

Mining Impact Tracking in Guinea

Sustainability Management Capstone Workshop - Spring 2020

Research and writing for this paper completed by
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Management Masters of Science Program under
the guidance of Professor Lynnette Widder.

Client



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EXECUTIVE SUMMARY

This report is a record of work completed in the 2020 Spring semester by capstone students in the Masters of Sustainability Management degree program of Columbia University. The work includes the study of current conditions, baseline research, the use of GIS (geographic information system) mapping and extensive interviews, all of which culminates in stakeholder mapping and scenario planning for community-based environmental impact assessment of bauxite mining in Boké, Guinea. These findings are intended to form the foundation for a new two-year funded research project co-sponsored by the Earth Frontiers Seed Grant of Columbia's Earth Institute, and the UN Development Programme in Guinea, which will receive the research findings. The proposed research intends to develop a community mobile application-based technology that allows inhabitants of Boké to locate, record and map visible impacts of bauxite mining -- in particular ore-containing red dust that extraction and transportation may propagate. Our report is addressed to the United Nations Development Programme in Guinea.

Bauxite is the mineral from which aluminium is refined. Guinea has the world's largest bauxite deposits and its mining industries are expanding rapidly with the distribution of new mining concessions. Mining operations is the second largest economic sector in Guinea (after agriculture), contributing 26% of its GDP. However, environmental, social and economic safeguards, especially for local populations, remain inadequate due to a (i) gaps in environmental and social impact reporting by certain mining companies and (ii) lack of resources for environmental monitoring and enforcement in government agencies. As a result of the mining impacts, the health and livelihood of many Guineans are affected, and increasing incidents of mining-related social unrest and strikes have proven disadvantageous

to both local populations and mining operations. By improving the transparency and reliability of environmental impact tracking, there is an opportunity to establish improved conditions for all parties and to build capacity for good natural resource governance practices.

In preparation for this report, our research focused on three main categories: (i) Background research - providing an overview of bauxite mining in Boké, Guinea with focus on health impacts, community characterization and communications context, (ii) Strategic approach, highlighting possible partnerships with mining companies strengthening their corporate sustainability policies, and local NGOs leveraging existing community projects, and (iii) Methodological and analytical approach, utilizing Geographic Information Systems (GIS) technology and citizen science precedents. From this research, we have distilled three key opportunities:

- 1** Mining companies may contribute positively to the communities in which they operate on many levels, for example, by building infrastructure such as hospitals and waterways. Yet those actions are often ad hoc in nature, negotiated with local town authorities rather than managed holistically, and do not directly address the damage that mining operations are causing by dispersing dust. Community-Based Environmental Impact Tracking offers an opportunity for mining companies to directly address their environmental impacts, create transparency and trust within local communities and lay the groundwork for a functional grievance system that can mitigate against violence and disruption. Fundamental changes to mining operations may prevent environmental damage altogether and improve community

relations. In addition, significant international funds earmarked for sustainable development may be available to companies that distinguish themselves as good actors.

2 There is an opportunity to leverage Guinea's high mobile phone penetration (92%), growing 3G/4G penetration and existing community-powered Geographic Information System (GIS) platforms for community data collection in Guinea. Maps and geographical datasets have been produced by a variety of different international organizations and can be used to orient data collection in Guinea. We identified available datasets that can serve as a basis for the creation of new maps and other GIS products -- chiefly mining plot data from the Ministry of Mines and the Sentinel satellite, as well as publicly available maps from nonprofits such as humanitarian organization Open Street Maps. However, the quality of the information is dependent on the quality of the process itself. This report identifies potential partners as well as past and current projects that can model these benefits and practices.

3 Given these similar citizen-science projects in Guinea, including at least one directed specifically at increasing capacity at the Ministry of Environment, there is an opportunity to adopt a collaborative approach, leveraging existing stakeholders to forward the objectives of this research project. Local NGOs play a critical role in community empowerment, and they are highly trusted entities among the local communities. However, for many reasons discussed in this report, the scope of their work is often limited in reach. There is much potential for their work to be scaled up.

To facilitate a collaborative approach, we have identified and created profiles for each stakeholder group, highlighting their key motivations and disincentives. Using these profiles, we have designed seven distinct implementation scenarios for introducing a community application-based technology for environmental impact tracking in the Boké. For each scenario, attention was given to the flows of finance and information respectively. Economic sustainability, verification

of information collected and appropriate checks and balances on the processing and access to information were the primary criteria for evaluation. In several cases, the attempt was made to build upon current high-functioning structures. Of these scenarios, we would like to recommend the one entitled "Technologically Versatile and Structurally Connected" as it was perceived to be the most practical and aligned with each stakeholders' needs and motivations. A thorough description of these scenarios is found in the concluding portion of this report. All interviews and information mapping in support of these scenarios is collected in the appendix.

Travel prohibition due to COVID-19 and political unrest in Guinea in spring 2020 unfortunately led to a missed opportunity for the group to conduct a site visit to Guinea and to verify some of the assumptions made in the stakeholder profiles and scenarios, as well as to cultivate some of the potential partners the team had identified in Conakry and Boké. Future work could focus on verification of assumptions and refining the scenarios based on more in-depth discussions with the stakeholders.

CAPSTONE TEAM

Aditi Bansal holds a B.S. in Chemical Engineering and Development Studies from the Ohio State University. She is currently a Master's candidate at Columbia University, studying Sustainability Management with a focus on climate justice. She is in the process of exploring a PhD in Climate Migration, Social Justice and International Policy.

She is a co-founder of a nonprofit and a social enterprise, where she worked on the grassroots level to combat gender inequity and food insecurity, in collaboration with civil society organizations, educational institutions and local government. She also has experience in the private sector as a data analyst and consultant.

Julia Bontempo's background in Industrial Design and Anthropology has enabled her to work in development and research roles for a variety of sustainability related projects, including low-waste homegoods, beehives, recycling programs, and building materials. Currently, she is researching urban heat islands in New York City and the social and physical vulnerabilities of the city and its buildings.

Julia holds a B.A. in Industrial Design from University of Notre Dame.

Savita Bowman has a background in business analytics with three years of experience working in the sustainable energy industry. At Tesla, Inc, she conducted asset management and financial risk mitigation for solar and storage energy products. She coordinated between the various departments including engineering, operations, permitting, and fund portfolio management to implement solutions. She later managed and trained up to 50 team members to conduct risk assessments, in addition to developing a closed-loop system that utilized client feedback to address internal process gaps.

Savita holds a B.S. in Environmental Studies from the State University of New York College of Environmental Science and Forestry (SUNY – ESF), with a minor accreditation in Management from Syracuse University. She is currently completing her M.S. in Sustainability Management at Columbia University.

Vanessa Douer began her career in marketing and advertising analytics at ActionX, later acquired by WPP, the largest advertising company in the world. She was an early entrant in the shift of consumers from desktop to mobile computing. The team Vanessa managed serviced key client verticals and was responsible for over 8 million dollars in revenue.

She went on to work for UBQ Materials where she was able to use her analytical and customer knowledge in a project that promises to transform the world. UBQ is an Israeli start-up that converts household waste, including 100% of the organics, into a bio-based thermoplastic material that can substitute plastic and wood in thousands of applications. It was at UBQ that Vanessa became focused on sustainability and the Circular Economy. Vanessa holds a B.A in History from the University of Pennsylvania.

Nick Kracov began his career at Environmental Financial Products, LLC researching emerging environmental markets and analyzing their daily trading activity. He then spent two and a half years in the project development group at Invenergy, a privately-held developer, owner, and operator of wind, solar, battery storage, and natural gas assets. Nick is currently a Co-Portfolio Manager at Molecule Ventures, a boutique ESG investment fund.

Nick received his B.S.M. with cum laude honors from Tulane University in 2015 with minors in both Legal Studies and Portuguese, and expects to receive his M.S. in Sustainability Management from Columbia University in May 2020.

Cynthia Leung is a Master's Candidate in the Columbia University Sustainability Management Program and holds a B.A. in Quantitative Economics and a minor in Global Sustainability from University of California, Irvine. She currently serves on the Sustainability Management Student Association as VP of Community Outreach and on the Women & Sustainability Board as Director of Initiatives.

She is starting a social enterprise to build a solar charging station for disaster relief purposes. She recently completed the 2020 Rockefeller - Acumen Student Social Enterprise Accelerator and is a Clinton Foundation CGI U Commitment Maker. Last summer, she interned with the Clinton Foundation with the Clinton Climate Initiative and focused on their Islands Energy Program.

Prior to Columbia, Cynthia was a Project Development Manager on the Utility team at SunPower where she worked on developing over 1 GW of solar projects over 6.5 years. She was a Professional Mentor and Impact Coach for the TechWomen Program and is a Certified Mentor under the Mentoring Standard. She has hosted over a dozen trainings and talks on sustainability, communication, and mentorship in four countries.

Gregoire Mazars is a former energy consultant for British firm Sia Partners, where he advised utilities on how to protect vulnerable customers and provided market research to global groups (Total, Shell, Macquarie). Prior to that, he has interned for energy ventures and research centers in the U.S. Gregoire has been working as a pro bono consultant while earning his Master's Degree in Sustainability Management from Columbia University since January 2019.

Simone O'Sullivan holds a B.Econ and a B.Commerce from the University of Queensland, Australia. She is currently a Master's candidate at Columbia University with a focus on renewable energy and the circular economy. She developed her consulting business over the last 5 years and has consulted to a number of US, Canadian and Australian based SMEs primarily around climate change policy, carbon footprint and renewables. Prior to this she ran a renewable energy fund for the Victorian state government in Australia, worked in a Vietnamese Jatropa ,biofuels startup and wrote climate policy for Origin Energy, one of Australia's leading energy providers.

She was the co-founder of the New York chapter of the Circular Economy Club and aims to focus on bringing new climate and circular economy technologies to market.

Julian Tung began his career in media marketing as well as freelance photography. Through his travels, he began making films focusing on the environmental degradation caused by corporate institutions, in the efforts of spreading awareness about the marginalised communities and wildlife affected. He holds a B.A. Sustainable Development from Columbia University. He is currently completing his M.S. in Sustainability Management at Columbia University.

Meng Yi Bay started his career in the Singapore National Environment Agency and Ministry of Environment & Water Resources, where he took on different roles in operations and policy. In his last position, he led a team in the Environmental Protection Policy Department. He played a paramount role in the development of several key policies, such as Singapore's position on circular economy, food waste master plan and Extended Producer Responsibility for packaging.

He graduated from National University of Singapore in 2009 with a Degree in Chemical and Biomolecular Engineering and a minor in Technopreneurship. He is currently doing his Master of Science in Sustainability Management at Columbia University.

INTRODUCTION

This report forms the foundation for the research project co-funded by the Earth Institute and the United Nations Development Programme in Guinea. The two year research project, beginning in January 2020, will see the development of an application-based technology, coupled with satellite photography, that will allow community members and other appropriate actors in the field to record, geo-locate, and map visible impacts of bauxite mining through their mobile phones, in particular the spread of red dust pollution.

The United Nations Development Programme (UNDP) is focused on eradicating poverty and the reduction of inequalities and exclusion through capacity building. Its signature programs include support of integrated climate change strategies, advancement of cross-sectoral climate resilient livelihoods, ecosystem-based adaptation, fostering resilience for food security, climate resilient integrated water resource and coastal management, and promotion of climate resilient infrastructure. UNDP adopts a partnership approach, partnering with public agencies, private companies, and civil societies to promote sustainable development. UNDP is based in some 170 countries. Its Guinea office is in the capital city of Conakry.

Guinea has the world's largest sources of bauxite deposits and its mining industries are expanding rapidly without the necessary safeguards against the mining impacts on the communities. The specific region of Boké is home to most bauxite mining operations. Mining impacts on the local communities have proliferated since 2016 changes in tax regimes to support the mining sector.

Lax mining practices and ore transportation in open trucks and train cars has resulted in red dust pollution. This dust is widely dispersed, polluting the waterways and air, affecting the food crop farming, water quality and health problems. Noting that many Guineans rely on farming for their livelihood, it seems clear that the deterioration of the environment has had a detrimental impact on the local economy. Red dust infiltrates water bodies and flows and renders them toxic, while destroying the crops these bodies irrigate.

There is a perceived lack of political will to take strong measures against the mining companies that breach their environmental obligations. Public agencies that oversee the mining industry are also underfunded and unable to carry out the necessary monitoring and enforcement duties. Mining operations, which contribute 26% to Guinea's GDP, have been disrupted by civil unrest as a direct response to the negative

impacts of mining. A 2018 strike, for example, incurred losses of a million USD per day for one of the mining companies.

This research project intends to develop and pilot a community mobile application-based technology that allows inhabitants of Boké to use and contribute to digital imagery that tracks the presence of red dust.

This report aims to provide the research foundation for future research project teams; chiefly, it comprises short literature reviews of key topics and a stakeholder mapping exercise for the relevant region. In its Appendix, this report provides summaries of over 20 interviews that the team conducted across a wide array of stakeholders and actors. All material generated by the team ultimately informed seven propositions for implementations of an app (“scenarios”), which is in the last section of this report. These scenarios are based upon the flows of information and funding, and the level of trustworthiness (from the Guinean public to the institutions involved) that these scenarios provide.

1. Research Findings

The following reports have been prepared by individuals in the Capstone team. Each topic discusses essential supporting information required to determine other outcomes of the report -- that is, the stakeholder analysis and the implementation scenarios. They have been arranged in order to address the fundamental issues first, the context for Guinean life and then more specific issues related to relevant technologies and their precedents in citizen science.

The first two reports discuss human health and environmental and social impacts of bauxite mining and the extent to which they are currently reported in Guinea. The next two, context to relevant stakeholders and aspects of Guinean life; namely, communities (women and youth) and NGOs. The last three reports are relevant to the implementation of the app: the role of communications and technology in Guinea, citizen Science precedents and geographical information systems (GIS) technology in Guinea.

- 1.1 Health Impacts of Bauxite Mining in Boké Region
- 1.2 ESI and CSR Reporting by the Bauxite Mining Industry
- 1.3 Local Non-Governmental Organization (NGO) Landscape in Guinea
- 1.4 Community Characterization
- 1.5 Communications and Technology Context
- 1.6 Citizen Science Precedents and Case Studies
- 1.7 Utilization of Geographic Information Systems and Data Collection Technology to Map Environmental Impacts in Boké, Guinea

1.1 Health Impacts of Bauxite Mining in Boké Region

A literature review of bauxite mining related health impacts across the world

Abstract

Our report considers the impacts of bauxite mining, and its related activities, on human health. The scope of our project centers around the Boké region of Guinea in West Africa where we reviewed other studies to determine the possible health risks from near-by bauxite mining activities. Noting limited health data directly related to bauxite mining in Guinea and the cumulative impact of bauxite on human health, this review incorporates a broad range of international studies and historical health data.

Summary of Findings

- Bauxite dust exposure as a result of bauxite mining activities is a risk to human health.
- The health risk of bauxite is associated with respiratory disease, cardiovascular illness and gastrointestinal issues with cumulative impacts over a long period of time. With the limited studies available it appears that cancer is not a significant issue.
- It may take many years for the health impacts of bauxite exposure to fully arise.
- Impacts will persist until the land is rehabilitated after mines have closed. However, there are no plans to close the mines in the near future and clear rehabilitation plans are not available for the Boké area.

Recommendations

Based on this review, we recommend a number of actions to help to promote the health and well being of communities in the Boké region:

1. Dust from Guinea mining activities should be tested for other substances that may also be harmful to human health.

2. Health workers in Guinea to be trained to understand the long term impacts of bauxite dust exposure.
3. Guinean health records could identify cases of bauxite related health issues so that data can be tracked over time. We acknowledge that this is not possible with the current data tracking process for the health system at this time.
4. If and when training and accurate data is available, actions for minimising the impacts of bauxite dust on the population could be created.
5. Bauxite dust should be minimized by the mining companies in their daily operations.

Research Findings

This review focuses specifically on the direct human health impacts of bauxite mining activities i.e. what happens to the human body when it is exposed to dust, chemicals, and other outputs from bauxite mining.

The review does not cover the indirect impacts that have a secondary impact on human health such as economic impact from lower crop yields; reduced income, food scarcity and mental stress. Abdullah provides an excellent graphic descriptor of the many activities and impacts felt by bauxite mining in this region.¹ It describes five categories of impacts from mining operations. This review focuses on the short, medium, and long term impacts on human health as well as natural disasters and related diseases.

Another study from 1987 in Jamaica summarised the overall impacts of bauxite mining.² The removal of top soil and vegetation had the most significant impact on human health due to damage to and loss of crops, polluted water, clothing, furnishings

and respiratory issues.

Background

The development of Guinea's bauxite mining began in the 1970s but has increased exponentially over the past 5 years with the successful Société Minière de Boké (SMB) joint venture in 2014 of Winning Shipping, a Singaporean maritime firm, and UMS, a Guinean logistics firm and Shandong Weiqiao, a Chinese aluminium producer.

The timing coincided with the 2015 banning of bauxite mining by the Malaysian government due to the burden of environmental damage and public health problems in Pahang state. This increased the international focus on bauxite mining in Guinea and created a significant increase in mining operations. There are a number of other large mining company consortia in the Boké region including Compagnie des Bauxites de Guinée (CBG), Russal and Guinea Alumina Corporation (GAC), all of whom have similar mining practises to SMB.

Understanding How Bauxite Mining Pollutes

Bauxite rock contains 60-70% aluminium and ferric oxide, 5% silica, and the rest is usually clay.³ Bauxite dust is red in colour due to high iron oxide content. It mostly occurs near the soil surface with deposits usually 4–6 meters thick under an overburden of up to 10 meters thick. Thus open cut mining is most prevalent. However it is the associated activities with the mining that also cause pollution: site clearance and road building, open-pit drilling and blasting, loading and haulage, vehicular movement, ore and waste rock handling.

Human Rights Watch reported that an estimated 4000-5000 SMB trucks travelled on roads from mines in Boké throughout the day and into the night, 7 days per week.⁴ It also reported that these 50 tonne trucks travel in convoy on unpaved roads that crush and stir up a very significant amount of dust. CBG transports its haulage by rail but the rail boxcars are uncovered, allowing dust and dirt to escape from the moving trains.

As reported by Human Rights Watch, there are many communities around these roads who are being exposed to dust and transport emissions from road and rail.

Health Impacts

Donoghue studied a range of potential health impacts associated with bauxite mining and alumina refining.⁵ It referred to a number of other reports including one by Townsend that used a cross section of data for workers who were employed at a US based mining site, alumina refinery and an alumina based chemical plant between 1975-1981.⁶ Health impacts were studied for workers who had high exposure for 20 or more years. It found that lung function was reduced compared with the general public statistics. However as Donoghue reported, there was no distinction between exposure to bauxite dust, alumina or caustic mist, which was a significant weakness of this report. It noted that the most important health risks for workers are not from the bauxite itself

but from noise generated from mining equipment and activities such as blasting, as well as ergonomic and trauma injuries from physical labour.

Another study looked specifically at cancer rates and bauxite exposure of workers. Fritschi used statistical analysis of data from 6,485 employees working in bauxite 3 bauxite mines, 3 alumina refineries and 2 smelters in Australia for 19 years from 1983 to 2002.⁷ Data was based on employment and health records for 19 years from 1983 to 2002. Although the report acknowledges that the statistical sample was small and interpretation must be performed cautiously, it found that the rates of cancer and mortality for the study group was no different to the general population.

These reports provide a positive outlook for the Guinean people. However they are limited in three significant ways:

1. Western world operations, where the health and safety standards are much higher than the standards currently employed in Guinea, suggest lower particulate matter in air than in Guinea. In response to the statistically significant results from the Townsend study, Donaghue notes that “the exposures [of the 1975 - 1981 workers] were clearly much higher than those typically sustained during contemporary bauxite mining,” indicating that modern practises lower the risk of negative symptoms from bauxite exposure.⁸ However, Guinea mining operations do not operate with ‘modern’ health and safety standards, and thus those high exposure rates experienced in 1975 - 1981 in the US test cases may still be prevalent in Boké mining operations.
2. Mining workers were only exposed during the working hours, compared with Guinean communities surrounding the mines who live with constantly high exposure rates on a 24 hour basis. This worsened during the dry months of the year.
3. These studies provide no analysis of public health issues, which

Bauxite operation site,
AlCircle.com



can be significantly different to workers. The mines studied in these reports are situated in remote locations, away from human activities. Therefore public health concerns have not been discussed.

Malaysia provides a comparative case study of the public health impacts of bauxite mining. Once China's biggest supplier of bauxite, Malaysia banned bauxite mining in 2015 when unregulated mining practices created extreme water and air pollution for local neighboring communities and the city of Kuantan with a population of more than 400,000. The government lifted the moratorium in March 2019 with the introduction of standard operating procedures around bauxite transportation and compulsory EIAs.

Abdualla reports on both the health and environmental impacts of bauxite mining activities in Malaysia, which are in close proximity to the general public including schools. The report notes that there has been a 'steady increase' in asthmatic and respiratory issues in 2015 health data compared with the previous year.⁹ More work is currently being done to understand the causality of this increase.

Fine particulate matter has been the focus of many health studies over the years. Abdulla refers to the study by Pope which studied 1.2 million American adults' health data and air pollution exposure from 1982 - 1998.¹⁰ It concluded that long term exposure to 'combustion-related' fine particulate matter had causal links to heart and lung cancer. Bauxite dust was not a factor in this report, however the particulate matter from road transport is of significant concern and relevance to Boké.

The World Health Organisation recognises that fine particulate matter is a serious risk to public health and links it to respiratory and heart disease. The WHO Air Quality Guidelines state that the finer the particulate matter the higher the risk of health concerns.¹¹ This is due to the fact that the smaller the particulate, the deeper they it can go into the lungs and airways and cannot be removed. Bauxite dust is below the acceptable ranges of the WHO Air Quality Standards of PM10 to PM2.5.

Mining Operators Actions

CBG addressed the health impacts of bauxite mining in its Environmental and Social Impact Assessment regarding its MTPA expansion project. It undertook its own air quality monitoring, although the results were not made publicly available. It acknowledged that the air quality was below WHO standards and that "it could increase the risk of health effects on the respiratory system."¹²

CBG agreed to address air quality issues from current and future operations, and to work with local communities. This is still a work in progress. Please refer to the section "Environmental and Social Impacts Reporting by the Bauxite Mining Industry in the Boké Region, Guinea" by Aditi Bansal in this report for more information.

Guinean Health Records and Standards

According to the Guinean 2018 Health report, respiratory issues are

ranked first for hospitalisation and death, more than Malaria and other diseases.¹³ However, this ranking is misleading - the primary reason being that Malaria education and prevention is increasing, and thus related deaths are reducing. Respiratory illness is also a catch-all classification, associated with many other illnesses and no data is readily available to distinguish between the underlying causes of the respiratory illnesses.

Human Rights Watch lamented the fact that there is a severe shortage of hospital and medical data in the country.¹⁴ More studies and data are needed to quantify the impact of bauxite in relation to chronic physical illness. Slow development of diseases may appear many years later if the current risk is not properly addressed and controlled. An interview with Dr. Barry of the Guinean Ministry of Health revealed that since there were many serious illnesses facing the population, health statistic collation for bauxite dust is simply not a focus issue for the Ministry of Health. The limited resources and data collection process only allows for the reporting of the most significant health issues - such as the early warning system for the outbreak of Ebola. This is communicated through hospitals and clinics in a passive way to the Ministry. One of the scenarios for the implementation of the Mining Impact Tracking application uses the existing health data collection process as a basis for bauxite data collection.

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1.2 ESI and CSR Reporting by the Bauxite Mining Industry

A literature review of environmental reporting in the Bauxite Mining Industry

Abstract

Corporate Sustainability Responsibility (CSR) is a voluntary program that a company adopts to improve its transparency and accountability regarding economic, social and environmental issues. In a broad sense, a company which adopts CSR principles should include in its practices such benefits to society as social programs, volunteerism, philanthropy and environmental initiatives. CSR is being adopted by an increasing number of companies globally due to growing social pressure and a shift towards long-term investment horizons. By partnering with local communities to fund pilot projects such as the Community-Based Environmental Impact Tracking For Bauxite Mining In Guinea, mining companies can create long-term investments that benefit the community overall, and gain traction within the CSR movement.

At the same time, as part of the push for transparency and accountability, governments are also mandating Environmental Sustainability Impact Assessments (ESIA). Guinea has seen an abundant interest from international mining companies that are looking to exploit the resources that Guinea has to offer. The companies focused on mining within the Boké region include, La Société Minière de Boké (SMB), la Compagnie des Bauxites de Guinée (CBG), and the Guinea Alumina Corporation (GAC). In order to understand the scope of environmental and social impact of mining on the Boké region, we reviewed the Guinean government's environmental reporting requirements and the available environmental reports produced by these mining companies. Additionally, we conducted a literature review to understand the overall impact of bauxite mining on the environment, focusing on scientific articles from a global perspective.

Research Findings

Reporting Background

In a series of interviews conducted by Human Rights Watch in 2018, Boké community leaders were outspoken when discussing the threats to health and air quality that the mining industry represented. Additionally, it was noted by local health officials that there is a lack of data collection regarding air quality and inadequate local health statistics, both of which are needed to make the necessary health assessments of the population to enact policy changes.

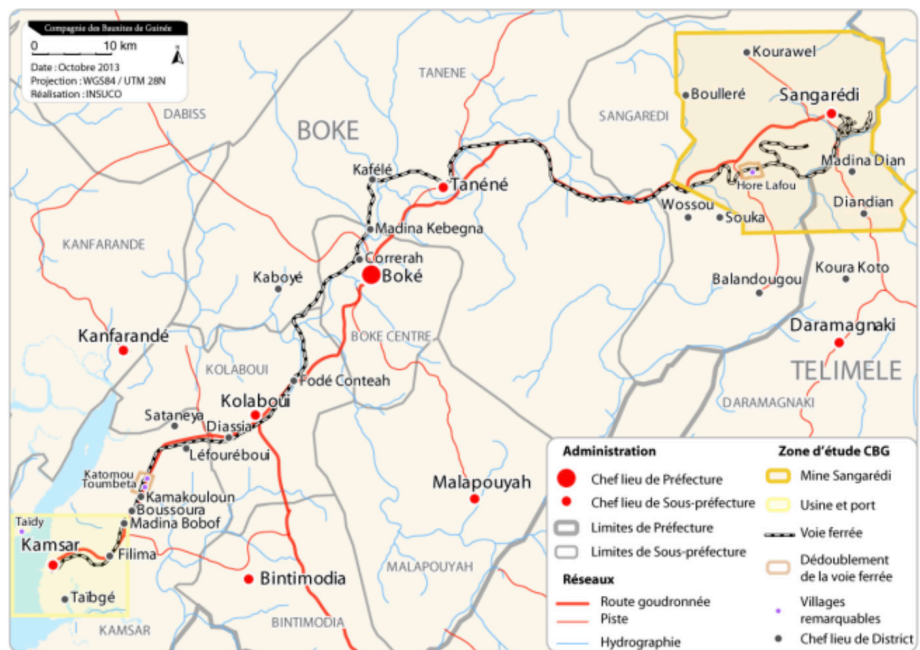
Although several mining companies promote CSR projects on their websites, Human Rights Watch interviews reveal that the companies fail to promptly or meaningfully respond to complaints about bauxite mining's impacts on the land, livelihoods, health and water sources of locals.¹ SMB even conducts regular meetings with local communities but is alleged to pursue no further meaningful actions beyond this.

ESIA reports by the mining companies in Boké are very limited. Firstly, there are only two ESIA reports publicly available. CBG and Alufer Mining Company have produced reports but there is nothing publicly available from other major mining companies. The reports that are available have no historical data, which limits the understanding of the growth and magnitude of impacts and provides no basis for comparison

CBG EISA

The assessment produced by CBG was for a mining operation in the Sangaredi sub-prefecture in Guinea, established in 2013. This report was comprehensive, with baseline studies conducted to collect data on air quality, ambient noise, surface and groundwater quality, sediment quality and soil quality. It included biodiversity mapping within the region with a consideration for impacts on valued ecosystem components, and biological

Map of CBG's Project Area.



resources, such as estuaries and woodfuel. Lastly, a socio-economic baseline study was conducted inclusive of qualitative and quantitative research to delineate existing social structures, infrastructures and demographics. All the data from baseline studies was used to corroborate the impact on the Sangarédi region and suggest mitigation strategies for each one of the impacts.²



Map of Alufer's Project Area.

Alufer: The Bel Air Bauxite Mining Project

This ESIA was conducted for the Alufer mining company's project in the Bel Air region. Although the report covers all the areas of impact included in the CBG EISA, it does not encompass comprehensive quantitative data for each of the segments of impact. The report generally outlines the overall impact that the region will face due to the operation. The non-technical report that is publicly available states that details of the assessment, as required by the International Finance Corporation (IFC) Performance Standards, are accessible on IFC's website, however, the links attached on Alufer's Sustainability page do not correspond to any existing material. Therefore, the report is ineffective in understanding and mapping the data collected and the mitigation, management strategies implemented by the corporation.

Environmental Impacts of Mining

As there is a lack of historical data, assessment and reporting available for environmental impacts of bauxite mining in Guinea, a literature review for mining impacts not exclusive to Guinea was conducted. The research studies found were primarily conducted in South and Southeast Asia.

Impact on Native Ecosystems

Research undertaken in the Indian villages of Udgiri, Kolhapur,

Maharashtra with two adjoining bauxite mines found that there were changes in physico-chemical properties of the local soil. Aluminum toxicity was found to be the primary reason for plant growth deterioration. Additionally, the high toxicity negatively implicates microorganism life.³

In Western Ghats of Kolhapur district, another region of India, research found significant impacts on vegetation, small water bodies, biodiversity and forest cover.⁴ Furthermore, blasting and removal of ore caused sediment build up, which decreases the flow rate of rivers that the surrounding towns rely upon for various activities. Similar evidence of environmental impacts by the government owned Kerala laterite mine was found by a preliminary study in the Southern Indian towns of Karinadalam and Kinanur, with additional evidence of degradation of flora and fauna.⁵

Impact on water sources

All studies verified that water sources for different regions with bauxite mining operations are significantly impacted.

Several studies undertaken in South Africa found that acidic water runoff from mining has effects on domestic, industrial, and agricultural users. There is also concern for groundwater pollution due to higher concentration of heavy metals dumped into rivers and other water sources. The high acidity of mining water leads to reduction of aquatic life, contamination of water supply and depletion of ecosystems.⁶ In the region of Eastern Ghats of Andhra Pradesh, India, research displayed similar results with negative effects on surrounding surface and groundwater due to mining water discarding.⁷ Additionally, “communities in the Boké region shared with Human Rights Watch that confiscation of land for mining or mining infrastructure had prevented communities from accessing streams and natural springs where they previously found water, while an influx of people seeking jobs in mines increased pressure on remaining water resources.”⁸ Therefore, mining activities not only pollute the water resources communities rely upon, they also have a detrimental impact on the accessibility of water, which creates additional hardship for people who have to travel further to access water for their daily activities.

Impact on air quality

The processes undertaken to establish a mining operation including excavation, removal of top soil and vegetation, transportation of bauxite and unwanted elements and stockpiling of bauxite cause severe degradation of air quality mainly through dust pollution.⁹ “The World Health Organization (WHO) found that exposure to any fine particle dust, which makes up a portion of the dust produced by mining activities, can cause, trigger or exacerbate respiratory and cardiovascular diseases.”¹⁰

Using CSR to create shared value

Although the ESIA's for the Boké mining companies are lacking the rigor of a credible assessment, all mining companies have the ability

Removal of topsoil for an open mining pit, Zambia.
*Dharni Sampda for
GreenGroundswell.com*



to create shared value, which has been shown to produce long-term benefits.¹¹

Shared value can be viewed as a way to strengthen the resiliency of the local community and environment to ensure that the long-term needs of the community are met. Under shared value principles, communities can continue to prosper even after the mining corporations have exited. Not addressing community and environmental impacts of the mining industry is a liability to company profits and a mitigatable risk.

Steps to creating shared value

1. Identify and prioritize the social challenges that provide an opportunity to increase revenue and/or reduce costs.
2. Make a business case for the potential of value creation in the field of activity chosen by the company, “modeling the potential business and social results relative to cost.”
3. Calculating relative revenues and costs of the proposed model.
4. Measure the resulting impacts on the community from the perspective of the business and community.¹²

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1.3 Local Non-Governmental Organization (NGO) Landscape in Guinea

Local NGOs' Role in Community Empowerment and Engagement

Abstract

This section provides an overview on the local mining-related NGO (non-governmental organization) landscape in Guinea. Based on literature survey, we have identified four NGOs that have been active in the past five years and provided an overview on their role in Guinea. In particular, we focus on the Association for Mines without Poverty and their work because this organization offered their research team access to its data and was amenable to interviews.

Local NGOs play a critical role in community empowerment and engagement, acting as a mediator among the community, government and mining companies. They are perceived as independent and trusted entities by the local communities and their projects are funded by international organizations.

However, due to lack of resources (in financial support and manpower), the scope of their work is often limited in reach. As a result, the role of NGOs may be overlooked in general. There is much potential for their work to be scaled up and much benefit from partnering with them.

Findings

The work of mining-related NGOs in Guinea is not well-documented. Among the NGOs that we surveyed online, many of them are resource constrained and are poorly staffed (fewer than five people, except for CECIDE). In addition, not all of them have a functioning website. The insights from this paper are primarily sourced from the interviews that our team has conducted, supported by secondary information from reports and websites. Transcripts of all interviews are provided in the report appendix.

Local NGOs play a critical role in community empowerment and engagement, acting as a

mediator among the community, government and mining companies. They host community dialogues to document the environmental and social impacts of mining operations and empower the community to take productive action against the mining companies' poor behavior. For example, the Association for Mines without Poverty (AMSP) has worked with international NGO Witness to document evidence of mining impacts through videos and photos.¹ In addition, two local NGOs – the Centre for International Trade and Development (CECIDE) and the Association of Rural Development and Mutual Aid (ADREMGUI) – have filed a complaint against the International Finance Corporation (IFC) on behalf of 13 villages in Guinea, for funding the expansion of the Compagnie des Bauxites de Guinée (CBG) bauxite mine. They are demanding compensation for the environmental damage and land grabbing instigated by CBG.²

One of the key challenges faced by NGOs is access to information. Civil society activists and community leaders have highlighted the lack of transparency in the mining sector, exemplified by the difficulty they face in accessing Environmental & Social Impact Assessments (ESIA), government and company inspection reports, audits and monitoring data. Without these documents it has been difficult to hold mining companies accountable to environmental and social standards.

It is also common for local and international NGOs to work together. Based on an interview with Mr Adebayo Okeowo, Witness Program Manager for Africa, there “are many partners working together” in the same community covering different aspects, for example, community engagement and empowerment (AMSP), documentation of evidence (Witness) and preparation for legal actions against mining companies (Natural

Justice).³ Their main sources of funding appear to be from international donors from the United States and Europe.

Although relations have been contentious in the past due to the NGOs legal actions and publicized complaints against the mining companies and the Guinean Government, there is potential for the relationship between them to improve. Based on an interview with AMSP, the relationship with mining companies has been “bad but is improving” following the release of the Human Right Watch Report in 2018.⁴ Prior to the HRW Report release, mining companies used to view NGOs as an obstacle to their mining operations. However, since that report produced powerful negative publicity, mining companies have been softening their stance against NGOs and looking for ways to collaborate with them. In February 2020, AMSP was invited by the Société Minière de Boké (SMB) to go through their recently completed environment impact assessment study. Similarly, the Guinean Ministry of Environment might also work with local NGOs to conduct ongoing environmental impact assessments. While there is some information exchange between local NGOs and government, both parties currently work independently.⁵ It is possible that greater data collection, transparency and community engagement can promote shared value for all parties and there is some willingness to move in the right direction.

Introduction of Key NGOs

1. Association of Rural Development and Mutual Aid (Association pour le développement rural et l'entraide mutuelle en Guinée; ADREMGUI)

Formed in 2009, ADREMGUI represents the rights of rural communities in Guinea with the following objectives:

1. Strengthening partnerships between the State and civil society organizations.
2. Building capacity to empower local communities to effect positive change to their livelihood and environment.
3. Carrying out conflict prevention and promoting peace and transparency.
4. Supporting sustainable agriculture and mining of resources.⁶

Together with CECIDE, ADREMGUI filed a complaint to International Finance Corporation (the private sector arm of the World Bank) on behalf of 13 villages in Guinea in March 2019 to highlight the environmental and social impacts from mining operations from CBG.20 CBG subsequently replied in a press release that “over the past four years, with the support of its shareholders and the government of Guinea, the CBG has adopted the highest standards at the international level, with the environmental and social performance standards of the International Finance Corporation.”

ADREMGUI's objectives are aligned with the development of the application to empower local communities and promote transparency. Columbia University could work with ADREMGUI to introduce the application to the local communities.

2. Association for Mines without Poverty (L'Association Mines Sans Pauvreté; AMSP)

AMSP was founded in 2013 and is one of the more active mining-related local NGOs in Guinea. Its mission is to improve the transparency of the mining sector with regard to its impacts and to focus on poverty reduction in the affected communities.

One of the key roles of AMSP is to build capacity in communities so as to empower them to protect their human rights. One such project is the "Regional Governance of the Extractive Sector in West Africa" funded by the German Development Cooperation.⁷ In total, the project trained 65 community leaders, including 45 representatives from rural areas and 20 representatives from the urban commune of Boké. The training program is divided into three themes, namely: (i) Rights of communities, (ii) Documentation of impacts and remedies and (iii) Joint monitoring of impacts and advocacy systems. The training workshops led to a multi-stakeholder forum and the formation of a platform responsible for ensuring joint monitoring of the impacts linked to mining operations in Boké. The forum also undertakes collective advocacy actions in favor of localities affected. An educational booklet which summarizes the regulatory provisions of the Mining Code was made available to participants by the project.

AMSP is also working with international NGO Witness to improve participation of affected communities in the Environmental and Social Impact Assessment (ESIA) process. Witness has trained a diverse group of 20 men and women in the region of Boké to document the impacts of mining through photos and videos.²² Witness also provides smart phones to selected individuals. Due to the large amount of data and poor internet connectivity in these villages, community-generated

A member of Association Mines Sans Pauvrete speaks with community members.
ONG Mines Sans Pauvrete, 2020
Facebook



photos and videos will be collected through a flash drive.

3. Même Droits pour Tous (MDT)

MDT is an NGO advocating for the defense and promotion of human rights. It was founded in 2004 by Guinean lawyers and young legal professionals with the aim of combating human rights violations in Guinea.⁸

MDT offers legal assistance to people in conflict with the law and deprived of their liberty; to victims of illegal and abusive detentions; and to people who are victims of various violations of their human rights and who, traditionally do not have access to reparation. This includes victims of torture and gender-based violence. MDT's legal assistance activities are based on three fundamental criteria: i) The gravity of human rights violations; ii) The vulnerability of the victims, and iii) Lack of assistance from other organizations.

In 2015, MDT, together with CECIDE, filed a complaint following the involuntary resettlement of 377 households in the rural area of Kintinian in Siguiri Prefecture by AngloGold Ashanti, a South African based gold mining company. It is the third biggest gold mining company in the world with 21 offices in four continents.⁹ Although AngloGold Ashanti claimed that the households consented, villagers said they were intimidated into signing consent forms; many added they did not understand the contents of agreements they signed. In addition to concerns over intimidation and lack of informed consent, MDT and CECIDE mentioned that most affected villages were never consulted about the resettlement plan. According to the NGOs, the villagers received inadequate compensation for their lost land and the mechanism for resolution of resettlement disputes has not been disclosed to villagers.

While MDT do not have experience in documenting evidence of mining impacts, MDT has experience in engaging the local communities and utilizing the evidence to build a legal case against the mining companies. In the scenario that mining companies are not willing to participate in the development of application, MDT could be part of a bigger consortium of NGOs and other organizations, where MDT focuses on analyzing the data collected and providing legal advice to the consortium. This would put pressure on the mining companies to take actions to mitigate their impacts on the communities.

4. Centre for International Trade and Development (Centre du Commerce International pour le Développement; CECIDE)

CECIDE was founded in 2000 and is a Guinean NGO committed to promoting and protecting the social and economic rights of marginalized populations. It promotes active participation from stakeholders in the public policy process in the areas of governance, mining, peace and security. On mining, CECIDE focuses on the following four areas:¹⁰

1. Promoting protection of rights of local communities vis-a-vis the mining and energy sectors and improving community living conditions.

2. Promoting access to energy; raising awareness and educating people on the issues and impacts of climate change in the development process.
3. Promoting access, knowledge, control and monitoring of mining legislation, mining agreements and conventions by the population and the authorities.
4. Promoting transparency in the management of mining royalties in general and in particular communities.

In addition to projects with MDT and ADREMGUI mentioned earlier under 3.0 and 1.0 respectively of this section, CECIDE conducted a training program in the rural commune of Kintinian prefecture of Siguiri in 2019 to empower locals with knowledge of the regulatory process to which mining is subject.¹¹ Over 100 people were trained in the three day workshop.

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1.4 Community Characterization

Mapping the Role of Youth Activists, Women and Local Communities

Abstract

Our review focuses on the characterization of local communities, including youth activists and women, within the Boké region in Guinea. The local communities of this region live in close proximity to internationally owned bauxite mining companies. Although Guinea is one of the world's largest exporters of bauxite, its exports have yet to result in improved living standards and wealth for its citizens. While Guinea's abundance of mineral resources has not led to civil war, like those which ravaged Liberia and Sierra Leone, it still has not resulted in the strong, stable and transparent institutions necessary for socio-economic development in society.¹

One reason for this discrepancy is that the mining industry is not held accountable for its impacts. The lack of accountability is especially noticeable in communities closest to the bauxite mining activities. Bauxite dust builds up in waterways and chokes vegetation, crops, and water wells along the bauxite transport routes and near mining sites. It destroys the marine ecosystem and agricultural fields near the Boké bauxite port. This portion of the report considers the characteristics of the populations which are most adversely affected by the pollution from mining, how conflict is diffused, and how decisions that impact the community are made.

Research Findings

Background

Prior to the emergence of the bauxite industry, the Boké region was sparsely populated with most inhabitants living in villages, with some villages dating back two centuries.² Over time, international mining companies have employed a significant number of workers from their own home countries. The availability of work has also

attracted migration from other parts of Guinea and other African countries.

The government of Guinea is deeply dependent on revenues from the extractive industry, specifically mining, which accounts for almost 26% of Guinea's GDP.³ In the absence of good governance, local communities obtain limited benefit from the mining industry's activities, and revenues from bauxite mining largely benefit the state and mining companies. The mobile application that is being proposed to achieve transparency in the reporting and grievance process to mitigate the polluting impacts of mining operations will require buy-in from community members. The community would play an important role in utilizing the proposed application technology and could potentially be a source for data gathering in its roll out.

Since none of the team members from this capstone are from Guinea, the team conducted a literature review of available reports on Guinea to build an understanding of existing processes and perspectives that drive community members to action. The objective was to create a baseline understanding of policies and research completed to date on community dynamics and then rely on interviews of people who had worked in Guinea within our community groups.

Mining Sector Contributions to Local Communities

The contrast of the living standards between the workers living within the mining enclave and the majority of Guineans in the Boké living outside it, is crucial to understanding the relationship between company and community. For example, Compagnie des Bauxites de Guinée SA (CBG) prioritized infrastructure development to support its mining activities and CBG employees. Most CBG workers have access to free health care, housing, and 24/7 water and electricity.⁴ On top

of that, some high-level managerial employees are even provided with additional amenities, including refrigerators, stoves, and washing machines.⁵ Meanwhile, the majority of the Guinean population still has “no access to essential services such as water, electricity, and health services.”⁶ As a result, a clear divide in the quality of life between the native inhabitants and the CBG employees, and other foreign migrants has grown.

To better understand the disparity in living standards and access to essential services between local indigenous communities and mining company employees, a further examination of the socio-economic contribution of the mining companies in the bauxite mining region of Boké is needed. The Extractive Industries Transparency Initiative (EITI), of which Guinea is a member, is a “voluntary initiative which aims to reinforce, in countries rich in mineral, oil and gas resources, good governance of the public revenues derived from their extraction.”⁷ Each member country is required to publish a yearly report “including full disclosure of state revenues from the extractive industries, as well as the disclosure of all significant payments made to the government by mining companies.”⁸ This report also publishes the payments made to the local communities by the mining companies. Guinea’s 2017 report states that CBG paid for the operations of a local hospital, run by the National Agency for the Development of Mining Infrastructure (ANAIM), up to US\$3.5 million annually, while any additional costs were paid for by the hospital.⁹ In addition, the company made some voluntary expenditures amounting to 10,878,899,056 GNF (or around US\$1.1 million).¹⁰ These expenditures included the renovation of a primary school and construction of a cultural center.¹¹ To put these payments in context, Alcoa which owns 23% of CBG had a total revenue of around US \$10 billion in 2019.

Our research shows that local actors have tried a multitude of ways to bring change to their communities, ranging from lawsuits to grievance mechanisms. So far, the only demonstrable change has been achieved through protests at mining sites. Protests over the years have led to millions of dollars lost in mining operations, and therefore mining companies have demonstrated that they are willing to pay any cost to maintain stability and avoid disruptions to their activities. For example, in 2017 a protest erupted in Boké that halted mining production for a few days. It was only then that local officials and mining companies sent a delegation to listen to their demands.¹²

Women

Women make up 51.62 percent¹³ of Guinea’s population. Therefore, to understand social roles and structures, it is imperative to map the role of women in society. In 2005, the UN estimated that 46% of girls in Guinea between the age of 15 and 19 were married, divorced or widowed.¹⁴ The prevalence of child marriage in the Guinean society has severely impaired the role women can play, especially as the Civil Code includes language that legalizes patriarchal family structures. Women also lack access to health services due to the poor women’s health infrastructure. This is reflected in the maternal mortality rate of Guinea,

which is 576 deaths for 100,000 live births, the 14th highest one in the world.¹⁵ According to the World Bank, women in Guinea also suffer from a low literacy rate of 22 percent.¹⁶ This rate varies by urban and rural settings by 53 percent and 15 percent, respectively.¹⁷

From this brief overview, it may be inferred that women are disenfranchised and do not play a role in society. However, there is historical evidence of women in Guinea leading grassroots decolonization efforts which led to independence in 1958. “The Guinean branch of the Rassemblement Démocratique Africain (RDA), its detractors said, was a party of prostitutes, school drop-outs, and divorced women; aggressively opposed by the French colonial administration.”¹⁸ It was found that “Guinean women used long established networks to convey anti-government information.”¹⁹ During this time, women in Guinea broke many established gender norms, in order to engage politically and mobilize in the nationalist movement, however, these transformations did not translate into a shift of gender roles post-independence.²⁰

To verify desk research and build a nuanced narrative, the team conducted interviews with organizations with programs and projects in Guinea, including Peace Corps, UNDP and Human Rights Watch (specifically their research team for the Bauxite Mining Report). Through these interviews, we learned that although gender segregation is stark, women have their own community groups that engage in community issues and are a platform for advocating for collective grievances. With regard to mining operations, women were concerned primarily with the economic outcomes for their communities because mining companies had not delivered on their promise to bring economic prosperity. As women play a significant role in driving the informal sector in Guinea, it would be important to engage and empower them to create networks of environmental monitoring even though their primary concerns are economic.

Vice-mayor of Boké Mamadou Diallo describes the bauxite boom as an environmental disaster for his community.

Image by Jennifer O'Mahony for Mongabay.



Youth

According to the CIA Factbook, youth account for 60% of the Guinean population. It is vital that they are included in any stakeholder mapping, especially since youth activism may be a strong force for change. In the absence of official reports, the team relied heavily on interviews with contacts who had worked with youth and youth advocate organizations. These findings may help to lay the foundation for understanding the potential role for youth in the stakeholder scenarios for data collection.

In developing a stakeholder profile for youth, interviews helped to inform drivers and deterrents for engagement and to characterize the lifestyles they lead. Based on interviews with two Peace Corp representatives who had taught students in Guinea, Matan Skolnik and Anna Canero, it appears that youth typically have access to smartphones and are more likely to be literate than older populations.^{21 22} Their familiarity and access to technology may make youth a preferred demographic as potential data collectors and photographers for future iterations of the tracking portion of this project. Skolnik stated that most students walked for miles to schools, meaning that they would be able to cover significant distance and capture photos of any impacts along their walks to and from school. In a meeting, Ousame Bocoum from UNDP affirmed that youth could play a potentially important role in collecting data given these circumstances.

Based on the interviews with Skolnik and Canero, students are incentivized by sports, specifically soccer, movies, dancing, and music. They also have a sense of pride in Guinean independence and see the “acute disparity in wealth,” yet it remains unclear to them how to change the outcome. Skolnik mentioned that youth leadership councils often meet at a “Maison du Jeunes” or Youth Houses to discuss issues or watch movies and soccer.²³ These meetings would be one potential social avenue to introduce a mobile application to youth stakeholders, if the future project teams saw fit.

Since youth represents one sector of the community, the Capstone team also spoke to two members from the Harvard Student Research team, Lily Kim and Samantha Lint, to learn more about their experiences with communities in Boké. While law students at Harvard, Kim and Lint had worked with the Human Rights Watch to research bauxite mining in Guinea. Two organizations with which they collaborated were the Association Mines Sans Pauvreté (ASMP) and Association pour le développement rural et l’entraide mutuelle en Guinée (ADREMGUI).²⁴ Both ADREMGUI and ASMP spoke the local native languages in Boké and were key collaborators in conducting interviews with the research team and building trust within the communities they visited.

Youth may be the least influential stakeholder by means of access to power structures. However, they represent the largest population demographic and have higher literacy rates comparable to any age group. Youth could play a larger role in data collection given the physical distance they cover on a daily basis, literacy competency, and familiarity with newer technology. It will be important to engage with leaders of youth organizations or schools as a means to reach out to youths more broadly.

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1.5 Communications and Technology Context

Disseminating and Receiving Information in Guinea

Abstract

We reviewed existing literature to provide an understanding of the current landscape of communications and technology within Guinea. Our findings shed light on the strengths and weaknesses of the system and how it relates to the implementation of a mobile app-based monitoring solution to document the physical impacts of bauxite mining in Boké, Guinea.

Guinea, currently experiencing political unrest, is at a point in its history where change and transparency is a priority among its people. Only recently, in 2010, democracy, freedom of speech, and accountability were at the forefront of national agenda.¹ For this reason, it is important to understand the communication networks that exist within the country. How is information disseminated? What are the main methods of communication? Do locals purchase and use phones? If so, how many of them are smartphones and what is the extent of their involvement on social media? With the advent of the internet and cellular communications the communication landscape in Guinea has begun to evolve, especially in rural communities where locals are far more isolated. The prevalent communication methods available in Guinea are radio, cellphones, and television used for both information sharing and bidirectional communication.

Social media alone has opened up a whole new pathway for transparency. In more developed countries it is not uncommon to walk into a public space and see the majority of people looking down at their cell phones texting, looking through Instagram, Facebook, or Twitter. Social media has even allowed tracking capabilities to mark yourself “safe” during natural disaster events. Because of this we also reviewed technological adoption and ownership of smartphones in Guinea.

Summary of Findings

1. The most common method to disseminate information in Guinea is through radio as it is the most affordable and versatile mode of communication.²
2. Mobile phone penetration is significantly high in Guinea with 92% of the population owning mobile phones.³
3. 3G and 4G penetration is currently low at 29%; however, it is growing year over year.⁴
4. Use of mobile banking and financial services is still relatively low in the country.⁵
5. Those with smartphones are utilizing social media platforms, namely Facebook.

Recommendations

1. A team that is well versed in the functioning of the app and its processes will be needed to train the stakeholder group(s) who are in charge of data collection and data management to ensure a level of technical literacy among users.
2. The stakeholder(s) in charge of data management will need to practice quality control and be in charge of training in the long-term to ensure any new updates or changes are properly implemented among all data collectors uniformly.
3. Further research on bandwidth and capabilities of running the app smoothly without crashing or glitches needs to be tested as on the ground internet broadband capabilities are still unknown.

Scope of Review

This review focuses specifically on the current existing network of communication within Guinea (i.e. radio, phone, television), the rate of technological adoption, and the utilization of social media or financial platforms to conduct day to day activities.

We did not review the potential for certain technologies to be introduced or how communication and technology is expected to evolve. We simply considered the historic and current state of these communications and technologies. Unfortunately, secondary data found through this literature review cannot be confirmed with primary research as we were not able to travel to Guinea to collect on the ground data.

Findings

1. Information Sharing

The most common mode of information sharing in Guinea is radio.⁶ Its inexpensive and portable nature makes it a good candidate for locals who are not able to purchase more expensive technologies such as televisions. This is not to say that televisions cannot be found in Guinea. Televisions are more concentrated in towns with larger populations such as Conakry and are typically found in shared spaces like coffee shops.⁷ Other modes of communication and information such as newspapers and magazines do exist. However, they are not heavily utilized due to the low literacy rates within Guinea.⁸

1.1 Radio

Radio is the most common method of communication. Since Guinea's independence in 1958, radio has been heavily utilized as an instrument for propaganda within the country. Even with democracy on the rise, the government has maintained a watchful eye on the information that is disseminated and there is still a lack of transparency within the country.

Women celebrate the installation of a new radio station.
LaRose for UNICEF



Private radio stations began obtaining licenses in 2005. By 2006, the first private radio station, Radio Nostalgie, started broadcasting. Many more followed after this, with at least 17 private FM stations recorded in 2011. Audience participation is common on radio shows with most stations typically conducting one daily phone-in programme. This is also common on government-run radio networks such as Radio Rurale where locals can call in to voice their opinions on current events and issues.

The state broadcaster in Guinea is Radiodiffusion- Television Guinéenne (RTG) and it broadcasts primarily in French. They operate two stations: Radio Guinéenne also widely known as Radio Nationale, broadcasting nationwide from Conakry, and Radio Kaloum Stereo (RKS), an entertainment station that broadcasts to Conakry and surrounding areas. Radio Rurale de Guinée, a government-run network of 23 local stations in the interior of Guinea broadcasting in local languages, receives some of their news and programming from RTG.

Struggles radio has faced in Guinea include intermittent military aggression, poor funding, and violent attacks during the political transition years of 2009 and 2010.⁹ Consequently, private radio stations practice self-censorship and in several cases bribery from political and religious groups have compromised the integrity of the content.¹⁰

Internet radio broadcasting, a less popular method of information sharing, also exists. However, due to low computer and smartphone penetration, most people rely on traditional radio.

1.2 Television

As of 2011, the main broadcaster for televisions was the state broadcaster Radio Television Guinéenne (RTG). There are two main channels: RTG1 and RTG2. Due to RTG's low programme production budget, most of their programmes are imported. Television is not as common in Guinea with only 47 TV sets per 1,000 population and is typically found in more urban and populated areas such as Conakry.¹¹ Urban areas also have many more shared spaces where locals can congregate and watch television that is available through cafes. Television is also commonly used to disseminate the state's propaganda and is heavily controlled by the government.

However, as gambling on sports, particularly soccer, has become a popular activity in Guinea, the availability of televisions has become more common over the years.¹²

Poverty among locals, especially in rural areas, as well as unreliable power supplies have contributed to the difficulty in television adoption. RTG claims that their signal reaches 40% of the country; however, locals cannot afford to purchase televisions and are only able to access this method of receiving information in highly populated and urban areas in Guinea.¹³

1.3 Newspapers & Other

Newspapers, magazines, and other forms of news sources such as online news are less common in Guinea. Newspapers and magazines

can be found in Conakry; however, it is not common to find written publications in rural areas. Poverty, low literacy, and distribution challenges have all contributed to the low success rate of print media. According to Infoasaid, only 38% of adults could read and write in 2011. A slightly more updated number from the CIA World Factbook shows that this number has since gone down as they recorded a literacy rate of 30.4% in 2015 (38.1% males, 22.8% females).¹⁴

Horoya, the only daily newspaper, run by the Ministry of Information and the government news agency Agence Guinéenne de Presse (AGP) sells less than 1,000 copies per day. Privately owned and operated newspapers appeared in 1991 when print media was liberalized and were publishing on a weekly or fortnightly basis. The most long-standing and revered independent publications are Le Lynx and La Lance, owned by the same publishing house, and Le Diplomate, which also owns the Conakry radio station Sabari FM. In 2008, around 10 independent publications were being distributed regularly in Conakry, some of which also had an online presence.¹⁵

Challenges print media faces in Guinea are costs associated with printing, censorship, military intimidation and restrictive media laws.¹⁶

2. Communication & Technology

Phones are the second most utilized method of communication in Guinea -- assuming it has not yet surpassed radio in recent years. A smartphone with 3G capability can be purchased for as little as \$34 USD.¹⁷ The bare-bones Alcatel UG 3G smartphone is offered by the telecom company Orange in Guinea and has a memory capacity of 4 Gigabytes (GB).¹⁸ In terms of mobile penetration, there are 12.35 million people using mobile phones in Guinea. That is 92% of the population, 29% of which are connected with 3G or 4G.¹⁹ Internet usage has grown and is continuing to grow at a rate of 19% annually and with 1.9 million currently active on social media, which is 14% of the total population. Among the social media platforms, Facebook has the most subscribers with 1.9 million active users, of which 60% are male and 40% are female.²⁰ Instagram comes in second with 220 thousand users, of

Orange Guinée employees
Orange Guinée



which 68% are male and 32% are female.²¹ Because sports is one of the most popular topics of discussion, the highest trending searches relate to sports scores because gambling on sports is a popular activity as mentioned earlier.²²

In addition to social media penetration, we also wanted to understand the use of financial products and services. There is a low usage of financial services with only 3% of the population owning a credit card, and 5% making online purchases. 23.5% and 13.8% of individuals over 15 have bank and Mobile Finance Service accounts, respectively.²³ The financial capabilities of locals was reviewed in order to determine the feasibility of implementing a monetary incentive in encouraging participation for the app-based project of environmental impact tracking for Bauxite mining in Guinea.

Some challenges we expect in implementing this app based solution are low technical literacy of users and software limitations.²⁴ Despite there being a high mobile phone penetration, the number of users with 3G and 4G is low. Furthermore, their use is typically limited to social media platforms and social activities like gambling and score checking online. Due to this, there might need to be a technical team in place to train users on how to upload the data collected onto the app.

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1.6 Citizen Science Precedents and Case Studies

Employing Local Stakeholders & Communities to Collect Scientific Data

Abstract

Stakeholder participation data collection, often referred to as “citizen science,” has been increasingly sought for by environmental policy makers and consulting scientists. The data becomes more inclusive and relevant when it is collected by communities whose environment is polluted, or whose lives are affected. These communities have the most direct access to the data over the long term.

There are also pitfalls to avoid. The quality of the information that policy makers or communities receive from this process is dependent on the quality of the process itself. There is a growing understanding among the scientific community that citizen science isn’t a miracle solution and that it must be used with sensitivity and cautiousness.¹

We finish this review by studying several existing Data Collection Technologies (DTCs).

Research

1 Use and shortcomings: process

Examples of citizen science worldwide are abundant. In the U.S., the federal government itself funds dozens of citizen science initiatives. Stakeholder participation is used to map and study biology, landslides (e.g. the Cooperative Open Online Landslide Repository, or COOLR), and environmental pollution. Successes and failures are both numerous. While successful projects are normally more publicized, they do not always map their success in a scientific or peer-reviewed manner.

Several pitfalls can be drawn from these projects that arise during the collection part of the citizen science process. First, the trustworthiness and accuracy of the data -- it can be difficult to ensure

the quality of data collected by non-experts with high emotional involvement in the results.² To counter this, projects often include pre-collection volunteer training and guidelines (e.g. iNaturalist, an increasingly popular biology data collection website that teaches users how to identify plants and animals.) Training makes the data more valuable to researchers.³ When such training is not available, data should be reviewed and evaluated by experts, when possible.

There are other issues to consider about the later end of the projects, after data collection. We can infer from current citizen science literature that a map with citizen-collected data is not the final product; geospatial tools are jumping off points for further questions, analyses and patterns reading. They can be used to create geospatial literacy among the community and a bridge to achieve the community’s needs. In the case of Boké, transparency through mapping is not the final objective -- limiting impacts from bauxite mining is.

As mentioned earlier, citizen participation varies with economic incentives; therefore projects may lose momentum when grant funding stops.

Finally, while there are limitations in the data collection process, there are few successful case studies for data transmission. Many projects use pre-constructed third party online mapping platforms to transmit the data to researchers. SafeCast, an environmental citizen science organization headquartered in Japan, is building a network of sensors to monitor particulate matter pollution based on data by volunteers.

1.1 Use and shortcomings: participation and equity

Citizen participation is bound to wax and wane along with interest and economic incentives. While the communities benefit from being involved in

the collection process, these benefits are offset by the time consumed and the loss of unremunerated intellectual property -- unpaid labor, in short. This trade-off should, when possible, be reduced or avoided altogether by training and remunerating participants.⁴

While citizen science aims at creating more equity, equity was not always found in this process. Negotiated, written and mutual agreements between the scientists and the communities were not consistent-- yet such agreements ensure the genuinity of the local relevance and the capacity of researchers to use the data into a wider context.

Motivation also differs within and between sectors of society; one community may have different drivers for different people. It is not possible to use the most optimal data collection process because it will not always be attractive to users, nor to create a process that is engaging for everyone. Hence, the process must be tailored for the people it serves and their skill sets, but not be bound to one stakeholder profile.⁵

1.2 Best practices for citizen science

Mark Reed, a researcher specializing in environmental governance and research impact based in the UK and the US, wrote an exhaustive literature review on citizen science in 2008. From this review, Reed highlights several features of best practice for stakeholder participation that we believe encompass most of the aforementioned shortcomings of citizen science. These are:

1. “These features emphasise the need to replace a “tool-kit” approach, which emphasises selecting the relevant tools for the job, with an approach that emphasises participation as a process.
2. It is argued that stakeholder participation needs to be underpinned by a philosophy that emphasises empowerment, equity, trust and learning.
3. Where relevant, participation should be considered as early as possible and throughout the process, representing relevant stakeholders systematically.
4. The process needs to have clear objectives from the outset, and should not overlook the need for highly skilled facilitation.
5. Local and scientific knowledge can be integrated to provide a more comprehensive understanding of complex and dynamic socio-ecological systems and processes.
6. Such knowledge can also be used to evaluate the appropriateness of potential technical and local solutions to environmental problems.
7. Finally, it is argued that to overcome many of its limitations, stakeholder participation must be institutionalised, creating organisational cultures that can facilitate processes where goals are negotiated and outcomes are necessarily uncertain. In this light, participatory processes may seem very risky, but there is

growing evidence that if well designed, these perceived risks may be well worth taking. The review concludes by identifying future research needs.”



Citizen Science in Africa leads a workshop for African Conservation Managers.

Tropical Biology Association

2 Precedents in West Africa

The benefits of using local knowledge is obvious to the exercise of mapping data -- in Africa as in any other place. In Nairobi, for example, the Matatus project aimed at creating a map of local public transit roads. The fact that the scientists and students at the University of Nairobi, who were tasked with collecting the data, knew the roads and used them themselves in their daily lives, made the process much more intuitive.

Unfortunately, there are not many examples of citizen science projects in Africa and West Africa particularly, in the Global South as a whole. The MammalMAP project aims at updating the distribution records of African mammal species. Here again, the data is mostly collected by professional scientists and wildlife and conservation experts or authorities.

Overall, project teams usually either employ scientists on the ground already equipped with the required skills (university faculty and students, for example) or train them. Still, finish sentence or delete

Communication and transmission of data may be different from Western countries' examples. Telecommunications company Airtel launched its “321” service in several East African countries in 2016, which let consumers dial a number and access public services information. Could information be transmitted in a similar way between citizens of Boké and regulators, leaders or other authoritative entities? What’s the most natural medium of fast communication in the region? What kind of skills would it take to be the operator in this scenario? Where would they have to live?

Motivations may differ as well. Aesthetic and fascination for nature is often a key driver of participation in the Global North -- as found by a survey of volunteers to Stardust@home, a NASA-led citizen science project that has users classify online images from NASA’s Stardust spacecraft.⁶ In the case of Boké, we expect the main driver of participation to be the desire for decent conditions of living, which might transcend the need for remuneration.⁷

Overall, there is a need to think about the use of this data and how the geospatial product would help to solve the problems at hand. Whether the key barrage to sustainability in Boké is transparency, institutions or property rights, the visualized data from this project should help undo these barrages.

3 Data Collection Technology

We assess the prevailing data collection technologies (DCTs) to elucidate how different solutions might fit with the deployment strategy to come in the project implementation phase. The utilization of an

objective suitability framework to provide an overview of the preeminent data collection technologies revealed that:

1. While most DCTs are highly customizable and can be structured to meet project objectives, not all solutions are created equal in terms of the type of data (audio versus photo versus text) that can be collected. Data storage options and data security are also highly varied.
2. Technological know-how can be a limiting factor for low-budget projects as free DCTs require some coding/programming knowledge. “Off the shelf” paid solutions are most easily reworked to cater to project needs
3. Data collection technologies offer varying degrees of support from their respective developers. Projects considered humanitarian initiatives appear to have a broader support network for developing and deploying solutions.

Recommendations

1. An internal evaluation of a project’s human, financial, and intellectual capital is a critical exercise before determining a compatible data collection technology.
2. Human capital requirements can be reduced by selecting a mature solution that offers a high level of support and maintenance from the service provider. This combination is typically only offered by paid solutions, requiring an assessment of a project’s available financial capital.
3. Free DCTs offer a simple solution if financial capital is a limiting factor, but intellectual capital can be a barrier as free solutions may require coding/programming knowledge.
4. KoboToolBox appears to be the best solution for a “Phase I”, small-scale roll out of the project at hand. The technology is free, highly customizable, requires minimal coding/programming knowledge, allows for textual and photographic data collection, is highly secure,

**Students practicing GPS tagging
using an android phone**
*Tino Toupane for Humanitarian Open
Streetmaps*



offers unlimited storage, and has a deep support network from humanitarian organizations with which Columbia and other project stakeholders likely already have relationships.

Research Findings

Evaluating the suite of data collection technology (DCT) options requires an understanding of the project's demands from the technology, the context in which the technology will operate, and the risks/costs associated. Findings from internal project research areas and analogous citizen science data collection initiatives⁸ were used to guide the creation of an evaluation framework that supports an objective assessment of each DCT's suitability.

DCT Suitability Assessment Framework:

1. Solution Maturity – Has the solution worked elsewhere for similar initiatives?
2. Operating System Compatibility – Will the application work on devices typically found in the project's operating region?
3. Offline Functionality – Will the technology work offline (without internet access)?
4. Customization – Can input forms and other functionalities be tailored to meet project needs?
5. Data/Storage Capabilities – How much storage? What type of data can be collected? Can the application facilitate the delivery of GPS coordinates and other relevant location-based data?
6. Support/Maintenance Considerations – Can the party responsible for data management also ensure the technology functions properly?
7. Cost – How much does the service cost?

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1.7 Utilization of Geographic Information Systems to Map Environmental Impacts in Boké, Guinea

Employing Local Stakeholders & Communities to Collect Scientific Data

Abstract

Pollution generated from the mining and transportation of bauxite has impacted the health and livelihood of communities of the Boké Region, Guinea. Established environmental data collection techniques enabled through community-powered Geographic Information System (GIS) platforms have the potential to equip Boké communities with the tools and evidence needed to catalyze change. Existing datasets provided by The Ministry of Mines and European Space Association, as well as existing community-powered data collection, such as Humanitarian Open Street Maps project, can provide baseline information and precedent to inform UNDP's pollution-specific data collection efforts.

Research Findings

1 Background: Geographic Information Systems

Documenting the presence of bauxite industry-generated dust through verifiable media is an effective way to build a body of evidence of environmental pollution. At present, photographs and videos of dust pollution have been collected as a practical and powerful way to contribute to this body of evidence. Geographic Information Systems (GIS) enable the management, manipulation, analysis, and presentation of geographically related information.¹ The combination of visual evidence with geographic evidence yields unique benefits for stakeholders looking to demonstrate presence of dust pollution in the Boké Region:

Spatial and Temporal Analysis - Recording the location of visual evidence through geotagging would provide stakeholders with a spatial representation of dust pollution within the Boké

Region, and, if evidence collection persists over time, a temporal analysis of how pollution is changing over time.

Verification Capabilities - This database of relevant information can not only be used to analyze to gain insights into the bauxite pollution crisis in Boké, but also to develop compelling visuals that transcend literacy and language barriers, and influence policy planning and future environmental monitoring.

Communication - Additionally, attributing locations to visual evidence allows for the possibility to verify information, which is vital in the region's current atmosphere of distrust between communities, government, and mining industry.

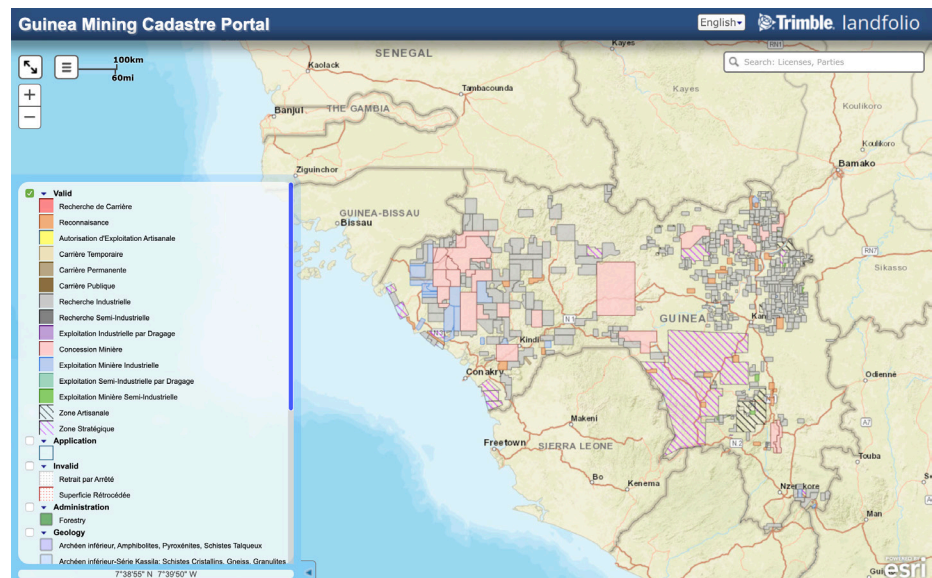
2 Existing Datasets

Explicit environmental data, in any form, regarding pollution generated by the Bauxite industry has yet to be compiled in geospatial format. Multiple organizations have collected forms of geospatial data relevant to the environmental impacts of mining in Boké, such as geospatial imagery and regional economic and community infrastructures.

2.1 Mining Plot Data - Ministry of Mines

The Ministry of Mines and Geology has located parameters of current (most recent maps from January 2016) mining and extraction parcels through conventional mapping, and hosts digital PDFs of these parcels online.² The Ministry of Mines and Geology is the official source for this information; however, given the lapse in time between the last known date of publication as well as missing referential data on individual maps - legends and keys, for example - this may be an unreliable or incomplete source. Additionally, the format of this data being in PDF requires manual conversion, which is laborious and has potential for error.

Guinea Mining Cadastre Portal



Transitioning away from PDF maps, data regarding mining plots has been captured in an online mapping portal known as the “Guinea Mining Cadastre Portal,”³ which was developed by the Ministry of Mines and Geology and Trimble Land Administration,⁴ a California-based tech company that works with companies to develop maps for their work. The data represented in the portal is managed and verified by the Centre for Mining Promotion and Development (CPDM), undertaking a continuous data validation exercise of all licenses in Guinea.

2.2 Mining Plot Data - Sentinel Satellite Data

The SENTINEL Satellites are geo imagery satellites owned and operated by European Space Station in Paris, France and were manufactured in partnership with Airbus Defence and Space.⁵ Cameras on satellites can capture 12 different wavelengths of light, in addition to evidence of air pollution.⁶ Imagery has been collected since the launch of the first Sentinel Satellite in 2015 and is updated regularly, revisiting a site every “10 days at the equator with one satellite, and 5 days with 2 satellites under cloud-free conditions which results in 2-3 days at mid-latitudes.”⁷ The imagery captured by the Sentinel Satellite has a resolution of 10 meters, which allows viewers to visually identify the presence of red dust, as compared to other, lower resolution satellite options, such as NASA’s Landsat (30 meter resolution).⁸ Sentinel Imagery is available through Copernicus Open Access Hub with proper registration credentials.⁹

2.3 Open Street Maps

Humanitarian OpenStreet Maps Team (HOT) is an international team focusing on the development of publically available maps of social and physical infrastructure in order to support humanitarian and sustainable development goals. HOT has launched three projects within Guinea, one of which is still ongoing, and has been collecting data specifically relevant to health services in the wake of the Ebola crisis in 2015, or through the lens of economic development.¹⁰ HOT works in partnership with a variety of stakeholders--ranging from international

organizations such as the United States Government's 2 Cities Project, local humanitarian technology organizations like GeoSynapse and YouthMappers, local universities, and city governments. Utilizing participatory mapping techniques, these community mappers have geolocated over 34,000 buildings and over 20k Roads in Guinea.¹¹ Through this process these participants were able to create over 10 geolocated datasets, including:¹²

- Railways
- Airports
- Waterways
- Roads
- Buildings
- Sea Ports
- Education Facilities
- Financial Services
- Populated Places
- Health Facilities
- Points of Interest
- Places of Worship

Data is updated each month, and is volunteer based. As a result, detail of data varies depending on dataset and datapoint, for example two schools within the same "Points of Interest" database have varying levels of detail attributed to them aside from locational data.



Roads used to transport bauxite appear red in satellite imagery.
Google Timelapse

3 Representation of Future Datasets

Existing maps and geographical datasets have been produced by a variety of different organizations internationally, and can be used to orient data that would be collected as part of the mining impact tracking project in the Boké Region, e.g. proximity of mining concessions to rivers and arterial roads. It can also be used to elaborate upon or contextualize mining pollution related data within the communities that it impacts, for example, the majority culture of the subprefecture or number of schools or hospitals within the region, that would allow the team to develop useful strategies for the people who live in the Boké Region.

3.1 Quality of Dataset Reliant on Resources

Incidents of pollution captured by participants through photo, video, and location, would be limited by access to technology, for example charged phones, and access to affordable or funded network data, however, based on the work executed by HOT and similar participatory and other mapping programs, it seems that materials and resources could be made available to facilitate this. See "Communications and Technology Context" and "Citizen Science" sections for more context on data collection limitations.

3.2 Types of Datasets

Incidents of pollution will likely be aggregated within a point-based vector dataset--meaning dataset filled with pieces of information organized by a single location with a single set of coordinates--with details provided at submission, such as numerical id for data collector, location, time of collection. Non-locational data from external sources

could be added to the dataset in order to inform the conditions of the individual incident. For example, known weather conditions at time of collection within the incident area could illustrate inconsistencies in range of dust pollution.

As an alternative to or in support of a point-based vector dataset, incidents of pollution could be mapped out using a polygon-based vector dataset, in which an incident would have three or more locational reference points. This methodology would require more advanced or multiple in-field measurement techniques, but might provide better documentation of the spatial range of a single pollution incident or observance.

3.3 Updated Data Informs Ongoing Collection

Following in the steps of Humanitarian OpenStreetMaps Team, maintaining an accessible database with frequently updated data is an asset to the all stakeholders helping execute this pilot project. As information is collected, keeping an up-to-date collection of data accessible to stakeholders within the mining impact tracking pilot project framework can inform the trajectory of ongoing collection efforts, directing participants towards new sources of pollution for documentation, as well as providing a feedback loop for helping collectors understand what data is important and useful, as well as informing the ways in which data managers and program managers organize data and support the collectors.

Case Study: Water Charity

Water Charity, an international NGO, has implemented a ‘Water for Everyone Initiative’ in Gambia, Liberia and Togo to ensure that every person has access to clean water by 2023.¹³ The country’s water points, which consist of both open sources and wells, are mapped out and evaluated using the GIS tool, Survey123 developed by ArcGIS. This tool is also used in order to collect the community’s health and sanitation data with a focus on contaminated water. All of this data — both water mapping and health and sanitation — allow Water Charity to prioritize projects and communities based on urgency.

The key to this project’s success is the accurate mapping of water points in the region. Each region has its data collected by a survey team that visits the communities at least once a month to produce a real-time database of water sources. The surveyors are not full-time Water Charity employees, however they are paid a daily allowance and are trained before going out into the field. Galaxy Tablets, in which the GIS application is installed, are used to collect and process the data. In addition to the survey team, Water Charity also involves the community leaders and the local government, allowing the project to run smoothly.

Water Charity’s GIS Mapping demonstrates a successful implementation of a project where multiple stakeholders are involved and where technology is used to document and monitor an issue.

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2. Stakeholder Profiles

Understanding each stakeholder profile is critical to this report. Our team conducted an in-depth analysis of each stakeholder in the bauxite mining industry in Guinea, particularly in the Boké region. The goal of the analysis is to aid our understanding of what each stakeholder prioritizes, the benefits and challenges to each stakeholder, and the benefits and challenges they create within the system. We extrapolated information from interviews and research documents to create a baseline of understanding of each stakeholder's priorities. We added assumptions based on our interactions with our client at the United Nations Development Programme, Ousmane Boccoum. Unfortunately, due to our inability to directly contact the stakeholders on the ground, most of our assumptions must remain mere hypotheses. Therefore, it is imperative that future researchers on this project review and confirm the stakeholder profiles to ensure their integrity.

Each profile contains a brief introduction of the stakeholder and their role or contribution to the implementation of the project. The profiles cover each stakeholder's priorities, pains, gains, and incentives. The goal of the stakeholder profiles is to help readers understand how the scenario diagrams were formulated.

The Ministry of Mines and Geology

The Ministry of Environment, Water and Forestry

The Chamber of Mines

The Bauxite Environmental Network (BEN)

Guinea Alumina Corporation (GAC)

Local NGOs

Telecom Companies

Columbia University

Youth

Established Financiers

Ministry of Mines and Geology

About

The Guinean Ministry of Mines and Geology is responsible for the oversight and regulation of the country's mineral deposits, including their extraction, mining and sale. The current Minister, Abdoulaye Magassouba, was appointed in January 2016. Previously, he worked in both the private and public sector. Magassouba served as the Counsellor in Charge of the Bureau of Monitoring and Support of the Presidency. In this role, he was involved in the negotiations with GAC and other international investors for the relaunch of Guinea's bauxite mining sector. He and his cabinet are extremely well connected internationally in the mining sector.

Magassouba was a Fulbright scholar at Williams College USA in 2011.

Stakeholder Priorities

- Promoting foreign investment to foster mining development in Guinea
- Legislative and institutional reform including mining code reform, EITI certification and enhancing transparency
- Infrastructure sharing between mining companies and locals
- Developing growth corridors around main mineral transport roads
- Environmental and Social Development programs

Benefits of Participation

- Contributing to a major Ministry priority; enhancing transparency in the mining industry
- Using the app's data to understand the issues that must be addressed to develop the 'growth corridors' around the major road transport infrastructure in Boké
- Helping to inform the priorities of the strategic social projects outlined by the Ministry
- Enhancing partnerships with UNDP and other NGOs involved in the project

Challenges of Participation

- Weaken the Ministry's relationship with foreign investors and mining companies who do not want environmental impacts to be made public
- Reduce the Ministry's control over the information that is publicly

available about the mining industry in Guinea

- Accountability for the environmental impacts resulting in increased pressure to intervene.

Motivations

Positive Incentives

- Cooperation from at least one mining company in the region
- Government policies in which the Ministry's relationship with the community and the mining industry is enhanced

Negative Incentives

- Request the Ministry to participate in the program by the mining companies involved in the project
- Reduced control of the messaging and outcomes of the project

Barriers to Entry

- Increased certainty on the project's deliverables allowing the Ministry to assess the reputational risks and benefits of participating in the project.
- Increased interest from the communities and mining companies to participate in the project.

System's Gains and Losses

- **Bullet** The Ministry of Mines participation is essential for the project's implementation since the Ministry holds the political and relationship power in the mining industry in Guinea.

Ministry of Environment, Water, and Forestry

About

The Guinean Ministry of Environment, Water and Forestry (Ministère de l'Environnement, des Eaux et des Forêts, or MEEF) is in charge of the conception and coordination of the government's politics in natural resources and sustainable development. This includes preventing the degradation of the environment and putting in place control mechanisms to oversee changes in environmental and human capitals.¹

The Ministry is concerned with human impacts and development both in urban and rural settings. While the Ministry of Environment has not put out many official statements on the government's stance on or relationship with mining companies, one can infer that it is working to improve the mining companies' impact on the environment and communities.

The Ministry has recently received funding from the World Bank to equip prefecture-level leaders with cameras and protective gear to capture traces of environmental pollution.² There is potential for our proposed project to complement this funding initiative.

Stakeholder Priorities

- Conceptualizing environmental protection in Guinea
- Ensuring environmental protection; managing natural resources and ensuring their rational exploitation
- Promoting clean energy sources
- Creating observance and control mechanisms for environmental protection
- Educating the public on environmental protection issues and coordinating participation to international agreements and frameworks

Benefits of Participation

- Answering some of its mission's major key points by protecting the environment and populations' health
- Strengthening its own citizen-based pollution control program
- Possibly cementing its role as a regulator in regards to the mining sector

Challenges of Participation

- Losing resources that could be applied elsewhere
- Fragilizing its own local pollution control program

Motivations

Positive Incentives

- Showing tangible positive impacts on human health that a pilot program may have.

Negative Incentives

- No clear negative incentives were found.

Barriers to Entry

- Ensuring the Ministry's program and this project merge or complement each other adequately

System's Gains and Losses

- The system would gain greatly from the Ministry's participation as it embodies the government's stance of environmental regulation

References

1 Ministère de l'Environnement, des Eaux et des Forêts (MEEF). <http://meef-guinee.org/>

2 Interview with Aboubacar Kaba, Head of Service at the Laboratory of Environmental Analysis at the Ministry of the Environment, April 14, 2020

Chamber of Mines

About

The Chamber of Mines (Chambre des Mines de Guinée) is a mining consortium composed of CBG, CBK (Rusal), Friguia S.A. (Rusal), SAG S.A. (AngloGold Ashanti), Semafo and SMD, as well as a number of holder, associate or affiliate member companies. It advocates a self-serving approach with the government while implementing sustainable policies for communities that live around extractive operations.

Stakeholder Priorities

- Economic development for its own operations and stakeholders.
- Environmental protection from the impacts of mining operations
- Community development around its members' operations, most notable during the Ebola crisis.

Benefits of Participation

- Part of the Chamber's engagement is to implement the 2005 Extractive Industries Transparency Initiative (EITI, or ITIE in French), which entails transparent and sustainable mining operations.¹
- Build trust with local communities as unrest is perceived as a major potential roadblock to the financial sustainability of mining operations.

Challenges of Participation

- The Chamber allegedly already lacks funding to properly implement the EITI; it may not be inclined to divide its resources any further.
- Improving transparency of mining operations can be an arduous task; mining companies may prefer to do it at their own pace and in their own terms rather than have any transformation dictated by other parties.
- The program might result in changes in mining operations and mining companies might incur additional costs in mitigation actions.

Motivations

Positive Motivations

- Conveying community participation.
- Government policy initiative in favor of the mining industry.

Negative Motivations

- Persuading holder, associate or affiliate members of the Chamber to advocate for the involvement of the six founding members.
- (As the government) limiting operations or blocking policy making in favor of the mining industry -- allegedly a risky move for the government to take, as it is very eager to maintain a good relationship with the industry.
- Government forced reconciliation with existing plans for implementing the EITI.

Barriers to Entry

- More certainty in costs in implementation pathways.
- Understanding the communities as eagerness to see mining companies take part in the project.
- Cooperation of individual mining companies prior to voting on an agreement as the Chamber of Mines.

System's Gains and Losses

- A potential source of funding.
- Its participation would allow trust-building with communities.
- Central entity for mining companies' engagement in regards to sustainability.
- Mining companies could move forward together instead of blaming each other.
- On the other hand, should any mining company show signs of corruption when handling the data, its power in the matter would be non-negligible and diminish leverage for communities

References

- 1 Chambre des Mines. Online. <https://chambredesminesgn.com/>

Bauxite Environment Network (BEN)

About

Established under the aegis of the Chamber of Mines of Guinea (CMG), six companies (Guinea Alumina Corporation (GAC), the Bauxite Company of Guinea (CBG), Alliance Mining Commodities (AMC), Alliance Minière Responsable (AMR, an independent French firm whose aim is to develop mining projects in Africa), the Mining Company of Boké (SMB) and Alufer) operating in the Boké mining region of western Guinea joined forces on May 22, 2018, to create a Bauxite Environment Network (BEN dubbed REB in French).^{1 2} The goal of the network is to address the cumulative impacts of the mining industry on the ecosystem.³

Stakeholder Priorities

- Increase quality of biodiversity mitigation actions
- Strengthen the protection of the marine environment
- Monitor coastal erosion
- Biomonitor marine animals and “critical habitats”
- Rehabilitate rice fields damaged by sea-level rise
- Creation of an ecological corridor and the planting of trees to serve as energy sources for local communities.⁴

Benefits of Participation

- The data collected through the app can advance BEN’s priorities.
- Part of BEN’s strategy for marine environment protection is to develop a training component for village ecologists. The project’s app could be utilized to recruit ecologists in remote areas, and disseminate training materials.
- Monitoring coastal erosion through the app could be a possibility.
- As the network was created in collaboration with UNDP, this project could be an expansion of their partnership.

Challenges of Participation

- There is little downside BEN would experience in participating.

Motivations

Positive Motivations

- Developing additional features within the app that align with the networks priorities such as monitoring coastal erosions and critical habitats.

Negative Motivations

- UNDP is able to create a mandate in which BEN must actively collect data within the app.

Barriers to Entry

- Include biomonitoring capability to the mobile application (the app developed by the Lamont Doherty team),⁵ which is one of the goals of the BEN.

System's Gains and Losses

- Improved communications networks with mining companies who are motivated to address the negative externalities of their operations.

References

- ¹ Takoulev, Jean-Marie. "Guinea: Bauxite Environment Network Develops Plan To Protect Biodiversity." Afrika21, 14 September 2018. Online
- ² Média Guinée. "Boké: the Bauxite Environment Network (REB) is committed to reforestation around the governorate". 19 July 2019. Online
- ³ Takoulev, Jean-Marie. "Guinea: Bauxite Environment Network Develops Plan To Protect Biodiversity." Afrika21, 29 September 2019. Online
- ⁴ Ibid.
- ⁵ Patterson Jr. et al. "Biomonitoring is a tool for studying occupational and environmental exposure to chemicals, including persistent organic pollutants." Environmental Forensics for Persistent Organic Pollutants, 2014

Local Non-Governmental Organizations (NGOs)

About

Local NGOs play a critical role in community empowerment and engagement, acting as a mediator between the community, government and mining companies. They are perceived as independent and trusted entities by the local communities and their projects are funded by international organizations.

However, due to lack of resources, the scope of their work is often limited in reach. Based on literature survey, we have identified 4 NGOs that have been active in the past 5 years:

- Association for Mines without Poverty (L'Association Mines Sans Pauvreté; AMSP)
- Même Droits pour Tous (MDT)
- Centre for International Trade and Development (Centre du Commerce International pour le Développement; CECIDE)
- Association of Rural Development and Mutual Aid (Association pour le développement rural et l'entraide mutuelle en Guinée; ADREMGUI)

Stakeholder Priorities

- The exact priorities of the local NGOs differ based on their missions and focus. Most of them are upholding the rights of the local communities against mining operations.

Benefits of Participation

- Build capacity and credibility of NGOs
- Expand their existing initiatives (community engagement and empowerment)

Challenges of Participation

- Local NGOs might lose trust among the local communities if the project is funded by the mining companies
- Lack of resources - resources might be spread too thin and this might affect their existing initiatives

Motivations

Positive Motivations

- Financial support and assistance in manpower and technological support
- Facilitating partnerships with other stakeholders such as mining companies and UNDP

Negative Motivations

- Pressure and dissent among the local communities might nudge NGOs to participate

Barriers to Entry

- Money and Resources (manpower and technical capabilities)
- Partnerships with other NGOs, international agencies and mining companies.

System's Gains and Losses

- The system could leverage the NGOs' existing community initiatives to document the mining impacts.

Telecom Companies

About

The telecom companies in Guinea build and maintain the telecommunication infrastructure, and sell cellular devices to locals. The three main telecom companies in Guinea are MTN, Orange, and Cellcom.¹ Telecom companies are likely to be a neutral party for this project. They would be able to provide the telecommunication needs for this research project; however, they will likely not be active participants due to potential political consequences.

Stakeholder Priorities

- Increasing their revenues through selling their communication services
- Connecting locals through mobile phones, internet, television, and financial services.
- Enhancing their Corporate Social Responsibility (CSR) policies.²

Benefits of Participation

- Monetary gains from partnering with this project through cell phone sales and business network development.³
- Good publicity for telecom companies in helping local communities and increasing transparency.
- Youth will likely be in favor of their support and therefore their involvement may encourage and develop a client base in the long run.

Challenges of Participation

- Potential political backlash for aiding in a project that may cause government officials to be exposed due to increasing transparency.

Motivations

Positive Motivations

- Opportunities for CSR creating positive public perception.⁴
- Revenues through providing the technology needed for this program.

Negative Motivations

- Pressure from the government and local communities to participate in this program.

System's Gains and Losses

- The system would gain the technological supplies for data collection.
- The system would gain a long term partner to aid in developing transparency and even potentially technological literacy among locals.

References

- 1** Fitch Solutions Group Limited. "Guinea telecoms report - 2019." Online. 2019
- 2** Ibid.
- 3** Ibid.
- 4** Ibid.

Columbia University

About

Columbia University in the City of New York is a world renowned private university and research institution. Their role in this project to research bauxite mining in Guinea to increase transparency of health and environmental impacts. Columbia University's goal is to reduce the negative impacts of bauxite mining through better enforcement of existing regulations, remote sensing, field evidence submitted by affected communities via smartphones, and a legal review of best practices. UNDP Guinea has pledged substantial in-kind and financial support; this project is also co-funded by the Earth Institute (EI) at Columbia University.¹

Benefits of Participation

- The proposed project is in line with several aspects of the Earth Institute's mission.²
- Empowering citizens through citizen science and information sharing while ensuring sustainable mining operations.
- Offers opportunities, through the participation of students for service learning.
- Fostering capacity building for counterparts at local universities in Guinea.
- Potential to create a scalable low-cost technology for tracking the visible impacts of bauxite mining and model this information to inform legislation and compliance.

Challenges of Participation

- Potential political backlash for aiding a project that may cause government officials to be exposed due to increasing transparency
- Reputational risk with a possible unsuccessful implementation of the project

Motivations

Positive Motivations

- Access to data that could be used for other similar projects.
- Developing and maintaining networks of stakeholders and experts for future projects.
- Grants and funding would incentivize Columbia to participate

in the program.

Negative Motivations

- Pressure from the student body to participate in this program.

Barriers to Entry

- Formulating established relationships for smoother implementations of the project.

System's Gains and Losses

- An unbiased external third party who is driven towards increasing transparency and the wealth of data available on this topic.
- System would gain technical expertise necessary to successfully tackle the technical pieces within this project.

References

1 Earth Institute, Columbia University. "Earth Frontiers: Seed Funding for Interdisciplinary Sustainability Research and Practice Community-Based Environmental Impact Tracking for Bauxite Mining in Guinea: Project Proposal." Internal. Online. 2020

2 Ibid.

Youth

About

The youth makes up 60 percent of the population in Guinea. They are socially conscious. However, they remain politically disengaged and distrusting of established institutions. In the past, youth groups have been more likely to engage in action through protests and public demonstrations of dissent. Their dissent towards the government is influenced by high unemployment levels facing the majority of Guinean youth. The youth are proud of their Guinean culture and independence and are interested in being part of the change to improve the country's future. They are more literate than their elders and have access to smartphone communication. They are a potential group that could work on data collection given their ability to use smartphones, read, and their interest in Guinea's future.

Benefits of Participation

- By participating in this program, the youth of Guinea could improve the livelihood and environment of their communities
- The youth have displayed the desire to root out corruption and improve transparency in the mining sector.

Challenges of Participation

- The youth would be spending their time on an initiative that does not offer employment or remuneration.
- Engaging in a project that holds mining companies accountable could harm their chances of being employed by one of the mining companies.

Motivations

Positive Motivations

- National pride to improve their communities and their future prospects
- 60% of the youth in Guinea are unemployed so the offer of employment would be highly motivating. ¹

Negative Motivations

- The lack of trust in institutions might encourage youth to participate in this project. This is due to the isolation from political participation. ²

- Similarly, exclusion from the planning and implementation process for projects might encourage youth participation.³

Barriers to Entry

- An option for employment or remuneration for data collection would lower the barrier to entry for the youth in Guinea.

System's Gains and Losses

- The youth account for the majority of Guinea's population and as they are innately motivated to improve and contribute to their country, it would be imperative to engage them in this initiative through existing youth advocacy groups.⁴
- As educated and technologically literate members of their communities, youth could play an integral role in extensive data collection and rapid adoption of the technology.
- Partnerships with government agencies would increase the likelihood of the youth being unwilling to participate because of their historic exclusion from political processes and high distrust in the government.
- Ultimately, the system could be harmed by their lack of motivation to contribute to a system that is inclusive and or dependent upon government agencies.

References

¹ IRIN. "Defusing Guinea's Youth Unemployment Time Bomb." The New Humanitarian, 13 September 2013

² Bangura, Ibrahim Bangura. "Young People and the Search for Inclusion and Political Participation in Guinea." African Conflict and Peacebuilding Review, Vol. 8, Issue 1, Pp. 54-72. Spring 2018

³ IRIN. "Defusing Guinea's Youth Unemployment Time Bomb." The New Humanitarian, 13 September 2013

⁴ Central Intelligence Agency. "The World Factbook: Guinea." Online. 1 February 2018.

Financiers



Abdoulaye Magassouba
Minister of Mines and Geology of the
Republic of Guinea

About

A wide range of investors including multilaterals and private banks have funded bauxite mining companies and their project expansions/ infrastructure works in Guinea.

A non-exhaustive list includes:

- World Bank Group/ International Finance Corporation
- African Development Bank
- Export Development Canada
- Societe Generale
- ING Bank
- Germany's Deutsche Investitions- und Entwicklungsgesellschaft (DEG) Natixis
- BNP Paribas
- DFI PIDG
- Mubadala Investment Company

Stakeholder Priorities

- Make a return on their investment.
- Appease shareholders.
- Diversify investment portfolios.
- (Multilaterals) – support growth and development in emerging economies.

Benefits of Participation

- Positive PR exposure
- Support Environmental Impact Assessment compliance
- Avoid costly litigation

Challenges of Participation

- They would no longer be able to ignore the negative externalities generated by the projects they are funding.
- Financiers may encounter resistance from mining companies who received their funding. Companies may choose to work with other entities that do not require environmental programs.

Motivations

Positive Motivations

- Preemptive action will help avoid future complaints and litigations.

- IFC policy states that if a client fails to comply with its environmental and social commitments, as expressed in the legal agreements and associated documents, the IFC will work with the client to bring it back into compliance. If the client fails to re-establish compliance, the IFC will exercise its rights and remedies, as appropriate. ¹
- Reputation building by showing they have partnered with organizations like UNDP and Columbia to take responsibility for their actions.

Negative Motivations

- The proposed mobile application enables localized identification of negative externalities. By choosing not to participate, financiers may be accused of complacency in their borrower's violation of standards/agreements.
- This could be followed by massive reputational damage should the project decide to take findings of violation to media outlets.

References

¹ International Finance Corporation "Policy on Environmental and Social Sustainability" Online. 2012

3. Implementation Scenarios

After building the stakeholder profiles meticulously, our team was able to start designing the implementation scenarios. These implementation scenarios are essentially a scenario map depicting each stakeholder and their role within the model. The roles were broken down into a structure with three main responsibilities: data management, funding, and data collection.

Through our analysis we were able to formulate seven scenarios that are feasible to implement. These scenarios vary in levels of trust in each stakeholder or within the model itself, the level of funding, the amount of local and international players, utilization of other local resources, and the level of technological capabilities.

Scenario 1: Virtuous Community

Scenario 2: All Hands on Deck

Scenario 3: Integration with Medical Infrastructure

Scenario 4: Integrating Data Collection and Analysis into Schools

Scenario 5: Path of Least Resistance

Scenario 6: Pay the People

Scenario 7: Technologically Versatile and Structurally Connected

SCENARIO 1

VIRTUOUS COMMUNITY

Scenario Assumptions

In this scenario, it is assumed that all groups would like to improve the community as a whole. Since it can be presumed that everyone is acting with integrity, the level of trust is high. Therefore, checks and balances mechanisms used to ensure lack of corruption are unnecessary beyond general social accountability. This model also assumes that stakeholders would be willing to participate and collect data without any remuneration.

Data Management

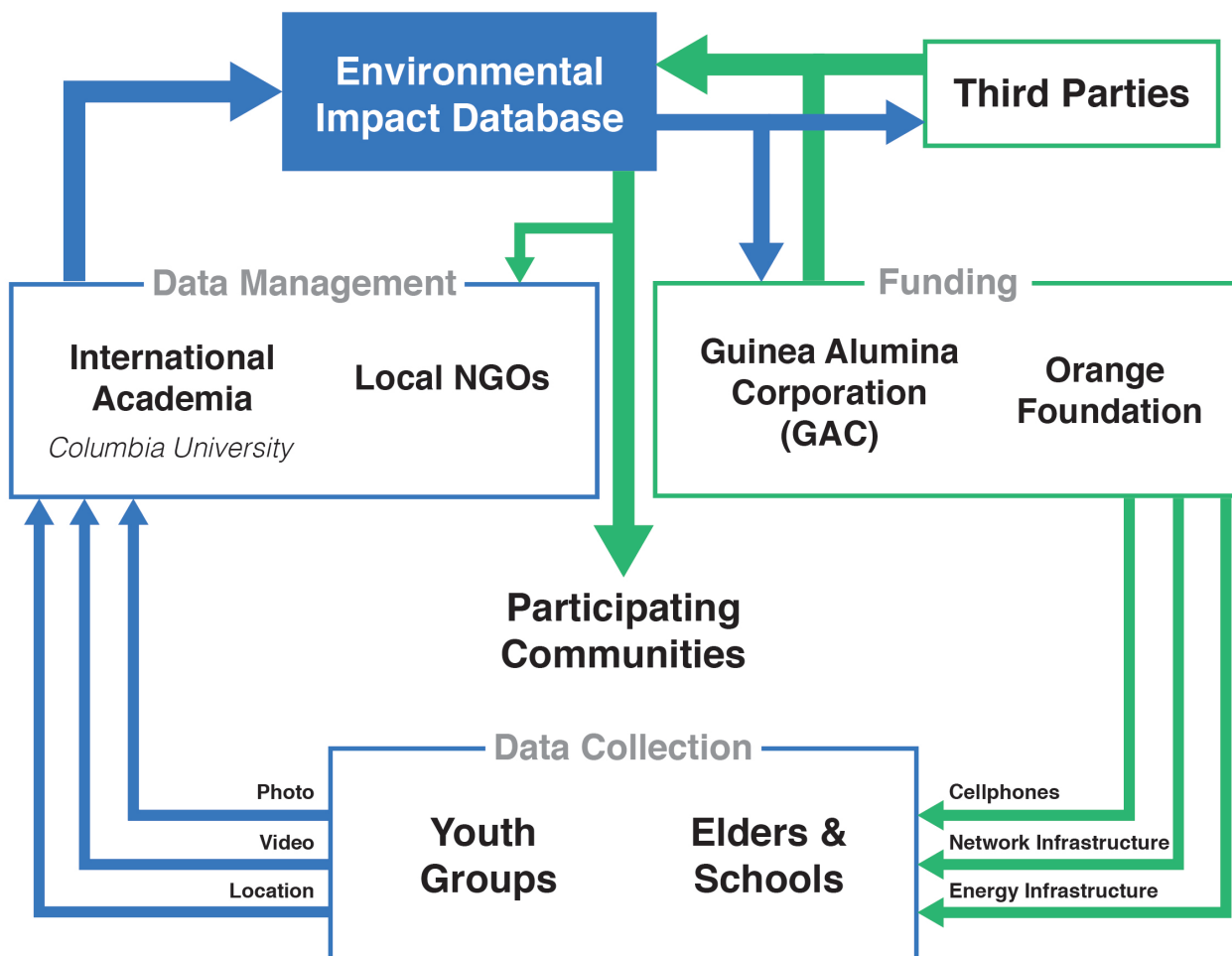
Data management will receive data from data collectors to analyze and verify, identify outlier information, maintain the environmental impact database, publish information in regular intervals, and help data collectors access information after it has been synthesized.

Funding

The funding partners will be in charge of providing stakeholders with materials needed to perform data collection and maintain operation of database servers and data management. They will also be able to purchase finalized data through the environmental impact database. In addition, the funding actors will have the potential to fund data management scholarships at universities.

Data Collection

Data Collectors will receive resources from funding parties through Non-Governmental Organizations (NGOs), and then utilize these materials to collect data, transmit data to Data Management stakeholders, and receive money from the environmental impact database.



1. International Academia

Columbia University

Function within System

Columbia University (CU) will be in charge of receiving data from data collectors, managing servers, and reviewing collected data to interpret and convert into reporting. CU will also provide a significant amount of money that will be used to maintain the database.

Benefits to Stakeholder

- CU would gain access to raw environmental data and be able to CU would gain access to raw environmental data and be able to utilize the data collection for research purposes
- Through this system, CU would gain access to an information collection network in Guinea, which could help programs within the CU education system pursue other projects.
- CU would forge strong connections and networks with international organizations like the United Nations Development Programme (UNDP) and other stakeholders within this system. These connections could lead to new opportunities for multiple programs within the CU education system.

Challenges to Stakeholder

- Researchers at CU do not have experience working with the mining industry's environmental impacts within the context of Guinean communities.
- CU could find difficulties with managing the data collection program from afar. CU needs to find a trustworthy partner on the ground that could assist with data management.
- CU's funding capacity might be more limited than what would be necessary for the project. Other streams of funding might be required.

Benefits to System

- CU has high technological literacy, and would be able to effectively initiate and manage this project from the outset.
- Locals have a higher level of trust towards international academic institutions. Local Universities are underfunded or are seen as biased, or potentially corrupt, diploma-printing organizations.
- CU would have access to supplementary data that could be used to verify the collected data and the robustness of final insights and conclusions.
- CU's distance and educational motivations prevent corruption that adds to the accountability and trustworthiness of the entire system.

Challenges to System

- The main challenge CU presents to this scenario is its distance from the project. The lack of personnel on the ground can hinder

the efficiency of the program as they are not able to adapt to changes immediately. There could be significant delays between data collection and data analysis.

- It is not sustainable for CU to be hosting the data storage in the long term, as it limits control of local stakeholders over their own intellectual property. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- The lack of in-person or on the ground involvement may not be as strong a mechanism to prevent corruption as they do not get to observe the day to day operations of the project.

2. Local Non-Governmental Organization (NGO)

Function within System

NGOs play a critical role in community empowerment, acting as a mediator between the community, government, and mining companies. They are generally trusted by local communities, which makes them an essential stakeholder in the implementation of this project.

The Local NGO would work in partnership with International Academia to establish a presence for the pilot project within the Boké region. This stakeholder would direct resources and participants appropriately within their roles and provide training to data collectors within the community. This stakeholder would also collect and document the funds transferred from the Funding stakeholders and convert them into the appropriate physical and technological resources that would be used by data collectors.

Benefits to Stakeholder

- Local NGOs are generally trusted by most stakeholders, but would benefit from the credibility gained from their participation in this system with international aid and educational organizations.
- Funding from this system could give Local NGOs the resources they would need to secure necessary equipment and personnel that could benefit other projects it may be pursuing. For example, this project will provide the NGO with access to data or data collection capacity that could potentially be of use to their own initiatives.
- Local NGOs will have the opportunity to strengthen existing relationships within communities. However, the Data Management portion of the project can be managed remotely and without significant physical or resource involvement of staff.
- If the Local NGO is not currently focused on environmental pollution and remediation, its involvement in this system will enhance the NGO's understanding of the interconnectedness between environmental problems and problems it is already tackling, for example, health or land tenure or education and sustainability.

Challenges to Stakeholder

- Local NGOs are generally underfunded and understaffed. Taking on a project of this size might preclude an NGO from participating; could require multiple NGOs to participate, which could make management of data more complicated or could draw resources away from their existing initiatives.
- Local NGOs may not have a good relationship with some government or mining entities, which could be problematic in the general management of this system. Increased contact with these stakeholders could directly heighten the potential for corruption and bias.
- Local NGOs might not have any experience in conducting data collection and would need significant direction and support from

other management stakeholders.

Benefits to System

- NGOs are a trusted stakeholder among locals, and therefore more likely to succeed in training and managing data collectors. The communities' support and trust of Local NGOs lends legitimacy to this project.
- The grassroots knowledge of NGOs that is informed by the communities in the Boké Region. This would inform the system with cultural and practical nuance that would be difficult to achieve if the system relied only on international and corporate stakeholders.
- Local NGOs might have some experience with similar projects and data collection techniques, which can facilitate the pilot project's implementation.

Challenges to System

- While Local NGOs do have on-the-ground knowledge, many of them have a niche focus with their work, which might lead to future complications with differing priorities between the system and this stakeholder.
- Local NGOs' limited manpower may create issues in timely data collection and training, slowing down initial implementation.
- Local NGOs may not have the technical experience needed for data management and hence will likely need to be trained by an international academic institution such as Columbia University or a more technical partner.
- Local NGOs have different missions and the mining industry has had different impacts on each community. Data Management will have to adapt to the needs of each community and each NGO.

3. Guinea Alumina Corporation (GAC)

Function within System

GAC's investors have expressed interest in upholding the company's pursuit of social and environmental sustainability goals on their Corporate Social Responsibility agenda.

Function within System

In this scenario, GAC provides funding that is handled and disbursed by both Data Management stakeholders. It purchases analyzed datasets from the Environmental Information Database.

Benefits to Stakeholder

- GAC's participation in this system would improve the company's Environmental Social Governance (ESG) ratings and Corporate Social Responsibility goals, which could open up opportunities with investors. Additionally, this program could be an opportunity to establish training for staff in sustainability related issues that will help to improve the company's ESG values in the future.
- Mining Companies have a strained relationship with communities of Boké. By opening up productive and ameliorative channels, GAC could set a standard for interactions and justice between mining companies and communities reducing public dissent.
- The mining company could acquire access to local data collected through this project and regular reports.
- Participating in this system would allow GAC to keep up with loan commitments from the International Monetary Fund, which mandate sustainability guidelines to follow in exchange for their continued financial support.

Challenges to Stakeholder

- By participating in this system, GAC runs the risk of bad press surrounding mining pollution or eventual environmental regulation damaging their potential for profits, which would be counter-productive to operations. Additionally, GAC will be tasked with tracking data that may expose corruption and potentially diminish their relationship with foreign investors.
- The problems with the current standards of reporting through a paid third party contractor has led to a conflict of interest in reporting. Participation in this project would be an acceptance of that fact, which may dissuade such participation in the first place.
- Perceived lack of monetary incentive for participation might be a disincentive for participation. This perception would need to be challenged with strong policy or explicit financial analyses, which might be offloaded financially to other stakeholders.
- The pilot project aims to include 30 people, which might be an unappealing small scale for a business of GAC's size.
- If GAC is investing in this project, it might want control over some

aspects of how funding is spent, either to decrease inefficiencies or to limit risks associated with bad press or potential regulations.

Benefits to System

- GAC has the financial resources to fund this system beyond the success of the pilot project.
- GACs participation would generate precedent to set new policies requiring more stringent reporting standards within the mining industry of Guinea.
- This stakeholder's Participation in this system is a display of goodwill from one of the most financially powerful stakeholders in Guinea. By demonstrating their willingness to participate and be involved in this process, it would encourage other stakeholders.

Challenges to System

- Considering GACs previous indications of interest in establishing a program like this, there are very few downsides to their participation within this system. However, if GAC were to be replaced with another mining company that had not explicitly consented and encouraged the development of a system, it could have the potential to add an element of corruption to the system's framework that would have to be mitigated by the addition of more powerful watchdog organizations.

4. Orange Foundation

Function within System

Orange is a mobile carrier service that provides the technological framework for the success of this project. Its aid is integral to achieving the intended widespread reach of this project: connect with the local communities to generate the necessary user data.

Orange Foundation provides the equipment and networks needed for data collection, including cell phones, a central power source where Data Collectors can charge phones, and local cellular network capacity. They are primarily in contact with the Local NGO.

Benefits to Stakeholder

- Orange Foundation has a Corporate Social Responsibility (CSR) program existing, in which it works with schools to provide educational technology. Orange would play a similar role in this system, and its participation would contribute to their CSR portfolio.
- Orange would have a unique opportunity to establish positive connections and place products with potential customers, as well as expand its cellular network.

Challenges to Stakeholder

- Orange could have compromised interests in favor of supporting the business of the mining companies that would hinder its participation in this system.
- Orange could have limited financial resources to allocate towards this project, and might have a bias towards its own business. This project might be beyond its interest in or capability to invest in the communities it serves.

Benefits to System

- Orange could provide implementation information, such as the size of the network that would be needed for testing within the scope of the pilot project as well as requirements and potential sites for expansion.
- Additionally, Orange could assist in facilitating the implementation of network hardware in participating pilot communities.
- Orange likely has no major pro-mining bias.

Challenges to System

- Depending on who the direct representative is, this stakeholder may be swayed by political unrest.
- Potential conflict of interest with mines may create hesitations in this stakeholder's involvement.

5. Youth Groups

Function within System

In this scenario, we expect that the youth have a selfless passion for improving their community stemming from national pride, a desire to root out corruption, and an aspiration to improve their future. Youth groups represent the predominant drivers in data collection for this project as this project hopes to empower the youth with the ability to speak out against detrimental practises within the mining industry.

Youth Groups utilize the cellphones and infrastructure provided by Orange to capture evidence of environmental pollution. They then send the data to the Data Management stakeholders through the Environmental Impact Database. Once data has been sold to Funding stakeholders and Third Parties, as members of the community, the Youth Groups receive the benefits through Community Development Funds.

Benefits to Stakeholder

- The members of this stakeholder group would gain the opportunity to actively participate in the remediation of environmental impacts. The pilot project has the potential to empower the youth by building organizational capacity.
- This stakeholder would be able to connect with international stakeholders, which could bring opportunities for development and improved capacity for their communities.
- This stakeholder would be able to interact with mining companies through a trusted, neutral stakeholder like international academia.
- The stakeholder would be able to utilize the data collected and synthesized through this program to support and validate their pollution-related complaints with data.
- This stakeholder would gain access to smartphone technology for data collection, which has the potential to yield co-benefits, chiefly greater connection.

Challenges to Stakeholder

- The primary concern of the members of this stakeholder group is facing retribution for their participation in this system. Participation in the data collection part of this system could be interpreted negatively by participant and non-participant mining companies. This could result in negative repercussions for this stakeholder, for example in the form of withheld compensatory payments for communities.

Benefits to System

- Activating the collective power of Guinean youth has the potential to change more than just mining company pollution for the better. Despite the fact that the youth account for 60% of the population, they are often a forgotten stakeholder amongst those in power.

Challenges to System

- The unpredictability of the youth could pose a challenge to the project. As such, if they do not recognize the significance of their role within this research project, the integrity of the data may be compromised.

6. Elders & Schools

Function within System

An efficient way of maximizing the number of users to a single smartphone is by collaborating with schools and elders who have the ability to organise the community towards a singular objective.

Elders and Schools utilize the cellphones and infrastructure provided by Orange to capture evidence of environmental pollution. They then send the data to the Data Management stakeholders through the Environmental Impact Database. Once data has been sold to Funding stakeholders and Third Parties, as members of the community, these community members receive the benefits through Community Development Funds.

Benefits to Stakeholder

- Elders and Teachers are respected members of their communities. Their participation in this system would allow them to maintain a position of leadership and relevance, especially with younger members of the community who might be disillusioned with the status quo regarding mining compensation.
- Participation in this system would include training to use smartphones, which would increase the technological literacy of this stakeholder group.
- Only teachers and elders who facilitate the data collection need to be technologically literate, therefore decreasing the number of people who require training.

Challenges to Stakeholder

- Relationships with the elders and schools need to be constantly monitored and maintained, so that they remain committed to the project.

Benefits to System

- The cooperation of schools and elders is imperative for the success of this pilot project. Community stakeholders are the most impacted by mining pollution and who this project is designed to help. Without their participation and guidance, the project could not be considered sustainable.
- If this program needs to grow beyond the pilot, it can only do so if a relationship of trust is built between community stakeholders and all other participant stakeholders.

Challenges to System

- This stakeholder will likely need more frequent engagement and motivation, especially if system goals or tasks change throughout the life of the project.

SCENARIO 2

ALL HANDS ON DECK

Scenario Assumptions

Current relationships between stakeholders have shown that stakeholders would not trust each other to participate in this system without bias: data collected by mining companies would be suspect to community members and vice versa. Including a multitude of stakeholders in the data collection process would encourage honest accounting of the data. In addition, the data gathered would be robust as each stakeholder group is able to collect data based on what is most important to them.

Additionally, Data Management intentionally involves stakeholders excluded or marginalized by mining activity by providing alternative employment to members of the agriculture sector who have lost their source of income due to pollution. Many of the members of the agriculture sector are women, and so directing the data collection and data management to provide insights that are especially relevant to these stakeholders is important. This scenario assumes that these stakeholders are willing and able to train and explore occupational interests beyond what they have traditionally known.

Data Management

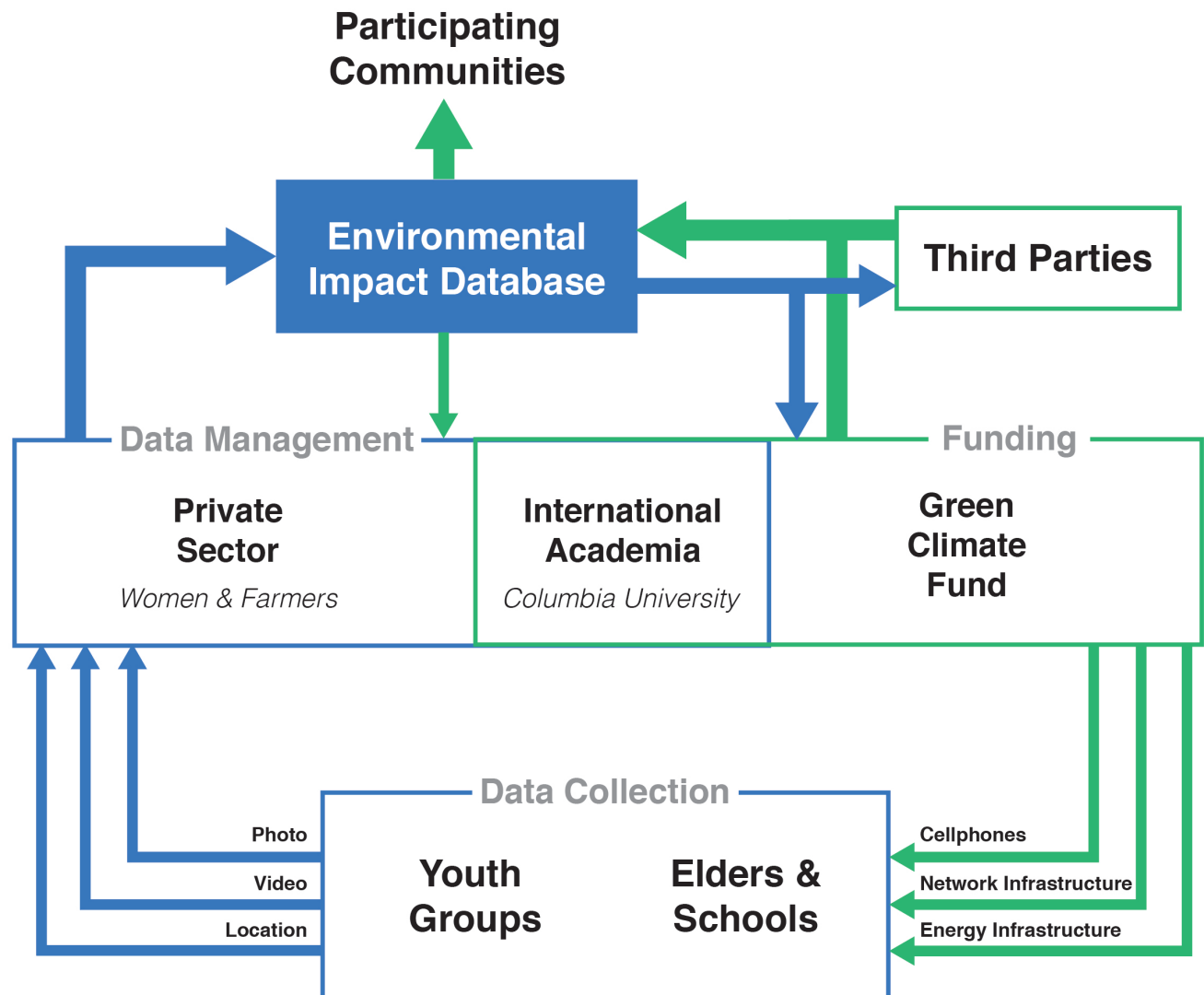
Data management will receive data from data collectors to analyze and verify, identify outlier information, maintain the environmental impact database, publish information in regular intervals, and help data collectors access information after it has been synthesized.

Funding

Funding stakeholders will supply financial and material resources to data management and data collection stakeholders. Funds will be used to maintain operation of database servers and pay data management stakeholders. Materials supplied, such as cellphones and network improvements, will be used to collect data. Funding stakeholders will also be able to purchase finalized data through the environmental impact database, with the potential to fund data management scholarships at university.

Data Collection

All Data Collectors receive resources from Funding Stakeholders through Non-Governmental Organizations (NGOs). Resources include materials to collect and transmit data to Data Management. Increasing the number of users increases the quantity of data collected. The quantity of data can assist verification efforts, as well as contribute to more informed analyses.



1. International Academia

Columbia University

Function within System

Columbia University (CU) will be in charge of receiving data from data collectors, managing servers, and reviewing collected data to interpret and convert into reporting. CU also directs the technical aspects of data collection. For example, if data collection methods should need to change in order to improve data. CU will also provide funding enough to allow technical analysis equipment will function.

Benefits to Stakeholder

- CU would gain access to raw environmental data and be able to direct the data collection to their benefit.
- Through this system, CU would also gain access to an information collection framework in Guinea, which could help programs within the CU education system pursue other projects.
- CU would forge strong connections and networks with international organizations like the United Nations Development Programme (UNDP) and other stakeholders within this system. These connections could lead to new opportunities for multiple programs within the CU education system.

Challenges to Stakeholder

- Researchers at CU do not have experience working with mining industry environmental impacts within the context of Guinean communities.
- CU could find difficulties with managing the data collection program from afar. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- CU's funding capacity might be more limited than what would be necessary for the project. Other streams of income might be required.

Benefits to System

- CU would be beneficial to this network because they have the technological literacy, and would be able to effectively initiate and manage this project from the outset.
- Locals have a higher level of trust towards international academic institutions. Local Universities are seen as underfunded or biased, or potentially corrupt, diploma-printing organizations.
- CU would have access to supplementary data that could contribute to more verification of collected data and the robustness of final insights and conclusions.
- CU's distance and educational motivations prevent corruption that adds to the accountability and trustworthiness of the entire system.

Challenges to System

- The main challenge CU presents to this scenario is its distance to the project. The lack of personnel on the ground can hinder the efficiency of the program as they are not able to adapt to changes immediately. There could be significant delays between data collection and data interpretation.
- It is not sustainable for Columbia University to be hosting the data storage in the long term, as it limits control of local stakeholders over their own intellectual property. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- The lack of in-person or on the ground involvement may not be as strong a mechanism to prevent corruption as they do not get to observe the day to day interactions of the project.

2. Farmers & Women

Function within System

This stakeholder group would be employed and trained to be in charge of data management on the ground. The farmers' and womens' knowledge of and connections within their communities would direct the data collection as well as steer data collection and synthesis towards insights that are relevant to communities beyond just mining company pollution data. This stakeholder would also distribute the physical equipment that would be needed to collect data to community-based data collectors.

Benefits to Stakeholder

- Impacted financially and occupationally by the destruction of crops due to mining related pollution, this stakeholder would benefit from a temporary to long-term change of occupation.
- Training required to perform this job would develop their communities' and their own educational capacity.

Challenges to Stakeholder

- This stakeholder does not have the knowledge that would allow them to participate in this system without significant training and technological sensitivity training.
- This stakeholder does not have time to contribute to this project, and may find it difficult to contribute on a regular basis.

Benefits to System

- Creating occupational pathways and networks between communities and the other stakeholders in this scenario could lay groundwork for economic development efforts.
- The consistent stream of income to this stakeholder provides a higher degree of economic security for the local population.

Challenges to System

- There is a chance of tension within the community if stakeholder groups are designated specific authority over others, especially considering that men generally hold positions of authority and we are recommending that women lead the charge in this scenario. Improving and maintaining the relationships between stakeholders is imperative to obtain cooperation from all stakeholders involved with the project.

3. Green Climate Fund

Function within System

Green Climate Fund is the world's largest fund dedicated to helping developing countries reduce their greenhouse gas emissions and enhance their ability to respond to climate change. This pilot project would be a good candidate for receiving funding from The Green Climate Fund. These finances are granted under specific criteria. The GCF does rigorous research that would hold mining companies accountable to commitments made in order to receive the funds.

This stakeholder vets and qualifies all stakeholders within this system. Then it provides finances to Data Management stakeholders which are used to sustain data management capacities as well as purchase data collection equipment to be distributed by community-based stakeholders.

Benefits to Stakeholder

- This stakeholder would gain several well-connected and high profile clients through their engagement with this project.
- This project is unique in the way that stakeholders are organized structurally within the system, and the project's success Boké might serve as a good example and lead to implementation elsewhere.

Challenges to Stakeholder

- This project would be ambitious--many stakeholders are responsible for the success of the project compared to the size of the project. GCF must engage in rigorous background checks and proposal screenings which might complicate the funding process.

Benefits to System

- GCF has been working in the sustainable development space for the past 10 years, and could provide insight into successes and pitfalls that other similar projects might have encountered.
- The rigor of GCFs vetting process lends legitimacy and leverage to this project, and opens pathways to greater funding in the future.

Challenges to System

- GCFs application requires an economic model for the project. This could be complicated for the stakeholders in this system to provide, considering that the project is not primarily entrepreneurial.

4. Government

Ministry of Mines and Geology

The Ministry of Mines holds a pivotal role in the oversight and regulation of the country's mineral deposits. This network is a valuable asset to the future growth of this project, as it would allow more access to influential figures within Guinean governance who may be willing to assist.

Ministry of Agriculture

The constituents of the Ministry of Agriculture's economic sector have been negatively impacted by mining pollution. This stakeholder could be compelled to take action in order to support the region's Agricultural industry.

Function within System

Members of this stakeholder group pay for and utilize cellphones to capture evidence of environmental pollution. They then send the data to the Data Management stakeholders through the Environmental Impact Database.

Benefits to Stakeholder

- This stakeholder's engagement in the process would prove to members of impacted communities that the government is taking action to mitigate pollution, which has the potential to reduce the chance of civil unrest.
- The successful execution of this system provides resiliency to Guinea's GDP by allowing for the resuscitation of the agricultural sector in the region.

Challenges to Stakeholder

- The project's ultimate goal is to restore the local population's voice, which directly undermines the ministry's control over public information.
- The data collected for this project would increase pressures on the ministry to take actions against the environmental degradation caused by the mining companies.

Benefits to System

- The Ministry of Mines would be taking steps towards enhancing transparency in the mining industry.
- The way in which data is gathered in this project can be used as a template for future data collection needs.
- The Ministry of Mines could improve their subpar relationship with the UNDP and NGOs involved in this project.

- This stakeholder's involvement in the project increases the other stakeholder's trust in the efficacy and equity of government efforts.

Challenges to System

- Foreign investments are attracted to the low barriers to entry imposed by the Guinean government. By participating in this project, the government would risk losing future investments. This would make it difficult for the ministry to continue to justify participation in this project.

5. Community

Youth Activists

Youth have a selfless passion for improving their community strengthened by their national pride, desire to root out corruption, and improve their futures.

Elders

Elders are leaders within their communities. They have continually advocated for justice against the damages to their communities caused by mining..

Function within System

This stakeholder utilizes cellphones, provided by Data Management stakeholders to capture evidence of environmental pollution. They then send the data to the Data Management stakeholders through the Environmental Impact Database. Communities with participating members own the data and receive payment generated from the sale of data through the environmental impact database in the form of Community Development Funds.

Benefits to Stakeholder

- This stakeholder would be able to interact with mining companies directly from a position of equal footing, and be consistently in contact with them throughout the evidence collection process.
- This system would legitimize and strengthen communication pathways between local communities and government.
- The stakeholder would be able to support and validate their pollution-related complaints with the data collected and synthesized through this program.
- This stakeholder would gain access to smartphone technology for data collection, which has the potential to yield co-benefits, chiefly greater connection.
- Active participation in this system would yield more trust and understanding of the system.

Challenges to Stakeholder

- The primary concern of the members of this stakeholder group is facing retribution for their participation in this system. Participation in the data collection part of this system could be interpreted negatively by participant and non-participant mining companies. This could result in negative repercussions for this stakeholder, for example in the form of withheld compensatory payments for communities.

Benefits to System

- The cooperation of the youth and elders is imperative for the success of this pilot project. Community stakeholders are the most impacted by mining pollution and who this project is designed to help. Without their participation and guidance, the project could not be considered sustainable.
- If this program needs to grow beyond the pilot, it can only do so if a relationship of trust is built between community stakeholders and all other participant stakeholders

Challenges to System

- The relationship of trust must be managed delicately in order to maintain involvement and investment with these communities for the future.

6. Industry

Guinea Alumina Company (GAC)

As a data collector, GAC is in a unique position to relay relevant data that would undermine the need for this project, however, as they remain privately held, they are under no obligation to report on the data points the project collects. Therefore in joining this project, GAC would be investing resources into improving their ESG score in preparation for shifting investment standards.

Function within System

This stakeholder pays for and utilizes cellphones to capture evidence of environmental pollution. They then send the data to the Data Management stakeholders through the Environmental Impact Database.

Benefits to Stakeholder

- GAC's participation in this system would improve the company's Environmental Social Governance (ESG) ratings and Corporate Social Responsibility goals, which could, in turn, open up opportunities with investors. Additionally, this program could be an opportunity to establish training for staff in sustainability related issues that will help to improve the company's ESG values in the future.
- Mining Companies have a strained relationship with communities of Boké. By opening up productive and ameliorative channels regarding environmental pollution, GAC could set a standard for interactions and justice between mining companies and communities that could reduce public dissent.
- The mining company could acquire access to ground data collected through this project and regular reports.
- Keeping up with loan commitments from the International Monetary Fund, which mandate sustainability guidelines to follow in exchange for their continued financial support.

Challenges to Stakeholder

- By participating in this system, GAC runs the risk of bad press surrounding mining pollution or eventual environmental regulation damaging their potential for profits, which would be counter-productive to operations. Additionally, GAC will be tasked with tracking data that may expose corruption and potentially diminish their relationship with foreign investors.
- The problems with the current standards of reporting through a paid third party contractor has led to a conflict of interest in reporting. Participation in this project would be an acceptance of that fact, which may dissuade such participation in the first place.

- Perceived lack of monetary incentive for participation might be a disincentive for participation. This perception would need to be challenged with strong policy or explicit financial analyses, which might be offloaded financially to other stakeholders.
- The pilot project aims to include 30 people, which might be an unappealing small scale for a business of GAC's size.
- If GAC is investing in this project, it might want control over some aspects of how funding is spent, either to decrease inefficiencies or to limit risks associated with bad press or potential regulations

Benefits to System

- GAC has the financial resources to fund this system beyond the success of the pilot project.
- GACs participation would generate precedent to set new policies requiring more stringent reporting standards within the mining industry of Guinea.
- This stakeholder's Participation in this system is a display of goodwill from one of the most financially powerful stakeholders in Guinea. By demonstrating their willingness to participate and be involved in this process, it would encourage other stakeholders.

Challenges to System

- Considering GACs previous indications of interest in establishing a program like this, there are very few downsides to their participation within this system. However, if GAC were to be replaced with another mining company that had not explicitly consented and encouraged the development of a system, it could have the potential to add an element of corruption to the system's framework that would have to be mitigated by the addition of more powerful watchdog organizations.

SCENARIO 3

INTEGRATION WITH MEDICAL INFRASTRUCTURE

Scenario Assumptions

This scenario was developed as an alternative to the seamless end to end data collection of some of the other scenarios. The assumption underlying this scenario is that some communities may not have sustainable access to the internet or to smart phone technology that would allow them to upload photos and data in real time. By using the preexisting health data collection process, it also provides a powerful additional benefit of partnering with the Ministry of Health or other health related stakeholders.

This scenario also assumes that the communities have high trust in the health system in Boké. The interview with Claire Standley, who worked in Guinea to establish the health data collection system from 2015 - 2019, raised the point that not all communities may have high trust with the government health system. So, involving the broader informal health network may be required, such as pharmacies and other private operators.

This model assumes that stakeholders would be willing to participate and collect data without any remuneration.

Data Management

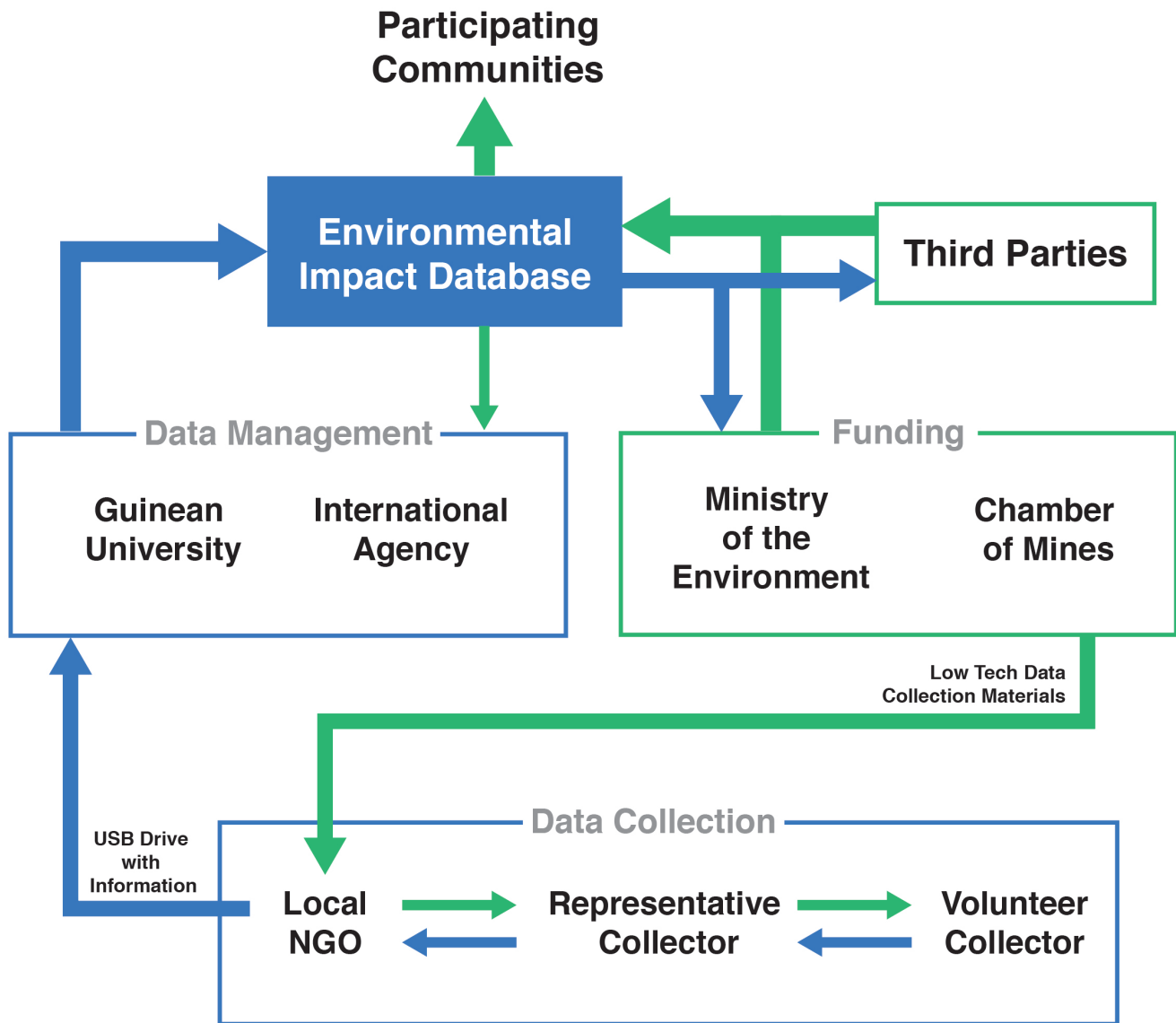
Data management will receive data from data collectors to analyze and verify, identify outliers, maintain the environmental impact database, publish information in regular intervals, and help data collectors access information after it has been synthesized. The environmental impact database in this instance is designed to fold into the existing health data collection and management process. Data management will also need to evolve as new types of information will need to be collected, particularly around health data.

Funding

The funding partners in this scenario will be in charge of supplying data management and data collection stakeholders with materials needed to collect data and funds to maintain operation of database servers and data management. The funding stakeholders will also be able to purchase finalized data through the environmental impact database. The funding actors will also have the potential to fund data management scholarships at university.

Data Collection

The data collection process involves data collectors collecting data using their smartphone, or using any other low tech data collection device. Data collectors will upload the collected data on central computer hubs installed at a community's school, pharmacy health clinic or hospital. This process removes many technology barriers to entry for this stakeholder group, but also affords co-benefits for exposure to medical resources and community cohesiveness.



1. Ministry of Health

Function within System

A core advantage of this process is the potential to use existing hardware and knowledge to manage the environmental data alongside the health data that is being collected. However, it will still require additional software and training to incorporate the additional data collection. It is unclear at this stage how the data is managed at this level, so it will require close partnering with the Ministry of Health to develop the new processes.

The Ministry of Health (MOH) will be working closely with other Data Management and Data Collection stakeholders to integrate environmental data collection into the existing health data collection process. The MOH will identify potential sites to host central hubs for data transfer.

Benefits to Stakeholder

- There is potential for the MOH to capitalize on expanding their existing data collection and analysis program to include environmental factors by finding additional funding through environmental organizations.
- The MOH would be able to broaden its outreach to communities by initiating a wider community effort for data collection of varying types.
- The MOH would be able to increase its exposure within communities and use its sway and connections to support and grow smaller medical offices, such as clinics and pharmacies.
- The MOH would be able to increase its connection and collaboration with International NGOs.

Challenges to Stakeholder

- MOH needs must be aligned with the needs of the UNDP for the purposes of this application, especially since the initial benefits of this program will focus on data transparency rather than directly relate to health outcomes.

Benefits to System

- The MOH will enhance the credibility and trust of the system as an 'objective' major stakeholder.
- The MOH already has access to data hardware, knowledge, processes and network that could be useful for this program.
- With the MOH's involvement, there is the potential to attract international NGO funding for enhanced health and environmental data collection. Thus, providing greater joint funding for the overall project.
- The MOH could utilize its extensive experience and relationships within the community for data collection training.

- The MOH could encourage the involvement of a broader network of community members (health providers and users) into the data collation processes.

Challenges to System

- Ensuring that the environmental data and health data processes are integrated may be more complex than what this Capstone Group's research has indicated. Also, it may change and evolve from the point of research to implementation.
- The environmental data collection may overburden an already stretched health data collection system if it is not implemented effectively.

2. International NGO

Function within System

International NGOs health and environment networks have access to international funding, but most importantly they can play a critical role in community empowerment by acting as a mediator between the community, government, and mining companies. The International NGO in this scenario is already working with the Ministry of Health and other health infrastructure stakeholders and guides International Academia towards the data that would be most relevant to this pilot project.

Benefits to Stakeholder

- This pilot project and project mission would directly align with some of the aims and goals of this stakeholder.
- The quality of data collected would enable this stakeholder to better advocate for social and environmental policies within Guinea and in other locations struggling with mining pollution
- This stakeholder would gain access to raw environmental data and be able to direct the data collection to their benefit.
- Through this system, the International NGO would also gain access to an information collection framework in Guinea, which could help programs within its organization to pursue other projects.

Challenges to Stakeholder

- This stakeholder might find difficulties aligning their priorities with those of the MOH and other NGOs operating in this space.
- Duration of involvement is unknown within this structure as this stakeholder may have to be involved for an extended period of time, which could make this stakeholder vulnerable to unforeseen internal costs
- There is not an established foundation of trust between the International NGOs, the mining companies, and the government organization.
- International NGOs might not be based within Guinea or Boké. The lack of personnel on the ground can hinder the efficiency of the program as they are not able to adapt to changes immediately. There could be significant delays between data collection and data interpretation.
- International NGOs are involved in many pressing public health issues such as Covid-19 and providing clean water, this project might distract and divert resources from these issues.
- This stakeholder might find it challenging to mediate the existing private and public funding connections within the medical infrastructure.

Benefits to System

- This stakeholder has experience working with similar cross-sector engagement projects, and could lend its expertise to the execution and management of the project.
- International NGOs lend a public perception of trustworthiness and credibility to the entire system. Additionally, based on this stakeholder's international presence, it could garner positive global media attention for this project.
- This stakeholder has access to funding for needs beyond the scope of this project, for example internet, medical and energy infrastructure needed for this project.
- This stakeholder is an independent and unbiased party and is well suited to serve as a verifying party of information.

Challenges to System

- International NGOs might be too niche with their focus for the system to adapt to suit the needs of the people impacted by mining pollution. This might lead to priorities different than what is best for the community as the project would be beyond the reach of this stakeholder.
- International NGOs typically face excessive bureaucracy within their organization, which could slow down the project milestones.

3. International Academia

Columbia University

Function within System

CU will be in charge of receiving data from data collectors, managing servers and the Environmental Impact Database, and reviewing collected data to interpret and convert into reporting. CU also directs the technical aspects of data collection, the role of which could help establish the data management function but is not expected to be an ongoing role. CU will collaborate closely with other Data Management stakeholders. The role may be transferred to a local academic institution for ongoing management.

Benefits to Stakeholder

- CU would gain access to raw environmental data and be able to direct the data collection to their benefit.
- Through this system, CU would also gain access to an information collection framework in Guinea, which could help programs within the CU education system pursue other projects.
- CU would forge strong connections and networks with international organizations like the United Nations Development Programme (UNDP) and other stakeholders within this system. These connections could lead to new opportunities for multiple programs within the CU education system.

Challenges to Stakeholder

- Researchers at CU do not have experience working with mining industry environmental impacts within the context of Guinean communities.
- CU could find difficulties with managing the data collection program from afar. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- CU's funding capacity might be more limited than what would be necessary for the project. Other streams of income might be required.

Benefits to System

- CU would be beneficial to this network because they have the technological literacy, and would be able to effectively initiate and manage this project from the outset.
- Locals have a higher level of trust towards international academic institutions. Local Universities are seen as underfunded or biased, or potentially corrupt, diploma-printing organizations.
- CU would have access to supplementary data that could contribute to more verification of collected data and the robustness of final insights and conclusions.
- CU's distance and educational motivations prevent corruption that adds to the accountability and trustworthiness of the entire system.

Challenges to System

- The main challenge CU presents to this scenario is its distance to the project. The lack of personnel on the ground can hinder the efficiency of the program as they are not able to adapt to changes immediately. There could be significant delays between data collection and data interpretation.
- It is not sustainable for Columbia University to be hosting the data storage in the long term, as it limits control of local stakeholders over their own intellectual property. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- The lack of in-person or on the ground involvement may not be as strong a mechanism to prevent corruption as they do not get to observe the day to day interactions of the project.

4. Guinea Alumina Corporation

Function within System

In this scenario, GAC is partnered with Columbia University in order to facilitate data collection with their own resources. GAC's investors have expressed interest in upholding the company's pursuit of social and environmental sustainability goals on their Corporate Social Responsibility agenda.

Benefits to Stakeholder

- GAC's participation in this system would improve the company's Environmental Social Governance (ESG) ratings and Corporate Social Responsibility goals, which could, in turn, open up opportunities with investors. Additionally, this program could be an opportunity to establish training for staff in sustainability related issues that will help to improve the company's ESG values in the future.
- Mining Companies have a strained relationship with communities of Boké. By opening up productive and ameliorative channels regarding environmental pollution, GAC could set a standard for interactions and justice between mining companies and communities that could reduce public dissent.
- The mining company could acquire access to ground data collected through this project and regular reports.
- Keeping up with loan commitments from the International Monetary Fund, which mandate sustainability guidelines to follow in exchange for their continued financial support.

Challenges to Stakeholder

- By participating in this system, GAC runs the risk of bad press surrounding mining pollution or eventual environmental regulation damaging their potential for profits, which would be counter-productive to operations. Additionally, GAC will be tasked with tracking data that may expose corruption and potentially diminish their relationship with foreign investors.
- The problems with the current standards of reporting through a paid third party contractor has led to a conflict of interest in reporting. Participation in this project would be an acceptance of that fact, which may dissuade such participation in the first place.
- Perceived lack of monetary incentive for participation might be a disincentive for participation. This perception would need to be challenged with strong policy or explicit financial analyses, which might be offloaded financially to other stakeholders.
- The pilot project aims to include 30 people, which might be on too small a scale for a business of GAC's size.
- If GAC is investing in this project, it might want control over some aspects of how funding is spent, either to decrease inefficiencies or to limit risks associated with bad press or potential regulations.

Benefits to System

- GAC has the financial resources to fund this system beyond the success of the pilot project.
- GACs participation would generate precedent to set new policies requiring more stringent reporting standards within the mining industry of Guinea.
- This stakeholder's Participation in this system is a display of goodwill from one of the most financially powerful stakeholders in Guinea. By demonstrating their willingness to participate and be involved in this process, it would encourage other stakeholders.

Challenges to System

- Considering GACs previous indications of interest in establishing a program like this, there are very few downsides to their participation within this system. However, if GAC were to be replaced with another mining company that had not explicitly consented and encouraged the development of a system, it could have the potential to add an element of corruption to the system's framework that would have to be mitigated by the addition of more powerful watchdog organizations.
- Funding for this project primarily comes from GAC, and their support of this system might change with the outcome. Strict regulations or other limitations that come as a result from this research and program could cause the enthusiasm of COM for participation to wane.

5. Chamber of Mines

Function within System

The Chamber of Mines (COM) has limited ability to fund the project, however, it would be tasked with the oversight and transparency of expenditure of funds to ensure that there was no misappropriation or corruption to influence the data and analysis. Mining companies have a good relationship with the COM and may be willing to allow them this function for the benefit of credibility of the whole system.

Benefits to Stakeholder

- The COM appears to have a good relationship with NGOs, Academia, and other stakeholders that will be strengthened through this project. This stakeholder will also have the opportunity to build relationships with others as they would be viewed positively.
- This system includes both environmental and health programs. These Corporate Social Responsibility (CSR) and Public Relations (PR) based initiatives will help improve their public image, which trickles up to investors.
- This pilot project would grant COM access to the insights found in the analyzed data, which would improve this stakeholder's understanding of the issues communities face as well as enable it to inform its strategies for action and resolution.
- As the COM interacts with the other stakeholders within this system, it will encounter more opportunities to influence and advocate for itself within a transparent political context.
- This system provides trustworthy and unbiased data collectors, which is important for the COM.
- By involving the COM rather than an individual mining company, it allows the entire mining industry to move forward together and creates fewer loopholes.
- The network and connections that COM would develop through this system might help them gain a political advantage within the mining industry in Guinea.

Challenges to Stakeholder

- The COM might have limited funding and manpower in comparison to individual mining companies, which may lead to the interests of these companies outweighing ones of the collective group.
- Tensions might arise internally between COM member companies and externally between those mining companies who are involved in the project and those who have chosen not to be. There needs to be consensus on the direction of the project.
- The COM must commit to long term funding for the research, regardless of the outcomes. This might be too much of a financial risk, especially considering that negative outcomes are possible.

Benefits to System

- An endorsement from COM may encourage other mining companies apart from GAC to be involved in the project.
- The COM could act as a central entity for mining companies' to collaborate on sustainability issues.
- COM's involvement could smooth over relationships between mining companies and other stakeholders within the system, paving the way for the mining companies' eventual adherence to environmental policies.
- Supporting some of the interests of the mining companies using the COM as a communication channel will help develop the support from the mining companies.
- The COM has substantial funding for this project and will likely have long term capacity for funding.
- The COM's involvement will grant the project and its stakeholders access to infrastructure improvements that mining companies are already deploying.
- The network and connections that COM would develop through this system might help them gain political advantage within the mining industry. This would allow them to influence mining companies to improve mining industry processes in the long run.

Challenges to System

- The COM might have limited funding and manpower, as opposed to the individual mining companies. Furthermore, COM might not be as unified or organized as is advertised and currying favor with individual mining companies might be necessary
- Tensions may arise within the COM members who are supportive and those who are opposed to the project. Trying to manage the internal relationships and pressures within the COM may be detrimental to the project.
- Communities do not trust mining companies and the COM. All scenarios require the consent and support of communities and it will require serious effort to amend this distrust.

6. Bauxite Environment Network

Function within System

The Bauxite Environment Network (BEN) is made up of representatives from six mining companies active in Guinea who are dedicated to reducing the environmental impacts of bauxite mining in marine or riverine environments. Similar to the Chamber of Mines, BEN would be tasked with the oversight and transparency of expenditure of funds to ensure that there is no misappropriation or corruption to influence the data and analysis. They may function as the central funding mechanism through which the mining companies coordinate funding.

Benefits to Stakeholder

- Participation in this pilot project could elevate BEN's profile within the Guinean Mining Industry and Boké Communities and help them develop a partnership with UNDP.
- Communities might find BEN to be trustworthy or neutral, which gives BEN the opportunity to act as a mediator and strengthen strained relationships between the mining industry and communities.
- BEN's existing relationships with Local NGOs would help establish networks to select locations for central hubs for data collection.
- Part of BEN's strategy for marine environment protection is to develop a training component for village ecologists. The app could be utilized to recruit ecologists in remote areas, and disseminate training materials.
- Monitoring coastal erosion through the app could be a possibility, thus meeting one of BEN's priorities.
- Insights gained from the analysis of environmental data could help BEN develop more comprehensive strategies for existing environmental impact mitigation efforts.

Challenges to Stakeholder

- BENs primary focus is mitigating the impact of bauxite pollution in marine environments, while this pilot project's primary focus is mitigating the impact of bauxite pollution on terrestrial environments. It might be difficult for BEN to change its focus.

Benefits to System

- This stakeholder's involvement might encourage mining companies who are not currently involved in BEN to participate in the pilot project, or make commitments with BEN.

Challenges to System

- Tensions might arise externally between mining companies who are members of BEN and those who have chosen not to be. There needs to be consistent consensus on the direction of the project.
- Ensuring that BEN remains committed to the project long term could be an issue unless some of its own goals can be met with the project.

7. Ministry of Health

Function within System

The Local NGOs will coordinate between data collection points (schools, pharmacies, clinics and hospitals) and data collectors (youth, elders, women, farmers and students). They will be in charge of managing the collection and distribution of data, and maintaining relationships. They are also responsible for distributing funding to the data collection points, conducting data collection training and distributing materials needed for data collection (i.e. cell phones, computers, etc). They will identify areas where infrastructure needs to be built, in order to support data collection and transmission. Finally, the selected NGO will provide communities with access to analyzed data.

Benefits to Stakeholder

- Local NGOs are generally trusted by most stakeholders, but would benefit from the credibility gained from their participation in this system with international aid and educational organizations.
- Funding from this system could give the Local NGO the resources it needs to secure necessary equipment and personnel that could benefit other projects it may be pursuing. For example, this project will provide the NGO access to data or data collection capacity that could potentially be of use to their own initiatives.
- Local NGOs will have the opportunity to strengthen existing relationships within communities.
- If the Local NGO is not currently focused on environmental pollution and remediation, its involvement in this system will enhance the NGO's understanding of the interconnectedness of environmental problems and problems it is already tackling, for example, health or land tenure or education and sustainability.

Challenges to Stakeholder

- Local NGOs are generally underfunded and understaffed. Taking on a project of this size might preclude an NGO from participating; could require multiple NGOs to participate, which could make data management more complicated; or could draw resources away from their existing initiatives.
- Local NGOs would be required to travel to individual communities on a regular basis in order to collect data, which could be challenging.
- Local NGOs may not have a good relationship with some government or mining entities, which could be problematic in the general management of this system. Increased contact with these stakeholders could directly heighten the potential for corruption and bias.
- Local NGOs might not have any experience in conducting data collection and would need significant direction and support from Data Management stakeholders.

Benefits to System

- NGOs are a trusted stakeholder among locals and therefore more likely to succeed in training and managing data collectors. The communities' support and trust of Local NGOs lend legitimacy to this project.
- The on-the-ground knowledge of NGOs, which have a great deal of contact and information regarding communities in the Boké Region, would inform this system with cultural and practical nuance that would be difficult to achieve if the system relied only on international and corporate stakeholders.
- Local NGOs might have some experience with similar projects and data collection techniques, which can facilitate the pilot project's implementation.

Challenges to System

- While Local NGOs do have grassroots knowledge, many of them have a niche focus with their work, which might lead to future complications with differing priorities between the system and this stakeholder.
- Local NGOs' limited manpower may create issues in timely data collection and training, slowing down initial implementation.
- Local NGOs may not have the technical experience needed for data management and hence, will likely need to be trained by an international academic institution such as Columbia University or a more technical partner.
- Efficacy of mission varies from community to community, and will frequently need to adapt to the needs of each community.

8. Cultural and Medical Institutions

Function within System

Schools, pharmacies, health clinics and hospitals are the main cultural and medical institutions within the Boké Region that would have the capacity to host a central computer hub through which community members could upload their environmental data. Data will be transmitted from these central computer hubs to data management stakeholders for processing and analysis.

Benefits to Stakeholder

- Health related institutions may directly benefit from additional funding and resources brought forth by the project, as well as continued foot traffic coming from community members accessing the central computer hub on a regular basis.
- Schools and the community members who run them would directly benefit from additional funding and resources brought forth by the project.

Challenges to Stakeholder

- Finding resources and time to incorporate the new curriculum and the new processes into schools and health facilities may be challenging without significant funding.
- Pharmacies are not trusted by the medical community, as they have been described as dirty and disorganized, but are sometimes trusted by the communities, but for the reason that communities might trust non-mainstream health organizations. Utilizing this institution would require work to find a middle ground where it could be trusted by most stakeholders.

Benefits to System

- Informal pharmacies and health clinics are geographically diffused throughout the communities and capture significant foot traffic through their doors, creating good depth and reach as convenient collation points.
- Hospitals already have established data collection processes in place, creating a less complicated implementation process.
- Trained hospital staff could also train pharmacies and schools in data collation, depending on resource availability.
- Hospitals are already trained in data privacy and patient protection and thus will understand its implications for this project, and work to maintain the anonymity of data collectors.
- Hospital and school participation may increase the trust from the mining companies, and could also help mining companies justify participation for CSR reasons.

Challenges to System

- Raising the funds needed for training schools and pharmacies in particular may be challenging as they do not have existing data collection measures in place.
- Ensuring that all schools, pharmacies and hospitals in Boké have the same training and access to resources will be challenging. If not, inconsistencies may arise, creating an unintended bias e.g. missing information in one area versus another. However this would arise with any of the scenarios discussed.

9. Communities

Function within System

Community members that use or have regular contact with Schools, Pharmacies Health Clinics and Hospitals should be included as members of this stakeholder group.

The members of this stakeholder group collect data using their smartphones, or using any other low tech data collection device, and uploads data to a central computer hub located at a community's school, pharmacy, health clinic, or hospital whenever they come into contact with them. This stakeholder group includes women, agricultural workers, elders, youths, and schools.

Benefits to Stakeholder

- This scenario requires that the stakeholder travel to wherever the central computer hub would be. Even with incentives of free wifi, this might be a barrier to participation if the computer hub is not located in a central enough spot.

Challenges to Stakeholder

- This scenario requires that the stakeholder travel to wherever the central computer hub would be. Even with incentives of free wifi, this might be a barrier to participation if the computer hub is not located in a central enough spot.

Benefits to System

- The health and environment nexus is explored through this system. By linking environmental impacts and health through data collection, all data management stakeholders can gain a better idea of how mining pollution is impacting communities in the Boké region. This could not be done without access to health data of communities.

Challenges to System

- If data collection and transmission is not simultaneous or automatic, human motivation and error dictates whether or this data is sent regularly. The burden of participation in this program lies more heavily on the data collectors in this scenario as compared to others.

SCENARIO 4

INTEGRATING DATA COLLECTION AND ANALYSIS INTO SCHOOLS

Scenario Assumptions

Teachers and principals are respected members within their communities, playing a key role in community life through education and weighing in during public meetings.

There are multiple citizen science projects that have been integrated into school curricula of all learning levels in which students are taught math, science and other subject matter through the lens of a particular scientific activist project. Students benefit from learning material relevant to their education and communities. At the same time, the community benefits from collected and analyzed data.

One of the scenario's drawbacks includes extended timelines in working with the Ministry of Education to implement citizen science curricula within schools. The Ministry of Education has to approve all curriculum changes which would make this challenging to enact. However, if this model were to be implemented, we recommend the project be implemented as an extracurricular activity.

Data Management

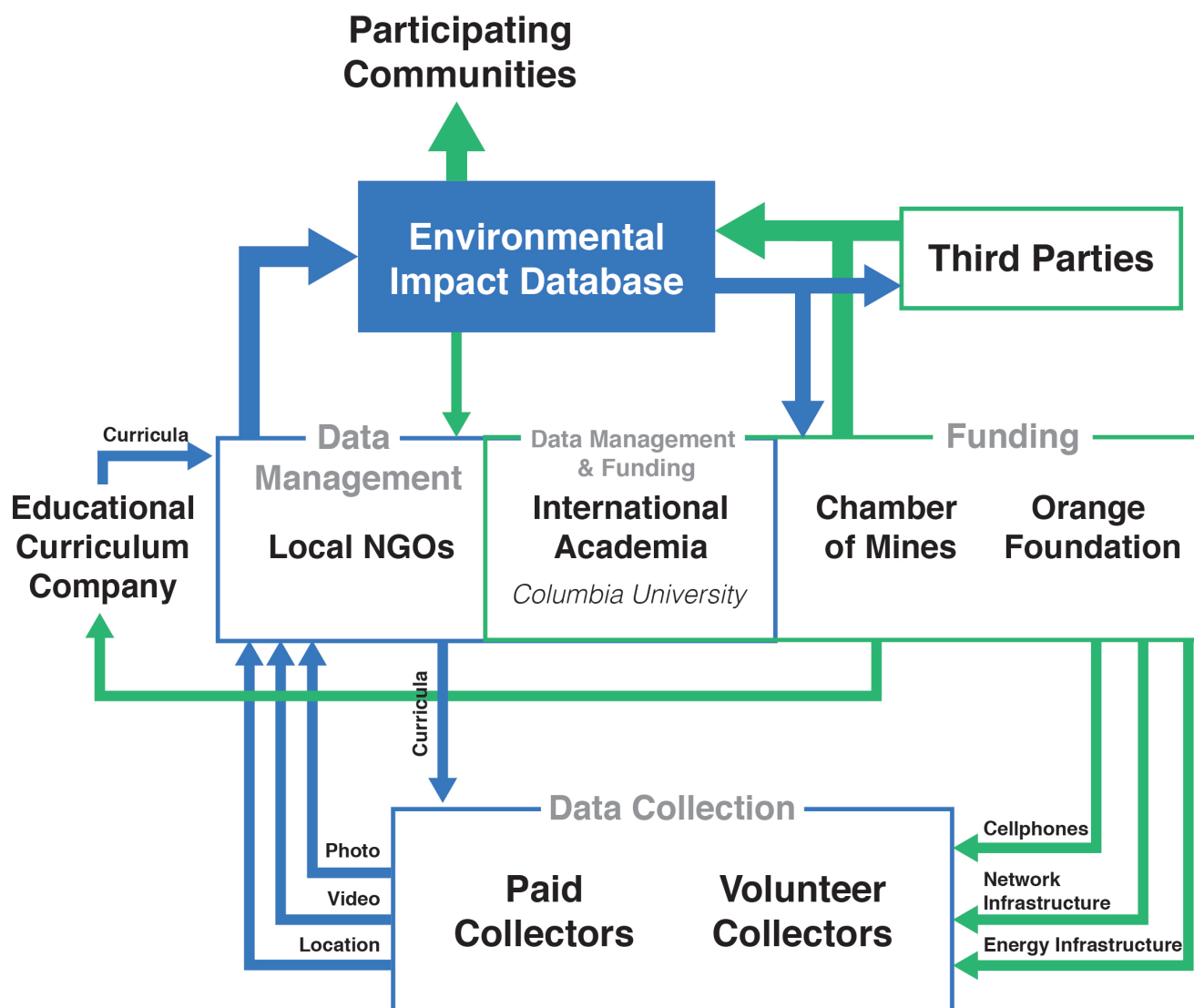
Data management will receive data from data collectors to analyze and verify, identify outlier information, maintain the environmental impact database, publish information in regular intervals, and help data collectors access information after it has been synthesized.

Funding

The Funding stakeholders will provide funding to Data Management stakeholders and have no contact with any Data Collection stakeholders. They will initially provide resources to the Educational Curriculum Company to begin the curriculum design process.

Data Collection

Data Collectors will collect data as part of a citizen science project involving the educational infrastructure present within Boke. They will receive educational materials as well as technological materials and interact primarily with the Local Non-Governmental Organizations (NGOs).



1. Local NGOs

Function within System

NGOs play a critical role in community empowerment, acting as a mediator between the community, government, and mining companies. They are generally trusted by local communities, which is essential in facilitating this project.

The Local NGO will collaborate with the educational curriculum company to understand Guinean grade level curricula. This stakeholder is responsible for collecting, processing, and analyzing the raw data collected by data collectors and will collaborate with international academia to collect and manage the data.

Benefits to Stakeholder

- Local NGOs are generally trusted by most stakeholders, but would benefit from the credibility gained from their participation in this system with international aid and educational organizations.
- Funding from this system could give the Local NGO the resources it needs to secure necessary equipment and personnel that could benefit other projects it may be pursuing. For example, this project will provide the NGO access to data or data collection capacity that could potentially be of use to their own existing initiatives.
- If the Local NGO is not currently focused on environmental pollution and remediation, its involvement in this system will enhance the NGO's understanding of the interconnectedness of environmental problems and problems it is already tackling, for example, health or land tenure or education and sustainability.
- The Local NGO will have the opportunity to strengthen existing relationships within communities. However, the Data Management portion of the project can be managed remotely and without significant physical or resource involvement of staff.

Challenges to Stakeholder

- Local NGOs are generally underfunded and understaffed. Taking on a project of this size might preclude an NGO from participating; could require multiple NGOs to participate, which could make data management more complicated; or could draw resources away from their existing initiatives.
- Local NGOs would be required to travel to individual communities on a regular basis in order to manage data collection, which could be challenging.
- Local NGOs may not have a good relationship with some government or mining entities, which could be problematic in the general management of this system. Increased contact with these stakeholders could directly heighten the potential for corruption and bias.
- Local NGOs might not have any experience in conducting data analysis and would need significant direction and support from

other management stakeholders.

Benefits to System

- NGOs are a trusted stakeholder among locals and therefore more likely to succeed in training and managing data collectors. The communities' support and trust of Local NGOs lend legitimacy to this project.
- The on-the-ground knowledge of NGOs, which have a great deal of contact and information regarding communities in the Boké Region, would inform this system with cultural and practical nuance that would be difficult to achieve if the system relied only on international and corporate stakeholders.
- Local NGOs might have some experience with similar projects and data collection techniques, which can facilitate the pilot project's implementation.

Challenges to System

- While Local NGOs do have on-the-ground knowledge, many of them have a niche focus with their work, which might lead to future complications with differing priorities between the system and this stakeholder.
- Local NGOs limited manpower may create issues in timely data collection and training, slowing down initial implementation.
- Local NGOs may not have the technical experience needed for data management and hence will likely need to be trained by an international academic institution such as Columbia University or a more technical partner.
- Efficacy of mission varies from community to community, and will frequently need to adapt to the needs of each community.

2. Educational Curriculum Company

Function within System

Using existing standards for citizen science curriculum design, this stakeholder would be responsible for creating the curriculum for data collection that would allow NGOs to easily train data collectors.

The Educational Curriculum Company will collaborate with the Local NGO to identify the level of education within Schools as well as the International Academia and Guinean University to ensure that the curricula addresses the needs of the project well. This stakeholder will also be responsible for updating the curricula as the project evolves and the needs of data collectors vary.

Benefits to Stakeholder

- This stakeholder would benefit from a more positive public perception and could use this pilot project to complete some of its Corporate Social Responsibility (CSR) goals.
- Depending on the company chosen, this pilot project would give this stakeholder the opportunity to diversify its offerings and expand its market reach.

Challenges to Stakeholder

- This stakeholder may not be located within Guinea or have experience designing curricula for communities like those in the Boké region and therefore, testing the effectiveness of curricula will need to be monitored closely.
- Locals work better with multimedia and videos, instead of written questions and prompts. There will be a significant amount of work needed to tailor curricula to the needs of students and teachers.

Benefits to System

- Using educational curricula is an established method and tool for citizen science.
- This tool can help students develop their technological literacy and potentially become applicable in their other coursework.

Challenges to System

- There may be delays in relaying the effectiveness of curricula if the stakeholder is not located close to the project which would create delays in properly executing the project. For this reason, efficient and strong collaboration with the NGO partner and international academia is crucial.
- Curricula is at the discretion of the Ministry of Education and usually requires an approval period. By the time approval is received, stakeholders that were most interested in this project may lose interest.

3. International Academia

Columbia University

Function within System

This stakeholder will collaborate with the educational curriculum company to identify desirable data points. This stakeholder will be responsible for reviewing, processing, and analyzing the raw data. This stakeholder will also work closely with the NGO to ensure that their needs are met in terms of training teachers and pivoting their focus depending on the stage of the project. In the long run, once the project becomes well established and each stakeholder is well trained to perform their job function, the International Academia stakeholder can transition to Guinean University or simply be removed depending on the readiness of each stakeholder and the bandwidth of the international academic institution.

Benefits to Stakeholder

- CU would gain access to raw environmental data and be able to direct the data collection to their benefit.
- Through this system, CU would also gain access to an information collection framework in Guinea, which could help programs within the CU education system pursue other projects.
- CU would forge strong connections and networks with international organizations like the United Nations Development Programme (UNDP) and other stakeholders within this system. These connections could lead to new opportunities for multiple programs within the CU education system.

Challenges to Stakeholder

- Researchers at CU do not have experience working with mining industry environmental impacts within the context of Guinean communities.
- CU could find difficulties with managing the data collection program from afar. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- CU's funding capacity might be more limited than what would be necessary for the project. Other streams of income might be required.

Benefits to System

- CU would be beneficial to this network because they have the technological literacy, and would be able to effectively initiate and manage this project from the outset.
- Locals have a higher level of trust towards international academic institutions. Local Universities are seen as underfunded or biased, or potentially corrupt, diploma-printing organizations.
- CU would have access to supplementary data that could contribute to more verification of collected data and the robustness of final insights and conclusions.

- CU's distance and educational motivations prevent corruption that adds to the accountability and trustworthiness of the entire system.
-

Challenges to System

- The main challenge CU presents to this scenario is its distance to the project. The lack of personnel on the ground can hinder the efficiency of the program as they are not able to adapt to changes immediately. There could be significant delays between data collection and data interpretation.
- It is not sustainable for Columbia University to be hosting the data storage in the long term, as it limits control of local stakeholders over their own intellectual property. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- The lack of in-person or on the ground involvement may not be as strong a mechanism to prevent corruption as they do not get to observe the day to day interactions of the project.

4. Chamber of Mines

Function within System

The Chamber of Mines will share the funding responsibility with the private telecommunications company selected. This partnership will ideally create a strong funding pillar to allow the project to run smoothly and uninterrupted. The Chamber of Mines will act more in a financial capacity to feed funding towards the data management teams.

Benefits to Stakeholder

- The COM appears to have a good relationship with NGOs, Academia and other stakeholders that will be strengthened through this project. This stakeholder will also have the opportunity to build relationships with other stakeholders within the context of this scenario in which they would be viewed positively.
- This system includes both environmental and educational programs. These Corporate Social Responsibility (CSR) and Public Relations (PR) based initiatives will help improve their public image, which trickles up to investors.
- This pilot project would grant COM access to the insights found in the analyzed data, which would improve this stakeholder's understanding of the issues communities face as well as enable it to inform its strategies for action and resolution.
- As the COM interacts with the other stakeholders within this system, it will encounter more opportunities to influence and advocate for itself within a transparent political context.
- This system provides trustworthy and unbiased data collectors, which is important for the COM.
- By involving the COM rather than an individual mining company, it allows the entire mining industry to move forward together and creates fewer loopholes.
- The network and connections that COM would develop through this system might help them gain a political advantage within the mining industry in Guinea.

Challenges to Stakeholder

- The COM might have more limited funding and manpower than advertised, as opposed to the individual mining companies, which might mean that the interests of individual mining companies could outweigh the collective group's priorities and efforts.
- Tensions might arise internally between COM member mining companies as well as externally between those mining companies who are involved in the project and those who have chosen not to be. There needs to be consistent consensus on the direction of the project.
- The COM must commit to long term funding for the research, regardless of the outcomes. This might be too much of a financial

risk, especially considering that negative outcomes are possible.

Benefits to System

- An endorsement of this system and project through COM's participation in it may encourage other mining companies apart from GAC to be involved in the project.
- The COM could act as a central entity for mining companies' to collaborate on sustainability issues.
- COM's participation in this program and connection with members of the community could create opportunities for occupational education for students and youth within the environmental mining space.
- COM's involvement could smooth over relationships between mining companies and other stakeholders within the system, paving the way for the mining companies' eventual adherence to environmental policies.
- Supporting some of the interests of the mining companies using the COM as a communication channel will help develop the support from the mining companies.
- The COM has a substantial funding stream for this project and will likely have a long term capacity for funding.
- The COM's involvement will grant the project and its stakeholders access to infrastructure improvements that mining companies are already deploying.
- The network and connections that COM would develop through this system might help them gain a political advantage within the mining industry in Guinea. This would enable them to influence mining companies to improve mining industry processes in the long run.

Challenges to System

- The COM might have limited funding and manpower, as opposed to the individual mining companies, and COM might not be as unified or organized as is advertised and currying favor with individual mining companies might be necessary. Tensions may arise within the COM members who are supportive and those who are opposed to the project. Trying to manage the internal relationships and pressures within the COM may be detrimental to the project.
- Communities do not trust mining companies and the COM. All scenarios require the consent and support of communities and it will require serious effort to amend this distrust.
- Funding for this project primarily comes from COM, and their participation depends on the outcome. Strict regulations or other limitations that come as a result from this research and program could cause the enthusiasm of COM for participation to wane.

5. Telecom Company

Orange Foundation

Function within System

This stakeholder will partner with the Chamber of Mines to provide financial support through supplying the technological needs such as cell phones and network capabilities to data collectors for raw data collection. Involving a local private technological company would ideally create better bonds between each stakeholder while increasing transparency, as technology inherently promotes transparency and the sharing of information.

Benefits to Stakeholder

- Orange Foundation has an existing Corporate Social Responsibility (CSR) program, in which it works with schools to provide educational technology. Orange would play a similar role in this system, and its participation would contribute to their CSR portfolio.
- Orange would have a unique opportunity to establish positive connections and place products with potential customers, as well as expand its cellular network.

Challenges to Stakeholder

- Orange could have compromised interests in favor of supporting the business of the mining companies that would hinder its participation in this system.
- Orange could have limited financial resources to allocate towards this project, and might have a bias towards its own business. This project might be beyond its interest in or capability to invest in the communities it serves.

Benefits to System

- Orange could provide implementation information, such as the size of the network that would be needed for testing within the scope of the pilot project as well as requirements and potential sites for expansion.
- Additionally, Orange could assist in facilitating the implementation of network hardware in participating pilot communities.
- Orange likely has no major pro-mining bias.

Challenges to System

- Depending on who the direct representative is, this stakeholder may be swayed by political unrest.
- Potential conflict of interest with mines may create hesitations in this stakeholder's involvement.

6. Teachers

Function within System

This stakeholder will be responsible for receiving the curricula and working with Data Management to implement the coursework. This stakeholder will also be responsible for maintaining strong communication with Data Management stakeholders to relay the results of data collection and the benefits and drawbacks of the curricula.

Benefits to Stakeholder

- Teachers would gain access to excellent teaching materials that would be tailored to the students, the technology provided by Funding stakeholders, and the environmental data collection pilot project.

Challenges to Stakeholder

- The switch to a new curriculum could present a challenge as teachers would need support to learn and test new teaching methods. However, this could incite the development of a network of teachers across the Boké region which would strengthen organizational and community capacities.
- Learning a new curriculum would require significant bandwidth and time management, something this stakeholder may not have.
- Teachers might not have the technical literacy needed to collect data or teach the collection of data.

Benefits to System

- Teachers are well respected within their communities and could serve as a trustworthy intermediary between data collection and data management.

Challenges to System

- Depending on the technical literacy of this stakeholder there may be a learning curve delay, which could postpone the pilot project's implementation.
- If there are inefficiencies or low levels of communication between this stakeholder and data management, this model will suffer.

7. Students

Function within System

Students will be trained by Teachers to collect the raw data needed for this project, using the curriculum provided by the Educational Curriculum Company. Students will be the key stakeholder in raw data collection in the field throughout the duration of the project.

Benefits to Stakeholder

- This stakeholder would gain access to excellent and relevant course materials.
- The members of this stakeholder group would gain the opportunity to actively participate in the remediation of environmental impacts. The pilot project has the potential to empower the youth by building organizational capacity.
- This stakeholder would be able to connect with international stakeholders, which could bring opportunities for development and improved capacity for their communities and schools.
- This stakeholder would be able to interact with mining companies through a trusted, neutral stakeholder like international academia.
- This stakeholder would gain access to smartphone technology for data collection, which has the potential to yield co-benefits, chiefly greater connection.

Challenges to Stakeholder

- The curriculum provided as part of this system would necessitate an adjustment period in which students and youth would need to get up to speed with what the curriculum was teaching. This would likely be a different method and style of teaching than what students are accustomed to.
- The quality of education, though it can be managed through curriculum and class design, ultimately depends on the quality and commitment of the teacher. Teachers generally require motivation to make changes to their regular working style.

Benefits to System

- This stakeholder would be well trained in data collection, and their data would be very relevant to their lives as the study of it would be part of their classwork.
- Children are unbiased relative to the other stakeholders in this scenario, and can be depended on to provide accurate data.

Challenges to System

- As this is a system integrated into the educational system, there are likely to be some delays in its deployment. The learning curve period for both teachers and students could take weeks to months for data collection to begin.
- If curricula are not informed by Guinean school culture, they might be inaccessible to students and teachers. This could lead to lack of interest in this stakeholder to utilize material.

8. Local Schools

Function within System

This stakeholder will be responsible for working with Teachers to implement the curricula to Students. Schools will collaborate with Teachers and the Local NGO to gain a better understanding of the educational capacity of the Students in order to craft a more tailored curriculum. They will also be responsible for ensuring that they maintain strong communication with Teachers and Data Management to guarantee effective implementation and provide feedback to Data management when needed to improve the material.

Benefits to Stakeholder

- Participating schools will receive funding and infrastructural improvements, for example network and power upgrades and equipment that would be necessary for the execution of coursework.
- Access to these materials would Improve technological literacy of students and teachers.
- Schools would receive brand new, engaging, and relevant coursework, which would elevate the quality and diversity of existing teaching content and methods.

Challenges to Stakeholder

- No inter-school network exists that would allow teachers and other faculty to collaborate about new curricula or about data collection. This could be incredibly challenging for teachers, especially in more rural communities.
- School capacity may already be low and implementing curricula like this would require time and resources, especially from teachers within schools that already have their regular classes to manage.

Benefits to System

- In addition to developing environmental impact data collection, this scenario would also contribute to the development of Guinea's educational system and infrastructure.
- This system builds upon existing educational infrastructure and its essential teaching and evaluation formats. Students are a captive audience and youth are motivated to participate. Once established, this system could have longevity beyond the pilot project.

Challenges to System

- The Ministry of Education must approve any curriculum changes. This process may create delays in implementing course material and therefore lead to longer turnaround timelines.

SCENARIO 5

PATH OF LEAST RESISTANCE

Scenario Assumptions

This scenario follows the path with the greatest ease of implementation, avoiding areas of conflict and engaging stakeholders that have expressed interest to participate in this project.

This scenario leverages the strengths and existing initiatives of the stakeholders: the mining companies, NGOs and international agencies, and aligns the interests of all stakeholders as much as possible. However, this scenario lacks safeguards in the design and implementation of the project as it hands over the management of the project to the local NGO for ease of implementation.

Funding

The funding actor would fund the manpower and resources required for the data collection, storage, and analysis. In return, they would be able to have access to the raw data collected. However, the funding partner would have limited influence on the project's analysis or purpose. This is designed to ensure that the integrity and credibility of the data is collected.

Project Manager

The project manager oversees the design and implementation of the project, ensuring that the project meets its milestones. Columbia University will act as an advisor to the project manager. The project manager also receives the funding from the mining company and disburses the funding to the other actors in the project.

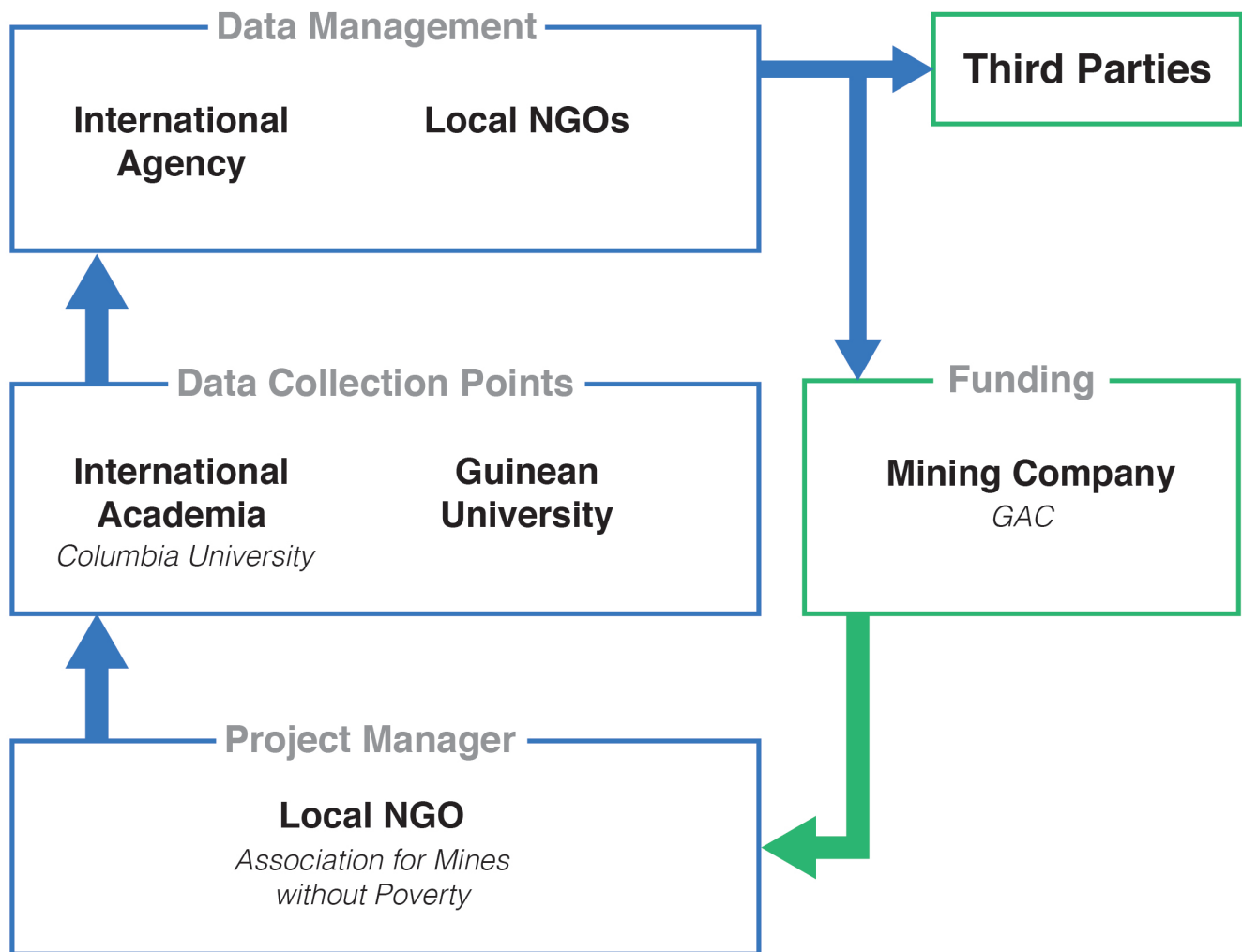
Data Storage

The actor will receive data from the project manager, store the data in their server and maintain the environmental impact database. In addition, the actor would also help to analyze and verify, and identify outlier information.

Noting that local universities do not have the technical capacity, it is proposed that Columbia University take up this role in the near future. In the medium to long term, Columbia could help build capacity and secure resources for the local universities before handing over the role to said local universities.

Arbiter and Analysis of Data

The arbiter will uphold the integrity of the data collected through analyzing and verifying, and identifying any outlier information. This team will also prepare a report of the data collected and the findings. In addition, their role might evolve as this project changes in terms of needs for the project or any new types of information that need to be collected.



1. Mining Company

Function within System

The Mining Company is the key funding partner, providing financial resources to sustain the project. The mining company will participate in discussions with NGOs and local communities, to receive first-hand feedback on the impacts of mining operations. Data and findings from the project will be used by the Mining Company to implement best practices within the mining industry.

Benefits to Stakeholder

- GAC's participation in this system would improve the company's Environmental Social Governance (ESG) ratings and Corporate Social Responsibility goals, which could, in turn, open up opportunities with investors. Additionally, this program could be an opportunity to establish training for staff in sustainability related issues that will help to improve the company's ESG values in the future.
- Mining Companies have a strained relationship with communities of Boké. By opening up productive and ameliorative channels regarding environmental pollution, GAC could set a standard for interactions and justice between mining companies and communities that could reduce public dissent.
- The mining company could acquire access to ground data collected through this project and regular reports.
- Keeping up with loan commitments from the International Monetary Fund, which mandate sustainability guidelines to follow in exchange for their continued financial support.

Challenges to Stakeholder

- By participating in this system, GAC runs the risk of bad press surrounding mining pollution or eventual environmental regulation damaging their potential for profits, which would be counter-productive to operations. Additionally, GAC will be tasked with tracking data that may expose corruption and potentially diminish their relationship with foreign investors.
- The problems with the current standards of reporting through a paid third party contractor has led to a conflict of interest in reporting. Participation in this project would be an acceptance of that fact, which may dissuade such participation in the first place.
- Perceived lack of monetary incentive for participation might be a disincentive for participation. This perception would need to be challenged with strong policy or explicit financial analyses, which might be offloaded financially to other stakeholders.
- The pilot project aims to include 30 people, which might be an unappealingly small scale for a business of GAC's size.
- If GAC is investing in this project, it might want control over some aspects of how funding is spent, either to decrease inefficiencies

or to limit risks associated with bad press or potential regulations.

Benefits to System

- GAC has the financial resources to fund this system beyond the success of the pilot project.
- GACs participation would generate precedent to set new policies requiring more stringent reporting standards within the mining industry of Guinea.
- This stakeholder's Participation in this system is a display of goodwill from one of the most financially powerful stakeholders in Guinea. By demonstrating their willingness to participate and be involved in this process, it would encourage other stakeholders

Challenges to System

- As the project is funded by the mining company, there might be conflict of interests to produce data that favors the mining company. There is a need to establish a system with safeguards to build trust with the local communities and NGOs due to the negative image of mining companies.
- Funding might not remain secure over a longer period due to many uncertainties, such as a change in company management or priorities

2. Local NGO

Association for Mines without Poverty

Function within System

Association for Mines without Poverty (AMSP) will oversee the design and implementation of the project, particularly: community outreach, relevant partnership (for example with other NGOs such as Witness), engagement of local communities and data collection. This stakeholder will also manage the finances of the project and ensure financial sustainability and prudence.

Benefits to Stakeholder

- AMSP has existing community empowerment initiatives in Boké. With additional funding, AMSP would be able to enhance and expand their initiatives.

Challenges to Stakeholder

- AMSP might not have the necessary manpower or technical resources to effectively execute the project. As AMSP delegates resources to this project, this might have a negative impact on their other existing initiatives.

Benefits to System

- AMSP has a good understanding of the local communities and would be able to identify the relevant groups for data collection.
- AMSP has also good working relationships with other NGOs such as Witness and Natural Justice, in Boké. Collaborating with AMSP will allow the project to tap into the resources of these NGOs

Challenges to System

- Columbia University might have limited control over the project if AMSP is taking the lead in designing and implementing the project.
- There is a need to establish some safeguards to oversee the management of funds by NGOs.

3. International Academia

Columbia University

Function within System

Columbia University (CU) will receive data, store the data in their server and maintain the environmental impact database. CU will also help to analyze, verify and identify outlier data points. This role should transition to being played by a Guinean University.

Benefits to Stakeholder

- CU would gain access to raw environmental data and be able to direct the data collection to their benefit.
- Through this system, CU would also gain access to an information collection framework in Guinea, which could help programs within the CU education system pursue other projects.
- CU would forge strong connections and networks with international organizations like the United Nations Development Programme (UNDP) and other stakeholders within this system. These connections could lead to new opportunities for multiple programs within the CU education system.

Challenges to Stakeholder

- Researchers at CU do not have experience working with mining industry environmental impacts within the context of Guinean communities.
- CU could find difficulties with managing the data collection program from afar. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- CU's funding capacity might be more limited than what would be necessary for the project. Other streams of income might be required.

Benefits to System

- CU would be beneficial to this network because they have the technological literacy, and would be able to effectively initiate and manage this project from the outset.
- Locals have a higher level of trust towards international academic institutions. Local Universities are seen as underfunded or biased, or potentially corrupt, diploma-printing organizations.
- CU would have access to supplementary data that could contribute to more verification of collected data and the robustness of final insights and conclusions.
- CU's distance and educational motivations prevent corruption that adds to the accountability and trustworthiness of the entire system

Challenges to System

- The main challenge CU presents to this scenario is its distance to the project. The lack of personnel on the ground can hinder the efficiency of the program as they are not able to adapt to changes

immediately. In addition, there could be significant delays between data collection and data interpretation.

- It is not sustainable for Columbia University to be hosting the data storage in the long term. It would be ideal for local universities in Boké to host the data collection as they are better able to coordinate with local NGOs and communities. Columbia University will build capacity within the local universities to enable them to do so.

4. International Agencies

UNDP, World Bank

Function within System

The international agency will be in charge of reviewing findings and reports from NGOs and local universities, push for regulatory improvements, manage and review the progression of the project, and mediate between the private public partnership structure of funding within this model to ensure lack of corruption.

Benefits to Stakeholder

- This pilot project and project mission would directly align with some of the aims and goals of this stakeholder.
- The quality of data collected would enable this stakeholder to better advocate for social and environmental policies within Guinea and in other locations struggling with mining pollution
- This stakeholder would gain access to raw environmental data and be able to direct the data collection to their benefit.
- Through this system, the International NGO would also gain access to an information collection framework in Guinea, which could help programs within its organization to pursue other projects.

Challenges to Stakeholder

- This stakeholder might find difficulties with aligning their priorities with those of the other NGOs operating in this space.
- Duration of involvement is unknown within this structure as this stakeholder may have to be involved for an extended period of time, which could make this stakeholder vulnerable to unforeseen internal costs beyond what is planned for the pilot.
- There is not an established foundation of trust between the International NGOs, the mining companies, and the government organization.
- International NGOs might not be based within Guinea or Boké. The lack of personnel on the ground can hinder the efficiency of the program as they are not able to adapt to changes immediately. There could be significant delays between data collection and data interpretation.
- Noting many pressing public health issues such as Covid-19 and providing clean water, this project might distract and divert resources from international agencies from these issues.

Benefits to System

- This stakeholder already has experience working with similar cross-sector engagement projects, and could lend its expertise to the execution and management of the project.
- International NGOs lend a public perception of trustworthiness and credibility to the entire system. Additionally, based on this stakeholder's international presence, it could garner positive global

media attention for this project.

- This stakeholder has access to funding for needs beyond the scope of this project, for example internet and energy infrastructure needed for this project.
- This stakeholder is an independent and unbiased party and is well suited to serve as an arbiter as well as a verifying party for potential/current investors of mining companies.

Challenges to System

- International NGOs might be too niche with their focus for the system to adapt to suit the needs of the people impacted by mining pollution. This might lead to priorities different than what is best for the community as the project would be beyond the reach of this stakeholder.
- International NGOs typically face excessive bureaucracy within their organization, which could slow down the project milestones.

5. Local NGOs

Function within System

The local NGOs will lead in the data analysis and verification with Guinean Universities and International Agencies.

Benefits to Stakeholder

- Local NGOs are generally trusted by most stakeholders, but would benefit from the credibility gained from their participation in this system with international aid and educational organizations.
- Funding from this system could give the Local NGO the resources it would need to secure necessary equipment and personnel that could benefit other projects it may be pursuing. For example, this project will provide the NGO with access to data or data collection capacity that could potentially be of use to their own initiatives.
- The Local NGO will have the opportunity to strengthen existing relationships within communities.
- If the Local NGO is not currently focused on environmental pollution and remediation, its involvement in this system will enhance the NGO's understanding of the interconnectedness of environmental problems and problems it is already tackling, for example, health or land tenure or education and sustainability.

Challenges to Stakeholder

- Local NGOs are generally underfunded and understaffed. Taking on a project of this size might preclude an NGO from participating; could require multiple NGOs to participate, which could make data management more complicated; or could draw resources away from their existing initiatives.
- Local NGOs may not have a good relationship with some government or mining entities, which could be problematic in the general management of this system. Increased contact with these stakeholders could directly heighten the potential for corruption and bias.
- Local NGOs might not have any experience in conducting data analysis and would need significant direction and support from the International Agency stakeholders.

Benefits to System

- NGOs are a trusted stakeholder among locals and therefore more likely to succeed in training and managing data collectors. The communities' support and trust of Local NGOs lend legitimacy to this project.
- The on-the-ground knowledge of NGOs, which have a great deal of contact and information regarding communities in the Boké Region, would inform this system with cultural and practical nuance that would be difficult to achieve if the system relied only on international and corporate stakeholders.

- Local NGOs might have some experience with similar projects and data collection techniques, which can facilitate the pilot project's implementation.

Challenges to System

- While Local NGOs do have on-the-ground knowledge, many of them have a niche focus with their work, which might lead to future complications with differing priorities between the system and this stakeholder.
- Local NGO's limited manpower may create issues in timely data collection and training, slowing down initial implementation.
- Local NGOs may not have the technical experience needed for data management and hence will likely need to be trained by an international academic institution such as Columbia University or a more technical partner.
- Efficacy of mission varies from community to community, and will frequently need to adapt to the needs of each community.

SCENARIO 6

PAY THE PEOPLE

Scenario Assumptions

This scenario is focused around a payment strategy where data collectors are paid for their participation and work, whereas in the other scenarios, payment options are not offered. This scenario assumes people will not be as productive or enthusiastic to collect data if they are not incentivized. Research indicates that locals are looking for job opportunities and education for their children, therefore providing a chain for job opportunities at multiple levels within data collection and synthesis would create a direct and immediate benefit.

The suggested payment structure is payment per submission and the submissions are anonymous to protect participants. This allows multiple locals to participate and gain training without having to permanently be data collectors.

Data Management

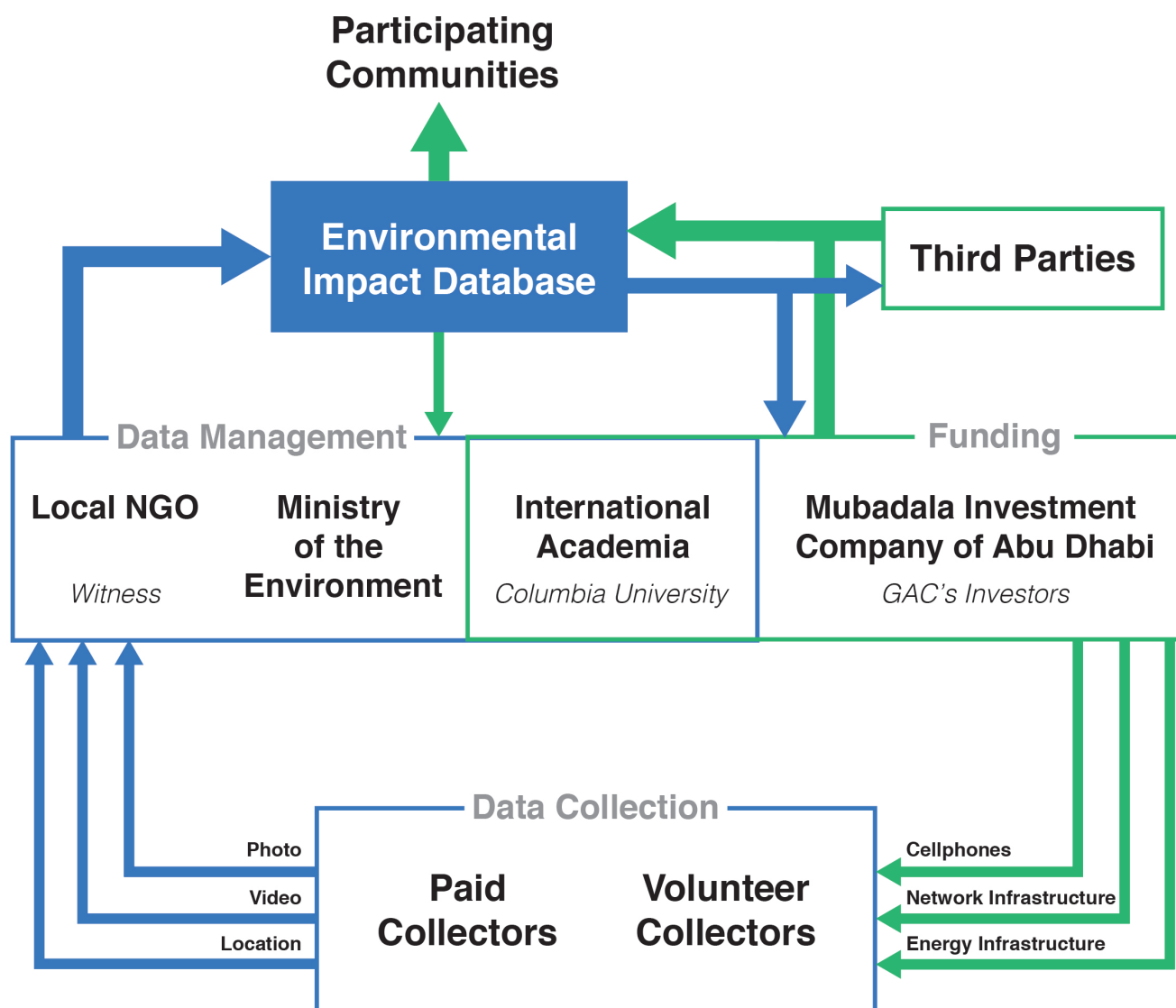
Data management will receive data from data collectors to analyze, verify, and identify outlier information. In addition, this stakeholder will maintain the environmental impact database, publish information in regular intervals, and help data collectors access information after it has been synthesized. The Data Management team will need to evolve as the project progresses.

Funding

This stakeholder will act purely as a funding partner that feeds in the financial resources needed to maintain the data servers and provide the data collectors with materials such as cellphones for data collection.

Data Collection

Receive funding from funding parties and utilize materials to collect data, transmit data to data management, and receive money from the environmental impact database. Receive training from data managers and collect raw data on the ground regarding mining activity.



1. Local NGO

Witness

Function within System

This stakeholder will be in charge of receiving raw data, processing, and analyzing the data. They will also maintain any servers and keep training for data collection up to date. This stakeholder will work closely with the Ministry of Environment (MOE) to complete data management during the duration of the project.

Benefits to Stakeholder

- Local NGOs are generally trusted by most stakeholders, but would benefit from the credibility gained from their participation in this system with international aid and educational organizations.
- Funding from this system could give the Local NGO the resources it would need to secure necessary equipment and personnel that could benefit other projects it may be pursuing. For example, this project will provide the NGO with access to data or data collection capacity that could potentially be of use to their own initiatives.
- The Local NGO will have the opportunity to strengthen existing relationships within communities. However, the Data Management portion of the project can be managed remotely and without significant physical or resource involvement of staff.
- If the Local NGO is not currently focused on environmental pollution and remediation, its involvement in this system will enhance the NGO's understanding of the interconnectedness of environmental problems and problems it is already tackling, for example, health or land tenure or education and sustainability.

Challenges to Stakeholder

- Local NGOs are generally underfunded and understaffed. Taking on a project of this size might preclude an NGO from participating; could require multiple NGOs to participate, which could make data management more complicated; or could draw resources away from their existing initiatives.
- Local NGOs would be required to travel to individual communities on a regular basis in order to manage data collection, which could be challenging.
- Local NGOs may not have a good relationship with some government or mining entities, which could be problematic in the general management of this system. Increased contact with these stakeholders could directly heighten the potential for corruption and bias.
- Local NGOs might not have any experience in conducting data analysis and would need significant direction and support from other management stakeholders.

Benefits to System

- NGOs are a trusted stakeholder among locals and therefore more

likely to succeed in training and managing data collectors. The communities' support and trust of Local NGOs lend legitimacy to this project.

- The on-the-ground knowledge of NGOs, which have a great deal of contact and information regarding communities in the Boké Region, would inform this system with cultural and practical nuance that would be difficult to achieve if the system relied only on international and corporate stakeholders.
- Local NGOs might have some experience with similar projects and data collection techniques, which can facilitate the pilot project's implementation.

Challenges to System

- While Local NGOs do have on-the-ground knowledge, many of them have a niche focus with their work, which might lead to future complications with differing priorities between the system and this stakeholder.
- Local NGO's limited manpower may create issues in timely data collection and training, slowing down initial implementation.
- Local NGOs may not have the technical experience needed for data management and hence will likely need to be trained by an international academic institution such as Columbia University or a more technical partner.
- Efficacy of mission varies from community to community, and will frequently need to adapt to the needs of each community.

2. Ministry of Environment

Function within System

The Ministry of Environment (MOE) will be in charge of maintaining the servers in addition to receiving, processing and analyzing the raw data. They will also be responsible for any training required for the data collection. This stakeholder will work closely with the chosen NGO to manage data collection through the duration of the project.

Benefits to Stakeholder

- The MOE would have the opportunity to collaborate with various stakeholders within the scenario to develop social and environmental policies.
- The MOE would have the backing of the International Agency as it attempts to enact or enforce legislation, and be respected and acknowledged for its mining work, when it has previously not had external support.
- The MOE would be able to cultivate a more visible relationship with the Chamber of Mines, not behind the scenes, which would make it easier for this stakeholder to be accountable.
- Collaborating with the Local University would allow for the MOE to develop and improve environmental education and research.
- The public perception of the MOE would improve due to positive involvement to create transparency on the issues created by mining companies.

Challenges to Stakeholder

- The MOE does not have a strong authoritative relationship with the Mining Companies, and this could lead to difficulties in the organization and management of this scenario.
- The MOE does not currently have as much dispensable finances as COM, but this could change with their participation in the system.

Benefits to System

- Their involvement would allow for potential long-term policy improvements which could help structure the future of managing environmental issues in Guinea.
- This stakeholder is local and therefore they will be able to play an active role in ensuring the progression of the project.

Challenges to System

- This stakeholder's public perception of being ineffective and unsupported might not inspire other stakeholders to participate.
- The MOE is focused primarily on the environmental impacts of mining, and might not be able to address some of the more social impacts, like land tenure etc.

3. International Academia

Columbia University

Function within System

The presence of an international academic institution will develop transparency between the private funding entity and the existing data management group which consists of an NGO and the MOE. This also ensures an additional layer of accountability to avoid the misuse of funds. This stakeholder will be responsible for collecting, processing, and analyzing raw data in addition to contributing technological resources such as software and data servers.

Benefits to Stakeholder

- CU would gain access to raw environmental data and be able to direct the data collection to their benefit.
- Through this system, CU would also gain access to an information collection framework in Guinea, which could help programs within the CU education system pursue other projects.
- CU would forge strong connections and networks with international organizations like the United Nations Development Programme (UNDP) and other stakeholders within this system. These connections could lead to new opportunities for multiple programs within the CU education system.

Challenges to Stakeholder

- Researchers at CU do not have experience working with mining industry environmental impacts within the context of Guinean communities.
- CU could find difficulties with managing the data collection program from afar. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- CU's funding capacity might be more limited than what would be necessary for the project. Other streams of income might be required.

Benefits to System

- CU would be beneficial to this network because they have the technological literacy, and would be able to effectively initiate and manage this project from the outset.
- Locals have a higher level of trust towards international academic institutions. Local Universities are seen as underfunded or biased, or potentially corrupt, diploma-printing organizations.
- CU would have access to supplementary data that could contribute to more verification of collected data and the robustness of final insights and conclusions.
- CU's distance and educational motivations prevent corruption that adds to the accountability and trustworthiness of the entire system.

Challenges to System

- The main challenge CU presents to this scenario is its distance to the project. The lack of personnel on the ground can hinder the efficiency of the program as they are not able to adapt to changes immediately. There could be significant delays between data collection and data interpretation.
- It is not sustainable for Columbia University to be hosting the data storage in the long term, as it limits control of local stakeholders over their own intellectual property. CU needs to find a trustworthy partner on the ground in Guinea that could assist with data management.
- The lack of in-person or on the ground involvement may not be as strong a mechanism to prevent corruption as they do not get to observe the day to day interactions of the project.

4. Mubadala Investment Company of Abu Dhabi

Function within System

This stakeholder would be responsible for supporting the monetary needs of this project so Data Management is able to operate well.

Benefits to Stakeholder

- GAC's participation in this system would improve the company's Environmental Social Governance (ESG) ratings and Corporate Social Responsibility goals, which could, in turn, open up opportunities with other investors and/or purchasers.. Additionally, this program could be an opportunity to establish training for staff in sustainability related issues that will help to improve the company's ESG values in the future.
- Mining Companies have a strained relationship with communities of Boké. By opening up productive and ameliorative channels regarding environmental pollution, GAC could set a standard for interactions and justice between mining companies and communities that could reduce public dissent.
- The mining company could acquire access to ground data collected through this project and regular reports.
- Keeping up with loan commitments from the International Monetary Fund, which mandate sustainability guidelines to follow in exchange for their continued financial support.

Challenges to Stakeholder

- By participating in this system, GAC runs the risk of bad press surrounding mining pollution or eventual environmental regulation damaging their potential for profits, which would be counter-productive to operations. Additionally, GAC will be tasked with tracking data that may expose corruption and potentially diminish their relationship with foreign investors.
- The problems with the current standards of reporting through a paid third party contractor has led to a conflict of interest in reporting. Participation in this project would be an acceptance of that fact, which may dissuade such participation in the first place.
- Perceived lack of monetary incentive for participation might be a disincentive for participation. This perception would need to be challenged with strong policy or explicit financial analyses, which might be offloaded financially to other stakeholders.

Benefits to System

- GAC has the financial resources to fund this system beyond the success of the pilot project.
- GACs participation would generate precedent to set new policies requiring more stringent reporting standards within the mining industry of Guinea.

- This stakeholder's Participation in this system is a display of goodwill from one of the most financially powerful stakeholders in Guinea. By demonstrating their willingness to participate and be involved in this process, it would encourage other stakeholders.

Challenges to System

- Considering GACs previous indications of interest in establishing a program like this, there are very few downsides to their participation within this system. However, if GAC were to be replaced with another mining company that had not explicitly consented and encouraged the development of a system, it could have the potential to add an element of corruption to the system's framework that would have to be mitigated by the addition of more powerful watchdog organizations.

5. Paid Collectors

Orange Foundation

Function within System

These data collectors will be identified by the NGO as they have the most on the ground networks to determine who would be the best candidates. These candidates will be a small select group of collectors, preferably located in each village to expand the project's reach, and will have the full technical skills to collect data as well as the responsibility to train volunteers. These collectors will be paid regularly as they are a permanent component while part of the project.

Benefits to Stakeholder

- Members of this stakeholder group would receive training and practice in both data collection and management, which are transferable skills, and improving their technical literacy.
- This stakeholder group is consistently employed by the NGO stakeholder, receiving regular payment.
- This position gives members of this stakeholder group the opportunity to learn more about and engage with stakeholders in the mining industry.

Challenges to Stakeholder

- Paid collectors would be required to travel between communities in order to collect data and establish and develop data collection projects there.
- Anonymity is challenged for these stakeholders, and they might face retribution for their participation in this system. Participation in the data collection part of this system could be interpreted negatively by participant and non-participant mining companies and government institutions. This could result in negative repercussions for this stakeholder, for example in the form of withheld compensatory payments for their communities.

Benefits to System

- Rather than having a group of completely anonymous data collectors, this system would cultivate a group of trained and accountable data collectors, motivated by money and by occupational success. This would reduce the amount of time that NGOs would need to spend training new data collectors.
- Data may potentially be more reliable because the collectors are being paid and therefore there might be incentive to provide good quality work.

Challenges to System

- Payment structure could also yield poor quality results. A correct price point and payment structure would have to be developed to incentivize participation and accountability amongst this stakeholder group.

6. Volunteer Collectors

Function within System

Volunteer Collectors are trained by Paid Collectors and NGO representatives. Volunteers go into the field, supervised by a Paid Collector, and collect pollution data, then upload data with the help of a Paid Collector and receive money per submission from the Paid Collector. Volunteer Collectors remain anonymous.

Benefits to Stakeholder

- The members of this stakeholder group would be paid for their efforts, which would be a significant incentive, depending on the determined price point, considering that many community members have lost sources of income because of mining pollution.
- Volunteer Collectors would receive training in data collection and improve their technical literacy.
- Anonymity is maintained for individual volunteer collectors.

Challenges to Stakeholder

- Volunteer Collection is not a permanent working opportunity, which could be a disincentive for community members thinking about participating.
- Considering that the length of this pilot project is unknown, individuals of this stakeholder group might not be able to commit to volunteer for the length of this study.
- The introduction of new technology will result in a learning curve, which would require time and effort to overcome and could dissuade community members from participating and following through.
- Anonymity is actively fought for within this system, but communities with participants in this system can be identified because of the community development fund that would be set up for participating communities.

Benefits to System

- Locals can develop their technical skills which may aid in getting jobs in the future and developing the local technical literacy rate.
- By participating in this system, Volunteer Collectors enable a Community Development Fund to be established for their community.
- Data may potentially be more reliable because the collectors are being paid and therefore there might be incentive to provide good quality work.

Challenges to System

- Payment structure could also yield poor quality results. A correct price point and payment structure would have to be developed to incentivize participation and accountability amongst this stakeholder group.

7. Community

Function within System

Communities will receive funding for infrastructural improvements through a Community Development fund that would be established once members of their community participate in the Data Collection process by becoming permanent or temporary volunteers for Data Collection.

Benefits to Stakeholder

- Participating communities get infrastructural improvements through Community Development Funds paid for by the sale of data from the information database.
- As participants have the opportunity to be paid for their data collection, this could create professional networks that would provide economic opportunities for members of these communities.

Challenges to Stakeholder

- Fear of retribution from mining companies is a significant barrier to entry for communities. If a member participates and then that triggers the development of a community development fund, that community could be punished by mining companies. Community consensus or majority for participation would be needed as the positive and negative results affect more than just the participant.

Benefits to System

- The cooperation of communities in this system is imperative for the success of this pilot project. Community stakeholders are the most impacted by mining pollution and who this project is designed to help. Without their participation and guidance, the project could not be considered sustainable.
- If this program needs to grow beyond the pilot, it can only do so if a relationship of trust is built between community stakeholders and all other participant stakeholders.

Challenges to System

- Communities will likely need more frequent engagement and motivation, especially if system goals or tasks change throughout the life of the project.

SCENARIO 7

TECHNOLOGICALLY VERSATILE AND STRUCTURALLY CONNECTED

Scenario Assumptions

This scenario is a more versatile structure in that it can assume circumstances where access to network, power, and internet will be limited and others where technology capabilities will not be an issue. In the low technology scenario it assumes that we can rely on the existing networks within communities that help disperse information. Situations may also arise where the designed app will require more data than people are personally able to provide.

We think that it is important for the longevity and sustainability of the project to keep actors within the data management and funding roles local. However, we believe that an international agency would be the best actor to prevent corruption and mitigate power shifts as well as direct data collection and analysis. We also see an international party being able to neutrally advocate for policy changes in collaboration with the Ministry of Environment (MOE) and Chamber of Mines (COM).

Data Management

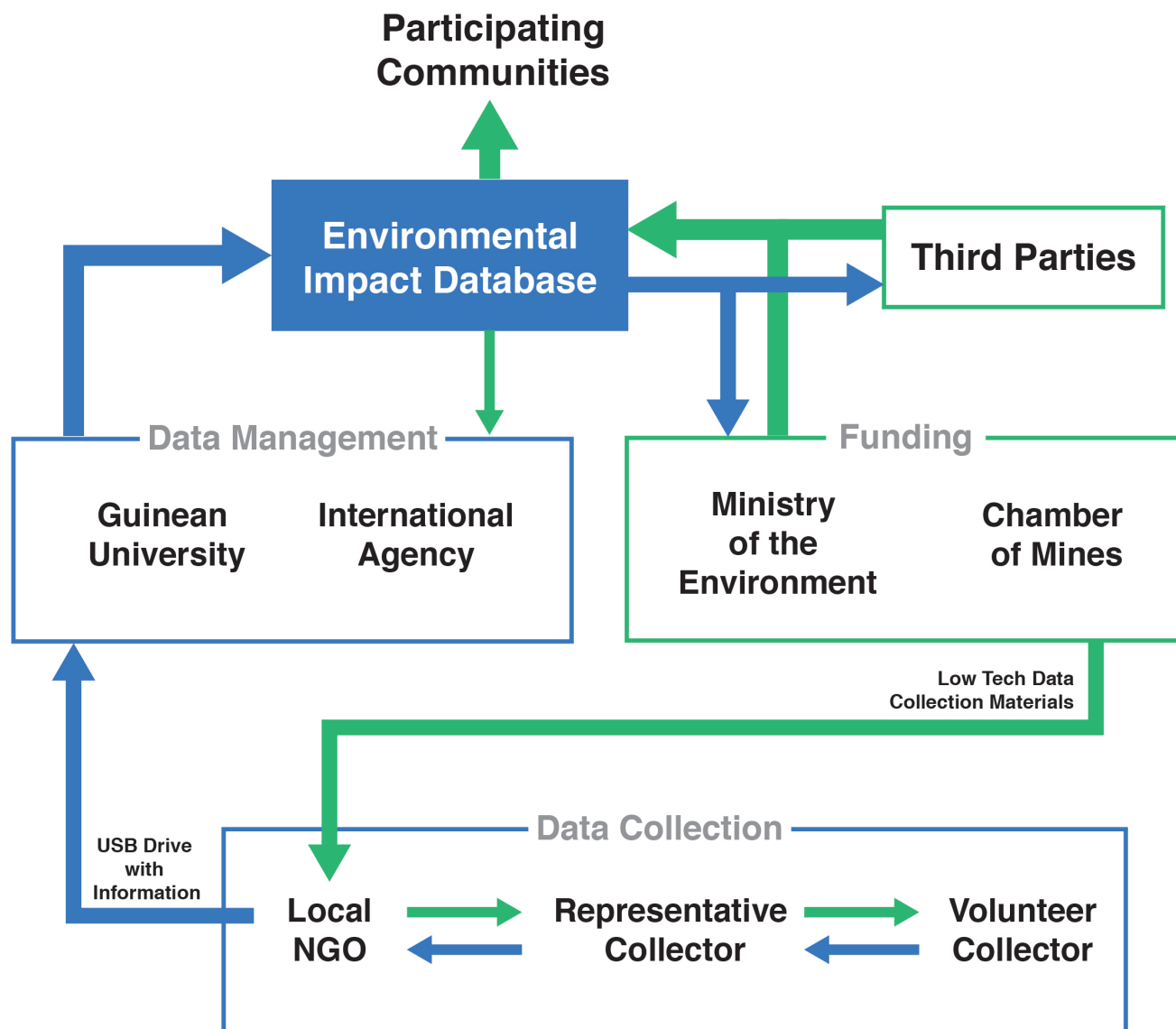
Data management will receive data from data collectors to analyze and verify, identify outlier information, maintain the environmental impact database, publish information in regular intervals, and help data collectors access information after it has been synthesized. The environmental impact database in this instance is designed to facilitate transmission of data for sale to third parties and funding parties. This team will also need to evolve as this project changes in terms of needs for the project or any new types of information that will need to be collected.

Funding

The funding partners in this scenario will supply Data Management and Data Collection stakeholders with materials needed to collect data and funds to maintain operation of database servers and data management. The funding stakeholders will also be able to purchase finalized data through the environmental impact database. The funding actors will also have the potential to fund data management scholarships at university.

Data Collection

Receive funding from funding parties through Non-Governmental Organizations (NGOs), utilize materials to collect data, transmit data to data management, and receive money through a Community Development Fund from the environmental impact database.



1. Guinean University

Universite de Boké
Universite Kofi Annan
de Guinee

Function within System

The Guinean University will work with International Academia at the beginning, but with the intention of shifting responsibility over to the Guinean University in order to make the program self-reliant and sustainable. This stakeholder role is able to create a partnership network between a few different local universities. They will be in charge of receiving raw data, processing, and analyzing the data. They will also maintain any servers and keep training for data collection up to date. Guinean Universities will work closely with the international agency to produce reports and findings that inform policy recommendations. The chosen Guinean University will receive direction from the selected international agency on how to change or add to existing data collection scope.

Benefits to Stakeholder

- The Guinean University would have the potential to strengthen networking and connections with government, international agencies, and NGOs active in the field.
- External funding Ministry of Environment, Chamber of Mines, and the International Agency could be provided and used to bolster data management capabilities for this program.
- Students and educators could increase their technological literacy through research opportunities within this scenario.

Challenges to Stakeholder

- Currently Guinean Universities are limited in funds as well as research manpower and equipment.
- Given this lack of resources, it is difficult to determine what level of technological literacy students and professors would have and whether or not it would prevent this stakeholder from participating in this scenario.
- Guinean universities currently have ties with mining companies, and could potentially spoil connections with them and lose professional opportunities at mining companies for their students.

Benefits to System

- Currently Guinean Universities are limited in funds as well as research manpower and equipment.
- Given this lack of resources, it is difficult to determine what level of technological literacy students and professors would have and whether or not it would prevent this stakeholder from participating in this scenario.
- Guinean universities currently have ties with mining companies, and could potentially spoil connections with them and lose professional opportunities at mining companies for their students.

Challenges to System

- Guinean Universities are not considered to be trustworthy due to their connections with mining companies as well as their sometimes low educational standards for degree conferences. Any university that participates within this system would need to be vetted and would require supervision to ensure that the data being managed would be accurate.
- The level of technological literacy and access to equipment is unknown and varies from institution. Bringing this stakeholder up to the level necessary for their participation in this system might require greater upfront investment.

2. International Agency

UNDP, World Bank

Function within System

The selected International Agency will review findings and reports from the Guinean University, push for regulatory improvements, manage and review the progression of the project, and mediate between the private public partnership structure of funding within this model to ensure lack of corruption.

Benefits to Stakeholder

- This pilot project and project mission would directly align with some of the aims and goals of this stakeholder.
- The quality of data collected would enable this stakeholder to better advocate for social and environmental policies within Guinea and in other locations struggling with mining pollution
- This stakeholder would gain access to raw environmental data and be able to direct the data collection to their benefit.
- Through this system, the International NGO would also gain access to an information collection framework in Guinea, which could help programs within its organization to pursue other projects.

Challenges to Stakeholder

- This stakeholder might find difficulties with aligning their priorities with those of the other NGOs operating in this space.
- Duration of involvement is unknown within this structure as this stakeholder may have to be involved for an extended period of time, which could make this stakeholder vulnerable to unforeseen internal costs beyond what is planned for the pilot.
- There is not an established foundation of trust between the International NGOs, the mining companies, and the government organization.
- International NGOs might not be based within Guinea or Boké. The lack of personnel on the ground can hinder the efficiency of the program as they are not able to adapt to changes immediately. There could be significant delays between data collection and data interpretation.
- Noting many pressing public health issues such as Covid-19 and providing clean water, this project might distract and divert resources from international agencies from these issues.

Benefits to System

- This stakeholder already has experience working with similar cross-sector engagement projects, and could lend its expertise to the execution and management of the project.
- International NGOs lend a public perception of trustworthiness and credibility to the entire system. Additionally, based on this stakeholder's international presence, it could garner positive global

media attention for this project.

- This stakeholder has access to funding for needs beyond the scope of this project, for example internet and energy infrastructure needed for this project.
- This stakeholder is an independent and unbiased party and is well suited to serve as mediator between MOE and COM, to prevent corruption and to advocate for all parties as well as a verifying party for potential/current investors of mining companies.

Challenges to System

- International NGOs might be too niche with their focus to adapt to suit the needs of the people impacted by mining pollution. This might lead to priorities different than what is best for the community as the project would be beyond the reach of this stakeholder.
- International NGOs typically face excessive bureaucracy within their organization, which could slow down the project milestones.

3. Ministry of Environment

Function within System

This stakeholder is a funding agent, which makes them an invested stakeholder with something to lose. They will receive reports and data from the international agency to keep and inform local policies. They will also work with the COM to provide funding towards this project and therefore will have to maintain regular communications with COM.

Benefits to Stakeholder

- The MOE would have the opportunity to collaborate with various stakeholders within the scenario to develop social and environmental policies.
- The MOE would have the backing of the International Agency as it attempts to enact or enforce legislation, and be respected and acknowledged for its mining work, when it has previously not had external support.
- The MOE would be able to cultivate a more visible relationship with the Chamber of Mines, not behind the scenes, which would make it easier for this stakeholder to be accountable.
- Collaborating with the Local University would allow for the MOE to develop and improve environmental education and research.
- The public perception of the MOE would improve due to positive involvement to create transparency on the issues created by mining companies.

Challenges to Stakeholder

- The MOE already has a contentious relationship with the COM, which could lead to difficulties in the organization and management of this scenario.
- The MOE does not currently have as much dispensable finances as COM, but this could change with their participation in the system.

Benefits to System

- Their involvement would allow for long-term policy improvements which could help structure the future of managing environmental issues in Guinea.
- This stakeholder is local and therefore they will be able to play an active role in ensuring the progression of the project.

Challenges to System

- This stakeholder's public perception of being ineffective and unsupported might not inspire other stakeholders to participate.
- The MOE is focused primarily on the environmental impacts of mining, and might not be able to address some of the more social impacts, like land tenure etc.

4. Chamber of Mines

Function within System

The Chamber of Mines in this scenario will be the co-funding partner working with MOE to fund this project and will have to maintain regular communications with the MOE. The COM will participate in policy discussions, set internal goals for mining companies beyond what is policy, and will be privy to some of the data and reports from the findings to inform safety and regulatory changes within the mining industry.

Benefits to Stakeholder

- The COM appears to have a good relationship with NGOs, Academia and other stakeholders that will be strengthened through this project. This stakeholder will also have the opportunity to build relationships with other stakeholders within the context of this scenario in which they would be viewed positively.
- Corporate Social Responsibility (CSR) and Public Relations (PR) based initiatives will help improve their public image, which trickles up to investors.
- This pilot project would grant COM access to the insights found in the analyzed data, which would improve this stakeholder's understanding of the issues communities face as well as enable it to inform its strategies for action and resolution.
- As the COM interacts with the other stakeholders within this system, it will encounter more opportunities to influence and advocate for itself within a transparent political context.
- This system provides trustworthy and unbiased data collectors, which is important for the COM.
- By involving the COM rather than an individual mining company, it allows the entire mining industry to move forward together and creates fewer loopholes.
- The network and connections that COM would develop through this system might help them gain a political advantage within the mining industry in Guinea.

Challenges to Stakeholder

- The COM might have more limited funding and manpower than advertised, as opposed to the individual mining companies, which might mean that the interests of individual mining companies could outweigh the collective COM group's priorities and efforts.
- Tensions might arise internally between COM member mining companies as well as externally between those mining companies who are involved in the project and those who have chosen not to be. There needs to be consistent consensus on the direction of the project.
- The COM must commit to long term funding for the research, regardless of the outcomes. This might be too much of a financial

risk, especially considering that negative outcomes are possible.

Benefits to System

- An endorsement of this system and project through COM's participation in it may encourage other mining companies apart from GAC to be involved in the project.
- The COM could act as a central entity for mining companies' to collaborate on sustainability issues.
- COM's participation in this program and connection with members of the community could create opportunities for occupational education for students and youth within the environmental mining space.
- COM's involvement could smooth over relationships between mining companies and other stakeholders within the system, paving the way for the mining companies' eventual adherence to environmental policies.
- Supporting some of the interests of the mining companies using the COM as a communication channel will help develop the support from the mining companies.
- The COM has a substantial funding stream for this project and will likely have a long term capacity for funding.
- The COM's involvement will grant the project and its stakeholders access to infrastructure improvements that mining companies are already deploying.
- The network and connections that COM would develop through this system might help them gain a political advantage within the mining industry in Guinea. This would enable them to influence mining companies to improve mining industry processes in the long run.

Challenges to System

- The COM might have limited funding and manpower, as opposed to the individual mining companies, and COM might not be as unified or organized as is advertised and currying favor with individual mining companies might be necessary. Tensions may arise within the COM members who are supportive and those who are opposed to the project. Trying to manage the internal relationships and pressures within the COM may be detrimental to the project.
- Communities do not trust mining companies and the COM. All scenarios require the consent and support of communities and it will require serious effort to amend this distrust.
- Funding for this project primarily comes from COM, and their participation depends on the outcome. Strict regulations or other limitations that come as a result from this research and program could cause the enthusiasm of COM for participation to wane.

5. Local NGO

Witness

Function within System

This stakeholder will serve as an intermediary between Data Collectors and Data Management. They will be in charge of managing the collection and distribution of data, maintain relationships and possibly the distribution of funding to the Representative Data Collector, conduct data collection training when necessary, distribute materials needed for data collection (i.e. cell phones, computers, etc). They will work in conjunction with the local university to identify areas where infrastructure will need to be built in order to support data collection and transmission. Finally, the selected NGO will provide communities with access to analyzed data.

Benefits to Stakeholder

- Local NGOs are generally trusted by most stakeholders, but would benefit from the credibility gained from their participation in this system with international aid and educational organizations.
- Funding from this system could give the Local NGO the resources it would need to secure necessary equipment and personnel that could benefit other projects it may be pursuing. For example, this project will provide the NGO with access to data or data collection capacity that could potentially be of use to their own initiatives.
- Local NGOs will have the opportunity to strengthen existing relationships within communities.
- If the Local NGO is not currently focused on environmental pollution and remediation, its involvement in this system will enhance the NGO's understanding of the interconnectedness of environmental problems and problems it is already tackling, for example, health or land tenure or education and sustainability.

Challenges to Stakeholder

- Local NGOs are generally underfunded and understaffed. Taking on a project of this size might preclude an NGO from participating; could require multiple NGOs to participate, which could make data management more complicated; or could draw resources away from their existing initiatives.
- Local NGOs would be required to travel to individual communities on a regular basis in order to collect data, which could be challenging.
- Local NGOs may not have a good relationship with some government or mining entities, which could be problematic in the general management of this system. Increased contact with these stakeholders, for example, the COM, could directly heighten the potential for corruption and bias.

Benefits to System

- NGOs are a trusted stakeholder among locals and therefore more likely to succeed in training and managing data collectors. The

communities' support and trust of Local NGOs lend legitimacy to this project.

- The on-the-ground knowledge of NGOs, which have a great deal of contact and information regarding communities in the Boké Region, would inform this system with cultural and practical nuance that would be difficult to achieve if the system relied only on international and corporate stakeholders.
- Local NGOs might have some experience with similar projects and data collection techniques, which can facilitate the pilot project's implementation.

Challenges to System

- While Local NGOs do have on-the-ground knowledge, many of them have a niche focus with their work, which might lead to future complications with differing priorities between the system and this stakeholder.
- Local NGOs' limited manpower may create issues in timely data collection and training, slowing down initial implementation.
- Local NGOs may not have the technical experience needed for data management and hence will likely need to be trained by a more technical partner.
- Efficacy of mission varies from community to community, and will frequently need to adapt to the needs of each community.

6. Representative Data Collector

Local Representatives of Local NGOs

Function within System

This stakeholder is in a formal or informal leadership position within his or her community, with a deep understanding of person-to-person communication networks. This stakeholder will serve as a waypoint between NGO and Basic Data Collectors of the Community, guiding Basic Data Collectors through training, collection, and verification processes, helping them upload data to a central database, and facilitating communication between communities and NGOs.

Benefits to Stakeholder

- This stakeholder is already likely a leader within his or her community, but participating in this system and assuming responsibility and leadership for this task will help build respect within the community.
- Participation in this system would include training to use smartphones, which would increase the technological literacy of this stakeholder group.
- This stakeholder group could potentially be employed by the NGO stakeholder, receiving regular payment.

Challenges to Stakeholder

- As this stakeholder is already a leader within his or her community, they might already be working on several other projects. Finding community members that fill a leadership role but are not already overexerted might be challenging.
- Participation in this system does not afford any anonymity and the data collectors or their communities could potentially be targeted by mining companies.

Benefits to System

- Local representatives are highly trusted among the members of their communities and therefore will encourage involvement of locals within this project.
- Local representatives have a social and historical knowledge of their community and land, which would better inform pilot project implementation and data management.

Challenges to System

- The benefits that the local representative can provide depend on the integrity of the individual, and depend on whether or not the local representative is able to withstand or avoid influence from mining companies. If integrity is compromised, the system will suffer as it is common for local representatives to accept bribes from other entities to avoid the submission of potentially sensitive data.

7. Basic Data Collectors

Function within System

This stakeholder will be trained to collect pollution data, then transmit data to Representative Data Collectors, and will remain anonymous. The stakeholder will receive equipment provided by funding stakeholders, but will not be paid directly, but through the Community Development Fund.

Benefits to Stakeholder

- In this system, this stakeholder is not required to already have a smartphone or internet, which is more inclusive. Do not need smartphones to submit data.
- This stakeholder would gain access to smartphone technology for data collection, which has the potential to yield co-benefits, chiefly greater connection.
- The members of this stakeholder group would gain the opportunity to actively participate in the remediation of environmental impacts. The pilot project has the potential to empower the stakeholder's community by building its organizational capacity.
- The stakeholder would be able to utilize the data collected and synthesized through this program to support and validate their pollution-related complaints with data.
- This stakeholder would gain access to smartphone technology for data collection, which has the potential to yield co-benefits, chiefly greater connection.
- Members of this stakeholder group would be supporting their community through Community Development Funds paid for by the sale of data from the information database.

Challenges to Stakeholder

- This is a volunteer role, and members of this stakeholder group might need monetary incentives to participate.
- Considering that the length of this pilot project is unknown, individuals of this stakeholder group might not be able to commit to volunteer for the length of this study.
- The introduction of new technology will result in a learning curve, which would require time and effort to overcome and could dissuade community members from participating and following through.
- Anonymity is actively fought for within this system, but communities with participants in this system can be identified because of the community development fund that would be set up for participating communities.

Benefits to System

- Data is likely to be trustworthy as local volunteers participating in this project have similar values of increasing transparency to aid the

overall health and environmental situation within Guinea.

- By participating in this system, Basic Data Collectors enable a Community Development Fund to be established for their community.
- The cooperation of communities in this system is imperative for the success of this pilot project. Community stakeholders are the most impacted by mining pollution and who this project is designed to help. Without their participation and guidance, the project could not be considered sustainable.
- If this program needs to grow beyond the pilot, it can only do so if a relationship of trust is built between community stakeholders and all other participant stakeholders.

Challenges to System

- Considering that the length of this pilot project is unknown, individuals of this stakeholder group might not be able to commit to volunteer for the length of this study. This would result in a rotating group of volunteers that could be difficult to manage and organize.
- Motivations for participation will vary from participant to participant. Data Management stakeholders will need to work with Representative Data Collectors to identify these motivations on a community by community basis.
- Communities will likely need more frequent engagement and motivation, especially if system goals or tasks change throughout the life of the project.

CONCLUSIONS & RECOMMENDATIONS

Bauxite dust exposure is the main risk to human health as a result of bauxite mining activities; it is linked to respiratory disease, cardiovascular illness and gastrointestinal issues with cumulative impacts over a long period of time. Limited studies and data available on bauxite dust exposure leads us to recommend that health workers in Guinea keep monitoring its long term impacts and, as we intend with this project, that mining companies limit exposure of the population from their activities. There are also negative impacts on ecosystems and their production of services, as actors on the ground are well aware. Pollution of water sources, in particular, destroys crops and reduces access to water for populations.

The mining companies' environmental and social impact assessments (ESIA) are limited, and will need improvement as corporate social responsibility (CSR) efforts and benefits to employees (see: Community Characterization) alone cannot outdo the damages of bauxite dust exposure. Civil society activists and community leaders have highlighted the lack of transparency in the mining sector, exemplified by the difficulty they face in accessing ESIA's, inspection reports, audits and monitoring data. CBG's and Alufer's reports are a first step in the right direction, and all mining actors on the ground should ally with the government and willing organizations to increase transparency together.

Different actors can find shared value in this goal as public unrest creates uncertainty for mining operations. In the face of mildly effective lawsuits and grievance mechanisms, communities have found that protests only and the subsequent losses of revenues for companies prompt a strong reaction.

Regulation (or self-regulation) of bauxite-related impacts is close-to-impossible without transparent disclosure of mining operations. This transparency, we believe, can be triggered by cooperation and access to information by all parties. The scenarios we propose for implementing a GIS-based solution put them at their center.

Youth and women, as well as other local-level groups and their respective leaders can be identified to carry these partnerships. The work of mining-related NGOs in Guinea is not well-documented -- still, local NGOs play a critical role in community empowerment and engagement, acting as a mediator among the community, government and mining companies. Although relations have been contentious in the past due to the NGOs legal actions and publicized complaints against

the mining companies and the Guinean Government, there is potential for the relationship between them to improve.

This partnership between actors can ultimately reinforce existing citizen-led data collection efforts, or lay completely new projects like in some of our scenarios. Our scenarios revolve around the use of geospatial products, in particular maps that are built using data collected both by satellites and people on the ground. Documenting bauxite dust through verifiable media is an effective way to build a body of evidence of environmental pollution.

At present, photographs and videos of dust pollution have been collected as a practical and powerful way to contribute to this body of evidence. Existing maps and geographical datasets can also be used to elaborate upon or contextualize mining pollution related data within the communities that it impacts. We identified existing datasets that can serve as a basis for the creation of new maps and other GIS products: mining plot data from the Ministry of Mines and the Sentinel satellite, as well as publicly available maps from humanitarian organization Open Street Maps.

In our scenarios, the roles are broken down into a structure with three main responsibilities: data management, funding, and data collection. These scenarios vary in motivations for each actor, levels of trust in each stakeholder or within the model itself, the level of funding, the amount of local and international players, utilization of other local resources, and the level of technological capabilities.

Our seventh “Technologically Versatile and Structurally Connected” scenario was highlighted by our point of contact at the UNDP Guinea as a particularly viable one. This scenario is a more versatile structure in that it can assume circumstances where access to network, power, and internet will be limited and others where technology capabilities will not be an issue.

Orrore si suntior sum aut pellate
porrovitae modis illabor aligendia
con conest, qui omniend animagnis
apernatquam, cum quatemquam,
quibuscit laccae cus velis simus



We think that it is important for the longevity and sustainability of the project to put local actors in charge of data management and funding. However, we believe that an international agency would be the best actor to prevent corruption and mitigate power shifts as well as direct data collection and analysis. We also see an international party being able to neutrally advocate for policy changes in collaboration with the Ministry of Environment and Chamber of Mines.

Ultimately, community-based environmental impact tracking offers an opportunity for mining companies to directly address their environmental impact, create transparency and trust within local communities and lay the groundwork for a functional grievance system that can mitigate against violence and disruption. Note that our models do not address the confiscation of land from Guineans for mining purposes.

Travel prohibition due to COVID-19 and political unrest in Guinea in spring 2020 prevented our group from conducting a site visit to Guinea and verifying some of the assumptions made in the stakeholder profiles and scenarios. Future work could focus on verification of assumptions and refining the scenarios based on more in-depth discussions with the stakeholders. We encourage the United Nations to fortify existing projects on the ground that increase transparency, and to carefully engage with all stakeholder groups' representatives before launching the project.

4. Appendix

Aboubacar Kaba

Contact's Role: Head of Service at the Laboratory of Environmental Analysis (Laboratoire d'Analyses Environnementales, or LAE), which operates under the Ministry of Environment

Contact Information: boubahkaba@gmail.com

Capstone Student: Gregoire Mazars

Location of Contact: Conakry, Guinea

Date: April 14, 2020

Contact's Background:

Mr. Kaba has been working at the Laboratory of Environmental Analysis (LAE) for five years and has extensive experience in environmental impact assessments as an engineer-chemist. At the LAE, he was tasked among other things with coordinating environmental inspections for the Guinean Bureau of Environmental Studies and Assessment (BGESE), helping implement pollution management programs, and, most crucially for our project, to ensure contribution of the private sector in regards to this management.

Key points:

- The government has bolstered its involvement in environmental impact assessment with the help of the World Bank, notably.
- Community-led committees (CPSES) are equipped with protective gear and cameras to map and report pollution in mining sites of major companies.
- A 2017 environmental and social evaluation and a cumulative impacts study in the region of Boké by consulting group EGIS and Norda STELO form the basis of action for the Ministry moving forward.

Interview Notes:

Relationship with the World Bank and operative pillars for pollution control

Environmental impacts from mining operations are far-reaching and the government does not have the capacity to monitor them all. Notably, the temporality of some impacts makes it difficult for Ministry staff to measure them before they dissipate. In 2015, the Ministry received disinfection gear from the World Bank, which it started using in 2016 for its inspections. The funding for this equipment was meant to give communities the capacity to conduct inspections of each of the six major mining companies -- not limited to bauxite-related, but also diamond and iron extraction in the face of their increasing impact.

The information acquired from these inspections is not used for impact assessment or reports by the government. On the other hand, the government asked the World Bank to conduct cumulative impacts assessments of the prefectures of the Boké region (including the Boké prefecture) in 2017. The group found the request to be pertinent and accepted, and forwarded the mission to consulting groups EGIS and Norda STELO, which respectively conducted a strategic environmental and social evaluation (évaluation stratégique environnementale et sociale, or ESES) and a cumulative impact study (étude des impacts cumulatifs, or EIC) of mining activities. These two studies form the core over which the Ministry now

builds its environmental monitoring efforts moving forward.

New funding from the World Bank and prefecture-level control

The Ministry plans on bolstering its regulatory efforts. It won't personally conduct environmental impact assessments during development and exploitation phases of new mining concessions, but it will coordinate these assessments as they are led by the Bureau Guinéen d'Etudes et d'Evaluation Environnementale (BGEEE). In order to further equip local communities with pollution control capacity, Mr. Kaba and his colleagues asked the World Bank and the African Development Bank for further funding -- with the prefectural-level governments as a centerpiece of their new axes of action. The organizations agreed to not only fund more equipment in 2018 (including PHmeters, and motorbikes to allow community leaders to move swiftly to polluted sites), but also widen the funding to other activities, such as agriculture, fisheries, aquaculture, and more.

Under this funding, the environmental prefecture-level government helps create "proximity control structures." Mayors and representatives of women, youth or activity-specific leaders are involved in management of pollution and form committees (Comités Préfectoraux de Suivi Environnementaux et Sociaux, or CPSES). They receive a GPS, cameras and motorbikes to use to report pollution through up to four inspections per year in sites of each major mining company, at the expense of said company. Every socio-economic activity is represented within these CPSES.

Reports from these inspections are currently underway, and will be sent to any party that requests that information (such as the Human Rights Watch, which has already expressed interest.)

Elizabeth Zehe

Contact's Role: Currently a Master's candidate of Social Work Candidate at New York University. Beth was part of a team of researchers introducing mobile health tools to support Ebola surveillance and contact tracing in Guinea.

Contact information: LinkedIn: <https://www.linkedin.com/in/beth-zehe-b88a2714/>

Capstone Student: Savita Bowman

Location of Contact: Zoom Conference Link, 12PM EST

Date: April 14, 2020

Contact's Background:

Beth is currently a Master's candidate of Social Work Candidate at New York University. Prior to that, she had done a lot of work in the field of healthcare, specifically focusing on the technological aspects. She was part of the team that implemented contact tracing in Guinea during the Ebola crisis. Her work with other associates at the Columbia University Earth Institute entitled "Introduction of Mobile Health Tools to Support Ebola Surveillance and Contact Tracing in Guinea" covered the methodology and issues they ran into while implementing this application. She was identified to determine the ease of implementing an app in Guinea and the technological literacy of locals due to her technological and on-the-ground training exposure.

Key Takeaways:

The main challenges in working with locals were the technological aspect as app functionality, technological capacity and technological literacy can all become obstacles.

Content literacy of supervisors and health officials was higher during the Ebola crisis; however, training was not straightforward.

They developed the app to be user-friendly. Due to low content tracers, they created multimedia videos to reduce the need for agents to have to read.

Working with government entities was not difficult. Such entities were also acting during the Ebola crisis and therefore their involvement was welcome.

Interview Notes:

One of Elizabeth's main focus was training and technological capabilities. Her team leveraged local resources. They sat in New York; however, they had 3 local agents on the ground in Conakry, and worked with a government-appointed head. The Earth Institute already had a contract/connection with open source mobile platform CommCare at the time.

There were different requirements and training focuses depending on the individual being trained. Supervisors and government officials were looking at data day to day. People interacting with the app's dashboard and health officials had to have high literacy and were given more specialized training; content literacy in these agents was higher, notably the ability to read reports.

One of the key challenges was the technology aspect. Troubleshooting instincts were not advanced, reports not loading, and there were lag times. Agents were also used to working in paper form rather than through technological applications. It would sometimes be difficult for them to maneuver the app/dashboard. Expectation for content literacy of the contact tracers was lower, built into the interface as logically as possible to create a more user-friendly interface. The application would prompt you to do different things based on what was collected. Selecting from a predetermined list. They tried to build in multimedia to play videos or play the questions so they didn't have to read. Training was easier for contact tracers than government officials.

The hardest part was troubleshooting a particular issue: something wasn't loading, and the battery died.

2-3 people on the ground were working with them to help implement it.

She went to Guinea twice: first in November 2014, then in February 2015, both times with the goal of deploying a lot of the phones and getting resources to contact tracers. They ran the pilot in Conakry then expanded to four areas. She worked on the majority of training.

What was the infrastructure of healthcare like? -- They did not have a lot of interaction with formal healthcare, they were working with on the ground civilian volunteers. She was focused on technology deployment specifically. They needed the deployment of grassroots efforts to prevent overwhelming the local healthcare system.

Jenik Radon

Contact's Role: Columbia University SIPA Professor

Contact Information: jr2218@columbia.edu

Capstone Student: Cynthia Leung, Nick Krakov

Location of Contact: New York, Columbia University

Date: April 8th, 2020

Contact's Background:

Jenik is an immense resource on strategies to implore companies to take decisive action to correct harmful impacts. Jenik advises public authorities and civil society in a number of emerging nations, particularly in respect of the negotiation of extractive industry agreements, especially oil and gas, and sustainable natural resource development. Jenik has particularly relevant experience in the extractive industries as it relates to human rights and grievance mechanisms.

Key points:

The way you apply pressure to achieve transparency is not through a long document, but through clear, hard evidence. You need a clear “before” and “after” assessment of the impacts that people can visualize. Pictures or evidence showing the impacts before and after mining operations start will be powerful.

Your ally is accuracy. Show who has completed an EIA and who hasn't. Do not mess up the reporting because this needs to be credible and trustworthy.

If you're going to be effective, you need to be hard hitting.

Use the Columbia brand to push forward the importance of the topic (i.e. “an Ivy League school in New York draws attention to the Boké Region of Guinea to look at environmental impacts of bauxite mining practices.”)

Utilize the media and exposure. Some of the financiers for these projects care about their PR. These companies include: Germany's Deutsche Investitions- und Entwicklungsgesellschaft (DEG), ING, IFC (See notes below for more detail)

Contracts in mining usually require all the reporting that we are looking for, but are laxly enforced.

Consider leveraging churches as a community-based approach.

Additional Interview Notes:

Transparency - Digitalization & Columbia University - “Your ally is accuracy”

Clearly publicizing and displaying impacts/missing information is critical to enabling transparency. Research teams should ask themselves if it is possible to identify and demonstrate flaws in the EIAs via timelapse photos. It is even possible to conduct a mailing campaign to send to the stock exchanges.

The Columbia brand is powerful abroad and if the university is looking at it it makes the project significant. Exposure via the Columbia website is another powerful channel.

In Jenik's experience, Chinese companies will do exactly what they are told and nothing more in terms of environmental and social safeguard implementation, while Western Companies tend to quickly claim that subsidiaries are doing the dirty work and it's not their fault. In order to obtain the mining concession in the first place, the mining Companies and the government usually establish certain data points that never arrive.

If our efforts identify clear instances where project impacts break terms of an explicit agreement with financiers, these entities will be easily "embarrassed" if they are exposed for financing bad mining projects. Jenik made clear that certain banks care more than others, but many will face scrutiny that they would prefer to avoid.

Perrine Toledano

Contact Role: Lead Economics and Policy Researcher, Columbia Center on Sustainable Investment

Contact information: ptoled@law.columbia.edu

Capstone Student: Julian Tung

Location of Contact: Tel Aviv, Israel (During CoronaVirus Pandemic). NY, NY.

Date: April 8, 2020

Call Time: 20 minutes

Contact's background:

Perrine leads research, training and advisory projects on fiscal regimes, financial modeling, local content, revenue management, contract transparency, optimal legal provisions for development benefits and leveraging extractive industry investments in rail, port, telecommunications, water and energy infrastructure for broader development needs

Key points:

Corporations are mostly using the environmental, social and governance (ESG) or CSR reporting as a sales pitch instead of actually changing the status quo to improve ESG factors. Private institutions are even worse as they have no obligation to report anything and are even less motivated to report on sustainability-related issues. All the reports you will read are cherry picked statements that prop up the company's ESG score. Don't believe any of it. Even if there is a third party organisation checking for ESG factors (e.g GRI), the company is still paying for that service, which has led to conflict of interest issues.

The best ways to work around these shortcomings is to judge by the size of the company and look out for the faults, scandals, community disruptions etc. Remember that everything reported by the companies is biased. In recent years, there has been a significant increase in resources aimed to expose the exploitation of communities by international corporations operating in developing countries.

Useful Resources for Continued Research:

<https://www.business-humanrights.org/>

<https://www.justice.gov/criminal-fraud/related-enforcement-actions>

<https://www.traceinternational.org/compendium>

<https://www.sfo.gov.uk/our-cases/>

<https://www.goodjobsfirst.org/violation-tracker>

Tino Toupane

Contact's Role: Founder of Geosynapse, Local Geospatial Data NGO

Contact information: Email: tino.toupane@gmail.com, Skype: tino.toupane

Capstone Student: Nick Kracov

Location of Contact: Conakry, Guinea

Dates: February 26, 2020 & March 24, 2020

Contact's Background: Founder of Geosynapse Guinee – From Senegal, moved to Conakry 7 years ago for work.

Key Points:

There is a small community of GIS professionals in Guinea that has experience working with multinational/academic institutions.

Geosynapse has experience structuring youth-based training and mapping initiatives within communities in Boké.

Geosynapse has experience creating customized data collection interfaces using open-source technologies like KoboToolbox

Relevant Project Experience

Secondary Cities

Geosynapse was the lead partner on a “Secondary Cities” (2C) project with Boké University as supporting partner. 2C is an initiative coordinated and funded by the Office of the Geographer of the U.S. State Department. This project aims to develop the essential data needed for urban planning by generating a baseline dataset of services (e.g., schools, health centers) and infrastructure (e.g., roads, water supply, electricity).

The Boké-Kamsar corridor is the heart of the bauxite mining industry in Guinea. Bauxite is a raw material used to make aluminum and Guinea has over 30% of the world's supply. Bauxite is exported through the port of Kamsar. According to Guinea government agencies, recent annual growth rates in the Boké-Kamsar corridor approach 10% annually. Rapid growth and the expansion of mining activity present multiple challenges for urban planning, infrastructure, health care, and education in this region.

The budget is 100k for 1 year. Geosynapse trained 25 students (members of YouthMappers Guinea - OpenStreetMaps affiliate) on how to do field data collection/surveys using KoboCollect.

Land Use/Land Cover Mapping Initiative

Recently finished project (2018 - Feb.2020) funded by the French Development Agency (Agence Française de Développement (AFD)) working with the Guinean Ministry of Agriculture. Its goal was to process imagery and produce a land use/land cover map of the entire country.

The Guinean Ministry of Agriculture struggled to find internal personnel with the required capabilities.

Geosynapse ended up being contracted to do the bulk of the work (7/10 people on the project were Geosynapse team members) over a 2 years span to produce the report.

World Bank

Tino is an independent contractor supporting the World Bank Group (WBG) with historical/actual mapping of key Guinean infrastructure.

Other Information

Methodologies

The Secondary Cities project was conducted using KoboToolbox, the open source geospatial data collection platform.

Technology

Tino confirmed that many phone stores have opened up with the arrival of Chinese mining workers. The primary device being sold is the Tecno brand, which, according to Tino “allows for a geotagging precision of 3-5 meters.”

Dr. Penda Diallo, PhD

Contact's Role: Lecturer, University of Exeter, Camborne School of Mines

Contact Information: P.N.Diallo@exeter.ac.uk, 00447788983348

Capstone Student: Vanessa Douer Seinjet

Location of Contact: Exeter, United Kingdom

Interviewee Background:

Penda received her PhD from the University of Edinburgh, School of Social and Political Sciences with a focus on the impact of mining on development and politics. She identifies and works with local, national and international institutions, supporting the design of locally appropriate development projects as well as advising different stakeholders on building sustainable community relationships in mining areas. She has spent time conducting field research in Guinea.

She is the author of Regime Stability, Social Insecurity and Bauxite Mining in Guinea Developments, Since the Mid-Twentieth Century.

Key points:

Dr. Diallo believes the local communities in Boké would participate in the project; they are the ones who suffer the most from mining activities.

There is a lack of trust throughout the country.

The data management aspect of the project is extremely important as information is power. Researchers involved with this project should ask themselves: who do we want to give power? Do we want to make it accessible and equitable?

There is a stark difference between the mining companies and local communities' infrastructure. For example, local residents are not allowed to use the roads built by mining companies.

Dr. Diallo is friendly with a senior employee at GAC, who is also the president of the Bauxite Environment Network. Future researchers on this project should contact Dr. Diallo as she has many contacts in Guinea.

Data Management:

The researchers on this project need to understand the context in which the system will be implemented. In Guinea, there is a lack of trust which is only exemplified by the political situation. Both trust and political issues make people feel very insecure and unsafe on a daily basis. As such, data management, or more importantly who has control of the data, is essential to the system. Dr. Diallo believes information is power and who receives that power will affect the project's outcome. For example, if the government is in charge of the data, will the local communities be hesitant to participate in the project? If the mining company is involved, will the data be tainted? She believes the best option would be to keep the data open source with clear guidelines of what it will be used for and how it will be used.

In addition, data management can be very challenging in Guinea because of lack of infrastructure.

Lack of Trust:

In 2019, Dr. Diallo spent a few months in Guinea conducting field research. In both the mining communities

and cities, people expressed their fear. The fear is such that communities believe there are government spies infiltrated in Bauxite mining companies. Along with fear, the people do not trust those in power. The lack of trust widens as mining companies use their power to silence those who criticize them. For example, she knows someone who was investigating a mining company and received threatening messages. The mining companies also use their financial power. Dr. Diallo knows a journalist who used to criticize the mining companies and suddenly his language changed in support of those same companies. She believes he was paid off. Social unrest increases the lack of trust. The government usually sends out the military and incarcerates the youth to end protests.

Local Community:

Negative impacts of mining coupled with the lack of social and economic development in the region, have left the communities in a hard place where daily life is a struggle. During her time in Guinea, Dr. Diallo met a young boy whose rice fields were damaged because oil was poured into the coastline. He would have sent her photographs of the damage if he had a proper phone. Another man, whose water source had been polluted, did not know what to do nor who to contact. There is no dialogue between the mining companies and the communities.

The local communities are also suspicious of foreigners. They believe that the government has spies everywhere. They also believe that the Peace Corps are spies.

Lack of Infrastructure:

The main town in Boké is roughly 40 minutes away from the local communities and mining activities. The local residents travel to town by foot because only company employees are allowed to use the road. Dr. Diallo clearly describes the issue: “imagine living in the village your entire life, and a company comes in, and within a year they build a road you can’t use. You have to continue walking all the way to town.”

Environmental Impacts:

On paper, it might look like the government is concerned about the environment, but the reality is that only the communities are concerned.

Bocar Thiam

Contact's Role: Land Tenure Advisor, Tetra Tech Africa, Consultant in social sciences; local governance, land tenure

Contact information: +1 202 725 0734; LinkedIn: <https://www.linkedin.com/in/bocar-thiam-64248310/>

Capstone Student: Simone O'Sullivan

Location of Contact: Maryland, USA

Date: March 13, 2020

Contact's background:

Bocar is a native Guinean now living in the US. From 2013 - 2016 he was Guinea's Country Director of USAID and he previously worked in the artisanal mining industry (diamonds) on property rights. In 2001 - 2003 he also worked for Aluminum producers Alcoa and Alcan, as part of a refinery feasibility study in Guinea. He is a social scientist specialising in local governance, land tenure, property rights and natural resources management and governance in Africa and the Americas.

Key points:

The mining code was originally too restrictive for mining companies, so the Guinean government made the code more lenient, giving priority to mining over community well being.

Communities do NOT trust the government or mining companies, they DO trust the NGOs

Mining companies would like to see the royalties being spent on long term projects in the communities; however, the decentralisation of royalties - through a fund called FODEL - is not working. There is no transparency and the funding is not being distributed as directed in the Mining Code.

The new mining code has developed clear guidelines about a decentralised approach to the use of royalty funds. Those funds are supposed to be flowing to each community, who has direct responsibility for fulfilling their strategic plans, including the 'shopping list' of infrastructure and other needs that are to be paid for by royalties.

Interview Notes:

What is the relationship like between the mining industry and the people? Who does the community most trust to manage their interests?

In 2011, the new President developed greater governance over the mining industry through the mining code that the mining industry did not like as it was too restrictive. A number of mining companies threatened (or took steps) to pull out of Guinea. Government revised the Code with the mining industry so that they wouldn't leave, at the expense of the people. The relationship between the people and mining industry is very difficult: there is no trust between the community, government and the mining companies. The communities do trusts the NGOs.

Mining companies originally made the mistake of giving communities cash to ease the company's development path. Now trying to correct this - the short term cash incentives meant that the people were constantly coming back to ask for more. Mining companies are now pushing for the government to use

their royalty funds to invest in long term projects such as community based development projects.

The mining code established a process for royalties to be paid back to the people and especially to the communities directly impacted by mining activities. (See discussion on PAGSEM in interview with Jamison Suter). However, the 'decentralisation' of funds management is not working.

Bocar has contacts from Alcoa who have more detailed knowledge of how FODEL, the fund that manages the royalty payments, operates.

Adebayo Okeowo

Contact's Role: Program Manager, Witness, Africa

Contact Information: adebayo@witness.org; okeowoadebayo@gmail.com; +27768644325

Capstone Student: Savita Bowman, Meng Yi Bay

Location of Contact: WhatsApp Phone Call

Date: Friday, March 13, 2020

Contact's Background:

Adebayo is the Africa Program Manager at WITNESS and leads the organization's efforts in Africa. His current focus is on exploring, through research and practice, the intersection between human rights and technology. Prior to joining WITNESS, he worked as the Advocacy Coordinator for the Centre for Human Rights based in South Africa, during which time he led continent-wide campaigns that addressed human rights abuses against marginalized and vulnerable groups, especially women, children, migrants and persons with albinism.

Key Takeaways:

Witness has completed many projects and is active all around the world advocating for human rights. They have done quite a bit of work on the ground in Conakry and Boké conducting training on documenting pictures and videos of injustice.

Through their training, they sometimes offer smartphones. They insist on the geolocation of photos, which is demonstrated through their training with locals.

Connectivity in Boké and smaller towns is not as good as Conakry. Rarely do they receive data directly from locals because the file sizes are too large. Data is usually collected on a flash drive by a local NGO.

In their experience, SMB has been open to dialog and mediating with local communities to help remediate the problems they have caused. While SMB is not very active, they are the most responsive out of all the mining companies Witness has worked with.

Mr Adebayo Okeowo has worked with Mr. Mamady in the communities, using technology to document evidence for human rights issues. Witness is New York-based, but they also operate in other regions like Latin America, Mexico, Brazil, Amsterdam, and Nigeria (Africa project). They support communities, activists and human rights defenders, and help them through the court system to get people justice. They believe in documenting things through the digital era. They have worked in the International Criminal Courts on large landmark cases.

They do not only document; they are also using the videos and photos collected to drive changes, for example for their work in Guinea with the communities that are affected by bauxite mining. They are working to create more accountability within SMB (operating in Boké) together with other NGOs through visual documentation, with the following objectives:

- Enabling community dialog between corporate and the locals.
- Documenting the violations they are experiencing.
- Organizing training for people to take stock of impacts to their land and livelihood.

Savita Bowman clarifying question: Are you working with SMB?

They are not partnering with SMB but are taking them on. They are going in and conducting in-person field training (over a number of days or sometimes a week) to make their case more compelling. Adebayo is also collaborating with Mr. Mamady from AMSP (see interview with Mr. Mamady) and other NGOs to create awareness of SMB's mining impacts in China.

Bay Meng Yi: What is your experience of training in Guinea, what is it like?

Adebayo Okeowo: Women do not have mobile phones as much as men. There is inequality between men and women. However, Witness always tries to have a mixed group in their training.

Adebayo has not gone to Guinea to conduct training. Witness has recently restricted travel due to Covid-19. However, he is still trying to go in April 2020.

Witness does offer mobile phones to some of the people they train. They prefer to conduct training in small groups of 20 as they think that it is better to have a close group to monitor development. Trainees can also pass on the training to their own communities. They have done training in Conakry and Boké and they might do training in Madiana. Their only interaction with the Chinese is to hold them accountable. At no point do they have engagement with Chinese companies. Through the pictures and documentation of the problems, Witness attempts to challenge the mining companies and trigger them to act.

Adebayo Okeowo highlighted his concern on how the app would be able to run with heavy data. He added that there is not that much connectivity where the mines are. While the connectivity in Conakry is fine, the connectivity fluctuates as they move towards other smaller towns. App may not work due to internet connectivity.

Bay Meng Yi: Who funds their projects for phones and training?

Adebayo: This project involves a few organizations (Witness, Nmap, IDI).

AMSB is a local organization that they work with, funded by the 11th hour project. Funding is dispersed through each and every organization to focus on all different kinds of work. NED also funds some of the work they do. Initial work was to give people cell phones and cameras to document change. However as most people have phones now, they have changed their focus. He has done some work in Senegal and they gave phones to some of the people they trained there.

Bay Meng Yi: How do they collect the videos and photos from the phones they distribute? And besides the documentary what do they do with photos?

Adebayo Okeowo: Pictures and videos are deployed for different reasons: they can be taken to court, notably, where they will support the case. However, Witness does not argue the cases. The documentation can be tendered in court. In the case where they worked with Mr Mamady from AMSP, they introduced data to the reports for analysis. Natural Justice creates something called a "photo story" that documents issues and incorporates story telling.

They collect the pictures using a flash drive and working with another NGO. When the NGO gets back to the cities, they send the flash drive to Witness. These pictures and videos do not usually get transferred online by community members because the files are too large. Rarely do they send the videos and images via text because of the large file sizes and the poor connectivity. Jing Jing Zhang aims to use the pictures and videos to create a documentary of mining impacts in China.

Bay Meng Yi: How open are you to receiving funding from mining companies for projects to help with their environmental impact assessments/CSR?

Adebayo Okeowo: It depends, but he thinks that Witness might be hesitant. Witness might not accept it but it depends on the situation. It was difficult for him to imagine why the mining company, who is creating the problems, would pay them to document their environmental impacts.

Savita Bowman: How has SMB reacted to the pressure you've applied to hold them accountable?

SMB is one of the more responsive mining companies; they have been open to dialogues. They are also open to remedying some of their cases where they have participated in mediation processes with the communities.

Bay Meng Yi: Part of our capstone project is to document the mining dust using satellite photos, matching them with what they see on the ground.

Adebayo Okeowo: Conakry to Boké is a 5-hour drive. Boké has some connectivity but it is not that great. He suggested that we should not rely on having internet connectivity. In terms of connectivity, Conakry and larger cities are a lot more promising.

Another aspect to consider is that, often when they approach the local communities, the latter do not know the exact community boundaries. Satellite imagery that shows mining encroachment over time would be beneficial to help them understand how their community has changed or been negatively impacted over the years. They have case studies of their land defense projects.

Bay Meng Yi: Are videos and photos geolocated? How important is this to you in the data collection process?

Adebayo Okeowo: It is one of the key things they insist on when they conduct training because they can verify and confirm the data's integrity. They recommend downloading apps to preserve metadata -- these are downloadable from the Google Store.

They have not received the pictures from Guinea yet. They were going to get pictures during a meeting in San Francisco with AMSP but that did not happen. He was going to try to get the photos when he goes to Guinea. He expects most of the photos to be geolocated.

Savita Bowman: How many people have phones, and of those how many are smart phones?

Adebayo Okeowo: Generally, most people have phones, but he does not know whether they have smartphones. Their local partners help to coordinate the training on the ground - who conducts the training, what their needs are and who can attend the training. Mr. Mamady from AMSP is very internet-savvy and he has become the bridge between Witness and the local communities. He also helps to

collect the documentation and passes it to Witness.

Bay Meng Yi: How open are these communities to these interventions?

Adebayo Okeowo: Many communities are reaching out to Witness asking for help. These communities understand and appreciate the value of the work that Witness provides, for example in land defense, war crimes, DRC child soldiers, and their work around Cameroon and other places in general.

Anna Canero

Contact's Role: Peace Corps, Guinea

Contact information: annamcanero@gmail.com

Capstone Student: Aditi Bansal, Julia Bontempo, Cynthia Leung

Location of Contact: NYC

Date: March 12, 2020

Contact's Background:

Anna, a friend of Matan Skolnik, lived 30 minutes outside of Boké when they were in the Peace Corps together teaching middle school math. She's currently getting her Master's in International Political Economic Development from Fordham University.

Key Points:

From a cultural perspective, it is important to understand the dynamics between the three language groups: Sousou, Pular, and Malanki. The language groups are pivotal to the power dynamic in the country. Sousou are the minority and hold many positions of power but Guinea's current president is Malanki. This defines who the political leaders serve in the communities, especially when a specific language group holds power on a national level.

As Anna's town did not have a high access to electricity, and the community depended on Phone Charging Business for People, run by a local, to charge their phones.

Enterprising Phone Charging Business is key to the relation of phone use and charging for communities if we want to deploy an app.

The dynamics between residents of the local communities are also important to understand, including the dynamic between elders and the youth.

Adults have higher influence and activity leadership capacity than the youth. The youth will never do anything to contradict their elder as the elder is the most respected person in the family.

There is still a lot of gender inequality when it comes to girls participation in school, particularly as they get older. In more conservative regions, girls may have less access to education.

Schools are most interconnected when it relates to sports. They will gather through soccer tournaments and people actually want to help fund trips to other schools for soccer matches.

Anna believes a great way to reach out to youths is to leverage the Maison Des Jeunes, where soccer matches are screened. It's a good way to introduce an app or engage in a setting they enjoy and feel comfortable in.

Interview Notes:

Communities to know because they are interconnected and involved in mining:

Colobui, Roundabout, Boké, Kamsar

Dynamic between three Language groups: Sousou, Pular, Malanki.

Dynamic:

- Place a lot of importance based on what language group you are talking to.
- A lot of political violence between language groups.
- The Sou Sou minority hold the power.
- Sousou is the dialect you would use when you are in Boké.
- Pular is the majority, but have never had someone in power (The “Grieving majority”).
- Third group is the malanki people, in the easter part of country, closer to Mali.
- The current president, Afakande, is malenke.

Local government, prefecture:

- French governance system
- President > cabinet
- Local government highest/higher leaders is the prefect.

Boké is a prefecture, one of the larger types of governing bodies. If you are going to work with the government on an app:

- The mining industry is under the hands of the Chinese. They only work with local government and getting them on board will require you not to present your project in a non-threatening manner.
- A lot of kids would go to work in Sangaredi.

Were you working with the school as well? High school/middle school hybrid. I remember Matan mentioned that the principle of the school had a lot of power, was that the same case for your school?

- The professor/principal was influential in that he will be invited to big gatherings, and if he says we're going to strike, we are going to strike. The principal will know the families of students.

Youth and youth activists are part of a community we are really curious about --what are some things that they cared about and how were they involved in the community's struggles? If you were to try to influence them to do something, what would it take? Youth leaders?

- Youth leaders are very passionate about getting the students more engaged for their education. They would hold debates and open it up to the public. They would debate and ask, “why is Guinea poor?”
- Adults have higher influence and activity leadership capacity than the youth. The youth will never do anything that will contradict their elder as the elder is the most respectable person in the family. The youth also really looks up to professors and teachers when they're good.

Are these debate groups unique to your schools?

She said they were very unique to her school.

Youths are passionate about poverty, how is that awareness, how do they care? Matan had said something about students being passionate about corruption and asking “why are other countries progressing better than us?”

I don't think they are talking about economic inequality in Guinea. A lot of their discussions has to do with how much they are on the internet, everyone has phones, and access to the internet.

How do people communicate or get information?

Radio is big -- it will talk about certain things regarding the economy. I think they derive their information from the internet, their phones, but also what their professors talk about, and they listen to the radio as well. Phones are dominant. Older people use radio; young people are primarily on phones. Usually the old folks will sit outside and listen to the radio together, teenagers will be on their phones together but also separately.

How were phones charged and used in the communities?

She said there was a phone charging business for people in her town because they didn't have access to energy (electricity). The charging station was essentially a shack, with a diesel generator hooked up to multiple extension cords. In the shack there were multiple outlets against the wall. It cost 100 francs to charge the phone. The residents would leave their phones and return when it was fully charged. She mentioned most people have two phones, a smartphone and a burner phone. Those with more money had two smartphones.

People also protested because they knew that cities had electricity, and the mayor had to install a minigrad.

Are there riots against the mining companies?

The mining industry is a controversial topic. an Imam (venerated religious leader) got killed by a truck. It sparked a 2 day riot because mining companies use these trucks and take away the bauxite and there is not a lot of traffic regulation, so. When that happened, the community got very angry because they know the government does not hold Chinese companies accountable. There was dissent because people felt like they never saw the profits.

Some of the younger men decided to ride into town, burned the subprefect's town, and the records office. There were papers everywhere -- the only way that people kept town records.

The army police had to come in. The relationship between the mining companies and the local communities is very tenuous.

Relating to that, are there concerns about environmental impacts?

Yes, but there is no way to measure them. She said you would see entire sections of road and trees covered in dust.

Was there a desire to measure and share grievances?

There is an opportunity to get the community active in measurement. In regards to government reception: the government doesn't have neither the power, nor the money to take on massive infrastructure projects and has to rely on mining companies.

The Chinese built the road to Kamsar, resort stations, highways...

The government relies on foreign money for development, and is less likely to regulate the companies -- there are but a few heavy taxes on companies and registered businesses.

Was there primary education for girls higher secondary education? What was their cell phone usage like? What role did women play in society or governance, community spaces specifically for them?

There are women's groups in Guinea, and each town will typically have one. Women will come together and form a business idea. She said that in her town, women volunteer and work to produce dry fruits and nuts. However, these women's groups don't have a lot of political weight. It is rare to hear of a female chief or village elder as a community leader.

For younger girls, it is very tough to finish school. They are often married off at 14 with the goal of starting off their life with someone who is established. It is hard as teachers to get female students involved. Some are really great students, but because of prevailing tradition, fathers won't care and marry them off anyway.

Would families be against girls owning cell phones? Women owning cell phones?

Pular-speaking people, which is Matan's group, are more conservative -- they migrated from the Islam-prone North.

Do women engage outside of their regions?

Women tend to work in the health center, where there is some economic opportunity for them. They work in marketplaces or in little stores that sell essentials. They are primarily engaged in the informal sector. Anna also saw seamstresses; oftentimes when a girl gets married or quits school, she becomes a seamstress for a tailor. Most of the tailors, the people who own the business, are men, while their workers are women.

In terms of youth activist organizations and interconnectedness between their school network: Matan had said they were disconnected, and autonomous as far as how they function. What networks would you see as potential partners to help youths?

At the debate club at Anna's school, they would communicate with other schools, but it was challenging.

The best bet would be to explore inter-school connectedness, because all principles know each other, went to school together, and are in constant contact with Kamsar.

Every school has a soccer team and schools will play against each other in an annual tournament; that is the closest you will get to youth organized.

She said to leverage the Maison des Jeunes. This is a great way to engage with youths if you're sharing an app.

Dr. Alpha Mamoud Barry

Contact's Role: Executive Program Manager, Ministry of Health, Guinea

Contact information: + 224 622 64 6480 Live:alphaguinea_1

Capstone Student: Simone O'Sullivan

Location of Contact: Conakry, Guinea

Date: March 11, 2020

Contact's background:

Dr Barry is an epidemiologist who works for the Ministry of Health in Guinea. He is a Guinean native and resides in Conakry. Dr Barry works for the Ministry of Health in their infectious disease unit. He also consults for external organisations such as the WHO.

Key points:

Bauxite dust is a very real health concern; however, it is not a focus of the Ministry.

Children under 10 and the elderly are at greatest risk.

There are immediate impacts such as respiratory infections and allergies.

Longer term impacts relate to chronic respiratory disease with links to coronary diseases and related complications.

He sees an increasing trend in respiratory disease in health statistics in Guinea.

Interview Notes:

What are your perspectives on the health impacts of bauxite dust in the Boké region?

Dr Barry has seen an increase in the diagnosis of respiratory disease since 2015 -- when bauxite mining operations intensified in Boké. Previously, malaria was the most significant cause for consultation with doctors and death, but with malaria being more controlled, now respiratory infections are the number one reason for going to the doctor and cause of morbidity. Older people and children under the age of 10 are at the highest risk of both infection and longer term impacts of dust inhalation.

Addressing this issue is not a priority for the Ministry of Health as there are many other serious illnesses that are prevalent in the community. However, he believes that long term exposure will lead to chronic respiratory diseases and become a very significant issue in the community over the next 5 - 10 years.

He would like to see a study provide the scientific proof of these views so that greater governmental emphasis can be placed on this issue. He believes the Ministry of Health would be very supportive of a study of this nature.

The current health data available is not sufficiently specific to see the cause of increasing respiratory disease but there is a trend showing its increase. He has read a study by the Zaman Institute regarding

the community recovery after Ebola and suggests that this is an example of an organisation that has the capacity to develop and run such a study.

He does not have a perspective on the mining industry and its actors; however, he has political journalism contacts in the country who have good insights into the issues. Dr. Barry said he would be happy to receive a list of information that is needed to progress Columbia University's research in this area.

Peter Chirico

Contact's Role: Natural Resource conflict specialist, Associate Director of the U.S. Geological Survey's Bascom Geoscience Center in Reston, VA.

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Capstone Student: Simone O'Sullivan

Location of Contact: Washington DC, USA

Date: March 10, 2020

Contact's background:

Peter has worked in Guinea over many years in the area of land tenure and conflict zones around small-scale illicit mining of ores such as diamond and gold mines. He worked with USAID and other NGOs to determine land rights and resource locations for artisanal diamond and gold mines in Guinea over the period 2008 – 2014. Most small mines are on land that has one or more traditional village claims over it; therefore, land ownership can be an extremely contentious issue if there is also mineral wealth associated with it. He did the geological surveys to determine boundaries, grade and volume of mines and most of his work was located outside Boké.

Peter also worked for Bellzone, a joint exploration company between Australia and China on a proposed iron ore exploration site in Guinea. The project included a port and rail development and entailed a large planning process that linked up several different mines.

Although he does not work directly with bauxite mining, he understands the government, corruption, stakeholders and relationships between the mining industry and communities in Guinea.

Key Points:

Very limited trust exists between the Ministry of Mines and the people and the NGOs

The land tenure program run by USAID was well supported by the Ministry of Mines originally; however, once they worked out their share of the mining revenue, their interest in the program waned.

The Chinese mining companies have now taken over much of the power regarding mining since 2015 in Guinea, which is creating greater transparency issues. Peter's view is that they may not be supportive of any program that they do not control.

NGOs are most appropriate to lead the local communities on any program implementation

Interview Notes:

What are your views on the relationship between the mining industry and the government?

Peter's view is that the Russian influence in mining and the Guinean government was very strong until 2015, when the Chinese mining companies signed agreements for significant mining operations, particularly in Bauxite. The latter have taken the lead in influencing the Guinean government since then. Russian investors have tried to maintain control in Guinea with Mr. Conte visiting Mr Putin in 2016 to garner more support once the Chinese mining companies began to ramp up investment and mining operations

in Guinea. For example, Russia organised the Sochi African Mining Conference to demonstrate their influence in Africa. Still, Chinese interests have taken over and they have their own way of dealing with the Ministry of Mines, including expenditure on populist infrastructure such as soccer stadiums. The Chinese have also invested in roads and infrastructure, which is mostly to serve their own operations, though they agree to allow the Ministry to claim and publicize some of these projects as Government projects. Peter believes that other mining companies are forced to compete with this new way of influencing the government and that the new mode of operation between the mining industry and the government is even less transparent than it was before 2015.

The Minister of Mines is extremely politically connected internationally, and in particular with African communities and families. In African communities, boundaries between countries 'don't mean much' – the ethno-linguistic groups and families have a series of relationships in Africa that are cross-border.

How did the USAID program seek to help to increase transparency?

The USAID property rights program was established in 2008 and sought to set a transparent system to determine land tenure for mining companies, especially where there are competing ownership claims, illicit mining and impacted communities.

The Ministry was originally extremely supportive of the USAID property rights program. However, the Ministry lost interest and support for the program as time went on. Peter's view was that the successive Ministers and influencers eventually determined that their share of the funds flowing from the mines and the program was not as relevant for them once they had made their own claim to the revenues, regardless of what claims were still outstanding for the communities impacted by those mining operations.

Which groups would local people and communities trust for implementation of our product?

NGOs, both local and international, are the only groups widely supported by the local communities due to the great mistrust people have towards both the government and the mining companies.

How best to influence and garner support of the mining companies for implementation of this program?

The Chamber of Mines is the best option for influencing and encouraging support of mining companies; however, Chinese investors may not be very supportive of any program that they do not have control over.

Contact recommendations:

CECIDE is an NGO that has conducted work in the civil society area with locals and the employment issue in mines. Kabinet Cisse is its Executive Director.

USAID employs Abdu Rohman Sor, although he does not have influence in the current political scene because his family association is not linked to current governmental power.

Bocar Thiem, who was the project lead for the USAID land tenure program, has good knowledge about the relationships between mining companies and the government. Please refer to the interview with Bocar Thiem on March 11 2020.

Lily Kim

Contact's Role: Harvard law student, Human Rights Watch Research Team member

Contact information: hakim@jd19.law.harvard.edu, 857-600-9493

Capstone Student: Aditi Bansal, Julia Bontempo, Cynthia Leung

Location of Contact: Boston, MA

Date: March 10, 2020

Contact's Background:

Lily Kim is a Harvard Law student who was part of the team that conducted research on bauxite mining in Guinea with Jim Wormington from Human Rights Watch.

Key Points:

Working with local NGOs and local leaders such as school heads is imperative to establishing trust and communication on a grassroots level.

Men prefer short-term compensation, such as direct cash transfer from mining activities. Women prefer long-term compensation in the form of land tenure.

Local leaders are deeply connected to mining companies and frequently take bribes in exchange for overlooking environmentally degrading practices.

Interview Notes

Gender segregation is pretty stark in Guinea. Most meetings were held separately between men and women. Male figures were considered to be leading the community. Meeting with women required a separate meeting with just women and there was a female leader, and co-leader. She visited in 2017; there were massive protests in the Boké region going on at the time due to a blackout, and lack of water and electricity. There was a lot of dissent against the government.

They also worked primarily with two community-based organizations, AMSP (Mamadi Jouvoulde) and ADREMGUI. The HRW group works closely with these organizations, but she was not sure if they still exist. These organizations were the middleman between the research team and the community members, especially since most communities use their native language, which is not French. She said that it was very crucial that these organizations were there to help the research team.

She met with an American journalist who was collecting drone footage of mines to write a piece on bauxite mining. He planned on selling the information.

Their team met with the Ministry of Mining. She said that they met with someone in the mid-status meeting with a human rights group from Harvard. They explained that Guinea needs the money and the business from the mining companies. The person they interviewed understood that communities are struggling but they communicated that they were doing their best. They defended doing business with mining companies, even though she tried to convey the concerns of the community. She thinks that communication is the main challenge because there is a lack of communication between communities and local governments. She found that community leaders were generally trustworthy. They played the role of talking to mining companies and trying to negotiate, but a lack of transparency remained. Men

prefer short- term compensation, such as direct cash transfer from mining activities. Women prefer long- term compensation in the form of land tenure.

Although community leaders are trusted, they often take Mecca trips as a bribe from mining companies. Mining companies also offer employment opportunities for young men in exchange for the eviction of the entire community, and the selection process for the jobs is not very transparent. Some elders have good diplomacy skills.

Local NGOs (ASMP, ADREMGUI) receive the highest level of trust -- they seem to be concerned not only with mining, but also with more holistic about environmental issues.

Boké has very poor connectivity. She remembers 2-3 days without the internet. People do have cell phones, but not smartphones. Primarily, young men had phones. There were phone shop stores that sell data and SIM cards. Mining companies have brought in a lot of jobs into Boké, but there are still a lot of farmers in Boké. The younger generation is also working on farms. WiFi is not stable nor consistent. Some structures had chargers, but not every house had chargers. Most of the houses are self-built houses, so they are probably getting the internet from community centers.

Use of data by the communities

There are a lot of individual accounts about the environmental impact of mining. They don't really have a mean of measurement, only individual stories. For example, the road is so dusty that food is getting contaminated. Community members are concerned about the economic impact on their livelihoods.

Communities hold a lot of sentimental value for places where they were born and raised. Different offers are made to different villages; if the community members are located close to the mining areas, they are highly compensated. Therefore, Lily observed some inequity between where jobs were offered and who was most impacted.

Connection to the health services in the community

Lily visited two bigger villages that had their own health clinics. Transportation is a major issue: roads are not paved and there are lots of motorcycles. She noticed mostly men using the vehicles.

Trustworthiness of schools

Lily remembers one village One village where the school teacher was also one of the village elders, and held a respected position.

Organizations Recommended:

AMSP (Association Mines Sans Pauvrete)

Justin Mamady Koivogui (director/head) mkoivogui.amp2013@gmail.com

Asiatou Diallo (head of Boké region)

ADREMGUI

Ciba

Osman

Jamison Suter

Contact's Role: ESR External Relations Manager at the Société des Mines de Fer de Guinée (SMFG)

Contact Information: jamison.suter@nimbairon.com

Capstone Student: Simone O'Sullivan

Location of Contact: London, England

Date: March 10, 2020

Contact's Background:

Jamison has worked in Guinea part time since 2001, both with local NGOs and as a representative of mining companies. He currently works for the Société des Mines de fer du Nimba (SMFG) as an external relations manager for the iron ore mine in the north of Guinea, at the intersection of Sierra Leone and Liberia. Although he does not have direct experience with bauxite or the Boké region, he is well versed on the political landscape in regards to mining in the country.

Key points:

The new President Conté established the Projet d'appui A la Gouvernance dans le Secteur Minier (PAGSEM) in 2011 to improve regulation over the mining industry but it has had a limited impact to date.

GAC, CBG and Alufer were supportive of PAGSEM, while other mining companies were not.

There is very limited transparency regarding the flow of revenue funds back to the communities.

Mining companies are frustrated by the lack of action, transparency and mismanagement of these funds and thus take action in their communities on their own.

The Chamber of Mines would be a good resource for pushing the bauxite dust tracking project forward.

Interview Notes:

What are your views on the relationship between the mining industry and the government?

The Guinean government established PAGSEM (Projet d'Appui A la Gouvernance dans le Secteur Minier) in 2011 with the election of President Conté and his push for greater regulation over the mining industry. The World Bank provided \$20m to improve governance in the mining sector, specifically through five Ministries - Mines and Geology, Economy and Finance, Budget, Environment, and Transport.

The government intended on formalising an environmental and social impact assessment (ESIA) process for mines. The public tender to develop this process was advertised three years ago but has never been awarded. A strategic environmental evaluation of the Guinean mining industry was also conducted by a French consultancy. However, Jamison does have a regional assessment made by a consultant for another area of Guinea that was never made public -- this was forwarded to the capstone group confidentially.

GAC, CBG and Alufer were supportive of the PAGSEM process but other companies were not. PAGSEM has not really progressed towards its aims because the government has changed its view since the

project's inception and decided to encourage mining development to get revenue flowing into the country and 'worry about problems later.'

What are your views on the regulatory mechanisms for Guinea's sharing of mining revenue and their transparency?

There are three mechanisms by which Guinea receives and redistributes mining revenue.

The FODEL is a new fund that is designed to take 0.5% of total annual bauxite revenues per company to the prefecture in which mining occurs. This is a very large sum of money, anywhere between \$USD10 million to \$100 million per year. The FODEL was only finalised in 2019 and there is no transparent process associated with the funds management at this stage, so they are still in the "honeymoon" phase. The general population are not aware of what they are entitled to; however, this will change quickly. Jamison is concerned that when the population understands what they are entitled to, this will create social unrest because the funds do not appear to be flowing back to the communities as outlined in the FODEL fund structure.

Land taxes are the second way in which Guineans should receive financial benefit from mining in their country. Every concession over 500km² must pay land tax to the communities where the mines are located. This is a fairly transparent process but is only worth \$USD 15,000 - \$20,000 per year per community who receives it.

The third way that funds should flow back to the communities is through the National Fund for Local Development (FNDL) contributions. FNDL is managed by the Ministry of Mines and Geology under a group called the ANFIC. According to the Mining Code, fifteen percent of all mining generated revenue earned by the Guinean Government is to be evenly distributed to all 240 communities across the country via the FNDL. Communities then have local development plans that have been termed 'shopping lists' to fulfill with these funds. For example, schools, roads, community buildings, water access and other infrastructure projects that each community has outlined in their plans. Jamison believes that these funds should amount to approximately \$USD 50,000-\$100,000 per year per community throughout the country.

He believes that these funds are not flowing back to the communities and that there is a lack of transparency around said flows. Mining companies are frustrated by the lack of action, transparency and mismanagement of these funds and thus take action in their communities on their own.

Who do you believe will be supportive of this project?

GAC, CBG, Alufer and Chamber of Mines are all likely to support greater transparency. If it's a voluntary process whereby mining companies can become a 'coalition of the willing' and be a part of the solution, this will encourage all mining companies to take part -- even those who would rather not support this initiative.

Ebrima Marong

Contact's Role: Gambia Country Director, Water Charity

Contact information: +220 701 4890

Capstone Student: Vanessa Douer

Location of Contact: Gambia

Date: March 9, 2020

Contact's Background:

Ebrima Marong is Gambia's Country Director for Water Charity, a non-profit focused on helping communities access clean water and sanitation. He is in charge of assessing communities and implementing sustainable projects that provide safe drinking water. He was the person responsible for implementing GIS water mapping for Gambia.

Water Charity has completed 40 projects in communities, clinics and nursing schools. Most of their funding is through individuals on their website and Facebook page.

Key Points:

Using GIS technology, Water Charity mapped out water sources for the entire country. The data is updated at least once a month and is used to prioritize communities based on urgency.

It is critical to involve the local community for logistical aspects of the project. Involving the community from the onset also allows the community to take ownership of the project once it's completed.

In addition, Marong has a strong relationship with the local government who also plays a role within the system.

Interview Notes:

GIS Mapping:

Using the app Survey123 developed by ArcGIS, Water Charity maps out community water points with GPS. (geo-tagged). The country is divided into regions, each with their own data collectors, who travel to the local villages at least once a month in order to keep the data updated. The data collected includes: water points, both open sources and wells, sanitation and health data, such as the number of people with diarrhea in the last 2 weeks and the village leader's name and number. They use the GIS data to prioritize projects based on urgency.

Data Collectors:

The non-profit has roughly 40 data collectors, who are not directly employed by Water Charity. Instead, they are given fuel cost for their motorcycle and a daily allowance. Marong mentioned the data collectors are doing it for the love of their country. The data collectors are given Galaxy Tablets and Smartphones for the survey. In addition, they are trained for 2-3 days on how to use the tablets/phones prior to traveling to the local communities. Marong also coordinates with the communities' District Chiefs who are each leaders of a few communities.

Government Involvement:

There is a strong trust towards and understanding with the Gambian government. The project involves the Rural Community Development Officers, Rural Water Officials, and the Gambia Minister of Health, each with a specific role. Water Charity along with the government also organize day training sessions on water sanitation teaching communities how to stay healthy and save water.

Community Involvement:

Previously, the charity had a hard time getting the community to take ownership of the water projects once it was completed. If the water system broke, the communities would not fix it nor would they call Water Charity. From these experiences, Water Charity developed a Community Management Model. For the model to work, the community needs to be involved from the onset of the project. For example, Water Charity uses local labor or local materials. At the Village Choir, Marong helps the community set up a Water Management Committee. The committee consists of a President, Vice President, Auditor, Assistant Auditor, Treasurer, Advisor and Secretary. Each member is there to ensure transparency.

Marong records the committee details and trains them on how the model works. The Community Management Model requires each household to contribute a monthly allowance for repairs. The money collected belongs to the community and can only be used for the water system. The community is informed of how much money is collected each month at the Village Choir. The government officials help the committee open a bank account at a local bank, where the money should be kept. In addition, the money collected should be deposited by at least three people from different families to guarantee nothing is stolen. Marong visits each community 3 months after the project is completed to ensure the model is running smoothly. The model is important to ensure sustainability and reduce reliance on the NGOs.

Mamady Koivogui

Contact's Role: Executive Director NGO (Association for Mines without Poverty)

Contact Information: mkoivogui.ams2013@gmail.com; +224 628 494 720

Capstone Student: Meng Yi Bay

Location of Contact: WhatsApp Phone Call

Date: February 28, 2020

Contact's Background:

Mr. Mamady Koivogui is the Executive Director of the Association for Mines without Poverty (AMSP), a local Guinean NGO. He was quoted in several mining-related reports including the 2019 Human Right Watch Report on the “Human Right Impacts of Bauxite Mining in Guinea”.

Key Takeaways:

AMSP shared that they were involved in several community engagement and empowerment projects, including documentation of mining impacts on the local communities. In particular, they were working with an international NGO, Witness, to train the local communities, including Boké, to take videos and photos. Mr. Mamady would link us up with the representative from Witness.

AMSP's relationships with the government and mining companies were evolving. In particular, relationships with mining company SMB have improved in recent times.

AMSP was funded by international foundations but they are open to the possibility of accepting funding by the mining companies if they are able to remain independent.

Interview Notes:

Mr. Mamady shared that the Association for Mines without Poverty was founded in 2013 with the mission to improve the transparency of the impact of the mining sector and focus on poverty reduction in the communities. He added that the organization is doing the work of the government by ensuring the communities are not negatively impacted by the mining companies.

Noting that its founder is working in the Ministry of Mines in a senior position, how is AMSP working with the government to further its objective?

He highlighted that they do not work with the government, but they do share information and reports with the government. While he acknowledges that the founder (Dopavogui Joseph Siba) was now working for the Ministry of Mines (as the Deputy DG), Mr. Mamady assured that they remain independent. Relationships with the government were “sometimes good and sometimes bad” and there were days that they were not welcomed at their offices.

How is AMSP funded; whether they receive funding from mining companies and the government?

Mr Mamady said that they organized workshops in the community, and these were funded typically by

international foundations in the US and Europe. These workshops were aimed at engaging the community on the impacts of mining and building capacity to document the impacts.

Mr Mamady highlighted that they were not funded by the government and it would be “complicated” if they do accept funding from them. Mr Mamady shared that their relationship with mining companies is ‘not good’. He mentioned that there is no transparency and the mining companies do not appreciate the work of the NGOs. Mr Mamady further lamented that there is bribery between the mining companies and the government.

Mr Mamady highlighted that the relationship with mining companies was bad but is improving following the release of the Human Right Watch Report last year. Mining companies used to see NGOs as an obstacle to their mining operations. However, this has changed and he shared that he was recently invited to SMB office for the first time to go through their recently completed environmental impact assessment report.

Would AMSP be open to getting funding from mining companies?

Mr. Mamady shared that he was open to receive funding from the mining companies from community development under some conditions so as to remain independent and credible. Given the option, they would prefer accepting money from mining companies via the government. This was due to the poor image of mining companies.

He is currently working in communities where SMB and CPG are operating, and he is working with a US-based NGO - Witness in documentation of mining impacts in terms of photos and videos. Witness conducts training to the community on how to best document these impacts. When asked, he mentioned that these videos and photos are geo-located.

Mr. Mamady highlighted most of these documentations were done by village / community leaders. While he acknowledged that village leaders were being compensated by mining companies, in addition to gifts during festive seasons, he still trusted the community leaders to be impartial.

Witness does not have an office in Guinea but they have an office in Nigeria. They are planning for the next community training to be in April 2020. Mr Mamady would link us up with the representative in Witness.

Claire Standley

Capstone Student: Simone O’Sullivan, Julia Bontempo

Location of Contact: Hamburg, Germany

Contact information: claire.standley@georgetown.edu;

Contact’s Role: Assistant Research Professor, Centre of Global Health Science and Security, Georgetown University

Date: February 28, 2020

Contact’s Background:

Claire worked for various NGOs and USAID and visited Guinea approximately 11 times in a four year period between 2015 - 2019 at the end of the Ebola crisis in Guinea.

Key points:

Mining companies can play a key role in the provision of health services in Guinea, especially during crises like Ebola.

The Mining companies were frustrated by the lack of transparency around expenditure of funds by the government provided by the mining companies.

Mining companies are extremely sensitive to bad press as it can directly impact their stock prices.

Memorandums of Understanding (MoUs) are standard and well received when dealing with different parties in a process in Guinea.

Finding a champion within the key ministry can be extremely advantageous.

Seeking partnerships vs funding is a better way to approach relationships.

Finding local-level relationships vs institutional relationships is key to getting things done in Guinea.

French speakers must be part of the implementation team for any project; otherwise, language barriers will slow progress.

What was your role in Guinea?

Claire’s main role in Guinea centered around the establishment of a process for gathering health data -- to be centrally analysed as a pre-warning system for outbreaks of disease such as Ebola. The health system is not discussing bauxite dust health issues, respiratory problems in general or Covid-19. There are more deadly and pressing health issues with which to deal.

Is health data available in Guinea and how is it collated?

In 2015/16, the Ministry of Health adopted a district-level health system and internet capability was made available at regional, prefectural, and sub-prefectural level. The strategy used to implement this new system is called the Integrated Disease Surveillance and Response (IDSR) and was established in 1998 by the World Health Organization (WHO) Regional Officer for Africa. Health data information

gathering is initiated at the subprefectural level, primarily at health centres, where information is gathered on paper, then sent by phone to the prefectural level and compiled. The regional level receives these reports monthly. Patient's basic health data is gathered and, although it is rudimentary at this stage, data collection has improved over the past few years with this new process.

The process is a passive one: data is gathered at the health extension level, with someone who possibly has a nursing degree, passing information up the chain. Traditionally, private clinics in rural areas, usually funded by mining companies, rarely reported to health authorities. However, they are now starting to contribute and enhance community-based surveillance as a whole.

Internet connectivity is paid for by the IOM (International Medical Corps) but the internet is not available continuously. Usually the internet is connected only when needed, with the availability of solar panels. The data is compiled in a database at the national level by the Office of Strategy and Development in the Ministry of Health. RTI international (rti.org) led the implementation of the database and currently manages and repairs it.

What role does the mining industry play in community health?

Mining companies often have their own health system in Guinea, providing health care directly and exclusively for workers. The mining sector was very engaged during the Ebola outbreak, building a hospital in Boké, taking in patients from the community, and more. We need to understand how to better integrate private health services and provide mining companies with access to national level data. Claire said that the mining companies felt demonized during the Ebola outbreak, as they were seen as an endless source of cash and services, but had no say in where the money was being spent.

Sharing of information by the government regarding financial expenditure was definitely limited. Mining companies were also concerned about information being used against them. For example, if their employees contracted Ebola, it would negatively impact share prices if word of infection spread.

What implementation processes were most important for gaining consensus among parties?

The main one for us was the Memorandum of Understanding (MoU), especially with the International Organisation for Migration who provided funds and services. Implementation would still work without the MoU, but the latter made the roles and responsibilities clearer, as well as who would provide the funding for specific needs. It was also easier to implement as we were coming from a crisis situation during and after Ebola, when it was in everyone's interest to overhaul and improve the processes.

Another important factor was finding a champion within the Ministry of Health and it is better to seek partnerships over funding. Claire mainly sought local level vs institutional contacts and reflected that they were lucky because her boss made a key contact through her child's nursery school parent group. From that point on, they were able to leverage local information, services and participation.

Other important points, cultural or otherwise?

During the Ebola crisis, many people expressed distrust towards the formal health system and went to an informal pharmacy or health clinic before they went to a government run health clinic. Claire could understand why - she visited a health center where a medical biologist, not even a doctor, was operating in a pile of rubble offering some injections. There is still a significant informal health industry in Guinea, however she is hopeful that it is less now after the crisis.

It was very important to have fluent French speakers operating on the ground. It was basically impossible to work in English, even though an increasing number of people at the regional level can speak English. Surprisingly, there is more alignment with Russia and Cuba, and locals are more likely to speak Russian and Spanish than English, particularly in the medical field where a lot of people receive formal training in Cuba.

Many professionals in academia have jobs within the government. For example, the National Laboratories Directorate head is also the Dean of Medicine at the University of Conakry. This is simply because academia does not pay enough for a full-time wage.

Guinea produces a lot of veterinarians, who are very well trained and willing to work in humanitarian fields. The World Bank did a project across the human and animal health sectors, which showed that veterinarians are completely underutilized in their training in epidemiology, and medicine.

Samantha Lint

Contact's Role: Harvard Student Research

Contact Information: slint@jd20.law.harvard.edu; 301-221-7802

Capstone Student: Cynthia Leung, Aditi Bansal, Julia Bontempo

Location of Contact: Cambridge, MA

Date: February 27, 2020

Contact's Background:

Contact was in Guinea in March 2019 with the United Clinic at Harvard while Human Rights Watch was doing some field research in the Boké region. Graduated Harvard Law School | J.D. Candidate '20 University of Richmond | B.A. International Studies and French '14

Key points:

Understanding the gender dynamics

Mapping community organizations to partner with for the project

Trustworthiness of various stakeholders in the community (i.e. the community leaders, Chamber of Mines, Guinean government - local and national, etc.)

Interview Notes:

Samatha shared that she was in Guinea last March 2019 with the United clinic at Harvard; Human Rights Watch (HRW) was doing some field research in the Boké region. She mentioned that she may have had some meetings with the local government, but, due to a strep throat, she missed a couple days. Most of her time was spent at community meetings, and she could tell us what she'd been able to observe about women's engagement in the community.

With respect to youth, she did have an interesting meeting with a technical university where most students were going to get into the mining sector on in radio. It was interesting to hear why the youth were going into mining, and what their impression of mining companies was.

The interviews were conducted in several villages, four of which had already been impacted and two that were preparing to be impacted by mining operations. The interviews were conducted in large groups of 20-40 people. Youth were present but did not speak much due to the hierarchical structure and community status. The meetings were primarily led by an older man with a younger, more literate person -- likely a school teacher -- serving the role of translator.

The communities felt misled by mining companies. Families with young adult children thought that mining would bring opportunities of economic prosperity for them. Women were more concerned with the impact on their children, in particular the lack of jobs for their admittedly low-skilled children in comparison to university-educated children. Many of the children saw the mining industry as their best option. They were getting internships, and expecting to get jobs. They were determined to work in this field in order to protect communities and contribute to economic development. They were not unaware of the impacts, but were more concerned about economic development for Guinea. Of the community groups, women and youth cared most about environmental protection.

Communities with historic presence of mining were not concerned about the tradeoff of environmental degradation with infusion of jobs through the industry. They all had concerns about adequate compensation, water quality, and frustrations around engagement by mining companies in villages. The companies did various environmental impact assessments but and their own sub-contractors hired contractors.

The role of women in community settings:

Engagement with women in villages is typically achieved through a community-wide women's organization that is led by a female head. It is common to have a separate meeting with all the women and another meeting with all of the men in the village/community. Women did not display any signs of hesitation when speaking with male colleagues, but they did not speak in front of male community members during the community-wide meetings. During the women-only meetings, the president of the women's organization would do most of the speaking while a few others would occasionally interject.

Is the “ president” within the ranks of the government?

The president of the women's organization is an informal role. The role was not always held by the oldest woman in the village; it was usually a French speaker. However, in villages where there are no french speakers, the research team used a translator to communicate.

Are women employed with mining companies?

No. Most of the women had their own small kitchen garden growing initiatives, selling their produces at the market, and some of them had developed businesses selling small quantities of water or lunch to mining workers. However, they were seldom engaged directly. No women worked within the mining operations, and they had less direct engagement with employment, or environmental analyses. The team only spoke to the men and women were annoyed with that.

Do you feel like women are empowered within their communities?

Role of women within the community is considered to be insignificant. Women could create change, if they were considered to be important community leaders. Women are the silent bedrock of communities.

Did women have cell phones?

She did not notice that. During a community meeting, there would be men with a POC (push-to-talk). The literacy rate was quite low..

Is there anything you think would be valuable?

Pictures of environmental impacts would be helpful. Community complained about water drying up, oil being polluted and structural damage from dynamiting. It was challenging to make the mining companies care about this issue because there is a lack of proof that links the impacts to the mining operations. HRW put a lot of effort into shaming certain companies. As a result, the company watered roads more, taking more water from communities, which limited their access to water. The mining companies left wells in disrepair and surrounding communities would have to go back to old water sources that the mining companies had already taken over. Fishing was impacted from the oil leaked from barges.

Did you see trucks with or without covers?

Roads that were used by mining companies were covered with red dust. The ratio of trucks with covers on and trucks without covers was around 50/50. Companies were watering the road for dust control.

What were communities doing to mitigate environmental impacts themselves?

There is not much land use rehabilitation efforts led by communities. They didn't even try to rehabilitate them because it's so difficult. There was one rehabilitated area with 6 small dead cashew trees, in comparison with football fields-sized areas of stripped land. People talked about being frustrated because they could have rehabilitated the land if the topsoil was left intact.

How did people air grievances to mining companies? Did they go to the local government?

She was not sure about the grievance system in place.

Community dynamics to be mindful of:

If you are approaching the local communities as a non-Guinean, she recommended to be clear about who you are representing, especially if you are White or Asian as you might be mistaken as being part of the mining companies.

Cross community collaboration

She said that there is a strong connection between ethnic groups and their respective political affiliations in Guinea. Local NGOs could tell more about impacts and communications across communities, especially since local NGOs can speak the local languages.

Interview Dynamic

One on one interview generally failed because the group drew so much attention that multiple people would show up.

How were you incentivizing people to show up, e.g. payment or gifts?

Jim Wormington arranged most of the meetings. She mentioned that she did not observe any payments or gifts.

Matan Skolnik

Contact's Role: Peace Corp Volunteer, who taught at a public high school

Contact Information: ms5925@gsb.columbia.edu, 212-854-1060

Capstone Student: Cynthia Leung & Aditi Bansal

Location of Contact: New York (works at the Columbia Business School at the Tamer Center for Social Enterprise)

Date: February 19, 2020 & February 24, 2020

Contact's Background:

Peace Corp Volunteer, who taught at a public high school in Dalaba, middle of Guinea in the Pular region.

Key points:

This interview was focused on building an understanding of Guinean culture from the perspective of someone who was not native to Guinea, and to better understand the dynamic relationships of youths in their communities as Matan worked with students.

The youth are proud about their Guinean culture and independence and are interested in being a part of the change to improve the country's future. They are more literate than their elders and have access to smartphone communication. They are a potential group that could work on data collection given their ability to use smartphones, read, and their interest in Guinea's future.

It's important to navigate the cultural dos and don'ts and work with community leaders as stakeholders. Heads of schools are well connected and typically know the mayor of a community. They have respect from their communities and can potentially help given their connections on a local level.

Interview Notes:

Can you tell us a bit about mobile penetration in Guinea?

Everyone has a phone, but everybody doesn't have smartphones. People know how to use smartphones to an extent; however, they are illiterate, so there are limitations. People know how to use Facebook, and are not using Google; main applications include Whatsapp, Facebook messenger and Facebook. Matan's students mostly had smartphones and amongst them popular apps included Calculator, Dictionary, Music, and Camera. Literacy rates are higher within students.

Can you expand on the availability of network connectivity?

Matan said that there is connectivity on one of the networks, unless you go to the most remote areas of the region. "Beeping: is a communication habit: one calls and immediately hangs up, signifying "Please call me because I don't have any credit on my plan." People make frequent but very short phone calls (e.g "Hi, how's your family, job, friends?).

Radio and tv (coffee shops have BBC Africa, watch news on TV) are sources of entertainment and information.

How do you access data?

He said that you have to pay by use of data.

What were the gender dynamics like in Guinea?

It is a patriarchal society with strong, established gender roles. There is a high prevalence of child and early marriage. Schooling is prioritized for boys.

What are the relationship dynamics in a school setting?

Relationships between students and teachers are less formal in schools. Heads of the schools (Principals) are leaders in the community. They are fluent in French and have strong relationships with the mayor and town leaders.

What is the local culture like that you experienced in your district?

Matan said that when you are meeting with figures of authority, it is important to introduce yourself as follows:

“Hello, this is who we are....

“We are grateful for you hosting us...

“We are here because...

It is important and polite to reach out to a mayor when you’re visiting a city or locale. People do not like their pictures being taken without permission. Younger generation speak French since schools started teaching French in the 1970s.

Students

Transportation

People get around by foot, motorcycle, or bicycle

Kids travel alone

Younger kids are likely to go to elementary schools closer to home

Carrots

- Soccer
- Mesi
- Ronaldo
- Movies (Action Movies & Local Guinean films similar to Tellanova)
- Men form “Video Clubs” to watch movies
- Dancing

- Any kind of movement
- People like to dance by themselves or in front of a mirror
- Music
- Students likes learning American songs
- Afrobeats, Sidiki Diabete, Divito
- Candy & Lollipops (used in class)

Sticks

- Doing homework, it was hard to get them to do homework on their own time
- Corporal punishment
- Public humiliation (Ex: Blackboard displaying a students name and why they are not in school)

Students really care about:

- Pride in Guinea
- They know that they are the first French colony to gain independence - “We’d rather have freedom and poverty than riches and chains”
- Freedom on paper, but “when the French left, they took the lightbulb with them”
- Pride in independence regardless of the poverty
- Kids are passionate about improving the country. They want to root out corruption after seeing politicians handing out money to people in towns. They know that the president is less loyal to regions. They also see the acute disparity in wealth and know that the country is rich in natural resources, yet still poor.
- They don’t want foreign entities to have access to these resources.
- They have youth leadership councils or Youth Houses (Maisons des Jeunes)

Teachers

Teachers’ salaries are very low and there is an annual strike for pay. Students strike because the teachers stop teaching and because they are upset about the institutions failing them.

Most teachers are men, and there is an exam to become a teacher.

The Teachers Union in Guinea is the SLEG.

Most schools are independent public schools, though a network of private schools exists.

Carrots

Appreciation

Respect & Recognition - They have low salary and their work is not highly valued, so being recognized

for what they do is a carrot

Sticks

Strikes - Sometimes teacher's salaries are frozen by the banks when they protest

Mariama Barry

Contact's Role: Staff, Inclusive Development International

Contact Information: mariama@inclusivedevelopment.net

Capstone Student: Gregoire Mazars, Vanessa Douer Seinjet

Location of Contact: Conakry, Guinea

Date: February 24, 2020

Key points:

CBG's grievance mechanism doesn't work, according to Mariama. Transcripts of interviews that served as a basis for the 2019 lawsuit against CBG can be shared.

Pollution mapping will be good for communities. In the absence of precise information, the companies push the blame around.

Interview Notes:

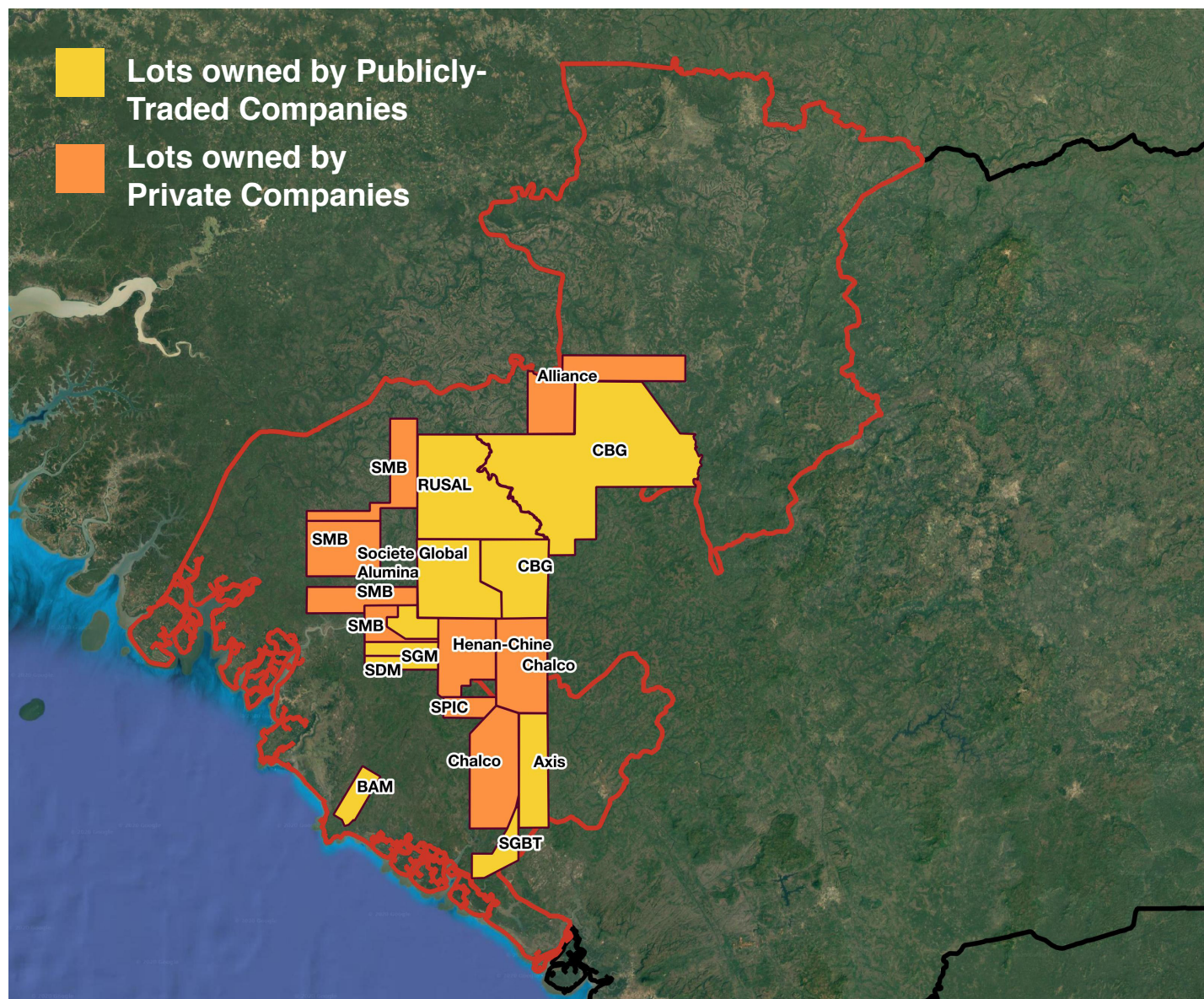
Inclusive Development International is one of the NGOs that enabled a lawsuit against CBG in February 2019. Mariama confirmed that CBG's grievance mechanism doesn't work -- she sees it only as a means to further cheat communities as there are no favorable follow-ups ever. She already gave the transcripts of the interviews conducted by Inclusive Development International in 13 villages and used as a basis for the lawsuit to local (West African) NGOs, but she is willing to put us in touch with them; maybe we can collaborate and have access to the interviews.

She suggested that we keep logs of the interviews conducted by Inclusive Development International as to not replicate this work ourselves, and to add legitimacy to what we write. The lawsuit can be found online (see below) and contains that information.

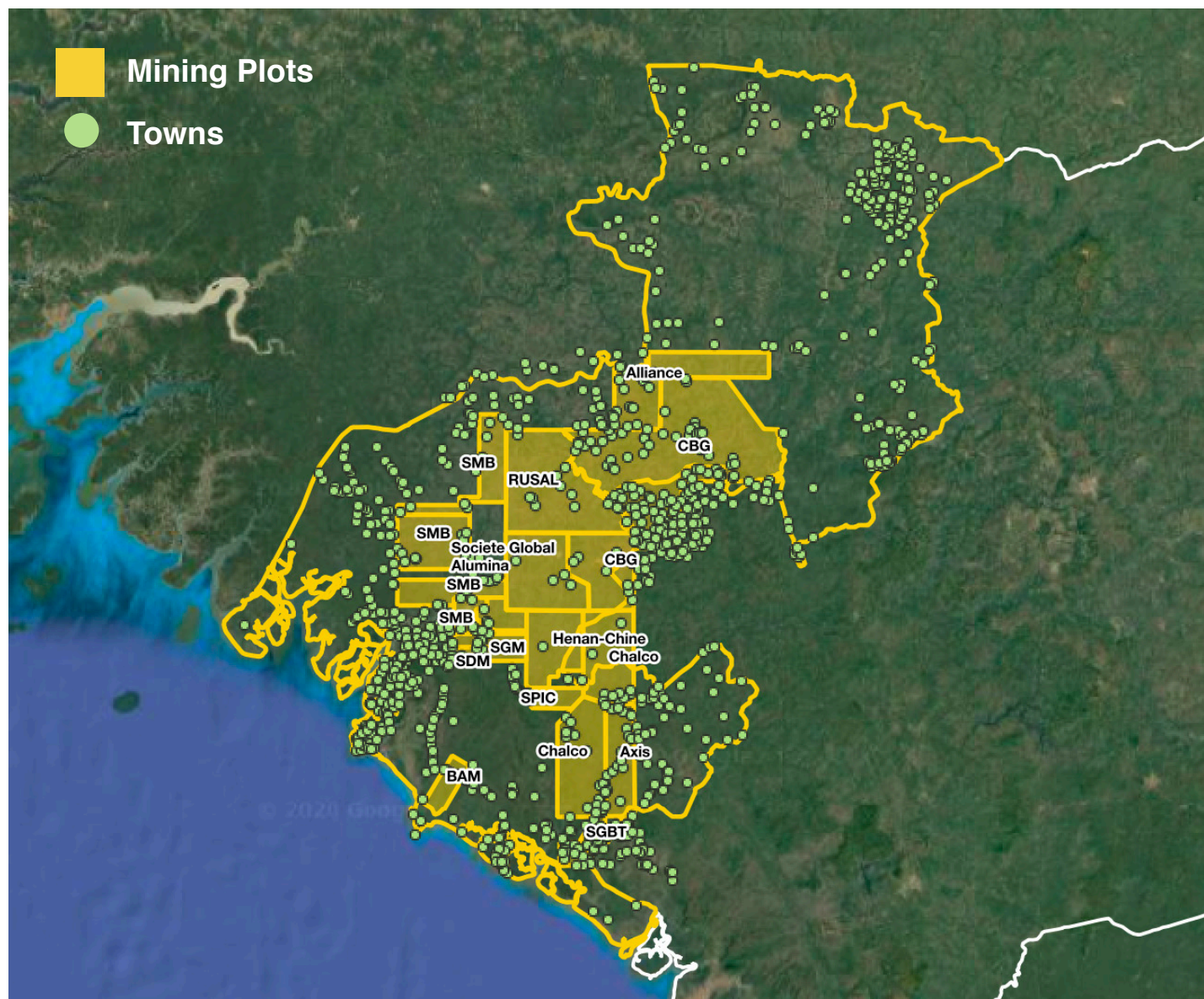
She thought our project was very interesting and useful -- the communities she worked with are suffering from cumulative impacts of two companies (Russal and, we inferred from our discussion, CBG.) It is difficult to blame one or the other without precise knowledge of where originate what impacts. Hence, mapping will be good for communities, the civil society and advocacy groups alike. In the absence of that information, the companies push the blame around.

Complaint concerning IFC loan to the “Compagnie des Bauxites de Guinée” (CBG)

URL link: https://www.inclusivedevelopment.net/wp-content/uploads/2019/02/CBG_CAO-Request-for-Mediation_FINAL-EN.pdf



Map generated using data from Guinea Mining Portal Cadastre and Humanitarian Data Exchange.



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