away. While Ngotto itself has largely maxed out the number of fishponds that water and geography allow, other villages are just getting started. The chief informed Eudes that he had dug his pond and wanted fingerlings. Working free of charge, Eudes packed some fish in a water cooler and carried it in his lap, "like a baby," on the back of a motorbike, changing the water at each of the 12 streams they passed on their way back to Mbangali. While challenges and uncertainties remain—such as whether there is a risk of market saturation and whether technical knowledge will be maintained—it is clearly boom time for fish farming. Vegetable farming is the next most popular activity as measured by the number of sites—currently 176, with an estimated 34 active ones. There are several key differences with fish farming. First, vegetable farming appears to be an activity preferred by women, who in general are the primary actors in agriculture, though men will often help to clear land. Second, vegetable farming can be highly profitable, though not on the same level as fish farming and not all year round. Gardens are only viable in the dry season when plants do not risk rotting or getting washed away in downpours. While this small growing season might dampen the activity's appeal, this doesn't seem to be the case, mainly because the dry season also corresponds to the year's most difficult period in terms of disease, discomfort, and food insecurity. The only accessible vegetable is the forest "coco" leaf,¹⁹ as dry conditions make tender manioc leaves hard to come by. As such, having fresh vegetables is highly desired, and this translates into household and market demand. Vegetable gardening comes with some challenges and limitations, besides the growing season. First, it is labor intensive, especially if the site's geography requires soil infilling and restoration of soil fertility with composting and rotations of nitrogen-fixing plants. In addition, constant weeding, watering and protection from cattle and theft require daily vigilance. For this reason, vegetable farming appears well suited to communal production, and many farms visited were organized this way. Fish farming, on the other hand, did have several community ponds, but the majority are

¹⁵ Personal communication with Sébastien Pennes, PRADD Chief of Party.

¹⁶ Figure converted from the 522.2 acres reported in the most recent quarterly report.

¹⁷ From the February 2012 census, combining individual and group POMIGER sites.

¹⁸ Community meeting, Loppo, January 13, 2012

¹⁹ *Gnetum africanum*, known as *fumbwa* in the two Congos.

individually owned and run, even if many of these individuals are also members of a community pond at the same time. In addition, vegetable farming is challenging technically, and for this reason requires perhaps the most continuous follow-up by technical agents, which makes it resource intensive. For example, several site visits to new gardens showed tomato seedlings that needed replanting within days or they risked not producing ample fruit. Technical advice of this nature is critical for new and experienced farmers alike. Fish

farming, in contrast, while requiring lots of technical guidance up front, subsequently needs relatively little once a pond is built, a feeding regimen established, and at least one harvest has been conducted.

SNAPSHOT

When it comes to spontaneous adoption, fish farming is king, but there was one interesting case of a vegetable farm start-up encountered by the consultant's team. While driving across a bridge near Ngotto, the team came across a vegetable garden, and stopped to take a look at the tomatoes, spinach, and other plants. The owner was later identified—Romaric Mbenge, a young employee of a logging company, who converted an old mining site into a garden on his own. He doesn't have a watering can, so transports water from a nearby stream into a hole he dug, and then uses a tin cup to water his plants. When later approached to ask him why he started vegetable gardening, he said he was motivated by the difficulty to find vegetables in the dry season. Aleck Soupene, POMIGER's Director, then gave him some technical advice—replant those tomatoes or they might get stunted—and then later had the POMIGER team provide Romaric with a watering can and weekly visits by the field agents as soon as they complete their training in vegetable farming.

Vegetable farming has already paid dividends for Anicet Ngondo, an artisanal miner from Bossou, about a half hour's drive from Ngotto. The association Botindi, with four men and seven women, is in its second season. Being market day and a Sunday, the women had other obligations, but Anicet took some time to show his personal and communal gardens, in addition to his fishponds. Members are waiting for seeds from PRADD for this season, but in the meantime have planted what they can with seeds saved from last year, supplied by the project but sourced from the FAO. Anicet still has land with diamond gravel, but left mining about three years ago because he can't afford a water pump, and was sick of the uncertain income, which could vary from nothing to \$100 in a given year. "In our parents' time, there were lots of diamonds, but now there's nothing," he said. "All we do now is carry gravel like donkeys." The income from gardening and fish farming have helped finance other investments and expenses. He used money from last year's harvest to buy a chicken, goat, and pay his kids' school fees.



Tomatoes sold the best, followed by lettuce. The revenue from the community gardens stayed in the shared account and has been used as "health insurance," being drawn upon by members in case of need. He also has a fishpond, and income from the last three harvests totaled \$148. "Now every day I live normally," he said.

Related to this challenge is the issue of seed production and procurement. With certain species—cucumber, tomatoes, watermelon, amaranth greens, spinach, and onions—it is relatively easy to keep seeds from a harvest for the following season.²⁰ The main barrier is behavioral, since individuals are not generally used to keeping seeds to plant for a new season.

However, the production of seeds for lettuce, cabbage, carrots, and parsley is technically too complicated, so these must be purchased from technicians. These issues will be elaborated upon in the discussion about the commercial production units.

Finally, though agroforestry has seen less growth compared to the other activities, it is

²⁰ Interview with Aleck Soupene, POMIGER's director, who is a trained agronomist.

theoretically the most profitable activity once an initial investment is completed. Agroforestry is also attractive from an ecological perspective, since in degraded forest areas the trees cohabit with regenerating forest. In addition, plots can be located further away from settlements, although once production begins theft is a concern.

However, while agroforestry's long-term time horizon is an asset once trees start producing, this long initial investment period is a key behavioral barrier. A PRADD field agent summarized the issue this way with the proverb: "Whoever plants a tree won't necessarily be around to eat its fruit." When pressed on what this meant, he explained that it referred to the long time horizon, the level of risk involved, but also the superstitions that long-term investments are bad because they attract bad luck and jealousy that will conspire against potential success. He went on to say that fish had the opposite effect: it was reassuring to visit one's fish because they were in effect a safety net, whereas tree planting might never be fruitful.

For this reason the property rights angle of PRADD is especially interesting when it comes to agroforestry. Unfortunately not enough sites were visited to come to any conclusions—and it is too early in the project to evaluate fully—but the fact that agroforestry participants are all individuals is telling. In addition, of the 25 agroforestry sites in the February 2012 census, 48% have PRADD certificates of customary tenure, as opposed to 41% of fish farmers and 28% of vegetable gardeners. Agroforestry is also an area that has received particular attention from a land tenure point of view, since planting trees is a customary sign of owning property in many African contexts, including in PRADD's intervention sites.²¹

One site in Ngotto revealed some of the challenges with agroforestry. Cola trees were planted two years ago in the presence of the mayor and with much public attention. During the consultant's visit, however, it took 15 minutes to uncover a single sapling amidst thick underbrush. According to the POMIGER Director, it is typical for people to plant trees and wait for them to reach maturity before beginning to weed. However, this means that the trees will not have enough nutrients to fulfill their capacity. In addition, a lack of identification could lead to a risk of trampling or loss in fire.

A young man named Alexie Ngenga expressed interest in tending the trees, but was reportedly intimidated by the fact that the elderly gentleman who owns the site has a PRADD certificate.²² Alexie has some experience with trees: he had a friend from Bangui bring saplings when he finished high school five years ago, and has planted a variety of trees. "With diamonds, you have to suffer. But with my trees, I sell the fruit and I live." There was a recent death in the family of the elderly gentleman who owns the site, so he could not be interviewed.

In a general sense, however, there does appear to be interest, especially in oil palms. The manager of the commercial production unit in Boda said that people had come asking for saplings, but production was currently insufficient, and the commercial production unit (UCP) north of Berberati is reportedly far under capacity compared with the demand from miners in the area.²³

2.2.3 CONTEXTUAL FACTORS AND MOTIVATIONS

Despite key differences in the challenges and opportunities presented by each POMIGER activity, all have been met with interest and relative success. In the following section, we examine some of the factors and motivations behind this interest, as well as factors that may be inhibiting even further adoption.

²¹ A look at the database shows that most mining sites are demarcated with banana trees.

²² According to Ben Eudes

²³ According to focus group discussion in Berberati.

2.2.4 ECONOMIC CONTEXT

The most fundamental reason why POMIGER activities have taken off has been the ongoing economic crisis in the country. Quite simply, as revenue from diamonds continues to decline or stagnate, people's choices when it comes to food and money continue to tighten. In this sense, POMIGER's growth is due in no small part to its timing, opportune for a project but difficult for its beneficiaries. It also provides strong evidence how, as noted in the literature review, artisanal and small-scale mining are intricately linked to livelihoods and poverty.

The economic situation has been examined in analyses of the two socioeconomic surveys conducted by PRADD in late 2010 and mid-2011 (data from the third survey is currently being analyzed). Significantly, the RRA and subsequent triangulation uncovered the same trends identified in these analyses.²⁴ While there is regional variation, the general pattern uncovered in the RRA is as follows: in the 1980s and 1990s, the vast majority of households gained their income almost exclusively from the diamond economy. While many families had small subsistence agricultural fields, mainly tended by women, almost all men worked in the mines. Some people took advantage of this lack of investment in agriculture: Ngoulo's AFL Philippe, for example, cultivated a large number of fields and used that revenue to finance his diamond operations. But the majority found it more profitable to stay with mining, and this seemed to work for many years—people in Ngoulo rank the decade around 1980 as when their well-being was the best in terms of money and food. However, this dependence on diamonds made them vulnerable to the shocks that occurred between 2000 and 2010.

First, there was the fallout from political instability, beginning with a failed coup attempt in 2001 and continuing through the elections of 2005—and to a lesser extent, until today. It is difficult to gauge to what extent these events affected rural livelihoods. One effect in Ngoulo was a marked population influx of refugees from the north—mainly cattle herders—beginning in 2000. While most villages in mining provinces were founded post-independence and are composed primarily of immigrants—Ngoulo counts over 15 distinct ethnic groups—this influx was an anomaly, and lasted until 2008 or 2009, when additional shocks arrived.

In 2008, the majority of purchasing offices were ordered closed by the president, and this led to a drying up of financing, which normally passed from these offices to independent collectors and then to the artisanal miners. Because artisanal diamond mining is highly dependent on financing, this made it extremely difficult for artisanal miners to find “assureurs” or “patrons,” those people who provide food, cash and tools in exchange for exclusive buying rights on their own terms, usually more favorable to them than for the miner. One PRADD staff member in Berberati recalled how military officers raided collectors’ offices, including the safes. While the reasons and context for these actions are complex, the subsequent lack of financing in effect “arrested” the population, according to the staff member, and led to a food security crisis, among other consequences.

In addition, the average selling price per carat had been steadily declining during the decade, reaching a low of 47,643 CFA (\$95) per carat in August 2008, 50% lower than the average selling price in 2000.²⁵ In an economy where artisanal diamond miners don’t see a large proportion of the revenue anyway, this effect on them was likely felt all the more strongly. These trends led to a forced transition back into agriculture, since people could no longer afford to buy their food and needed other ways to make cash. Indeed, analysis from the first socioeconomic survey from January 2011 showed a modest increase in overall income in 2010 compared to 2009, the height of the shock’s effect, and this increase was due entirely to agriculture. In July

²⁴ The most detailed report, from January 2011, was only examined by the consultant after field research, lending further significance to the findings, since the report did not bias field research but nonetheless similar conclusions were reached.

²⁵ Source: Bureau d’Evaluation et de Contrôle de Diamant et d’Or (BECDOR)

2011, this trend was confirmed, with the proportion of income from agriculture increasing from 44 percent in 2010 to 59 percent in July 2011.²⁶

However, the 2010 survey analysis also noted that despite this nominal increase in overall income, families were still overall experiencing a general impoverishment. This was especially evident with respect to animal ownership: between 2009 and 2010, the proportion of poultry owners dropped from two-thirds of households to one-half, and this continued to decline in the July 2011 socio-economic survey.²⁷ In addition, the proportion of households without any animal assets increased by 20 percent.²⁸ In 2011, evidence emerged of purchasing power decreasing as well. Anecdotally, 2011 showed some improvements, with some attributing higher earnings to PRADD's education campaigns and sensitization of several "good" collectors,²⁹ coupled with a rise in prices per carat (with an average of 93,000 CFA between January and September 2011). These effects should not be overlooked, but a full examination of the impact of PRADD's other intervention areas is beyond the scope of this report.

There are regional variations in these trends worth noting. In Ngoulo, the closure of a nearby logging company in late 2010 not only decreased overall salary income³⁰ but also impacted the price of manioc. Several women who sell manioc in the local market noted that the price of manioc peaked in 2008, in their view because logging company workers came to buy it from Ngoulo. As a result many people began planting manioc fields, and the combination of the closure of the company and over-supply has led to a price drop from oversupply: there is currently manioc rotting in fields.³¹ This price decline was estimated by another man to have gone from 2500 CFA per small basin in 2009 to 1000 CFA today, with some days the price falling as low as 750 CFA.³²

A final element of the economic context has to do with decision-making and risk. Since diamond mining is an inherently uncertain activity, attitudes toward risk are an important factor in choices, if alternatives exist. People's appetite for risk would presumably decrease in a precarious economic situation, since the cost of not earning anything from diamonds is higher. In addition, when there is a lack of funds for investment, the probability of not finding diamonds also increases. This in effect changes the risk calculation, since less financing means that less area can be mined, which decreases the probability of finding diamonds. These aspects of people's decisions were evident during fieldwork, with several interviewees stating how they prefer aquaculture because there's less risk, and also implying that risk of not finding diamonds has increased, in part because certain rich areas have already been mined out, but also due to lack of financing.

In summary, one cannot understand the enthusiasm for POMIGER activities, especially fish farming, without understanding this major economic transition and its underlying factors. As the socioeconomic analysis of 2010 data noted:

This trend is unlikely to have been induced by PRADD. However, PRADD sensitizations and trainings on income diversification are certainly ringing the right bell in people's mind. Artisanal mining populations are ready to return to an agriculture-based economy, or at least to diversify income sources. For this, they will need technical advice and support.

The current study confirms this analysis, although there are several other motivating factors worth noting before delving into how PRADD's technical advice and support played a decisive role as well.

²⁶ PRADD Quarterly Report, October 2011, p. 29

²⁷ Ibid., p. 30

²⁸ Ibid., p. 6

²⁹ Interview with Philippe, AFL in Ngotto

³⁰ Op. Cit., p. 29

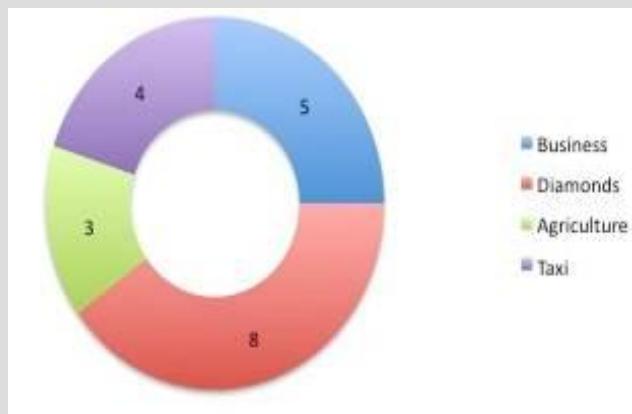
³¹ Conflict Matrix Exercise, RRA, Ngoulo

³² Wealth Ranking Exercise Household Interview, Ngoulo

RRA HIGHLIGHT: WEALTH RANKING EXERCISE

The Rapid Rural Appraisal in Ngoulo uncovered basic but crucial contextual information about POMIGER. Among its most fruitful exercises was the wealth ranking: a carefully selected group of 8 people were asked to divide 25 black-eyed peas into as many wealth groups as they wanted, with the number of beans in each group proportional to its size. Some were initially reluctant, fearing that the exercise was leading toward identifying and talking about those who were rich, which would attract bad luck. When reassured that the exercise was general, however, they soon agreed upon three wealth groups:

Group 1. These people form less than 10 percent of the population, and tend to be businessmen and diamond buyers (Ngoulo doesn't have any officially registered collectors). In the past 2 years, this group has slightly increased in size (from about 4 to 8 percent, according to the rough bean estimates). On the surface, this is a puzzling trend in a context of continuing economic crisis, but one which was also picked up in PRADD's socioeconomic analysis from January 2011. In a discussion on why overall diamond production is increasing while average diamond income is decreasing, it appears that inequality is on the rise, since collectors will tend to only invest what little funds they have in the most successful miners, who are by definition wealthier.³³



Participants identified one young man as belonging to this group, and was selected for a household interview.³⁴ He was born in Ngoulo, but studied in Bangui, and is from the Sanga ethnic group, those who originally settled in this area after emigrating from the Republic of Congo. His income stream is quite diversified (see chart). He owns 3 mining sites, 2 of which are active; one of the “surveillants” is his brother. Last year he financed 4 other mining sites. He doesn't do independent purchasing, as people generally only sell to those who have financed them, and he sells both to collectors and to purchasing offices. He uses some of the manioc he produces as rations as part of his financing. While diamonds are his main activity, the combined income from petty trade (mainly fuel) and his motorcycle taxi business surpass his diamond income. This distribution has been the same since he returned from Bangui three years ago. He has a satellite dish, TV and DVD player, multiple motorcycles.

Group 2. The middle-income group represents about 30 percent of the population, according to the 8 exercise participants. In general there are two sub-types: those who are “chefs de chantiers,” owners with workers directly under their supervision, and artisanal miners who finance others to work their sites. They get this money either from financiers higher up the value chain (collectors and buyers) or a small amount of people use their own money to finance this work, sometimes from agricultural products or other petty trade. When asked how one joins this group, participants said it was mainly a matter of luck: if a poor artisanal miner happened to find a diamond large enough to pay off his or her debts and have enough to invest, they would be able to climb up.

³³ First report, page number

³⁴ See methodology section for how these were selected.

Elie Bana and his wife Julienne Aboutabe were identified as a household that fell into this category. Elie moved to Ngoulo in 1959 when the French closed down the road to Bayanga, to the south. He began as a mineworker and a bushmeat hunter. Between 1990 and 1994, he would spend many months in the forest regions hunting, and it was during one of these trips when he prospected for and acquired his first mining site. Most sites closer to Ngoulo were already staked out by that time. To mark his spot he would carve signs in trees and also planted banana and avocado trees along the limits. In 1996, he hit the jackpot, pulling out a 55-carat diamond. Although he declined to talk about the details, the discovery immediately put him in trouble with the mining authorities, who arrested him. He declined to reveal to whom he ended up selling the diamond and for how much. With the income he earned, however, he was able to buy a second house in Nola, the nearest town, and also begin financing others, including several relatives. For the relatives, his cut would be 40 percent; for others, 60 percent.

Things haven't been smooth sailing, however: in 2009 and 2010, he was unable to work his two sites, one of which is PRADD-certified, due to lack of financing. In 2010, diamonds represented only 10 percent of his income, which as a whole was 80 percent less than a "typical" year.

However, 2011 has been better. An aging cousin gave him a new mining site, and he is financing a pygmy artisanal miner with 4 to 5 people on the site. He has been able to finance this work on his own: 2010 was a good year for agriculture, and his wife Julienne had managed to save 20,000 CFA (\$40). In addition, Elie received 50,000 CFA (\$100) in connection with a daughter's marriage.³⁵ He says that this type of artisan-to-artisan financing is becoming more common, as funds from collectors runs dry.

Group 3. The remaining 60 percent of Ngoulo's residents are those who don't have land, labor or luck to get ahead. About half are mining workers (paid on a daily basis) or former workers who can't labor anymore. The remainder are artisanal miners who own land. However, in order to work this land, they are in debt: half only have some debt (they are given food rations), while the remainder has lots of debt (they are given food rations plus money and tools).

Maurice Moussou and Nyambutu Angel were identified by the RRA participants as a representative family in this situation. They have been in Ngoulo for six years, having come because of a relative.

Of all families, they are the most dependent on diamonds as a proportion of their household income: while the man in Group 1 got 20 percent of his income from diamonds, and in a good year Elie (Group 2) got 50 percent of his income from diamonds, Maurice and Angel get 65 percent of their income from diamonds, and even more if you count the amount from their financier.³⁶

Maurice owns a mining site, but it is far away: about 50 kilometers away on the border with the Dzanga-Sanga protected area, and he works there with his son. He says that guards harassed them last year, making to stare directly at the sun while being accused of hunting in the protected area. His site doesn't have a certificate: it was identified by PRADD but was too far away to be included in the georeferencing process.



³⁵ He didn't want to call this arrangement a dowry.

³⁶ Perhaps not coincidentally, this 65% corresponds to Ingram et. al (2011) average amount of income from diamonds among artisanal miners working in TNS. Interestingly, Maurice's site is near Dzanga-Sanga, raising the question of whether those miners who venture that far tend to be poorer.

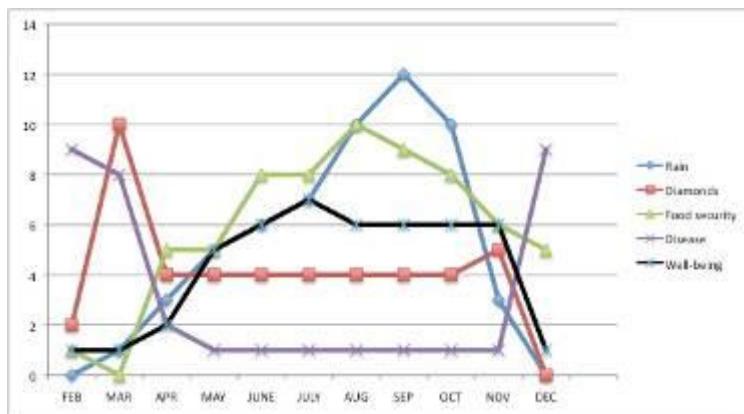
He goes to the site twice a year, staying between 2 weeks and 2 months at a time. In the dry season before heading out he will typically help clear land on their agricultural plot for his wife to cultivate. Angel says that in the past women would often hire laborers for slash and burn, so their husbands could go straight to the mines, but they can't afford to do that anymore. She also says that in their parents' time, families would have enough money to buy food, and the forests were less restricted so hunting was easy.

This year, Maurice has a financier, a "patron," who has provided him with tools and some money. It's hard to find a patron these days, he says. He does all the work with his son, but they recently were involved in a family dispute and the son is in jail for a reason he didn't wish to disclose. The family recently sold their only pig to help cover the bail money, but this wasn't enough. They have no other savings. "I try this and that but I can't get out," Maurice said.

2.2.5 FOOD SECURITY

Another key motivating factor behind POMIGER is food insecurity. This is closely linked to the economic transformation underway during the past four years. Indeed, it was the lack of money from diamonds that sparked food insecurity since people were no longer able to purchase their food. This catalyzed the return to agriculture, both as a strategy to make money but also to eat. However, there are additional elements to food security as a motivating factor that deserve attention.

First, the RRA uncovered the crucial effect of seasonality, with the dry season being particularly miserable. (See chart; the y-axis shows the number of beans, corresponding to intensity.) This was particularly evident with respect to vegetable gardening, since as noted above, finding fresh vegetables in the dry season is nearly impossible.



A second important food security consideration is related to fish and the availability of other animal proteins. People tend to not include manioc in their consideration of food security, but rather define food security as having enough fish or meat to eat. Manioc is considered a given, although according to the NGO that runs the fish production unit in Berberati, there was a manioc production crisis in that region in 2009 because of the economic crisis described above. During Ngoulo's historical matrix exercise, people said

that manioc is always there, however. Instead, food security is measured as the availability of meat and fish, and both have become scarce. Bushmeat has declined because animal habitat is further away, because of overhunting, or because of enforcement in the protected areas in 1990.

However, the situation with fish is dramatic. Prior to POMIGER, getting fish in Loppo was extremely difficult. Dried river fish was available from as far away as Bayanga, but this could cost up to 5,000 CFA (\$10) per fish. (In contrast, tilapia is currently selling between 1,000 and 2,000 CFA per kilo.) In addition, people purchase fish that comes all the way from Cameroon, according to residents of Loppo. Fish stocks in streams have all but disappeared in many parts of Sangha-Mbaeré. According to interviews and the RRA, there were several reasons. First was the use of ichthyotoxic plants (especially *tephrosia*) by women as a fishing method. In the case of Ngoulo, participants in the historical matrix exercise and the conflict matrix exercise noted a sharp decline—in effect, a collapse—between 1990 and 2000, and for them the main reason was the use of this poison. Focus group participants in Loppo noted a similar collapse in their region between 1995 and

1997, but they cited diamond activities as the key reason for the decline. Observation of the environmental damage on waterways caused by mining confirms that this hypothesis is plausible.

These motivations are key for understanding both the desire of people to cultivate vegetables and raise fish for their consumption, but this is also naturally linked to market demand for these products that has made these activities attractive. While this effect isn't as dramatic for agroforestry, there is a food security element behind the demand for palm oil trees, which appear to be the most popular of proposed tree species. Although not visited because of time constraints, the site of Nandobo 50 kilometers north of Berberati contains many artisanal miners enthusiastic about palm oil production. According to PRADD staff in Berberati, a key motivation for this is the scarce and expensive nature of palm oil in the region, since oil has to come either from Cameroon or all the way from Bangui, hundreds of kilometers away.

2.2.6 ADDITIONAL CONTEXTUAL FACTORS

Three other factors—geography, previous exposure and psychosocial dimensions—have also affected people's decisions. Geography is a particularly relevant for fish farming, since the technical requirements for setting up a pond are limiting. One reason why Loppo has been particularly successful, for example, has been the existence of five separate streams feeding into the Loppo River. The slope of these streams is within the optimal 2 to 5 degree range—enough to take advantage of gravity, but not so much as to wash the fish away during the wet season. On the flip side, the village of Mbanza has no fishponds, not for lack of interest, but because the slope is too extreme.³⁷ In addition, the distance from the site to the owner's residence is also a factor, especially given the issue of theft—people coming in the night with fishing rods, for example.

Previous exposure is also a factor that shouldn't be overlooked: fish farming in old “marmines” (abandoned pits) is not a new idea that the project introduced. Indeed, as described above, POMIGER activities were chosen based on community suggestions. Many POMIGER beneficiaries are young enough to remember the Peace Corps, which included a large fish farming initiative, and POMIGER has capitalized on that experience and surviving infrastructure. Indeed, the first multiplication sites for fingerlings in Boda were located in former Peace Corps tanks, and the commercial product unit under construction in Berberati is also a converted Peace Corps site. On the level of perception, however, many have needed little convincing about fish farming's benefits, with several people recalling helping out their fathers or uncles' ponds when they were kids. In Loppo, others have spent time or have relatives who live in the Landja neighborhood of Bangui, where there is an advanced fish farming practice, and from which POMIGER's *tilapia nilotica* originate.

The social security benefits of POMIGER activities also deserve mention as a motivating contextual factor. While the income earned from these activities serves a clear and immediate cash and food security incentive, the long-term security that these activities promise is not lost on participants. When asked why they are practicing fish farming, many people mentioned their concern about what they are going to do when they don't have enough strength to dig in the mines anymore. This is especially true among older people, and anecdotally the majority of fish farmers are older. In Beya, almost all of the enthusiastic fish farmers are retired miners who now have nothing to do with that industry. The same is the case in Loppo. In effect, as one respondent put it, fishing farming is people's “retirement.”

This promise of additional social security is a motivating factor not only among those on the verge of old age, however. Just as the “gambling mentality” is a draw toward diamonds, knowledge of its flipside—that the house will probably win—motivates people away from diamond mining, if they can. As noted in the section on economics, attitudes toward risk are an important consideration. Several people noted the mental anguish of not knowing if you'll find a big diamond—or any diamond, and this can lead people to prefer a more stable source of revenue if available. These dimensions raise complex questions about to what extent POMIGER offers, in relation to diamond mining, an *additional* economic activity, an *alternative* economic

³⁷ Aleck Soupene interview

activity or a *complementary* economic activity.³⁸ This will be taken up later on in a discussion on economic impact and viability.

2.2.7 IMPROVED PROPERTY RIGHTS

A final contextual consideration, central to PRADD's approach, is the role of property rights in motivating participation in POMIGER. On the surface, the theory is straightforward: people should be more likely to invest in productive activities on their land, such as POMIGER, if they feel their property rights are secure. The theory was summarized in a 2011 USAID Policy Brief³⁹ this way: "Through strengthening tenure security and clarifying property rights at various stages of the mining process, these resource conflicts can be reduced significantly while also providing incentives for mitigating environmental impacts of this extractive sector" (p.1).

This intuition makes special sense with activities with higher risk due to longer time horizons, like agroforestry. The logic goes that since PRADD has improved property rights over mining claims through its geo-referenced and community-validated certificates of customary tenure, and has demonstrably reduced land conflicts as a result (from 142 to 4 in one year⁴⁰), those with certificates should be more likely to be enthusiastic adopters of POMIGER activities. An empirical strategy to test this hypothesis across POMIGER sites was considered, but methodological and theoretical problems made this impossible to carry out.⁴¹

On a smaller scale, the quantitative survey in Loppo made some attempt to examine this question empirically. First, four questions were included specifically aimed at gauging attitudes about several dimensions of land tenure security. The questions were chosen based on the different aspects of the "property rights bundle" that surfaced during field interviews. Responses were coded on a three-point scale: disagree (0), somewhat agree (1) and strongly agree (2).⁴² While the resulting scale did not have a broad range, it was broader than a simple dichotomous variable and allowed for some nuances to emerge. An attempt was made to construct a "Land Tenure Security Index" for use in subsequent analysis by combining the scores, but this was not possible for statistical and theoretical reasons.⁴³

However, each question individually revealed some interesting trends. The following table presents the mean score for each question, the mean score for those reporting having a PRADD certificate, and the mean score for those reporting that they do not have a PRADD certificate. Having a PRADD certificate was defined as

³⁸ An *additional* economic activity would be simply a "plus" that doesn't necessarily have a major trade-off with diamond mining, but is a relatively simple expansion of the income pie. An *alternative* activity would be related, through opportunity costs, to diamond mining would therefore be dependent on the level of revenue that one gains from diamond mining. A *complementary* activity would be additional but have a close, positive relationship with diamond mining: for example, financing diamond exploitation through income from the complementary activity, or using diamond mining tools to farm fish.

³⁹ Property Rights and Resource Governance Briefing Paper # 14.

⁴⁰ Ibid., p. 6.

⁴¹ A simple cross-tab analysis and chi-square test was considered for two sets of dichotomous variables: those with certificates and those without certificates, and those who adopted POMIGER activities and those who did not. From a practical standpoint, the lack of a master list of POMIGER participants was a key impediment. In addition, PRADD's database focuses on those with certificates, rather than those without. In addition, POMIGER participants were not completely self-selecting: initial participants were identified from the list of geo-referenced miners (most with certificates) who indicated having mined-out land available. In other words, the only way to get an unbiased sample would be to go out to the field and randomly sample from all artisanal miners, and this would be costly and difficult. Most fundamentally, however, discussion with program managers and qualitative research revealed that the null hypothesis was unlikely to be rejected, since the relationship between certificates and POMIGER is indirect at best.

⁴² During field testing, it was determined that the questions needed to be sequenced by first asking if the respondent agreed or disagreed with the statement, and if they agreed, then asking them if they agreed somewhat or a lot. Without this sequencing, responses tended to split between strongly agree and disagree, with no middle ground.

⁴³ From a statistical point of view, a reliability analysis of the proposed scale returned a sub-optimal Cronbach alpha (0.47). This makes sense from a theoretical standpoint, since each question is not measuring the same thing, but rather different dimensions of land tenure security, from clarity of boundaries to the right of sale.

having a certificate for any mining site that a respondent owned, whether it is active, in reserve or converted into a pond.⁴⁴

Questions	Mean score (n=95)	Mean score for those with certificates (n=40)	Mean score for those without certificates (n=55)
1. The limits of my pond are clear and respected by most members of the village	1.78	1.88**	1.71**
2. I can sell my pond without asking for permission from anyone	1.34	1.6***	1.15***
3. I am confident that a company cannot seize my land where my pond is located without negotiation with me	0.71	0.8	0.64
4. I am confident that my children will inherit my pond	1.96	1.98	1.95

** Significant at 95% level *** Significant at 99% level

These results reveal firstly that the confidence is highest regarding inheritance (nearly 100% strongly agreed) and lowest about fear of expropriation. Second, there is a pattern of higher levels of agreement with the statements for those with PRADD certificates compared with those without. Since the questions focused on fishponds, this suggests that the PRADD certificates—though issued for any type of mining site—have a general positive effect on increasing the perception of security, even for land not currently being mined.

Among the statements, the different scores on the first and second for those with and without certificates are statistically significant.⁴⁵ This suggests that the certificates have a significant effect on people's confidence in the recognition of boundaries, and has an even more significant effect on their confidence in their ability to sell their fishponds. The latter conclusion coheres with anecdotal evidence of a land market developing for both fishponds and mining sites as a result of the PRADD certificates. It also coheres with the theoretical relationship between land tenure and a land market, since “[t]enure insecurity acts to drive up the transactions costs associated with negotiating and enforcing contracts.”⁴⁶ In addition, a legal study commissioned by PRADD noted that under customary law, even if one sells a piece of land, the original owner and his or her descendants can always take it back (Sende, 2011).

An examination of statistically significant correlations between these land tenure security dimensions and other variables also reveals some interesting results. For example, agreement with the first statement—clarity of limits—is negatively correlated with several variables related to conflict. It is negatively correlated to reports of conflicts over limits (coefficient: -0.31, p<0.01) and positively correlated with those who report no conflicts (coefficient: 0.53, p<0.01). The second statement—confidence in the right of sale—is moderately positively correlated with having a PRADD certificate for either a pond or a mine (coefficient: 0.28, p<0.01), reinforcing the hypothesis from the t-tests.

Another important relationship worth exploring is the significant positive correlation between wealth and having a certificate, at least in Loppo. This relationship will be examined in the next section.

Besides these limited quantitative analyses, qualitative research led to some other pertinent observations and tentative conclusions with regard to the role of the PRADD certificates and improved land tenure security. It

⁴⁴ The reason for this combination was that only 13 respondents reported having a certificate for ponds, whereas 39 reported having certificates for mining sites (ranging from 1 to 7 sites). The combination allowed a large enough sample to perform a simple t-test on all subset mean scores to determine if the difference from the overall mean was statistically significant or not.

⁴⁵ Based on Student's t-test of equality of means between the two categories.

⁴⁶ USAID. “Land Tenure and Property Rights: Framework.” Volume I. Draft, Sep. 2005, p. 21.

should be noted, however, that a full exploration of the land tenure issues were beyond the scope of this assignment, since measuring land tenure security is much more difficult than just using the “proxy” of holding a certificate, and there are limitations with survey questions used in Loppo.

RRA HIGHLIGHTS: CONFLICT MATRIX

Qualitative evidence from the RRA confirmed the certificate’s role in reducing conflicts. The conflict matrix exercise in Ngoulo’s RRA consisted of two steps: first, all conflicts were listed and defined. Second, conflicts were ranked by participants by their level of intensity (high, medium, and low). This was then used as a basis to delve into social relations, power structures and how they have evolved through time.

Of the 18 types of conflict initially identified, three were identified as being of high intensity: water conflicts, conflicts between farmers and cattle-herders, and family conflicts. (Later, a fourth high intensity conflict was added at the urging of the land chief: conflicts involving witchcraft.) When asked to identify how intensity rankings changed through time, conflicts related to diamonds was ranked as high in the past, but because of the certificates, its intensity is now medium, according to the participants.

Details of conflicts varied, but water conflicts primarily regarded access to the village’s only bore well, and the distance to poor water springs several kilometers away. Indeed, water conflicts appear to be important in other places too—perhaps surprisingly in a forested region—and have implications for the future of aquaculture and agriculture. The land conflicts between cattle-herders (*les peuls*) and farmers are active in Ngoulo, with representatives from both becoming visibly upset during the RRA. Cattle-herders do not have enough land to graze their animals, despite a zone delineated by the government nearby, and farmers feel they should be compensated for losses incurred from cattle incursions, or that the cattle-herders should pay for fences. These issues could affect vegetable gardening, though no cases of this were encountered during fieldwork. However, these conflicts point to the potential benefits of continuing PRADD’s groundwork from the first phase in setting up land use plans and associated governance structures.

Anecdotal evidence shows the remarkably positive effect that the certificate has had on general perceptions of land tenure security. During the in-depth household interview with Elie Bana (profiled above), he was pressed on what value-added the certificate gave him, compared with an *attestation de vente* or a *patente*.⁴⁷ The *patente* is the best way to reduce harassment by the mining brigade, he said. However, many do not want to pay for the permit because they fear that the state will tell them they cannot mine on their land when they declare it. This might partly explain the effect that PRADD has had on increasing the number of people applying for permits.⁴⁸ The *attestation de vente*, on the other hand, has value in that it is recognized by the land chief, and can be a *de facto* title. However, it is only issued in the case of a sale—and many sites are claimed through oral approval or no approval at all from a land chief. In addition, the land chief that issues an *attestation de vente* may ask for a cut in any subsequent diamond income, especially if a large stone is found.

So what’s good about the PRADD certificate? “It’s a birth certificate,” Elie explained. Its value is two-fold: first, it gives you more security from the risk of your land being expropriated by a company or by the state. There is something about knowing that your site’s coordinates are in a computer in Bangui that gives security, and as noted in the recent legal studies on PRADD, PRADD certificates have been used by judges to resolve conflicts and have been used to force a cooperative to compensate the certificate holder.⁴⁹ However, as discussed above, the survey in Loppo revealed that fear of expropriation remains high, with 60% of respondents (n=95) stating that they did not agree with the statement about having confidence that a company couldn’t take over their land arbitrarily. (This should be qualified, however, by the fact that only 9 of these people reported having ponds on land that was certified.)

⁴⁷ *Attestation de vente* is a document provided by or signed by the land chief to certify a sale, and the *patente* is the mining permit.

⁴⁸ Other reasons being the sensitization campaigns and the fee reduction.

⁴⁹ Sende, 2011.

The second value, according to Elie, is that the certificate is hereditary. Holding the certificate not only gives you security that your land won't be expropriated, but that your family will inherit the land upon your death. The survey in Loppo revealed that most people (96%) are strongly in agreement about their children inheriting their ponds. However, the survey did not find a difference in perception between those who had and didn't have a PRADD certificate, suggesting that that this confidence could be independent of the certificate and preexisting in the customary system. In addition, the question of the place of the spouse in inheritance was not explored by the survey.⁵⁰

A point of clarification is called for. It is not so much that the certificate itself gives someone greater tenure security or enhances the value of the land, rather it is more the process of geo-referencing the claims and publicly validating them with the community and local authorities that make the property owner more secure in their claim over the land. The security generated from everyone knowing the land is recognized as belonging to a given miner gives that miner greater comfort in investing his/her labor and scarce resources to enhance the value of the land. The certificate of property rights is only an instrument that states whose land it belongs to; however, given the process that was undertaken, it gives miners confidence that the land is clear of competing claims. This is why an informal land market is developing with the certificates, as discussed on the following page.

SNAPSHOT

Leonard Likamule is a mine owner and fish farmer and Jean-Claude Yapoubisi is a mining day laborer and farmer. They live in the same part of town. Likamule plans to sell a portion of his land to Yapoubisi once mining operations are complete. They haven't yet agreed on a price, though Yapoubisi mentioned a figure of 15,000 CFA during a group meeting. Likamule has a PRADD certificate for his sites.



These perceptions are relevant to POMIGER insofar as having security—at least defined as no conflicts over limits (as a result of local recognition and legitimacy), low risk of expropriation without consent, and hereditary rights—could incentivize participation. However, the link between these factors and the certificate are not straightforward. First, it should be noted that the perception of what the PRADD certificate confers and the reality may not cohere. In focus group discussions and interviews,⁵¹ there is concern about the certificate's ambiguity when it comes to use and duration. In effect, while the certificate has gone a long way in clarifying rights, two of the typical three dimensions of the property rights bundle—time and assurance, though not size—remain somewhat ill-defined.⁵² The document appears to confer indefinite ownership, though this is not explicit, and it is the regional director of the mining ministry that signs it, leaving the possibility that it is not valid for other uses, such as agriculture. In addition, there was reportedly one case of a traditional chief asking for a cut based on the fact that the certificate is called “customary” and this term implies not only that it is customary in the sense of being a *de facto* recognition by peers but that the right is always negotiable according to the will (and sometimes whim) of the designated customary authority.⁵³ Hence, while most people perceive this to be a document with some clout when it comes to the state, that might be questioned and unravel later when it comes to non-

⁵⁰ Inheritance by children appears to be relatively secure in the customary system. The real test of the certificate's effect would be if the document specified inheritance by the spouse first, and this change was reflected in both attitudes and behaviors.

⁵¹ FGD in Berberati and interview with UCP manager in Ngotto.

⁵² The three dimensions referenced are from USAID. “Land Tenure and Property Rights: Framework.” Volume I. Draft, September 2005.

⁵³ Discussion with Sébastien Pennes, PRADD COP.

mining uses after a certain amount of time. These issues have been identified elsewhere in internal PRADD documents and in the report on the legal status of the certificate, and go beyond the scope of this report, but their emergence in stakeholder interviews about POMIGER make it relevant.

Beyond concerns with the certificate, there is the question of how the certificate in its current form influences POMIGER. According to three senior PRADD staff members, the customary certificate's main influence on POMIGER is through putting a value on the land. As noted previously, a land market has emerged for mining sites thanks to the certificate, and there is also evidence of a land market for POMIGER sites (see box). In Loppo, for example, the survey found that 12 fishpond owners (out of 94) purchased the land for their ponds, for an average price of 37,800 CFA (about \$75), and 7 people reported selling completed fishponds. During fieldwork in Loppo, 4 sales were documented, with terms varying from 15,000 CFA and a goat, all the way to 60,000 CFA. The analysis of survey results suggests, for reasons discussed on the previous page, the certificate has had a real impact on people's confidence in selling their ponds. This is true even if the ponds themselves do not have a certificate.

There was also a particularly interesting and problematic case of conflict over fishponds in Beya in areas where the PRADD certificate was not issued. It is positive though unsurprising to note that during fieldwork nobody reported boundary conflicts in POMIGER sites with certificates associated with them.

CASE STUDY: CONFLICT IN BEYA

When the study team arrived in Beya for a meeting about a reported land conflict involving fishponds, a miner drunk on palm wine spoke up. "I will break your tanks," he said. "Your fish will spill everywhere." Others laughed under their breath, making clear that he was more bluster than threatening, but the atmosphere was nonetheless tense. At issue: several of Beya's 20 or so fishponds are on former mining pits dug by a woman named Marie-Claire Pependa and her sons. (The drunk man appeared to be a friend of one of her sons.) When PRADD field agents had come with the idea of fishponds, the land chief recognized that a lack of fish was a problem, and so he decided to designate all mined out areas on the stream for fish production. A scramble of sorts ensued, with some putting up talismans to stake their claims. A group of elderly Muslim gentlemen were particularly enthusiastic, and they formed an association called Boungouli, and set up both a communal and individual ponds, including one by Mr. Goni in the area that Mrs. Pependa had worked a few years before.

The case of Beya illustrates the problems associated with uncertain land tenure status with mined out sites. The land chief maintained a particularly strong control over the land, noting that even if people mined these areas, the land remained his. It was his father who first arrived in the area prospecting for diamonds in the 70s, and founded Beya in 1975 when he found a rich deposit along a stream villagers have nicknamed Mosorapan, or "lots of money." In 1978, after problems with cattle destroying fields became an issue, Beya moved closer to the road. Beya is typical of many villages in the area: far from being run by age-old "traditional" authorities, they are settlements that are controlled by one or more pioneering families. Similar settlements in Dzanga-Sanga are currently undergoing this process, with the original chef de chantier turning into a village chief, even designing a flag for the settlement, which are illegal from the state's point of view.⁵⁴ Under this system, the chief had simply reclaimed his right to the land and declared it as a new fish production zone.

At first it appeared as if Mrs. Pependa was upset mainly about losing access to diamond gravel. She had arrived in 2006 at a time when the area under question was bustling with mining activity, and had started to work a site. At the time, there was no need to get permission from the land chief, she said.

⁵⁴ According to the conservator.

Now that the area is largely mined out, there are only a few active holes. “But what if there’s a diamond worth 5 million in there?” she asked. The chief explained that those who attended the POMIGER training understood that they could take mined-out sites, which was indeed PRADD’s policy, and the mayor would certify that the sites were indeed mined out. The chief cited one case where a man was allowed to establish a fishpond only on the part of his site that was already mined out. However, when asked whether she wanted to dig in the site, she equivocated.



The ponds themselves exemplified the success and challenges across the region. On the one hand, the ponds appear to be flourishing and cared for. Most are run by elderly men no longer involved in mining who were concerned about their “retirement.” Some already have experience with fish farming: one man recalled how when he was a kid his brother-in-law had a pond, and this memory made him especially enthusiastic when POMIGER came proposing to modernize fishing. In addition, the area is environmentally transformed, according to those who saw the site before: whereas the far bank was barren before, it is now full of banana and manioc and Laos grass, all used for fish feed, but also food.

The stream is flowing again, and some physical dangers have been reduced. (They recalled one case of a woman with a mental disorder who fell into an old pit and died.) However, there are technical challenges in the ponds: some are not built correctly so have to wait for the rain to fill with water, while others have dikes too narrow to withstand flooding in the wet season, and there have been instances of pond collapse and fish being washed away. Not everyone viewed this as a problem, however; one man laughed and recalled how his friend didn’t have to buy fingerlings since fish from another’s pond floated right down into his during a flood.

When asked about if she wanted to set up ponds, Mrs. Pependa didn’t seem interested. At a group meeting, she remained upset about the situation. As with several PRADD sites, a practical decision was made to only georeference the most active areas, and in the case of Béya, the most active area was a separate stream about 20 kilometers away. The land chief was asked if the situation would have been different if there were certificates issued to these sites. He conceded that there would have been a property right, but that it still wouldn’t have changed his decision that the sites needed to be ceded so there would be fish for the village. For her part, the woman noted that she had complained in Nola and to the gendarmerie about the appropriation of her site, and implied that if there was a certificate, she would have taken it to court.

The case of Béya offers an interesting reference point to what POMIGER might look like without certificates. First, it is interesting to note that there isn’t a single fishpond that was created by an artisanal miner who worked the pit where the pond is located. In Loppo, in contrast, most fishponds are being built by the artisanal miners, or their family members, who own the site—and most sites have certificates. The sites in Béya entered this commons zone, although the land chief had the ultimate say in these matters. This raises the question of whether more artisanal miners with certificates would have converted the sites themselves. In the case of Mrs. Pependa, she didn’t seem interested in fish, as she had other mining sites elsewhere. A related question is the following: if there were certificates, there would be ground for this

woman to demand—and perhaps receive—compensation for her land. However, this raises the question of whether the current group of elderly gentleman, many of whom did not have access to land, but are all very enthusiastic fish farmers, would have come in and had the initiative and money to purchase and restore these sites. In Beya, the conflict notwithstanding, the ambiguous tenure seems to have enabled people without access to land to gain access, since these men used to be involved in mining, but were primarily from a group of cattle-herders.



Back in the meeting, the woman made a final proposal to resolve the conflict: PRADD should pay her for the sites, since they are PRADD fishponds. (It was later alleged that this had been the woman's hope all along.) The Director of Sustainable Development explained how this was not possible, nor was it the intention of the program. In the end, she made the following declaration: "I say, in front of the chief, that if someone wants to build a fishpond, that they ask my permission and I can sell it." Other people disagreed: "If it's old, anyone can take it, you don't have to pay," one man said. The chief thought for a moment and then said, "Yes, that's fine. Whatever the owner wants to do is fine with me."

2.2.8 LOPPO

Loppo exemplifies both POMIGER's successes with fish farming, but also its limiting factors and future challenges. This section presents a deeper analysis of the village, focusing on the survey but also integrating some qualitative fieldwork.

As noted, geography is a key factor behind aquaculture's feasibility, and Loppo's numerous ponds—209 according to the February 2012 census—exist because of a favorable slope and ample access to good water sources. Respondents identified 18 different names for their water flows, though most were concentrated along 4 of them. Another factor noted above—aquaculture's history in the area—also applies to Loppo. One of the region's AFLs said there were around 30 fishponds before the project, and in the late 90s there was reportedly a Catholic project that also expanded the number of ponds. Indeed, the survey found that a full 60% of respondents owned a pond before 2010. Whether or not the project can claim credit for initiating fish farming, however, its trainings and technical advice were both popular and catalytic. Many reported that the previous ponds consisted of a few *tilapia zilli* thrown into pits, whereas PRADD's approach of introducing *tilapia nilotica* as part of a comprehensive training and extension program was different.

PRADD first introduced the fingerlings to the ponds of two associations, Zingo and Djeme, which then served as pilot and multiplication sites. After the first harvest of 27 kilos, fish from Zingo were distributed to



both members and others who wanted them, such as Mr. Auguste Daito profiled below, free of charge. In subsequent harvests, members continued to reap the benefits, and some fish were transferred to other villages, including Ngoulo, the site of the RRA and the province's new commercial production unit. Free distributions then stopped, and the two association's members individually began selling fingerlings and fish to others. Members of the Zingo association reported a range of 5 to 20 people who bought fish from them for their own ponds.

This spontaneous expansion has only continued. Over 30 percent of survey respondents reported building a new pond in the last six months, since July 2011. And while 32 percent of survey respondents reported their original fish source as PRADD, the remainder either purchased fingerlings or simply got them for free from a neighbor. This expansion has continued: during site visits, the field team came across Martin "Galilee" Yanga, for example, who was in the process of digging a new fishpond on his mining land. He said he's tired of mining, though his children are still active, and got the idea of farming fish from his neighbors. His case is not unique: the highest number of survey respondents, 58%, reported getting the idea for a pond from a neighbor, whereas 15% said they got their idea from PRADD sensitization and 15% from the fact that they had a pond before (the responses were not mutually exclusive).

The ponds themselves have a variety of characteristics, some of which are summarized in the following table:

Average number of ponds per person	2.2 (range from 1 to 7; average number of ponds currently with fish: 1.8)
Average pond size	100m X 100m (1 hectare) □
Percentage of ponds on reclaimed mining pits	43%
Percentage of respondents who already owned the land for their pond	47% (with 14% getting the land as a gift, 25% from a family member and 12% purchasing it)
Percentage of respondents who built their ponds alone	76% (40% hired laborers, 27% used family labor, 13% relied on their associations)
Percentage of respondents who reported using tools provided by PRADD	5%
Percentage of respondents who participated in PRADD training sessions	65%
Percentage of respondents who received a direct site visit by a PRADD agent	66% (89% have been visited by an AFL)
Percentage of respondents who have received technical advice from a neighbor	86%
Percentage of people reporting at least one conflict associated with the ponds	37% (14% reported conflicts with limits, 4% with water and 27% with theft)
Percentage of people who have at least some tilapia nilotica	82% (31% have exclusively nilotica)
Percentage of people who have sold fingerlings to others	77%

The socioeconomic profile of pond owners in Loppo varies. During fieldwork, many appeared to be older, having adopted fish farming as a type of social security or retirement plan. For those who were younger, their reason was because diamond mining was not viable at the moment. For example, Daito Auguste, 59, owner of five ponds, has been quite successful: his last harvest yield 350,000 CFA (\$700) and he is eager to expand production beyond *nilotica* to shrimp and even carp. In 2011, he made no income from diamonds, and 60 percent from selling fish. He recently encouraged his son, Louis-Marie, 27, to also begin converting a site, and he was encountered doing that during the site visit. Louis-Marie currently doesn't have enough money to afford a barrel of diesel to



in the CAR in its study, in the Dzanga Sangha protected area, to be 36. In addition, given that CAR's life expectancy at birth is 48.4 years,⁵⁵ this suggests that fish farmers in Loppo tend to be older than the general population.

Several other characteristics are worthy of note:

<i>Mine owners</i>	47% (Active in 2011: 28%)
<i>Mean number of mines owned</i>	1.98 (std. dev. 1.17)
<i>Mine workers (non-owner day laborers)</i>	55%
<i>Financiers (patrons or assureurs)</i>	15%
<i>Artisanal miners who are financed</i>	63%

Two wealth indices were constructed based on indicator items identified in the qualitative research. The first was an 8-point scale composed of 6 indicators items (satellite dish, electricity generator, motorcycle, plastic chairs, television and tin roof), in addition to dichotomous variables of whether the person finances others and buys diamonds, two characteristics of wealthier people. The second index was a 5-point scale composed of indicators for ownership of mining tools (shovel, crowbar, jig, probe, and pump). These scales were created by conducting a factor analysis on all variables potentially related to wealth, in combination with

⁵⁵ UNDP Human Development Index 2011. <http://hdrstats.undp.org/en/countries/profiles/CAF.html>

theoretical justification for their inclusion based on the wealth ranking exercise in the RRA. A reliability analysis was then conducted on both scales: the first has a Cronbach alpha of 0.82 and the second 0.79, both above the conventional threshold of 0.7.

The first scale is biased toward identifying those in the highest wealth categories, as defined by participants the RRA in Ngoulo. The mean score is 1.34 (standard deviation of 1.90), and highly skewed (1.9) toward low values: over 75% of respondents scored either 0 or 1. Interpretation of this index depends on assumptions about where to make the cut-off between a high relative wealth ranking and a non-high relative wealth ranking. Assuming that some non-wealthy members receive a score of 1 or 2 (by ownership of a tin roof, for example), one could make the cut-off at 2. In this case, of the survey respondents, 16% could be classified as wealthy. This is slightly higher than the 5 to 10% range defined in Ngoulo, suggesting that fish farmers in Loppo could have more wealthy members than the general population, but not by a large margin.

The second scale is not skewed, mainly because of the way tool ownership is ordered: 86% own a shovel, 60% a jig, 48% own a crowbar, 39% own a probe and 17% a pump. Overall, 14% own all five and 13% own none. Assuming that the relatively well-off own all five—able to exploit sites below the water table and not needing to borrow tools—the 14% figure is close to the 16% from the first scale. Similar to the first scale, relationships between the index and key variables are scarce, except for pond quantity (0.20, $p < 0.05$) and whether the person is an active miner or not (0.25, $p < 0.05$).

However, both wealth indices are positively correlated with possession of a PRADD certificate (either on the land with the pond or any owned mining site): the first index has a coefficient of 0.30 ($p < 0.01$) and the second index a coefficient of 0.26 ($p < 0.05$). Two logistic regressions were also performed on each index separately in order to further test these relationships, both of which returned significant results.

Number of observations = 95

LR chi²(1) = 8.78

Prob > chi² = 0.0031

Certificate Dummy	Coefficient	Std. Error	Odds Ratio	Std. Error
Wealth Index (8-point scale)	.3534043***	.1330782	1.423907***	.1894909

Number of observations = 95

LR chi²(1) = 6.46

Prob > chi² = 0.0110

Certificate Dummy	Coefficient	Std. Error	Odds Ratio	Std. Error
Wealth Index (5-point scale)	.3337094**	.135469	1.396137**	.1891333

** Significant at 95% level *** Significant at 99% level

The significant results show that on average, the odds of having a PRADD certificate are 1.4 times greater for every unit increase in either wealth index scale. Interpreted in terms of marginal probabilities,⁵⁶ the probability of having a certificate among Loppo's fish farmers with a score of 8 on their wealth index is 89%, among those with a score of 6 it's 79% and among those with a score of 0 it's 31%. On the five-point scale, the probability of having a certificate among Loppo's fish farmers with a score of 5 on their wealth index (i.e., owning all tools) is 62%, and among those with a score of 0 on their wealth index (i.e., owning no tools), the probability of having a certificate is 24%. It is unclear from a theoretical standpoint why this relationship exists; one possibility is simply that wealthier people are more likely to be mine owners, which is a prerequisite of having a PRADD property rights certificate.

⁵⁶ Stata's function "prtab" was used.

Motivations for fish farming identified in the field were also quantified in the survey. A scale from 0 to 2 was used as with land tenure security, with 0 being not important, 1 somewhat important and 2 very important.

Motivation	Average Score □(min 0, max 2)
I have no more energy to work in diamond mining	1.13
I have no luck to find diamonds	1.05
I don't earn enough money from diamonds	1.03
I don't have enough to eat in my home	1.22
Fish sells for a lot of money	1.12
The fish pond restores the environment	1.76

The environmental motivation scored the highest, which could be a result of PRADD's sensitization campaigns, in which the environmental message was prominent. While not having "any energy left" was a key motivation noted in field work by several people encountered, the overall survey showed it to be less important than thought—or at least not important for everyone. In fact, the score on the first motivation is negatively correlated (-0.35, $p<0.01$) with a man's age, suggesting that older respondents find this motivation less important, or else they don't wish to admit it.

Two additional questions were asked on a 0 to 2 scale, though ranging from disagree to strongly agree, as with the land tenure security perception questions. The first was whether the respondent thought they had enough technical knowledge, and the average score was 1.17. The second was if they thought they could earn more money from fish farming than from diamonds, and the score was 1.46, which is relatively high. Anecdotally, this high score was confirmed in group meetings in Loppo. The question of the relationship between fish farming and diamond income will be explored in the next section, when the impacts on livelihoods are discussed.

Additional information on the technical practices and the scale of fish sales is also of interest:

Most common feeding frequency	1 to 4 times weekly (46%)
Percentage who bought feed	10%
Most common food placed in composting pit to fertilize water	Food waste (62%) Followed by herbe de Laos (59%), dung (28%), animal skin (24%) and fruit (20%)
Most common food fed directly to the fish	Potato leaves (72%) followed by manioc leaves (67%), termites (45%), rice bran (19%)
Average number of harvests in 2011	1.66 (std. dev. 0.86)
Average number of kilos harvested in 2011	63 (range: 0 to 750)
Average income from fish	45,188CFA (\$90) □(range 0 to 500,000)
Average consumption: sale ratio	1:5
Places of sale	At the pond (77%), local market (76%) and nearby city of Nola (7%)
Primary place of sale	At the pond (71%)
Percentage who wait until holidays to harvest their fish	26%

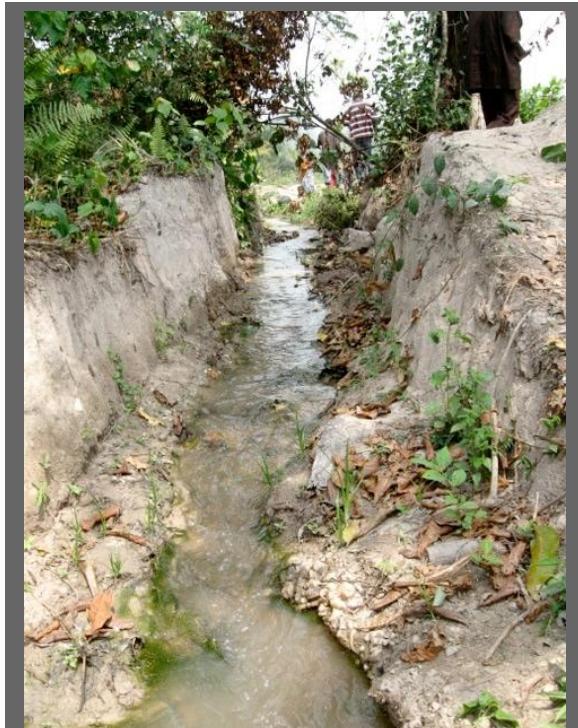
Next, a linear regression analysis was attempted to uncover the factors that account for the wide variation in 2011 fish production levels (from 0 to 750 kilos). Despite numerous attempts to uncover key predictors,

besides mechanical ones such as the number of ponds, no satisfactory model was found. One potential conclusion is that certain factors thought to perhaps determine harvest outcomes—like feed frequency and feed type, participation in trainings, visits by technical agents—do not have a strong effect on production levels. This merits further exploration, however.

Finally, water management emerged as a key issue in Loppo, which has implications for the future sustainability of the model. A majority (53%) of fish farmers reported *not* having enough water, and the issue emerged during fieldwork as well. The stream with PRADD's pilot ponds had a number of ponds that were completely dry, although during the visit POMIGER's director suggested a technical solution to divert the stream in such a way that everyone gets water. However, key informants noted that another stream—with 27 ponds—had a number of water-related conflicts. During the dry season, only 3 of these 27 ponds have enough water, and the owners have not come to an agreement. One suggestion by POMIGER's director was to enlarge the spring's source, as was done in Balego (profiled in the next section), but it's unclear if this will provide a solution.

The larger issue appears to be in organizing water management. Auguste Daito, for example, has had issues with his river flooding during the rainy season, so has worked with his upstream neighbors to enlarge the stream's channel between ponds. It may be desirable to explore the role of the water rights regime in the area,

such as whether it's feasible to add an allotment approach to what appears to be a riparian rights system.⁵⁷



The flooding problems faced by Auguste Daito also point to technical challenges that Loppo's fast expansion has brought. As aquaculture has taken off, construction standards of ponds are not always met, increasing the risk of wall collapse and other issues. Part of this is due to lack of knowledge, such as how to construct a correct deviation or ensure that pond walls are sturdy enough. Another aspect has to do with the availability of material: while PRADD supplied a certain amount of PVC piping, many have resorted to other solutions, such as using bamboo or old iron pipes from the long-defunct Centramines site nearby. While these solutions show initiative, they make it unlikely that ponds will last as long as 50 years, as claimed in POMIGER's training manual. In addition, with the winding down of the AFL program in December 2011, field visits will likely decrease, raising questions about how to sustain the provision of technical expertise.

⁵⁷ PRADD's Chief of Party has suggested the possibility of introducing allotments long-term. The case of Beya is also interesting from a water rights perspective: according to the POMIGER director, the land chief made a water rights argument against the woman whose mining sites were converted without her permission. The water belongs to the state, he said, although in practice it appears that the customary system emerging for fishponds is riparian, in the sense that those with rights to the land adjacent to the water have the right to make use of its water resources.

3.0 POMIGER: A VIABLE MODEL FOR LAND AND LIVELIHOODS?

3.1 ECONOMIC IMPACT AND VIABILITY

3.1.1 IMPACT ON LIVELIHOOD DIVERSIFICATION AND DEPENDENCY

A key research question is whether the POMIGER model has succeeded in diversifying livelihoods and decreasing dependency on diamond traders. As discussed above, livelihood diversification—and a general move back toward agriculture—can be traced in large part to the economic crisis in the diamond economy. POMIGER intervened at a time when diamond income was falling, and people seemed to respond to the adage that you cannot walk on just one leg.⁵⁸

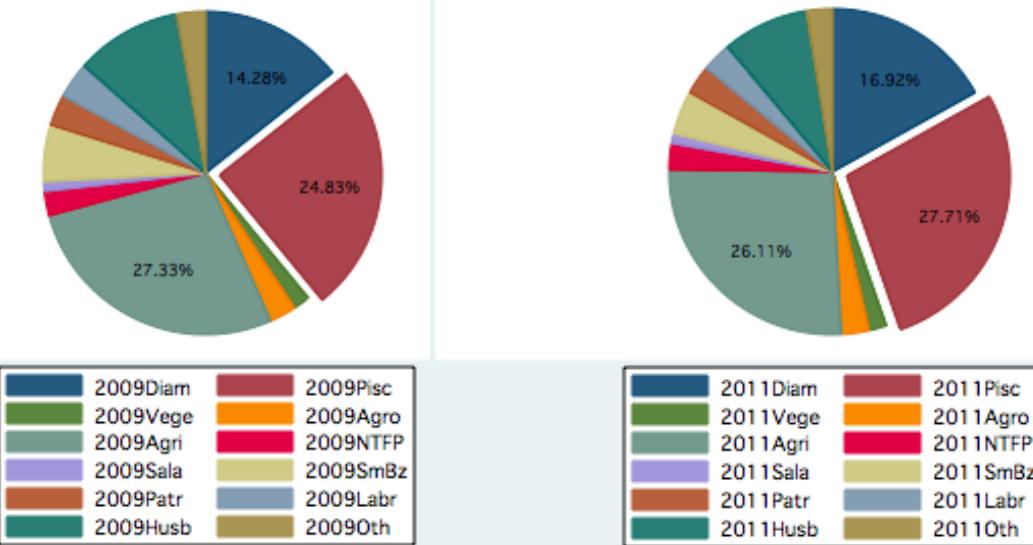
The household survey in Loppo offers a relevant, though not generalizable, look at these questions. The survey included a section aimed at uncovering relative sources of income and relative changes income using the “bean method” common in participatory research. Respondents were asked to first indicate from a choice of 12 categories where their income came from in 2011. They were then asked to divide 20 beans among these categories in proportion to the relative contribution of each source to their overall income. Respondents were then asked make changes to reflect income in 2009, two years ago.

Finally, they were asked to indicate how their income evolved between 2009 and 2011. This was done by offering 10 beans to represent their 2009 income, and then letting them add or subtract any number of beans to show its change over time. These methods are standard in qualitative research as a way to uncover trends and spark discussion, but there is no known precedent using the method as part of a structured questionnaire. It is unlikely to provide scientifically valid figures, but with ample qualifications offers a snapshot of relative livelihood sources as perceived by respondents.

Overall results showed that among respondents participating in the exercise, fish farming represented the largest source of revenue in both 2009 and in 2011. In addition, the proportion of revenue from fish farming and diamonds increased between 2009 and 2011, and the proportion of revenue from agriculture decreased, although none of these changes are statistically significant at the 95% level.⁵⁹ Comparisons with PRADD’s socioeconomic surveys suggests some validity of the data: the proportion of income from agriculture, including fish farming, changed from 44% to 59% between 2010 and 2011. Results from the Loppo survey show a combined aquaculture and agriculture income proportion of 54%, which is in the same range. One surprising result, however, is large role of aquaculture before POMIGER, in 2009, assuming that the exercise is returning valid data. The survey’s finding that 61% of respondents (n=94) owned a pond before 2010 seems to corroborate this, however. An additional surprising finding is the fact that aquaculture on the whole is making a larger contribution to income than diamond mining, according to participants in this exercise.

⁵⁸ This was cited by PRADD’s microfinance coordinator.

⁵⁹ T-tests were conducted with the hypothesis that the mean value for 2009 equaled the mean value for 2011.



Overall results from relative income sources, with 2009 on the left and 2011 on the right. The three largest categories are aquaculture (red); agriculture (teal green); and diamond mining (blue).

Since the survey targeted fish farmers, and less than half were mine owners, and of those only 28% were active in 2011, could account for this finding.

Comparing the proportions alone doesn't tell us much without looking at whether overall income increased or decreased between 2009 and 2011. Respondents did not report a large change between 2009 and 2011, with the average increase being just a fraction of bean (2.5%). However, despite this low average, the variation in responses is very high, with a standard deviation of 37.5% and a range from a decrease of 80% to an increase of 60% compared with 2009. Because of this variation, the analysis of relative income sources was redone after dividing respondents into two groups: those with increased incomes, and those with decreased incomes. The results were quite different.

For those whose incomes increased between 2009 and 2011 ($n=45$, 60%), the proportion of revenue from diamonds increased from 11% to 16%. In addition, the proportion of revenue from aquaculture increased from 27% to 31%. Assuming validity of the numbers, both of these changes are statistically significant at the 95% level. No other changes in income are statistically significant at this level. For those whose incomes decreased between 2009 and 2011 ($n=38$, 40%), the proportion of revenue from diamonds changed from 17% to 16%, and the proportion of revenue from aquaculture changed from 23% to 25%. However, no changes in this group were statistically significant at the 95% level.

Together this suggests that for those fish farmers in Loppo reporting through this exercise increased incomes between 2009 and 2011 (60%), all sources of revenue didn't rise in the same proportion, but instead that diamonds and aquaculture accounted for a large portion of the increase. Between these two sources, diamonds account for slightly more of the increase compared with aquaculture, but not by much. No conclusions can be made about those whose incomes fell. While this method is somewhat unconventional and limited in applicability, the results cohere with trends unveiled in the July 2011 household survey and in qualitative research, notably that aquaculture has assumed a major role in the livelihoods "basket" for many people, and that it has contributed strongly to an increase in income for many participants. In addition, while fieldwork uncovered cases of people choosing POMIGER activities over mining, the survey showed that on the whole, fish farming has not supplanted diamonds, even among dedicated fish farmers. This is important evidence that POMIGER offers not an alternative livelihood, but an additional or complementary one.

Whether this has decreased dependency on diamond traders is another matter. The quantitative survey addressed this question indirectly, by asking respondents how they used the money earned in 2011 from aquaculture. The most popular use from the options presented was clothing (63 households), followed by healthcare (53 households), education (39 households) and food (25 households).

However, only 11 households reported spending the money on buying tools and 6 reported using the money to finance mining activity. This suggests that at least for Loppo's fish farmers, revenue from POMIGER has little direct link to the diamond economy, except as providing an additional source of money for both active and non-active miners.

However, there is anecdotal evidence that POMIGER could help finance diamond activity and hence reduce dependency. For one, several interviewees explained the importance of cash for artisanal miners: even if one grows one's own food and owns tools (two forms of "assurance" from the financiers), miners need cash not only for expenses like education but also for things like alcohol and cigarettes. These consumption items were noted by several people as an important element of decision-making.⁶⁰ Hence if POMIGER activities help increase cash sources, this could lead to less dependency for some.

In addition, the case of Elie Bana in Ngoulo shows that non-diamond income can help: his wife's agricultural work and the wedding gift formed the basis of his financing. In addition, one young man in Berberati was motivated to use aquaculture income to help expand his diamond mining (see box). However, others were skeptical that this revenue can ever be enough for serious diamond mining.⁶¹

While the POMIGER model, especially aquaculture, appears to be a viable model in terms of having a positive economic impact, viability in terms of durability through time is harder to judge. A key question is whether a strong performance in the diamond economy, due to a favorable domestic policy context and good international demand, could result in abandoning these activities. While political uncertainty and ongoing

SNAPSHOT

While visiting the commercial fish production unit near Berberati, the NGO told the team of several people who had already converted mining sites into fishponds in anticipation of the fingerlings. One such person was young miner named Barthelemy Badare who was in the process of constructing at least 3 large ponds. He has used his own diamond money for the labor to build these ponds. He has built dam to divert water, and said he is considering diverting the entire stream. He was originally skeptical when the NGO approached him to suggest the idea of fish farming, but he eventually responded to the message the NGO was giving, summarized as, "Without agriculture, aquaculture, what will we eat to work in the mines?" He remembers helping out with his dad's pond, built with assistance from the Peace Corps, and now plans to do better. "I will first mine that part," he says, pointing to some workers sifting through gravel, "and then fill it with fish." Pointing elsewhere, he continued, "Then I'll mine that part, and fill that with fish as well."



⁶⁰ Interviews with André Kitte and Aleck Soupene

⁶¹ Interview in Ngoulo with Andre Kitte.

fiscal problems casts doubt on a diamond boom, some economic forecasters project a real GDP growth rate of 3.3% in 2012 and 3.5% in 2013 as a result of rising prices for timber and diamonds.⁶²

This study has shown the rational choices of POMIGER participants with respect to livelihood choices, and in one sense, should diamond financing start flowing again, it is possible that many will choose to devote more time to mining. However, this study has also shown how the economic crisis has precipitated enthusiasm for POMIGER, but it is not its cause. Aquaculture has a long history in the region, and there's no reason to believe that should fish farming or other economic activities prove to be remunerative and feasible, that people won't continue to diversify. In fact, the RRA showed that diversification is more pronounced among those who are wealthier as a result of diamonds: those in Group 1, while involved in financing diamonds and owning multiple pits, are the ones most engaged in other activities, from taxis to agriculture. It follows that should the diamond economy take off in a way that benefits a larger segment of artisanal miners, diversified activities like those proposed by POMIGER will only become more popular, not less. In this sense, POMIGER is not an "alternative livelihood," or a life boat in a time of crisis, but a strategy integrally linked to other components of PRADD sustainably reinvigorate the rural economy.

IN FOCUS: INDIVIDUAL VERSUS ASSOCIATION

Conceptually, the POMIGER model differs from similar initiatives in Sierra Leone in its encouragement of individual adoption rather operating only through cooperatives. Mazalto (2009) conceived of a model in which people were members of an association and also working their own sites. One justification for this approach was to take into account the "individualistic" nature of miners in CAR, while also promoting the benefits of a collective approach. While POMIGER's pilot sites tended to focus on associations, the subsequent spontaneous growth has been dominated by individuals, suggesting how POMIGER's focus on motivated individuals has worked. The current shift toward a commercial entrepreneurial model fits in with this approach. However, the role of the 25 associations shouldn't be downplayed either.

For one, they were crucial catalysts in the project's early stages: as described in Loppo, two associations with two communal ponds were the jumping point of the village's fishing boom, through free and then paid distribution of fingerlings. These associations can also play a key role in sensitization, as the association running the commercial unit (UCP) in Berberati has done, described below. Yet associations are key to including people who may have a harder time accessing or running an individual site, including certain groups of women, those who don't own property, those who are relatively poor and other vulnerable groups.



Some of the associations the Ngotto's former AFL Ben Eudes leased land to likely fall into this category. Not only do they provide a way to share time and labor costs for those who cannot afford them, but they also provide a measure of social security and solidarity. The group Maboko na Maboko, for example, has 10 women members, and made 80,000 CFA (\$160) in their last tilapia harvest. President Elodie Dopola explained how most of the money was put into the group's account, and they are considering using the money for other income-generating activities, such as buying and reselling cloth (*paignes*). Other associations cited using the money to pay for children's school fees and for health emergencies in members' families.

⁶² Source: Economic Intelligence Unit, accessed February 26, 2012

3.1.2 COMMERCIAL PRODUCTION UNITS

POMIGER is currently implementing a new model: instead of direct distribution of inputs (seeds, saplings and fingerlings) to beneficiaries. POMIGER is creating “commercial production units” (or UCP, from the French) for each of these inputs to sell to clients. There are nine UCP, three per province and three per activity type, run by individual entrepreneurs (6 of 9) and association (3 of 9) competitively selected in August 2011 based on five criteria: sufficient time, minimum technical and financial capacity, local residence and good community standing, legitimate ownership of sufficient land and prior business experience in their chosen activity.

All aquaculture UCPs were visited for this study. Ngoulo, the site of the RRA, is also the site of Sangha-Mbaeré’s province’s fish center. The first of three large ponds (over 900 square meters), fed by a partial dam, already has fish inside it, brought from Loppo. Additional ponds were under construction at the time of visiting. The aquaculture UCP in Ngotto, for Lobaye province, is fully constructed. The final aquaculture UCP in Berberati, for the Mambéré-Kadeï province, is currently under construction. The study also included a site visit to a vegetable garden UCP in Bokumba (Lobaye province), run by an association, which has over 30 raised beds prepared but no seeds yet, and an agroforestry UCP in Boda which has several thousand saplings, mainly oil palms, but also cola nut trees, avocado trees and orange trees, all of which will be distributed in May 2012.

Because the establishment of these units is still in early stages, a comprehensive analysis is not possible. Instead, the findings from these visits will be presented in the form of the following SWOT analysis:

Strengths	Weaknesses
1. Preexisting customer base 2. High potential capacity of entrepreneurs	<ul style="list-style-type: none"> Detailed business plan lacking Insufficient technical capacity in some units
Opportunities	Threats
1.) Integration of technical services 2.) Enhancement of business and financial model 3.) Partnerships with traders and government agencies	1. Demand saturation 2. Technical and logistical constraints

STRENGTHS

1. Preexisting customer base

POMIGER’s emphasis on sensitization and technical capacity building has in effect created a ready-made customer base. In a general sense, demand for the inputs is assured, as long as interest in the activities remains high. As one PRADD field agent put it, if you’re given a gun, you’ll go ahead and buy the bullets; but if someone gives you a bunch of bullets, you won’t necessarily go and buy a gun. Analogously, because people have already invested in preparing fish tanks and vegetable plots, they have every incentive to go ahead and pay for fingerlings and seeds.⁶³ The reverse is not true, however: distributing inputs before



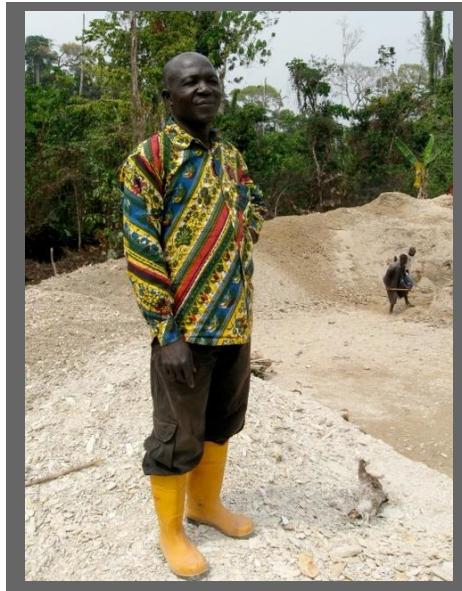
⁶³ PRADD staff focus group discussion, Boda.

investing in the sensitization and capacity building has a higher probability of failure, and according to PRADD agents, this has been the approach of other less successful humanitarian projects in the region. The example of the study team receiving notes with “orders” for fish, cited above, is anecdotal evidence of the demand that POMIGER’s approach has engendered.

In addition, the new model is not a pure shift from distributional and commercial; POMIGER has already created a precedent by directly and indirectly encouraging people to invest their own money. In the case of aquaculture, this was in part due to technical limitations: POMIGER was unable to bring in fingerlings to distribute to everyone, so PRADD set up association-run ponds in Boda, Ngotto and later in Ngoulo as multiplication sites. As described earlier, these associations originally distributed to others for free, but then individual members were free to charge others for fingerlings. The evidence of this is particularly strong in Loppo: 60% of the fingerlings used in the biggest harvests of 2011 were purchased, either from neighbors or another person, evidence people’s willingness to pay. While this is less marked in agroforestry and vegetable farming, Narcisse Dambali (pictured), the head of the UCP in Boda said there were about 30 people unaffiliated with POMIGER who have come to express interest in oil palm saplings, since they are only available closer to Bangui. And the young vegetable farmer in Ngotto bought his seeds from Berberati, showing that there is both demand and willingness to pay, at least in a general sense.

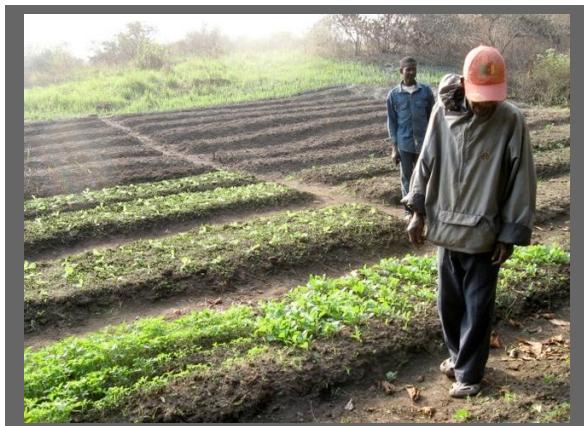
2. High potential capacity of entrepreneurs

The competitive selection process of the entrepreneurs has led to a high potential capacity and competence of the entrepreneurs. For example, André Kitte of Ngoulo (pictured) is a seasoned businessman and president of an artisanal diamond mining cooperative. He plans on attracting business through prices and economies of scale: if others are selling for 1,000 CFA a kilo, he’ll sell for 750 CFA, and he’ll be able to do so with three major tanks built to high standards with PRADD’s financial and technical assistance. Other entrepreneurs also have experience through other business interests: the UCP head in Boda also is a beer wholesaler. While it remains to be seen whether this potential translates into results, impressions of the five entrepreneurs visited were positive.



WEAKNESSES

1. Detailed business model is lacking



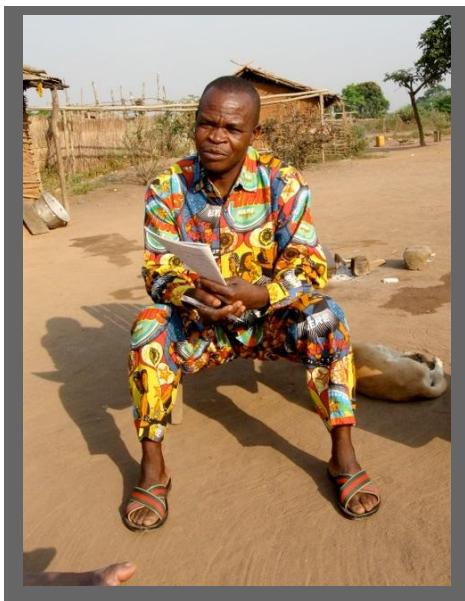
At present, no UCP owner has a written business plan, and most have not thought through in detail how they plan to make a profit. For example, the head of the aquaculture UCP in Ngotto, Ben Eudes, has not yet calculated or kept track of the cost of fish feed, nor has he accounted for other fixed or variable costs. The agroforestry UCP also has no cost information, and none have considered how to integrate the cost of transportation into their prices. Clearly the model will not succeed in the long term without these elements, but it is too early to judge this aspect in detail, since PRADD will soon be providing training and will work with the entrepreneurs to set initial prices.

2. Insufficient technical capacity

At present, some UCP entrepreneurs did not demonstrate sufficient technical capacity. For example, the agroforestry UCP in Boda is in effect a distribution point, not a production center: the saplings were brought in from Bangui, and are being watered until they are ready to be distributed by POMIGER agents. In addition, the vegetable seed UCP in Bokumba, run by an association called Sarasimote, is waiting for seeds for their impressive 30 raised beds, but none of the 9 members have received any training on how to produce seeds. In addition, in the case of vegetable farming, certain seed types are too technically challenging to be produced by non-agronomists, and yet these varieties are among the most profitable. As with business capacity, however, it is too early to judge this element fully, since planned trainings have not yet been carried out.

OPPORTUNITIES

1. Integrate technical services

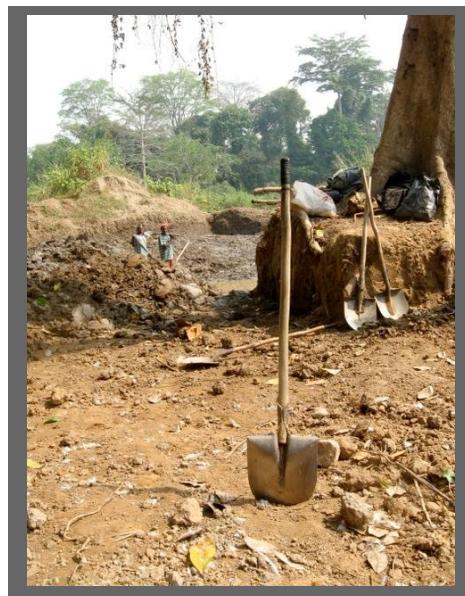


The AFLs (such as Philippe of Ngoulo, pictured) played a key awareness-raising, organizational but also technical role in POMIGER: they visited sites, and some are in effect local “extension agents.” With their transition to become “change agents” in December 2011, and the ending of their compensation, their future is uncertain. However, there is a real opportunity to integrate some or all of them into the commercial production unit and more generally explore the possibility of including technical services as part of the model. This could especially be beneficial for vegetable farming, where technical follow-up on a regular basis is especially important. The association model—versus the individual entrepreneurial model—might have a comparative advantage in this regard. For example, the association running the aquaculture UCP in Berberati has already reached out to potential fish farmers, including the “boss of bosses” profiled earlier, in a way that combines sensitization with marketing and technical assistance. For entrepreneurs, integrating the cost

of paying AFLs or hiring others to provide such services could provide a value-added and leverage POMIGER’s investment in training and capacity building. This could be especially useful as POMIGER explores training support for fish transformation through smoking and salt curing.

2. Business strengthening and integration with microfinance

PRADD’s microfinance point person has already provided trainings to soap associations in business planning, and these types of trainings should be beneficial to increase the capacity of the entrepreneurs. Another opportunity worth exploring is the integration of POMIGER activities with the microfinance and shared equipment “bank” currently under exploration and implementation for mining activities. Many of the same tools used in mining are used in land reclamation, and accessing equipment is still an obstacle for many, especially vegetable farmers’ need for watering cans, which are not used in mining.



While beyond the scope of this report, synergies with microfinance could help improve the commercial model's viability.

3. Partnerships with traders and government

There are numerous challenges to overcome with the UCP model, including transportation of the inputs from the UCP to clients, the procurement of seeds and certain saplings that cannot be grown at UCPs for technical reasons, and the procurement of materials previously distributed by PRADD, such as PVC piping for fishponds. These could be critical issues when PRADD is no longer available to finance or provide these intermediary services. However, fieldwork shows that even the smallest village in the region has a class of traders and businessmen who regularly acquire consumer goods from regional centers or from Bangui. An opportunity exists to integrate these individuals into the model; perhaps they could begin stocking PVC pipe, for example. In addition, there are opportunities to work more closely with government extension agents, who have strong technical capacity and motivation but limited means. For example, a government agricultural agent in Boda, from the agency ACDA, has been providing technical support to the agroforestry UCP in Boda. Other parts of government have experience and expertise with both fish farming and sapling production, which currently focuses exclusively on government-owned teak plantations. While POMIGER has made commendable efforts to involve these services, and practical challenges remain in doing more, there should be ways to capitalize on their experience and legitimacy. Collaboration with future development interventions in the rural economy might be one way to do this.

THREATS

1. Demand saturation



A key question is whether demand inputs will suddenly collapse not because of logistical or pricing issues, but because people simply don't need them anymore. This is especially worrying for aquaculture: as the case of Loppo demonstrates, people are getting their fish from neighbors. While they may be paying for them, what incentive do they have to go all the way to Ngoulo? In one sense, even the fish UCPs may be more properly described as distributors or multipliers: demand will be high in new areas that do not yet have fish, but then the UCPs will eventually become simply high-volume fish producers. This would not be a terrible outcome, but calls into question the long-term viability of the model.

During field interviews, however, people expressed willingness to pay more for fish from the UCPs, if they have the potential to grow bigger. As long as the UCPs provide a superior feed regimen, the UCP fish could be of higher potential weight. If fish in ponds start to become “dwarf” due to poor feeding practices, demand for UCP fish could be sustained. However, if neighbors closer by manage to produce high quality fingerlings, demand for UCP fish will fall, in which case the UCPs will either need to stop, or diversify into other more technically challenging fish species such as carp or shrimp.⁶⁴ In the short term, demand saturation is less likely for agroforestry and vegetable farming, because of lack of alternatives, but this is certainly a possibility later on.

2. Technical and logistical constraints

As noted, logistical concerns—mainly linked to transportation—threaten to derail the project. PRADD’s limited transportation means have been critical to the functioning of the project, and alternatives are currently limited. A final potential threat is related to the water issues. Two of the three aquaculture UCPs have

⁶⁴ There has already been interest expressed in Loppo for introducing these species as well.

involved damming streams. The UCP in Ngoulo is already functioning, though the durability of the construction is unclear. In Berberati, the technical challenges—and the risks—are moderately high (see box).

HIGHLIGHT: UCP BERBERATI

Antoine Ngene-Mbida is president of Union des Jeunes Agriculteurs, the association selected to run the aquaculture UCP in Berberati. The three ponds, currently under construction, will be fed by a 500-meter canal connected to a reservoir first created by the Peace Corps in the 1970's. The reservoir's dam was first built in concrete. "We used to go on boat rides on the lake," Antoine recalled. "It was more than 200 meters long." When the Peace Corps left sometime around 1975, it developed a leak and began to crumble, and in 1980 an association repaired it with tin sheets. Then in 1987, CAR President Kolimba held a conference in Berberati, and the dam was destroyed to harvest all the reservoir's fish, distribute them to people, and feed dignitaries for a few days.

Balembe Mathieu, an artisanal miner hired to build the new dam, the first since 1987, is fashioning the new structure out of sand bags and wooden supports. He is confident that it will work, and has experience diverting much larger streams for diamond mining. However, even though it's using local materials and methods, there are questions about its durability, including the risk of sudden collapse, potentially endangering other users below.



While assessing the viability of these enterprises is not possible at this phase, future strategy will need to take into consideration the interaction between the customer and enterprise dimensions. On the customer side, one must consider demand, knowledge, services and customer finance; on the enterprise side, one must consider the technology, the entrepreneur, enterprise support and enterprise finance.⁶⁵

At present, customer demand is robust. Knowledge and services have been provided by POMIGER's staff and the AFLs, though the future provision of these services is unclear. In addition, less attention has been paid to customer finance, though this may change as microfinance is explored for PRADD's mining activities. In addition, the investment required by "customers" is not exorbitant; many have been able to pay for the investment themselves, or else form an association when not possible.

On the enterprise side, more work remains. The technology is generally there: from simple fish-aerators, to PVC tubing to quality saplings and seeds. However, the fundamental challenge, as yet unresolved, is in the procurement and transportation of these technologies, in addition to their products. The entrepreneurs have been selected well, and many have personal qualities and experience that increases their likelihood of success, though additional capacity building is needed. Similarly, enterprise support has only just begun: the same quality of training applied to the future customers has not yet been completed with the entrepreneurs. Finally, enterprise finance deserves some attention, in terms of the fundamental cash flow of each business, but also possibilities for further expansion through financing options. While this analytical framework isn't entirely relevant for a project that continues to have strong donor component, the framework does bring to light strengths and weaknesses.

⁶⁵ Schema developed by Phil LaRocco, an expert in enterprise-centered model of investing in energy businesses in developing countries, founder of non-profit E+Co and adjunct professor at Columbia University's School of International and Public Affairs.

3.2 ECOLOGICAL IMPACT

3.2.1 IMPACTS AND MITIGATION MEASURES

As set forth in this study's original concept note, assessing ecological sustainability involves three steps: first, assessing the nature of the rehabilitation measures involved in POMIGER activities; second, assessing the spatial scale of adoption and hence the spatial impact; and third, assessing the durability of the mitigation impact through time.



No widely accepted framework for assessing environmental impact in artisanal diamond mining was found. However, although this study does not include an environmental impact assessment, it is worth noting to what degree POMIGER, in general, alleviates negative impacts. The following framework has been developed with reference to environmental impact standards in mining used by the World Bank (1998), the IFC (2007), and South Africa Water Research Commission (2004). The categorization was based on field observations and previous documents on the impacts of ASDM in CAR, including Ingram et al. (2011) and Mazalto (2009).



Impact Type	Specific impacts and general level of severity	POMIGER's mitigation impact and level of remediation
Water use and quality	High □ Ponding, fish spawning destruction, river bank and flow modification of larger streams, bed modifications, increased sedimentation, erosion, increased turbidity, indigenous vegetation removal, complete cessation of small water courses, loss of drinking water. □	Significant Direct restoration of certain streams, planting grass (potatoes, herbe de Laos) and other plants for fish feed that also stabilize banks and prevent erosion, streamflow and riverbed restoration for aquaculture.
Wastes & hazardous materials	Low □ Artisanal diamond mining does not use mercury like many forms of gold mining. In principle, gravel piles can oxidize and release certain metal ions.	Moderate Where infilling occurs, gravel piles are not left to oxidize but are buried.

Impact Type	Specific impacts and general level of severity	POMIGER's mitigation impact and level of remediation
Ecology & biodiversity	High While the impact depends on scale, ASM is locally very destructive of aquatic and terrestrial habitats. Pits can also trap endangered animals in protected areas. Secondary effects include poaching by migrant miners in protected areas.	Moderate POMIGER does not directly restore lost habitat, and full conversion to agricultural land will not restore anything. However, by replacing and strengthening soils and/or practicing agroforestry, an environment conducive to natural regeneration can be created, especially of forests, though with enough time, this can also occur without intervention.
Air quality	Low There appears to be little air quality impact, except perhaps in large non-alluvial quarries where dust and mechanized equipment could create issues.	Insignificant
Aesthetics & Noise	Medium ASDM in CAR is highly destructive aesthetically, though noise isn't an issue because of low mechanization.	Significant Land restoration and rehabilitation plays a major role in restoring aesthetics.
Energy Use	Low Low mechanization makes this impact minor, except in areas with many diesel water pumps.	Insignificant
Social & Health Hazards	Moderate Risk of falling into pits, increase risk of water-borne disease because of stagnant water and increased turbidity, increased breeding of mosquitos; health hazards to divers.	Significant Pits are refilled or converted into ponds; tilapia nilotica can eat mosquito larvae.
Land degradation	High Loss of arable land through holes, erosion of fertile topsoil. In PRADD's provinces of CAR, "moonscapes" like in Sierra Leone are less common because of lower density	Significant Infilling of pits and restoration of soil fertility can help reclaim lost land

In a full assessment, it would be important to weight each category. For example, the water impacts from ASDM are much more severe than aesthetics, regardless of their intensity level. However, this schema gives an overview of the effectiveness of POMIGER in remediating some of ASDM's most severe negative environmental impacts.

HIGHLIGHT: RESTORATION IN BALEGO

PRADD is restoring several streams devastated by artisanal mining. As perhaps the most deleterious effect of mining, regeneration of streams—beyond what is being done to facilitate aquaculture—offers an important benefit to communities.



In Balego, in the province of Mambéré-Kadeï, one such restoration was recently completed on a stream that had flowed fine 12 years ago, according to village officials, but then it completely stopped because of mining activity. As a result, one of only five open water sources near the village (there are no bore wells), with an official population of 7,840 people, was completely destroyed. Even though the area is located in a forest zone, water scarcity is severe in the dry season, and as noted above, water issues are the primary source of conflict in several localities. Similar devastation was seen throughout the region, and was also cited as a key driver of the loss of river fish.

Balego's restoration was conducted with volunteer labor with local materials. (PRADD's director of sustainable development, Aleck Soupene, is pictured.) The source of the spring was first enlarged by digging into the wall from which water seeped; then, a small reservoir was created using sandbags and an outflow created with bamboo. Old pits along the former streambed were then filled up and a woven cane fence provided some structure, and potato plants on the side begin to reconstruct the bank and prevent erosion. A recent measurement showed a change in stream flow from 3.53 liters per minute to 8.57 liters per minute. The improvement will likely be even more dramatic when the rainy season starts up again in a few months.



3.2.2 SCALE AND DURABILITY

The issue of scale is important, however, both in terms of whether POMIGER is reaching those sites most in need of rehabilitation, and to what extent the sum of rehabilitated sites is making a dent in the overall negative impact. As noted above, it is important to note that not all POMIGER sites are on reclaimed sites. Indeed, the proportion in both the registry and the survey in Loppo stands at 43 percent. However, the number of sites from an ecological perspective is less important than the surface area relative to the surface area of exhausted sites.

Data from the February 2012 registry indicates that the area of current POMIGER sites located on former mining pits is 17.47 hectares for individual sites and 1.63 hectares for group sites, or 19.1 hectares. This doesn't include sites that may have been restored through POMIGER actions but which are no longer active. PRADD's database of georeferenced and certified mining claims contains an estimated area of mined-out land for each site at the time of registration. While there are almost certainly estimation inaccuracies in these numbers, they nonetheless offer a rough way to calculate the surface area of degraded land.

Of 1717 sites from the database successfully transferred to ArcGIS for this study, 940 were classified as inactive and with portions that were exhausted. The average site of the exhausted areas in these sites was 3911 square meters, making the total amount of exhausted area 367.63 hectares by this definition. Using this figure as a total—which excludes unregistered sites and exhausted portions of active sites, but which may be inaccurately measured—POMIGER has restored roughly 5% of mined out areas in the two provinces. This would not be an insignificant impact, but it does contextualize POMIGER’s success in the full magnitude of the problem.

One limiting factor for the expansion of the POMIGER model is geography. Fish ponds are not suitable everywhere, and more importantly, most POMIGER activities must be close to villages. It is unlikely that POMIGER will work in remote sites far from permanent settlements. This phenomenon can be seen empirically: the average distance from all registered mining sites imported into ArcGIS (n=1717) to the nearest settlement is 45 meters. In contrast, the average distance from georeferenced POMIGER sites (n=60) to the nearest village is 17 meters.⁶⁶

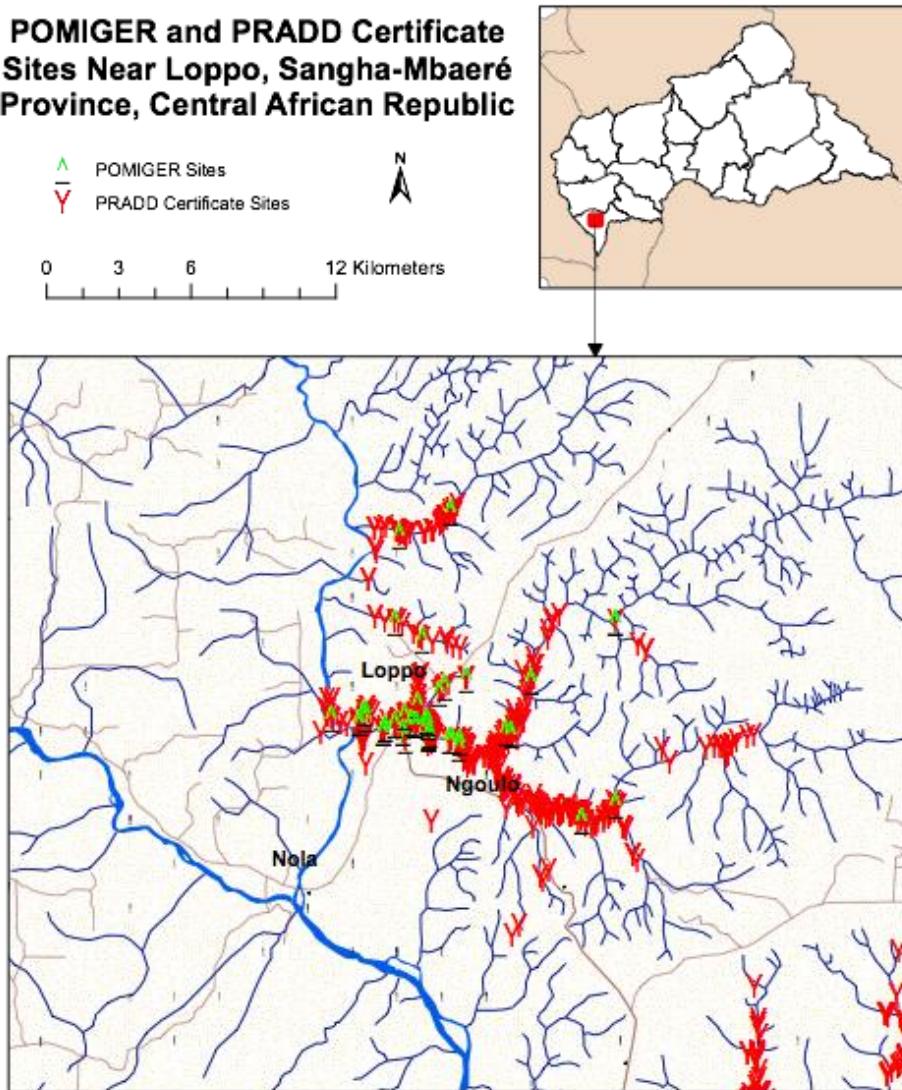
The issue of distance is of special relevance as mining expands far away into protected areas, like the Dzangha-Sangha reserve. PRADD has sought to work with conservation partner WWF to come to a solution, and this model is unlikely to work in remote areas. The main scenario of success would be a situation where POMIGER activities become so profitable, and traveling far into protected areas becomes so risky, that miners opt to stay closer to home. For some, this would mean giving up mining, since closer sites are already occupied or exhausted. The results of this study suggest that this scenario, while unlikely, is not completely farfetched for some, since the profits from some POMIGER activities have approached or surpassed diamond revenue, and if additional activities manage to revitalize the rural economy, this could take pressure off the forests. However, this remains a major challenge.

The specific qualitative characteristics of the exhausted sites can limit the model’s widespread application. For example, there are major artisanal mining sites that involve dozens or hundreds of workers excavating vast areas. Often these owners are less interested in the proposed restoration measures, being focused on their diamonds and other business interests, and the amount of work required for rehabilitation can be too prohibitive to be worth it. Should a diamond boom return, and this results in more intensive exploitation, POMIGER could be a hard sell. However, with the clarification of property rights, it is conceivable that large-scale owners might be convinced to invest in forest plantations or lease and/or cede certain portions to those who would put it to productive use, assuming the site suitable for such activities.

As a final environmental consideration, it is worth noting that POMIGER activities themselves can have environmental impacts, especially with regards to water. As noted in Loppo’s case study, unsustainable water abstraction for aquaculture could put renewed stress on water resources, and result in usage conflicts, as less water is available for drinking and/or other uses, like laundry or soaking manioc. Similarly, damming also brings with it potential negative environment consequences, including flooding and water depletion. These issues may best be addressed through revitalizing PRADD’s efforts at land-use planning in POMIGER zones, and facilitating cooperation amongst users of a single watercourse.

⁶⁶ This was computed using the Point-Distance tool in ArcGIS 10 that calculates the distance from every point to the closest human settlement. Although the figures appear quite small, and could be the result of a calculation error, the difference between the means is what’s important.

**POMIGER and PRADD Certificate
Sites Near Loppo, Sangha-Mbaeré
Province, Central African Republic**



Map created by Terah U. DeJong using data from PRADD and the World Resources Institute

3.3 KEY PRINCIPLES AND PRACTICES

This study has so far approached the question of POMIGER's replicability by looking closely at the details of the program, with an emphasis on the contextual factors and motivations that form its working environment. In this section, a slightly different angle will be examined, mainly, the specific strategies and lessons from the implementation process, drawing from focus groups and interviews with PRADD staff. The following is a summary of 10 key principles and how PRADD staff translated them into practice. The contribution of these approaches should not be neglected as a major reason for the program's high adoption rate, in addition to the contextual factors and economics of the intervention.

- a.) POMIGER's **development-oriented rather than humanitarian approach** was a key principle translated into practice. The Director of Communication noted that as a development project, the needs and will must be driven by beneficiaries, otherwise its impact would not outlive the project. During sensitization campaigns, this was a key message: the solution wouldn't come from the state or the project, but from them. While this may seem like a given, or even a banality, communities were accustomed to handouts from humanitarians, as Mazalto (2009) noted, and many were habituated to a dependent relationship with "patrons," and as such saw PRADD in this light. POMIGER played a key role in transmitting the approach of PRADD in general, and this development approach was a foundation for initial work. For example, tools and material were not distributed right away, but instead people were told to use their own tools, and once they showed they were serious, PRADD stepped up its support. In addition, the strong investment in understanding existing activities, such as aquaculture's long history, through several RRAs and other preliminary research, is also a way that PRADD put this principle into practice.
- b.) POMIGER's model offered a **strong economic incentive for behavioral change leading to the rehabilitation of mined-out sites**. Indeed, during initial phases of the project, people would say that they understood how they were destroying the environment, but how could they afford to fill up the holes? POMIGER offered a way to do this by showing people how the incentive equation could be modified. People still needed to be convinced, and the dire economic situation helped, but hearing of someone earning 700,000 CFA from a pond full of fish, as happened in Loppo, was powerful. This is a significant accomplishment, as witnessed by challenges faced in other countries noted in the literature review. The long-term viability for all activities has not been proven, but the right economic model appears to have been found for this context.
- c.) POMIGER's sensitization efforts **integrated behavior change communication with practical training**. The emphasis on practical training was repeatedly highlighted by PRADD staff as a key reason for their success so far. The communications team developed a sophisticated communication toolbox, including laminated educational materials, but also communication scripts and tip sheets. "Less preaching, more teaching," was the motto, according to PRADD's communication director. In general, the "typical" approach of large-scale motivational workshops was not adopted, but was rather integrated into practical training about fish species and raised vegetable beds.
- d.) **Quality personnel management** may also seem like a given, but cannot be taken for granted. Human resource selection was and is highly competitive, with the project chief personally screening hundreds of applications for key positions. In addition, incentives for staff were favorably aligned, including paying AFLs for their work to increase accountability, and offering field agents per diems to encourage them to spend maximum time in the field.
- e.) **Proximity communication** was also a key principle and practice of POMIGER. Also called the "Jehovah's Witness" model by the communications director, it favored individual persuasive interactions over large workshops. The origins of this strategy can be seen in Mazalto (2009, p. 98) and this was internalized by field agents, who would sleep in the villages, go from door to door, stay up until late hours to meet with returning miners around a fire, and above all, listen. They would chat

about their ancestors, and their hopes for the future, and this *causerie pedagogique* would eventually build enough trust in a typically distrustful community.

- f.) Beyond this one-on-one communication, letting the “converted” serve as **peer witnesses** was a key strategy. The AFLs were the beginning of this approach, since they were selected in part for their ability to reach many people in their communities. Even in mass communication, however, such as PRAADD’s radio program, communication by peers and respected experts was favored over project staff. Similarly, the technical films still under development use local actors and local testimonies in local languages. Finally, exchange visits were organized: recently, for example, 19 people from the new province were sent on paid visits to sites in the established POMIGER provinces, and were left to speak with others on their own terms, and the credibility of this positive word-of-mouth has paid off, with rapid enthusiasm evident in the new province.
- g.) A similar element was the **identification of opinion leaders and catalysts to act as first adopters**. By organizing high-impact initial successes, a *concurrence d’émulation* was fostered, encouraging others to not get left behind and follow suit. Many interviewees and staff members continually cited the initial arrival from Bangui of PRAADD staff with fish in the middle of the night, and the exciting event it created. Working alongside opinion leaders, like church leaders, these tangible first steps set off the *tâche d’huile* (the oil stain), which was the expression used by many to capture the growth, especially with aquaculture.
- h.) The close relationship with PRAADD’s **property rights clarification** initiative is also a key principle of the model. From a communication standpoint, POMIGER’s tangible benefits to artisanal mining communities helped build trust and convince people that the certificates were not a scheme by the Americans to steal their diamonds, which was a real suspicion in early stages of the project. It is possible that the early land use planning approach did not take off because it lacked this tangible component. In addition, as described in this study, the property rights angle has indirectly incentivized POMIGER by reducing conflicts and creating a value for the land.
- i.) The CAR **government has also been involved** in various ways, both consultative and substantive. All training materials were approved by relevant ministries, and the remnants of an old GTZ project helped during the growing and training for agroforestry.⁶⁷ In addition, the regional mining director in Boda was and is a key ally to the project, and has played a mediating role between artisanal miners and ministry officials in Bangui, who can be removed from the reality on the ground.
- j.) Finally, POMIGER took a **hybrid individual-communal organizational approach** that worked both through community-based organizations, who often help women and marginalized communities, while also encouraging individual entrepreneurship.

⁶⁷ Programme Gestion Participative des Ressources Naturelles.

HIGHLIGHT: TWO BROTHERS

In Ngotto, the aquaculture UCP manager Ben Eudes—the man who helped transport fingerlings on a bike in a water cooler “like a baby”—has been involved with POMIGER for several years now. He was part of Mazalto’s original seven pilot sites. He’s Ngotto’s “change agent” – former AFL – and has been involved in all aspects of PRADD’s work. PRADD brought the message of development, he said. “And I was courageous enough to take it up.” In the early days he would go from mining site to mining site explaining what the project was about. “People were reluctant at first,” he recalled.

He was the first to work with POMIGER on aquaculture. After consulting with his family, he leased some of his land without cost for the ponds of 5 local associations, in addition to his own ponds. His late father had had a fishpond, which he did in an “archaic” fashion, and which one day was destroyed in order to continue mining. “I said to myself, ‘Let’s rebuild this—it’s our heritage.’”

He remembers when PRADD agents showed up at 5 in the morning—it was too hot to transport fish in the day—with fingerlings fresh from Bangui. He was the first to put fish into a pond. “It was the pride of our family,” he said. The event made the rest of his work easier. “From that moment on, everyone believed that PRADD was here to help people, and people were interested in the project.”

The certificate has meant a lot to him, he says, recalling how after finding a big diamond a few years back a collector had him arrested and falsely claimed to be his assureur. He was forced by the authorities to sell his diamond to this man. These types of things are much less common.

His brother Victorien Ouizembe, who helps run the UCP and also is president of one of the associations on his brother’s land, agreed. “In the old system, people only thought they were making money, but they really weren’t.” The change of mentality that PRADD has brought has been fundamental. “At first people thought PRADD was a diamond collector: they’d give us material and then take the diamonds.” But once they realized what the project was about, everything changed.

He credits a return to agriculture as helping break this system. “If you now work your own fields, and instead of going to a patron for your 10 basins of manioc, you use your own, then you get a diamond, have it evaluated, and your social level will change,” he said. The certificate has also been important. He’s studied in Cameroon, where he says property rights are more advanced, and he hopes that like there companies won’t be able to take land without negotiation. But he’s concerned about the certificate’s legality in CAR.

He still has diamond mines, though in areas that are not suitable for aquaculture because of no water in the dry season. Instead, he works through his association, called Lawa Lawa, or “Whatever happens, we’ll succeed.” All nine members are artisanal miners. Why not have his own pond? “Freedom without control is dangerous,” he joked, and explained how he hoped to take a loan from the association to invest in raising animals. “This is our ancestral land,” he said, pointing to a bamboo grove. “Our parents planted these so we could make ladders to climb raffia palms and extract wine.” The restoration has already had positive environmental effects, including making the trees less likely to lose leaves in the dry season.



Diamond mining has always been risky. “With diamonds, it’s hit or miss,” he said. “But this is a constant source of revenue.” His association has done two harvests so far: the first was 217 kilos and the second 157 kilos, which he credits partially to having fed the fish animals skins, inexpensive in the dry season because of migrant Chadian herders in the vicinity. Sales from both the harvests were done on holidays—the first on New Year’s, the second on Mother’s Day—to ensure that people would buy everything up in one go. He thinks that while locals wouldn’t buy dried tilapia, there could be a market for it in Boda or places where fish is scarce. He hopes to convince his members to set up a pig farm nearby and use the manure to fertilize the ponds. “Fish eat more than rabbits,” he complained. “You feed them, come back in two hours, and it’s as if you never fed them in the first place!”



He credits POMIGER’s focus on trainings and exchange trips with creating the “tâche d’huile” – the oil drop effect – with aquaculture. “You want to do something, you get trained by someone with knowledge, and then you yourself become someone with knowledge.” He thinks that as soon as there are similar success stories with agroforestry, those will also serve as a “locomotive.” His next project is animal husbandry, but he’s also interested in planting oil palms. “I’ll plant them and then after four years—that’s it! I’ll really take off!”

4.0 CONCLUSION

POMIGER is still a young program, and as the current phase of PRADD winds down, there are numerous risks, including fizzling demand, water conflicts, ambiguities with the certificate, among other issues. Nevertheless, the positive attention paid to the approach, and the goodwill and rapid growth of its beneficiaries, is both astonishing and commendable. The extent of rehabilitation is unprecedented in artisanal diamond mining, and the impact on people's livelihoods at a critical juncture is real. The program is not a panacea, and has real limits and limitations, but its combination of land tenure, practical training, solid economic benefits, and strategic communication deserves serious consideration for all those seeking to improve the artisanal diamond mining environment.



4.1 RECOMMENDATIONS

What follows is a summary of key conclusions and recommendations, each responding to one of the five key questions motivating this study.

Is POMIGER an ecologically sound model to mitigate the environmental impact of artisanal diamond mining?

Ecological soundness was defined as the nature of the mitigation measures, the spatial extent and the durability through time. POMIGER's mitigation measures have strong effects on certain major impacts from artisanal diamond mining, especially water, biodiversity, aesthetics, health issues, aesthetics and soil degradation. The local effect of fishpond development and stream regeneration is particularly positive, and overall there may be positive effects on broad-scale systems such as regional hydrology and deforestation, though this is difficult to quantify. The spatial extent of POMIGER's activities are impressive compared with other attempts at environmental restoration in small-scale mining: between 50 and 211 hectares have been restored, representing at least 5 percent of exhausted mining land identified as part of PRADD's property rights methodology. This figure brings into relief certain limitations of the approach, such as the mismatch between ideal sites for POMIGER activities and the location of mining activities. In addition, distance from villages is a key limiting factor, meaning that remote mining sites, such as those located in or near protected areas, may not be appropriate for POMIGER activities. The prospects of the rehabilitation lasting through time are good: most POMIGER sites are located on completely mined out land, reducing the chances of reopening them for exploitation, and the property rights clarification increases the

likelihood that land will be managed in a sustainable and productive manner. Finally, there are key secondary ecological impacts from POMIGER activities themselves, especially with regards to water management, which merit mitigation plans.

Recommendations:

- Examine the potential impacts and safety issues associated with damming, and develop guidelines for both the production units and for individual ponds.
- Develop a water management strategy on key watercourses, especially in Loppo, so that conflicts are minimized and that different usage needs are balanced. Facilitating the development of water user associations and allocation strategies may be one solution.
- Ensure that the technical standards of fishponds are maintained to mitigate the risk of floods and deterioration of fishponds.
- Revisit the land-use planning and zoning approach from POMIGER's first phase as a strategy to manage POMIGER's environmental impacts and integrate other natural resource management concerns, including pasture management.

Is POMIGER an economically sound model to allow artisanal mining households to diversify their income and reduce their livelihood dependency on diamond traders?

There is evidence that POMIGER has increased the incomes of its participants, especially in the case of fish farming. Indeed, aquaculture's popularity suggests in and of itself that POMIGER's economic model is sound, insofar as it has identified an activity with real potential to generate income. Overall, POMIGER activities have opened up avenues of stable and less risky income that in some cases surpass even diamond revenue. While the diamond economy remains fundamental, there is a noticeable shift towards livelihood diversification, and this trend is likely to continue. While POMIGER appears to have attracted people who are slightly wealthier than average, group-level work is one way to ensure that marginalized people without access to land are reached. In addition, POMIGER appears to be an especially important strategy for older people who may not be physically able to labor. Finally, there is anecdotal evidence that income from POMIGER activities can and is being used for investment in diamond mining, thereby reducing dependency on diamond traders, although POMIGER is unlikely to produce enough cash to supplant the need for financing.

Recommendations:

- Continue to support vegetable farming, despite not being a year-round activity, because of its vital role in food security and its involvement of women.
- Identify ways to ensure that younger miners are reached in communication campaigns.
- Prepare for the possible saturation of the fish market by looking at ways to promote the transformation and preservation of fish.
- As a way to avoid "mission creep," identify opportunities for other actors—like government agencies, traders or other development projects—to take on and expand POMIGER activities.
- Devise a strategy to continue offering engaged, regular technical assistance, perhaps by encouraging other organizations to hire PRADD's AFLs and by integrating CAR's extension agents.

Is POMIGER truly sustainable under the recently implemented commercial model?

While it is too early to fully assess the viability of the new commercial model, the approach has excellent potential and represents a continuation of POMIGER's emphasis on entrepreneurship. Strengths of the model include a preexisting customer base and a selection process that identified

entrepreneurs and groups with track records in business. Weaknesses include a lack of detailed business plans and insufficient technical capacity in some units. There is a danger that units will become passive distribution hubs, as opposed to viable businesses. In addition, demand saturation of certain items, such as fingerlings, could make the units unprofitable unless they diversify into other activities or offer some other “value proposition.” In addition, transportation and other logistical constraints, including the procurement of material, remain major obstacles that have not been overcome. However, there are opportunities to diversify services, strengthen the attractiveness of products through integrating technical services and creating of partnerships with local traders and government agencies.

Recommendations:

- Provide hands-on, rigorous training in business model development, and ensure that the cash flow model is viable.
- Facilitate partnerships with local traders to help find sustainable solutions to transportation and input procurement challenges, such as by subsidizing traders to transport PVC pipes or seeds.
- Explore possible integration of technical expertise into the business model as a way to capitalize on the AFLs and make the products more attractive.
- Examine the need or potential for micro-finance for both the entrepreneurs and for their customers.
- Facilitate closer partnerships with government extension agents, especially in the case of agroforestry

Which if any core components of POMIGER can be highlighted for a replicable model?

The following are recommendations for other environmental restoration projects based on the lessons learned from POMIGER:

- Identify activities that involve restoration but that are also profitable, attractive and feasible.
- Offer practical trainings followed by regular field visits for individual technical assistance.
- Create incentives for staff to spend as much time as possible in the field.
- Compensate community-level facilitators as a way to increase incentives and accountability.
- Combine association-level and individual-level organization models, capitalizing on the potential for individual entrepreneurship and also for the benefits of a collective approach.
- Use local material whenever possible, such as during the regeneration of streams, to increase the potential for maintenance.
- Use local opinion leaders, exchange visits, demonstration sites and other persuasive communication techniques
- Ensure that property rights are clarified, in both individual sites and for associations, as a way to minimize conflicts and incentivize long-term investment
- Ensure that sites are fully mined out to reduce the risk of reopening them later on and undoing the rehabilitation.
- Ensure that the activities bring quick and tangible benefits, both as a way to create momentum but also increase trust and goodwill for other long-term and abstract objectives.

What role, if any, has the PRADD clarification of land rights and related PRADD certificate played in increasing land tenure security and incentivizing POMIGER activities?

The clarification of land rights has played an important but indirect role in POMIGER, primarily by reducing conflicts and fostering the creation of a land market. There is evidence that the

certificates, even if not held for individual POMIGER sites, have increased people's confidence in their ability to sell their land and in the respect of limits by other people in their community. Fear of expropriation by external companies remains, but anecdotally participants view the certificate as a way to strengthen the legitimacy of their claims in the eyes of the state. These factors have played a role in incentivizing POMIGER activities, and may have contributed to making the individual entrepreneurial model attractive. However, there is concern that the certificate's ambiguity when it comes to duration, and whether a certificate signed by the mining ministry remains valid for post-mining activities, threatens to undermine the certificate's positive effects in the future.

Recommendations:

- Identify and implement a strategy to rectify some of the problems with the certificate's format, including its duration and validity for other activities.
- Develop a strategy for better integrating the certificate into CAR's legal and policy environment, including strategies for long-term tenure reform.

Overall, the extent of rehabilitation brought about by POMIGER is unprecedented in artisanal diamond mining, and the impact on people's livelihoods at a critical juncture is real. The program is not a panacea, and has real limits and limitations, but its combination of land tenure strengthening, practical training, solid economic benefits, and strategic communication deserves serious consideration for all those seeking to improve the artisanal diamond mining environment.

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1300 Pennsylvania Avenue, NW
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