Algorithmic Analysis of Nigerian Agrarian Businesses

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1. Introduction

1.1. Abstract

The purpose of this senior project is to explore the process of collecting data on Nigerian agrarian businesses, developing an analysis scheme to assess their health and investment viability, and displaying this information via a web application for interested parties to interface with.¹ Today 84% of Small-Medium enterprises (SMEs) in Africa are under or unfinanced, leaving a $150Bn financial gap. With these crippling conditions, many firms are unable to scale to their full producing capacity—benefiting on technologies acquirable at scale—leaving their communities in poverty. Currently, the majority of these small-medium businesses end up failing in their first 3 years of operations.

1.2. Context

As cellular connectivity increases, so does internet connectivity in the developing world but especially in Africa. In fact, internet usage on the African continent has increased by 7,415.6% since 2000.² With these encouraging figures, the reality is that data can be leveraged for Africa’s development. With this unprecedented growth, multinational technology

¹ Note: This project is a continuation of my Fall 2016 Special Project and includes much of the same background content.
² http://www.internetworldstats.com/stats.htm
companies are setting their sights on Africa as the burgeoning market continues to expand.

Right now, Nigerian SMEs rely on bank loans for funding. Nigerian banks charge very high interest rates (up to 30%) in addition to other imposed charges. Many even refuse to loan to SMEs, instead favoring large and well-connected businesses. Most SMEs are forced to finance themselves off savings and loans from family members which is rarely enough.

Typically, it takes investors under 10 minutes to decide whether they want to move forward with a prospect or not. Foreign Africa-focused investors, on the other hand, generally have neither a network nor contacts on the Continent, so they’re left with a few options: cold reach outs to the few businesses they hear about, scouring google and LinkedIn for connections and leads, and/or paying financial services firms in country (KPMG, PwC) to find prospects for them. Many investors will go the outsourcing route, but even then, they are often forced to wait between 2-4 weeks and pay thousands of dollars for a handful of prospects that are already well-known. The result? They receive a long and cumbersome report on the prospects.

If Africa hopes to become a top destination for foreign investment, especially amongst its developing peers, Africa-focused investors need to be able to invest in African businesses similar to how they invest in businesses in more-developed parts of the world. Categorized by the region’s tumultuous past, investors need access to the same, if not more, data pertaining to the business’s history, management ability, and future plans. Not only that, investors want to see
businesses that suit their particular interests. Existing investment platforms have a tendency to show all investors the same exact opportunities – but investors require a tool that plugs into their methodology for evaluating companies.

1.3. Opportunity

Africa’s population will double in size by 2050; Nigeria will become the 3rd most populous country in the world in that same time frame, eclipsing the United States. And while Nigeria’s population boom may be an exciting opportunity, food insecurity is a big problem that already exists in Nigeria. Every year, over one million Nigerians die from hunger and malnutrition. With the population growing at its current rate, Nigeria will face a real humanitarian crisis if it is not able to grow food for its citizens.

Investors understand that with population growth like that, there will be millions of people added to the middle-class, creating huge business opportunities; in fact, the desire to invest in Africa has quadrupled in the last 2 years (PWC). And according to McKinsey & Co., the rate of return on foreign investment in Africa is higher than in any other emerging market.

Without a doubt, technological solutions with savvy implementation measures can drive development in Nigeria. This project attempts to codify previous investor sentiments in the private investment space and use it conjunction with current business data to determine the proficiency of companies in the agricultural market.
2. Data Collection

After deciding that I wanted my work to focus on Nigeria’s agricultural sector, I went about the process of sourcing information from business owners. Collecting deep business information from these company owners was a non-trivial exercise to say the least.

I started by using my access to various databases that Yale has purchased for student use (CBInsights, Privco, etc.) to begin collecting information. I thought these world-class sites would have plenty of information in my country and industry of interest but was sadly disappointed. CBInsights, boasting 1.1 million private company profiles, had only 34 agricultural companies (Jan. 2017) in the African continent’s largest economy. What little information they had was information scraped from a few news clippings. In most cases, there wasn’t a person-specific contact address that I could access.

2.1. Data Acquisition Status Quo

Private company data databases like CBInsights, Privco, and Mattermark rely on largely public news to populate their databases. The companies implement web crawlers (see Figure 1) to ingest millions of articles and use them to scrape out important information. Because Africa, in general, does not have as large and centralized of a business news industry, these
scrapers aren’t as effective at finding company information on their own.

2.2. Data Acquisition Tactics

Thus, private company data companies that currently operate in African markets rely on calling business owners and requesting their data. Business owners receive little value from these interactions – only the “chance” an investor will contact them – and often don’t make an effort to update the data over time. For the purposes of this study, I called and emailed 185 businesses to collect data on 50. This 27% yield rate also included follow-up correspondence, additional calls, and frequent reminders.

Company data was often submitted via email (Figure 3). From there I would piece through the information and create a .csv file for each company. These would be read into the platform along with a rating algorithm that assigns weights to different cell entries to quantitatively score companies along their 9 factors.

2.3. Accelerating Data Acquisition
I found this aspect of the work to be much more difficult than I imagined. Business owners would hang up while I was speaking, I often had poor call reception, and effectively explaining the idea was rather difficult. I learned to mention that I was a student at Yale early on and started using my Yale email address in lieu of my project email. I would recommend other students set their deliverables around the number of calls they will place, making the deliverable on dependent on the yield rate. A few businesses were willing to fill out detailed Google Form
surveys which made parsing the data for .csv input easier on my end. In the future, I might consider working with a more tech-savvy industry as many agribusiness owners aren’t very tech-oriented.

3. Economic Opportunities

The internet is a strong candidate for bolstering Africa’s existing development activities. While the continent accounts for just 3% of global internet traffic, experts estimate that mobile broadband usage will grow 20% to 60% by 2020. This figure has real ramifications because bolstering broadband access has been shown to also augment local gross domestic product (GDP). In emerging markets, The World Bank has estimated that a 10% increase in broadband penetration can drive as much as 1.38% of economic growth.

And the internet is a currently untapped resource, waiting to drive leapfrogging. McKinsey estimates that the internet contributed just 1.1% to Africa’s GDP in 2013. But at the industry’s growth rate, the internet and mobile industries could supply 10% of Africa’s GDP ($300Bn) in 2025.

3.1. Wealth Transfer in Developed World

“As the world’s richest individuals approach retirement, the next three decades will see trillions fall into the hands of their younger family members—the biggest wealth transfer in history from one generation to the next, according to a new
report.” This figure is estimated from $16-$59 trillion over the next few decades.¹⁴

According to the Global Impact Investing Network, the impact investing industry is poised to grow from its current $60 Billion market to a $2 Trillion market by 2025. Given that the industry was virtually non-existent two decades ago, this is indicative of how ready investors are to begin putting their investments to work for global development.

3.2. Investors

As previously mentioned, CBInsights, a leading private company database, has just 34 data entries in Nigeria's agricultural industry. Yet a 2016 BCG report states that ~11,000 African companies have revenues of $10m to $100m and assets of $20m to $200m. The most promising middle market targets are off the radars of most funds. Once you go lower than the $10m revenue threshold, that number of companies easily jumps into the tens of thousands. The gap is clear.

Investors and corporations around the world, seeking higher yields and access to new markets, are eager to tap into Africa’s growth economies and capitalize from the strong fundamentals. The desire to invest is evident, the capital is not the issue but the access is. It is incredibly difficult for investors to find the right opportunities. The high cost of access to

information across African markets is a key limiting factor that constricts deal flow and business opportunities with the continent’s middle-market companies.

I’ve had ~15 interviews with investors and many complain about time wasted doing ‘hard-core’ googling and cold emails they send to find and chase leads that are few and far between as well as monitoring where FDI is going. These leads seldom respond because of the fear of fraud.

With the use of data analytics, the early deal consideration process can be digitized to allow foreign investors to clearly see accurate data on well-run African SMEs.

4. Product

4.1. Platform Features

These features make the deal sourcing process much faster and cheaper. Essentially, investors can spend less time searching for companies and more time understanding them.

- The Platform collects a much larger range and more in-depth data (see Appendix A).
- Investors can assess how they are performing relative to their market (I will continue building in more market data APIs).
- Investors can utilize advanced search to look for very specific types of companies (see Appendix C).
• Our platform also allows investors to set their preferences based on their risk appetite and profile recommends them businesses that suit their interests and strategy. The platform uses multi-factorial analysis to quantify businesses’ performance along various investment factors (see Appendix B).
  
  o Investors can alter the weightings of 9 investment factors (Business Model, Growth Plan, Legal, Social Benefit, Financial, Market, Team, Accounting, and Market) to suit their investment strategy.
  
  o The platform utilizes a “page rank” algorithm of the companies to display the ones that best meet an investor’s strategy.

4.2. Platform Architecture

There are 72,000 lines of code in the codebase (majority is open source code). To be more specific, it has a dynamic backend that queries company data stored securely using MongoDB and makes this data available via RestFul APIs. The web application displays this data in a comprehensive UI with graphical interfaces and controls catered to the investor experience. I deploy the MongoDB, Express, Angular and Node.JS (MEAN) stack on AWS leveraging on their robust services to monitor, scale and ensure the availability of the service. Because the platform is implemented on this stack, setting up a local environment is rather difficult and requires the installation of several services (npm, bower, bitnami, etc.). For this reason and the privacy of business data, I will not submit a localized copy but am willing to provide login information (see 8. Appendix).
5. Conclusion and Discussion

Internet connectivity is a human rights imperative for Africa. Establishing the infrastructure necessary will promote heightened levels of entrepreneurship, a stronger link between Africa and its Brain Drain expatriate community, and higher governmental accountability.

African political bodies must be wise stewards of the internet, promoting openness, accessibility, and ingenuity via the web. Africa’s internet story has the potential to be one of its greatest of the next decades because it can unleash private sector growth to put its populations to work.

6. Acknowledgments

I would like to thank all the individuals-- professors, friends, TAs-- who have supported me in the Computer Science major at Yale. My interest in the subject matter was sparked by in CGSC 110 my freshman fall and took off the next semester in Professor Yang’s Introduction to Programming (CPSC 112). Since then, I’ve been taught by professors who have baffled, challenged, and encouraged me to learn about the field. I believe Computer Science is one of the most beautiful systems mankind has created and am proud to consider myself a pupil of the discipline. Special thanks to Professor Aspnes for mixing his great sense of humor with database knowledge in CPSC 223 and for being my Special Projects Advisor. I’d also like to thank Professor Stephen Slade for providing me with additional help on this semester’s project.
7. Reflection

I will be moving forward with this senior project as a company of my own after graduation. I believe there is a great opportunity to link private investment dollars with exceptional companies and would like to help facilitate these digital interactions. What’s more, My platform hopes to enlist companies online in a meaningful and active manner. From there, who knows how quickly internet solutions will emerge to help small African companies leverage digital business services for their growth. This is the reality I’m betting on moving forward.

I hope to make a tangible difference in ameliorating many of the challenges investigated in this senior project. Africa’s true development can be accelerated with the technologies to galvanize investment. The past has shown how important foreign direct investment can be for a country’s development and African states are no exception. With strong ICT availability and innovative solutions in the digital business space, African states can accelerate their growth and find a global footing. Innovators can create products that allow businesses and institutions to be incredibly more productive, creating value to build state, community, and household. Many tools exist and many more will emerge but incredible leadership will be required to promote equitable growth and prosperity.

8. Appendix

Note: If necessary, I can provide temporary access to the live platform (staging.ikeora.releaf.ng) for grading purposes. Because company data masking tools have not been implemented, I
must keep a strong guard over who sees this private company information.

Students interested in this project may email me at Ikenna@releaf.ng if they would ever like to see how the project has progressed and gain demo access to the database.

Appendix A
Appendix B

Dashboard

R-Factor Weightings

<table>
<thead>
<tr>
<th>Business Mode</th>
<th>Growth Plan</th>
<th>Legal Factor</th>
<th>Financial Factor</th>
<th>Market Factor</th>
<th>Team Factor</th>
<th>Social Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Important</strong></td>
<td><strong>Important</strong></td>
<td><strong>Important</strong></td>
<td><strong>Important</strong></td>
<td><strong>Important</strong></td>
<td><strong>Important</strong></td>
<td><strong>Important</strong></td>
</tr>
</tbody>
</table>

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Our Food is Out of This World

Galaxy Commodities is a farming organization, trading locally and exporting internationally. Galaxy Commodities has now been in operation as an independent commodities trader for over 3 years. They farm Cashews, Cocoa, Palm Kernel Shell Nuts, Ginger, and Sesame Seeds. They own 1 hectare in Abuja, 5 hectares in Benin; 4 hectares dedicated to plantain production. Currently source their produce from farmers all over the country and the majority of their customers are processing plants within the Lagos-Ibadan area. Galaxy is looking to set up their own processing plant.

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Bringing Innovative Technology to the Forefront of the Nigerian Agriculture Sector

Eniuro Gro Farms Limited produces and sells premium quality vegetables for the Nigerian market utilizing greenhouses.

R-Factor: 5/18/950

Employees: 7
Ranking: 1
Revenue: $100,000

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Directly Fresh Food

Fresh Direct Nigeria is an eco-friendly social enterprise that produces premium organic produce through hydroponics and community action. Fresh Direct Nigeria has multiple divisions: Produce, Technology, Distribution and Consultancy. So they don’t just farm, they create low-tech affordable technologies to simplify farming and grow a farmer network. Fresh Direct Technologies is the division that conceptualizes and designs all their technologies using indigenous, locally found materials and recycling or up-cycling materials. We lower the barrier to entry into agriculture for young/urban farmers by using waste materials.
## Appendix C

### Business Industry

- Agricultural/Support Services
- Manufacturing and Equipment Services
- Fertilizer
- Irrigation Services
- Management/Consultation
- Marine
- Transportation/Logistics
- Other
- Processing
  - All crop + animal sub-industries
  - Canned Products
- E-Commerce
  - All crop sub-industries
  - Marketplace
  - Delivery
- Retail
  - All crop sub-industries
- Crop farming
  - Cattle
  - Cashmere
  - Cacao
- Coffee
- Lanna
- Fruits
- Garlic
- Olives
- Vegetables
- Maitake
- Palm Oil

### Data Table

<table>
<thead>
<tr>
<th>Annual Revenue</th>
<th>Gross Profit Margin</th>
<th>Year Growth</th>
<th>Funding in Data</th>
<th>Type of Funding</th>
<th>Investment Stage</th>
</tr>
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<tbody>
<tr>
<td>$0-$9,999</td>
<td>$0-$9,999</td>
<td>0-6%</td>
<td>$0-$100,000</td>
<td>Venture</td>
<td>Seed</td>
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<tr>
<td>$10,000-$49,999</td>
<td>10,000-$49,999</td>
<td>7-15%</td>
<td>150,000-$200,000</td>
<td>Note</td>
<td>Series A</td>
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<tr>
<td>$50,000-$999,999</td>
<td>500,000-$999,999</td>
<td>16-25%</td>
<td>200,000-$500,000</td>
<td>Note</td>
<td>Series B</td>
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<tr>
<td>$1,000,000-$1,999,999</td>
<td>1,000,000-$1,999,999</td>
<td>26-35%</td>
<td>500,000-$1,000,000</td>
<td>Note</td>
<td></td>
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<tr>
<td>$2,000,000-$4,999,999</td>
<td>2,000,000-$4,999,999</td>
<td>36-45%</td>
<td>1,000,000-$2,000,000</td>
<td>Note</td>
<td></td>
</tr>
<tr>
<td>$5,000,000-$9,999,999</td>
<td>5,000,000-$9,999,999</td>
<td>46-55%</td>
<td>2,000,000-$5,000,000</td>
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<tr>
<td>$10,000,000-$19,999,999</td>
<td>10,000,000-$19,999,999</td>
<td>56-65%</td>
<td>5,000,000-$10,000,000</td>
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<td>$20,000,000-$49,999,999</td>
<td>20,000,000-$49,999,999</td>
<td>66-75%</td>
<td>10,000,000-$20,000,000</td>
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<td>$50,000,000-$999,999,999</td>
<td>50,000,000-$999,999,999</td>
<td>76-85%</td>
<td>20,000,000-$50,000,000</td>
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<td>$1,000,000,000-$1,999,999,999</td>
<td>1,000,000,000-$1,999,999,999</td>
<td>86-95%</td>
<td>50,000,000-$100,000,000</td>
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<td>2,000,000,000-$4,999,999,999</td>
<td>96-100%</td>
<td>100,000,000-$200,000,000</td>
<td>Note</td>
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### Additional Data

- **Government Support:** Yes / No
- **Accelerator:** Yes / No
- **Ownership:** Public / Private