



Foundations of Agricultural Technology Ecosystems Piracicaba

Sponsored By

Rabobank

Rabo Frontier Ventures



Prepared For

Connie Bowen
Kieran Gartlan
Tomás Peña
Carlos Hirsch

Prepared By

Sarah Fuller
Holly Martin
Eric Ontieri
Brant Tagalo
Thomas Tandler



The researchers from the Washington University in St. Louis would like to extend our deepest thanks to the following individuals for their time, energy, and special contributions to this project. Without their passion and engagement, this study would not have been possible – *obrigado*.

The Interviewees

Mateus Mondin, ESALQ
Joaquim Cunha, PECEGE
Luana Moro, Skylar AI, PECEGE
Jose Tome, AgTech Garage
Ricardo Campo, Pulse Lab
Pedro Pugliese, Hub SP
Gabriela Estevam, @Tech
Franklin Ribeiro, Invest SP
Guilherme Dal Lago, Raizen
Klever Jose Coral, Avance Hub, Coplacana
Joao Roberto Spotti Lopes, ESALQ
Silvia Helena Galvao de Miranda, ESALQ
Pedro Valentim Marques, ESALQ
Sergio Pascholati, ESALQ, ESALQTec
Francisco Jardim, SP Ventures
Donovan Rodero, Smartbreeder
Henrique, Clinica de Leite
Leandro Gioppo, Agrimart
Alexis Hakim, Perfect Flight
Marcos Petean Gomes, Genica
Marcelo Coutinho, Brazil Beef Quality (BBQ)
Jose Damico, Scicrop
Ticyana Banzato, Entrepreneur
Henrique Junqueira Franco, Cropman
Avram Slovic, InstaAgro
Christine Gould, Thought for Food
Diego Valenica Lopez, Thought for Food
Claudio Freitas, Thought for Food

Acknowledgements

The Yield Lab

Connie Bowen, The Yield Lab Institute
Kieran Gartlan, The Yield Lab LATAM
Tomas Pena, The Yield Lab LATAM
Carlos Hirsch, The Yield Lab, SOLINFTEC

Washington University in St. Louis, Center for Experiential Learning

Daniel Bentle, Director of the Center for Experiential Learning, Adjunct Professor,
Olin Business School
Richard Ryffel, Adjunct Professor and Finance Senior Lecturer, Olin Business School
Jeffrey Brown, Graduate Fellow, Olin Business School (MBA 2019)

Executive Summary

If the private sector is the growth engine of economic development, the entrepreneurial ecosystem within is the propeller – without a strong enabling environment in place that develops new ideas with intentionality, consistent growth and momentum are difficult to maintain. Entrepreneurial ecosystems can vary by context (especially in informal and developed economies) but several common underpinnings are often present that are vital to the ecosystem’s success, including access to financing, policy and public sector support, physical and digital infrastructure, human capital, and strong industry networks and resources that provide connectivity between the elements.

These ecosystems take time to develop, and due to their varying level of complexity – and by extension, the complexity of the associated industry – are difficult to measure. One of the most critical sectors contributing to future economic growth and development required is agricultural technology. Food production is vital to economic security and growth, and it is in society’s collective best interest to understand, promote, and nurture the conditions that lead to innovation in this space.

Study Background

Formed in 2014, the Yield Lab identifies contexts experiencing underinvestment in agriculture ventures and seeks to address that lack of capital and provide support for early stage agriculture technology (AgTech) companies. The Yield Lab Institute supports this mission through research and thought leadership that promotes the global connectivity of agriculture-focused entrepreneurs and endeavors to understand and help strengthen the conditions that create successful, flourishing AgTech ecosystems. To that end, the Yield Lab partnered with Washington University in St. Louis’ Center for Experiential Learning (CEL) to commission case studies of AgTech ecosystems that examine the unique conditions and collection of industry resources and leadership in varying global contexts.

In 2018, the Yield Lab and the Austral University Campus Rosario and their Center for Food and Agribusiness in Argentina partnered with the CEL to create a case study of the AgTech ecosystem in Rosario. The student research team also completed a study of the surrounding AgTech environment in the Washington University’s home city of St. Louis. The results of these studies were published by the Yield Lab in the spring of 2019. These two contexts served as the kickoff point for a growing portfolio of research and continued partnership between the CEL and the Yield Lab, which led to the 2019 study focused on the AgTech ecosystem in Piracicaba, Brazil.

Purpose

This study is intended to showcase the unique factors present in Brazil's operating environment that have led to the thriving AgTech ecosystem present in Piracicaba, a designated "smart city" located in the southern territory of São Paulo state. The collection of top agriculture universities provides an unparalleled pipeline of talent for the ecosystem; as a result, Piracicaba has become a teeming intersection of entrepreneurs, nearby accelerators and incubators, businesspeople, and industry giants. This case study will describe these stakeholder entities and examine their connectivity, present the vast opportunities available for further investment and development, and identify areas where the ecosystem's network can be further strengthened to enhance growth outcomes.

Research Lenses

As discussed above, there are common identifiable domains key to the success of entrepreneurial ecosystems. This study examines the contextual conditions in Piracicaba – and Brazil at large – through these lenses to understand the current state of the ecosystem and the opportunities present for further development there. The domains examined in this study are finance, public policy, human capital, and infrastructure, and the connectivity between them is also discussed. The principle findings, conclusions, and recommendations for each of these study lenses as applied to Piracicaba and Brazil are below. For an orientation to the study recommendations as part of a five-year plan for advocacy, further investment, and development, visit the conclusion of this document.

Finance

Findings

1. The AgTech lifecycle is relatively long and better-suited for investors with patient capital and longer time horizons.
2. Brazil has two growing seasons, fertile soil, and rain-fed agriculture that has allowed the country to become the leader in tropical agriculture innovation and research.
3. The development in São Paulo of AgTech-focused funds and the launch of a venture debt fund shows the continued evolution of the venture capital pipeline.
4. Innovative sources of seed/angel capital are becoming available from agricultural executives, farmers, and cooperatives although they lack coordination.

5. Many startups are founded or funded by university professors; however, state universities cannot leverage staff, infrastructure, or alumni as a source of partnership, support, or capital as there is no policy framework to address conflicts of interest.
6. Corporate venture capital is becoming involved in Brazil through direct investments or co-direct investments although corporates are still punching below their weight.
7. Corporates are setting up incubators for internal innovation and external innovation – they are also interested in startups outside of their product space.
8. Cooperatives are offering smart capital as they have the infrastructure, capital, market, networks, and incentives to do so. They have the ability to pilot with startups and witness the value proposition before investing. Some cooperatives are looking to AgTech and FoodTech to move further up the value chain or to monetize their byproducts.
9. Government is partnering with venture capital to source investments in AgTech as it looks to set up its own direct investments into AgTech startups.
10. The state government in São Paulo is funds research grants that were accessed by the majority of startup entrepreneurs interviewed.

Conclusions

1. Innovative sources of seed/angel capital are available from agricultural executives, farmers, and cooperatives although they lack coordination.
2. Serial entrepreneurs are missing as a source of capital (e.g. founders of Bug Agentes Biológicos - sold to Koppert – and no material interaction with the AgTech Valley or startups afterward).
3. The legal and policy framework concerning state universities does not allow for commercializing research, licensing agreements, or endowments – there is no bridge between pure science and applied science.
4. Corporate venture capital is visibly mobilizing in Brazil as the country leads in tropical agriculture innovation.
5. In the absence of a mature ecosystem and defined development pipeline, corporates are offering founders jobs in exchange for assigning intellectual property (IP) for their research.
6. The level of complexity is a roadblock to accessing government funding. Federal and state funding should be organized and aligned for easier and more broad utilization.
7. The government's direct involvement as a venture capital investor (with a lower cost of capital) might eventually serve to

discourage private investors.

Recommendations

1. Farmers, agricultural executives, and cooperatives should become better organized to serve as an accessible source of seed/angel capital.
2. AgTech can become more innovative in sourcing early investment – for well-matched opportunities – by utilizing methods like crowdfunding. In 2017, Brazil passed a law to create a framework for crowdfunding which has proved successful in raising equity for some companies.
3. Universities have a vast network of successful alumni working in the industry and in government; for example, ESALQ has an alumnus as the former Minister of Agriculture. It would be beneficial to further emphasize the leveraging of these networks as sources of capital or expertise (e.g., ESALQ does not yet have an angel alumni group, which represents a great development opportunity).
4. Universities should consider defining a pipeline to move research ideas from the lab into the field (e.g., ESALQ is trying to address this through ESALQTec, which incubates ideas).
5. In some cases, startups may look to partner with foreign universities that are unencumbered by state university policy. They may look to incorporate or patent abroad to harness foreign capital and get around funding challenges.
6. Corporate venture capital should deepen its partnerships with startups, incubators, and accelerators and provide non-financial support such as infrastructure inputs, data for experimentation, or mentorship (a successful example of this is the Sygenta and InstaAgro partnership)
7. Further marketing and socialization of the federal and state funds available to entrepreneurs may increase awareness of how to begin developing venture ideas.

Public Policy

Findings

1. Brazil's macroeconomic conditions have improved greatly over the past two decades due to the government's ability to pursue consistent macroeconomic policies based on stable inflation, declining public debt, and a flexible exchange rate.
2. Brazil ranks at the midpoint in global rankings (in 2017) but above the regional median (in Latin American and the Caribbean) on several measured dimensions of governance.

3. Financial markets in Brazil are largely bank-based. Bank credit relative to the gross domestic product (GDP) in Brazil is the second-largest among Brazil, Russia, India, and China (the BRICs) after China but is significantly below the levels of some of the largest Organization for Economic Cooperation and Development (OECD) economies. Banks' intermediation spreads are quite high by international standards.
4. The World Economic Forum scored Brazil's financial market development at 3.7 on a scale of 1 to 7 (best) in its 2017 global competitiveness report. This metric is based on the opinions of Brazilian businesses on fundamental dimensions of credit markets.
5. Brazilian entrepreneurs consider financial access through local equity markets and venture capital insufficient and access to loans challenging as indicated by the World Bank Ease of Doing Business assessment. Piracicaba, however, provides many incentives to startups and innovators.
6. The total tax rate on Brazil's company profits (68 percent) is estimated to be above average for Latin America (in 2017).
7. The Greater Brazil Plan is the third industrial policy announced by the Brazilian federal government in the last decade, following the 2004 Industrial, Technological, and Foreign Trade Policy (PITCE) and the 2008 Productive Development Policy (PDP).
8. The world-renowned University of São Paulo: Luiz de Queiroz College of Agriculture (USP-ESALQ) ranks fifth in global Agricultural Sciences universities and is first in the southern hemisphere, supplying the AgTech Valley with unparalleled intellectual prowess and agricultural research in the global south.
9. The Brazilian youth unemployment rate roughly doubled from 16.8 percent in 2007 to 30.21 percent in 2017. While unemployment (or at-risk for unemployment) policies are primarily composed of compensation measures, the government has, for quite some time, undertaken initiatives to improve "market insertion."
10. Successive Brazilian governments have pursued important institutional and regulatory reforms in the infrastructure sector since the 1990s.
11. In the mid-2000s public investment in infrastructure was significantly increased through various federal and state programs. Governments at the federal and state levels also introduced various tax and credit incentives to increase private investment in infrastructure.
12. Since 2000, patent protection in Brazil has improved. In the agricultural sector, the Brazilian government pursued an open innovation system and Intellectual Property Rights (IPR) policy, which facilitated technology transfer, the diffusion of new cultivars, and the filing of international patents.
13. Piracicaba has streamlined many of the complex regulatory environment and intellectual property policies to ease the burden on entrepreneurs and corporations.

14. Policy motivations and objectives in commercial agriculture consist primarily of boosting production in the sector while making it more technologically advanced and sustainable.
15. Since 2012, objectives expanded to emphasize the development of storage and irrigation infrastructure, soil conservation and recovery, and investments in technological innovation in agriculture.
16. Brazilian agricultural policy uses three main instruments: price support, credit concessions, and insurance support.
 - Price Support: a price support may be either a subsidy or a price control, both with the intended effect of keeping the market price of a good higher than the competitive equilibrium level.
 - Credit Concessions: the purpose of rural credit policy is to decrease the high cost of domestic borrowing to the agriculture and the agro-processing sectors.
 - Insurance Support: support to agricultural insurance is aimed at mitigating fluctuations in farmers' incomes.

Conclusions

1. Trends indicate that Brazil's macroeconomic climate will continue to improve as public sentiment towards entrepreneurship and innovation is strengthened. The new Bolsonaro administration and induction of pro-business representatives in the Senate and Lower House of Congress have contributed to a noticeable shift in the data measuring the level of positive economic outlook.
2. Businesses bear a substantial tax burden and high costs to comply with tax regulations that are coupled with high interest rates. Due to the concept of "origin-taxation" in Brazil, companies operating nationwide are required to comply with each state's individual tax rules, and credits for interstate transactions are frequently delayed or refused. A bright spot in Brazilian tax policy, however, is the allowance for a range of incentives to support the development of sectors vital to technological advancement and innovation, which were introduced in 2011 as part of the government's Greater Brazil (Brasil Maior) Plan.
3. Although access to premier educational facilities has improved, intersections and interactions between academic disciplines are still lacking, making it challenging for researchers to enter the entrepreneurial sphere due to sparse business skillsets. Similarly, meaningful academic interactions between schools are limited.
4. The gaps in infrastructure are well-recognized by the government, hence it has undertaken institutional and regulatory reforms to address challenges in the infrastructure sector.
5. The level of both state and local government support offered for entrepreneurship and innovation has been inconsistent in the past, however, recent trends – such as regulatory progress on climate-related issues as well as intellectual property rights – show that positive reforms are imminent.

Recommendations

1. The existing system for inflation targeting should be strengthened and the clarity of fiscal operations improved. Risk assessments from credible research agencies that show progress and the promising future outlook could serve to increase (foreign) investor confidence.
2. Brazilian AgTech faces a dearth of early investment – the Piracicaba municipality should move towards offering more support in the form of funding mechanisms or programs tailored towards the local innovation community.
3. Key AgTech representatives should work towards building stronger relationships with SEBRAE with the aim of increasing private-sector participation in the long-term credit market.
4. Advocacy should be focused towards the establishment of a more streamlined tax system that imposes fewer compliance costs (with the larger goal being movement towards a unified national tax system).
5. To benefit the Piracicaba ecosystem, the municipality should consider working towards improvements in its tax regulations and policies for venture entrepreneurs, offering incentives to open their firms in the city.
6. An analysis of labor force training programs should be conducted to place greater focus on market insertion as an outcome and on the transferability of skills - coordination can then be initiated with relevant policymaking bodies to implement suggested changes.
7. The government may commission a third party (e.g. SEBRAE) to identify the most critical points of improvement to create a strategy for infrastructure development.
8. The government should consider commissioning a review to determine which tax and credit incentives most encourage private investment, and further develop those incentives.
9. Key AgTech Valley leaders should look to establish closer collaboration with SEBRAE (and others such as EMBRAPA & HubSP) to strengthen AgTech's representation and create a foundation for engagement with policymakers. This will provide a platform for voices to be heard around issues affecting regulatory processes and IP regulation and protection, which deeply affect the successful development of the industry.

Human Capital

Findings

1. With nearly 25,000 alumni and 3,400 students currently enrolled the University of São Paulo - ESALQ provides a significant amount of human capital to the AgTech ecosystem within the São Paulo and Piracicaba region.
2. Spaces like ESALQtec are important providers of additional support to startups and entrepreneurs (innovation space, networks,

etc.)

3. Three strong backgrounds are deemed particularly valuable for success in the AgTech industry – business, computer science, and agronomy.
4. Computer science and agronomy backgrounds are well-represented in Piracicaba, however, there is an overall shortage of business backgrounds/skills.
5. Professors and entrepreneurs are trying to build support within universities to provide more cross-functional classes and business resources for budding entrepreneurs (e.g. PECEGE).
6. Agriculture industrial firms are a key provider of highly-skilled and trained workers (e.g., Raizen and Monsanto/Bayer).

Conclusions

1. A growing number of graduates are entering the startup space rather than joining large corporations after graduation in the São Paulo and Piracicaba region, sparking an increased demand from students and a limited number of professors for the incorporation of entrepreneurship into the curriculum.
2. ESALQ is very successful in assisting entrepreneurs on the engineering and science spectrum, opportunities exist to strengthen the Ag Science programs by introducing core business classes.
3. Large corporations such as Raizen and Monsanto/Bayer provide experienced, highly-skilled human capital to the AgTech ecosystem as well as key resources and may offer mentorship support to entrepreneurs and startups on a case-by-case basis, assisting in the growth and expansion of select startups.

Recommendations

1. An internal review of higher educational programs should be initiated that incorporates student feedback towards different areas of study, with an eye towards increasing the intersection of and engagement between different areas of study, specifically, with business (e.g. business and agronomy).
2. Partnerships with other agriculture universities (e.g., Agro Paris Tech) can be utilized to gain insights regarding their academic approach towards integrating a business curriculum.
3. Mentorships and professional development opportunities within hubs such as Pulse and Invest SP are vital to a startup's development. Hubs could consider making core business concept learning modules available to their entrepreneurs through established online platforms such as CrossKnowledge or D2L, to bridge business skills gaps among their entrepreneurs.

4. A professional networking forum should be formalized that allows entrepreneurs to establish important linkages within the industry that sharpen and complement their skills, as well as create business opportunities or funding connections.

Infrastructure

Findings

1. Despite limited logistical infrastructure across its rural areas, Brazil is a global powerhouse in terms of agricultural production and exports, creating a robust environment primed for the improvements offered by AgTech innovation.
2. There are many AgTech facilitators present in Piracicaba, including hubs and incubators, government-backed hubs, corporate funded accelerators, and corporate- and university-supported testing facilities
3. The digital connectivity needed to support AgTech solutions is limited in more rural areas of Brazil but has improved over the past couple of years due to corporate initiatives that are creating their own mesh networks, as well as private and public investment in the infrastructure needed to expand connectivity.
4. Technological adoption by producers relies heavily on proven success and positive network effects; however, negative experiences with AgTech create reluctance from producers to adopt new technologies.

Conclusions

1. Brazil is a low-cost competitor in the world agricultural market, but low production costs are offset by high transportation costs due to the lack of cheap, reliable means of transportation. Further advocacy and investment for improved infrastructure would help reduce inefficiencies grow profits within the industry.
2. A high density of AgTech players in Piracicaba creates an innovation-rich environment, geared specifically towards supporting AgTech startups to bring solutions to market for producers.
3. The interaction between AgTech facilitators in Piracicaba is not adversarial as players generally support each other, but they operate by following individual incentives, which may or may not align with growing the ecosystem as a whole.
4. Limited digital connectivity presents an excellent opportunity for investment, as efficiency gains due to increased adoption of AgTech solutions present massive upside savings for producers
5. Facilitators and cooperatives such as Coplacana play a key role in connecting producers to AgTech innovations and solutions, ensuring producers are adopting the correct solutions for their challenges. Positive experiences create positive network effects and help spread AgTech solutions.

Recommendations

1. The agricultural industry and AgTech ecosystem should improve organization for advocacy efforts at the municipal, state, and federal level for improved infrastructure investment specific to agricultural needs.
2. Investment from private and public investors should be actively promoted to continue building out digital connectivity for producers.
3. New entrants should seek to replicate the success of Coplacana to bring solutions to market that address producers' specific needs. Equip producers with the means to determine the root of the problems they experience so that they can identify the correct solutions for their situation.

Overall Study Recommendations

1. The AgTech Valley in Piracicaba has experienced such strong growth that it may benefit from some added self-governance to be positioned to effectively advocate for the Valley's/AgTech's interests where needed and to effectively move promising startups through a discernible pipeline of development.
2. There is a need for further socialization of potential investments as living along a continuum – this will create better matchmaking between investors and opportunities (categorized by expected return, desired risk profiles, etc.). This will also aid in the flow of information to incentivize more [corporate/impact] investment, highlight angel/VC opportunities at various growth stages (and ticket sizes), and better involve other “unencumbered” sources of capital (private-/public-sector grants, foundation money) by addressing the unique factors of Ag investments (e.g., longer lifecycle, commodity pricing, etc.).

Table of Contents

Executive Summary	1
Study Background.....	1
Purpose.....	2
Research Lenses.....	2
Introduction	14
Client: The Yield Lab Institute.....	14
Study Implementation.....	14
Finance	16
Seed/Angel Capital.....	17
Venture Capital.....	19
Corporate Venture Capital.....	20
Federal/State Funding.....	22
University Support.....	23
Current Financing Gaps.....	25
Localized Solutions for Capital.....	26
Summary.....	28
Connectivity: Finance and Public Policy.....	30
Public Policy	32
Macroeconomic Environment.....	33
Financial Policy.....	38
Taxation.....	40
Infrastructural Policy.....	41
Human Capital Policy.....	42
Entrepreneurship and Innovation.....	45
Agricultural Policy.....	48
Summary.....	50
Human Capital	55

Universities	55
Corporations	60
Labor Force	61
Summary	63
Infrastructure	66
Logistical Infrastructure	68
Digital Infrastructure	70
Summary	73
Conclusion	76
Five-year Plan for Further Development of the AgTech Ecosystem in Piracicaba / Brazil	78
Sources	84

Acronyms and Abbreviations

AgTech	Agricultural Technology
BNDES	National Bank for Economic and Social Development
BRICs	Brazil, Russia, India, and China
CEL	Center for Experiential Learning (at Washington University in St. Louis)
GDI	Gender Development Index
EMBRAPA	The Brazilian Agricultural Research Corporation
ESALQ	University of São Paulo: Luiz de Queiroz College of Agriculture
FAPESP	<i>Fundação de Amparo à Pesquisa do Estado de São Paulo</i>
FDI	Foreign Direct Investment
FINEP	Funding Authority for Studies and Projects
FIP	São Paulo Innovation Fund
GDP	Gross Domestic Product
IP	Intellectual Property
IPR	Intellectual Property Rights
OECD	Organization for Economic Cooperation and Development
PAC	Accelerated Growth Pact
PPI	<i>Programa de Parcerias de Investimentos</i> / Program for Investment Partnerships
R&D	Research and Development
SEBRAE	Brazilian Micro and Small Enterprises' Support Service
SME	Small- to Medium-sized Enterprise
USP	University of São Paulo

Introduction

Client: The Yield Lab Institute

The Yield Lab is comprised of a group of agribusiness experts that believe that agriculture innovation is essential to feed a rising global population. Formed in 2014, the Yield Lab identifies contexts experiencing chronic underinvestment in agriculture ventures and seeks to address that lack of capital and provide support for early stage agriculture technology companies. It has experienced rapid expansion and currently operates 19 portfolio companies and three international accelerators, with each accelerator investing USD 100,000 annually in selected early-stage AgTech companies. The accelerators also provide network-focused programming focused on customers, collaborators, and capital, and provides mentorship opportunities through its team of agribusiness experts. The Yield Lab Institute also strives to improve the connectivity between AgTech entrepreneurs and their stakeholders and is building a research portfolio that seeks to inform the stakeholder community about the unique factors of the Yield Lab's different operating contexts and highlight opportunities for investment in AgTech. The Yield Lab seeks to build a global web of agriculture entrepreneurs to better position the industry to sustainably address food supply challenges as a central underpinning of economic security, development, and growth.

Study Implementation

Team

This study was implemented on behalf of the Yield Lab by a team of Washington University in St. Louis students through the university's Center for Experiential Learning, an educational center located in the Olin Business School. The student team consisted of five students: Brant Tagalo, Eric Ontieri, Holly Martin, Thomas Tandler, and team lead Sarah Fuller, who are all studying business disciplines at the university and come from various prior career backgrounds. The team was also guided by the expertise of two faculty advisors, Richard Ryffel and Daniel Bentle, whose combined backgrounds in consulting, financial services, agricultural systems, and business development contributed greatly to the study outcomes.

Methodology

The team utilized a mixed-methods approach consisting of secondary document review and primary data collection through interviews

with key academics, entrepreneurs, business-leaders, and other figures directly associated with the AgTech ecosystem in Piracicaba and São Paulo. The literature review spanned over four weeks, and the interviews were primarily conducted over the course of six days that the team spent in-country visiting a university, startup hubs, and co-working spaces, with some taking place via conference call after the fieldwork period. The Yield Lab connected the team with the key interviewees, who were chosen for their expertise, engagement with the AgTech ecosystem, and to represent the breadth needed across associated backgrounds (academia, founders, venture investment, etc.) to inform this study.

The team used two interviewers and two notetakers during the interviews, and received translation support as needed from the Yield Lab. The researchers collected key themes throughout the interviews and began organizing the data in-country at daily debrief sessions where the themes were discussed, note files were confirmed and consolidated, and approach refinements were considered.

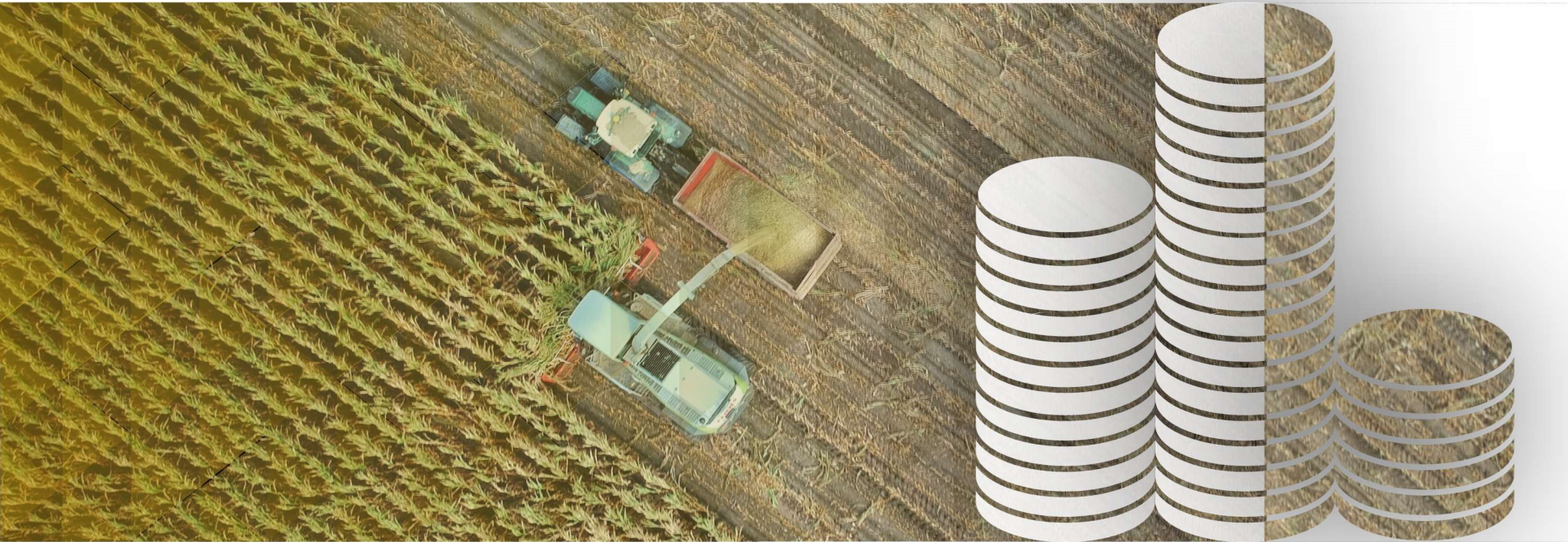
After the fieldwork in Brazil was complete, the team communicated with certain interviewees to clarify or further follow up on specific points. The study then moved into the analysis phase: the researchers created a coding tree structure and utilized a qualitative data analysis (QDA) software to code all of the primary interview data. Key themes from this coded data were presented to the Yield Lab as direct follow up from the fieldwork phase in Brazil. The secondary data was then coded and layered with the primary data and the full study analysis was undertaken by the team members to arrive at the study findings that form the basis for this whitepaper.

Tools

The study team used a web-based QDA software, Dedoose, to complete the coding for the interview notes and secondary data. The data was then exported to Microsoft Excel for review and analysis across the coded themes to inform the study findings. Various other presentation and publishing software packages were also used throughout the study.

Timeline

The study began in January 2019 with a kickoff meeting between the Yield Lab and the CEL research team to set expectations and goals for the study in Piracicaba. The team traveled to Brazil the week of March 10, 2019 to complete fieldwork interviews with key stakeholders. Coding and analysis of all data were completed in the final weeks of March, with early themes presented to the Yield Lab on April 8, 2019. Feedback was incorporated and the whitepaper was written, compiled, and edited over the last three weeks in April



Finance

Agriculture constitutes approximately 24 percent of Brazil’s GDP, but until recently, investment in AgTech lagged behind what was seen in other industries (such as FinTech or MedTech). In 2018, \$69.6 million was invested in the AgTech space compared to \$623 million of total investment into all Brazilian startups.¹ AgTech is set to profit from Brazil’s coming of age as a valid investment opportunity. In 2018, at least 10 Brazilian startups achieved unicorn status (any startup that reaches a USD \$1 billion dollar market value as determined by private or public investment) with the highest profile example being 99taxi, a ride-hailing company that was acquired in 2018 for over \$1 billion by the Chinese ride-hailing service, Didi.² Another example is Stone Pagamentos, a payments processor that listed on NASDAQ and raised over

¹ “2018 AgTech Investment Review”, Finistere Ventures, accessed April 22, 2019, https://files.pitchbook.com/website/files/pdf/Finistere_Ventures_2018_AgTech_Investment_Review_PJZ.pdf

² Eric Newcomer, “Didi Buys 99 Taxis, Igniting Fight With Uber in Latin America”, Bloomberg, accessed April 22, 2019, <https://www.bloomberg.com/news/articles/2018-01-03/didi-buys-99-taxis-igniting-fight-with-uber-in-latin-america>

\$1.1 billion, shedding light on Brazil as a viable source of investment returns.³

AgTech has traditionally had a long development cycle that encompasses many years of research, the wait-time necessary for regulatory approval, and the years spent to meaningfully penetrate the market. The financing cycle is also subject to and highly dependent on the annual April harvest. Recent trends have shown a shortening of the life cycle, however, with an example being Strider, a farm management software startup that was acquired by Sygenta just five years after being founded.⁴

In fact, 2018 was a banner year for AgTech. Significant transactions include not only Sygenta's acquisition of Strider but also Solinftec's Series B financing (both farm management software startups) that raised funds from TPG (Texas Pacific Group) and AgFunder.⁵ Moreover, the first venture debt fund was structured by SP Ventures on behalf of the BNDES bank (National Bank for Economic and Social Development), the first such credit facility for startups.⁶ The emergence of such specialty funds targeting AgTech shows the continued maturation of the ecosystem.

Seed/Angel Capital

Sources

The largest concern for most of the startup founders interviewed was the noticeable chasm between seed capital and Series A funding, reflected both in interviews and in the 2nd Census conducted by AgTech Garage and ESALQ.⁷ Once a startup manages to become revenue generating, it is more likely to find a potential venture capital match, as the majority of investors looking to make investments are clustered in Series A. Before making it to that stage, however, a startup will likely require seed money or angel funds, which are particularly difficult to ascertain without personal connections to wealthy donors.

³ "Stone Pagamentos raises US\$1.1B on NASDAQ", LAVCA, accessed April 22, 2019, <https://lavca.org/2018/10/01/stone-pagamentos-raises-us1-1b-on-nasdaq/>

⁴ "Sygenta to acquire Strider", Sygenta, accessed April 22, 2019, <https://www.syngenta.com/media/media-releases/yr-2018/26-03-2018a>

⁵ Louisa Burwood-Taylor, "TPG ART Invests in Brazilian Digital Ag Startup Solinftec", AgFunderNews, accessed April 22, 2019, <https://agfundernews.com/breaking-exclusive-tpg-art-invests-in-brazilian-digital-ag-startup-Solinftec.html>

⁶ "First Public Call for Selection of Credit Funds for Small and Medium-Sized Enterprises", BNDES, accessed April 22, 2019, <https://www.bndes.gov.br/wps/portal/site/home/mercado-de-capitais/fundos-de-investimentos/chamadas-publicas-para-selecao-de-fundos/chamada-publica-fundo-pme-inovadoras>

⁷ "2º Censo AgTech Startups Brasil", AgTech Garage, accessed April 22, 2019, <https://www.AgTechgarage.com/censo/>

Genica

Located in the heart of Piracicaba's AgTech Valley, Genica is a biotech startup primarily focused on Agribusiness. The organization hopes to provide key innovations that assist in improving the sustainability and efficiency of the agriculture industry within Brazil. They also have a partnership with ESALQTec which provides residents with access to laboratories assisting in the expansion and development of new innovative products.

The firm is currently aiming to create production management tools through the use of eco-friendly chemical pesticides and biological agents, as their slogan reflects, "Solutions for Generations and our proposal is system management using rationally the chemical defenses." While Genica was only recently founded (in 2015), it has made great strides towards achieving this goal and is hoping to grow organically as the organization expands operations.

Several interviewees referred to Brazil as having a particularly risk-averse culture; this is coupled with the fact that often little benefit is realized as the first mover in agriculture - there is little incentive for investors to invest in the AgTech value chain. Further complicating this is the fact that AgTech is competing with more established industries (like FinTech) for funds, and with high interest rates the norm in Brazil, an investor is compensated well without needing to pursue riskier investments.

For those who do receive early stage investments, the three recurring sources of funding mentioned by the interviewees as most accessed are connections to high-net-worth donors, an individual founder's assets, or FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) state grants from the São Paulo Research Foundation. Outside of these three funding options, new ventures currently have few available means of moving forward. Some startups are attempting to innovate around this challenge by establishing dual-business structures, with a successful case being Bug Agentes Biologicos (that sustained itself by selling pictures of pests and insects to multinationals while it was developing its product). Genica, a gene-editing startup, is a third-party distributor of pesticides which serves as a means to fund themselves. This is a positive approach as entrepreneurs interact with distributors, multinationals, the wider market, and potential clients. They are also further developing business skills that will serve them later.

The situation is starting to improve, however, as new sources of funding begin to materialize. The need for "patient" capital (investments with longer maturity expectations) and further time horizons are being addressed by innovative sources such as farmers and alumni angels.

Alternative Sources of Capital

Given the relative lack of available paths forward, Brazilian entrepreneurs have to be creative to source capital. Entrepreneurs have pitched to and partnered with cooperatives and directly with farmers to pilot their ideas, with partners sometimes offering to make an investment after witnessing the value proposition first-hand at the test sites. BeefTrader, a startup working out of @tech hub in Piracicaba,

Pulse Labs

Pulse Labs is coworking space and startup accelerator owned by Raizen, a joint-venture between Anglo-Dutch oil and gas giant Shell and Brazilian energy conglomerate Cosan, which created the leading company in the production of sugar, ethanol, and bioenergy in Brazil. Pulse was established in conjunction with SP Ventures and NXTP Labs to spur innovation, both internal and external to Raizen. Launched in August 2017 and located in the Piracicaba Technology Park, Pulse has attracted the interest of over 400 startups and has accelerated 15 companies.

Pulse is unique because it caters to startup ideas from Raizen employees working on internal innovation as well as external entrepreneurs, hoping to find synergies and create partnerships. Pulse Labs is somewhat unique because they are open to accelerating startups that work outside of sugarcane, Pulse's main area of expertise. They are the smartest capital in town, providing infrastructure, office space, capital, and mentorship to innovative, revenue-generating startups.

is working on cattle management practices in feedlots at Avance, a virtual hub owned by the Coplacana cooperative. This relationship concluded with an investment.⁸ InstaAgro, an online implements store, is another example of a venture successfully leveraging agricultural executives who understand the startup's addressable market and value proposition in order to source early capital.

Alumni Angels

A potential local solution (albeit limited at this stage) to the funding gap has been a growing number of university alumni angel networks. An example is Poli Angels, an angel club started by engineering alumni from the University of São Paulo (EPUSP). They wish to invest \$125,000 (500,000 reais) into AgTech startups and are primarily interested in the hardware sector.

Given their breadth of understanding of the market and

technology, they are well-positioned to provide smart capital and advice. Another example is GVAngels, an angel club comprised of alumni of FGV (Fundação Getulio Vargas) at the São Paulo School of Business. Universities, having already established their own alumni networks, have the connections and relationships to establish and foster these groups.

Venture Capital

SP Ventures

SP Ventures, a local venture fund established in 2007, has proven successful in mobilizing investment funds and generating profitable exits.

⁸ Priscilla Perez "Startup @ Tech Offers Technology for Profitability" Gazeta de Piracicaba. Accessed April 22, 2019.
http://www.gazetadepiracicaba.com.br/_conteudo/2018/10/home/603198-startup-tech-oferece-tecnologia-para-lucratividade.html

One of their success stories is the 2017 sale of Bug Agentes Biologicos to Koppert, a Dutch company.⁹ Currently, SP Ventures is the investment manager of the São Paulo Innovation Fund (FIP) partnering with Densenvolve (the Development Agency of the state of São Paulo), FINEP (Funding Authority for Studies and Projects), FAPESP (São Paulo Research Foundation), and SEBRAE-SP (Brazilian Support Service for Micro and Small Enterprises) to focus on technology startups in São Paulo. They are primarily targeting AgTech, FinTech, and HealthTech innovations. ¹⁰ SP Ventures has also been integral to the structuring of the Brazil Venture Debt I Fund in partnership with BNDES to create a credit facility for startups nationally. It is the first such credit facility available to startups.

Corporate Venture Capital

Corporate ventures are mobilizing and moving into Latin America considering Brazil is at the forefront of tropical agriculture. The “A,B,C,D” multinational trading companies – Archer Daniel Midlands (ADM), Bunge, Cargill, and Louis Dreyfus – are all regionally headquartered in São Paulo. Since Brazil has two planting seasons, fertile soil, and a highly favorable climate, it is the perfect testing ground for a company to implement trials of their solutions that are specifically suited to the climate conditions of the global south.

While Brazil has a well-established corporate venture capital history, AgTech as a sector has lagged behind other investment opportunities, although trends are changing. There is an increase in transactions with corporate ventures partnering to co-invest in deals or promoting other local investors like SP Ventures. Other major corporate ventures also have established or are in the process of establishing a presence in Latin America. A typical entry point is to co-invest with a local venture fund with more knowledge of the market (e.g. Syngenta Ventures and Bunge Ventures co-investing in Agrofy alongside SP Ventures).¹¹ Corporate ventures also invest as limited partners in investment funds targeting the AgTech space as well.¹²

Monsanto Ventures has taken a more direct approach by sourcing and investing directly in AgTech startups. Their inaugural Brazilian investment was in Grao Direto in 2018, a platform to digitize trading grain, which is traditionally done via phone calls and WhatsApp

⁹ “Koppert acquires BUG creating the largest biocontrol company in Latin America” Koppert, accessed April 22, 2019, <https://www.koppert.com/news/koppert-acquires-bug-creating-the-largest-biocontrol-company-in-latin-america/>

¹⁰ “São Paulo Innovation Fund”, FAPESP, accessed April 22, 2019, http://pesquisaparinovacao.fapesp.br/tempo_de_colher/900

¹¹ “SP Ventures, Syngenta, Bunge, & Endeavor lead series A investment in Agrofy”, LAVCA, accessed April 22, 2019, <http://demo.creosen.com/lavca/2018/03/06/sp-ventures-syngenta-bunge-endeavor-lead-series-investment-agrofy/>

¹² “2018 AgTech Investment Review”, Finistere Ventures, accessed April 22, 2019, https://files.pitchbook.com/website/files/pdf/Finistere_Ventures_2018_Agtech_Investment_Review_PJZ.pdf

Avance / Coplacana

Based in Piracicaba, Coplacana, short for the Cane Planters Cooperative of the State of São Paulo, is a massive cooperative of over 10,000 agricultural producers operating across Brazil. First founded in 1948 with the mission of providing inputs and assistance to the rural sugar cane producer, Coplacana members' farms are now highly diversified, producing everything from grains to livestock and ranging from 5 hectares to over 70,000 hectares. The size of Coplacana, diversity of its members, and history of success in the agribusiness sector allows the organization to take an intrinsically fragmented system of producers and centralize their efforts to foster cooperation and ultimately strengthen the rural producer.

Avance is a technology and innovation hub within Coplacana whose purpose is to identify startups and technology that would be useful for producers and to work with those startups to develop their ideas and bring them to market. They have recognized that the problems faced by producers often vary by scale and scope, but not by type, so they have partnered with universities and organizations in Brazil, to include ESALQ, AgTech Valley, and @Tech to find solutions that can be adopted and scaled for use by all of its members. This model of communicating with producers to identify their problems and then approaching startups and entrepreneurs to build a solution is a unique approach to technological adoption in the agriculture industry in Brazil that has been highly successful. Not only does it promote new innovation, but it also creates highly effective positive network effects among producers that are critical to the spread and adoption of new technology.

messages. Monsanto partnered with Canary and OpenVC Fund to close the investment and is actively looking for its next opportunity.¹³

Some corporations are taking a different approach. Raizen, a joint venture between Cosana and Shell, set up its own innovation hub called Pulse Labs. Pulse offers an environment to foster both internal and external innovation. In addition to supporting startups, Raizen employees are encouraged to put forward innovative ideas and the best are invited to join the hub to develop their ventures. Pulse Labs possesses a particularly unique model as it supported directly by the sugarcane industry. This allows startups with talented entrepreneurs to grow alongside the industry – rather than the industry directly hiring the best and brightest – is a new approach. Another unique facet was opening the hub to startups working outside of sugarcane, with the rationale being that sugarcane is only the fifth largest crop in Brazil, and it would be limiting not to target the four larger addressable markets like soybeans and cotton. Pulse is looking for startups globally with the aim of providing a soft landing for these ventures to pilot in tropical agriculture regions.¹⁴

A somewhat novel approach that Coplacana is using with their hub Avance is to identify potential startups and approach them directly to join the hub. They offer non-financial forms of support like infrastructure and scientific data for pilot testing; the startup Beeftrader

¹³ "Monsanto's Venture Capital Arm Makes First Direct Investment in Brazil", Monsanto, accessed April 22, 2019, <https://monsanto.com/company/ventures/articles/monsantos-venture-capital-arm-makes-first-direct-investment-brazil>

¹⁴ Emma Cosgrove, "Brazil's First AgTech Accelerator Program Pulse Seeking Startups", AgFunderNews, accessed April 22, 2019, <https://agfundernews.com/breaking-brazils-first-AgTech-accelerator-program-pulse-seeking-startups.html>

received an investment from Avance after the company piloted its feedlot management system using Coplacana testing sites. This relationship is symbiotic as startups receive to smart capital and the cooperative is able to access external innovation.

Federal/State Funding

On the federal level, the Financiadora de Estudos e Projetos (FINEP), or Funding Authority for Studies and Projects, is an organization of the Brazilian federal government under the Ministry of Science and Technology, devoted to the funding of science and technology in the country. One example of their programs is the FINEP Startup Program which aims to close the gap of support and funding between the contribution made by acceleration programs, angel investors, and crowdfunding tools and the potential infusions of seed money and venture capital funds.¹⁵ FINEP is also a limited partner in the São Paulo Innovation Fund, another avenue of support for innovation.

BNDES has also taken a keen interest in AgTech, viewing it as another way of stimulating the expansion of industry. BNDES launched an angel fund in 2017, seeding it with \$25 million (100 million reais) to support angel investment into startups with revenues in excess of 1 million reais. DOMO Invest, a venture capital fund, was selected as the investment manager of the angel fund.¹⁶ BNDES has also expressed interest in developing its own infrastructure to allow it to invest directly into AgTech startups, which may ultimately bode well for the industry.

On the state level, Desenvolve SP, the Development Agency of the state of São Paulo, is a leading limited partner in the São Paulo Innovation Fund. Desenvolve's invests in state-of-the-art technology as a way of helping state research centers breed startups.¹⁷ FAPESP, on the other hand, is a state foundation, funded by 1 percent of São Paulo state taxes and dedicated to the support of research projects in higher education. FAPESP provides grants for basic research, research infrastructure, and applied research.¹⁸

At the local level, the Piracicaba Technology Park is a shared project between the city and the state, having been established by state decree. The land on which the park is located was donated by the municipality, and it is managed by a committee that includes stakeholders from private industry. The vision for the park is to have all startups, incubators, accelerators, investors, and other relevant

¹⁵ "Finep Startup", FINEP, accessed April 22, 2019, <http://www.finep.gov.br/apoio-e-financiamento-externa/programas-e-linhas/finep-startup>

¹⁶ "Brazil's BNDES selects DOMO Invest to manage R\$100m angel co-investment fund", LAVCA, accessed April 22, 2019, <https://lavca.org/2018/07/18/brazils-bndes-selects-domo-invest-to-manage-r100m-angel-co-investment-fund-em-portugues/>

¹⁷ "About Desenvolve SP", Desenvolve SP, accessed April 22, 2019, <https://www.desenvolvesp.com.br/en/institutional/about-desenvolve-sp/>

¹⁸ "The São Paulo Research Foundation" FAPESP, accessed April 22, 2019, <http://www.fapesp.br/en/6026>

stakeholders located within its bounds to promote density synergies and to be beneficially placed near ESALQ for added network effects.

University Support

ESALQTec and University Incubators

The Luiz de Queiroz College of Agriculture at the University of São Paulo (ESALQ) is a globally ranked top five university, known for its academic reputation and research in agricultural sciences. The university noticed that they lacked a pipeline to provide students with the tools and skills to transform their research into market-ready solutions. ESALQ has taken the step of establishing its own innovation hub in ESALQTec. This hub works to support startups from within but does not currently provide access to any university resources such as computing power and research labs. University officials mentioned that they are currently working on a framework to share the school's resources and unburden startups at ESALQTec from having to fund their own infrastructure.

Alumni Angel Networks

ESALQ (as part of USP), being a world leading university, have an old and well-connected network of alumni. This network, if well engaged, can become a source of capital and expertise in the development of the AgTech ecosystem in Piracicaba.

Recently, a self-organized alumni angel network outside the university has emerged. This should be further encouraged, as alumni angel networks would be more effective if they could engage universities and identify ecosystem gaps as potential opportunities.

Clinica De Leite

Clinica De Leite is a not-for-profit institute within ESALQ (Luiz de Queiroz College of Agriculture, University of São Paulo) accredited by the Ministry of Agriculture, Livestock and Supply (MAPA) to provide analysis of raw milk samples from suppliers, checking for quality and herd conditions as obligated by law. It begun in 1996 as a milk quality assurance project, with resources from the Foundation for Research Support of the State of São Paulo (FAPESP), ESALQ university, the Institute of Animal Science of the Secretariat of Agriculture and Food Supply (São Paulo) and the Brazilian Association of Breeders. The lab currently analyzes more than 300,000 samples every month, serves 35,000 farmers, control 35% of the market and has \$4 million dollars (20 million reais) in revenue.

In addition to the analysis, the clinic offers training that enables producers improve milk productivity and quality through a program called Agro Lean. It was created by the clinic to professionalize dairy management with the twin goals of retaining talent and increasing revenue. The training has expanded to include farmers outside dairy farming and built to address the need for efficient farm management. Agro Lean teaches the implementation of the MDA system, a system that encourages the elimination of waste, continuous process improvement and problem identification, while providing tools to track all three. They provide training to individuals through summits and classes and provide management consulting to certify companies as lean organizations.

University Policy

University professors continue to be integral to the startup ecosystem either as founders, funders, or advisors. Given that they are state university employees, there are policy questions at play involving the appropriate level of direct involvement in private enterprise and the use of university resources to further private ventures. For example, university policies expressly forbid professors from owning more than 50 percent equity in a startup and from receiving direct remuneration. The policies also do not allow for partnerships or for the use of university resources, which is very limiting for startups. The policy response has essentially been to dissuade academics from any material collaboration with startups; however, this is an opportunity as there is strong demand amongst startups looking to partner with universities.

Universities have a detailed understanding of pure research making them world leading organizations, yet there is no policy that allows state universities to commercialize their research or create applied science solutions. There is no framework for endowments that allow for alumni donations or partnerships with corporates. These are all opportunities waiting to be accessed and utilized.

The current policy does allow, however, for the creation of not-for-profit institutes within the university, with the most successful examples at ESALQ being Clinica De Leite and PECEGE. Clinica De Leite is a milk-testing lab that performs regulatory-mandated testing of milk samples and controls 40 percent of the market in Brazil. This institute generates 20 million reais in annual revenue with 85 percent coming from milk testing and the rest from its consultancy practice.

PECEGE is an education portal for distance learning at USP created in 2013 to find ways to produce and disseminate knowledge. Its courses have proven popular not only to local but also to international students, necessitating innovation to expand its constituency to the English-speaking (and other languages, like French and Spanish) world and came up with Skylar. Skylar is a plug-in that leverages artificial intelligence

Scicrop

Scicrop is a data analytics startup that is bringing the new frontier of big data, machine learning, and artificial intelligence to agriculture. Their platform collects and analyzes real-time data on climate, soil, pests, diseases, logistics, and market prices and provides customized analysis that enables growers to make data-driven decisions to improve yields and reduce their cost of inputs.

Their suite of farm management products includes a weather prediction platform designed to provide hyperlocal climate scenarios down to 200 acres and provides a customized 15-day forecast. Having realized the gap in reliable tropical weather predictions, Scicrop is working on developing and setting up their own weather stations, having an installed base of 220 (and expect to reach 5,000). Combining real-time weather, and 10 other prediction variables, Scicrop's platform aggregates data and models for localized yield prediction down to the hectare, enabling the client to make informed decisions towards the goal of efficient farm management.

to produce real-time English sub-titles for distance-learning courses. Skylar is an example of an innovation that, though created for academia, has applications outside of academia as well.

Foreign Universities

Startups have also begun to partner with foreign universities for expertise and support. A recent example is the partnership between Scicrop and University of California-Irvine for weather data and prediction. Scicrop is a Brazilian startup working towards creating localized weather prediction accurate to within 200 acres. It is establishing 5,000 weather stations to create its own weather prediction infrastructure and has 200 stations currently. Scicrop manufactures, delivers, and installs its own weather stations and ran a successful pilot in Napa Valley. Scicrop is partnering with UC Irvine because it is looking to leverage its more developed research in weather prediction. Scicrop also is expanding from weather prediction into yield prediction for crops, targeting an accuracy rate in the high eighties.

Current Financing Gaps

Seed/Angel Capital

A recurring theme in conversations with entrepreneurs was the difficulty in raising seed/angel capital and talent. Brazil has had a tradition of favoring employment with brand name companies after graduation with entrepreneurship not seen as a viable avenue to employment. However, after the financial crisis of 2008, attitudes have begun to change. The few successful businesses which have received wide attention, like Strider and Bug Agentes Biologicos, have surfaced the possibilities in AgTech. We are seeing stakeholders within the agricultural value chain with hidden pools of capital and expertise like cooperatives stepping forth to fill the gap. Trends and cultures take time to evolve and AgTech is developing a following within and outside of the investment ecosystem.

Series B/Series C

Venture capital investors mentioned in interviews the dearth of capital in the Series B and C stage for startups. While corporate ventures are only beginning to engage, angel investors and venture capital are hard pressed to see exit opportunities for their investment. Venture capital funds have cash reserves and are willing to engage at the Series A level; however, exit opportunities in the form of a sale to corporate ventures or private equity or an initial public offering need to be available. The capital pools already exist in Brazil, but currently are primarily geared towards other sectors like FinTech.

Corporate Venture Capital Missing

Within the last two years, corporate ventures have begun to invest in AgTech in Brazil with Sygenta and Bunge co-investing and Monsanto making direct investments. They have also recently started making acquisitions with Sygenta acquiring Strider in 2018. With more than 300 AgTech startups in the São Paulo region alone but with relatively few acquisitions to date, the general sentiment continues to be that corporate ventures are not yet operating at capacity when it comes both to investment and acquisitions. There is a large opportunity here for agro-industrials to step into the space.

Localized Solutions for Capital

Crowdfunding

In July 2017, the Brazilian Securities and Exchange Commission (Comissão de Valores Mobiliários – CVM) enacted Rule ICVM 588, regulating crowd-funding in Brazil.¹⁹ The rule codifies what type of company profiles, revenue floors, investor profiles, investment caps, investment windows, and minimum caps must be fulfilled to participate in crowdfunding. This policy had the unintended effect of helping to fill the funding gaps that exist in AgTech.

One example is Leuven, an artisanal brewery from Piracicaba whose Irish-style Red Ale won a bronze medal at the World Beer Cup. Leuven sought to expand from its downtown location by selling 40 percent equity. The company settled on crowdfunding through Kria, a platform enabling direct equity investments from individual investors into small companies. Leuven managed to raise \$1.5 million (6 million reais) in under three days from 300 investors. The average investment was \$5,000 (20,000 reais) with the largest investor holding a 2 percent stake. Not only did Leuven attract 300 investors, but it also gained 300 customers and advocates.²⁰ Another example is Horus Aeronaves, a drone startup that was in need of a bridge loan. The company managed to raise 500,000 USD (2 million reais) on the Eqseed crowdfunding platform in under three days. For well-matched opportunities, there may be a greater appetite at the community level to invest smaller amounts.²¹

¹⁹ “CVM Instruction 588”, Comissão de Valores Mobiliários, accessed April 22, 2019, <http://www.cvm.gov.br/legislacao/instrucoes/inst588.html>

²⁰ “Cervejaria LEUVEN”, Kria, accessed April 22, 2019, <https://www.kria.vc/empresas/cevejaria-leuven>

²¹ “Brazilian drone startup Horus raises R\$2M on equity crowdfunding platform Eqseed”, LAVCA, accessed April 22, 2019, <https://lavca.org/2018/09/04/brazilian-drone-startup-horus-raises-us2m-on-equity-crowdfunding-platform-egseed-em-portugues/>

Cooperatives

Coplacana was the first sugarcane cooperative established in São Paulo in 1948 to offer inputs and assistance to rural farmers. It has since expanded to 10,000 members and includes farmers from other crops such as soybeans.

Coplacana has created its own virtual hub, Avance, where it creates partnerships with startups and provides non-financial support.²² Support includes access to Coplacana's sugar mills, feedlots, and plantations to provide infrastructure for startups to pilot their products.

Impact Investing

Brazil has an active and thriving impact investing sector with eight funds managing \$177 million targeting MedTech, EdTech, and financial inclusion.²³ These funds have little to no traction in AgTech to date, but this could represent an opportunity that with proper socialization with the funds, results in movement towards AgTech.

A potential example of an appealing AgTech investment for impact investment is as an environmentally-friendly and commercially viable solution called Perfect Flight. This is a startup that is working towards pre-flight and post-flight analysis of aerial pesticide spraying. Having mapped out population centers as sensitive zones, the

Perfect Flight

Perfect Flight is an aerial application consultancy company that provides producers a transparent and realistic view of the fertilizer applications made on their crops. A resident startup of the Pulse Hub in Piracicaba, their simple yet elegant solution uses planes' GPS systems to track where they have flown so that pilots and producers can see clearly where the product was applied. The application creates easy-to-read analytical reports for the producers which track application history and costs. This allows producers to increase efficiency over spreading areas, saving them money on fertilizer products. In addition to efficiency gains, Perfect Flight also displays restricted areas such as neighboring crops, populated areas, beehives, rivers, lakes, and mines to significantly reduce negative environmental impact resulting from aerial application.

The simplicity of design but sophistication of their underlying technology creates huge growth potential for Perfect Flight; protected by national and international patents, this technology can be applied anywhere in the world where aerial application is used. They are currently partnered with several large, international companies, including Bayer, FMC, Syngenta, Ourofino Agrociência, and BASF among others, whose clients can use Perfect Flight's products. To date, planes using Perfect Flight have flown nearly 2 million kilometers, applied 2.9 million liters of products, and processed 1.5 million hectares of land.

²² "COPLACANA and AVANCE hub open selection for AgTechs at Agrishow 2019", Coplacana, accessed April 22, 2019, <http://www.coplacana.com.br/coplacana-e-avance-hub-abrem-selecao-para-AgTechs-na-agrishow-2019/>

²³ "Mapping the Impact Investing Sector In Brazil", Aspen Institute, accessed April 22, 2019, https://assets.aspeninstitute.org/content/uploads/files/content/docs/pubs/ImpactInvestingStudy_FINAL_VERSION_ENGLISH.pdf

startup reduces the incursions of population centers with pesticides. With post-flight analysis, the farmer can confirm the correct and accurate application of chemicals to plantations, saving on costs and toxicity. Their technology is already in use with Raizen in their plantations and the firm is looking to expand into Argentina.

Foreign Capital Markets

Some AgTech startups are looking outside of Brazil to address their seed/angel capital constraints. Beeftrader from @tech is considering incorporating in the U.S. to avoid funding restrictions locally (and because U.S.-based investors are generally more comfortable funding startups based in the U.S.). It is also easier to get funding by patenting solutions in the U.S., where ample capital exists to fund new and disruptive ideas. FinTech startups that are ready for public markets have also tapped equity markets in the U.S. for funding, a trend that may be replicable in AgTech. Stone Pagamentos, an e-commerce and point-of-sale-focused FinTech, listed on the NASDAQ in 2018, raising over \$1.1 billion to achieve a market capitalization of \$6.6 billion.

Summary

Findings

1. The AgTech lifecycle is relatively long and better-suited for investors with patient capital and longer time horizons.
2. Brazil has two growing seasons, fertile soil, and rain-fed agriculture that has allowed the country to become the leader in tropical agriculture innovation and research.
3. The development in São Paulo of AgTech-focused funds and the launch of a venture debt fund shows the continued evolution of the venture capital pipeline.
4. Innovative sources of seed/angel capital are becoming available from agricultural executives, farmers, and cooperatives although they lack coordination.
5. Many startups are founded or funded by university professors; however, state universities cannot leverage staff, infrastructure, or alumni as a source of partnership, support, or capital as there is no policy framework to address conflicts of interest.
6. Corporate venture capital is becoming involved in Brazil through direct investments or co-direct investments although corporates are still punching below their weight.
7. Corporates are setting up incubators for internal innovation and external innovation – they are also interested in startups outside

of their product space.

8. Cooperatives are offering smart capital as they have the infrastructure, capital, market, networks, and incentives to do so. They have the ability to pilot with startups and witness the value proposition before investing. Some cooperatives are looking to AgTech and FoodTech to move further up the value chain or to monetize their byproducts.
9. Government is partnering with venture capital to source investments in AgTech as it looks to set up its own direct investments into AgTech startups.
10. The state government in São Paulo is funds research grants that were accessed by the majority of startup entrepreneurs interviewed.

Conclusions

1. Innovative sources of seed/angel capital are available from agricultural executives, farmers, and cooperatives although they lack coordination.
2. Serial entrepreneurs are missing as a source of capital (e.g. founders of Bug Agentes Biológicos - sold to Koppert – and no material interaction with the AgTech Valley or startups afterward).
3. The legal and policy framework concerning state universities does not allow for commercializing research, licensing agreements, or endowments – there is no bridge between pure science and applied science.
4. Corporate venture capital is visibly mobilizing in Brazil as the country leads in tropical agriculture innovation.
5. In the absence of a mature ecosystem and defined development pipeline, corporates are offering founders jobs in exchange for assigning intellectual property (IP) for their research.
6. The level of complexity is a roadblock to accessing government funding. Federal and state funding should be organized and aligned for easier and more broad utilization.
7. The government's direct involvement as a venture capital investor (with a lower cost of capital) might eventually serve to discourage private investors.

Recommendations

1. Farmers, agricultural executives, and cooperatives should become better organized to serve as an accessible source of seed/angel capital.
2. AgTech can become more innovative in sourcing early investment – for well-matched opportunities – by utilizing methods like

crowdfunding. In 2017, Brazil passed a law to create a framework for crowdfunding which has proved successful in raising equity for some companies.

3. Universities have a vast network of successful alumni working in the industry and in government; for example, ESALQ has an alumnus as the former Minister of Agriculture. It would be beneficial to further emphasize the leveraging of these networks as sources of capital or expertise (e.g., ESALQ does not yet having an angel alumni group, which represents a great development opportunity).
4. Universities should consider defining a pipeline to move research ideas from the lab into the field (e.g., ESALQ is trying to address this through ESALQTec, which incubates ideas).
5. In some cases, startups may look to partner with foreign universities that are unencumbered by state university policy. They may look to incorporate or patent abroad to harness foreign capital and get around funding challenges.
6. Corporate venture capital should deepen its partnerships with startups, incubators, and accelerators and provide non-financial support such as infrastructure inputs, data for experimentation, or mentorship (a successful example of this is the Sygenta and InstaAgro partnership)
7. Further marketing and socialization of the federal and state funds available to entrepreneurs may increase awareness of how to begin developing venture ideas.

Connectivity: Finance and Public Policy

Having recognized the importance of addressing the funding gap in AgTech, the federal government is moving quickly to codify laws that would allow both foreign and domestic capital to meet the sector's needs.

An example is the Rule ICVM 588 enacted by the Brazilian Securities and Exchange Commission (Comissão de Valores Mobiliários – CVM) to create a legal structure around crowdfunding. Though crowdfunding is considered a FinTech innovation, AgTech is looking to leverage this momentum to solve its funding challenges as well. Two companies, Leuven and Horus Aeronaves, have seen success raising capital on crowdfunding platforms. The tremendous appetite for these two listings shows that a potential AgTech crowdfunding niche does exist for the right opportunity, and currently, there is movement towards creating crowdfunding platforms that specialize in AgTech startups. These platforms would segment the market for investors who are already conversant in AgTech and are comfortable with the risk profile and return horizons.

Another example is the effort by BNDES to develop its own infrastructure to enable the organization to make direct investments into AgTech startups as opposed to making co-direct investments or investing as a limited partner into investment funds. Currently FAPESP on the state level and FINEP on the federal level, provide grant funding for startups that have made a noticeable impact given the dearth of seed/angel investing. While the ecosystem would profit from more capital finding its way to innovative startups, there is the question of whether private investors would be willing to compete with the government, given their difference in cost of capital.

The federal government is also working on a law to simplify and codify the creation of startups. This is in line with the trend in recent years to create laws that simplify the process of starting and running a business in Brazil. The Microempreendedor (Small Entrepreneur) allowed small firms to become formal contractors and the Simples Nacional (Simple National) was a 2007 unified tax initiative to reduce tax rates and help reduce filing time for entrepreneurs and small business owners.²⁴ The Empresa Individual de Responsabilidade Limitada (Limited Responsibility Individual Business) allows a single individual to open a limited liability corporation, no matter how small the business. All of these laws are making it easier for entrepreneurs to start and fund their business in Brazil.²⁵

²⁴ Juliana Mello, “All about Lucro Real and Lucro Presumido”, The Brazil Business, accessed April 22, 2019, <https://thebrazilbusiness.com/article/all-about-lucro-real-and-lucro-presumido>

²⁵ Juliana Mello, “Introduction to EIRELI”, The Brazil Business, accessed April 22, 2019, <https://thebrazilbusiness.com/article/introduction-to-eireli>



Public Policy

Agriculture is one of Brazil's most important sectors, contributing approximately 24 percent to the national GDP in 2017.²⁶ This productivity is the consequence of advancements in agricultural sciences and technology. Today, continued activity in AgTech innovation has further increased operational and environmental efficiencies in agriculture, yielding higher profits from lower costs and higher revenues. After interviewing startup entrepreneurs and academics in Piracicaba, it is evident that the innovative activity and capacity of Brazil's AgTech Valley positions Piracicaba to become one of the leading global AgTech hubs. Recent public policy reforms have contributed to the agricultural sector's growth, indicating that both public policy and industry initiatives are increasingly focusing on the sustainability of agricultural development.²⁷ To realize its status as the leading global AgTech hub, further liberalization, establishment, and streamlining of

²⁶ Reuters (2017), "Brazil Agriculture, Agribusiness Contributed 23.5 Pct to GDP In...". <https://www.reuters.com/article/brazil-agriculture/brazil-agriculture-agribusiness-contributed-23-5-pct-to-gdp-in-2017-cna-idUSE6N1ND008>.

²⁷ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

public policies in taxation, infrastructure, education, entrepreneurship, and innovation is necessary for the continued cultivation of a more innovative and entrepreneurial agricultural sector.

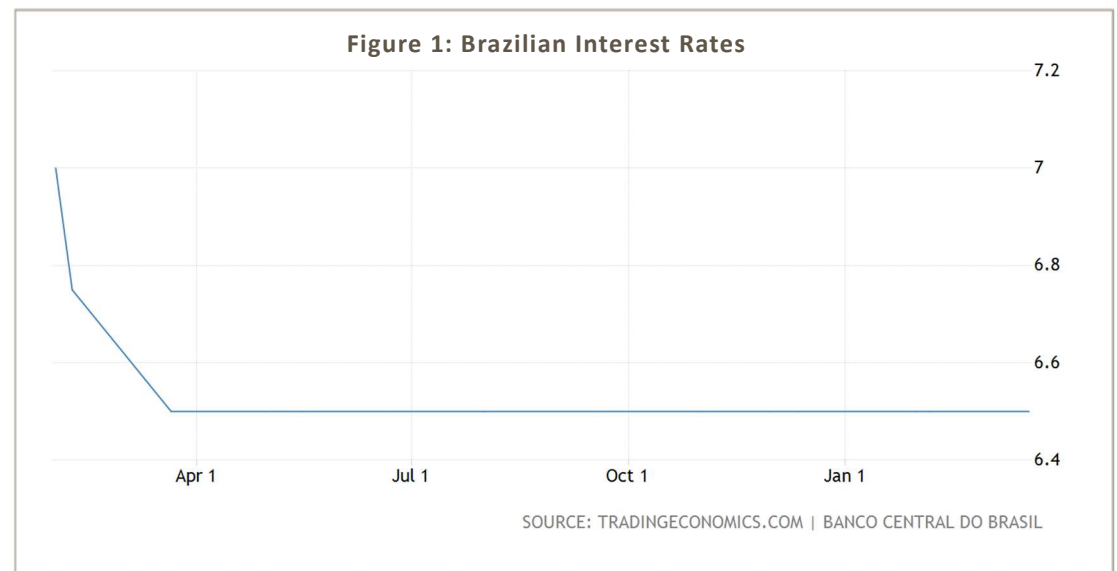
Macroeconomic Environment

Overview

Brazil's macroeconomic conditions have significantly improved over the past two decades, contributing to its rise in becoming the biggest economy in Latin America and the 9th largest in the world in 2017.²⁸ This success is largely due to the government's ability to pursue consistent and predictable macroeconomic policies based on stable inflation, declining public debt, and a flexible exchange rate.

Today, local businesses operate in a steadier macro-economic environment and with improved public governance, but some areas still need improvement. There are current and longer-term risks to macroeconomic stability, including the risk of high inflation, the deterioration of fiscal performance, rising household indebtedness levels, and uncertainties surrounding global economic conditions. However, trends indicate that Brazil's macroeconomic climate will continue to improve as public sentiment towards entrepreneurship and innovation has strengthened.²⁹

The new Bolsonaro administration and induction of pro-business representatives in the Senate and Lower House of Congress contribute to the positive economic outlook. Bolsonaro was the only presidential candidate to support pension reform,



²⁸ Statistical Times (2019), "Projected GDP Ranking (2019-2023)." World GDP Ranking 2019. <http://statisticstimes.com/economy/projected-world-gdp-ranking.php>.

²⁹ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

without which the World Bank estimates that Brazil's debt to GDP ratio would rise from roughly 75 to above 150 percent by 2030. On February 2019, Brazil's economic minister – also the cofounder of Brazilian investment bank BTG Pactual – Paulo Guedes stated that a pension reform plan that will save \$1 trillion reais (USD \$350 billion) over 10 years will be approved “within five months.”³⁰ Following Bolsonaro's triumph, the currency ratio appreciated from 4.1 to 3.62 (BRL to USD) and long-term interest rates are near historic lows at 6.5 percent, indicating declining inflation expectations and a stronger outlook for growth [Figure 1]. In February 2019, Brazil's economic minister Paulo Guedes announced that investor tax reforms and a privatization plan are in the works.^{31, 32}

State of Government Institutions

Governance systems and institutions affect the risk perceptions of potential innovators as it indicates the level of bureaucratic complexity. When government is accountable, transparent, and predictable, and institutions work well, economic agents see their risks reduced and are more willing to exploit the opportunities and invest in innovation. Governance systems play an important role in addressing market failure, influencing the behavior of firms as well as the efficient operations of farm input and output markets.

The OECD Integrity Review commends Brazil for continuous reform over the past decade to enhance integrity within its public administration. These reforms have focused on increasing transparency and direct citizen oversight over public service delivery and promoting high standards of conduct among federal public officials to create a culture of integrity. Acknowledging the progress made, this report stresses the importance of going further in these directions and outlines a broad set of actions that could be undertaken to further these efforts.³³

Room for further improvement in overall governance is implied by the World Bank's governance indicators, which in 2017 positioned Brazil at the midpoint in global rankings and above the regional median (Latin American and Caribbean) on dimensions of governance such as voice and accountability (perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media), political stability, government effectiveness, regulatory quality,

³⁰ Rapoza, Kenneth. "Brazil's New Government Is Promising Wall Street The Moon." *Forbes*. February 11, 2019. <https://www.forbes.com/sites/kenrapoza/2019/02/11/brazils-new-government-is-promising-wall-street-the-moon/#e021a9f332e3>.

³¹ Lee, Alec. "What Businesses Should Know About Brazil's New President." *Harvard Business Review*. December 11, 2018. <https://hbr.org/2018/12/what-businesses-should-know-about-brazils-new-president>.

³² Banco Central Do Brasil. Interest Rate. May 2019. <https://www.bcb.gov.br/en/#!/c/INTEREST/>.

³³ OECD (2012), *OECD Integrity Review of Brazil: Managing Risks for a Cleaner Public Service*, OECD Public Governance Reviews, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264119321-en>.

and rule of law.³⁴ According to Fernando Pertini, CEO of Millenia Costa Rica wealth management, “you’ve got a strongman president who is pro-market. If [Bolsonaro] gets away with half of what [Guedes] is proposing, I believe the rally on the broader market will be huge.”³⁵

Trade and Investment

Trade liberalization and foreign direct investment (FDI) are critical parts of framework conditions for innovation. The expansion of markets worldwide is a main driver behind technological innovation and productivity gains as larger markets become available to innovators and consumers.³⁶ All of the countries that have shown high innovation performance have growth strategies that are oriented towards global markets. International openness also results in more intense domestic competition and hence drives innovation locally.

Apart from increasing market size and competition drivers for innovation, trade and FDI operate as immediate channels for increasing technology, knowledge, and managerial expertise, which also has indirect effects on innovation. FDI brings innovations to their respective industries, but may also cause spill-over effects for other companies in the same industry. This may result from a “competition effect” (e.g., domestic businesses improving their processes and products in response to FDI), from a “demonstration effect” (e.g., domestic actors imitate better practices of companies with foreign capital), or from a “labor market effect” (e.g., training of local workers prompts a learning process that can, with time, spread to the rest of the economy).³⁷

The exposure of Brazil’s overall economy to foreign markets has been relatively low to date; the average of total imports and exports was approximately 7 percent of GDP in 2009-11, one of the lowest shares among OECD and BRIC (Brazil, Russia, India, and China) countries. The Organization for Economic Cooperation and Development (*OECD*) is a unique forum where the governments of 34 democracies with market economies work with each other, as well as with more than 70 non-member economies to promote economic growth, prosperity, and sustainable development.³⁸ BRIC refers to Brazil, Russia, India, and China, which are all deemed to be at a similar stage of newly-

³⁴ WGI (2017), Worldwide Governance Indicators database. World Bank, <https://govdata360.worldbank.org/indicators/hf1ddcad0?country=BRA&indicator=382&viz=choropleth&years=2017&indicators=944>

³⁵ Rapoza, Kenneth. "Brazil's New Government Is Promising Wall Street The Moon." *Forbes*. February 11, 2019. <https://www.forbes.com/sites/kenrapoza/2019/02/11/brazils-new-government-is-promising-wall-street-the-moon/#e021a9f332e3>.

³⁶ OECD (2010), *The OECD Innovation Strategy: Getting a Head Start on Tomorrow*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264083479-en>.

³⁷ OECD (2015), *Innovation, Agricultural Productivity and Sustainability in Brazil*, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

³⁸ "OECD." *Wikipedia*. April 15, 2019. <https://en.wikipedia.org/wiki/OECD>.

advanced economic development.³⁹

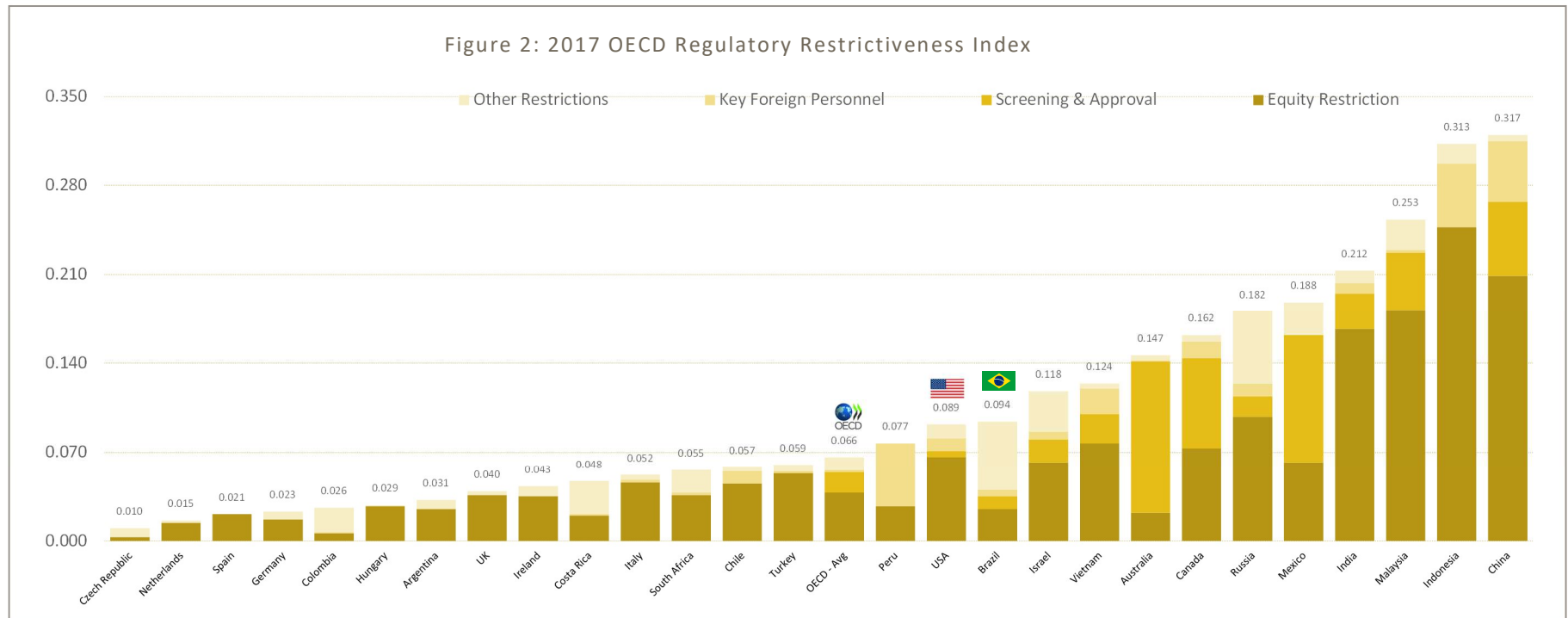
Low overall trade exposure is in part due to Brazil having a large domestic market that is geographically distant from some of its principal external markets. The agriculture and agro-processing sectors, however, are more exposed to trade than the rest of the Brazilian economy overall.⁴⁰

In contrast, Brazil is not particularly restrictive towards foreign suppliers and has a relatively open FDI system. The 2017 OECD FDI Regulatory Restrictiveness index scores regulatory restrictiveness across 45 countries on a scale of 0 to 1 (most restrictive). In a 2017

³⁹ "BRIC." Wikipedia. April 15, 2019. <https://en.wikipedia.org/wiki/BRIC>.

⁴⁰ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

assessment, Brazil scored ~0.09, slightly above the United States and the OECD average [Figure 2].⁴¹ Restrictions on FDI in the agricultural sector are scored substantially higher than the aggregate of agriculture and agro-processing sectors, while the agro-processing sector faces fewer restrictions.⁴² This indicates that the agro-processing sector is primed to absorb FDI to increase innovative activities in agricultural



processing. Given the density and innovative activity of the Piracicaba AgTech ecosystem, the city possesses great potential to absorb FDI.

⁴¹ OECD (2017), OECD Going Digital Toolkit. <https://goingdigital.oecd.org/en/indicator/74/>.

⁴² OECD (2013c), OECD FDI Regulatory Restrictiveness Index. <http://www.oecd.org/investment/fdiindex.htm>.

Financial Policy

Overview

Innovation typically requires borrowing or other types of external funding, particularly for startup businesses. A well-functioning domestic financial system with sufficient provision of varied services to borrowers of different profiles facilitates the innovation process, especially for longer-term investments which are critical. This is especially true for small-to-medium-sized enterprises (SMEs) as they are likely to depend more on internal sources of financing as compared to large businesses that are capable of drawing on international/external funding more readily. This is particularly relevant in more rural areas, such as Piracicaba, where SMEs are dominant.⁴³

Financial markets in Brazil are largely bank-based. Bank credit relative to GDP in Brazil is the second-largest among the BRICs after China but is significantly below the levels of some of the largest OECD economies.⁴⁴ Banks' intermediation spreads are high by international standards [Figure 3].⁴⁵ This increases the cost of capital and creates a bias toward short-term high-risk investment rather than longer-term investment. High borrowing costs are particularly onerous for small- and medium-sized firms whose access to foreign financing is limited.

Figure 3: 2017 World Bank WDI Intermediation Spread

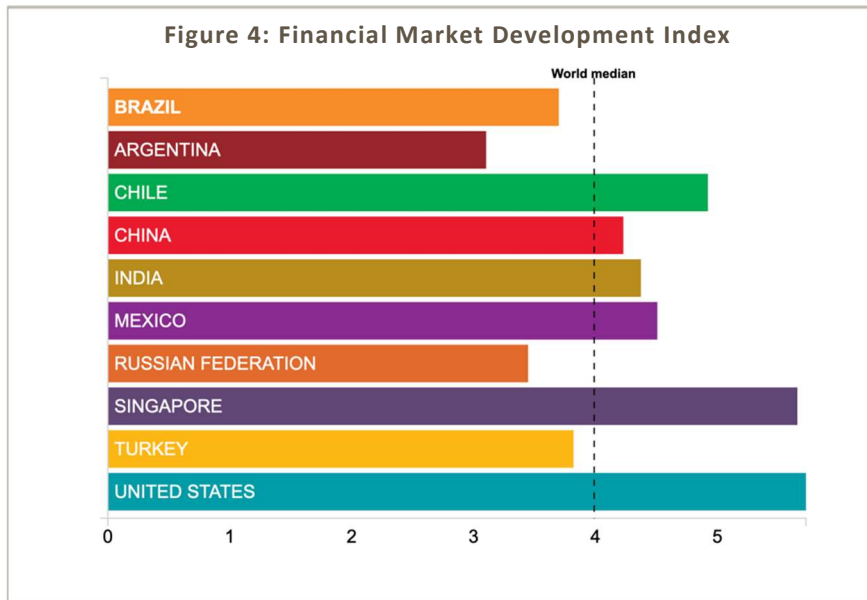
	2009	2010	2011	2012	2013	2014	2015	2016	2017	AVG
Brazil	34.	29.	32.	28.	18.	20.	29.	38.	37.	30.00%
South Africa	3.9	3.4	3.5	3.5	3.4	3.3	3.4	3.2	3.1	3.41%
New Zealand	3.8	3.5	3.6	3.4	3.1	2.6	2.8	3.0		3.23%
United States	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.18%
Australia	2.9	2.8	3.2	3.5	3.4					3.16%
Canada	2.0	2.0	2.1	2.0	2.0	2.1	2.3	2.2	2.2	2.10%
Japan	1.5	1.5	1.4	1.3	1.2	1.2	1.2	1.3	1.2	1.31%
Mexico	1.6	0.9	0.7	0.5	0.5	0.6	0.4	0.6	0.7	0.72%
United Kingdom	0.1	0.0	0.0	0.2	0.2	0.1				0.10%

Created from: World Development Indicators | Series : Risk premium on lending (lending rate minus treasury bill rate, %)

⁴³ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

⁴⁴ WDI (2013), World Development Indicators Database, World Bank, <http://data.worldbank.org/data-catalog/world-development-indicators>.

⁴⁵ WDI (2017), World Development Indicators Database, World Bank, <https://databank.worldbank.org/data/reports.aspx?source=2&series=FR.INR.RISK#>



Several factors shed light on the increased borrowing costs in Brazil: a high Central Bank refinancing rate, high taxation in the banking sector, and the existence of directed credit that banks are required to provide at regulated interest rates (potentially resulting in high spreads charged on non-regulated lending).⁴⁶

In its global competitiveness report, the World Economic Forum scored Brazil's financial market development at 3.7 on a scale of 1 to 7 (best) in 2017 [Figure 4].⁴⁷ This metric is based on the opinions of Brazilian businesses on fundamental dimensions of credit markets. Their evaluation of trustworthiness and confidence in the financial markets is mixed: while they evaluate the soundness of banks and the regulation of security markets to be relatively robust, they assign a subpar score to the degree of legal protection of borrowers.

Brazilian entrepreneurs consider financial access through local equity markets and venture capital insufficient and access to loans challenging as indicated by the World Bank Ease of Doing Business assessment. Piracicaba, however, provides many incentives to startups and innovators, including the density of innovators present and its proximity to São Paulo. However, due to the inaccessibility of financing, it is still challenging to move young companies through development to maturation.

⁴⁶ OECD (2011), *Managing Risk in Agriculture: Policy Assessment and Design*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264116146-en>.

⁴⁷ WDI (2017), *World Development Indicators Database*, World Bank, <https://tcddata360.worldbank.org/indicators/inn.fin.mkt.dev.country=BRA&indicator=739>

Taxation

Businesses bear a substantial tax burden and high costs to comply with tax regulations. Taxation affects the returns for innovation, and thus the decisions of firms and individuals to invest in research and development (R&D) and new ideas. The total tax rate on Brazil’s company profits (68 percent) is estimated to be above average for Latin America in 2017 [Figure 5].⁴⁸ The tax system is also burdensome to comply with, mainly due to the complexity of indirect taxes such as the state-based value-added tax. Due to the concept of “origin-taxation” in Brazil, companies operating nationwide are required to comply with each state’s individual tax rules, and credits for interstate transactions are frequently delayed or refused.⁴⁹

Figure 5: Brazil 2017 Tax Rate

Summary of Greater Brazil Measures*	
Establishment of the Brazilian Funds’ Management Agency (ABGF)	Fiscal Policy
Establishment of climate-related financing (Fundo Clima)	Fiscal Policy
Establishment of training-related financing (BNDES Qualificação)	Fiscal Policy
Expansion of innovation-related financing (BNDES and FINEP)	Fiscal Policy
Expansion of sector-specific financing (BNDES “Pro” programs)	Fiscal Policy
Expansion of trade-adjustment financing (BNDES Revitaliza)	Fiscal Policy
Expansion of working capital financing (BNDES PROGEREN)	Fiscal Policy
Extension of countercyclical financing (BNDES PSI)	Fiscal Policy
Harmonization of state-owned banks policies	Fiscal Policy
Allowance of technological risk contracts in government procurement	Innovation Policy
Financing of not-for-profit science and technology institutions	Innovation Policy
Increasing support for not-for-profit science and technology institutions	Innovation Policy
Acceleration of tax credit devolution (PIS/COFINS)	Tax Policy
Broadening of the simplified tax regime for individual entrepreneurs (MEI)	Tax Policy
Broadening of the simplified tax regime for SMEs (Simples Nacional)	Tax Policy
Deferral of tax collection (PIS/COFINS)	Tax Policy
Establishment of sectoral tax regime for broadband (REPUBL-Redes)	Tax Policy
Establishment of sectoral tax regime for the defense industry (RETID)	Tax Policy

⁴⁸ WDI (2017), World Development Indicators Database, World Bank, https://tcdata360.worldbank.org/indicators/h4f35be65?country=BRA&indicator=637&countries=ARG,CHN,MEX,USA,CHL,CAN,GBR,RUS&viz=bar_chart&years=2017

⁴⁹ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

A bright spot in Brazilian tax policy is the allowance for a range of incentives to support the development of sectors vital to technological advancement and innovation, which were introduced in 2011 as part of the government’s Greater Brazil (*Brasil Maior*) Plan [Figure 6].⁵⁰ The Greater Brazil Plan is the third industrial policy announced by the Brazilian federal government in the last decade, following the 2004 Industrial, Technological, and Foreign Trade Policy and the 2008 Productive Development Policy.⁵¹

Infrastructural Policy

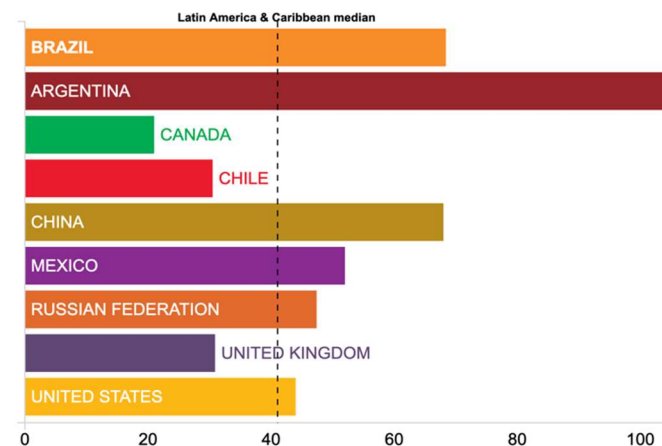
Overview

Successive Brazilian governments have pursued important institutional and regulatory reforms in the infrastructure sector since the 1990s. In the mid-2000s, public investment in infrastructure was significantly increased through various federal and state programs. Governments at the federal and state levels also introduced various tax and credit incentives to increase private investment in infrastructure. Agriculture is set to gain substantially from infrastructure improvements resulting from better transportation conditions.

Infrastructural Development

Regulatory reforms in the infrastructure sector included the creation of administratively and financially independent federal regulatory agencies, as well as the strengthening of public-sector decision-making and accountability processes. The opportunity for and role of private participation in infrastructure projects has been broadened. Concession agreements (defined as negotiated contracts between a company and a government that grant the firm the right to operate a specific business within the government's jurisdiction) were

Figure 6



⁵⁰ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

⁵¹ Brazil-U.S. Business Council. Greater Brazil: INDUSTRIAL POLICY, COMPETITIVENESS, AND GROWTH. PDF. Washington, DC: US Chamber of Commerce, 2015.

launched in the road and airport sectors, and a significant expansion of concession contracts is forecasted.⁵²

The gaps in infrastructure are well-recognized by the government, hence it has undertaken institutional and regulatory reforms to address challenges in the infrastructure sector. Federal and state governments have introduced various tax and credit incentives to encourage private investment in infrastructure and public investment has recently increased with a range of national and state-level programs.⁵³

The Program for Investment Partnerships (*Programa de Parcerias de Investimentos* or PPI) intends to intensify interactions between the Brazilian public and private sectors through partnership agreements to pursue public infrastructure development. The Brazilian National Development Bank (BNDES) is authorized to support the PPIs through the Partnership Structuring Support Fund (*Fundo de Apoio à Estruturação de Parcerias* or FAEP), established explicitly for such partnerships.⁵⁴

In 2005, a pilot infrastructure development project was launched. It was replaced in 2007 by the Accelerated Growth Pact (PAC) by the Lula da Silva administration. PAC aims to grow both private and public infrastructure investments and improve coordination of political entities involved in infrastructural policies. In its first phase (2007-2010), PAC expenditures were valued at \$352 billion. In 2010, the Dilma Rouseff administration continued the program as PAC-2 and increased the budget to USD \$512 billion for the second phase (2011-2014). PAC's coverage is expansive, with approximately 48 percent of phase two expenditures allocated to the energy sector, 29 percent to the housing sector, 11 percent to the transport sector, and 12 percent designated for water and urban infrastructure as well as urban development.^{55, 56}

Human Capital Policy

Overview

Piracicaba's AgTech ecosystem is endowed with a wealth of intellectual capacity in terms of research production. The world-renowned University of São Paulo: Luiz de Queiroz College of Agriculture (USP-ESALQ) ranks fifth in global Agricultural Sciences universities and

⁵² OECD (2011), *Managing Risk in Agriculture: Policy Assessment and Design*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264116146-en>.

⁵³ OECD (2015), *Innovation, Agricultural Productivity and Sustainability in Brazil*, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

⁵⁴ PWC. "Brazil - Corporate Tax Credits and Incentives." *Brazil - Corporate Tax Credits and Incentives*. <http://taxsummaries.pwc.com/ID/Brazil-Corporate-Tax-credits-and-incentives>.

⁵⁵ OECD (2011), *OECD Economic Surveys: Brazil 2011*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/eco_surveys-bra-2011-en.

⁵⁶ OECD (2013), *OECD Economic Surveys: Brazil 2013*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/eco_surveys-bra-2013-en.

comes in first in the southern hemisphere, supplying the AgTech Valley with unparalleled intellectual prowess and agricultural research in the global south.⁵⁷ To maximize local human capital, however, educational and labor policies can better promote intersection between different schools (e.g., business and sciences).

Labor Policy

The Brazilian youth unemployment rate roughly doubled from 16.8 percent in 2007 to 30.21 percent in 2017.⁵⁸ While unemployment (or at-risk) policies are primarily composed of compensation measures, the government has, for quite some time, undertaken initiatives to improve “market insertion.” That is, measures that provide transferrable skills to facilitate labor entrance into markets, therefore creating a more versatile and adaptable workforce.

Since the 1990s, the Brazilian government has pursued diversification of the National Employment System (Sistema Nacional de Emprego, SINE)—financed from the Fund for Worker’s Support (Fundo de Amparo ao Trabalhador, FAT), accumulating various turnover and revenue taxes and payroll contributions—to encompass programs beyond compensation measures.⁵⁹ There has been a focus on strengthening market insertion measures, especially for youth who account for the majority of the unemployed, into the labor pool. Currently, Brazil’s employment programs consist of four areas: unemployment insurance, job placement through intermediation of government agencies, vocational training, and employment and income generation.⁶⁰

The scope of Brazilian labor policies consists of employment and income generation initiatives using FAT funds to provide credit for business ventures. In 2008, the fund financed 17 credit programs for an assortment of business activities and sub-sectors, including four programs targeted towards rural business. Of these four, the most important is PRONAF (Programa Nacional de Fortalecimento da Agricultura Familiar), which supports the development of “family” (smallholder) agriculture. Another important program for employment and income generation is PRONAMP (Programa Nacional de Apoio ao Médio Produtor Rural), which provides loans to small- and medium-sized farm owners that are not eligible for credit through PRONAF. The focus of PRONAF and PRONAMP on small- and medium-sized farms

⁵⁷ USP ESALQ. International Rankings Confirm ESALQ’s Global Leadership in Agricultural Sciences | Luiz De Queiroz College of Agriculture. <http://www.en.esalq.usp.br/node/868>.

⁵⁸ Statista. "Brazil - Youth Unemployment Rate 2007-2017 | Statistic." Statista. 2017. <https://www.statista.com/statistics/811696/youth-unemployment-rate-in-brazil/>.

⁵⁹ Gonzales, R.H. (2010), “Employment Policies in Brazil: History, Scope and Limitations”, Working Paper N 70, September, 2010, UNDP International Policy Centre for Inclusive Growth and Institute for Applied Economic Research, Brasilia.

⁶⁰ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

implies that these programs can be considered as important instruments that have the potential to increase innovation by prioritizing innovative businesses.⁶¹

Educational Policy

In the 1980s, improving the educational system became a priority and was perceived as a vital prerequisite toward sustainable social progress as well as an investment in the future development of the nation.⁶² From 2000 to 2011, public educational expenditures grew from 3.9 to 5.9 percent of GDP, surpassing almost all of the OECD countries.⁶³ The OECD also coordinates efforts to aid developing countries outside of its membership, such as Brazil.⁶⁴ As of 2016, Brazil's public spending on education as a percentage of GDP decreased to 4.1 percent; however, despite this decline, Brazil's education spending as a percentage of GDP is still above all but four OECD countries, the United States, and the United Kingdom.⁶⁵

In 2011, a federal program *PRONATEC* was launched and now covers eight million students. The program's objective is to expand the federal network of technical schools, with a particular emphasis on providing opportunities to students from underprivileged socioeconomic backgrounds through free training, loan disbursements, and scholarships. Since 2013, the program introduced *PRONATEC Countryside*, a component tailored to the rural youth population.⁶⁶

Agricultural education institutions have become more evenly distributed across Brazil but are still mainly concentrated in the center-south region. The State of São Paulo hosts four prominent universities in Agricultural Sciences: Universidade de São Paulo (USP-ESALQ), Universidade Federal de São Carlos (UFSCar), Universidade Estadual Paulista "Julio Mesquita Filho" (Unesp), and Universidade Estadual de Campinas (Unicamp).

Although access to premier educational facilities has improved, intersections and interactions between academic disciplines are still lacking, making it challenging for researchers to enter the entrepreneurial sphere due to sparse business skillsets. Similarly, meaningful

⁶¹ Gonzales, R.H. (2010), "Employment Policies in Brazil: History, Scope and Limitations", Working Paper N 70, September 2010, UNDP International Policy Centre for Inclusive Growth and Institute for Applied Economic Research, Brasília.

⁶² OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

⁶³ OECD (2014a), Education at a Glance 2014: OECD Indicators, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/eag-2014-en>.

⁶⁴ Amadeo, Kimberly. "How the OECD Can Help You." The Balance. <https://www.thebalance.com/organization-economic-cooperation-development-3305871>.

⁶⁵ OECD. "Education Resources - Public Spending on Education - OECD Data." The OECD. <https://data.oecd.org/eduresource/public-spending-on-education.htm#indicator-chart>.

⁶⁶ OECD (2013), OECD Economic Surveys: Brazil 2013, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/eco_surveys-bra-2013-en.

academic interactions between schools are extremely limited. Hence, increasing engagements between these premier educational institutions and areas of studies (specifically cross-functional business programming) is vital towards strengthening the AgTech ecosystem.

Likewise, restrictions in collaboration between professors and businesses presents a challenge to entrepreneurship. Professor Mateus Mondin of USP-ESALQ expressed that while professors across disciplines wish to contribute to the startup ecosystem through investments and academic expertise, public policy prohibits professors from 1) owning above fifty percent of company shares, 2) receiving compensation (in any form) for advisory assistance, and 3) directly partnering with and/or affiliating with businesses. This is particularly disadvantageous for AgTech startups as the industry is still in its early stages of development and expansion.

Entrepreneurship and Innovation

Overview

The level of both state and local government support offered for entrepreneurship and innovation has been inconsistent in the past, however, recent trends – such as progress in regulatory climate and intellectual property rights – show that positive reforms are imminent. In Piracicaba, the known importance of agricultural innovations led to a greater streamlining of the complex regulatory environment and intellectual property policies.

Regulatory Environment

The level of complexity embedded in Brazilian regulatory processes places a relatively high administrative burden on startups in terms of upfront investments, translating into direct and indirect business expenditures.⁶⁷ However, the Brazilian regulatory climate has undergone many changes. According to the *World Bank: Doing Business Rankings*, the ease of doing business in Brazil has continually improved over the last several years and by approximately 3 percent from 2017 to 2018 [Figure 7].⁶⁸ This steady improvement is evident of the regulatory

⁶⁷ OECD (2015), *Innovation, Agricultural Productivity and Sustainability in Brazil*, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

⁶⁸ World Bank. "Doing Business in Brazil." World Bank. <http://www.doingbusiness.org/en/data/exploreeconomies/brazil>.

liberalization, especially in the São Paulo and Rio de Janeiro regions.

Figure 7: WDI Doing Business Ranking

Topics	DB 2019 Rank	DB 2019 Score	DB 2018 Score ⁱ	Change in Score (% points)
Overall	109	60.01	57.05	↑ 2.96
Starting a Business ✓	140	80.23	64.76	↑ 15.47
Dealing with Construction Permits	175	49.86	49.83	↑ 0.03
Getting Electricity ✓	40	84.37	82.46	↑ 1.91
Registering Property ✗	137	51.94	52.60	↓ 0.66
Getting Credit ✓	99	50.00	45.00	↑ 5.00
Protecting Minority Investors	48	65.00	65.00	..
Paying Taxes	184	34.40	34.40	..
Trading across Borders ✓	106	69.85	63.00	↑ 6.85
Enforcing Contracts	48	66.00	66.00	..
Resolving Insolvency	77	48.48	47.46	↑ 1.02

✓ = Doing Business reform making it easier to do business. ✗ = Change making it more difficult to do business.

In 2019, Brazil made the following improvements to increase its ranking relative to the ease of doing business:⁶⁹

- *Starting a Business*: Brazil made starting a business easier by launching online systems for company registration, licensing and employment notifications. This reform applies to both Rio de Janeiro and São Paulo.
- *Getting Electricity*: Brazil (São Paulo) improved the reliability of electricity by modernizing its grid network and introducing new software programs, allowing better outage management and distribution planning.
- *Securing Credit*: Brazil improved access to credit information by distributing at least two years of historical data. This reform applies to both São Paulo and Rio de Janeiro.
- *Trading Across Borders*: Brazil reduced the time required for import documentary compliance by introducing electronic certificates of origin. This reform applies to both Rio de Janeiro and São Paulo.
- *Labor Market Regulation*: Brazil changed regulations pertaining to intermittent work, work scheduling, compensation, employee termination, and union representation. This reform applies to both Rio de Janeiro and São Paulo.

Intellectual Property

Intellectual property protection is one of the hallmarks of innovation. It fuels further innovation by ensuring that the innovator themselves reaps the benefits of their idea.

⁶⁹ World Bank. "Doing Business in Brazil." World Bank. <http://www.doingbusiness.org/en/reforms/overview/economy/brazil>.

Since 2000, patent protection in Brazil has improved. In the agricultural sector, the Brazilian government pursued an open innovation system and Intellectual Property Rights (IPR) policy, which facilitated technology transfer, the diffusion of new cultivars, and the filing of international patents. This policy allowed new technology to be distributed at production costs.⁷⁰ As of 2016, the World Bank IP Protection Index positions Brazil above the regional median (Latin American and Caribbean) with a year-over-year average growth rate of 3.67 percent from 2012 to 2016 [Figure 8].⁷¹

Agricultural Policy

Overview

The main obstacle of the innovation cycle is to minimize the lead-time from invention to adoption of AgTech developments.

Recognizing the importance of alleviating this burden, the Brazilian Government established the Agency for Technical Assistance and Rural Extension (ANATER) in 2013 and allocated

budgetary transfers to increase agency staff to meet demands and improve access to subsidies amongst poorer farmers.⁷² This should in turn increase the productivity and environmental sustainability of farms (especially those of poorer farmers) and facilitate the

Agrimart

Agrimart is an e-procurement platform that connects producers of fresh fruit and vegetables directly to their consumers. The organization was founded with the mission of bridging the supply and demand gap that exists between producers and consumers by providing a direct-to-consumer approach. This resulted in increased consumer awareness of produce origin and also provided producers with a greater understanding of consumer demand (and perhaps adjust production accordingly).

Producers are contacted daily through WhatsApp by the platform's AI chatbot regarding their product availability. They are then able to negotiate a sale price via the chatbot that reflects the current demand/going rate on any specified product. Consumers are then able to request products and place an order and Agrimart sources the closest inventory for delivery.

The organization is currently targeting firms such as restaurants and supermarkets as their primary consumers, and already counts some large companies – such as Google in Brazil – as customers. They are exploring other public-sector growth opportunities within the Brazilian market.

⁷⁰ Correa, P. and C. Schmidt (2014), "Public Research Organizations and Agricultural Development in Brazil: How Did Embrapa Get it Right?", Economic Premise, No. 145, The World Bank, June, <http://siteresources.worldbank.org/EXTPREMNET/Resources/EP145.pdf>.

⁷¹ https://todata360.worldbank.org/indicators/entrp.ip?country=BRA&indicator=3375&viz=line_chart&years=2012,2016

⁷² OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

establishment of linkages to technological innovations and markets.

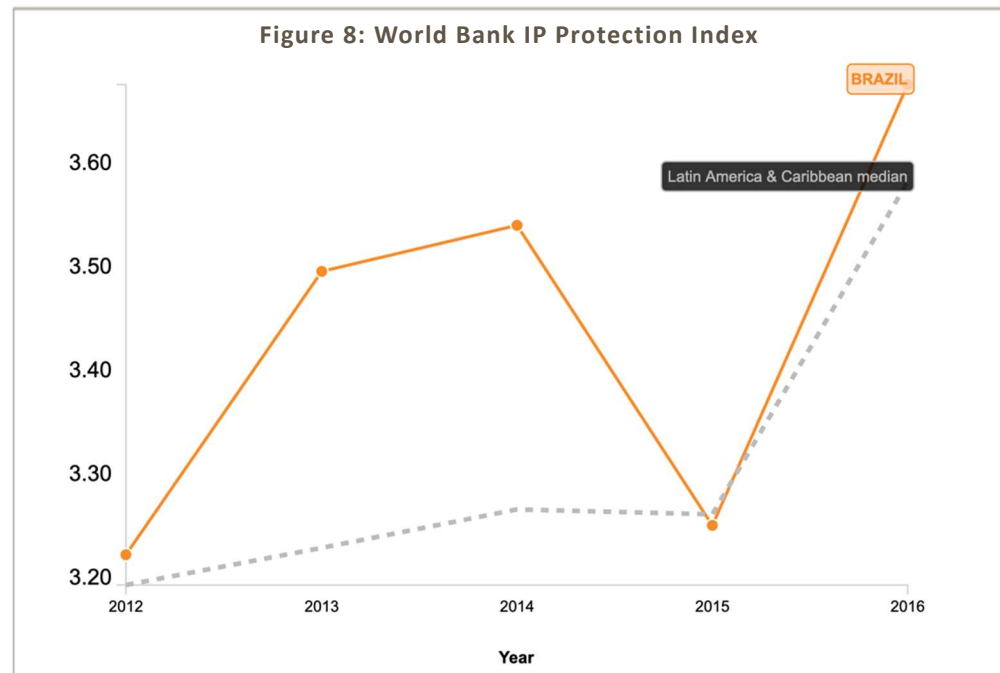
Policy Objectives

Policy motivations and objectives in commercial agriculture consist primarily of boosting production in the sector while making it more technologically advanced and sustainable. Since 2012, objectives expanded to emphasize the development of storage and irrigation infrastructure, soil conservation and recovery, and investments in technological innovation in agriculture.⁷³

Policy Instruments

Brazilian agricultural policy uses three main instruments: price support, credit concessions, and insurance support.

- *Price Support*: a price support may be either a subsidy or a price control, each with the intended effect of keeping the market price of a good higher than the competitive equilibrium level. A price support scheme can also be an agreement set in order by the government, where the government agrees to purchase the surplus of at a minimum price. For instance, if a price minimum were set in place for agricultural wheat commodities, the government would be forced to purchase the resulting surplus from the wheat farmers (thereby subsidizing the farmers) and store or otherwise dispose of it.⁷⁴
- *Credit Concessions*: the purpose of rural credit policy has been to decrease the high cost of domestic borrowing in the agriculture and the agro-processing sectors. Concessional credit covers both short-term (marketing and working capital loans)



⁷³ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

⁷⁴ "Price Support." Wikipedia. December 08, 2017. https://en.wikipedia.org/wiki/Price_support.

and investment loans, with specific sets of programs offered to (i) commercial producers and their co-operatives, and to (ii) smallholder farmers and specific rural groups (e.g. rural youth and women). Since the 2000s, adoption of new technologies and sustainable agricultural practices have been emphasized. The concession program Inovagro aims to support the adoption of technological innovations and good agricultural and farm management practices with a broad range of investments and services related to innovations eligible for support.⁷⁵

- *Insurance Support:* support to agricultural insurance is aimed at mitigating fluctuations in farmers' incomes. Four government-supported programs are in operation for both commercial and family farmers. In general terms, they provide support either in the form of insurance premium subsidies or by compensating farmers for production losses due to natural disasters. The PSR program (Programa de Subvenção ao Prêmio do Seguro Rural) grants insurance premium subsidies to commercial producers who establish contracts with insurance companies listed by the government. It covers all agricultural and livestock activities, as well as forestry and aquaculture.⁷⁶

These are applied along with regulations on land use, agricultural zoning requirements, regulations on biofuel use, and organic production. Brazil also directs public funds into the development of general services for agriculture and the agro-industry system as a whole, such as research, education, and infrastructure.^{77, 78}

Summary

Findings

1. Brazil's macroeconomic conditions have improved greatly over the past two decades due to the government's ability to pursue consistent macroeconomic policies based on stable inflation, declining public debt, and a flexible exchange rate.
2. Brazil ranks at the midpoint in global rankings (in 2017) but above the regional median (in Latin American and the Caribbean) on several measured dimensions of governance.

⁷⁵ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

⁷⁶ OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>

⁷⁷ OECD (2012), Agricultural Policy Monitoring and Evaluation 2012: OECD Countries, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/agr_pol-2012-en.

⁷⁸ OECD (2013a), Agricultural Policy Monitoring and Evaluation 2013: OECD Countries and Emerging Economies, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/agr_pol-2013-en.

3. Financial markets in Brazil are largely bank-based. Bank credit relative to the gross domestic product (GDP) in Brazil is the second-largest among Brazil, Russia, India, and China (the BRICs) after China but is significantly below the levels of some of the largest OECD economies. Banks' intermediation spreads are quite high by international standards.
4. The World Economic Forum scored Brazil's financial market development at 3.7 on a scale of 1 to 7 (best) in its 2017 global competitiveness report. This metric is based on the opinions of Brazilian businesses on fundamental dimensions of credit markets.
5. Brazilian entrepreneurs consider financial access through local equity markets and venture capital insufficient and access to loans challenging as indicated by the World Bank Ease of Doing Business assessment. Piracicaba, however, provides many incentives to startups and innovators.
6. The total tax rate on Brazil's company profits (68 percent) is estimated to be above average for Latin America (in 2017).
7. The Greater Brazil Plan is the third industrial policy announced by the Brazilian federal government in the last decade, following the 2004 Industrial, Technological, and Foreign Trade Policy (PITCE) and the 2008 Productive Development Policy (PDP).
8. The world-renowned University of São Paulo: Luiz de Queiroz College of Agriculture (USP-ESALQ) ranks fifth in global Agricultural Sciences universities and is first in the southern hemisphere, supplying the AgTech Valley with unparalleled intellectual prowess and agricultural research in the global south.
9. The Brazilian youth unemployment rate roughly doubled from 16.8 percent in 2007 to 30.21 percent in 2017. While unemployment (or at-risk for unemployment) policies are primarily composed of compensation measures, the government has, for quite some time, undertaken initiatives to improve "market insertion."
10. Successive Brazilian governments have pursued important institutional and regulatory reforms in the infrastructure sector since the 1990s.
11. In the mid-2000s public investment in infrastructure was significantly increased through various federal and state programs. Governments at the federal and state levels also introduced various tax and credit incentives to increase private investment in infrastructure.
12. Since 2000, patent protection in Brazil has improved. In the agricultural sector, the Brazilian government pursued an open innovation system and Intellectual Property Rights (IPR) policy, which facilitated technology transfer, the diffusion of new cultivars, and the filing of international patents.
13. Piracicaba has streamlined many of the complex regulatory environment and intellectual property policies to ease the burden on entrepreneurs and corporations.
14. Policy motivations and objectives in commercial agriculture consist primarily of boosting production in the sector while making it

more technologically advanced and sustainable.

15. Since 2012, objectives expanded to emphasize the development of storage and irrigation infrastructure, soil conservation and recovery, and investments in technological innovation in agriculture.
16. Brazilian agricultural policy uses three main instruments: price support, credit concessions, and insurance support.
 - Price Support: a price support may be either a subsidy or a price control, both with the intended effect of keeping the market price of a good higher than the competitive equilibrium level.
 - Credit Concessions: the purpose of rural credit policy is to decrease the high cost of domestic borrowing to the agriculture and the agro-processing sectors.
 - Insurance Support: support to agricultural insurance is aimed at mitigating fluctuations in farmers' incomes.

Conclusions

1. Trends indicate that Brazil's macroeconomic climate will continue to improve as public sentiment towards entrepreneurship and innovation is strengthened. The new Bolsonaro administration and induction of pro-business representatives in the Senate and Lower House of Congress have contributed to a noticeable shift in the data measuring the level of positive economic outlook.
2. Businesses bear a substantial tax burden and high costs to comply with tax regulations that are coupled with high interest rates. Due to the concept of "origin-taxation" in Brazil, companies operating nationwide are required to comply with each state's individual tax rules, and credits for interstate transactions are frequently delayed or refused. A bright spot in Brazilian tax policy, however, is the allowance for a range of incentives to support the development of sectors vital to technological advancement and innovation, which were introduced in 2011 as part of the government's Greater Brazil (Brasil Maior) Plan.
3. Although access to premier educational facilities has improved, intersections and interactions between academic disciplines are still lacking, making it challenging for researchers to enter the entrepreneurial sphere due to sparse business skillsets. Similarly, meaningful academic interactions between schools are limited.
4. The gaps in infrastructure are well-recognized by the government, hence it has undertaken institutional and regulatory reforms to address challenges in the infrastructure sector.
5. The level of both state and local government support offered for entrepreneurship and innovation has been inconsistent in the past, however, recent trends – such as regulatory progress on climate-related issues as well as intellectual property rights – show that positive reforms are imminent.

Recommendations

1. The existing system for inflation targeting should be strengthened and the clarity of fiscal operations improved. Risk assessments from credible research agencies that show progress and the promising future outlook could serve to increase (foreign) investor confidence.
2. Brazilian AgTech faces a dearth of early investment – the Piracicaba municipality should move towards offering more support in the form of funding mechanisms or programs tailored towards the local innovation community.
3. Key AgTech representatives should work towards building stronger relationships with SEBRAE with the aim of increasing private-sector participation in the long-term credit market.
4. Advocacy should be focused towards the establishment of a more streamlined tax system that imposes fewer compliance costs (with the larger goal being movement towards a unified national tax system).
5. To benefit the Piracicaba ecosystem, the municipality should consider working towards improvements in its tax regulations and policies for venture entrepreneurs, offering incentives to open their firms in the city.
6. An analysis of labor force training programs should be conducted to place greater focus on market insertion as an outcome and on the transferability of skills - coordination can then be initiated with relevant policymaking bodies to implement suggested changes.
7. The government may commission a third party (e.g. SEBRAE) to identify the most critical points of improvement to create a strategy for infrastructure development.
8. The government should consider commissioning a review to determine which tax and credit incentives most encourage private

Hub/SP

Hub/SP is a hub and acceleration program for startups offering education for entrepreneurs, promotional programs from the São Paulo government, coworking space for startups, and connections to public and private funding sources. While it focuses on innovation and entrepreneurship in general (not specifically AgTech), Hub/SP provides a unique channel for startup support by finding potential technological solutions for intended use by the state government. An initiative of Investe/SP, the São Paulo state agency for promoting investments and competitiveness, Hub/SP runs a 90-day individualized acceleration program that is free of charge for startups.

This acceleration program utilizes the government to help smooth over several key friction points that many startups face in Brazil. It offers individualized mentoring from their network of specialists, resident partners, and industry experts, helping entrepreneurs develop their solution through design thinking and prototyping space. For the startup's ideas to be adopted by the government, it must undergo a capacity test conducted by a third party that serves as a proof of concept for the startup to validate their solution as well as financial viability. Finally, startups are not required to sell their idea to the government once it has been approved and validated, which allows entrepreneurs to take advantage of Hub/SP's network of private funding sources to continue developing their technology and bring it to the private markets as well.

investment, and further develop those incentives.

9. Key AgTech Valley leaders should look to establish closer collaboration with SEBRAE (and others such as EMBRAPA and HubSP) to strengthen AgTech's representation and create a foundation for engagement with policymakers. This will provide a platform for voices to be heard around issues affecting regulatory processes and IP regulation and protection, which deeply affect the successful development of the industry.



Human Capital

Human capital plays a vital role in the sustainability of growth opportunities available to companies and investors looking to enter a new market. A review of universities and corporations, as well as the current labor force within Brazil, provides a comprehensive understanding of the country's available human capital. Research shows that 10.3 percent of Brazil's total workforce is currently employed within the agriculture industry,⁷⁹ indicating a strong presence of talent currently existing within the sector.⁸⁰ Interviews conducted in the region also indicated many areas within the current labor force ecosystem that hold great potential for growth as Brazil's workforce continues to develop.

Universities

⁷⁹ This percentage includes all aspects of the agriculture industry (i.e. farming, AgTech, agriculture science research, etc.).

⁸⁰ "Human Development Indicators - Brazil." Human Development Reports. Accessed April 17, 2019. <http://hdr.undp.org/en/countries/profiles/BRA>.

Brazil's universities are key suppliers of highly-skilled human capital and are important drivers of innovation within the agriculture industry. Brazil's higher education system consists of a combination of private and public universities, which host many different undergraduate and post-graduate programs. A consistent theme encountered across secondary literature is Brazil's numerous excellent universities, of which several have competitive world rankings.

Private Universities

As of 2017, Brazil has a total of 2,152 private universities. In 1996, for-profit higher education was legalized with the passing of The Principles and Purposes of National Education (LAW No. 9,394).⁸¹ The passing of this bill sparked tremendous growth for private universities, many of which enroll a small number of students and struggle with gaining sufficient amounts of funding for extensive research programs.⁸² Paulista University and the Pontifical Catholic University of São Paulo are included among the many great private programs offered within Brazil. While private universities provide a relatively small amount of human capital to São Paulo and Piracicaba, they play a larger role in providing educational opportunities for the local labor pool, as many cater specifically to working adults by offering specialized courses and evening classes.

Public Universities

Brazil also hosts nearly 300 public universities, also referred to as federal universities.⁸³ The University of São Paulo, located in Piracicaba, and the State University of Campinas, located approximately 80 km from Piracicaba, both offer globally-ranked agriculture science programs.⁸⁴ Together supplying over 5,000 graduates into the agriculture labor pool each year, they play a large role in growing the talent within São Paulo state and Piracicaba specifically.⁸⁵ Access to federal funding allows public universities to provide a higher-quality curriculum through access to a wider range of resources and by attracting top professors to their programs.

⁸¹ "Law No. 9,394, Of December 20, 1996." December 20, 1996. Accessed April 19, 2019. http://www.planalto.gov.br/ccivil_03/leis/l9394.htm.

⁸² Salto, Dante J. "Brazil: A For-Profit Giant." International Higher Education. 2014. Accessed April 19, 2019. <https://ejournals.bc.edu/index.php/ihe/issue/view/598/24>.

⁸³ "Universities." DWIH São Paulo. Accessed April 19, 2019. <https://www.dwih-saopaulo.org/en/research-innovation/the-research-and-innovation-landscape-in-brazil/research-and-innovation-organizations/universities/>.

⁸⁴ "The Best Universities in Brazil, Ranked." U.S. News & World Report. Accessed April 19, 2019. <https://www.usnews.com/education/best-global-universities/brazil>.

⁸⁵ "AEPLAN - UNICAMP" AEPLAN. Accessed April 28, 2019. https://www.aeplan.unicamp.br/anuario/anuario_2017.php.

University of São Paulo - ESALQ

The Luiz de Queiroz College of Agriculture, University of São Paulo (USP-ESALQ) plays a key role in supplying human capital to the São Paulo and Piracicaba AgTech ecosystem. Recently ranked in the top 10 best global universities for agricultural sciences by U.S. News,⁸⁶ the university is very successful within the domains of science and engineering. The graduate programs currently offered are International Plant Cell and Molecular Biology, Applied Ecology, Bioinformatics, and Bioenergy. To encourage and support startups and entrepreneurs within the program, ESALQ established an innovation space, ESALQTec. Students and graduates of ESALQ can use ESALQTec as an early “kickoff space” as they begin to grow and develop startup ventures. This space also creates an entrepreneurial atmosphere where the co-located entrepreneurs can intermingle and network.

ESALQTec

Founded in 1994, ESALQTec is a startup incubator located in Piracicaba on the Areão farm, which consists of 130 hectares (320 acres). The organization issues support by providing workspaces to entrepreneurs within the agriculture industry, that allows them access to networking opportunities and resources as they develop their products.

ESALQTec currently represents 70 companies with projects that range from information technology, entomology, biogas, biological controls, and many other research areas. Through the organization's partnership with the University of São Paulo - ESALQ, residents of the hub also have access to additional resources such as mentorship opportunities with professors. Access to this incubator allows young startups the opportunity to grow organically in a low-risk setting.

⁸⁶ "Top Agricultural Sciences Universities in Brazil | US News Best Global Universities." U.S. News & World Report. Accessed May 01, 2019. <https://www.usnews.com/education/best-global-universities/brazil/agricultural-sciences>.

Cropman

Cropman was created in 2018 and combines scientific knowledge with the needs of agribusiness, and is currently a resident of Pulse Labs.

- Precision Agriculture Solutions:
 - *Smart CEa*: characterizes soil fertility, types, and production environments central to agricultural input management
 - *Smart LAND*: points to the appropriate locations to conduct targeted soil sampling through topographic attributes and advanced geostatistic features to characterize the spatial variability of soil fertility with greater precision
 - *Smart FERT*: optimizes the use of fertilizer by recommending corrective sources, dosages, and application
 - *Sideways*: Utilizes the latest in data science (Machine Learning, Data Mining, and Big Data) for efficient database management.

In 2018 alone, Cropman received two awards: the Outstanding Graduate Student Award from the International Society of Precision Agriculture (Canada) and the Poster Award from at the ECO-BIO Conference 2018 (Ireland).

In addition to its in-country programming and facilities, the university offers students the opportunity to participate in an exchange program with a partner school, Agro Paris Tech. The program currently offers two-degree pathways: 1) Doctor of Agro Engineering, and 2) Doctor of Food Science, with all courses being taught in French (at Agro Paris Tech) or Portuguese (at ESALQ). While some students have strong enough language skills to meet the rigor demanded by the program, many others do not, which in turn limits its expansion. As faculty look to further evolve the program, implementing an English-speaking platform to encourage more participation is a prime consideration.

Incorporation of Entrepreneurship into Curriculum

Brazil's AgTech ecosystem has recently seen a strong movement towards entrepreneurship among recent graduates.

Interviewees spoke about how young professionals in the agricultural field no longer believe that joining a large

corporation such as Monsanto after graduation is their only option and that they are starting to find the startup space an attractive alternative. This movement towards wider entrepreneurship has triggered internal reflection within academia as well as increased demand from students for greater incorporation of business skills courses into the curriculum. While courses have traditionally been geared towards pure science (such as agronomy) or engineering, the need for a more cross-functional curriculum has been articulated by students as they look to move into the startup space. Students are now seeking degrees from top universities that include relevant skills that can be applied in a corporate or early venture setting; many interviewees mentioned the lack of core business knowledge and skills amongst the graduate pool as an impediment to groundbreaking research innovations finding a commercial vehicle to market.

Challenges

Broadening the curriculum to be more cross-functional could ultimately strengthen the current science- and engineering-focused agriculture programs, allowing graduates to achieve a well-rounded understanding of the agriculture industry. Additional support from faculty and professors within the university will assist with the integration of entrepreneurship courses into the established curriculum. As reflected in the interviews, the understanding of core business concepts, either through personal knowledge, connection to a corporation, or via a mentor, is vital to the success of a startup.

Interviews also reflected a common underutilization of the research that is currently being conducted within universities. As stated by Henrique Junqueira Franco, the Founder/CEO of Cropman, “There is a gap between research in university and production sectors.”⁸⁷ This disconnect often results in innovations that are well-intended but perhaps missing the mark of solving important core challenges experienced by producers in the field. Full utilization of the research currently conducted in connection with ESALQ would likely translate into an even greater opportunity to expand and improve the agricultural ecosystem in Brazil, and perhaps propel the country’s standing further on the global stage.

Strengths/Supporters Initiating the Change

The state of São Paulo hosts a growing number of innovation hubs serving as workspaces that provide entrepreneurs access to networking opportunities and other important resources. Invest SP, for example, is currently conducting a series of workshops to assist entrepreneurs with improving their business pitching skills and with targeting funding opportunities that best align with their respective business model. Located in Piracicaba PECEGE, an educational institute associated with ESALQ, is currently in the early stages of implementing a more well-rounded approach to ensuring students interested in entering the AgTech space have access to business-focused resources. PECEGEGo, a

⁸⁷Junqueira Franco, interview by CEL research team in Piracicaba, March 14, 2019.

university-affiliated program, designed not only to assist with idea generation and pipeline building but also to provide mentorship to entrepreneurs to ensure their pitches are effective enough to translate into investments. These two organizations are examples of how dynamic platforms can channel a focus on mentorship and the fostering of entrepreneurial skill sets, which can really drive change for Brazil's AgTech ecosystem.

Corporations

Agriculture corporations within Brazil have shown strong support for the startup community in the São Paulo region. Secondary research and interviews with industry experts identified Raizen and Monsanto (now Bayer) as two of the largest suppliers of human capital within the region's agriculture space, as employment within these organizations allows for greater exposure to resources, research initiatives, and other learning opportunities on a larger scale. Additionally, the presence of these corporations increases the likelihood of attracting talent and investments from outside of Brazil. These "soft-landing" opportunities with well-known industry giants ultimately create a more diverse talent pool in the region and help the São Paulo region – and by extension the AgTech Valley community in Piracicaba – to continue to grow and expand.

Raizen

Headquartered in São Paulo, Raizen is currently Brazil's leading

PECEGE

PECEGE is a public institution that brings together stakeholders from academia, the private sector, and public agencies to formalize an objective: to innovate in the production and diffusion of knowledge in the Piracicaba/São Paulo region. The organization is divided into four distinct divisions: education, extension, search, and solutions.

- . *Education:* PECEGE College offers undergraduate and postgraduate courses aimed at training professionals with for a high level of employability.
- . *Extension:* PECEGE develops online and face-to-face courses in the areas of management, agribusiness, finance, and marketing. The courses are taught by renowned professors from universities and the private sector.
- . *Search:* PECEGE invests in and conducts agricultural research, specializing in sugarcane (including sugarcane energy) and fisheries in partnership with the Confederation of Agriculture and Livestock of Brazil.
- . *Solutions:* PECEGE provides services in audiovisual production, event/organizational intelligence, and translation tools. Notably, their translation software Skylar is an automatic-simultaneous translation software developed through advanced AI techniques and machine learning for real-time translation of classes, which aims to break language and geographic barriers to facilitate the circulation of knowledge and increase global collaboration and connectivity.

With 1) PECEGE's strong connections in the private sector, public sector, academia, startup community, 2) sophisticated educational programs that are online-accessible, and 3) robust research capabilities and expertise, the organization provides the AgTech Valley with much needed support in the seed phase of the startup lifecycle.

Source: PECEGE. "Home." <https://pecege.com>

producer of sugarcane ethanol⁸⁸ and the leading international exporter of sugarcane. It employs over 35,000 people throughout Brazil, of which 22,000 work in an agribusiness role, and is, therefore, a key supplier of experienced, highly-skilled human capital to the AgTech space. Raizen is also supporting entrepreneurs directly; the corporation recently founded a Piracicaba-based accelerator program called Pulse Labs that supports innovations in and outside of the sugarcane industry. Raizen retains ownership rights over innovations created by its employees in keeping with typical corporate practice (though Raizen goes the extra mile to foster internally-driven innovation); however, they do not hold any ownership rights over the ideas of entrepreneurs with residency in Pulse. Students, Raizen employees, and entrepreneurs are all eligible to apply for a workspace in the accelerator, and acceptance into the program provides access to myriad resources geared towards innovation and entrepreneurship: a library of literary resources, mentorships, agricultural land for pilot testing, and networking opportunities with other startups. Formal training on business plan writing and creating an effective idea pitching is also provided.⁸⁹

Bayer (Monsanto)

São Paulo also hosts Bayer's Brazilian headquarters, which is focused on three main business areas: health, agribusiness, and innovative materials. Employing over 4,000 individuals throughout Brazil, the corporation provides its employees with access to training resources and learning opportunities unique to a multinational firm.⁹⁰ Additionally, both undergraduate and graduate students in Brazil have the opportunity to apply for agronomy internships and two business development programs with the company: the Bayer Institutional Training Program and the Trainee Bayer Program.⁹¹ The company also partners with innovative startups with ideas aligned to their core business through mentorship and investment. It is important to note, however, that interviews with Brazilian entrepreneurs indicated that although the resources and investment provided by a partnership with the organization could have assisted in propelling their startup forward, the partnership would may also have resulted in a forfeiture of their ownership rights to intellectual property produced as well.

Labor Force

⁸⁸ Over 61 percent of Brazil's annual sugarcane crop is used in ethanol production.

Barros, Sergio. "USDA Foreign Agricultural Service's Global Agricultural Network." August 30, 2018. [https://gain.fas.usda.gov/Recent GAIN Publications/Biofuels Annual_São Paulo ATO_Brazil_8-10-2018.pdf](https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Biofuels%20Annual_S%C3%A3o%20Paulo%20ATO_Brazil_8-10-2018.pdf).

⁸⁹ Raizen, 2017-2018 Annual Report. Accessed April 2019. https://www.raizen.com.br/relatorioanual/pdf/EN_Raizen_PDF_simplificado.pdf.

⁹⁰ "Bayer Brazil's Theo Van Der Loo." Bayer Brazil's Theo Van Der Loo. Accessed April 20, 2019. <https://www.boyden.com/media/bayer-brazils-theo-van-der-loo-2089033/index.html>.

⁹¹ "Young talents." Bayer Careers Brazil. Accessed April 20, 2019. <https://carreiras.bayer.com.br/en/working-in-bayer/jovens-talentos/>.

As the industry continues to grow and expand, it is important to gain a deeper understanding of the strong labor force currently present in the region. As of 2018, 38 percent of São Paulo's employed population is working in agriculture.⁹² Additionally, interviews described a wide-range of backgrounds occurring among entrepreneurs, ranging from the sugarcane industry to engineering and science to technology. As a broad overview of the current labor pool, Brazil ranks 79th worldwide on the United Nations Human Development Index (HDI) score, which represents the country's level of development across three key indicators (life expectancy, education, and per capita income). As a comparison, neighboring Argentina's HDI score is ranked 47th worldwide.⁹³

Statistics

To further understand the current labor conditions, additional statistics regarding Brazil's labor pool were examined. Health rankings are strongly correlated with projected workforce productivity and return on investment. Brazil has a life expectancy average of 75.7 years, with 8.9 percent of its GDP going towards health expenditures.⁹⁴ To compare, Argentina has a slightly longer life expectancy rate of 76.7 years, 6.8 percent of its GDP invested in health expenditures. Additionally, Brazil has seen a rise in their unemployment rate from 7 percent in 2013 to 12.9 percent five years later in 2018, reflecting results from a recent economic downturn. Finally, 86.3 percent of Brazil's total population is located in urban areas – over the past 20 years, this rate has increased nearly 5 percent and indicates a growing industrialization trend (population moving out of rural areas that are typically more agriculture-focused) that may result in the long-term slowdown of the agriculture industry.

Gender Representation

Brazil ranked above the worldwide average on the Gender Development Index (GDI) with a comprehensive score of .992, according to the United Nations Development Programme. In contrast, Argentina has a GDI score of .997, whereas, the worldwide average is .941.⁹⁵ Anecdotally, the ESALQ administration and faculty members discussed the dramatic increase in the number of women entering the field of agriculture, with a primary focus on food science (as reflected by their enrollment numbers). Research shows that 61 percent of Brazilian

⁹² "Labor Market." Investe SP – Paulista Agency of Promotion of Competitivity and Investments. Accessed April 19, 2019. <https://www.en.investe.sp.gov.br/why-sao-paulo/diversified-economy/labor-market/>.

⁹³ "Human Development Indicators - Argentina." Human Development Reports. Accessed May 1, 2019. <http://hdr.undp.org/en/countries/profiles/ARG>.

⁹⁴ "Human Development Indicators – Brazil; Health." Human Development Reports. Accessed April 17, 2019. <http://hdr.undp.org/en/countries/profiles/BRA>.

⁹⁵ MISSIN

women have completed at least some college education as compared to 57.7 percent of Brazilian men. Additionally, 8.7 percent of the total number of college graduates among students majoring in mathematics, engineering, manufacturing, and construction majors are women. This percentage has increased from 6.8 percent in 2000.⁹⁶ While the AgTech industry has seen an increase in the number of women entrepreneurs, they still face stiff challenges; one interviewee mentioned the general reluctance of agriculture/AgTech employers to hire women, as they often send employees out into the field and are concerned that they may be incompatible with producer culture and therefore less effective.

Cultural Attitudes Toward Entrepreneurship

Interviewees discussed a traditional mindset in Brazil, which has been predominantly risk-averse. Although the efficacy of this statement is subject to opinion, many key figures believe this hindered industry investments as well as the broad adoption of new technology by producers. At its height in 2008-09, the global financial crisis triggered a paradigm shift in Brazil out of necessity as the job market declined. This period is said to have sparked entrepreneurial awareness and even instituted a “cool factor” around startup culture, perhaps resulting in a collectively improved level of risk tolerance.

The sudden growth of entrepreneurial ventures created a flood of new technologies and proposed solutions for farm management and precision agriculture. The spike in available options and new technology resulted in many producers being approached by waves of brokers selling these new products, and many producers were ill-equipped to understand what effect (if any) that investment might have on their farm’s productivity. Producers began growing skeptical of these new innovations after cycles of failed investments and stagnant (or worse) yields. An interview with Ricardo Campo, manager of Pulse Labs sheds additional light on the reluctance of farmers to adopt new technology: “Farmers are not currently willing to test products but are eager to receive something that works.” Interviewees mentioned that the best approach to successfully launch a new product is to locate and convert the early adopters in the producer community, as word-of-mouth marketing and the “neighbor effect” are tremendously powerful in achieving product adoption.

Summary

Findings

⁹⁶ "Human Development Indicators - Brazil." Human Development Reports. Accessed April 17, 2019. <http://hdr.undp.org/en/countries/profiles/BRA>.

1. With nearly 25,000 alumni and 3,400 students currently enrolled the University of São Paulo - ESALQ provides a significant amount of human capital to the AgTech ecosystem within the São Paulo and Piracicaba region.
2. Spaces like ESALQtec are important providers of additional support to startups and entrepreneurs (innovation space, networks, etc.)
3. Three strong backgrounds are deemed particularly valuable for success in the AgTech industry – business, computer science, and agronomy.
4. Computer science and agronomy backgrounds are well-represented in Piracicaba, however, there is an overall shortage of business backgrounds/skills.
5. Professors and entrepreneurs are trying to build support within universities to provide more cross-functional classes and business resources for budding entrepreneurs (e.g. PECEGE).
6. Agriculture industrial firms are a key provider of highly-skilled and trained workers (e.g., Raizen and Monsanto/Bayer).

Conclusions

1. A growing number of graduates are entering the startup space rather than joining large corporations after graduation in the São Paulo and Piracicaba region, sparking an increased demand from students and a limited number of professors for the incorporation of entrepreneurship into the curriculum.
2. ESALQ is very successful in assisting entrepreneurs on the engineering and science spectrum, opportunities exist to strengthen the Ag Science programs by introducing core business classes.
3. Large corporations such as Raizen and Monsanto/Bayer provide experienced, highly-skilled human capital to the AgTech ecosystem as well as key resources and may offer mentorship support to entrepreneurs and startups on a case-by-case basis, assisting in the growth and expansion of select startups.

Recommendations

1. An internal review of higher educational programs should be initiated that incorporates student feedback towards different areas of study, with an eye towards increasing the intersection of and engagement between different areas of study, specifically, with business (e.g. business and agronomy).
2. Partnerships with other agriculture universities (e.g., Agro Paris Tech) can be utilized to gain insights regarding their academic approach towards integrating a business curriculum.

3. Mentorships and professional development opportunities within hubs such as Pulse and Invest SP are vital to a startup's development. Hubs could consider making core business concept learning modules available to their entrepreneurs through established online platforms such as CrossKnowledge or D2L, to bridge business skills gaps among their entrepreneurs.
4. A professional networking forum should be formalized that allows entrepreneurs to establish important linkages within the industry that sharpen and complement their skills, as well as create business opportunities or funding connections.



Infrastructure

To understand the infrastructure needed for the AgTech ecosystem in Piracicaba, one must understand the agriculture industry as a whole in Brazil. Historically, agriculture has been central to Brazil's economy, but over the past 30 years in particular, changes in public policy, farming practices, and new technology have propelled Brazil to the forefront of the global agricultural industry. Agriculture currently contributes roughly 5 percent to Brazil's GDP, while agribusiness, which encompasses the entire agricultural supply chain from inputs to

exporting, contributes more than 25 percent.⁹⁷

Brazil is the fifth-largest country in the world in terms of geographical area and is first in potentially arable land: more than 400 million hectares of land are available for agricultural production, but only 65.1 million hectares are currently

Figure 9: Brazil's Top Agricultural Products by Production and Exports

2018/2019 Harvest	Production (millions)	Exports (millions)	World Prod Rank	World Export Rank	Notes
Soybeans	121.2 metric tons (US \$39,300)	79.8 metric tons (US \$25,900)	2 nd	1 st	45% of global exports; 80% is sold to China
Sugarcane	34.2 metric tons (US \$16,500)	23.6 metric tons (US \$11,400)	1 st	1 st	Brazil accounts for 20% of global production and 40% of global exports
Coffee	60.2 60-kg bags (US \$8,240)	35.5 60-kg bags (US \$4,860)	1 st	1 st	Produced over twice as much as the second global producer (Vietnam)
Beef	10.2 metric tons (US \$5,520)	8.0 metric tons (US \$4,330)	2 nd	1 st	Second producer globally behind the United States
Orange Juice	15.7 metric tons (oranges)	1.1 metric tons (US \$2,530)	1 st	1 st	Of 15.7 metric tons produced, 4.9 were consumed domestically

farmed, according to the United Nation's Food and Agriculture Organization.⁹⁸ Despite significant expansion of the agricultural frontier, the country uses less than one-sixth of its available land, presenting enormous potential for agricultural production growth.

Brazil is a powerhouse in global agricultural exports. In 2017, Brazil exported more than USD \$80 billion in agricultural products, accounting for more than one-third of Brazil's total exports and making it the third largest agricultural exporter behind the U.S. and the European Union. Brazil has a wide variety of export partners, exporting to more than 100 different countries, with China, the United States, and Argentina, receiving the most, respectively.⁹⁹ In addition, Brazil's diverse climate, regular rainfall, and fertile soil lends itself to a wide array

⁹⁷ Simoes, Alexander. "Brazil." OEC - Brazil (BRA) Exports, Imports, and Trade Partners. Accessed April 19, 2019. <https://atlas.media.mit.edu/en/profile/country/bra/#Exports>.

⁹⁸ Valdes, Constanza, Kim Hjort, and Ralph Seeley. "Brazil's Agricultural Land Use and Trade: Effects of Changes in Oil Prices and Ethanol Demand, ERR-210." U.S. Department of Agriculture, Economic Research Service. June 2016.

⁹⁹ Simoes. "Brazil."

of agricultural production. The leading exports are soybean, sugarcane, coffee, beef, and orange juice, and Brazil is the leading exporter in the world for each [Figure 9]. Other noteworthy products include cotton, corn, rice, wheat, tobacco, poultry, and pork.

Brazil is well-positioned as one of the world's top suppliers of agricultural products, with significant growth potential. It has established itself as a market leader in exports, while also providing affordable food for its own population.¹⁰⁰ The size and strength of Brazil's agricultural capabilities naturally lends itself to the development of a robust AgTech ecosystem, and there is great potential for productivity gains through the adoption of AgTech solutions. However, despite the country's demonstrated global market leadership, significant growth obstacles exist, including logistical infrastructure development and digital connectivity.

Smartbreeder

Smartbreeder is a precision agriculture platform used for forecasting and automation of decision-making to optimize the performance and management of agricultural production. While previous methods would take one or two inconsistent factors into account, the Smartbreeder platform takes over 1,200 data points into consideration. It uses artificial intelligence, data mining, and mathematical models to help producers make decisions about which inputs to use, when, and in what quantities. These recommendations are made at a granular level, all the way down to day-to-day operations, and activities are prioritized for producers in terms of urgency and value.

Smartbreeder is a prime example of how much impact an AgTech startup out of Piracicaba can have on the agricultural industry in Brazil. Founded in 2009, Smartbreeder did not sign their first commercial contract until 2016. It faced many financial challenges in beginning, similar to many other AgTech startups. Smartbreeder utilized contracts with sugar mills to provide services while simultaneously developing its technology, and also used research grants like FAPESP to keep the startup in business. Today, they are an industry leader in farm management with more than 2 million hectares under management which is estimated to provide USD \$126 million in efficiency savings and productivity increases of approximately 5 million tons of sugar cane for their clients.

Logistical Infrastructure

According to a 2018 World Economic Forum study, Brazil ranks 107th out of 144 countries in infrastructure development.¹⁰¹ There are approximately 2 million kilometers (km) of roads in Brazil, making it the fourth largest highway system in the world; however, only 10

¹⁰⁰ Amaral, Weber Antonio Neves Do, and Alessandro Peduto. "Food Security: The Brazilian Case." International Institute for Sustainable Development. December 14, 2017. Accessed April 19, 2019. <https://www.iisd.org/library/food-security-brazilian-case>.

¹⁰¹ Rasso, Ebe, and Genard Burity. "Brazil - Infrastructure." Export.gov. October 10, 2018. Accessed April 19, 2019. <https://www.export.gov/article?id=Brazil-Infrastructure>.

percent are paved.¹⁰² Of these paved roads, more than one-sixth (about 34,000 km) are in the state of São Paulo.¹⁰³ While São Paulo benefits from a highly developed road network, access to a major international airport, major shipping ports, and a highly developed international business presence, the majority of Brazil, especially in rural areas, lacks cheap, reliable means of transportation and advanced infrastructure to support the production and shipment of agricultural products.

Rail and river transport serve as alternatives to highway shipping, but these methods remain underdeveloped, cost prohibitive, and unreliable. Rail is not widely used for shipping goods, due to an outdated and segmented rail system: different segments use different track gauges, thereby making it difficult or impossible for all trains to move freely through the system.

Brazil boasts an intricate river network of more than 60,000 km, 20 percent larger than the U.S., but this is under-utilized due to poor navigability.¹⁰⁴ Of Brazil's inland waterways, only one-fifth are useable for cargo transportation due to varying depths, waterfalls, insufficient damming, and existing dams without transportation locks. Due to the lack of alternative means of transport, the agriculture industry relies heavily on trucking to move goods from rural Brazil for distribution within the country and to the coasts for export – more than 60 percent of cargo transportation relies on roads.¹⁰⁵

While shortfalls in logistical infrastructure in Brazil hinder further industrial growth, this is hardly an unknown obstacle, and the Brazilian government recognizes the need for further infrastructure investments to better support the industry. Several successful government initiatives in recent decades have improved, modernized, and expanded Brazil's existing infrastructure. The most recent was the Investment Partnership Program (PPI), also known as "Projeto Avançar", which was launched in May 2016 with the goal of raising USD \$14.4 billion for building and operating roads, port terminals, railways, and power transmission lines.¹⁰⁶

There are several privately-funded infrastructure investments in Brazil as well. The mining giant VALE invested more than USD \$1.3 billion in their own rail systems between 2000 and 2006 and owns the concessions for three major railways, totaling about 2,000 km, to move raw materials from inland Brazil to the coasts.¹⁰⁷ Similar investment in transport infrastructure from the agricultural industry could lead to

¹⁰² Meyer, Amelia. "Brazil Roads." Brazil. April 16, 2019. Accessed April 19, 2019. <https://www.brazil.org.za/brazil-roads.html>.

¹⁰³ "Highway System of São Paulo." Wikipedia, the Free Encyclopedia. December 11, 2018. Accessed April 19, 2019. https://en.wikipedia.org/wiki/Highway_system_of_São_Paulo#Infrastructure.

¹⁰⁴ "South America, Brazil Inland Waterways." World Wide Inland Navigation Network. Accessed April 19, 2019. <https://www.wwinn.org/brazil-inland-waterways>.

¹⁰⁵ Mello, Juliana. "Logistics and Distances in Brazil." The Brazil Business. Accessed April 19, 2019. <https://thebrazilbusiness.com/article/logistics-and-distances-in-brazil>.

¹⁰⁶ Rasso, and Burity. "Brazil - Infrastructure."

¹⁰⁷ "Logistics." Vale. Accessed April 19, 2019. <http://www.vale.com/EN/business/logistics/Pages/default.aspx>.

decreased costs and a more efficient supply chain.

Investment in infrastructure can come from private or public sources. Further institutional advocacy from the agriculture industry and the AgTech ecosystem key leaders would likely help spur further investment and could be specifically geared towards the needs of the agriculture industry. Reducing inefficiencies in the supply chain will further reduce costs for producers, and create opportunities for new investment, to include investment in new solutions offered by AgTech innovation.

Digital Infrastructure

Connectivity

Digital infrastructure and connectivity across Brazil are improving at an impressive rate. Internet usage has increased from 70 percent to 75 percent from 2017 to 2018. Only five years ago, smartphone penetration in Brazil was at just 15 percent.¹⁰⁸ In the past two years, smartphone usage in Brazil is growing on par with population growth, increasing from 37.7 percent in 2017 (79.5 million users) to 42.2 percent in 2018 (91.2 millions users), also making it the fourth largest smartphone market in the world behind China, India, and the U.S.¹⁰⁹

Despite these impressive numbers and positive trends, connectivity is highly concentrated in urban areas; rural producers, therefore, remain relatively disconnected as cellular and data connectivity in the rural areas of Brazil can be extremely tenuous. This is particularly true for the characteristically large farms in Brazil. One of the biggest issues inhibiting the effective implementation of new technological innovation for AgTech startups and producers alike is the lack of communications infrastructure and connectivity. Brazil is lagging in the digitalization of agriculture due to the current lack of a reliable rural communications network.¹¹⁰

Digital Initiatives

Fortunately, the limited digital infrastructure and connectivity is a known problem, and it is viewed as a huge opportunity by key players in the AgTech ecosystem, as well as the federal government. One McKinsey Global Institute study stated that a fully-networked agriculture

¹⁰⁸ "84 Million Brazilians Are Connected to Smartphones." The Brazilian Report. June 27, 2018. Accessed April 19, 2019. <https://brazilian.report/money/2018/06/27/brazil-internet-smartphones/>.

¹⁰⁹ "Top Countries/Markets by Smartphone Penetration & Users." Newzoo. April 20, 2018. Accessed April 19, 2019. <https://newzoo.com/insights/rankings/top-50-countries-by-smartphone-penetration-and-users/>.

¹¹⁰ Freitas, Tatiana, and Fabiana Batista. "Giant Brazil Farms Look to Close Tech Divide." Bloomberg Technology. September 25, 2018. Accessed April 19, 2019. <https://www.bloomberg.com/news/articles/2018-09-25/giant-brazil-farms-look-to-close-tech-divide-as-deere-steps-up>.

industry in Brazil could save up to USD \$21.1 billion by 2025.¹¹¹

There are initiatives to extend and improve the existing infrastructure to leverage potential gains in efficiency. Deere and Company, a major farm equipment maker based in Illinois, USA, is teaming with telecommunications supplier Tropicom in Brazil to build towers and antennae to bring data connectivity to Brazil's rural areas. Other equipment makers are developing equipment that will be linked to satellites to transfer data where cellular service is unavailable.

Like VALE, Raizen, Brazil's fourth-largest energy company, has begun linking their sugarcane farms to their central operations controlling department to create their own infrastructure solutions. Raizen increased equipment Internet connectivity from 60 percent to nearly 100 percent. The resulting efficiency improvement - using 290 harvesting machines to reap the same area that once required 400 - saved the company USD \$250,000 per machine.¹¹²

There is continued focus on developing new technology as a low-cost alternative to the existing digital infrastructure. For example, Qualcomm, a global wireless technology corporation, is heavily invested in AgTech investments in Brazil, and is funding research into 4G variants such as narrow-band IoT: using existing point-to-point radio networks that exist on farms, and connecting them to the internet via small cell technology.¹¹³ AgTech startups in Brazil such as Solinftec already utilize point-to-point radio networks, or mesh networks, to connect their units of equipment to each other. Connecting these mesh networks to the internet through broadband or cellular connection would be a significant advancement.¹¹⁴

These initiatives serve as high potential examples of what may be possible with continued investment and further development of and support for new ideas that will help close the connectivity gap and benefit all stakeholders involved.

Piracicaba AgTech Ecosystem-Specific Infrastructure

Piracicaba is becoming known as the "AgTech Valley" of the world for good reason: it is now home to almost 50 percent of all of Brazil's

¹¹¹ Freitas, and Batista. "Giant Brazil Farms Look to Close Tech Divide."

¹¹² Freitas, and Batista. "Giant Brazil Farms Look to Close Tech Divide."

¹¹³ Cosgrove, Emma. "Why Qualcomm Ventures Sees Farm Connectivity Challenges as Opportunity." AgFunderNews. April 27, 2018. Accessed April 19, 2019. <https://agfundernews.com/qualcomm-ventures.html>.

¹¹⁴ Cosgrove. "Why Qualcomm Ventures Sees Farm Connectivity Challenges as Opportunity."

AgTech startups, with a multitude of incubators, accelerators, and hubs to support them.¹¹⁵ The infrastructure for the AgTech ecosystem within Piracicaba consists of these key players and the support they provide to startups and entrepreneurs.

Incubators provide space for startups to work and share ideas, as well as services, guidance, and operational structure for entrepreneurs. ESALQTec is a great example of an incubator in Piracicaba, leveraging resources available from ESALQ-USP for entrepreneurs and facilitating access to innovations.

Accelerators provide entrepreneurs with industry knowledge, professional connections (and sometimes capital) to help bring their ideas to market. Pulse Labs is an accelerator and hub under Raizen that is open to any agribusiness startup. The Raizen brand and connections – as well as well-placed partners such as SP Ventures and Thought for Food – give the Pulse residents credibility and clout in the ecosystem. These relationships are leveraged to create

unique opportunities to contribute to ecosystem development.

Hubs bring all types of players in the ecosystem together in a central location, integrating startups, corporations, potential investors, and other actors. This density serves its own purpose as well, including the facilitation of ideas exchange. There are several major hubs in Piracicaba such as AgTech Garage and Technology

Brazil Beef Quality (BBQ)

Brazil Beef Quality (BBQ) is an incubator startup of ESALQTec-USP and a resident of AnimalsHub, an organization that aims to boost and connect startups working on the future of livestock. BBQ's mission is to develop solutions to ensure beef has scientifically proven and measurable high quality by identifying the palatability of the meat through defined criterion and an applied methodology. BBQ envisions serving as an international leader for the development of quality meat production solutions. The startup offers an array of consulting services for clients of all sizes— from small businesses to multinationals:

- . *Carcass Classification*: Classification of the meat quality through the BBQ software.
- . *Sensory testing with consumers*: To date BBQ has conducted sensory testing with more than 1,100 consumers, providing for the development of meat grading intelligence with a high level of accuracy.

Until BBQ, a credible beef quality certification system at the national level did not exist in Brazil. BBQ benefits all links in the value chain as producers and intermediaries increase profits as end-consumers' willingness to pay increases when quality is guaranteed. As a pioneer in the standardization of Brazilian beef quality ratings, BBQ's practices serve as a model for startups to the imminent formalization of the AgTech sector

Source: BBQ. "Landing." <https://www.bbq-br.com>

¹¹⁵ Comtesse, Nathalie. "The Brazilian AgTech." Master's thesis, University of Lausanne, 2019.

Park, and the city has seen its first vertical AgTech hub with Animals Hub, serving the animal production side of agriculture.¹¹⁶

Some accelerators and incubators also provide labs and testing facilities for startups and entrepreneurs. Most AgTech startups lack capital, and lab access and testing facilities are expensive. In Piracicaba, facilities are available but often difficult to access as they are tightly controlled. For example, Avance, an accelerator run by Coplacana, whose mission is to find AgTech solutions for problems that the producers within the co-op are facing, provides 70 hectares of testing fields for startups chosen to be in their program. ESALQTec as an incubator cannot provide the testing equipment to be used by its resident startups, but it provides the space and, when it can, agricultural inputs for the startups to run the required tests to develop their technology/venture.

Startups and entrepreneurs have the access they need to the AgTech ecosystem through incubators, accelerators, and technology hubs in Piracicaba. Between 2007 and 2014, SP Ventures (a venture capital firm) evaluated 54 startups; in the next three years, they evaluated more than 400.¹¹⁷ This rapid growth is promising, and with the infrastructure of the AgTech Valley in place, the ecosystem itself must continue to grow with the number of startups it houses. Startups need access to these support systems to remain successful in developing and delivering innovative solutions.

As it stands today, the AgTech Valley has no formal structure and is completely self-governing. The players within the ecosystem can act in their own best interest to grow their businesses as well as foster creativity free of burdensome bureaucracy. In the current state of growth of the ecosystem, this serves as a major advantage. However, as the ecosystem continues to grow and gain influence in Brazilian agribusiness, there may be a need to inwardly align the activities of the individual players to each other's goals and the goals of the ecosystem as a whole. Players within the ecosystem are highly collaborative, but some self-driven internal alignment – led potentially by a credible third party – that does not impede continued innovation and entrepreneurship, would give the ecosystem greater collective bargaining power and autonomy with the agribusiness sector in Brazil.¹¹⁸

Summary

¹¹⁶ "The Brazilian Agtech Valley: The Piracicaba Valley and the Agro-Technological Revolution." Vaz De Almeida Advogados. May 30, 2018. Accessed April 19, 2019. <https://vazdealmeida.com/the-brazilian-agtech-valley-the-piracicaba-valley-and-the-agro-technological-revolution/>.

¹¹⁷ Jardim, Francisco. "Brazil Agtech Market Map: 338 Startups Innovating in Agricultural Powerhouse." AgFunderNews. July 13, 2018. Accessed April 20, 2019. <https://agfundernews.com/brazil-agtech-market-map-338-startups-innovating-in-agricultural-powerhouse.html>.

¹¹⁸ Comtesse. "The Brazilian AgTech."

Findings

1. Despite limited logistical infrastructure across its rural areas, Brazil is a global powerhouse in terms of agricultural production and exports, creating a robust environment primed for the improvements offered by AgTech innovation.
2. There are many AgTech facilitators present in Piracicaba, including hubs and incubators, government-backed hubs, corporate funded accelerators, and corporate- and university-supported testing facilities
3. The digital connectivity needed to support AgTech solutions is limited in more rural areas of Brazil but has improved over the past couple of years due to corporate initiatives that are creating their own mesh networks, as well as private and public investment in the infrastructure needed to expand connectivity.
4. Technological adoption by producers relies heavily on proven success and positive network effects; however, negative experiences with AgTech create reluctance from producers to adopt new technologies.

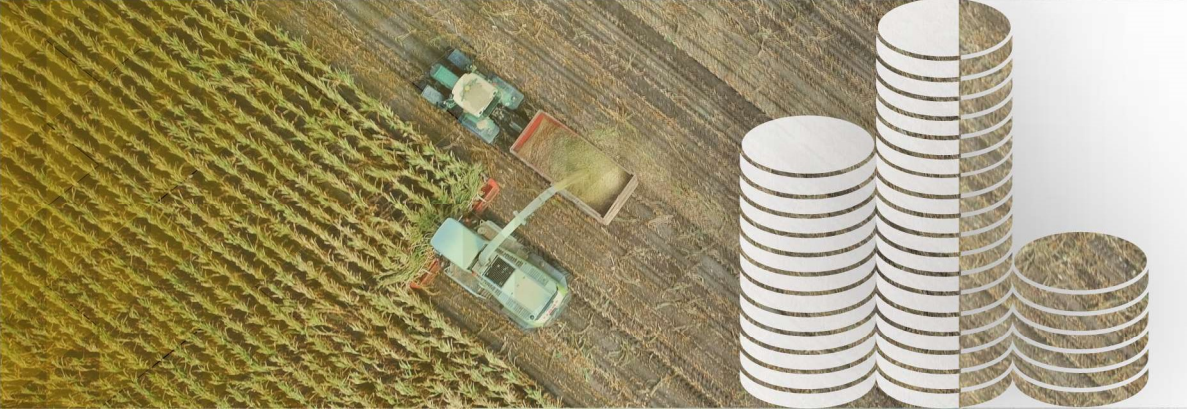
Conclusions

1. Brazil is a low-cost competitor in the world agricultural market, but low production costs are offset by high transportation costs due to the lack of cheap, reliable means of transportation. Further advocacy and investment for improved infrastructure would help reduce inefficiencies grow profits within the industry.
2. A high density of AgTech players in Piracicaba creates an innovation-rich environment, geared specifically towards supporting AgTech startups to bring solutions to market for producers.
3. The interaction between AgTech facilitators in Piracicaba is not adversarial as players generally support each other, but they operate by following individual incentives, which may or may not align with growing the ecosystem as a whole.
4. Limited digital connectivity presents an excellent opportunity for investment, as efficiency gains due to increased adoption of AgTech solutions present massive upside savings for producers
5. Facilitators and cooperatives such as Coplacana play a key role in connecting producers to AgTech innovations and solutions, ensuring producers are adopting the correct solutions for their challenges. Positive experiences create positive network effects and help spread AgTech solutions.

Recommendations

1. The agricultural industry and AgTech ecosystem should improve organization for advocacy efforts at the municipal, state, and federal level for improved infrastructure investment specific to agricultural needs.

2. Investment from private and public investors should be actively promoted to continue building out digital connectivity for producers.
3. New entrants should seek to replicate the success of Coplacana to bring solutions to market that address producers' specific needs. Equip producers with the means to determine the root of the problems they experience so that they can identify the correct solutions for their situation.



Conclusion

While agricultural technology may still be in the earlier stages of its development as an understood asset class and investment opportunity, the early-mover upside is well articulated in Piracicaba and in Brazil as a whole. As the global south's leader in tropical agriculture with vast hectares of arable land unused, with world-leading agriculture-focused universities providing a flood of qualified human capital that are knowledgeable about local conditions and producer markets, and with export partners that are leaders on the world stage, Brazil is positioned to take a starring role in the AgTech movement.

- ▶ Piracicaba, specifically, is an attractive hunting ground for domestic and foreign investors. Bordering the prestigious ESALQ university is the AgTech Valley, which includes the city's new Technology Park that boasts an impressive network of accelerators and co-working spaces that engender innovation. The density of entrepreneurs and startup ventures in the ecosystem – coupled with the expertise and market know-how from prominent sugarcane and other agriculture executives – makes Piracicaba a

one-stop shop for both technology solutions and location-specific industry and market knowledge. Piracicaba's proximity to the neighboring city of São Paulo adds to its stature, connectivity, and access to multinational agro-industrials, export centers, and finance markets.

While Piracicaba and Brazil experience some of the effects of underinvestment typically seen in developing economies, the myriad inputs for AgTech dominance are all present in the region. Investments in Piracicaba would not wither in isolation, but instead benefit from the additivity of the unique network of stakeholders and resources conducive to the innovation and commercialization of promising ideas.

While this study presented several recommendations across the examined domains of finance, public policy, human capital, and infrastructure, the complexity of both the environment and these suggestions is not lost on the research team. To bring together in summation the breadth of these proposals, and to better understand how each may take shape as stakeholders and investors continue to evolve the entrepreneurial ecosystem in Piracicaba, below is a suggested five-year plan that places the recommendations in context by the level of complexity and expected time horizon for implementation across each study domain. The research team leaves the assignment of these recommendations to responsible and appropriate actors in the capable hands of those that know best: the key stakeholders of the AgTech Valley and those rightfully in its orbit as industry catalysts and investment professionals.

Five-year Plan for Further Development of the AgTech Ecosystem in Piracicaba / Brazil

Overarching Recommendations

Plan Category	Immediate-term	Medium-term	Longer-term
	(Years 1-2)	(Years 3-4)	(Year 5)
Overarching	<ul style="list-style-type: none"> The AgTech Valley in Piracicaba has experienced such strong growth that it may benefit from some added self-governance to be positioned to effectively advocate for the Valley's/AgTech's interests where needed and to effectively move promising startups through a discernible pipeline of development. 	<ul style="list-style-type: none"> There is a need for further socialization of potential investments as living along a continuum – this will create better matchmaking between investors and opportunities (categorized by expected return, desired risk profiles, etc.). This will also aid in the flow of information to incentivize more [corporate/impact] investment, highlight angel/VC opportunities at various growth stages (and ticket sizes), and better involve other “unencumbered” sources of capital (private-/public-sector grants, foundation money) by addressing the unique factors of Ag investments (e.g., longer lifecycle, commodity pricing, etc.). 	

Finance

Plan Category	Immediate-term	Medium-term	Longer-term
	(Years 1-2)	(Years 3-4)	(Year 5)
Finance	<ul style="list-style-type: none"> • Farmers, agricultural executives, and cooperatives should become better organized to serve as an accessible source of seed/angel capital. • Universities have a vast network of successful alumni working in the industry and in government; for example, ESALQ has an alumnus as the former Minister of Agriculture. It would be beneficial to further emphasize the leveraging of these networks as sources of capital or expertise (e.g., ESALQ does not yet having an angel alumni group, which represents a great development opportunity). • Further marketing and socialization of the federal and state funds available to entrepreneurs may increase awareness of how to begin developing venture ideas 	<ul style="list-style-type: none"> • AgTech can become more innovative in sourcing early investment – for well-matched opportunities – by utilizing methods like crowdfunding. In 2017, Brazil passed a law to create a framework for crowdfunding which has proved successful in raising equity for some companies. • In some cases, startups may look to partner with foreign universities that are unencumbered by state university policy. They may look to incorporate or patent abroad to harness foreign capital and get around funding challenges. • Corporate venture capital should deepen its partnerships with startups, incubators, and accelerators and provide non-financial support such as infrastructure inputs, data for experimentation, or mentorship (a successful example of this is the Sygenta and InstaAgro partnership). 	<ul style="list-style-type: none"> • Universities should consider defining a pipeline to move research ideas from the lab into the field (e.g., ESALQ is trying to address this through ESALQtec, which incubates ideas).

Public Policy

Plan Category	Immediate-term	Medium-term	Longer-term
	(Years 1-2)	(Years 3-4)	(Year 5)
Public Policy	<ul style="list-style-type: none"> The existing system for inflation targeting should be strengthened and the clarity of fiscal operations improved. Risk assessments from credible research agencies that show progress and the promising future outlook could serve to increase (foreign) investor confidence. Key AgTech representatives should work towards building stronger relationships with SEBRAE with the aim of increasing private-sector participation in the long-term credit market. The government may commission a third party (e.g. SEBRAE) to identify the most critical points of improvement to create a strategy for infrastructure development. The government should consider commissioning a review to determine which tax and credit incentives most 	<ul style="list-style-type: none"> Brazilian AgTech faces a dearth of early investment – the Piracicaba municipality should move towards offering more support in the form of funding mechanisms or programs tailored towards the local innovation community. To benefit the Piracicaba ecosystem, the municipality should consider working towards improvements in its tax regulations and policies for venture entrepreneurs, offering incentives to open their firms in the city. 	<ul style="list-style-type: none"> Advocacy should be focused towards the establishment of a more streamlined tax system that imposes fewer compliance costs (with the larger goal being movement towards a unified national tax system).

Plan Category	Immediate-term	Medium-term	Longer-term
	(Years 1-2)	(Years 3-4)	(Year 5)
	<p>encourage private investment, and further develop those incentives.</p> <ul style="list-style-type: none"> • An analysis of labor force training programs should be conducted to place greater focus on market insertion as an outcome and on the transferability of skills - coordination can then be initiated with relevant policymaking bodies to implement suggested changes. • Key AgTech Valley leaders should look to establish closer collaboration with SEBRAE (and others such as EMPRABA & HubSP) to strengthen AgTech’s representation and create a foundation for engagement with policymakers. This will provide a platform for voices to be heard around issues affecting regulatory processes and IP regulation and protection, which deeply affect the successful development of the industry. 		

Human Capital

Plan Category	Immediate-term	Medium-term	Longer-term
	(Years 1-2)	(Years 3-4)	(Year 5)
Human Capital	<ul style="list-style-type: none"> An internal review of higher educational programs should be initiated that incorporates student feedback towards different areas of study, with an eye towards increasing the intersection of and engagement between different areas of study, specifically, with business (e.g. business and agronomy) Partnerships with other agriculture universities (e.g., Agro Paris Tech) can be utilized to gain insights regarding their academic approach towards integrating a business curriculum. 	<ul style="list-style-type: none"> Mentorships and professional development opportunities within hubs such as Pulse and Invest SP are vital to a startup's development. Hubs could consider making core business concept learning modules available to their entrepreneurs through established online platforms such as CrossKnowledge or D2L, to bridge business skills gaps among their entrepreneurs. 	<ul style="list-style-type: none"> A professional networking forum should be formalized that allows entrepreneurs to establish important linkages within the industry that sharpen and complement their skills, as well as create business opportunities or funding connections.

Infrastructure

Plan Category	Immediate-term	Medium-term	Longer-term
	(Years 1-2)	(Years 3-4)	(Year 5)
Infrastructure	<ul style="list-style-type: none"> Investment from private and public investors should be actively promoted to continue building out digital connectivity for producers 	<ul style="list-style-type: none"> New entrants should seek to replicate the success of Coplacana to bring solutions to market that address producers' specific needs. Equip producers with the means to determine the root of the problems they experience so that they can identify the correct solutions for their situation 	<ul style="list-style-type: none"> The agricultural industry and AgTech ecosystem should improve organization for advocacy efforts at the municipal, state, and federal level for improved infrastructure investment specific to agricultural needs.

Sources

1. “2018 AgTech Investment Review”, Finistere Ventures, accessed April 22, 2019, https://files.pitchbook.com/website/files/pdf/Finistere_Ventures_2018_AgTech_Investment_Review_PJZ.pdf
2. Eric Newcomer, “Didi Buys 99 Taxis, Igniting Fight with Uber in Latin America”, Bloomberg, accessed April 22, 2019, <https://www.bloomberg.com/news/articles/2018-01-03/didi-buys-99-taxis-igniting-fight-with-uber-in-latin-america>
3. “Stone Pagamentos raises US\$1.1B on NASDAQ”, LAVCA, accessed April 22, 2019, <https://lavca.org/2018/10/01/stone-pagamentos-raises-us1-1b-on-nasdaq/>
4. “Syngenta to acquire Strider”, Syngenta, accessed April 22, 2019, <https://www.syngenta.com/media/media-releases/yr-2018/26-03-2018a>
5. Louisa Burwood-Taylor, “TPG ART Invests in Brazilian Digital Ag Startup Solinftec”, AgFunderNews, accessed April 22, 2019, <https://agfundernews.com/breaking-exclusive-tpg-art-invests-in-brazilian-digital-ag-startup-Solinftec.html>
6. “First Public Call for Selection of Credit Funds for Small and Medium-Sized Enterprises”, BNDES, accessed April 22, 2019, <https://www.bndes.gov.br/wps/portal/site/home/mercado-de-capitais/fundos-de-investimentos/chamadas-publicas-para-selecao-de-fundos/chamada-publica-fundo-pme-inovadoras>
7. “2º Censo AgTech Startups Brasil”, AgTech Garage, accessed April 22, 2019, <https://www.AgTechgarage.com/censo/>
8. Priscilla Perez “Startup @ Tech Offers Technology for Profitability” Gazeta de Piracicaba. Accessed April 22, 2019. http://www.gazetadepiracicaba.com.br/_conteudo/2018/10/home/603198-startup-tech-oferece-tecnologia-para-lucratividade.html
9. “Koppert acquires BUG creating the largest biocontrol company in Latin America” Koppert, accessed April 22, 2019, <https://www.koppert.com/news/koppert-acquires-bug-creating-the-largest-biocontrol-company-in-latin-america/>
10. “São Paulo Innovation Fund”, FAPESP, accessed April 22, 2019, http://pesquisaparainovacao.fapesp.br/tempo_de_colher/900
11. “SP Ventures, Syngenta, Bunge, & Endeavor lead series A investment in Agrofy”, LAVCA, accessed April 22, 2019, <http://demo.creosen.com/lavca/2018/03/06/sp-ventures-syngenta-bunge-endeavor-lead-series-investment-agrofy/>
12. “2018 AgTech Investment Review”, Finistere Ventures, accessed April 22, 2019, https://files.pitchbook.com/website/files/pdf/Finistere_Ventures_2018_Agtech_Investment_Review_PJZ.pdf
13. “Monsanto’s Venture Capital Arm Makes First Direct Investment in Brazil”, Monsanto, accessed April 22, 2019,

- <https://monsanto.com/company/ventures/articles/monsantos-venture-capital-arm-makes-first-direct-investment-brazil>
14. Emma Cosgrove, "Brazil's First AgTech Accelerator Program Pulse Seeking Startups", AgFunderNews, accessed April 22, 2019, <https://agfundernews.com/breaking-brazils-first-AgTech-accelerator-program-pulse-seeking-startups.html>
 15. "Finep Startup", FINEP, accessed April 22, 2019, <http://www.finep.gov.br/apoio-e-financiamento-externa/programas-e-linhas/finep-startup>
 16. "Brazil's BNDES selects DOMO Invest to manage R\$100m angel co-investment fund", LAVCA, accessed April 22, 2019, <https://lavca.org/2018/07/18/brazils-bndes-selects-domo-invest-to-manage-r100m-angel-co-investment-fund-em-portugues/>
 17. "About Desenvolve SP", Desenvolve SP, accessed April 22, 2019, <https://www.desenvolvesp.com.br/en/institutional/about-desenvolve-sp/>
 18. "The São Paulo Research Foundation" FAPESP, accessed April 22, 2019, <http://www.fapesp.br/en/6026>
 19. "CVM Instruction 588", Comissão de Valores Mobiliários, accessed April 22, 2019, <http://www.cvm.gov.br/legislacao/instrucoes/inst588.html>
 20. "Cervejaria LEUVEN", Kria, accessed April 22, 2019, <https://www.kria.vc/empresas/cevejaria-leuven>
 21. "Brazilian drone startup Horus raises R\$2M on equity crowdfunding platform Eqseed", LAVCA, accessed April 22, 2019, <https://lavca.org/2018/09/04/brazilian-drone-startup-horus-raises-us2m-on-equity-crowdfunding-platform-eqseed-em-portugues/>
 22. "COPLACANA and AVANCE hub open selection for AgTechs at Agrishow 2019", Coplacana, accessed April 22, 2019, <http://www.coplacana.com.br/coplacana-e-avance-hub-abrem-selecao-para-AgTechs-na-agrishow-2019/>
 23. "Mapping the Impact Investing Sector In Brazil", Aspen Institute, accessed April 22, 2019, https://assets.aspeninstitute.org/content/uploads/files/content/docs/pubs/ImpactInvestingStudy_FINAL_VERSION_ENGLISH.pdf
 24. Juliana Mello, "All about Lucro Real and Lucro Presumido", The Brazil Business, accessed April 22, 2019, <https://thebrazilbusiness.com/article/all-about-lucro-real-and-lucro-presumido>
 25. Juliana Mello, "Introduction to EIRELI", The Brazil Business, accessed April 22, 2019, <https://thebrazilbusiness.com/article/introduction-to-eireli>
 26. Reuters (2017), "Brazil Agriculture, Agribusiness Contributed 23.5 Pct to GDP In...". <https://www.reuters.com/article/brazil-agriculture/brazil-agriculture-agribusiness-contributed-23-5-pct-to-gdp-in-2017-cna-idUSE6N1ND008>.
 27. Statistical Times (2019), "Projected GDP Ranking (2019-2023)." World GDP Ranking 2019. <http://statisticstimes.com/economy/projected-world-gdp-ranking.php>.
 28. Banco Central Do Brasil. Interest Rate. May 2019. <https://www.bcb.gov.br/en/#!/c/INTEREST/>.

29. OECD (2012), OECD Integrity Review of Brazil: Managing Risks for a Cleaner Public Service, OECD Public Governance Reviews, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264119321-en>.
30. OECD (2010), The OECD Innovation Strategy: Getting a Head Start on Tomorrow, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264083479-en>.
31. "OECD." Wikipedia. April 15, 2019. <https://en.wikipedia.org/wiki/OECD>.
32. "BRIC." Wikipedia. April 15, 2019. <https://en.wikipedia.org/wiki/BRIC>.
33. OECD (2017), OECD Going Digital Toolkit. <https://goingdigital.oecd.org/en/indicator/74/>.
34. OECD (2013c), OECD FDI Regulatory Restrictiveness Index. <http://www.oecd.org/investment/fdiindex.htm>.
35. WDI (2013), World Development Indicators Database, World Bank, <http://data.worldbank.org/data-catalog/world-development-indicators>.
36. WDI (2017), World Development Indicators Database, World Bank, <https://tcdata360.worldbank.org/indicators/inn.fin.mkt.dev.country=BRA&indicator=739>
37. WDI (2017), World Development Indicators Database, World Bank, https://tcdata360.worldbank.org/indicators/h4f35be65?country=BRA&indicator=637&countries=ARG,CHN,MEX,USA,CHL,CAN,GBR,RUS&viz=bar_chart&years=2017
38. Brazil-U.S. Business Council. Greater Brazil: INDUSTRIAL POLICY, COMPETITIVENESS, AND GROWTH. PDF. Washington, DC: US Chamber of Commerce, 2015.
39. OECD (2011), Managing Risk in Agriculture: Policy Assessment and Design, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264116146-en>.
40. PWC. "Brazil - Corporate Tax Credits and Incentives." Brazil - Corporate Tax Credits and Incentives. <http://taxsummaries.pwc.com/ID/Brazil-Corporate-Tax-credits-and-incentives>.
41. USP ESALQ. International Rankings Confirm ESALQ's Global Leadership in Agricultural Sciences | Luiz De Queiroz College of Agriculture. <http://www.en.esalq.usp.br/node/868>.
42. Statista. "Brazil - Youth Unemployment Rate 2007-2017 | Statistic." Statista. 2017. <https://www.statista.com/statistics/811696/youth-unemployment-rate-in-brazil/>.
43. Gonzales, R.H. (2010), "Employment Policies in Brazil: History, Scope and Limitations", Working Paper N 70, September 2010, UNDP International Policy Centre for Inclusive Growth and Institute for Applied Economic Research, Brasilia.
44. OECD (2014a), Education at a Glance 2014: OECD Indicators, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/eag-2014-en>.

45. Amadeo, Kimberly. "How the OECD Can Help You." The Balance. <https://www.thebalance.com/organization-economic-cooperation-development-3305871>.
46. OECD. "Education Resources - Public Spending on Education - OECD Data." The OECD. <https://data.oecd.org/eduresource/public-spending-on-education.htm#indicator-chart>.
47. World Bank. "Doing Business in Brazil." World Bank. <http://www.doingbusiness.org/en/data/exploreconomies/brazil>.
48. Correa, P. and C. Schmidt (2014), "Public Research Organizations and Agricultural Development in Brazil: How Did Embrapa Get it Right?", Economic Premise, No. 145, The World Bank, June, <http://siteresources.worldbank.org/EXTPREMNET/Resources/EP145.pdf>.
49. World Bank. https://tcdata360.worldbank.org/indicators/entrp.ip?country=BRA&indicator=3375&viz=line_chart&years=2012,2016
50. OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>
51. OECD (2012), Agricultural Policy Monitoring and Evaluation 2012: OECD Countries, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/agr_pol-2012-en.
52. OECD (2013a), Agricultural Policy Monitoring and Evaluation 2013: OECD Countries and Emerging Economies, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/agr_pol-2013-en.
53. Rapoza, Kenneth. "Brazil's New Government Is Promising Wall Street The Moon." Forbes. February 11, 2019. <https://www.forbes.com/sites/kenrapoza/2019/02/11/brazils-new-government-is-promising-wall-street-the-moon/#e021a9f332e3>.
54. Lee, Alec. "What Businesses Should Know About Brazil's New President." Harvard Business Review. December 11, 2018. <https://hbr.org/2018/12/what-businesses-should-know-about-brazils-new-president>.
55. Banco Central Do Brasil. Interest Rate. May 2019. <https://www.bcb.gov.br/en/#!/c/INTEREST/>.
56. WDI (2013), World Development Indicators Database, World Bank, <http://data.worldbank.org/data-catalog/world-development-indicators>.
57. WDI (2017), World Development Indicators Database, World Bank, <https://databank.worldbank.org/data/reports.aspx?source=2&series=FR.INR.RISK#>
58. Brazil-U.S. Business Council. Greater Brazil: INDUSTRIAL POLICY, COMPETITIVENESS, AND GROWTH. PDF. Washington, DC: US Chamber of Commerce, 2015.
59. Statista. "Brazil - Youth Unemployment Rate 2007-2017 | Statistic." Statista. 2017.

- <https://www.statista.com/statistics/811696/youth-unemployment-rate-in-brazil/>.
60. OECD (2015), Innovation, Agricultural Productivity and Sustainability in Brazil, OECD Food and Agricultural Reviews, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264237056-en>
 61. "Law No. 9,394, Of December 20, 1996." December 20, 1996. Accessed April 19, 2019. http://www.planalto.gov.br/ccivil_03/leis/l9394.htm.
 62. Salto, Dante J. "Brazil: A For-Profit Giant." International Higher Education. 2014. Accessed April 19, 2019. <https://Ejournals.Bc.Edu/Index.Php/lhe/Issue/View/598/24>.
 63. "Universities." DWIH São Paulo. Accessed April 19, 2019. <https://www.dwih-saopaulo.org/en/research-innovation/the-research-and-innovation-landscape-in-brazil/research-and-innovation-organizations/universities/>.
 64. "The Best Universities in Brazil, Ranked." U.S. News & World Report. Accessed April 19, 2019. <https://www.usnews.com/education/best-global-universities/brazil>.
 65. "AEPLAN - UNICAMP" AEPLAN. Accessed April 28, 2019. https://www.aeplan.unicamp.br/anuario/anuario_2017.php.
 66. "Top Agricultural Sciences Universities in Brazil | US News Best Global Universities." U.S. News & World Report. Accessed May 01, 2019. <https://www.usnews.com/education/best-global-universities/brazil/agricultural-sciences>.
 67. Junqueira Franco, interview by Center for Experiential Learning, March 14, 2019.
 68. Over 61 percent of Brazil's annual sugarcane crop is used in ethanol production.
 69. Barros, Sergio. "USDA Foreign Agricultural Service's Global Agricultural Network." August 30, 2018. [https://gain.fas.usda.gov/Recent GAIN Publications/Biofuels Annual_São Paulo ATO_Brazil_8-10-2018.pdf](https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Biofuels%20Annual_S%C3%A3o%20Paulo%20ATO_Brazil_8-10-2018.pdf).
 70. Raizen, 2017-2018 Annual Report. Accessed April 2019. https://www.raizen.com.br/relatorioanual/pdf/EN_Raizen_PDF_simplificado.pdf.
 71. "Bayer Brazil's Theo Van Der Loo." Bayer Brazil's Theo Van Der Loo. Accessed April 20, 2019. <https://www.boyden.com/media/bayer-brazils-theo-van-der-loo-2089033/index.html>.
 72. "Young talents." Bayer Careers Brazil. Accessed April 20, 2019. <https://carreiras.bayer.com.br/en/working-in-bayer/jovens-talentos/>.
 73. "Labor Market." Investe SP – Paulista Agency of Promotion of Competitiveness and Investments. Accessed April 19, 2019. <https://www.en.investe.sp.gov.br/why-sao-paulo/diversified-economy/labor-market/>.
 74. "Human Development Indicators - Argentina." Human Development Reports. Accessed May 1, 2019. <http://hdr.undp.org/en/countries/profiles/ARG>.

75. "Human Development Indicators – Brazil; Health." Human Development Reports. Accessed April 17, 2019. <http://hdr.undp.org/en/countries/profiles/BRA>.
76. Simoes, Alexander. "Brazil." OEC - Brazil (BRA) Exports, Imports, and Trade Partners. Accessed April 19, 2019. <https://atlas.media.mit.edu/en/profile/country/bra/#Exports>.
77. Valdes, Constanza, Kim Hjort, and Ralph Seeley. "Brazil's Agricultural Land Use and Trade: Effects of Changes in Oil Prices and Ethanol Demand, ERR-210." U.S. Department of Agriculture, Economic Research Service. June 2016.
78. Amaral, Weber Antonio Neves Do, and Alessandro Peduto. "Food Security: The Brazilian Case." International Institute for Sustainable Development. December 14, 2017. Accessed April 19, 2019. <https://www.iisd.org/library/food-security-brazilian-case>.
79. Rasso, Ebe, and Genard Burity. "Brazil - Infrastructure." Export.gov. October 10, 2018. Accessed April 19, 2019. <https://www.export.gov/article?id=Brazil-Infrastructure>.
80. Meyer, Amelia. "Brazil Roads." Brazil. April 16, 2019. Accessed April 19, 2019. <https://www.brazil.org.za/brazil-roads.html>.
81. "Highway System of São Paulo." Wikipedia, the Free Encyclopedia. December 11, 2018. Accessed April 19, 2019. https://en.wikipedia.org/wiki/Highway_system_of_São_Paulo#Infrastructure.
82. "South America, Brazil Inland Waterways." World Wide Inland Navigation Network. Accessed April 19, 2019. <https://www.wwinn.org/brazil-inland-waterways>.
83. Mello, Juliana. "Logistics and Distances in Brazil." The Brazil Business. Accessed April 19, 2019. <https://thebrazilbusiness.com/article/logistics-and-distances-in-brazil>.
84. Rasso, and Burity. "Brazil - Infrastructure."
85. "Logistics." Vale. Accessed April 19, 2019. <http://www.vale.com/EN/business/logistics/Pages/default.aspx>.
86. "84 Million Brazilians Are Connected to Smartphones." The Brazilian Report. June 27, 2018. Accessed April 19, 2019. <https://brazilian.report/money/2018/06/27/brazil-internet-smartphones/>.
87. "Top Countries/Markets by Smartphone Penetration & Users." Newzoo. April 20, 2018. Accessed April 19, 2019. <https://newzoo.com/insights/rankings/top-50-countries-by-smartphone-penetration-and-users/>.
88. Freitas, Tatiana, and Fabiana Batista. "Giant Brazil Farms Look to Close Tech Divide." Bloomberg Technology. September 25, 2018. Accessed April 19, 2019. <https://www.bloomberg.com/news/articles/2018-09-25/giant-brazil-farms-look-to-close-tech-divide-as-deere-steps-up>.
89. Cosgrove, Emma. "Why Qualcomm Ventures Sees Farm Connectivity Challenges as Opportunity." AgFunderNews. April 27, 2018. Accessed April 19, 2019. <https://agfundernews.com/qualcomm-ventures.html>.

90. Comtesse, Nathalie. "The Brazilian AgTech." Master's thesis, University of Lausanne, 2019.
91. "The Brazilian Agtech Valley: The Piracicaba Valley and the Agro-Technological Revolution." Vaz De Almeida Advogados. May 30, 2018. Accessed April 19, 2019. <https://vazdealmeida.com/the-brazilian-agtech-valley-the-piracicaba-valley-and-the-agro-technological-revolution/>.
92. Jardim, Francisco. "Brazil Agtech Market Map: 338 Startups Innovating in Agricultural Powerhouse." AgFunderNews. July 13, 2018. Accessed April 20, 2019. <https://agfundernews.com/brazil-agtech-market-map-338-startups-innovating-in-agricultural-powerhouse.html>.