



USAID
FROM THE AMERICAN PEOPLE

EVALUATION, RESEARCH AND COMMUNICATION (ERC)

Property Rights and Artisanal Diamond Development Project II
(PRADD II) Impact Evaluation Design Report

AUGUST 2014

This document was produced for review by the United States Agency for International Development. It was prepared by Cloudburst Consulting Group, Inc. for the Evaluation, Research, and Communication (ERC) Task Order under the Strengthening Tenure and Resource Rights (STARR) IQC.

Written and prepared by Heather Huntington, Michael McGovern, and Darrin Christensen.

Prepared for the United States Agency for International Development, USAID Contract Number AID-OAA-TO-13-00019, Evaluation, Research and Communication (ERC) Task Order under Strengthening Tenure and Resource Rights (STARR) IQC No. AID-OAA-I-12-00030.

Implemented by:

Cloudburst Consulting Group, Inc.
8400 Corporate Drive, Suite 550
Landover, MD 20785-2238

EVALUATION, RESEARCH AND COMMUNICATION (ERC)

Property Rights and Artisanal Diamond Development Project II
(PRADD II) Impact Evaluation Design Report

AUGUST 2014

DISCLAIMER

The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

CONTENTS

- CONTENTS** 4
- ACRONYMS AND ABBREVIATIONS** 5
- 1.0 INTRODUCTION** 1
- 2.0 BACKGROUND** 1
 - THE KIMBERLY PROCESS 1
 - ARTISANAL MINING IN FORECARIAH AND KINDIA 2
 - LAND TENURE 4
- 3.0 PRADD INTERVENTIONS AND THEORETICAL FRAMEWORK** 1
- 4.0 HYPOTHESES, DATA SOURCES & INDICATORS** 1
 - RESEARCH HYPOTHESES (H) 1
 - INDICATORS 2
- 5.0 RESEARCH & SURVEY METHODOLOGY** 1
 - PRADD IE TREATMENT AREAS 2
 - PRADD IE CONTROL AREAS 3
 - LIMITATIONS OF DIFFERENCE-IN-DIFFERENCES 3
 - MATCHED DIFFERENCE-IN-DIFFERENCES 4
 - TRIPLE DIFFERENCING 4
- 6.0 POWER CALCULATIONS** 1
 - HOUSEHOLD-LEVEL OUTCOMES 1
 - ARTISANAL AND SMALL-SCALE MINER OUTCOMES 5
- 7.0 CONCERNS AND CONSIDERATIONS** 1
 - EBOLA OUTBREAK 1
 - LIMITATIONS OF DIFFERENCE IN DIFFERENCES 1
 - BUNDLED INTERVENTIONS 2
 - INSUFFICIENT SAMPLE SIZE 2
 - MATURATION 2
 - HUMAN SUBJECT PROTECTION 3
 - SPILLOVERS 3
 - POLITICAL INSTABILITY 3
 - DIAMOND PRODUCTION MEASURES 3
- 8.0 IMPACT EVALUATION TIMELINE AND TEAM COMPOSITION** 1
 - IMPACT EVALUATION TEAM 1
- 9.0 DELIVERABLES** 1
 - BASELINE REPORT 1
 - FULLY DOCUMENTED DATA SET AND CODEBOOK 1
 - IMPACT EVALUATION REPORT 1
 - JOURNAL ARTICLES 1
 - PRESENTATIONS 1
 - DISSEMINATION 1
- 10.0 REFERENCES** 1

ACRONYMS AND ABBREVIATIONS

ASM	Artisanal and Small-Scale Mining
ATE	Average Treatment Effect
CLR	Cluster Level Reliability
CONADOG	National Confederation of Diamond Traders and Workers, Guinea
DD	Difference-in-Differences
EPORT	Electronic Program Observation and Reporting Tool
ERC	Evaluation, Research and Communication
GoG	Government of Guinea
H	Hypothesis
ICC	Intra-Class Correlation
IE	Impact Evaluation
IQC	Indefinite Quantity Contract
IRB	Institutional Review Board
FGD	Focus Group Discussions
FTF	Feed the Future
KII	Key Informant Interview
KP	Kimberley Process
KPCS	Kimberley Process Certification Scheme
LTPR	Land Tenure and Property Rights
LTD	Land Tenure Division
M&E	Monitoring & Evaluation
MDES	Minimum Detectable Effect Size
MMG	Ministry of Mines and Geology
MoA	Ministry of Agriculture
NGO	Non-Government Organization

PMP	Performance Monitoring Plan
PPS	Probability Proportionate to Size
PRADD	Property Rights and Diamond Development
RCT	Randomized Control Trial
RLRS	Rural Land Resources Service
RFP	Request for Proposals
SMARTER	Sustainable Mining by Artisanal Miners
STARR	Strengthening Tenure and Resource Rights
USAID	U.S. Agency for International Development

I.0 INTRODUCTION

This document describes the research methodology for an impact evaluation (IE) of the USAID-funded Property Rights and Artisanal Diamond Development Project II (PRADD II) in Guinea. PRADD II is implemented by Tetra Tech under the Strengthening Tenure and Resource Rights (STARR) Indefinite Quantity Contract (IQC) and under the auspices of the USAID Land Tenure and Property Rights Division. The project represents a 5-year program that began in September 2013, initially focused on Guinea and Cote d'Ivoire. PRADD II was developed to support diamond-producing States' compliance with the Kimberley Process Certification Scheme (KPCS), and seeks to strengthen internal control systems and increase the volume of rough diamonds that enter the legal supply chain. In addition, PRADD II aims to improve artisanal miners' livelihoods and support vulnerable communities by strengthening the tenure security of both primary (land owners') rights and secondary (miners') rights, improving governance of surface and sub-surface resources, and promoting economic development.

This proposed impact evaluation is focused on PRADD II's interventions in the Forecariah region of Guinea. It is designed to rigorously assess PRADD II's impact on strengthening surface and sub-surface property rights, enhancing livelihood outcomes, reducing land and natural resource conflict, and promoting environmental rehabilitation of artisanal mining sites. Given the design and implementation of PRADD II, the evaluation will measure the impact of PRADD's "bundle of interventions" rather than a specific intervention. The evaluation will examine the changes in these outcomes over a 5 year period between six artisanal mining sites in Forecariah prefecture (the treatment group) and six artisanal mining sites in Kindia prefecture that will not receive the program (the control group). As designed, this will be one of the first impact evaluations conducted on the effects of a property rights intervention in the context of the artisanal and small-scale mining (ASM) sector.

An impact evaluation of PRADD represents an important opportunity to inform policy and academic research on the ASM sector, including the effects of property rights interventions in artisanal and small-scale mining communities. There are a limited number of empirical studies in the artisanal mining sector. Given PRADD's status as the first and largest development program focused on the Kimberley Process and artisanal diamond mining challenges, a rigorous impact evaluation embedded in the program offers a unique opportunity to generate knowledge regarding the effects of ASM formalization. The evaluation will also develop the evidence base about the impact of strengthening land tenure and property rights to improve livelihoods and reduce conflict in countries with a large artisanal diamond mining sector.

2.0 BACKGROUND

THE KIMBERLY PROCESS

Guinea is an important producer of alluvial, artisanal diamonds, ranking 12th in the world in 2011 with just over 300,000 carats exported. New alluvial diamond deposits have been discovered around the country. As a result, diamond mining is ongoing in most regions of Guinea, including the prefectures of Kindia, Coyah, Forecariah, Telimele (in Maritime Guinea); and Beyla and Macenta (in Upper and Forest Guinea) (USAID 2014a). Kerouané still remains the highest diamond producing Prefecture of the country. Figure I.1 displays the prevalence of diamond occurrences across Guinea; the red highlighted region on the map indicates the location of the PRADD II program under evaluation.



FIGURE I.1. DIAMOND OCCURENCES IN GUINEA (CHIRICO ET AL. 2012)

The Kimberley Process Certification Scheme (KPCS) is an international certification scheme designed to prevent conflict diamonds from entering legitimate trade on world markets. The Kimberley Process (KP) lays out standards and requirements for monitoring the internal chain of custody from the mine site up the chain of custody to the point of export. KP participants must (1) certify diamond shipments as conflict free, (2) establish mine-to-export traceability systems, (3) implement national legislation and institutions pertaining to diamond mining, (4) possess internal controls and (5) commit to transparency and exchange of statistical data (USAID 2014b).

The Government of Guinea has been a KP participant since 2003, and in collaboration with the Guinean association of diamond miners, collectors, and exporters (CONADOG), has made important strides in formalizing the artisanal diamond sector to increase the proportion of diamonds entering officially-sanctioned marketing circuits. The government has implemented important policy reforms in the mining sector; a new Minister of Mines and Geology was selected in early 2014, and there is a new initiative to review the status of Guinea’s Land Code. Furthermore, the Ministry of Mines and Geology (MMG) demarcated 105 mining plots in Forécariah in 2013 – a process referred to as “parceling – as a key step in increasing the state’s presence and control over the artisanal diamond sector. To improve regulation and control over small-scale diamond mining, the MMG plans to conduct parceling operations across the entire watershed of Forécariah (USAID 2014a) though it remains to be seen whether the same approach used with the initial 105 plots in Forécariah will be repeated.¹

The MMG has had limited capacity and resources to oversee production and ensure the control and monitoring of diamonds across all of Guinea’s diamond mining areas. Previous efforts under PRADD I were made to decentralize the Ministry of Mines and establish prefectural-level Regional Mining Offices in mining areas, each with a Prefectural Director of Mines. However, at present, Kerouane Préfecture is the only location where the MMG has sufficient staff to adequately monitor artisanal and small-scale diamond mining (ASM). At the Préfecture of Forécariah, the Prefectural Director of Mines is the only official overseeing artisanal mining, assisted only by two unpaid local volunteers. Although parceling operations were implemented in Forecariah region, only five of the 105 parcels have been purchased (USAID 2014a).

Despite the efforts to improve governance of the artisanal mining sector, serious regulatory deficiencies persist that threaten the country’s compliance with KP regulations, and lack of compliance with KP procedures could effect the countries ability to legally export diamonds. The KP tripartite actors of government, the diamond mining sector, and civil society in Guinea acknowledge that the Government of Guinea (GoG) is failing to properly monitor the production of alluvial diamonds. In 2009, a KP Administrative Decision was issued on Guinea based on concerns over abnormally high export figures for 2007-2008 that were inconsistent with diamond production capacity. The problems of registration and traceability of diamond production – as well as the non-registration of miners – remain key threats to KP compliance. The GoG has been warned to undertake efforts to address weak internal chains of custody around diamonds by strengthening the monitoring of diamond production at the point of extraction (USAID 2014b).

ARTISANAL MINING IN FORECARIAH AND KINDIA

Diamond occurrences are present on the alluvial plains found throughout Forecariah and Kindia Prefectures in Guinea’s Guinée-Maritime region. The treatment and control sites are located in the Atlantic-draining Konkouré River basin and are defined by small-scale mining where artisanal diamond miners utilize open pit methods without the aid of mechanized tools and equipment.²

¹ Personal correspondence with PRADD: As of August 2014, there are a total of 130 parcels. MMG conducted additional parceling operation in 2014, and 14 of these parcels have been purchased.

² A site is cleared and the topsoil removed. Next, miners search for ilmenite and mica and dig down to the gravel layer that contains diamonds. The gravel is washed and sifted for diamonds.



FIGURE 1.2. MINING SITE IN FORECARIAH

Forécariah and Kindia prefectures are located in the Kindia Region of Southwestern Guinea where the dominant ethnic group and language is Soussou.³ Forecariah prefecture is 100 km from Conakry, covers an area of 4,200 km² and has an estimated population of 136,000, with a density of 32 inhabitants per km².⁴ Kindia prefecture is 137 km far from Conakry, covers an area of 9,648 km², and has an estimated population of 483,284 inhabitants, with a density of 50 inhabitants per km².⁵ The control sites for the evaluation are located in Damakanya and Friguiagbé sub-prefectures.

In both prefectures, diamond mining is a tertiary activity. Households are dependent on agriculture, trade and forest resources (charcoal production and cutting timber). In Forecariah, rice cultivation is the main agricultural activity, whereas Kindia is defined by the subsistence farming of vegetables, rice, cassava, and fruits. Most income comes from trade and the selling of forest products.

Despite the close proximity of diamond mining and agricultural activities, there are minimal conflicts, with those occurring being low-level conflicts. Local communities have an effective customary system for managing conflict involving key roles for customary landowners and village leaders. In addition, there is a large surplus of land for agricultural activities. Thus, strong social organization and an abundance of land serve to minimize conflicts between miners and farmers.

Forecariah was selected as a site for PRADD II due to its inefficient and unproductive mining system and the illegal and informal nature of most diamond sales. The structures to ensure compliance with the Kimberley Process (KP) are not present in Forecariah.⁶ In addition, there is extremely low uptake of parceling in the study area, although it represents a priority for the GoG to ensure compliance with the KP. Parceling is expected to facilitate traceable diamond production, improve output monitoring and fund the restoration of environmental rehabilitation. Yet, formal parceling is subject to the following limitations and challenges (USAID 2014a):

- Lack of local knowledge and awareness of the local population;
- Lack of state capacity to manage and monitor the parcels;
- Absence of geological data to inform parceling; and
- Unaffordable permit costs for local communities (2.5 million Guinean Francs (GNF)/ US \$357 per parcel).

³ Kindia prefecture is slightly more ethnically diverse than Forecariah – with a greater presence of Mandinka and Fulani herders.

⁴ <http://www.geohive.com/cntry/guinea.aspx>

⁵ Ibid

⁶ These include the Artisanal Mining Division of the Directorate of Mines (DNM), the Anti-fraud brigade, the Permanent Secretariat for the KP, and the National Bureau of Expertise (Diamonds and Gemstones).

The MMG has parceled approximately 130 active and inactive mines across Forecariah.⁷ Each parcel is one hectare and requires the user to purchase an artisanal mining permit. The cost of the permit and lack of enforcement mechanisms do not incentivize uptake and adherence to the official parceling scheme. Thus far, only 14 parcels have been purchased, and most of these are by external actors.

Moreover, the formal parceling system is not consistent with the long-established land tenure regime that currently regulates and manages access to the mining sites. Customary landowners are the descendants from the villages' founding families and have the authority to grant permission for diamond mining on their land. Customary landowners authorize mining on plots between 16 and 25m² for the cost of 20,000 – 50,000 GNF.

The customary land tenure system remains sophisticated and flexible. The local land tenure system as it is currently constituted seems to effectively manage the full range of land tenure challenges that are encountered. In Forecariah, customary landowners organize, control, and monitor artisanal diamond mining. The present system is a delicate balance in which savvy village-level actors know the limits of their lands and the customary prerogatives of each senior male actor and have a repertoire for negotiating with a range of different types of outsiders interested in land for farming, plantations, or mining. Although junior men and women are in principle granted insecure tenure rights, the prevailing situation of land abundance means that there is no indication of these groups being disadvantaged in practice, even in cases where the state or state-sponsored actors have tried to expropriate land from locals (USAID 2014a).

LAND TENURE

Despite the strength of the current customary system, PRADD has identified a potential for conflict between external actors that can afford mining permits and the local customary landholders that cannot adequately protect their tenure security under current legal procedures. Parceling gives permit holders exclusive mining rights for a renewable period of one year. Although Article 123 of the Mining Code states that “A mining right does not extinguish a property right,” the surface rights of customary land owners have not been officially recognized by the MMG, and customary owners do not have formal documentation for their land rights. Moreover, formal mechanisms are not in place to ensure that customary landowners are compensated for mining activities that take place as part of the parceling system, including compensation for the environmental rehabilitation of exhausted sites.

The Government of Guinea has yet to implement policies and laws that effectively clarify and secure customary land tenure. The Land Code of 1992 has not implemented formal procedures for recognizing and formalizing customary rights in rural areas. Under Article 9 of the Land Code, landowners can only formalize their property through an expensive and technical registration process that is not feasible for rural communities. Although the state issued a land policy directive for rural areas in May 2001, there remains an absence of viable administrative procedures through which customary landowners can receive formal documentation.

Against this backdrop of uncertain legal protections for rural land tenure, the MMG has been parceling alluvial plains for artisanal and small-scale diamond miners, and subsurface rights appear to be given a higher priority – to the detriment of existing surface rights. The parceling process is designed to allow

⁷ The break down for the parcels is as follows: Gbérédabon - 35, Safoulen -35, Khoboto -16, Siratoumany -19, Woula -8, Kansixoure -10, Momoyire -4, and Doto -3

the government to clarify and strengthen the access to sub-surface rights. However, the land undergoing parcellation is land held under customary ownership, and there are direct implications for the land tenure rights of communities affected by the parcelling process. This process has not been based on geological evidence and does not include adequate mechanisms to compensate surface right holders. As such, the parceling process has served to further reduce the tenure security for surface right holders and increases the potential for conflict between communities and miners/the government (USAID 2014a).

These are the development challenges that PRADD II will seek to address through its program activities over the next 5 years.

3.0 PRADD INTERVENTIONS AND THEORETICAL FRAMEWORK

This section briefly outlines PRADD II's program activities in Guinea. It highlights the specific interventions that are under investigation through the impact evaluation. As noted in the Introduction, given the design and implementation of PRADD II, the evaluation will measure the impact of PRADD II's "package of solutions" rather than a specific intervention.

The central objective of PRADD II is to increase the number of alluvial diamonds entering into the formal chain of custody, while expanding benefits accruing to diamond mining communities. To this end, PRADD II will strengthen the capacity of formal government, local customary institutions, civil society, and the diamond sector to enhance the monitoring of diamond production. From 2014-2019, PRADD II will implement interventions to improve economic development and clarify and strengthen surface and sub-surface property rights across local communities in the Forecariah region. Activities include piloting approaches to formalize customary tenure to surface rights and introducing refinements to the existing system of demarcating and parceling mining claims.

In Guinea, PRADD II is defined by four main activities:

- Activity 1: Clarification of Land and Property Rights
- Activity 2: Strengthening Governance and Internal Controls
- Activity 3: Economic Development in Artisanal and Small-scale Mining Communities
- Activity 4: Public Awareness and Outreach

Under each of these broad areas, PRADD II will implement interventions at multiple administrative levels and across a range of actors. For example, as described in more detail below, PRADD II will be working to build the capacity of the Ministry of Mines and Geology, in addition to a focus on micro-level community engagement.⁸ The impact evaluation is charged with investigating the treatment effects of PRADD II's *community* level interventions and *local impacts* on governance, tenure security, conflict, resource condition, etc.. The evaluation design controls for any national-level outcomes (from training, outreach, and policy) common to both the study regions.

ACTIVITY 1: CLARIFICATION OF LAND AND PROPERTY RIGHTS

Through Activity 1, PRADD II will support the clarification and strengthening of surface and sub-surface rights. The local-level interventions under evaluation in this Activity set include (1) the formalization of customary surface rights and (2) local capacity building for conflict resolution.

⁸ For example, PRADD has a series of activities designed to build capacity on land tenure and property rights. PRADD II will launch its capacity-building program through a training workshop that will cover land tenure and property rights concepts and case studies. Participants will include staff of the RLRS of the MoA and representatives of various Guinean Ministries. The evaluation design corrects for the presence of these high level interventions, although it cannot ascertain their marginal effect.

In particular, to strengthen the security of surface rights for customary landowners, PRADD II will promote land tenure formalization in rural areas through the new National Service for Rural Land Resources (RLRS). A recent presidential decree has upgraded the Rural Land Tenure Division of the Ministry of Agriculture (MoA) to the Rural Land Resources Service (RLRS). The RLRS is mandated to improve the policy, legal, and regulatory framework for rural land tenure, especially with regard to constraints related to the implementation of the 1992 National Land Code (Code foncier et domaniale—CFD).

The RLRS is preparing to launch a series of activities to promote a formal land registration and titling process. PRADD II will work with the RLRS to design procedures and standards for conducting an inventory of land, rights, and claimants in the six treatment sites in Forécariah. Lessons from this process will be used to provide technical support to MoA and MMG to design a multi-step approach to formalizing surface rights for customary landowners (USAID 2014a).

Under Activity 1, PRADD II will also identify resource-based conflicts and promote alternative mechanisms of conflict resolution. This intervention involves an in-depth diagnostic of conflicts present in treatment sites, including types of conflicts, their origins and intensity, existing mechanisms and institutions for conflict resolution, as well as the strength and weaknesses of the existing mechanisms and institutions. Based on this information, PRADD II will develop and deliver a training manual on alternative conflict resolution for miners and their communities across the treatment sites.

ACTIVITY 2: STRENGTHENING GOVERNANCE AND INTERNAL CONTROL

Activity 2 seeks to introduce an innovative pilot system in the Forécariah sector to strengthen governance and improve control of diamond production. The project will support the demarcation of reserved zones for ASM. PRADD II will provide technical and logistical assistance to MMG through the ASM Division to demarcate and geo-reference the entire proposed zone of Forécariah that the GoG classifies as having artisanal diamond mining potential. This will serve as the foundation for parceling operations on sites that have been identified as bearing diamond potential. Besides strengthening the presence of the government, PRADD II will work with MMG and customary landowners to refine the current parceling system to include a greater role for customary land owners in the administration and monitoring of diamond production. The overarching objective of Activity 2 is to increase control and improve monitoring of diamond production from the mine site up the chain of custody to the point of export.

Formalization of the mining sector represents the means of absorbing/integrating existing customary practices that govern ASM into the mainstream of a country's legal and economic affairs. This process involves strengthening certification schemes, traceability systems, demarcation, land registration and titling, and the development of a mining cadaster. The formalization of the ASM sector is based on property rights theory (Clausen et al. 2011). Thus, a critical component of PRADD II is to enable miners and land owners to gain legal, exclusive, and transferable (secondary and primary) property rights.

A number of studies have demonstrated the link between tenure security, investment, and economic development in rural areas (Deininger et al. 2011; Deininger & Chamorro 2004; Feder et al. 1988; Holden et al. 2009; Jacoby et al. 2002; Rozelle and Swinnen 2004). Secure tenure and clear assignment of rights – in conjunction with institutions to uphold and enforce those rights – provide incentives for people to undertake long-term investments by providing a sense of permanence and security (Besley 1995). Secure property rights are expected to promote longer-term investments and planning in

conservation and physical capital. This logic also applies when securing the use and management rights over communal resources.

PRADD II is based on this theoretical foundation and guided by the expectation that formalization will have a positive impact on livelihood strategies and outcomes, labor conditions, and environmental degradation. Given the sensitivity and complexity of land dynamics, it will be important for the impact evaluation to investigate differential treatment effects for various sub-groups and unintended negative externalities of PRADD II. Greenen (2012) summarizes several key concerns raised about formalization. First, some researchers have argued that the process may have a negative influence on livelihood outcomes, because it has the potential to weaken the current customary land system, which provides an important informal social safety net to local communities (Clausen et al. 2011, Maconachie and Hilson 2011, Okoh and Hilson 2011).

Second, not everyone will benefit from stronger property rights. Formalization may reinforce social and economic power relations that exacerbate unequal resource access (Fisher 2007, Greenen 2012, Platteau 2007). Third, in the context of weak state capacity, the actual administrative and bureaucratic costs of formalization may outweigh the benefits and threaten the sustainability of the system (Bandhirigah 2006, Clausen et al. 2011, Hilson and Potter 2005, Lahiri-Dutt 2004, Siegal and Veiga 2009).

Finally, despite being an informal system, there is a structure and a system of regulation in the current system. As described above in the context of Forecariah and Kindia, this leads to a symbiotic relationship between miners and customary land owners due to shared economic benefits (Nyame and Blocher 2009). Thus, there are very few incentives for diamond buyers, miners or customary land owners to support a formalized system with increased government control. In particular, licenses are not affordable and/or they are perceived as a threat due to increased fees, taxes and oversight. The current informal system is defined by an equilibrium where the land and time periods for mining activities are negotiated directly between the customary land owners and pit masters⁹. Financing for the industry comes from within the local merchant community. In this symbiotic relationship, each party receives benefits without the anticipated costs that registration, demarcation, and licensing would impose.

Given the paucity of empirical research and uncertainty about the program theory guiding the interventions, this IE represents a significant contribution to questions and concerns in the academic and policy literature regarding the challenges, opportunities, merits, and dangers of formalizing ASM in sub Saharan Africa.

ACTIVITY 3: ECONOMIC DEVELOPMENT IN ASM COMMUNITIES

Activities 3 and 4 represent complementary activities to the formalization and governance efforts. Activity 3 is designed to improve economic development in ASM communities by diversifying local livelihoods and supporting miners to increase the profitability of the ASM sector. PRADD II will introduce and train the miners and communities on improved mining techniques to maximize productivity, reduce environmental damages, and improve land rehabilitation. PRADD II will also provide technical and logistical assistance to miners and their communities for organizational development, financial management, diamond valuation, diamond marketing, and access to microfinance

⁹ Masters are external operators who fund and control diamond production and trade. They rent the mining site from customary landowners or purchase a parceled site, provide equipment and hire the miners.

opportunities. Finally, the project will support alternative livelihood activities that contribute to both livelihood diversification and the rehabilitation of mined-out sites.

ACTIVITY 4: PUBLIC AWARENESS AND OUTREACH

Activity 4 is designed to raise awareness and understanding of policies, laws, and regulations related to protecting and enhancing the security of tenure to surface and sub-surface resources or adopting improved mining practices. This Activity involves local communication and outreach on themes such as the Mining Code, the Land Code, the steps and procedures for formalizing surface and sub-surface rights, and the obligations of the Kimberley Process Certification Scheme.

4.0 HYPOTHESES, DATA SOURCES & INDICATORS

This impact evaluation tests a number of research hypotheses that follow from the evaluation objectives and program theory guiding PRADD II. The evaluation has the scope to rigorously assess the program's impact on indicators measured at the household level and those measured through miners. It does not have the power to identify community-impacts measured only at the village level, though qualitative methods will be used to investigate indicators measured only at the village level.

RESEARCH HYPOTHESES¹⁰ (H)

Specific hypotheses in this IE include:

At the community level:

- *H-1.* Communities receiving the PRADD II intervention (land use rights formalization, governance strengthening, economic development and public awareness) will have lower community-wide incidence of conflicts.
- *H-2.* Communities receiving the PRADD II intervention will have more transparent, accountable, and representative customary land governance institutions.
- *H-3.* Communities receiving the PRADD II intervention will have a reduced incidence of community land expropriation by the government without adequate consultation and fair and timely compensation.
- *H-4.* Communities receiving the PRADD II intervention will have improved environmental and natural resource conditions.
- *H-5.* Communities receiving the PRADD II intervention will have greater capacity to negotiate mutually beneficial contracts between communities, the state, and private sector investors.¹¹
- *H-6.* Communities receiving the PRADD II intervention will perceive greater tenure security and protection of their community land from encroachment by outside actors.
- *H-7.* Communities receiving the PRADD II intervention will invest more in improving the condition of their land and natural resources.
- *H-8.* Communities receiving the PRADD II intervention will have greater control, monitoring and legality of diamond production.

At the household level:

- *H-9.* Households in communities receiving the PRADD II intervention will have improved livelihood and welfare outcomes.
- *H-10.* Households in communities receiving the PRADD II intervention will invest more in improving the condition of their land and natural resources.

¹⁰ To promote a standardized research agenda, many of the hypotheses tested in the PRADD IE are also investigated across other evaluations conducted under ERC.

¹¹ This includes contracts for the use of customary land.

- *H-11*. Households in communities receiving the PRADD II intervention will be more knowledgeable about KP provisions and associated national mining law.

At the artisanal miner level:

- *H-12*. Artisanal miners in sites receiving the PRADD II intervention will have improved livelihood and welfare outcomes.
- *H-13*. Artisanal miners in sites receiving the PRADD II intervention will be more knowledgeable about KP provisions, the associated national mining law, diamond valuation and improved mining techniques.
- *H-14*. Artisanal miners in sites receiving the PRADD II intervention will experience a reduced incidence of conflicts.
- *H-15*. Artisanal miners in sites receiving the PRADD II intervention will perceive greater tenure security and secondary use rights.

To test these hypotheses, the evaluation will utilize 5 sources of community and household level data to investigate tenure security, natural resource and environmental conditions, and livelihood outcomes.

These data sources include:

1. Household survey data - The survey will collect data from the head of household and a primary female in the household. The specific sub-groups of interest for the study include women, youth and ethnic minorities, as reflected in the sampling methodology. The survey will cover a representative sample of the treatment and control groups, and it will aim to assess information about resource conflicts, livelihood activities, and tenure security;
2. Focus group discussions - The evaluation will collect data from focus group discussions with respondents identified through purposive sampling (Tongco 2007). The sub-groups of interest include women, youth, ethnic minorities and miners;
3. Key informant interviews with customary land owners and plantation owners; these interviews will provide data on shifting attitudes and outcomes regarding the security, governance and the condition of land and water resources, as well as perceptions about artisanal mining and the legality of diamond production in mining communities;
4. ASM survey data – A survey of artisanal miners and masters will be conducted with indigenous and foreign diggers, washers and masters;
5. Secondary or administrative data on land expropriation, contracts between communities and investors, maps, studies, production data and M&E data commissioned and collected as part of PRADD II. Please refer to Annex I for PRADD II’s M&E plan.

ERC and PRADD carefully reviewed PRADD II’s Performance Monitoring Plan (PMP) and the PRADD IE indicators to develop a comprehensive data collection plan that avoids overlap and maximizes the strengths of ERC IE expertise and PRADD M&E expertise. Given the overlap in indicators between PRADD and the IE, the IE will be responsible for a single baseline data collection that collects baseline indicators of interest to both ERC and the PRADD team. Subsequently, M&E indicators of interest to ERC will be shared by PRADD.

INDICATORS

Tables H1 through H15 detail suggested indicators to test the fifteen hypotheses listed above. The tables provide specifics on outcome indicators plus corresponding details on data sources, measurement, and other considerations. Note that these outcome indicators will continue to be refined as the IE design

process moves forward. Many of indicators overlap with PRADD II indicators listed in the projects PMP. The PMP is included as an Annex to this document.

COMMUNITY IMPACTS

H-1: COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL HAVE LOWER COMMUNITY-WIDE INCIDENCE OF CONFLICTS.

Indicators:

- A.** Prevalence of land and natural resource conflicts between:
 - farmers and artisanal miners
 - miners and customary land owners
 - family members (intra-family conflicts)
 - villages (inter-community boundary conflict)
- B.** Relationships between previously conflicting groups
- C.** Attitudes and perceptions of ASM and miners
- D.** Conflict intensity
- E.** Protection of vulnerable populations through conflict resolution
- F.** Capacity to respond to conflicts
- G.** Percentage of disputes resolved at the local level
- H.** Time to resolve disputes
- I.** Effectiveness and frequency of collaboration between diverse conflict resolution actors
- J.** Mechanisms for conflict resolution

Notes:

- 1) To the extent possible, each indicator will be disaggregated by type of conflict/dispute.
- 2) Data will be disaggregated by sub-groups to determine differential treatment effects on vulnerable versus powerful groups.

Data sources:

- A. Household survey
- B. Focus group discussions with women, youth and miners
- C. Key informant interviews with customary land owners
- D. ASM survey

H-2: COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL HAVE MORE TRANSPARENT, ACCOUNTABLE AND REPRESENTATIVE CUSTOMARY LAND GOVERNANCE INSTITUTIONS.¹²

Indicators:

- A.** Perceptions of transparency, accountability and representativeness of customary land governance among HH respondents
- B.** Participation of women and vulnerable groups in community land governance
- C.** Assessments of fairness and transparency of rules related to land-use and mining
- D.** Satisfaction with rules related to land-use and mining
- E.** Satisfaction with enforcement mechanisms for rule violations
- F.** Understanding rules of land governance

Notes:

- 1) Data will be disaggregated by sub-groups to determine differential treatment effects on vulnerable versus powerful groups.

¹² PRADD II is working with both customary and formal levels of government. However, the IE is only focused on investigating local level impacts. The study design can control for but not measure the impact of interventions directed at formal government.

Data sources:

- A. Household survey
 - B. Focus group discussions with women, youth, and miners
 - C. ASM survey
-

H-3: COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL HAVE A REDUCED INCIDENCE OF COMMUNITY LAND EXPROPRIATION WITHOUT ADEQUATE CONSULTATION AND FAIR AND TIMELY COMPENSATION.

Indicators:

- A. Frequency and size of community land expropriation
 - B. Evidence of adequate consultation during expropriation process
 - C. Evidence of fair and timely compensation
-

Data sources:

- A. Key informant interviews with customary land owners
 - B. PRADD II M&E data and other secondary/administrative sources
-

H-4: COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL HAVE IMPROVED ENVIRONMENTAL AND RESOURCE CONDITIONS.

Indicators:

- A. Attitudes and perceptions regarding the rehabilitation of artisanal mining sites
 - B. Subjective perceptions of past, present, and future land and resource condition
 - C. Evidence of natural resource depletion and water availability
 - D. Use of improved mining techniques
 - E. Evidence of mine site rehabilitation
 - F. Evidence of waterway rehabilitation
 - G. Number of fish ponds established¹³
-

Data sources:

- A. Household survey
 - B. Focus group discussions with women, youth, and miners
 - C. Interviews with customary land owners
 - D. Interviews with plantation owners
 - E. PRADD II M&E data
-

H-5: COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL HAVE GREATER CAPACITY TO NEGOTIATE MUTUALLY BENEFICIAL CONTRACTS BETWEEN COMMUNITIES, THE STATE AND PRIVATE SECTOR INVESTORS.

Indicators:

- A. Evidence of contracts that provide fair and adequate benefits to communities
 - B. Capacity of communities to engage and negotiate with government and investors
 - C. Community perceptions of empowerment and capacity
 - D. Women's involvement in community-level land negotiations
-

Data sources:

- A. Key informant interviews with customary land owners
 - B. PRADD II M&E data and other secondary/administrative sources
-

¹³ We are interested in those that are independently established and not directly set-up by PRADD.

H-6: COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL PERCEIVE GREATER TENURE SECURITY AND PROTECTION OF THEIR COMMUNITY LAND.

Indicators:

- A.** Household perceptions of greater security from encroachment by external actors, including miners
- B.** Household reporting of encroachment
- C.** Customary land owners' perceptions of greater security from encroachment
- D.** Customary land owners' reporting of encroachment
- E.** Percent of PRADD beneficiaries who have transferred their surface or sub-surface property rights
- F.** Number of land owners with documentation for property rights

Data sources:

- A. Household survey
- B. Key informant interviews with customary land owners
- C. PRADD II M&E data

H-7: COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL INVEST MORE IN IMPROVING THE CONDITION OF THEIR LAND AND NATURAL RESOURCES.

Indicators:

- A.** Person hours of labor on community-level investments, conservation, and irrigation projects
- B.** Construction of capital investments, conservation structures, and irrigation structures that benefit the community
- C.** Proportion of community land dedicated to long term crops/trees

Data sources:

- A. Key informant interviews with customary land owners
- B. Key informant interviews with plantation owners
- C. Household survey

H-8: COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL HAVE GREATER CONTROL, MONITORING, AND LEGALITY OF DIAMOND PRODUCTION.¹⁴

Indicators:

- A.** Production statistics on diamond production
- B.** Perceptions regarding the extent of illegal diamond production
- C.** Reports of smuggling
- D.** Production registration
- E.** Evidence of improved internal controls

Data sources:

- A. PRADD II M&E data
- B. Key informant interviews with customary land owners

¹⁴ The impact evaluation does not have the capacity to collect actual production statistics. However, the collection of this data is a major objective of the PRADD II program. PRADD II will collect this as high frequency data over time in the treatment sites to enable analysis of this hypothesis. Due to resource constraints, the collection of these production statistics will not be replicated in the control sites. Thus, we will be conducting a pre and post measurement but not DID, and therefore cannot control for external variables that may influence the outcome.

-
- C. ASM Survey
 - D. Administrative data sources
-

HOUSEHOLD IMPACTS

H-9: HOUSEHOLDS IN COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL HAVE IMPROVED LIVELIHOOD AND WELFARE OUTCOMES.

Indicators:

- A. Assets (Feed the Future (FTF))**
 - Size of household farmland
 - Consumer durables and agricultural assets/tools
- B. Expenditures (FTF)**
 - Food, clothing, tea, sugar, coffee and tobacco
 - Health
 - Education
- C. Income/prevalence of poverty(FTF)**
 - Farm income
 - Off farm income from charcoaling and timber
 - Off farm income from trade/wage labor
 - Income from ASM
- E. Sustainable livelihood strategies**
 - Household farmland management strategies
 - Fish farming
- F. Access to credit**

Notes:

- 1) These indicators will be disaggregated by the subgroups of interest: women and youth.
- 2) The overarching indicators used to test this hypothesis overlap with Feed the Future indicators.

Data sources:

- A. Household survey
 - B. Focus group discussions with women and youth
 - C. Key informant interviews with plantation owners
-

H-10: HOUSEHOLDS IN COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL INVEST MORE IN IMPROVING THE CONDITION OF THEIR LAND AND NATURAL RESOURCES.

Indicators:

- A. Household farmland management strategies**
- B. Person hours of labor on conservation, investment and irrigation - building of new soil conservation structures (terraces, soil or rock bunds, hedge rows, hours spent on conservation, whether households repaired existing conservation structures) (if applicable)**
- C. Evidence of individual investments - building of fences, chopping of brush, chopping of weeds, building of corrals (if applicable), purchase and use of equipment and mechanized tools**
- D. Proportion of land dedicated to long term crops/trees'**

Notes:

- 1) These indicators will be disaggregated by the subgroups of interest: women and youth.

Data sources:

- A. Household survey
-

B. Focus group discussions with women and youth

H-11. HOUSEHOLDS IN COMMUNITIES RECEIVING THE PRADD II INTERVENTION WILL BE MORE KNOWLEDGEABLE ABOUT KP PROVISIONS AND THE ASSOCIATED NATIONAL MINING LAW.

Indicators:

- A. Knowledge of National Mining Law
 - B. Knowledge of Rural Land Code
 - C. Understanding of KP provisions
-

Notes:

- I) These indicators will be disaggregated by the subgroups of interest: women and youth
-

Data sources:

- A. Household survey
 - B. Key informant interview with customary landowners
-

ARTISANAL MINER IMPACTS

H-12. ARTISANAL MINERS IN SITES RECEIVING THE PRADD II INTERVENTION WILL BE MORE KNOWLEDGEABLE ABOUT KP PROVISIONS, THE ASSOCIATED NATIONAL MINING LAW, DIAMOND VALUATION AND IMPROVED MINING TECHNIQUES.

Indicators:

- A. Knowledge of diamond valuation
 - B. Knowledge of improved mining techniques
 - C. Understanding of KP provisions
 - D. Knowledge of National Mining Law
-

Notes:

- I) These indicators will be disaggregated by indigenous and foreign miners.
-

Data sources:

- A. ASM survey
-

H-13. ARTISANAL MINERS IN SITES RECEIVING THE PRADD II INTERVENTION WILL EXPERIENCE A REDUCED INCIDENCE OF CONFLICTS

Indicators:

- A. Evidence of conflicts between:
 - Miners and customary landowners
 - Miners and farmers
 - Miners and financiers
 - Miners and government authorities
 - Miners and pit masters
- B. Conflict intensity
- C. Satisfaction with conflict resolution
- D. Percentage of disputes resolved at the local level
- E. Time to resolve disputes
- F. Conflict resolution mechanisms
- G. Capacity to respond to conflicts

Notes:

- 1) These indicators will be disaggregated by indigenous and foreign miners.
-

Data sources:

- A. ASM survey
-

H-14. ARTISANAL MINERS IN SITES RECEIVING THE PRADD II INTERVENTION WILL PERCEIVE GREATER TENURE SECURITY AND SECONDARY USE RIGHTS.

Indicators:

- A.** Percentage of licensed miners
 - B.** Miners' perceptions of sub-surface tenure security
-

Notes:

- 1) These indicators will be disaggregated by indigenous and foreign miners
-

Data sources:

- A. ASM survey
-

H-15. ARTISANAL MINERS IN SITES RECEIVING THE PRADD II INTERVENTION WILL HAVE IMPROVED LIVELIHOOD AND WELFARE OUTCOMES.

Indicators:

- A.** Diversity of livelihood options
 - B.** Dependence on diamonds
 - C.** Trends in ASM financing/credit sources
 - D.** Relationships between miners and collectors
 - E.** Income
 - F.** Assets, tool ownership, access to inputs
-

Notes:

- 1) These indicators will be disaggregated by indigenous and foreign miners
-

Data sources:

- A. ASM Survey
-

CONTROL VARIABLES

Indicators:

- A.** Household demographics
 - Household size
 - Ethnicity
 - Years cultivating (if applicable)
 - B.** Migration
 - C.** Highest level of education attained
 - D.** Number of males completing/in primary
 - E.** Number of females completing/in primary
 - F.** Access to bank services, insurance, cellphone services, and markets
 - G.** Development support from donors, NGOs, etc.
 - H.** Distance to roads and markets
 - I.** Population density
 - J.** Livelihood strategies
-

Data sources:

-
- A. Household survey
 - B. ASM survey
 - C. Customary
 - D. Secondary and administrative data (Census)
-

5.0 RESEARCH & SURVEY METHODOLOGY

The impact evaluation team recommends using a Difference-in-Differences (DD) design that compares PRADD II treatment areas in Forecariah prefecture to control areas in Kindia prefecture. The strengths and limitations of these different options are discussed below.

Difference-in-differences (DD) is a strategy that uses data with a time and control group dimension to control for unobserved and observed fixed confounding factors. DD is one of the most frequently used methods for impact evaluation. In the context of the PRADD IE, a DD method will compare the changes in outcomes over time between six mining sites in Forecariah involved in the PRADD program and six mining sites in Kindia that are not involved in PRADD. Given the small number of sites, lack of pretreatment data and the inability to randomize the PRADD II program implementation across these sites, a randomized control trial (RCT) or experimental design is not feasible for an evaluation of PRADD II. The DD approach represents the next best evaluation technique for analyzing the impact of the program.

The DD method is a quasi-experimental design. Although there is an underlying design behind the data collection, DD relies on statistical corrections to ensure that the evaluation design is valid. Thus, DD ultimately represents a data-driven method for evaluating the causal effect of a program. In theory, a well-designed DD method can be a powerful statistical tool to minimize selection bias between treatment and control groups.

As the name implies, we are examining two differences in a DD design. The first difference controls for factors that are constant over time (fixed effects) in each group, since we are comparing that group to itself. Put differently, we are differencing out time-invariant observable and unobservable traits. The second difference captures outside time varying factors by measure the before-and-after change in outcomes for a group that was not involved in the PRADD program but was exposed to the same set of environmental conditions. As a result, the counterfactual being estimated here is the change in outcomes for the control group.

For the PRADD IE, the DD method will be implemented as follows. The “first difference” in the difference-in-differences method represents the before and after effect in the treatment group; this controls for factors that are constant over time for the PRADD treatment areas. The “second difference” represents the before and after difference in the control group to control for outside time-varying factors. Finally, the first difference is subtracted from the second difference to generate the estimate of the treatment effect.

DD will allow us to take into account any differences between treatment and control groups that are constant over time. The strength of the method is that it controls time invariant observable and unobservable differences between treatment and control groups. This is a critical point. The implication is that the treatment and comparison groups do not necessarily need to have the same pretreatment conditions. For DD to be valid, the control group must have been subject to changes in outcomes of

interest that would have been experienced by PRADD II sites in the absence of the program. This is called the “equal trends assumption” and is discussed in more detail below.

The two key factors that are important for the validity of the study are (1) the selection of the control group that will serve as a valid counterfactual and (2) a comprehensive data collection plan to help control for time-variant observable differences between control and treatment groups, as well as aid in

our understanding of the mechanisms that link PRADD II to the outcomes of interest.

The control areas were identified in collaboration with PRADD II. Using mining sites in Kindia as a control group for the Forecariah treatment areas appears to be the most suitable approach for creating a counterfactual. After discussing the methodological requirements of the impact evaluation and challenges of program implementation in Forecariah, ERC and PRADD identified six active artisanal mining sites in Kindia to serve as control areas for the impact evaluation. The team relied heavily on a 2012 geological study of Guinea’s diamond production potential conducted in Forecariah, Kindia, and Macenta (Chirico et al. 2012).

The original list of control sites included several potential sites in Coyah and Telimele prefectures. A “Control Site Verification” was conducted by StatView – the data collection partner for the

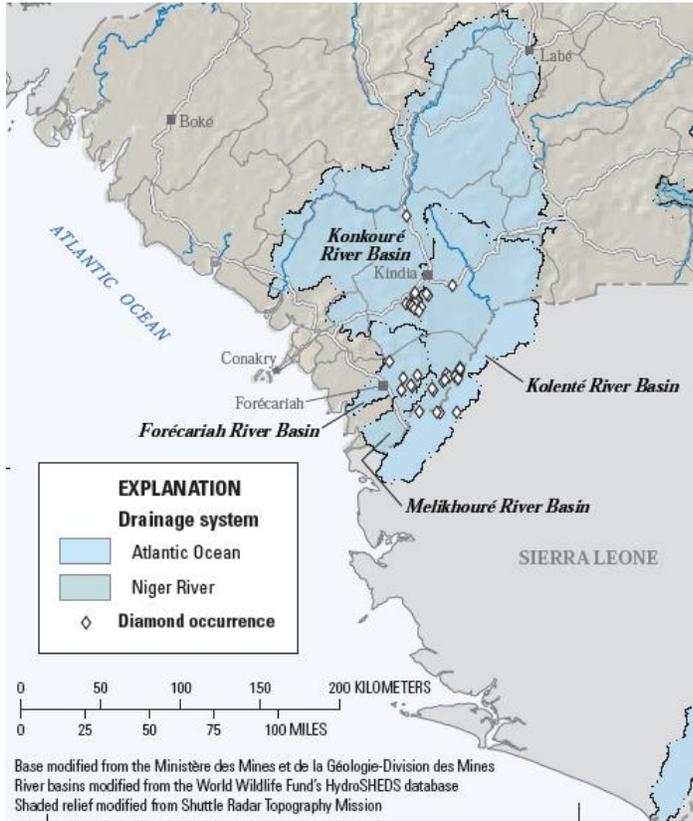


FIGURE 5.1 TREATMENT AND CONTROL AREAS (CHIRICO ET AL. 2012)

PRADD IE – which revealed that several of the sites were either inactive or involved mechanized versus small-scale mining.¹⁵ As such, these sites were considered insufficiently similar to Forecariah and, therefore, were excluded as potential control sites.

Figure 5 above illustrates the general location of the mining sites in Forecariah and Kindia. The specific site names and locations include:

PRADD IE TREATMENT AREAS

Forecariah Lowland Area/Basfonds	Adjacent Villages /District
Gberedabon	District Bassia
Safoulen	District Bassia

¹⁵ These other nonviable sites include: Kenenday (Forecariah – Coyah Region), Kenenday North (Forecariah – Coyah Region), Bouramaya (Forecariah – Coyah Region), Ferekoure (Kindia – Telimele Region), and Teme (Kindia – Telimele Region).

Siratoumany	District Feindroumodouya
Khoboto	District Kourouya
Kansixoure	District Kourouya
Woula (Khaliya)	District Bokaria

PRADD IE CONTROL AREAS

Kindia Areas	Adjacent Villages /District
Sitaya	Commune Damakanya
Momo Bangouraya	Commune Damakanya
Kebeya	Commune Damakanya
Menyima	Commune Damakanya
Angola	Commune Friguiyagbe
Lambaya	Commune Friguiyagbe

The second key part of this impact evaluation is a well-designed and comprehensive data collection effort. The DD design will enable the control of time invariant observable and unobservable differences between the treatment and control areas. To control for time varying differences, we will need to collect data on observable characteristics that may differ between the two groups. In addition to baseline and end line HH and ASM survey data; this evaluation will also rely on a significant qualitative data collection effort, including interviews with customary land owners. Furthermore, ERC is collaborating with PRADD regarding data sharing for PRADD's high frequency M&E data in treatment communities. The qualitative data and M&E data will improve our capacity to address research questions regarding differential program effects and the mechanisms linking tenure rights to improved livelihood outcomes, particularly at the community level.

LIMITATIONS OF DIFFERENCE-IN-DIFFERENCES

DD requires stronger assumptions than randomized selection. It is based on the assumption that the most important omitted variables are time invariant. The key identifying assumption for DD is the equal or common trends assumption, which states that the counterfactual trend behavior will be the same in the Forecariah treatment and Kindia control areas in the absence of the PRADD II intervention. This is a strong assumption and represents the key limitation of DD – it cannot control for time-variant differences between the treatment and control groups. For example, if the World Bank initiated an ASM or land tenure intervention in Kindia in 2016 – or an ethnic conflict affected one area disproportionately in 2017 – the DD would not be able to account or control for these events. Another possible event is a sudden diamond rush in the treatment or control areas; this has been know to occur in Forecariah and Kindia. For DD to produce a valid counterfactual, we must assume that no time varying differences exist between the treatment and control groups.

Thus, the DD strategy is valid if the PRADD II treatment is the only factor that induces a deviation from common trends for tenure security, livelihoods and economic growth – including other factors of interest to the evaluation. Although the treatment and control areas can differ before the implementation of the PRADD II program, this difference must not be reflected in different time trends for key indicators. Therefore, the risk to the validity of this DD design is that it will not be able to

effectively compensate for or eliminate differences between treatment and control that change over time (Abadie 2000).¹⁶

Several techniques are used to test the validity of the equal trend assumption. These include comparing changes in outcome in treatment and control units before program implementation and/or performing a placebo test with a placebo or “fake” control group. Unfortunately, due to budget considerations, this study will not have access to data from additional control groups or multiple time periods beyond baseline, midline, and end line. Although these data limitations constrain our ability to use preferred techniques to check the equal trends assumption, the evaluation will be able to perform a placebo test with *false outcomes* to assess the viability of the common trends assumption. In particular, the team will estimate the impact of PRADD II in the control group on knowledge indicators about the KP and National Mining Law that we expect PRADD II to change, in order to verify whether the assumption holds.

MATCHED DIFFERENCE-IN-DIFFERENCES

To improve comparability between the treatment and comparison groups, the researchers will also conduct the treatment analysis using matched difference-in-differences estimation. In addition to assessing PRADD’s overall treatment effect, the evaluation will also conduct the difference-in-differences method in conjunction with matching to compare treatment households that are most similar to control households. This will reduce the total number of households involved in the study and will have implications for the power calculations. Nevertheless, if this method reduces variation in the measures of interest, it will generate more precise estimates of a local average treatment effect between a subset of treatment and control households.

The steps for this process are as follows. First, baseline data on observed characteristics will be used to match treatment and control households. Second, difference-in-differences estimation will be used to estimate a change in the outcomes for the matched units. Finally, these double-difference estimates across the matched units will be averaged out after weighting for household size to determine the treatment effect.

TRIPLE DIFFERENCING

As noted above, the standard DD strategy assumes that both treatment and control areas would have followed the same trend if the intervention had never occurred. Given the long period of time between the baseline and endline surveys, this assumption may be difficult to justify; over the course of several years, other factors (unrelated to PRADD) may differentially affect welfare or conflict in the treatment and control areas. To guard against this threat to inference, we plan also to take a triple differencing approach. In short, we plan to stratify our survey to ensure that we sample households that are and are not engaged in artisanal diamond mining -- the focus of the PRADD intervention. We can then compare changes before and after the treatment (first difference) between mining and non-mining households (second difference) in treatment and control areas (third difference). The major advantage of this approach is that we “difference out” any changes in welfare at the community level that occur between the baseline and endline, which are not driven by PRADD’s effects on artisanal diamond miners. One

¹⁶ Discussions of DD limitations in the literature include: endogeneity of interventions (Besley and Case 2000); isolation of specific behavioral parameters (Heckman 2000, Blundell and MaCurdy 1999); linearity assumption (Athey and Imbens 2002); and large standard errors (Bertrand et al. 2004).

drawback of this approach is that it will not capture benefits of PRADD that accrue to all households, whether or not they are directly involved in mining. For this reason, it will be only one among many of the empirical approaches we pursue in our evaluation.

HOUSEHOLD SAMPLING METHODOLOGY

The indicators measured by the household survey are noted above in Section 4. Given the small number of sites and associated villages, data will be collected in all villages surrounding the treatment and control mining sites listed above. The household survey will be a Large N survey involving approximately 2000 respondents. The total number of villages expected for the study is approximately 60 across the entire study area. Within each village, we will survey the head of household from 20 households; in households with a male head of household, we will also implement a small survey module with the head/primary woman of the family.¹⁷ By including a large number of females in the survey, the evaluation seeks to assess differential treatment effects for women and men.

The IE Design Document will be updated with more information on the specifics of the household sampling methodology – including the generation of sampling frames and weights – following consultations with the data collection firm.

The household and community surveys will be collected through a cloud-based mobile data collection effort. This will promote data sharing and transfer between the evaluation team and implementing partners to ensure that the results of the data collection are communicated to communities as quickly and efficiently as possible. While there is additional up-front effort required to program the questionnaire and train staff and enumerators on the use of phones, an electronic data collection approach reduces data entry errors and improves the quality of the data (Caeyers et al. 2009).

ARTISANAL MINER SAMPLING METHODOLOGY

The artisanal miner survey will be a Large N survey involving approximately 1000 respondents. ASM miners in Guinea are a challenging population to efficiently survey due to the transient nature of the work. Efforts to survey similarly hard-to-reach populations, for example the homeless population in an urban area, rely on disproportionate stratified sampling, two-phase sampling, and the use of multiple frames, multiplicity sampling, location sampling, and panel surveys (Kalton 2009). One such method is time-space sampling, which involves extrapolation to a broader population based on surveys collected at discrete times in focused locations and applying a weighting scheme. By conducting surveys at the mines during times when miners could reasonably be expected to be amenable to participation, inferences about the larger group can be made without a comprehensive survey of the population. The evaluation team will work closely with the data collection firm to explore the costs and benefits of each of these methods.¹⁸

¹⁷ There is uncertainty about the number of female-headed households and the exact number of villages that will be included in the treatment group. We expect the final survey to be around 2000-2500 respondents.

¹⁸ Due to cost and efficiency concerns, the evaluation team does not recommend the use of a panel survey for ASM surveys of foreign miners in the control sites.

6.0 POWER CALCULATIONS

This section describes the statistical power calculations for the PRADD II IE. In this context, power refers to the probability of detecting an impact if one does exist. The associated power calculations indicate the minimum detectable effect size (MDES) of the PRADD II program that can be detected by this impact evaluation given the expected sample size. The MDES is the smallest measure of PRADD II's impact that can be identified by this evaluation.¹⁹

For the PRADD II IE, the research team will measure impact at the ASM and household level. The power calculations in this section are focused on quantitative survey data collected through the household and ASM instrument. The PRADD II field team estimates approximately 30 treatment villages in Forecariah. Therefore, we do not anticipate having sufficient power to detect community level effects measured only at the village level.²⁰

We do not have previous studies to draw from to inform our power calculations for key variables related to this study. Given limited pre-baseline village level data, we will not be able to improve the precision and power of the study through pre-sampling matching on village characteristics across treatment and control areas. As a result, we conduct more conservative estimates of the power calculations by ignoring the panel nature of the data that will be collected and using more conservative estimates for the parameters included in the power calculations.

The PRADD IE treatment assignment is not random. However, our selection of difference-in-differences (DD) as the estimation strategy implicitly assumes that the interventions are as good as random, conditional on group fixed effects. By relying on DD, we are making the very strong assumption that our Kindia comparison group represents an appropriate control group, such as one would find in an experimental study. On the basis of these assumptions, the power calculations were obtained using the Optimal Design software package (Raudenbush et al. 2011; Spybrook et al. 2011). The factors that determine the power of a study do not differ between an experimental and non-experimental design.

The discussion that follows assumes a power of 0.80 and estimates what will be the minimum detectable effect size (MDES) of PRADD's interventions under alternative scenarios for the number of households included in the sample.

HOUSEHOLD-LEVEL OUTCOMES

¹⁹ In general, an increase in the sample size of an evaluation increases the power of the evaluation. A more powerful evaluation can detect a smaller minimum detectable effect size.

²⁰ Nevertheless, the evaluation will provide a contextual and qualitative analysis of community level trends through an investigation of key informant interviews and focus group discussions.

BOX 6.1. KEY POWER CALCULATION PARAMETERS

The following describes the key parameters used to conduct the power analysis and sample size requirements for this impact evaluation.

α (alpha) is the Type I error and is also referred to as the p-value in statistics. Generally speaking, this is the probability of concluding there was an impact when no impact actually exists. Typical values of α are 0.1, 0.05, and 0.01 with lower values indicating greater confidence in results (that is, less chance of concluding there is a program effect when there is none).

β (beta) is the Type II error. Generally speaking, this is the probability of not concluding there was an impact when in fact an impact does exist. The sample power is equal to $(1 - \beta)$. Typical values of β are 0.1 and 0.2. Lower values of β indicate greater confidence in the results. Stated differently, lower values of β are associated with greater power.

CLR (Cluster Level Reliability) is an estimate of measurement error and is used to correct for the precision of outcomes measured at the village level.

σ^2 indicates that the evaluation is a fixed effect, versus a random effect, design. This means that we do not believe the villages in the study are necessarily representative of all villages in Guinea.

J is the number of villages in each arm of the impact evaluation design. There are two arms in this impact evaluation – the treatment arm and control arm.

Minimum Detectable Effect Size (MDES) - often represented by δ - is the magnitude of impact that can be detected for a given sample. The units of measure for δ are standard deviations from the mean. For example, if referring to household income and the average value is \$1000 per household with a standard deviation of \$100, then a value of $\delta=0.5$ implies that incomes of \$1050 or more are expected as a result of the intervention. In general, the smaller (larger) is δ the larger (smaller) will be the required sample size since a smaller (larger) impact will require a larger (smaller) sample size in order to detect.

Intraclass Correlation (ICC) – often represented by ρ (rho) – measures how strongly units measured in the same group or cluster resemble one another.

n is the number of households sampled per village.

Power is the probability of detecting an impact if one has occurred. The power of a test is equal to 1 minus the probability of a *type II error*, ranging from 0 to 1. Popular levels of power are 0.8 and 0.9. High levels of power are more conservative and decrease the likelihood of a type II error. An *impact evaluation* has high power if there is a low risk of not detecting real program impacts, that is, of committing a type II error.

Power calculations indicate the sample size required for an evaluation to detect a given minimum desired effect. Power calculations depend on parameters such as power (or the likelihood of Type II error), significance level, variance, and intra-cluster correlation of the outcome of interest.

This design represents a two-level cluster design with outcomes measured at the person or household level. The first level is the village and the second level is the measurement level (households). The power calculations for this design do not assume a panel survey, or the taking of repeated measurements in which the same households are re-surveyed over the lifetime of the study. A panel survey increases the power of the study. In practice, we plan to use a panel study and to collect three rounds of data, but for the purposes of ensuring our calculations will be at least as precise as represented here, we have not made use of the panel data assumption.

The power calculations are based on the following standard parameters:

- $\alpha = .05$

- $\sigma^2 = 0$ (fixed effects)
- $J=30, J=40$

In addition to these parameters, to estimate the household-level MDES requires information on the degree of correlation between households within a village or the intraclass correlation (ICC). The assumption here is that units within a group are correlated, which means that we do not gain completely new information from each additional unit surveyed; or, alternatively, that calculations treating these units as independent will overstate the precision resulting from the sample. This “loss” of information has to be taken into account in the power calculations through the ICC. A higher ICC indicates greater correlation between households and less new information from each additional household surveyed. Therefore, the MDES will increase with higher ICC values.

Table 6.1 provides the MDES under different assumptions about the sample size. While the standard parameters stay fixed, we alter (1) the number of households surveyed (N) from 10-30, (2) the ICC from .15 to .30, and the number of villages per arm from 30 to 40.

TABLE 6.1 SUMMARY OF MDES UNDER VARIOUS ASSUMPTIONS							
Villages per arm	Power	Alpha	N	ICC	MDES	ICC	MDES
30	.80	.05	10	.15	.36	.30	.45
30	.80	.05	20	.15	.33	.30	.43
30	.80	.05	30	.15	.31	.30	.42
40	.80	.05	10	.15	.31	.30	.39
40	.80	.05	20	.15	.28	.30	.37
40	.80	.05	30	.15	.27	.30	.36

Source: Authors' calculations

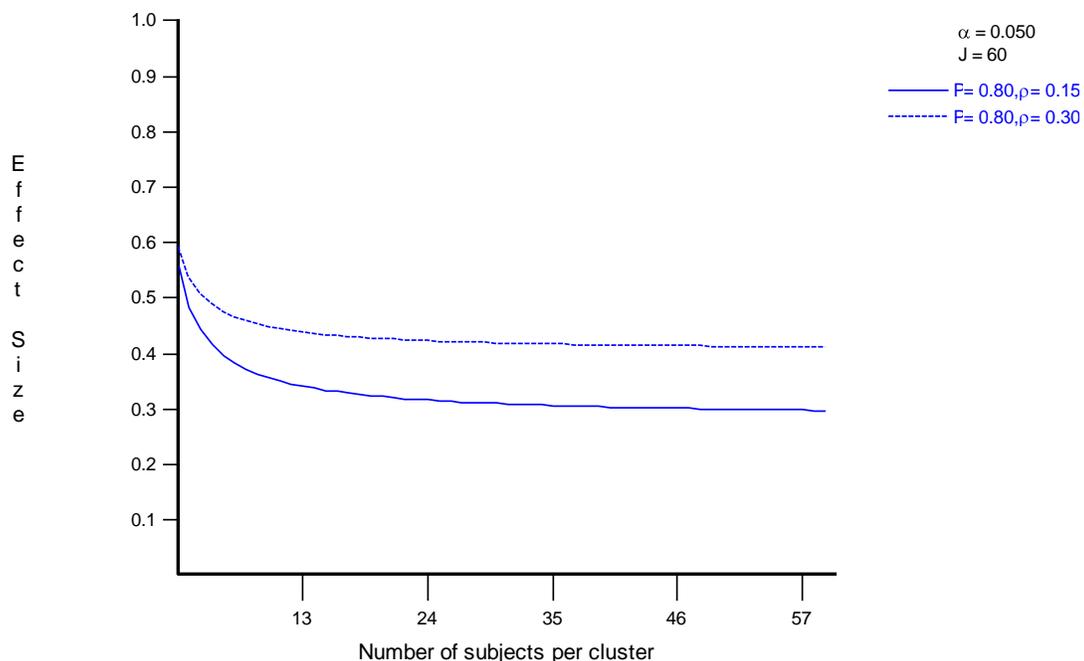


FIGURE 6.1. RELATIONSHIP BETWEEN MDES AND HH SAMPLE SIZE, TOTAL
ERC: P|VILLAGES=60

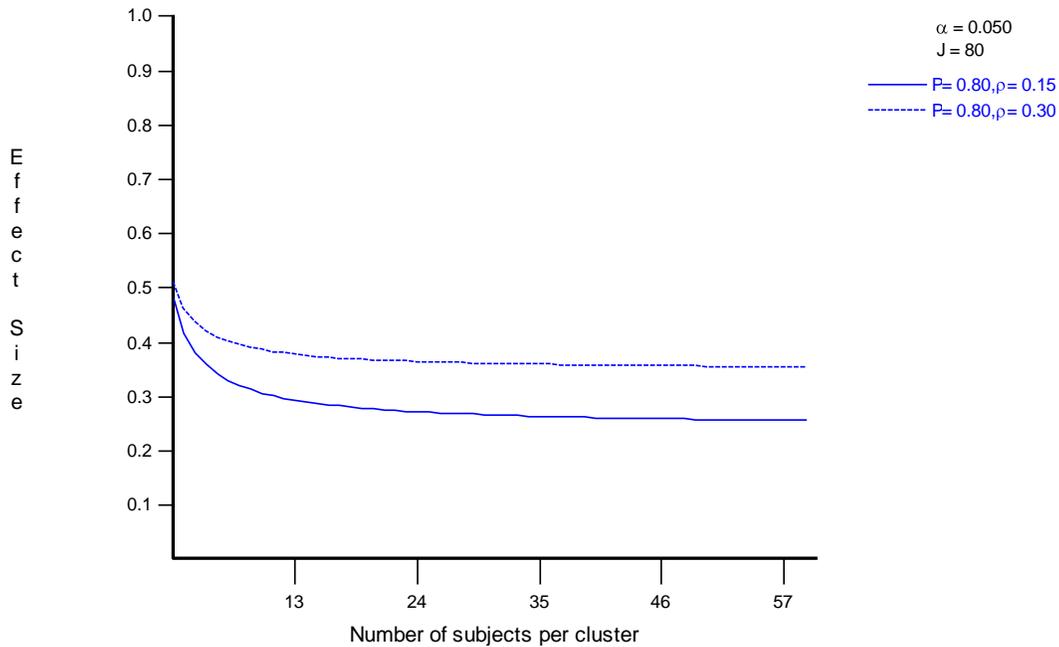


FIGURE 6.2. RELATIONSHIP BETWEEN MDES AND HH SAMPLE SIZE, TOTAL VILLAGES=80

Table 6.3 summarizes the sample implications from the ASM and household-level analyses.

TABLE 6.3. SUMMARY OF HOUSEHOLD MDES UNDER ALTERNATIVE SCENARIOS				
Villages per arm	Households	MDES	Total sample for two-arm design	
			Villages	Households
30	10	.36	60	600
30	20	.33	60	1200
30	30	.31	60	1800
40	10	.31	80	800
40	20	.28	80	1600
40	30	.27	80	2400

Source: Authors' calculations

** Model and parameter assumptions: i) power =0.80 (=1 - β), ii) α =.05, iii) CLR=0.7 (for village), iv) ICC=0.15 (for HH calculations)

The impact evaluation plans to collect data from approximately 2000 households. Given PRADD II's estimates of 30 villages in the treatment area, we expect to survey an average of 30 households per village. Some villages will have less than 30 household and some will have more – the data collection firm will adjust accordingly to oversample in larger villages.

If PRADD II identifies additional treatment villages, we will add these villages to our sample frame and subsequently reduce the number of households surveyed per village to keep the number of households surveyed around 2000. As Table 6.3 indicates, there are greater power gains from adding villages to the survey versus households.

ARTISANAL AND SMALL-SCALE MINER OUTCOMES

This design represents a multi-site (or blocked) trial with outcomes measured at the person level. The first level is the artisanal mining site and the second level is the measurement level (artisanal miners). There are 12 total sites in the study – 6 in the treatment area and 6 in the control area. The power calculations for this design do not assume a panel survey or the taking of repeated measurements. Although it may be possible to locate and resample some of the indigenous miners during future rounds of data collection, we believe it will be too logistically challenging to conduct a panel survey of miners during the evaluation, given the transient nature of ASM.

The power calculations are based on the following standard parameters:

- $\alpha = .05$
- $\sigma^2 = 0$ (fixed effects)
- $J=12$

Although we include a blocking variable for each of the 12 sites, our model assumes that the proportion of variance explained by the blocking variable or sites is zero. This ensures more conservative estimates for our power calculations.

Table 6.4 provides the MDES under different assumptions about the sample size. While the standard parameters stay fixed, we alter the number of expected miners per site.

Table 6.4. Summary of MDEs Under Various Assumptions					
Artisanal mining sites	Power	Alpha	N (miners per site)	MDES	Total sample of artisanal miners
12	.80	.05	50	.23	600
12	.80	.05	75	.19	900
12	.80	.05	100	.16	1200

Source: Authors' calculations

The impact evaluation plans to collect data from approximately 1000 artisanal miners across the 12 mining sites. This assumes an average of approximately 75 miners across the sites. However, we expect some mining sites to have only a few miners, whereas others will have a large population of miners. The data collection firm will adjust accordingly by oversampling miners in larger sites.

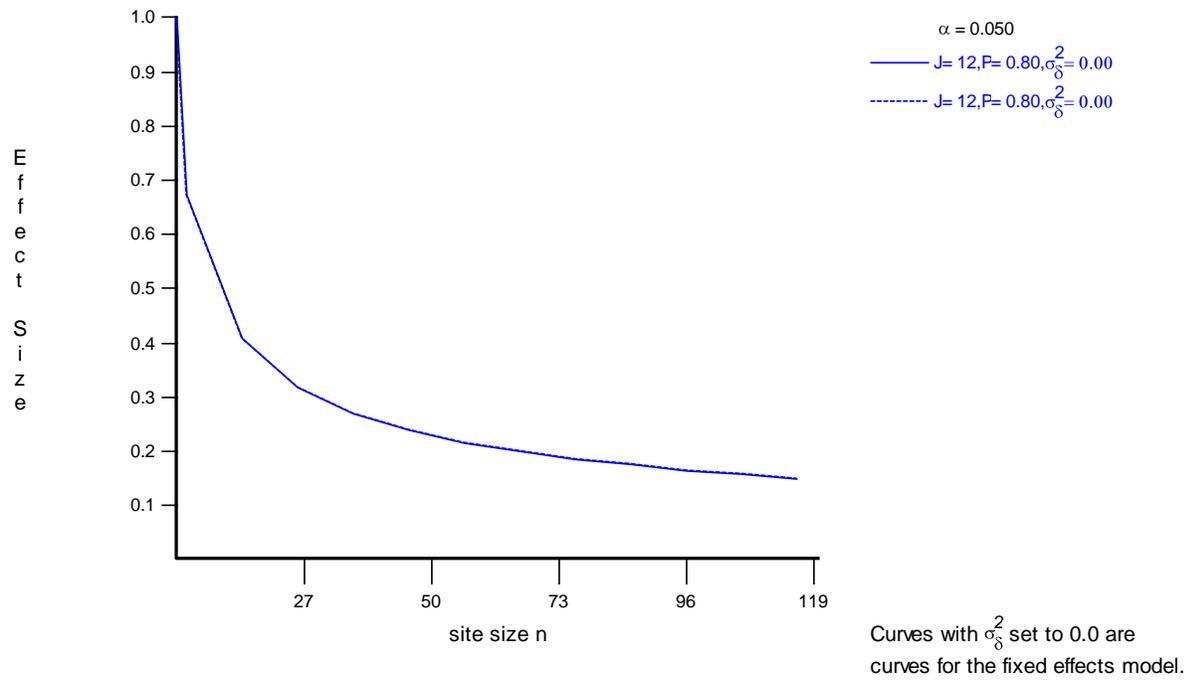


FIGURE 6.3. RELATIONSHIP BETWEEN MDES AND ASM SAMPLE SIZE, TOTAL SITES=12

7.0 CONCERNS AND CONSIDERATIONS

This section describes factors that present risks to the validity of the research inferences and evaluation methodology, as well as additional concerns raised by the implementing partners regarding the sensitivity of the research.

EBOLA OUTBREAK

The ongoing Ebola outbreak in Guinea represents the largest threat to the quality and implementation of the research study. Ebola cases have not yet been reported in the study sites of Forecariah or Kindia. However, cases have been reported in the capital of Conakry and a number of travel and flight restrictions have been imposed for flights to and from Guinea. Restrictions on international travel present significant obstacles to training the firm responsible for the PRADD II IE data collection. In addition, the introduction of local travel restrictions could delay the start of the data collection.

The PRADD II team continues to monitor the situation on the ground. In the meantime, the evaluation team has developed a set of contingency plans for the research, including moving from an electronic to paper based data collection and conducting training for field managers in South Africa.

LIMITATIONS OF DIFFERENCE IN DIFFERENCES

The proposed method to identify the impact of PRADD II assumes that time trends are similar in the Kindia comparison and Forecariah treatment groups before the intervention takes place and that the time trajectory will remain constant. That is, the time-varying factors are assumed to be the same between the treatment and comparison groups. If this does not hold true due to factors, such as conflict or shocks, that differentially affect the treatment and control groups, the impact estimates may be biased.

To help mitigate this weakness in the design, the estimation strategy will combine matching with DD to improve the comparability between treatment and control groups and will include covariates to control for factors that may influence the trajectory of the treatment groups over time. Moreover, supplementing end line DD regression analysis with time-varying geo-spatial information (i.e. on rangeland condition, market access, etc.) can reduce bias and improve the quality of estimated impacts.²¹

Forecariah villages have a well-organized leadership and customary land governance system. They exhibit a high level of cooperation and clear system of rules and traditions regarding mining and the resolution of land related conflicts. We do not have the same detailed analysis and data for the control

²¹ Inconsistent standard errors due to serially correlated time series data is a prevalent criticism of DD (Bertrand et al. 2004). We are using a very basic DD set up of two groups and two periods which does not present the same threat from serial correlation that is found in multi-period data. In addition, through cluster level random effects, our model specification will explicitly take into account the inconsistent standard errors from grouped data.

areas, and cannot confirm that there is the same degree of social capital and strength of customary institutions.

Nevertheless, there is the potential to exploit the natural sequencing of the PRADD program across Forecariah for a more rigorous investigation of treatment about specific activities of interest. In particular, PRADD will track activity implementation in each site through their Electronic Program Observation Reporting and Tracking (EPORT) system and share that data with ERC. Assuming that programming is naturally staggered, the evaluation may be able to use the mid-line data to compare sites in Forecariah that have received the treatment versus remaining sites in Forecariah that have not yet received the interventions of interest.

BUNDLED INTERVENTIONS

Given the complexities of the PRADD II implementation model, PRADD II will implement a bundled approach to activity intervention. The project team determined that purposefully phased implementation activities for strengthening the evaluation design would not be feasible for program implementation. Attempting a clean implementation schedule, given the proximity of sites, and villages within sites – would not be feasible given the large potential for spillover. Thus, the inferences that we draw from the impact evaluation will be focused on the overall impact of PRADD II for LTPR, livelihoods and ASM governance; the evaluation will not be able to tease apart the specific activities generating changes in outcomes.

In terms of the causal analysis, this evaluation will only be able to speak to the impact of the bundle of PRADD II interventions if the interventions are implemented simultaneously across project communities. The implication is that the evaluation cannot disentangle the causal effect of any one intervention. The evaluation will only be able to ascertain the average treatment effect for the project. We will be able to evaluate the impact of PRADD interventions on LTPR outcomes and we will be able to assess whether there are correlations between tenure rights and livelihood outcomes. However, we cannot isolate the causal effect of tenure rights versus other PRADD interventions on livelihood outcomes.

INSUFFICIENT SAMPLE SIZE

There are a large number of indicators and the size of sample required to detect impact will depend on the parameters of those indicators (i.e. mean and variability) along with the expected impact. A given sample size may be sufficient to detect program impact for one set of indicators but not for another. Given the lack of pilot studies and research in this area, we do not have any guidance on the mean and variability of the indicators of interest to this evaluation.

MATURATION

Some of the impacts may take a much longer time period to materialize than what is currently allowed for in terms of time between the baseline and end line data collection. To allow for this, the survey will collect information on anticipated changes for key proximate outcomes in cases where enough time will not have passed to measure a meaningful change in a more distal development indicator. For example, perceptions of land tenure security are measured in addition to some of the more long-term impacts – such as investment and livelihood improvements – that are expected from improved tenure security.

HUMAN SUBJECT PROTECTION

All data collection activities will adhere to professional and ethical standards for the treatment of human subjects. The evaluation team will submit the proposed impact evaluation to the Institutional Review Board (IRB) at Clark University. The IRB is an ethics body in charge of overseeing and monitoring research activities involving human subjects. The IRB's main role is to ensure that research procedures do not pose more than negligible risk to the participant subjects and to assess the adequacy of safeguards to protect subjects' rights, welfare, and dignity. Researchers are required by the IRB to: (1) inform the subjects about the purpose, risks and benefits of the study so that they can make an informed decision about whether or not to participate in the research and (2) protect the anonymity of subjects and the confidentiality of the data.

The evaluation will conform to the legal and other requirements governing research with human subjects in Guinea.

Given sensitivities over land issues, the evaluation team will also work closely with the PRADD II implementing partners to ensure local leader and community buy-in and understanding of the research prior to community entry and data collection.

Furthermore, the research team will provide training to all enumerators and qualitative researchers to ensure they understand these principles. Upon completion of research activities in the field, the data will be maintained in a way that adheres to general IRB principles. All analyses and publications will respect the anonymity of respondents; no identifying information will be used in reports or presentations. The mode of analysis will follow econometric standards for survey research, the aim of which is to make general claims about the participant and non-participant populations, not specific claims about identifiable individuals.

SPILLOVERS

This refers to the case when the comparison group may be affected by the treatment, even though they themselves were not directly treated. Comparison groups can be compromised because of activity in treatment areas. Spillover for interventions that do not specifically target miners is not a large concern for this study due to the distance between sites in Kindia and Forecariah. However, given the mobility of miners and the lack of a panel for the miner survey, the spillover of knowledge and particular mining techniques represents a threat to the validity of the survey. Moreover, given the cross-sectional nature of the ASM data, we will only have snapshots of various indicators from the miners without an effective means to measure/control for these problems. To the extent possible, the study will ask mining respondents to record the names and locations of past and current mining sites. This will provide some information about the level of ASM spillover between Forecariah and Kindia.

POLITICAL INSTABILITY

PRADD II builds on the knowledge and expertise generated during PRADD I, which was active until the 2009 coup led to the premature closure of the project. Despite the history of political instability, there is evidence of greater stability in Guinea, including successful legislative elections in September 2013.

DIAMOND PRODUCTION MEASURES

The impact evaluation does not have the resources and capacity to collect actual diamond production statistics across control sites. PRADD II will collect this information as high frequency data over time in the treatment sites. Thus, the analysis of hypotheses related to diamond production will be limited; the study will conduct a pre and post measurement in treatment sites, but not DID, and therefore cannot control for external variables that may influence the outcome.

8.0 IMPACT EVALUATION TIMELINE AND TEAM COMPOSITION

The baseline data collection for the household and community survey will be implemented from early October 2014 through mid-November. A midline data collection is tentatively scheduled for October – mid-November 2016 and the end line for October – mid-November 2018. Midline and end line will be used to assess the same features of tenure security, land, and ASM governance and livelihoods as the baseline surveys. During these three periods, data from focus groups and interviews will also be collected. To avoid seasonal effects, the baseline, midline and end line surveys are scheduled to occur at the same times each year.

Table 8, on the next page, provides a detailed timeline for the PRADD II IE Baseline data collection.

IMPACT EVALUATION TEAM

We propose the following composition of the Impact Evaluation Team:

Subject Matter Expert: Michael McGovern (University of Michigan, Cloudburst Group)

Impact Evaluation Specialist: Heather Huntington (Cloudburst Group)

Baseline Field Manager: Aleta Haflett (Consultant, Cloudburst Group)

Research Analyst: Darin Christensen (Stanford University, Cloudburst Group)

Survey Firm: StatView International

The evaluation team recommends working with StatView, Guinea for the data collection effort. StatView is a data collection firm with high capacity and extensive experience working on research projects for development agencies and academic institutions. They have conducted large surveys – including the widely respected Afrobarometer – and have the advantage of being able to mobilize a large group of well-trained enumerators and sociologists to conduct surveys and qualitative research.

9.0 DELIVERABLES

BASILINE REPORT

We plan to complete a baseline report by March 2015. The baseline report will provide rich descriptive data on communities in the study area, and will flag any potential imbalances across treatment groups. The baseline report will also include a data analysis plan for the impact evaluation (created after examining the distribution of variables in the baseline survey); this will include a plan for creating indicators, scales and indexes from the individual questions and data sources.

FULLY DOCUMENTED DATA SET AND CODEBOOK

Following each round of data collection, we will deposit a fully documented data set and codebook for the quantitative and qualitative data sources, with all identifiers removed, with USAID within three months after data collection (i.e., by mid-January 2015 for the baseline)...²² This data set and codebook can then be made public.

IMPACT EVALUATION REPORT

We will prepare impact evaluation reports within three months of the receipt of the midline and end-line survey results. The impact evaluation report will report the effects of the treatments versus controls on each of the outcomes of interest. In addition to investigating average treatment effects, the report will also include a discussion of heterogeneous treatment effects. The analysis in the impact evaluation report will follow the plan outlined in the baseline report.

JOURNAL ARTICLES

The evaluation team expects to publish at least two peer-reviewed journal articles within two years of the completion of baseline data collection.

PRESENTATIONS

The evaluation team will draft at least two presentations for different audiences (e.g. policy makers, academics, etc.) based on the evaluation research.

DISSEMINATION

All reports, data, and survey instruments are subject to review by LTD prior to release. When cleared for public release, documents and data will be available on the LTPR portal (<http://usaidlandtenure.net/>) and will also be submitted appropriately to the USAID Development Experience Clearinghouse (DEC).

We plan to share the results via presentations to a variety of stakeholders, including development partners and academic audiences. Given approval from USAID Mission and LTD, the evaluation team

²² Assuming the evaluation adheres to the scheduled midline and end line timeframe, the documented data sets for the mid-line and end line surveys would be ready by January 2017 and January 2019, respectively.

will collaborate with the implementing partners to ensure that the data will be presented to local stakeholders and communities in a culturally appropriate manner. In particular, the final reports for each stage of the evaluation will be translated in French and shared with the MMG. Results will be also shared with development experts in the US, including a presentation at USAID in Washington, D.C. In addition, we will present the results at academic and policy conferences and publish at least two peer-reviewed journal articles based on the research.

In Forecariah, the PRADD II team will play a major role as a conduit for public information and awareness surrounding the IE baseline activity. In the control areas of Kindia, StatView will be responsible for clearing the study through the necessary authorities.

10.0 REFERENCES

- Athey, S. & G. W. Imbens. (2002). Identification and Inference in Nonlinear Difference-In-Differences Models. *NBER Technical Working Papers 0280*, National Bureau of Economic Research, Inc. <http://onlinelibrary.wiley.com/doi/10.1111/j.1468-0262.2006.00668.x/abstract>
- Bertrand, M., E. Duflo & S. Mullainathan. (2004). How Much Should We Trust Differences-in-Differences Estimates? *The Quarterly Journal of Economics*, 119(1), 249-275. [http://www.catchword.com/cgi-bin/cgi?ini=bc&body=linker&reqidx=0033-5533\(20040201\)119:1L249;1-](http://www.catchword.com/cgi-bin/cgi?ini=bc&body=linker&reqidx=0033-5533(20040201)119:1L249;1-)
- Besley, T. (1995). Property Rights and Investment Incentives: Theory and Evidence from Ghana. *Journal of Political Economy*, 103(5), 903–937. Retrieved from <http://ideas.repec.org/a/ucp/jpolec/v103y1995i5p903-37.html>
- Besley, Timothy & Case, Anne, 2000. "Unnatural Experiments? Estimating the Incidence of Endogenous Policies," *Economic Journal*, Royal Economic Society, vol. 110(467), pages F672-94, November. <http://www.blackwell-synergy.com/servlet/useragent?func=synergy&synergyAction=showTOC&journalCode=ecoj&volume=110&issue=467&year=&part=null>
- Blundell, Richard & Macurdy, Thomas, 1999. "Labor supply: A review of alternative approaches," *Handbook of Labor Economics*, in: O. Ashenfelter & D. Card (ed.), *Handbook of Labor Economics*, edition 1, volume 3, chapter 27, pages 1559-1695 Elsevier. <http://www.sciencedirect.com/science/article/B7P5V-4FPGMDP-8/2/dc5d9dbc9d6ea0476c9c625f38c9411a>
- Caeyers, B., N. Chalmers, and J. De Weerd. 2009. A comparison of CAPI and PAPI through a randomized field experiment. Draft paper. Oxford, UK: Oxford University
- Chirico, Peter .G., Malpeli, K.C., Van Bockstael, Mark, Diaby, Mamadou, Cissé, Kabinet, Diallo, T.A., and Sano, Mahmoud, 2012, Alluvial diamond resource potential and production capacity assessment of Guinea: U.S. Geological Survey Scientific Investigations Report 2012–5256, 49 p. (Available online at <http://pubs.usgs.gov/sir/2012/5256/>.)
- Clausen, Fabian, Maria Laura, Barreto, Amir, D Phil Attaran. 2011. "Property Rights Theory and the Reform of Artisanal and Small-Scale Mining in Developing Countries." *Journal of Politics and Law*. 4(1): 15-26.
- Deininger, K., Ali, D. A., & Alemu, T. (2011). Impacts of Land Certification on Tenure Security, Investment, and Land Market Participation: Evidence from Ethiopia. *Land Economics*, 87 (2), 312–334. Retrieved from <http://le.uwpress.org/content/87/2/312.abstract>
- Deininger, K., & Chamorro, J. S. (2004). Investment and equity effects of land regularisation: the case of Nicaragua. *Agricultural Economics*, 30(2), 101–116. doi:10.1111/j.1574-0862.2004.tb00180.x
- Fisher, Elenor. 2007. "Occupying the Margins: Labour Integration and Social Exclusion In Artisanal Mining in Tanzania." *Development and Change* 38(4): 735–760.

- Holden, S. T., Deininger, K., & Ghebru, H. (2009). Impacts of Low-Cost Land Certification on Investment and Productivity. *American Journal of Agricultural Economics* , 91 (2), 359–373. Retrieved from <http://ajae.oxfordjournals.org/content/91/2/359.abstract>
- Jacoby, H. G., Li, G., & Rozelle, S. (2002). Hazards of Expropriation: Tenure Insecurity and Investment in Rural China. *American Economic Review*, 92(5), 1420–1447. doi:10.1257/000282802762024575
- Kalton, G. (2009). Designs for surveys over time. In D. Pfeffermann and C.R. Rao (Eds.), *Handbook of statistics: Vol. 29A. Sample surveys: Design, methods, and applications*. Amsterdam: Elsevier.
- Lahiri-Dutt, K 2004, 'Informality in mineral resource management in Asia: Raising questions relating to community economies and sustainable development', *Natural Resources Forum*, vol. 28, no. 2, pp. 123-132.
- Maconachie, Roy and Gavin Hilson. 2011. "Safeguarding livelihoods or exacerbating poverty? Artisanal mining and formalization in West Africa." *Natural Resources Forum*. 35: 293–303
- Nyame, Frank K. and Joseph Blocher. 2010. "Influence of land tenure practices on artisanal mining activity in Ghana." *Resources Policy*. 35: 47-53.
- Okoh, Godfried and Gavin Hilson. 2011. "Poverty and Livelihood Diversification: Exploring the Linkages Between Smallholder Farming and Artisanal Mining in Rural Ghana." *Journal of International Development*. 23: 1100-1114.
- Raudenbush, S. W., et al. 2011. *Optimal Design Software for Multi-level and Longitudinal Research (Version 3.01)* [Software]. Available from www.wtgrantfoundation.org.
- Rozelle, S., & Swinnen, J. F. M. (2004). Success and Failure of Reform: Insights from the Transition of Agriculture. *Journal of Economic Literature*, 42(2), 404–456. doi:10.1257/0022051041409048
- Siegel and Veiga. 2009. *Resources Policy : Vol 34. Artisanal and small-scale mining as an extralegal economy: De Soto and the redefinition of "formalization"*. Elsevier.
- Spybrook, J., Bloom, H., Congdon, R., Hill, C., Martinez, A., & Raudenbush, S. (2011). *Optimal Design Plus Empirical Evidence: Documentation for the "Optimal Design" Software* (pp. 0–215). Retrieved from [http://www.wtgrantfoundation.org/File Library/Resources/OD-Documentation-V3-0-10-17-11x--2-.pdf](http://www.wtgrantfoundation.org/File Library/Resources/OD-Documents/OD-Documentation-V3-0-10-17-11x--2-.pdf)
- Tongco MDC. 2007. Purposive sampling as a tool for informant selection. *Ethnobotany Research & Applications* 5:147-158.
- USAID. (2014a). *Property Rights and Artisanal Diamond Development (PRADD) II Diagnostic Study of Property Rights and Artisanal Diamond Mining in the Prefecture of Forecariah*. Washington, DC.
- USAID. (2014b). *Property Rights and Artisanal Diamond Development (PRADD) II Work Plan Year 1: May 2014 - April 2015*. Washington, DC.

U.S. Agency for International Development
1300 Pennsylvania Avenue, NW
Washington, DC 20523
Tel: (202) 712-0000
Fax: (202) 216-3524
www.usaid.gov