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CHINA-ZAMBIA ECONOMIC RELATIONS

Perspectives From the Agricultural Sector

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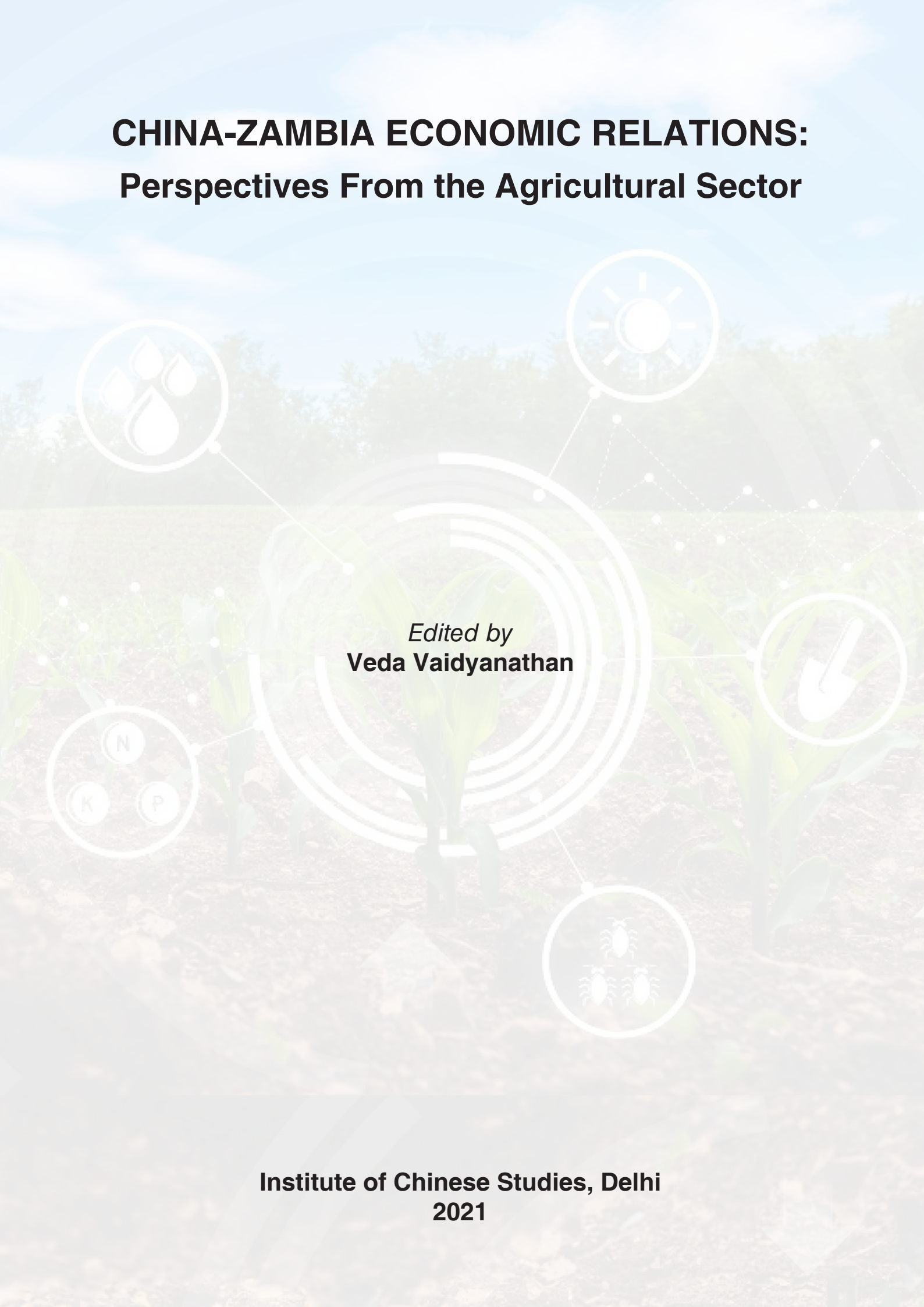
CHINA-ZAMBIA ECONOMIC RELATIONS:
Perspectives From the Agricultural Sector



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Preface

China's economic relations with emerging economies, particularly in the African continent, has generated significant attention due in part to the developmental outcomes of its trade and investment activities. The Institute of Chinese Studies (ICS) explores China's polity, economy, history, culture, society and foreign policy with particular reference to India-China relations. In recent years, ICS research has expanded to include China's relations with other parts of the world under its 'China in the World' research programme. As part of this endeavour, the study led by Dr. Veda Vaidyanathan titled '**China-Zambia Economic Relations: Perspectives from the Agricultural Sector**' comes at a timely moment.

This study is part of a series of projects that examine Chinese engagement in Africa. In November 2019, the ICS published a monograph examining Chinese infrastructure development in Tanzania and Kenya. The research project, also led by Dr. Vaidyanathan, adopted a case study method and involved a multi-cultural team which conducted extensive fieldwork and generated primary data. Similarly, this project will contribute to the larger conversation surrounding Chinese engagement in the African continent.

This study that combined serious desk research with fieldwork, is the result of a transcontinental collaboration between scholars from India, China and Zambia. The work provides an in-depth and critical analysis of the various layers of Chinese engagement in Zambian agriculture, explores the nature of cooperation, examines the multiple interventions, analyses the different models of investments and provides examples of new technologies used to address old challenges. Relying on interviews with several stakeholders and case studies of various projects, the study provides new insights just as it connects and contextualizes data provided by various international organisations. The ICS will continue to facilitate such transnational research projects examining Chinese engagement in various African countries. Considering that India is presenting itself as a viable partner to the African development effort, the ICS aims to inform policy makers, scholars and members of the industry of the fast-evolving dynamics of the region.

We are happy to offer this study as part of the ICS research programme and am sure it will contribute to the overall conversation on China's work in Africa. I commend Dr. Veda Vaidyanathan and the multi-country team on bringing out the study.

Ashok K. Kantha
Director, Institute of Chinese Studies, Delhi

Foreword

It is a great pleasure and privilege to write this Foreword for the Institute of Chinese Studies (ICS) monograph titled *China-Zambia Economic Relations: Perspectives from the Agricultural Sector*.

The ICS seeks to promote interdisciplinary study and research on China and East Asia while fostering links with governmental and non-governmental organizations in India through applied research. It is gratifying that the ICS has included in its research programme a number of African countries with 'Chinese connections', such as Kenya, Tanzania, and now Zambia with this monograph. In doing so, the ICS is rendering a great service in not only in highlighting Sino-African relations that have and continue to expand but in disseminating invaluable information and research outputs.

This is a remarkable monograph in some important respects, not least because it is a multinational effort led by Dr. Veda Vaidyanathan. The monograph drew together experts and researchers from China, India and Zambia. It provides an overview of China-Zambia economic engagement by closely looking at the cooperation between the two countries in agriculture.

It is befitting that both Chinese and Indian researchers should be involved in the research, not only because Zambia has greatly benefited from both Chinese and Indian technical assistance in various areas, but because it also signifies important global South-South cooperation. It is also noteworthy that the team of authors included Zambian Ministry officials which presumably incorporates policy and practical implementation outlook.

Even more importantly, the work done is significant in the way it was undertaken, most of it is evidence based. The authors collected grassroots perspectives from a multitude of stakeholders to shed light on relations of what might otherwise be lost by simply adhering to numbers.

The spread of chapters speaks to how comprehensive the monograph is while being sufficiently focused on its purpose. As will be apparent from the outline of the monograph, the coverage is broad ranging in keeping with what the researchers sought to canvas. The topics covered range from bilateral trade relations to investment training, knowledge transfer and technology demonstration, among many others.

I would like to mention in passing that from the International Labour Organization (ILO) point of view, the impact on jobs and capacity building through training and knowledge transfer which is apparent from some of the research is of great interest, hopefully, it will be followed up with other similar studies.

The monograph is also timely as it comes at a time when there is increasing debate about the role of China in Africa. There is, therefore, a need for evidence-based studies like this monograph provides, to contribute to an informed discussion about the impact of Chinese intervention in Africa.

I sincerely commend Dr. Veda Vaidyanathan and the other contributors for producing this informative evidence-based study. It will not only provide policymakers and researchers invaluable information on one of China's leading technological aid interventions but hopefully, it will further inspire similar studies on other Sino-African cooperation projects.

I would therefore strongly recommend this monograph to all policymakers, researchers and interested public at large who would like to gain insights not only into the specifics of China's role in Africa, but also the larger conversations surrounding South-South development cooperation.

Prof. Evance Kalula
Chairperson, ILO Committee on Freedom of Association (CFA)
Emeritus Professor of Law, University of Cape Town.

Acknowledgements

This research project was designed at the Institute of Chinese Studies (ICS) in 2019, with the aim of better understanding Chinese economic engagement in Zambia, especially examining the nuances of cooperation in the Zambian agricultural sector. A collaborative effort, this study brings to the fore voices of Indian, Zambian and Chinese scholars and experts based at multiple institutions including the ICS, Zambia Institute for Policy Research and Analysis (ZIPAR), the Ministry of Agriculture in Zambia to name a few.

Conducting an evidence based empirical study required thorough secondary research, data analysis, extensive fieldwork and was made possible due to funding from the Tata Trusts and their support is gratefully acknowledged. This project would not have been conceivable without the constant encouragement of Amb. Ashok K. Kantha, Director and Prof. Patricia Uberoi, Chaiperson, ICS. My gratitude extends to Amb. Ashok Attri, former Indian High Commissioner to Zambia and Amb. David Shinn, former US Ambassador to Burkina Faso and Ethiopia and Professor at George Washington University for reviewing the full draft of the monograph and providing constructive comments that helped strengthen it. I am also thankful to Prof. Evance Kalula, Chairperson, ILO Committee on Freedom of Association (CFA), Emeritus Professor of Law, University of Cape Town for his insights and for writing the foreword.

I would like to acknowledge the several stakeholders interviewed in Lusaka, Chisamba, Chingola, Ndola, Kitwe for their frank and open responses to questions posed, anonymously and otherwise. The support extended by officials at the Indian High Commission in Lusaka is also appreciated. Remarks and observations made by participants of the ICS Wednesday seminar titled ‘China in Zambia: Notes from the field’ held in December 2019 where primary findings were first presented is acknowledged.

Thanks to the contributors of this volume, for their patience and cooperation while this monograph was taking shape. I also join them in thanking the organizations that have enabled their research. My appreciation extends to Dr. Madhurima Nundy, Assistant Director, ICS for her support during multiple phases of the project cycle. The assistance provided by Ms. Adveetya Kachiar, Ms. Neha Mishra and Ms. Preksha Shree Chhetri during the process of publication is recognized and the work of Ms. Bihu Chamadia, Research Assistant on this study is also appreciated. The efforts of Mr. Prithvi Raj Singh, Administrative & Programme Officer, ICS and Ms. Poonam Singha, Accounts Officer, ICS for helping organize fieldwork logistics are also gratefully acknowledged. A hat tip to other Research faculty and Administrative staff at the ICS for their good humor, warmth and support extended during the course of this study.

Dr. Veda Vaidyanathan
Visiting Associate Fellow, ICS & Project Lead

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List of Abbreviations

ACCZ	Association of Chinese Companies in Zambia
AGOA	African Growth Opportunity Act
AIBO	Academy of International Business Officials
AI	Artificial Intelligence
ATDC	Agricultural Technology Demonstration Center
BOC	Bank of China
BOP	Balance of Payments
CATIC	China National Aero-Technology Import and Export Corporation
CAPIAC	China Association for the Promotion of International Agriculture Cooperation
CAAIC	China Africa Agriculture Investment Corporation
CCM	China Copper Mines
CDC	Centers for Disease Control
CNMC	China Non-Ferrous Metal Mining Company
CNMC	China Non-ferrous Metals Company
CSFAC	China State Farm Agribusiness Corporation
FAO	Food and Agriculture Organisation
FDI	Foreign Direct Investment
FOCAC	Forum on China Africa Relations
GDP	Gross Domestic Product
GoC	Government of China
GoZ	Government of Zambia
HCQ	Hydroxychloroquine
HRW	Human Rights Watch
ICT	Information and Communication Technology
MFEZ	Multi Facility Economic Zone
ML	Machine Learning
MoA	Ministry of Agriculture
MSME	Micro, Small and Medium Enterprises
NRDC	Natural Resources Development College

ODA	Official Development Assistance
PIGA	Partnership for Investment and Growth in Africa
SDGs	Sustainable Developments Goals
SEZs	Special Economic Zones
SME	Small and Medium Enterprises
SOE	State Owned Enterprises
TEVETA	Technical Education, Vocational and Entrepreneurship Training Authority
UAS	Unmanned Aircraft Systems
WHO	World Health Organisation
XAG	Guangzhou Jifie Technology Co. Ltd.
ZAMTEL	Zambia telecommunications
ZAF	Zambia Air Force
ZCMT	Zambia - China Mulungushi Textile Joint Venture
ZCCZ	Zambia-China Economic and Trade Cooperation Zone
ZCCM-IH	Zambia Consolidated Copper Mines
ZDA	Zambia Development Agency
ZIPAR	Zambia Institute for Policy Analysis and Research
ZMK	Zambian Kwacha

Introduction

Veda Vaidyanathan

Over the past two decades, since setting up the Forum on China Africa Relations (FOCAC) there has been significant interest in closely analyzing China's increasing footprint in African countries. Although economic considerations are frontlining conversations, the narrative that is often strung together is that of win-win partnerships and alternate models of development. While analysis pertaining to China-Africa engagement often presumes a continental posture, in reality, individual countries have very different strategies of dealing with China. Zambia, for one, has been a reliable partner for China with a relationship dating back to the Bandung Summit in 1955. While China's material and financial assistance to the country during its anti-colonial struggles until independence in 1964 often find mention in scholarly works, the oft-quoted example that backs up the claim of the China-Zambia 'all weather friendship' is the TAZARA railway.

Built in the 1970's, it was the largest ever foreign development project China had undertaken and Chinese engineers and technologies were sent to complete the historic railway line that helped Tanzania and Zambia reduce their dependence on apartheid South Africa. The National Museum in Lusaka has an entire section to commemorate this railway line, which has pictures of Chinese engineers wading through thorns and bushes, exhibits of workers possessions including straw hats and water bottles, maps and timelines explaining how and when each section was built. Decades after the railway first became operational, driving from the airport in Lusaka into the city, it is very clear that cooperation with the Chinese has been growing since. Several infrastructure-project sites in Lusaka have red banners at the front with Chinese characters, including an impressive new building of the 'Levy Mwanawasa General Hospital', built by the Shanxi Construction Engineering Group which has become incredibly critical in Zambia's fight against COVID-19.

The National Museum in Lusaka has an entire section to commemorate this railway line, which has pictures of Chinese engineers wading through thorns and bushes, exhibits of workers possessions including straw hats and water bottles, maps and timelines explaining how and when each section was built.

This monograph seeks to provide an overview of China-Zambia economic engagement, while closely examining their cooperation in agriculture. With 10 farming blocks, a total of 100, 000 hectares, the Government of Zambia has measures in place to lease land, usually for a period of 99 years to foreign investors. According to an official from the Zambian Ministry of Agriculture, the country is especially appealing to foreign investors as it is "politically stable, there has been no war since independence, no forex crisis and is blessed with a suitable climate" (Personal

Interview, Lusaka, September 2019). He explains that "the country is divided into 3 areas: Area 1 receives less than 800 mm rain, Area 2, between 800-1000 mm and Area 3, less than 1000 mm rain fall/ annum. As soil quality is high, the number and type of crops that can be grown are higher. This means that there is an opportunity to not just meet domestic demand but also export and sell, but right now, Zambia just doesn't have the volumes. But considering Chinese entrepreneurs are looking for markets outside China, their production capacity and technology advantage will allow them to establish quickly in Zambia" (Personal Interview, Lusaka, September 2019).

While Chinese entities have been active in Zambia's agricultural landscape for decades now, the nature, form and actors involved have undergone substantial change. Chinese firms are using technology including artificial intelligence to control pests and improve crop productivity, linking agricultural universities and resources with counterparts in China to build capacity, introducing new forms of funding with real estate companies branching out to build futuristic ecological parks where Chinese State and Privately-Owned large scale commercial farms work closely with local communities. Recognizing, separating and studying various layers of Chinese engagement in this sector provides an understanding of not only the myriad actors that exist, but throws light on the fact that their intentions, experiences and outputs are varied. This reminds us to not homogenize the China in Africa or China in Zambia theme, but to read between the lines and examine the granular details because the smaller components are as complex as the big picture and are also worthy of scholarly attention.

The significance of agriculture notwithstanding, fact remains that mining continues to be one of the most critical sectors for the Zambian economy. It is Africa's second-largest producer of Copper and contributes to 78.4 per cent of total export value, 31.4 per cent of government revenues (EITI, Zambia) and has therefore resulted in several global mining companies establishing a strong foothold in the country. While the sector has traditionally been dominated by Western companies, Chinese actors have been increasing their footprint across the value chain. A senior Zambian government official interviewed estimates that within the next three to five years, at least five of the mines in the Copperbelt region could be Chinese owned (Personal Interview, Kitwe, September 2019). In addition to Chinese companies purchasing majority shares in traditional mines, several small-scale businesses are active in the sector, processing copper collected from dump sites and exporting the products to India and China. While some of these entrepreneurs have experience with mining in China, others came to different parts of Africa as traders and moved to Zambia drawn by the potential of the mining sector.

While the sector has traditionally been dominated by Western companies, Chinese actors have been increasing their footprint across the value chain. A senior Zambian government official interviewed estimates that within the next three to five years, at least five of the mines in the Copper belt region could be Chinese owned

One of the cases examined closely during fieldwork in the Copperbelt was of China Copper Mines (CCM). According to the senior managers interviewed, the company's initial interest in the region stemmed from old documents which showed that Zambia Consolidated Copper Mines Limited had already explored the area and had found presence of Copper. Jiangxi Copper Corporation followed up on this and conducted pilot projects with their technical teams in China which were successful. CCM then proceeded to buy a large-scale mining license from a community of 40 shareholders or artisanal miners who, according to CCM, did not have the equipment needed to develop it. While the assessments had been accurate, the soil in the land they acquired contains 0.5 - 0.8 per cent Copper content, which isn't ideal as bigger companies have access to regions with 1.2 per cent Copper content. However, in the last 5 years, CCM's attempt has been to optimize production and they finally broke even in 2017.

While the inputs are sourced from South Africa and China, their Copper is sold to trading companies who in turn sell to clients in Taiwan, Malaysia and Abu Dhabi. The company employs over 300 locals and 23 Chinese workers who largely work as technicians including mechanical engineers for mining and processing, team leaders and administrators (Personal Interview, Chingola, Senior Manager China Copper Mines, September 2019). However, several charges of flouting labor and environmental regulations were leveled against CCM with residents of Chingola staging a protest in 2015. The Zambia Environmental Management Agency (ZEMA) served the company with an Environmental restoration order to take measures to 'reduce, remedy or mitigate adverse effects related to pollution of the Fitula and Muntimpa Streams and surrounding environs resulting from its Leaching and Solvent Extraction Operations" (Lusaka Times, October 2015).

Similarly, infrastructure development is a crucial component of China-Zambia engagement. Between the 1970's and 80's alone, in addition to the Tazara railway that connected Kapri Mposhi to Dar es Salaam, another significant project is the Zambia - China Mulungushi Textile Joint Venture (ZCMT). The original factory was built on a Ministry of Defense building with Chinese aid in 1983, was revived again in 1997 by management and technical staff from Qingdao Textile Corporation from Shandong Province, has since then expanded into 10,000 hectares of cotton farms, ginneries to process cotton, refinery to produce cotton seed oil and exports to several countries in the region and to the USA under the African Growth Opportunity Act (AGOA) (People's daily, November 2003). Other projects include the Lusaka-Kaoma Road (financed by an interest free US$12 Million loan in 1967, completed in 1975), the Serenje-Samfya-Mansa Road (financed by a US$14 Million-dollar loan, originally signed in 1974 and extended to 1987), a diplomatic radio station completed in 1973, the Mongu-Kalabo 34-kilometer road with 26 bridges across it, Tuta bridge in Northern Zambia are some of the others (Mwanawina, Inyambo, February 2008). In the more recent past, Chinese construction firms have undertaken projects that include the US$ 360 Million expansion project at the Kenneth Kaunda International airport in Lusaka, the new international airport in Ndola city of Zambia - which includes a 12,000 square

meter modern terminal building, a 3.5 kilometer runway, cargo terminal as well as a hotel - costing US$ 397 Million dollars, the Mongu - Kalabo Road, a 34 km road with 26 bridges constructed by China's Avic International, financing and construction of the 50,000 capacity National Heroes ultra-modern stadium in Lusaka, and 49,800 capacity Levy Mwanawasa Stadium in Ndola city on the Copperbelt Province (Xinhua, August 2014).

In 2018, the Kafulafuta water supply system project was undertaken by China National Complete Engineering Corporation. The project aims to improve access to clean and safe drinking water and involves the construction of a dam - which will hold about 125 million cubic meters of water - two pump stations, raw water pipelines, extension of the pipe network to un-serviced areas and repairing of old leaking pipes. The project is a part of Zambian commitment to Sustainable Developments Goals (SDGs) to provide universal access to safe and clean drinking water to all people by 2030 (Ministry of Water Development, Sanitation, and Environmental Protection, 2019). In 2017, Zambia and China signed an agreement worth US$ 280 Million for the construction of 1,009 communication towers across rural areas by Zambia telecommunications company network (ZAMTEL) and as of end 2018, 472 had been constructed (Platform for Agricultural Risk Management, 2019). In January 2020, the Kingsland City Housing Mega-housing project was launched between Chinese firm Sun Share Group and the Zambia Air Force (ZAF) to build 3000 high end housing units, malls, parks, schools and sports facilities across 2,718 acres. It is a Public-Private partnership project with three developers - Datong Construction, Drimtown Investments and Shangria Investments - who have been granted concessions for two-three decades by when they can break even before handing ownership to the ZAF (J. Hwang, 2020).

While most of players in the Zambian infrastructure markets were provincial companies from Henan, Fujian, Jiangxi with time, other SOE's and private players have begun to dominate the markets. Talking to managers from these construction companies, they admit that their biggest competition is other Chinese firms. However, in mega projects like the airport redevelopment plan, more than one Chinese company is involved. For instance, while Jiangxi overlooks project management, engineering and translation, there are over 4-5 sub-contractors like Huashi with over 200 workers, mostly foremen, working on site. In such project sites on average, 1 Chinese manager supervises 20 local workers. The issue of workers efficiency was also brought up regularly with multiple contractors arguing that management is more efficient in China and efficiency levels are also different.

However, there has also been some criticism of Chinese-built infrastructure in Zambia. Media reports that the Lusaka - Chirundu road built by China Henan company in 2011 was damaged after the first rains (The Economist, 2011). Similarly, two stadiums built by China in the capital Lusaka and Ndola were categorized as 'white elephant' investments and garnered significant criticisms locally as the cost-benefit ratio of impact on local communities or jobs these structures have created remain low.

Image 1 & 2: Chinese-built stadiums in Lusaka and Ndola

Source: Photographs taken by the author during field visit in 2019

Regardless, to facilitate growing Chinese businesses active in Zambia, the state-owned commercial Bank of China (BOC) opened a branch in Lusaka in 1997 in addition to a Chinese Centre for Investment Promotion and Trade. While the Association of Chinese Companies in Zambia (ACCZ) or the Chinese Chamber of Commerce also provide services and information to investors, the Economic Counselors office at the Chinese embassy gives investment advice to potential investors and assists Chinese businessmen in their interaction with Zambian authorities.

It is pertinent to mention however, that one of the biggest challenges facing Zambia is the country's national debt. According to World Bank data, the external debt stock of Zambia has jumped 45 per cent of GDP in 2019 from 37 per cent in 2018, and the total public debt stock is estimated at 89 per cent of GDP (World bank, 2020). Interestingly, China has been the single biggest creditor and finance provider to Zambia for its development and infrastructure projects since its independence and this brings up the issue of debt sustainability. Although Zambia has received the biggest debt relief in Africa with US$246 million, compared to US$3 million to Nigeria, (Development Reimagined, 2019), there were several reports that Chinese companies are refusing to restructure existing debts in light of the COVID-19 pandemic and are seeking fresh collateral in case of default, including Zambian state assets (CNBC, 2020) such as the electricity company Zesco, the TV and radio news channel ZNBC and even the Lusaka airport. While these claims that the Zambian government were exploring debt/asset swap options were dismissed by President Edgar Lungu and other officials in 2018 (The East African, 2018), Zambia became the first African nation to default on its debt in the pandemic era, when it defaulted on a US$42.5 million payment on a Eurobond (CNBC, 2020). Given that the estimates of the scale of Zambian debt to China range from US$3billion to US$20 billion, bondholders are reluctant to defer debt service payments as it could be diverted to servicing Chinese loans (P. Fabricius, 2021).

It is pertinent to mention however, that one of the biggest challenges facing Zambia is the country's national debt.

These doubts aren't entirely baseless as in March 2019, China Exim Bank threatened that Chinese contractors would stop work on infrastructure projects in Zambia if arrears were not paid and several road construction projects contracted to Chinese firms were suspended later that year. Faced with mounting debt, in 2020, President Lungu's office released a statement that he had requested President Xi for 'debt relief and cancellation' in a telephonic conversation in light of the negative impact the pandemic has had on the country's economy (The East African, 2020).

The increasing levels of debt have also contributed towards tangible negativity towards the Chinese community living in Zambia. It does not help that there is a perception of Chinese influence over Zambia's media landscape, a claim strengthened when state owned Times of Zambia published a lead story in Mandarin in October 2018 and garnered a lot of backlash (M. Evelyne, October 2018). Furthermore, China owned StarTimes - which has subsidiaries in over 30 African countries, termed by the Economist as 'the primary vehicle for the expansion of Chinese Soft Power in Africa' (The Economist, 2018) owns 60 per cent stake in TopStar Communications, a joint-venture set up to digitize its broadcast infrastructure, with Zambia's national broadcaster ZNBC - with ZNBC expected to repay the loans accrued to fund this digitalization from income generated by sales of decoders, subscriptions and advertisements. However, as ZNBC has failed to repay installments of the loan, rumors of a merger were floated with other reports suggesting that Chinese StarTimes has taken over some of ZNBC activities and will manage TopStar until the loan is repaid in full (Arve Ofstad and Elling Tjønneland, 2019). The increasing economic footprint across sectors has not only resulted in over a thousand Chinese companies active in Zambia but also the presence of a strong diaspora. This has led to the creation of platforms like the Zambia-China Association that allows SME's and businessmen to support each other, which comes with its own complexities and challenges.

It does not help that there is a perception of Chinese influence over Zambia's media landscape, a claim strengthened when state owned Times of Zambia published a lead story in Mandarin in October 2018 and garnered a lot of backlash

Another increasingly important aspect of China - Zambia relationship is their Cooperation in Health, especially in light of the global pandemic. Thus far, the Chinese government has sent 21 medical teams and 574 medical team members to Zambia since 1978 and the teams have treated more than 3 million patients, carried out more than 20, 000 types of surgeries and introduced and implemented over 700 new technologies and projects (Xinhua, 2019). Chinese doctors also visit Zambian hospitals on projects funded by the WHO such as the "Bright Journey" program aimed at galvanizing support towards the elimination of blindness in the world, wherein these doctors conducted eye surgeries at Levy Mwanawasa Medical University and also the Livingstone General Hospital. During the two weeks that the program was running around in December 2019, 822 people were screened with over a 100 receiving the surgery (Xinhua, 2019). In 2018, the Chinese government donated about US $314,000 to help Zambia control and

tackle the Cholera outbreak and Chinese enterprises operating in Zambia also had contributed over US $100,000 in cash donations (Xinhua, 2018).

As in other countries in Africa, interactions are not restricted to the Chinese state, sub-national actors like China's Luoyang city in Henan Province have signed agreements to collaborate with the doctors in the Chinese built Levy Mwanawasa Hospital. While the agreement involves construction of joint centers for cardiology, dermatology and so on, it also includes the promotion of Chinese traditional medicines at the hospital. They also plan to carry out exchanges in specialized subject development, disease prevention and control, personnel training and academic exchanges (Xinhua, 2019). Organisations like Huawei and philanthropists like Jack Ma have also made significant contributions to Zambia's fight against COVID-19 including protective equipment for front line staff, face shields, masks, ventilators and infrared thermometers.

They also plan to carry out exchanges in specialized subject development, disease prevention and control, personnel training and academic exchanges (Xinhua, 2019).

In telephonic interviews conducted with Zambian public health experts and members of the country's COVID-19 task force since the outbreak of the pandemic, they underscored the country's weak health infrastructure and its unpreparedness. While several sub-committees have been formed to research, oversee, advice and manage the limited resources, the challenges have been mounting. These included lack of laboratory equipment and technicians and low levels of testing - at the time of interview in August 2020 - only 25000 people out of a population of 17 million had been tested. They also mentioned that masks and sanitization weren't seriously enforced and so the urban spaces were still crowded. According to a doctor at the Zambia National Public Health Institute, disseminating information, asking people to socially distance themselves and making them aware of proper sanitization has been difficult, he asked "in some parts of the country where people don't have running water, how can they wash hands every 20 minutes?" (Telephonic Interview, August 2020).

They also mentioned that masks and sanitization weren't seriously enforced and so the urban spaces were still crowded.

China's assistance to Zambia during the pandemic becomes critical especially in light of the fact that Zambia has requested for emergency support under the Rapid Credit Facility to the International Monetary Fund. Other governments and organizations have stepped in with support including the World Bank (Approx. US$53 Million), the African Development Bank (Approx. US$34 Million), The United Kingdom (Approx. US$35 Million) and The United States of America (Approx. US$13 Million), Germany (Approx. US$18 Million) and India too contributed supplies of medical kits and consignments of medical drugs including the highly desired Hydroxychloroquine (HCQ). Furthermore, with the technical support from the U.S. Centers for Disease Control (CDC), the

first testing capabilities in Zambia was established in Lusaka on 11 February 2020 and helped validate machine processes, methods, and quality control for accurate results while another Lusaka-based lab opened on 12 February 2020 with the support of Japanese government (Global Call to Action Against Poverty, April 2020).

However, the main COVID-19 hospital in the country remains the Chinese funded and built Levy Mwanawasa Hospital in Lusaka with has 826 beds for patients who have tested positive and are symptomatic. Several video conferences have also been organized by experts in China and their Zambian counterparts to share their experience in fighting the pandemic. Additionally, an agreement has been signed between China and Zambia of 28 April 2020 for the supply of medical equipment to fight COVID-19 and the first batch of anti-epidemic goods had been handed to Zambia officially on the same day.

As this author argued in the ICS Analysis in June 2020, African partners including Zambia are going to be critical in Beijing's post Covid-19 narrative building exercise and this is already evident in Lusaka. As the first batch of supplies including medical face masks, protective suits and infrared thermometers arrived in Lusaka, the Zambian Ambassador to China, Winnie N. Chibesakunda stated "*Despite the unexpected nature of this outbreak and the complexity of dealing with an unknown virus, the Chinese government demonstrated an uncommon level of unity, preparedness, agility, commitment, efficient coordination of institutions at all levels, coupled with the invaluable collective cooperation and support of the public…The response of the Chinese government and its people to the COVID-19 pandemic has been exceptional and very inspirational"* (China Daily, 2020).

This project, undertaken as part of the ICS 'China in the World' Research programme sought to collect grassroots evidence from stakeholders in Zambia to understand the nuances of this dynamic relationship, that is often lost in the numbers. One of the key factors that sets this publication apart from others exploring similar themes is the fact that this multi-author volume is the collective effort of researchers and experts based in Zambia, India and China. In addition to perspectives of scholars based in research institutes in New Delhi (ICS) and Lusaka (ZIPAR), it also includes chapters written by officials at the Ministry of Agriculture, Zambia as well as a Zambian researcher based in China and a Chinese expert based in Africa. One of the researchers on this project, based at IIM-Kashipur at the time of writing, helped with strengthening the quantitative aspects of a chapter while another researcher at Central European University helped edit the drafts. This publication is therefore a truly transnational effort - which has taken over a year to complete. Moreover, information ascertained from secondary and primary sources is accompanied by insights collected during the fieldwork conducted by the authors at different times in Zambia.

This publication is therefore a truly transnational effort - which has taken over a year to complete.

CHAPTERS OUTLINES

The first chapter titled '*Bilateral Trade Relations between China and Zambia over 2000-2018*' authored by Dr. Ceaser Cheelo at the Zambia Institute for Policy Analysis and Research (ZIPAR), contributes to the literature on China-Zambia relations, analysing the evolving patterns of bilateral trade over the period 2000-2018 and the implications for Zambia, a small open economy. He uses internationally comparable data in a descriptive statistical analysis and empirically establishes the stylized patterns and trends of bilateral China-Zambia trade. Drawing a comparison between the starkly different economic contexts of both countries he examines the implications that conducting trade with China has on Zambia's smaller economy. He then identifies the commodities that are traded and attempts to explain the rationale behind China gaining significant market access over the past decade. Among other things, he also observes how a number of other factors - investment, finance, debt relations and geopolitical ties - confound trade relations.

The second chapter on Chinese Investments in Zambia from 2000-2018 provides a sectoral analysis of investment flows and puts into perspective what percentage of Foreign investment in Zambia originated in China. It then provides an overview of the Mining, Infrastructure and Manufacturing sectors focusing on the nature of jobs generated. It also examines high profile investments made in the infrastructure sector including development of multi-facility economic zones. It explains the impact that the fall of commodity prices, partly driven by the slowdown in China's industrial sector, had on the Zambian economy. The chapter also points out the impact that the devaluation of the Chinese Yuan had on the Zambian Kwacha. It also highlights how factors such as low rainfalls led to power shortages and inconsistent electricity supply (due to Zambia's reliance on hydro power) and the economic impact it had on companies, including Chinese owned mines.

Once an overview is provided on the Economic engagement between Zambia and China over the past decade, the monograph then shifts focus to the agriculture sector. The third chapter is authored by Musadabwe Chulu, Nkumbu Nalwimba & George T. Mudimu and is titled '*Enhancing Zambia's Human Capacity? The Dynamics of China-Zambia Agriculture Skills and Knowledge Transfer*'. It puts into context the significance of the agricultural sector and provides an overview of China-Zambia cooperation in agriculture. The main thrust of this chapter, however, is to provide a detailed perspective on the skills and knowledge transfer. It explores the dynamics of the Chinese training of Zambian officials, more specifically, drawing from primary and secondary data, the Chapter examines how the agricultural skills transfer occurs, what factors influence the training programs, and the relevance of the skills and knowledge to Zambia's agriculture vision and goals. The authors argue that the training has introduced Zambians to new technology as well as advancing knowledge on how to maintain existing technology; which is important to a nation that has limited resources to carry out a wide-scale human capacity building program. However, at the same time, the sustainability of the donor-driven nature of training programs has been exposed to the Zambian's state limited financial resources. More so, the utility and appropriateness of some of the skills transferred is brought under spotlight amidst different country

contexts. Themes such as training and participant selection, nature of training are explored as well as the applicability of knowledge transferred is also analysed. As the authors themselves have been recipients of Chinese scholarships and have been trained in China before returning to Zambia, the chapter couples the first-hand experience with a unique state perspective.

The fourth chapter titled '*Artificial Intelligence in Zambian Agriculture: Case Study of a Chinese firm 'XAG'*, by Muyobozi Sikalubya, a PhD scholar at Peking University evaluates the extent to which Chinese firms facilitates the application of Artificial Intelligence in the Zambian agricultural system, precisely on the fight against the Fall armyworm. As the agriculture sector in Zambia is facing multiple challenges the country has witnessed a significant decrease in production, triggering high demand for food. Correspondingly, the availability of natural resources such as freshwater and productive arable land is becoming increasingly constrained. There is therefore a need to adopt more productive, efficient, sustainable, inclusive, transparent and resilient production systems to safeguard food security in the country. Indisputably, advancement in digital innovations and technological investments offers a grander solution to contemporary challenges in the sector. Thus, in 2018 the Zambian government merged with the private sector to adopt and implement Artificial Intelligence in combating the fall armyworm in the agriculture sector. Accordingly, XAG a Chinese firm with a well-established agricultural research station specialized in developing crop-dusting drone's technology, designing mapping drones, offering training on the use of agricultural Artificial Intelligence systems availed their high-tech assistance in combating pests. Combined with visual recognition, pastures land and crop data, XAG firm has also made innovations in agricultural finance and agricultural information systems. This partnership provides agronomists with farming techniques ranging from plant protection, crop monitoring and farm management in order to ensure smart, efficient and sustainable agriculture in Zambia.

The fifth Chapter written by Ms. Tong Wu and this author examines contrasting case studies as China's investments in Zambian agriculture is not only diversified, but also futuristic. The chapter begins with examining the role of Agricultural Technology Demonstration Center's (ATDC) as a part of China's Aid programme in Africa. While illustrating ATDC's contribution in Zambian agricultural sector through transfer of agro-techonology, the chapter also delineates the structural, operational and Financial framework within which ATDC in Zambia runs. Further, the Chapter explains the contribution of Zhongken farms in Zambia's local economy. It also throws light on the production, local management and challenges faced by Zhongken farms. The chapter also discusses Zhongyang Eco-agricultural Industrial Park in its later section. It talks about the planning and the overall structure of the industrial park. In its three segments the chapter also discusses the challenges faced by the ATDC, Zhongken farms and Zhongyang Eco-agricultural Industrial Park as well as the social impact of the three on Zambia. Each segment also explains the training structure and framework given to those associated with them.

The sixth chapter by this author draws on fieldwork conducted across Lusaka, Chisamba, Chingola, Kitwe and Ndola in September 2019 when she met with Chinese entrepreneurs, agronomists, agriculture scientists, farmers, state officials, field workers, miners, small business

owners and academics in addition to Zambian policy makers, experts, government officials, trade union leaders, heads of vocational training institutes, business leaders and academics who provided her with unprecedented access to visit farms, project sites and mining areas to see first-hand and discuss the Chinese experience of working in Zambia and the Zambian experience of hosting Chinese actors. The conclusion brings together the findings presented by other authors and juxtaposes them against observations collected from the field.

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Chapter

1

Bilateral Trade Relations between China and Zambia over 2000–2018

Caesar Cheelo

INTRODUCTION

A growing body of literature reveals that trade relations between China and African countries have grown significantly in recent times. The evidence of these developments has been typically observed in terms of statistical or qualitative illustration, reflecting increasing levels of bilateral trade between China and African trading partners. A number of observers have been compelled to delve deeper into these trade relations, offering empirical insights into the drivers, implications and complexities that emerge with the intensification of these trade relations. Cheelo and Nakamba-Kabaso (2018), Postel (2017), Kanenga (2016), and Mwanawina (2008), among others, make various observations specifically about China-Zambia trade, investment, migration and other relations over different time periods.

This study makes a modest contribution to the literature on China-Zambia relations, focusing on bilateral trade relations between the two countries over the past two decades (2000-2018). We explore the evolving patterns of bilateral trade and their implications, particularly for the small open economy that constitutes Zambia. We utilize a simple and intuitive descriptive statistical approach, drawing on secondary data from authentic, internationally comparable sources to empirically establish the stylized patterns and trends of bilateral China-Zambia trade. Considering the expected trade and export dominance of 'big brother' China in this relationship, we bias the focus of the observations on 'small sister' Zambia.

The rest of the chapter is organized as follows: Section 2 sets the comparative economic context of China and Zambia; Section 3 explores the bilateral trade patterns between Zambia and China over 2000-2018; and Section 4 closes the chapter with concluding remarks.

ECONOMIC CONTEXT: COMPARING ZAMBIA AND CHINA

As many observers have found, on most macroeconomic aggregate indicators Zambia's growth performance pales in comparison to that of China. For instance, over 2015-2018, Zambia's annual

average current Gross Domestic Product (GDP) was around US$24 Billion compared to China's average GDP of just under US$12 Trillion per year over the same period (Table 1.1); China's economic activity was 506 time larger than that of Zambia. Similarly, China's record on real GDP growth rates, per capita GDP, and population dwarfed that of Zambia on these indicators.

Table 1.1: Aggregate indicators, Zambia and China

	Country	2000-2004	2005-2009	2010-2014	2015-2018
GDP (US$, current billions)	Zambia	5	14	25	24
	China	1,527	3,657	8,436	11,976
GDP growth (annual avg. %)	Zambia	5.5	8.1	6.6	3.5
	China	9.2	11.5	8.6	6.7
GDP per capita(US$, current)	Zambia	417	1,086	1,713	1,422
	China	1,192	2,769	6,238	8,661
Population (millions)	Zambia	11.0	12.5	14.5	16.6
	China	1,279.9	1,317.7	1,350.8	1,382.3
Labour force (% of population)	Zambia	42.3	41.5	40.6	41.4
	China	58.4	58.7	58.1	57.1
Agriculture value added (% of GDP)	Zambia	15.6	12.6	8.7	4.5
	China	13.4	10.5	9.0	7.8
Industry (incl. construction) value added (% of GDP)	Zambia	24.1	30.1	32.8	35.5
	China	45.3	46.9	45.2	40.6
Manufacturing value added (% of GDP)	Zambia	9.7	9.0	7.0	8.0
	China	32.0	32.1	31.3	29.3
Services value added (% of GDP)	Zambia	49.3	48.9	52.6	54.1
	China	41.2	42.7	45.8	51.6
Access to electricity (% of population)	Zambia	18.6	22.7	26.3	35.5
	China	97.3	98.6	99.9	100.0
FDI net outflows (% of GDP)	Zambia	-0.4	0.5	0.1	-0.1
	China	0.5	0.8	0.9	1.3
FDI net inflows (% of GDP)	Zambia	5.4	5.7	6.6	4.0
	China	3.5	4.0	3.2	1.7
Trade openness (goods and services exports plus imports) (% of GDP)	Zambia	65.2	60.0	78.2	74.4
	China	47.7	56.5	47.7	38.3
Trade balance (goods and services exports minus imports) (% of GDP)	Zambia	-9.8	1.6	0.8	-1.8
	China	2.4	6.6	2.6	2.0

Source: Author's construction from World Bank (2019)

On the contrary, comparing aggregate performance based on selected economic ratios presents a mixed picture, with Zambia fairing quite well on some indicators and fairly badly on others relative to China. Zambia's Foreign Direct Investment (FDI) inflows as a share of GDP outperformed China's record throughout the period from 2000-2018 (Table 1.1). This lends support to a wide range of observers who have advanced similar arguments, that as the natural resource endowments in Africa, Zambia included, started to be noticed around 2004-2005, sizable amounts of inward flowing FDI were realized, propped up by a so-called *global commodity price super-cycle* (Cheelo and Nakamba-Kabaso, 2018), (Kanenga, 2016). As a result, FDI flows to Africa often outpace flows to other countries and regions around the world.

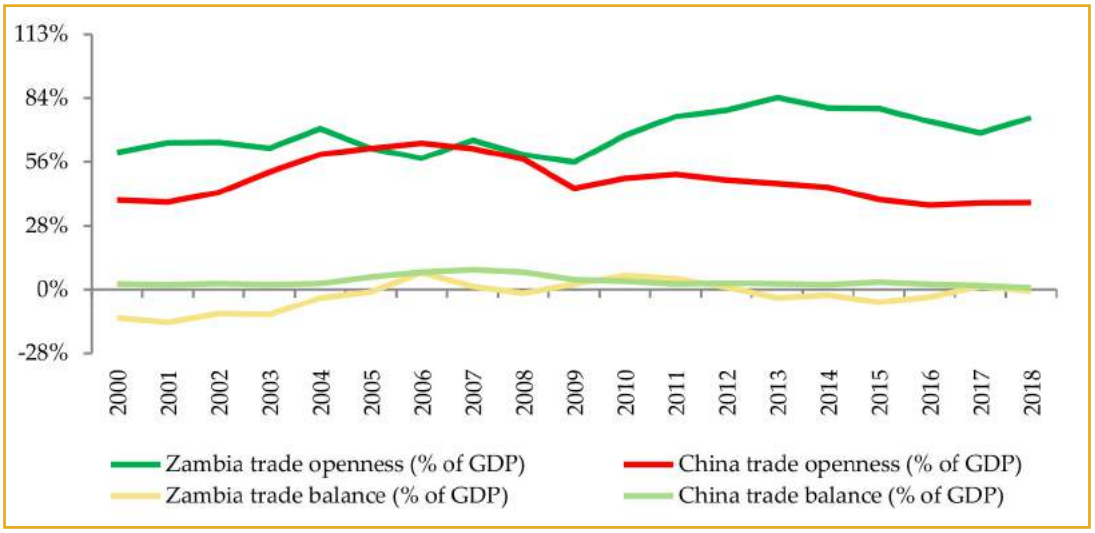
The share of the labour force in the total population during 2015-2018 was 41.4 per cent, somewhat behind China (with 57.1 per cent) (Table 1.1) although the labour quality disparities are not accounted for in these statistics.

In terms of key preconditions for international trade, two indicators are noteworthy, namely: manufacturing value-added share of GDP and percentage of the population with access to electricity (a proxy for one of four key trade facilitation services: energy; transport; finance and telecommunications (UNCTAD, 2016; Ndulo and Chanda, 2017). Zambia lagged far behind China on both of these indicators during 2000-2018. During 2015-2018, on an average, Zambia's manufacturing value-added was 8 per cent of the GDP compared to China's impressive 29.3 per cent of GDP; and the proportion of its population with access to electricity was only 35.5 per cent compared to 100 per cent for China. Clearly, some of Zambia's preconditions for trade do not readily enable the country to harness its full trade potential and realize the benefits of global free trade. Its services and industrial organization are not well-tailored for a highly aggressive and competitive business and trade environment.

Clearly, some of Zambia's preconditions for trade do not readily enable the country to harness its full trade potential and realize the benefits of global free trade.

The internal constraints notwithstanding, Zambia's trade openness (exports plus imports of goods and services all divided by GDP) was markedly higher than that of China throughout the last two decades. Over the period of 2000-2018 Zambia's trade openness averaged 69.5 per cent of GDP per annum, increasing from 60 per cent of GDP in 2000 to 76 per cent of GDP in 2018 (Figure 1.1). In contrast, China's openness marginally declined from 39 per cent in 2000 to 38 per cent in 2018, despite a relative increase in the interim, which led to a peak openness level of 64 per cent of GDP in 2006. Thereafter the openness gradually declined to 38 per cent in 2018.

Figure 1.1: Overall trade openness and balances, Zambia and China



Source: Author's construction from World Bank (2019)

Against this backdrop, the section that follows explores the trends and patterns of trade between Zambia and China over the period 2000-2018.

STYLIZED FACTS ON BILATERAL TRADE BETWEEN ZAMBIA-CHINA

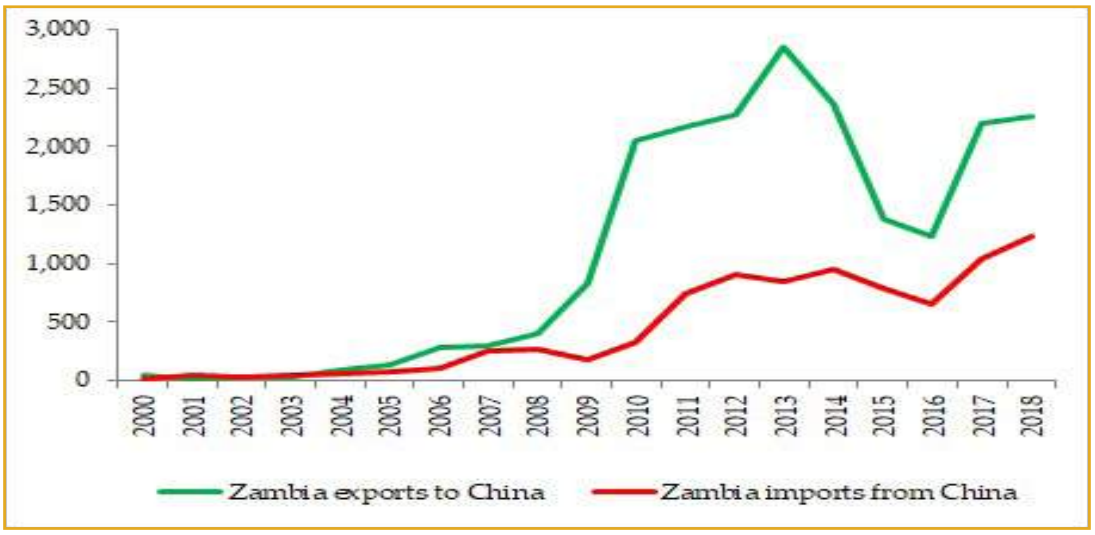
Asymmetrical International Trade Statistics

Before delving into the actual trends, patterns and implications of bilateral trade between China and Zambia, we consider the reliability and comparability of internationally sourced bilateral trade data. From a conceptual point of view, it should be that exports from Zambia to China exactly match with imports from Zambia to China; and conversely, Chinese exports to Zambia should be exactly equal to Zambian imports from China. In practice, however, significant disparities or asymmetries in international trade from one reporting perspective to another often arise for many reasons and can be quite vast, even when margins of error and omission are accommodated (World Bank, 2010). This can severely erode the reliability and comparability of international trade data. Indeed, this is the case for bilateral trade statistics for Zambia and China.

> ***In practice, however, significant disparities or asymmetries in international trade from one reporting perspective to another often arise for many reasons and can be quite vast, even when margins of error and omission are accommodated***

Figure 1.2 presents the total bilateral export and import trade trends for the two trading partners, reflecting the status from each country's respective reporting perspective; the underlying data are from an authentic internationally renowned source, UNCTAD Statistics. From the Zambian perspective, on an average Zambia's exports to China reportedly increased by 320 per cent per year in nominal terms, rising from US$38.4 Million in 2000 to US$2.3 Billion in 2018; whereas its imports from China increased by an estimated nominal 340 per cent per annum, from US$19.9 Million in 2000 to US$1.2 Billion in 2018.

Figure 1.2: Asymmetrical trade statistics for Zambia and China (a) Zambia's reporting perspective (b) China's reporting perspective



Source: Author's construction from UNCTAD Stats

In striking contrast, China's reporting perspective reflects that its exports to Zambia nominally increased by 157 per cent annual on an average, from US$32.9 Million in 2000 to US$961.4 Million in 2018; whereas its imports from Zambia nominally increased by estimated 352 per cent per year, from US$69.4 Million in 2000 to US$4.5 Billion in 2018. Thus, in 2018, what Zambia reported as imports from China was US$255 Million higher than what China reported as exports to Zambia. Similarly, Zambia's reported exports to China were US$2.2 Billion less than China's reported imports from Zambia. In the latter case, the disparity was equivalent to 24 per cent of Zambia's reported export trade worldwide and was therefore on a trivial disparity.

Since it is well documented that countries typically collect more revenue on imports than exports, and typically view imports, particularly finished products, as threats to domestic production, they tend to monitor and record import trade more vigorously and thus more accurately than they do exports (Javorsek, 2016, World Bank, 2010). Exports typically have an inherent downward or underreporting bias. This paper, therefore, focuses its analysis of Zambia-China relations on each country's bilateral imports from the other, assuming the respective country's reporting position.

That is, we use Zambia imports from China (from Panel (a) of Figure 1.2) and China imports from Zambia (from Panel (b)) to explore the bilateral trade relations between the two countries. This way, the paper avoids the underreporting biases associated with bilateral exports.

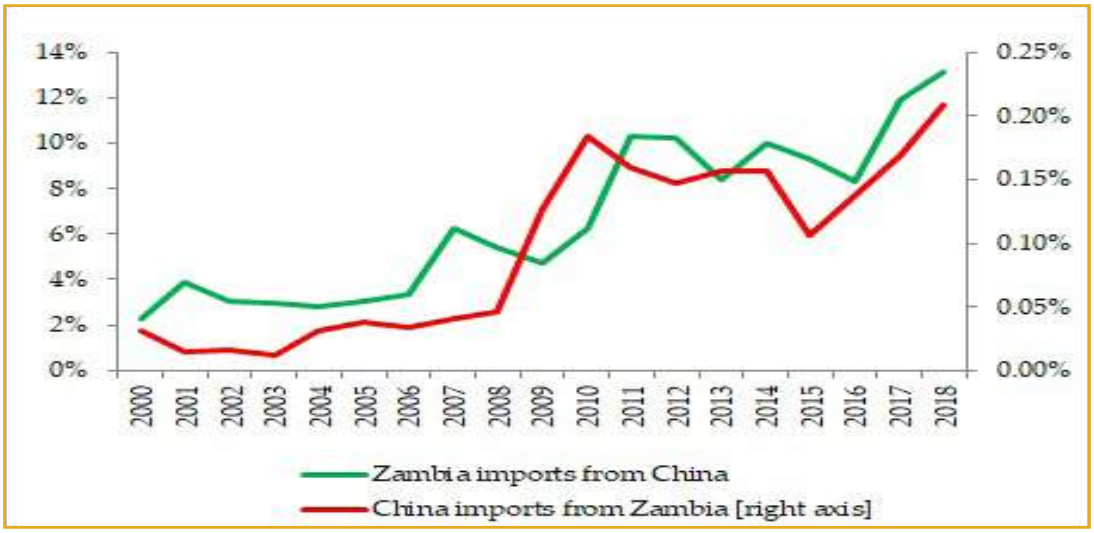
SIZE, BALANCES, SHARES AND GROWTH OF BILATERAL TRADE

As already highlighted in Figure 1.2, Zambia's imports from China stood at US$1.3 Billion in 2018 whereas its exports to China – formally captured as China's imports from Zambia – were estimated at US$4.5 Billion, implying a trade surplus of US$3.2 Billion for Zambia (and the same amount in deficit for China).

At a glance, the two countries experienced somewhat similar trends in bilateral imports as proportions of total imports, although the magnitudes of those shares were vastly different. The proportion of Chinese imports into Zambia increased from 2.2 per cent of total imports in 2000 to 13 per cent in 2018, elevating China to become Zambia's third-largest import source globally (Figure 1.3, Panel (a)). Similarly, Zambian imports into China also increased significantly, from 0.03 per cent of its total imports in 2000 to 0.2 per cent in 2018; albeit with Zambia accounting for a minute share of total imports into China. This was expected, given the vast difference in trade size between the Chinese and Zambian economies.

At a glance, the two countries experienced somewhat similar trends in bilateral imports as proportions of total imports, although the magnitudes of those shares were vastly different.

Figure 1.3: Bilateral trade shares and growth, and global commodity prices – (a) Shares (% of total imports), (b) Nominal growth (annual %)



Source: Author's construction from UNCTADStats

As reflected in Panel (b) of Figure 1.3, the nominal growth in overall world imports, as well as the bilateral imports of each country with the other generally shared a strong association with the changes in global commodity prices during 2000-2018, particularly in the last six years of the period. In the interim, the bilateral import trends saw some marked deviations from the general trend, notably: in 2001, 2004 and 2009 in terms of China's imports from Zambia; and in 2001, 2007 and 2011 regarding Zambia's imports from China. Overall, global commodity prices significantly influenced the bilateral and total (world) trade of the two countries, reflect fairly high dependency on primary commodity imports in Zambia and China.

IMPORT CONCENTRATION

The concentration of Zambia's imports from China is, in principle, the mirror image of the concentration of Chinese exports to Zambia. Import concentration is also the reciprocal of import

diversification, implying that the more concentrated a country's imports are in a few products, the less diversified they are. Typically, it is argued that the higher the import concentration the higher the trade risks for both the importing and import source countries.

The concentration of Zambia's imports from China is, in principle, the mirror image of the concentration of Chinese exports to Zambia.

A common way of measuring import concentration is to take the top *x* bilateral imported products over a given period (where *x = 1, 2,… n*) divided by total bilateral imports over the same period multiplied by 100. For instance, taking the five largest bilateral imports into Zambia from China as a proportion of all imports to Zambia from China, during 2015-2018, would reflect the top-5 import concentration ratio of Zambian imports from China.

Table 1.2 shows the import concentration ratios for top-5, top-10 up to top-40 Zambia (China) imports from China (Zambia). Zambia's concentration ratio on imports from China was fairly low over 2015-2018, with the top-1, top-3 and top-5 products from China accounting for 6.39 per cent, 18.74 per cent and 28.78 per cent, respectively, of total bilateral imports, and on the other side of the spectrum, the top-40 imports making up 78.44 per cent of the total. This reflects that Chinese exports to Zambia were quite highly diversified, implying that China's export earnings from Zambia did not depend significantly on one or a few product lines.

On the other hand, between 2015-2018 the concentration of China's imports from Zambia was very high. The top-1, top-3 and top-5 products from Zambia accounted for 89.81 per cent, 96.25 per cent and 98.71 per cent, respectively, of total bilateral imports. By the time we get to the top-10 imports, those made up 99.91 per cent of the total, reflecting that Zambian exports to China were very highly concentrated or limited to a few products. Thus, Zambia's export-earning stream from its largest export destination, China, significantly relied on essentially three product lines. This trade relation, therefore, placed Zambia at considerably high risk of export earning instability, depending on happenings in China. As the saying goes, *when China sneezes, Zambia catches the flu*.

Thus, Zambia's export-earning stream from its largest export destination, China, significantly relied on essentially three product lines.

Table 1.2: Top-x import concentration ratios, 2015-2018

	Top-1	Top-3	Top-5	Top-10	Top-20	Top-30	Top-35	Top-40
Zambia imports from China	6.39%	18.74%	28.78%	42.25%	60.60%	71.19%	74.96%	78.44%
China imports from Zambia	89.81%	96.25%	98.71%	99.91%	100.00%	100.00%	100.00%	100.00%

Source: Author's construction from UNCTADStats

COMPOSITION OF TOP-20 BILATERAL IMPORTS

This section looks at the specific nature and patterns of the top-20 bilateral import products for Zambia and China as to gain deeper trade and wider economic insights into the implications of bilateral trade, particularly for Zambia. Table 1.3 presents the top-20 bilateral imports for Zambia (from China) and China (from Zambia). The top-20 imports were calculated based on the period 2015-2018, and the baseline status of those same products as of 2000-2004 is also reflected.

The top-20 imports into Zambia from China were quite highly diversified, judging by their respective shares in total bilateral imports, which ranged from 1.44-6.39 per cent. A closer look shows that 19 of the products were manufactures going into key sectors in Zambia, notably: telecommunications; electric energy generation, distribution and supply; construction; transportation and mining. Essentially, China's exports to Zambia fed mainly into Zambia's growth sectors, whose growth was significantly underpinned by massive public infrastructure investment projects in road and building construction, electric energy and telecommunications, and by efforts to harness public and private sector investment in mining and transportation.

Table 1.3: Top-20 bilateral imports, 2015-2018 (US$ '000)

Zambia (from China)					China (from Zambia)				
Rank	Product	2000-2004	2015-2018	% of total (2015-2018)	Rank	Product	2000-2004	2015-2018	% of total (2015-2018)
1	Telecommunication equipment, & parts, n.e.s	12,675.4	59,549.2	6.39%	1	Copper	45,275.6	2,595,340.9	89.81%
2	Other machinery for particular industries, n.e.s	948.8	59,522.7	6.39%	2	Wood in the rough or roughly squared	9.9	108,767.1	3.76%
3	Civil engineering & contractors' plant & equipment	2,068.6	55,500.4	5.96%	3	Tobacco, unmanufactured; tobacco refuse	0.0	77,348.4	2.68%
4	Structures & parts, n.e.s., of iron, steel, aluminium	325.1	48,682.7	5.23%	4	Miscellaneous no-ferrous base metals for metallurgy.	19,429.4	47,897.6	1.66%
5	Motor vehic. for transport of goods, special purpo.	1,109.3	44,757.4	4.81%	5	Copper ores and concentrates; copper mattes, cement	2,386.5	23,034.4	0.80%
6	Road motor vehicles, n.e.s	367.9	32,714.6	3.51%	6	Ores and concentrates of base metals, n.e.s.	801.8	22,105.1	0.76%
7	Apparatus for electrical circuits; board, panels	1,096.4	28,138.2	3.02%	7	Wood simply worked, and railway sleepers of wood	9.1	5,867.4	0.20%
8	Equipment for distributing electricity, n.e.s.	508.1	23,009.4	2.47%	8	Leather	423.0	3,021.4	0.10%
9	Aircraft & associated equipment; spacecraft, etc.	110.8	20,865.7	2.24%	9	Cotton	6,066.7	2,509.3	0.09%

Zambia (from China)					China (from Zambia)				
Rank	Product	2000-2004	2015-2018	% of total (2015-2018)	Rank	Product	2000-2004	2015-2018	% of total (2015-2018)
10	Mechanical handling equipment, & parts, n.e.s.	232.0	20,704.8	2.22%	10	Pig iron & spiegeleisen, sponge iron, powder & granu	0.0	1,579.0	0.05%
11	Fish, fresh (live or dead), chilled or frozen	0.011	20,385.6	2.19%	11	Pearls, precious & semi-precious stones	11.8	1,131.1	0.04%
12	Rubber tyres, tyre treads or flaps & inner tubes	627.1	19,491.1	2.09%	12	Waste, parings and scrap, of plastics	0.0	517.9	0.02%
13	Electric power machinery, and parts thereof	531.6	18,729.3	2.01%	13	Other crude minerals	60.8	366.1	0.01%
14	Manufactures of base metal, n.e.s.	477.0	18,626.6	2.00%	14	Vegetables	0.0	429.4	0.01%
15	Automatic data processing machines, n.e.s	117.0	18,380.1	1.97%	15	Lead	0.0	203.5	0.01%
16	Television receivers, whether or not combined	997.8	16,220.4	1.74%	16	Sugar, molasses and honey	0.0	87.2	0.00%
17	Tubes, pipes & hollow profiles, fittings, iron, steel	203.2	15,436.2	1.66%	17	Civil engineering & contractors' plant & equipment	2.5	163.3	0.01%
18	Pumps (excluding liquid), gas compressors & fans	358.4	15,254.8	1.64%	18	Wood manufacture, n.e.s.	1.7	21.2	0.00%
19	Rotating electric plant & parts thereof, n.e.s.	155.4	14,953.8	1.61%	19	Works of art, collectors' pieces & antiques	0.3	19.8	0.00%
20	Heating & cooling equipment & parts thereof, n.e.s.	318.4	13,426.5	1.44%	20	Rotating electric plant & parts thereof, n.e.s.	0.0	19.1	0.00%

Note: n.e.s = not elsewhere specified

Source: Author's construction from UNCTADStats

The only finished (or final consumption) product *proper* was fish (ranked 11th in Table 1.3), which was virtually non-existent during 2000-2004, but grew to an impressive US$ 20.3 Million per year on average (or 2.2 per cent of total imports from China) over 2015-2018. In fact, from 2000-2005, China did not export any fish to Zambia, then in 2006, China recorded fish exports worth US$ 124,563, which rapidly grew to US$ 329,112 in 2009; in 2010, fish exports jumped to US$ 2.2 Million, and further to US$ 5.9 Million in 2012. From 2013-2018, Zambia's fish imports from China were in double-digit millions. This exponential growth of fish imports roughly coincided with the general recognition in Zambia and regionally of the growing fish deficit in the domestic economy in Zambia (Cheelo, 2018; Namonje-Kapembwa and Samboko, 2017; AfDB, 2016; Chauvin et al, 2012). Having noticed the deficit, China was able to re-organise its fish industry at home and increasing targeted production for the Zambian market, thus creating new jobs and a new export-earning stream; Zambia was not able to similarly harness the domestic opportunity of the fish deficit, thus losing out on jobs, industrial development and foreign exchange savings.

Chinese exports to Zambia clearly incorporated critical trade and economic information about the main gaps in domestic production in Zambia. This same "knowledge economy" model that China uses to understand the consumers of its export products around the world is a fundamental reason why the country has been so successful in expanding its export dominance globally.

Turning now to China's top-20 bilateral import perspective in Table 1.3, the country's imports from Zambia – or conversely, Zambian exports to China – made up only 0.21 per cent of its total imports and are dominated by one commodity, copper, which accounts for 89.9 per cent of all imports from Zambia. In 2018, Zambia was the 7th largest copper producer in the world with an estimated 854,000 metric tonnes, and behind Chile, Peru, China, the United States, DR Congo and Australia, in that order (Garside, 2020). Conversely, China was the world's third largest copper producer, with 1.59 million metric tonnes in 2018. Therefore, should anything happen to disrupt and stop Zambia's copper production and exports, China would most likely not feel much of an impact as it would have the option to switch to other top copper producers like Chile and Peru. In fact, according to data from UNCTADstat, imports of copper, copper ores, concentrates, mattes, etc. from Zambia were only 5.4 per cent of the total monetary value of global imports of these products by China in 2018, suggesting a marginal level of Chinese dependency on Zambia to satisfy its copper import demands.

The other top-20 import products to China from Zambia were relatively low value primary and resource-based commodities, except for: civil engineering & contractors' plant & equipment (ranked 17th in Table 1.3); and rotating electric plant & parts thereof (20th in Table 1.3). The exceptions were most likely items being re-exported to China second-hand after the construction and mining infrastructure development projects they were imported for came to a close.

Conversely, according to the Bank of Zambia's Balance of Payments (BOP) tables, copper, on an average, accounted for 72.2 per cent per year of Zambia's total export earnings during 2015-2018. And China was one of the top-2 export destinations for Zambian copper. Therefore, any drying up or weakening of copper demand in China would imply significant adverse effects on Zambia's balance of payments and fiscal positions. The country's high import concentration in one primary commodity directed at few export markets places it at a high risk of trade and economic distress from export market variabilities.

CONCLUSION

In this chapter, we explored the bilateral trade relations between China and Zambia over roughly two decades from 2000-2018. We highlighted the evolving patterns of aggregate and bilateral trade. Based on a simple and intuitive descriptive statistical approach, we made salient observations about the stylized patterns and trends of bilateral trade between China and Zambia as well as the implications of the relationship, particularly for the small open economy or small sister i.e., Zambia.

Broadly, we empirically established that Zambia-China import trade relations underpinned by vast difference in overall economic size and global trade performance, were remarkably

lopsided over the reference period. Imports to Zambia from China made up a significant share of Zambia's total imports whereas imports from Zambia to China were a marginal component of China's overall import profile.

Broadly, we empirically established that Zambia-China import trade relations underpinned by vast difference in overall economic size and global trade performance, were remarkably lopsided over the reference period.

Interestingly, in absolute monetary terms, Zambia enjoyed a bilateral trade surplus with China over the period, meaning that the country exported more to China than it imported from there. However, Zambia's exports to China were significantly concentrated in one resource-based, primary commodity, copper, exposing the country to high risks of market variability in one of its main copper export destinations, China. If realized, these variabilities would have far-reaching adverse effects on Zambia's balance of payments and fiscal position, among other things.

On the other hand, Zambia's imports from China were significantly diversified and dominated by manufactures, which Zambia significantly depended to drive key sectors like telecommunications, electricity, construction, transport and mining. China's ability to gauge the Zambian market and understand its diverse import needs, combined with its ability to increasing its production capacity to meet the needs, gave it significant market access over the period. This ability to establish relevance appears to be a hallmark of China's export expansion around the world.

Most likely, the trade relations between Zambia and China are confounded by other factors such as investment, finance and debt relations, geopolitical ties, and defence and security cooperation, among others. These were areas outside the scope of this chapter, but are important areas for further research.

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Chapter

2

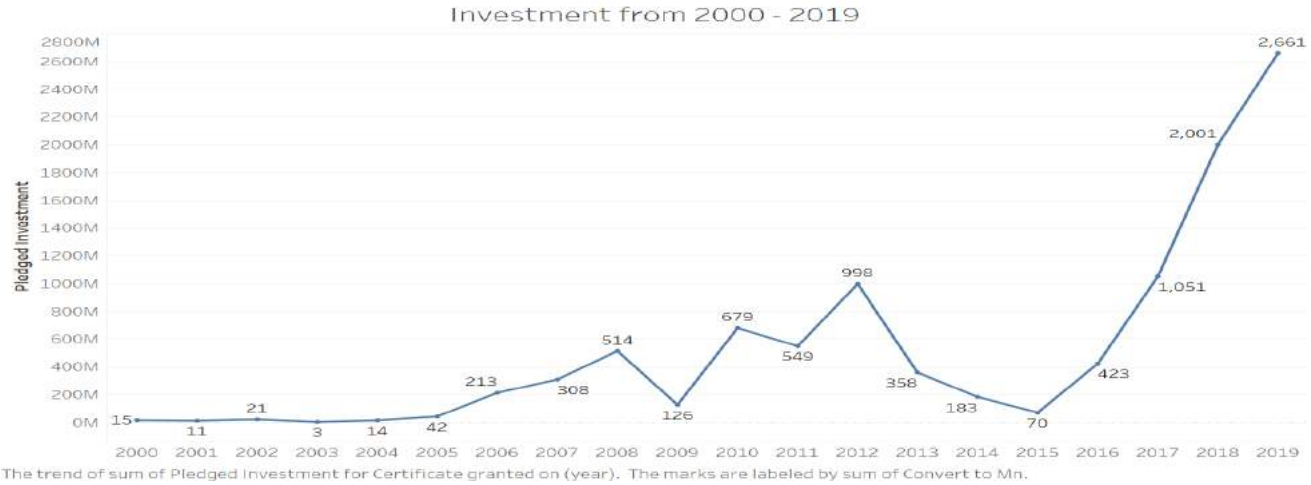
Chinese Investments in Zambia from 2000–2018: A Sectoral Analysis

Veda Vaidyanathan and Mukund Agarwal

TRENDS OF CHINESE INVESTMENTS INTO ZAMBIA FROM 2000 TO 2018

The Chinese investment inflow to Zambia steadily increased from 2000 to 2004 while the investment inflows from 2005 gathered a higher pace and peaked in 2008 before sharply declining in 2009. This can be mainly attributed to the recession in the third quarter of 2008. The period between 2009 and 2012 was highly uncertain and no major trend was visible. The period of 2012 to 2015 saw a major decline in investments.

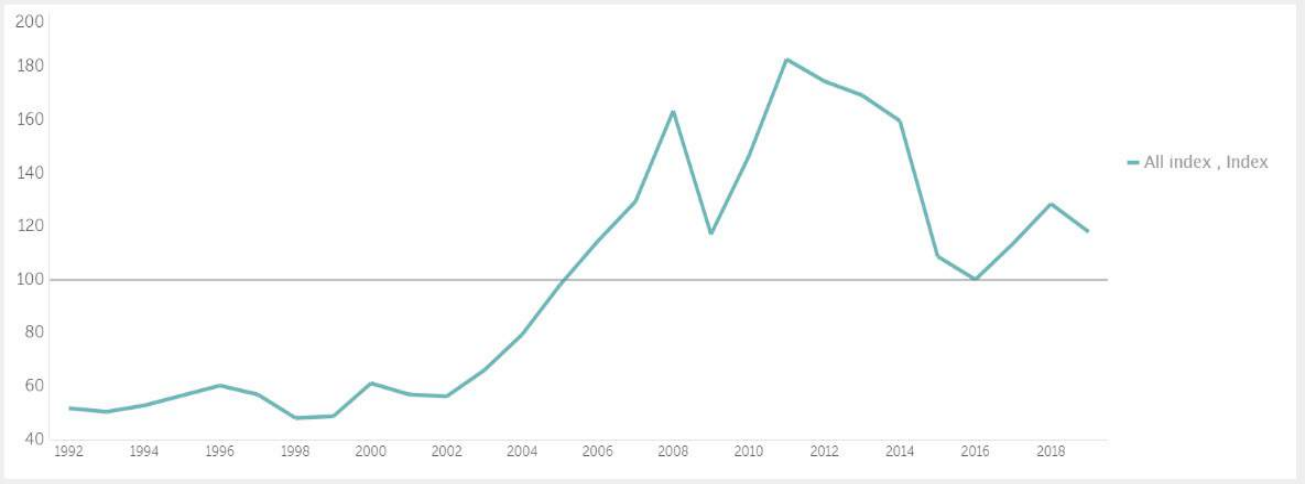
Figure 2.1: Investment from 2000 to 2019



Source: Created with data from Zambia Development Agency (ZDA)

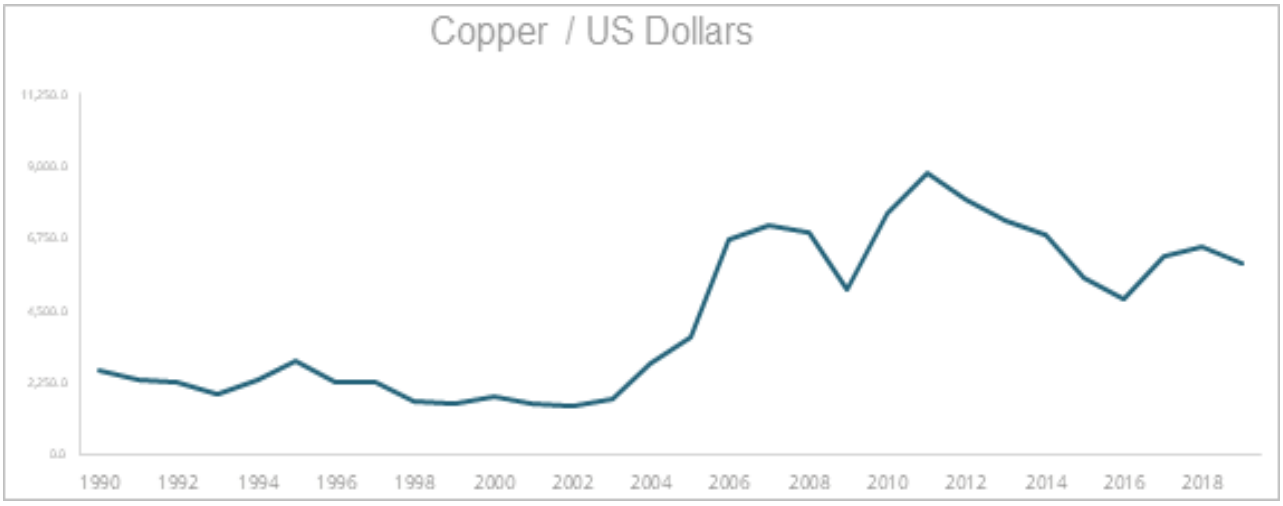
The downward trend in investment in the period between 2012 to 2015 can mainly be attributed to a global decline in commodity prices (both fuel and non-fuel) (IMF), forcing investors to hold back their planned investments. The decline in prices also forced firms to layoff labours, drawing ire both from the labour and the Government of Zambia. A severe electricity shortage was also experienced during this period. Zambia's currency, the kwacha, also lost 50 per cent of its value against the US dollar from 2014 to 2015 fueling higher price on imported goods (A. Kasoma, PMRC).

Figure 2.2: Global commodity prices from 1992 to 2019 (IMF)



Source: International Monetary Fund

Figure 2.3: Copper prices 1990 to 2019 (IMF)

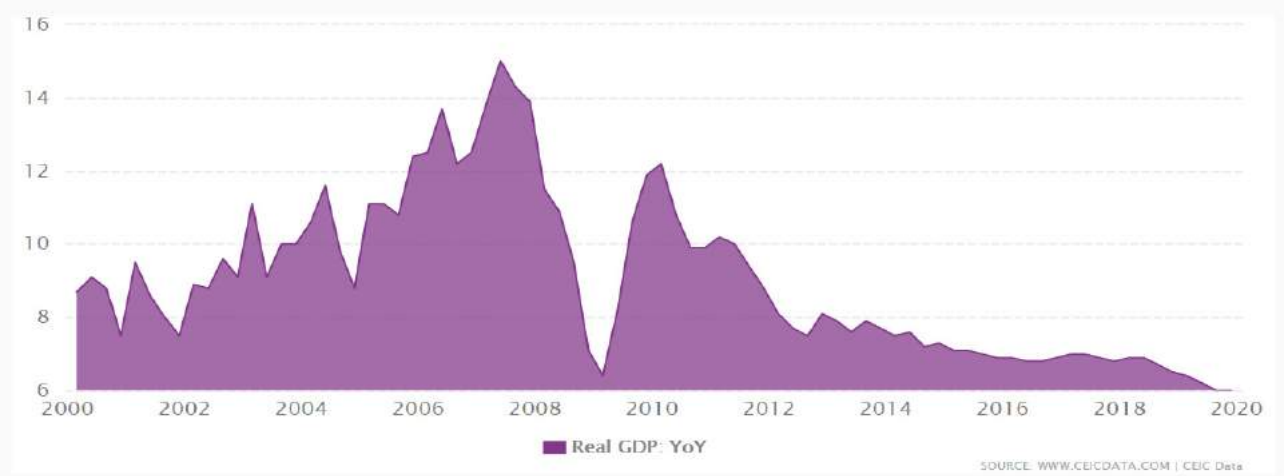


Source: International Monetary Fund

The investment again started picking up in 2016 due to rebound in global commodity prices and peaked again in 2019.

Drop in Copper Prices: China's real GDP growth averaged almost 10 per cent a year for three decades before 2015. However, the growth rate touched 7.3 per cent and 6.9 per cent in 2014 and 2015 respectively. The figure below depicts the real GDP growth rate for China from 2000 to 2019.

Figure 2.4: China Real GDP growth (1992-2020)

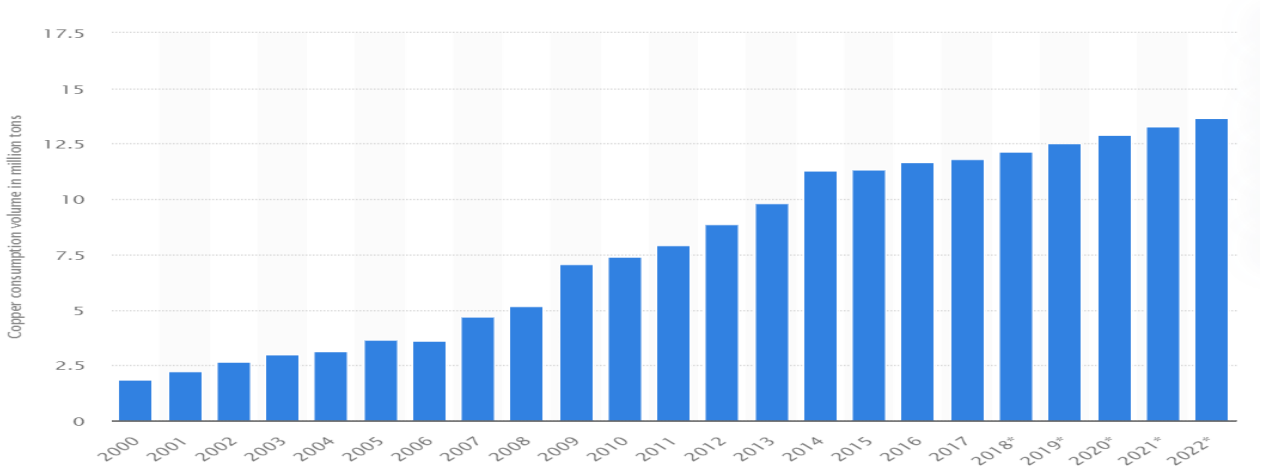


Source: CEIC data

Given that major demand had come from China over the years, the slowdown in China's industrial sector pushed global commodity prices to multi-year lows (Fortune, 2015). In the years 2014 and 2015, the Copper consumption in China nearly stagnated at 11.3 MT.

> ***In the years 2014 and 2015, the Copper consumption in China nearly stagnated at 11.3 MT.***

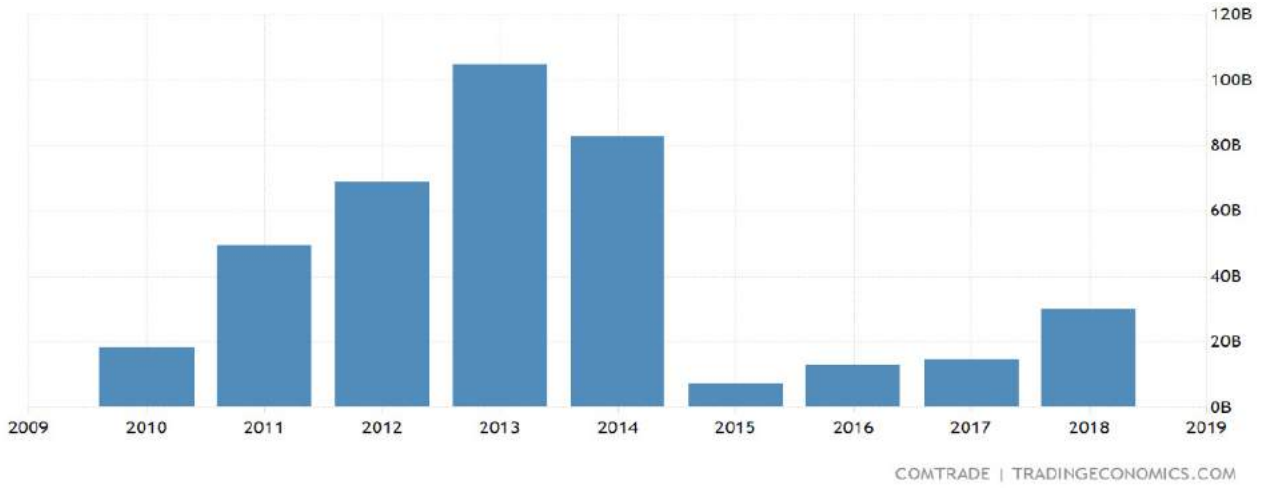
Figure 2.5: Copper consumption volume in China from 2000 to 2016, with a forecast up to 2022



Source: Statista

The stagnation or even slowdown was not just limited to Copper. The demand for all commodities had decreased during this period and the ripple effect of the slowdown in China was felt all across the world. The figure below shows the change (by value) in the import of commodities by China from 2010 to 2018.

Figure 2.6: China Imports of Commodities not specified according to kind



Source: Trading Economics

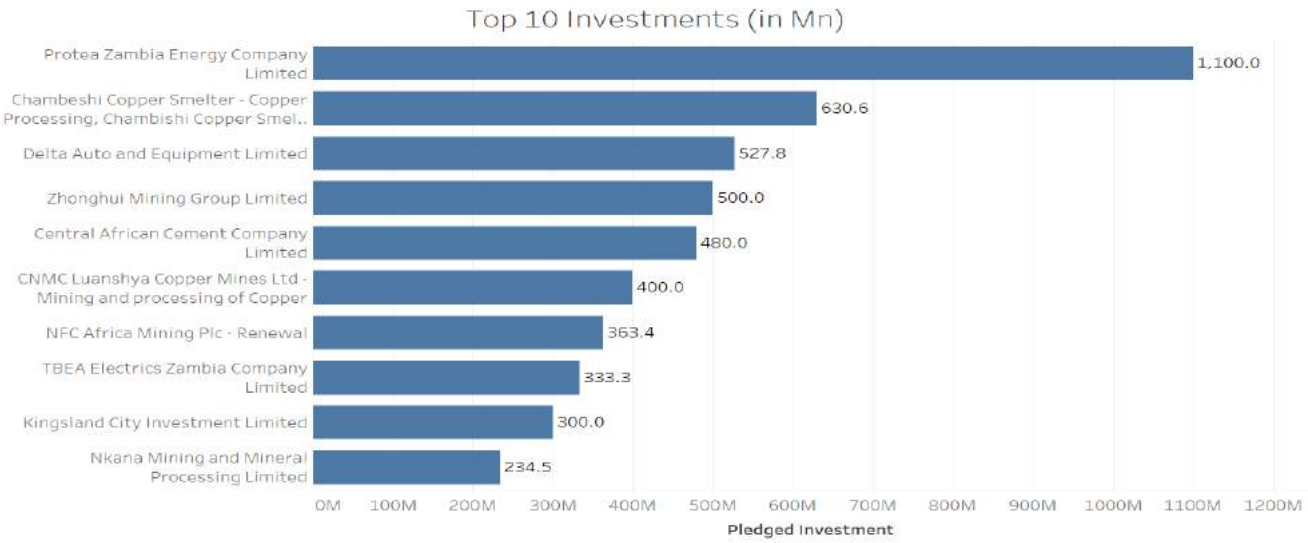
The export of copper accounted for more than 70 per cent of the total exports from Zambia (K. Shula, 2015), and the slowdown in copper prices thus severely impacted the economy of Zambia.

MAJOR INVESTORS INTO ZAMBIA - PERCENT OF CHINESE INVESTMENT

In the time period of analysis, nearly 98.8 per cent of the investments in Zambia were made by the Chinese investors alone. Chinese and Zambian investors in collaboration made nearly 1.09 per cent of the total investments. Australian, Canadian, Ethiopian, Nigerian, Taiwanese and Cayman Island investors were also marginally active. The Top 10 investments in Zambia, were all from mainland China and it formed nearly 40 per cent of the total investment in the country from 2000 to 2018. The major firms investing in Zambia are as follows:

> ***In the time period of analysis, nearly 98.8 per cent of the investments in Zambia were made by the Chinese investors alone.***

Figure 2.7: Top 10 major investors/firms in Zambia



Source: Created with data from Zambia Development Agency (ZDA)

The areas of investment included Copper and other non-ferrous metal mining and processing, infrastructure in early 2010. The firms, however, lately have made investments in the Energy and Service sectors.

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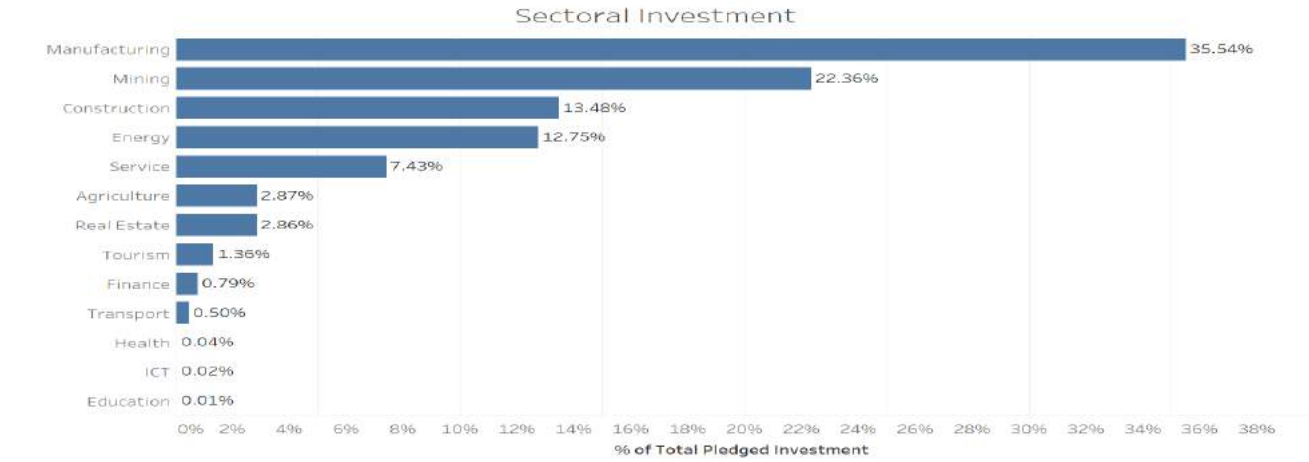
SECTORS OF INVESTMENT

Manufacturing and Mining investments form the major portion of investments in Zambia. Nearly 58 per cent of the total investments come from these two sectors combined.

This is followed by the Construction and the Energy Sector, contributing nearly 13 per cent of the total investments each. Agriculture, Real Estate, Tourism, Finance, Transport, Health, Information and Communication Technology (ICT) and Education form less than 3 per cent of the total investments in Zambia.

Mining, Manufacturing and Construction sectors feature in the Top 10 investments showing the inclination of foreign investors to capitalize on the natural resources rich country like Zambia. After 2018, there has been a renewed interest of investment in Energy and Service Sector, a one-off case if we consider investments from the year 2000.

Figure 2.8: Percentage of Total Pledged Investment in different sectors in Zambia



Source: Created with data from Zambia Development Agency (ZDA)

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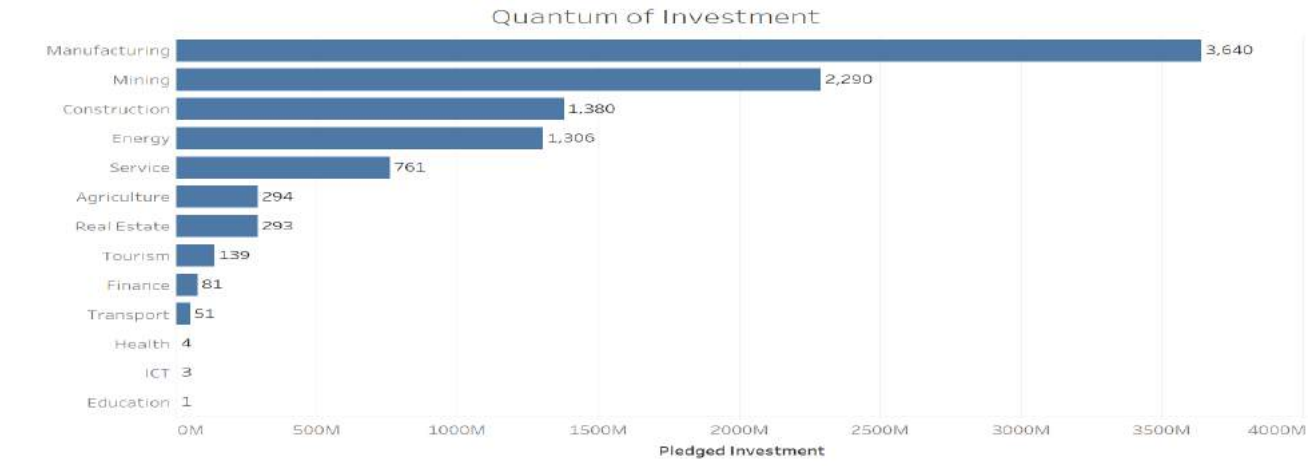
QUANTUM OF INVESTMENT

Over the years, the quantum of investment across various sectors have grown in accordance with the total investment inflows received. The table given below shows the quantum of investments received by various sector between 2000 & 2019.

Figure 2.9: Quantum of Investment in different sectors

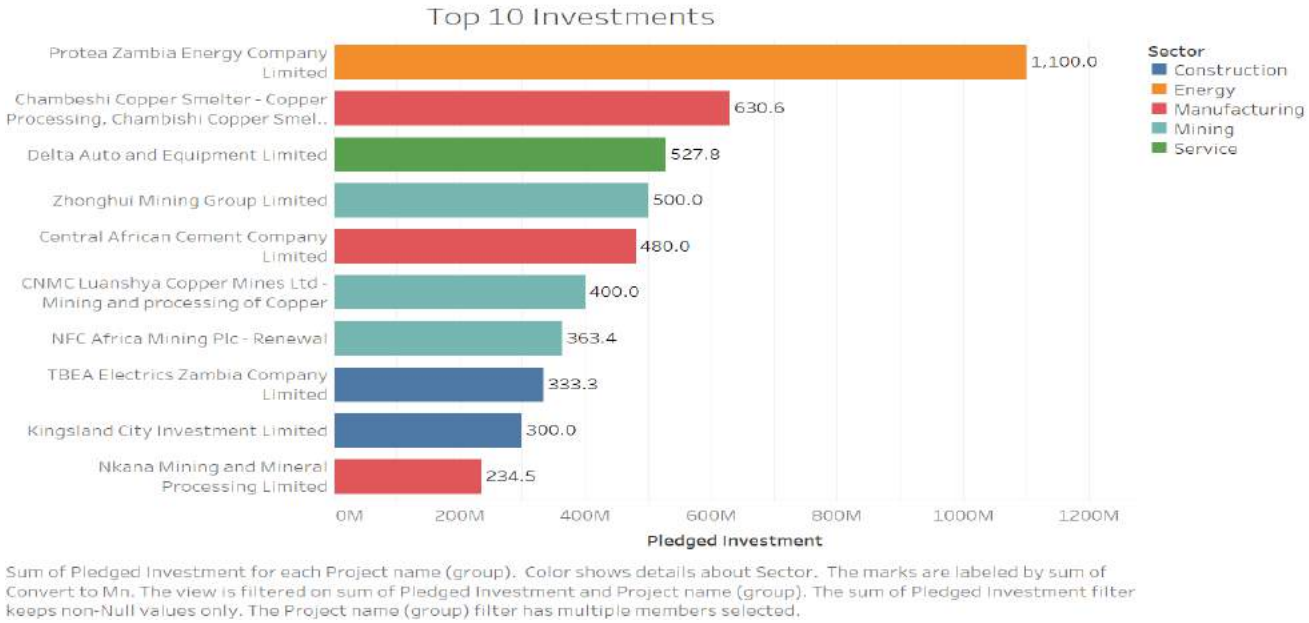


Source: Created with data from Zambia Development Agency (ZDA)

In the Manufacturing sector, the investments have been concentrated in Cement plants and construction materials unit, Copper smelters and processing units, Nickel mining and processing, and Textiles. Mining sector has generally concentrated on mining of Copper, Nickel, Manganese, Gold & Cobalt.

The table below shows the Top 10 investment by individual Company or Investor and their sectors respectively. Barring Protea Zambia Energy Company Limited & Delta Auto and Equipment Limited (which made investment in 2018 & 2019 respectively), all the investments have been in the Infrastructure, Manufacturing and Mining sectors.

Figure 2.10: Total Pledged Investment for each Project name (group)



Source: TBA

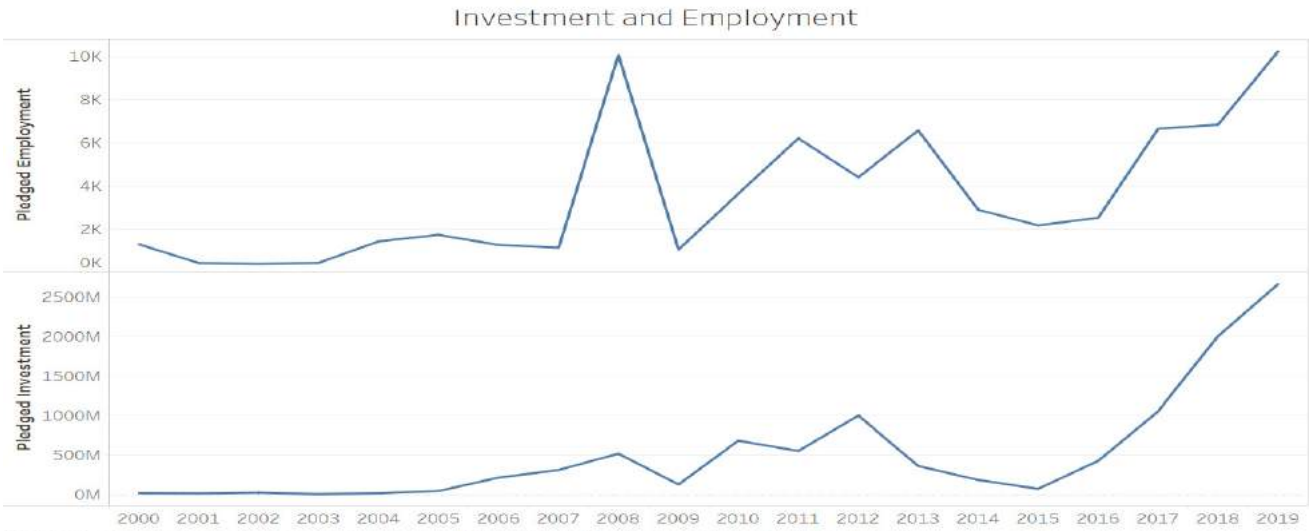
JOBS GENERATED

The employment generated has a direct correlation with the investments in various sectors over the years. Manufacturing, Mining, Agriculture and Construction have been the leading sectors to create employment.

> ***The employment generated has a direct correlation with the investments in various sectors over the years.***

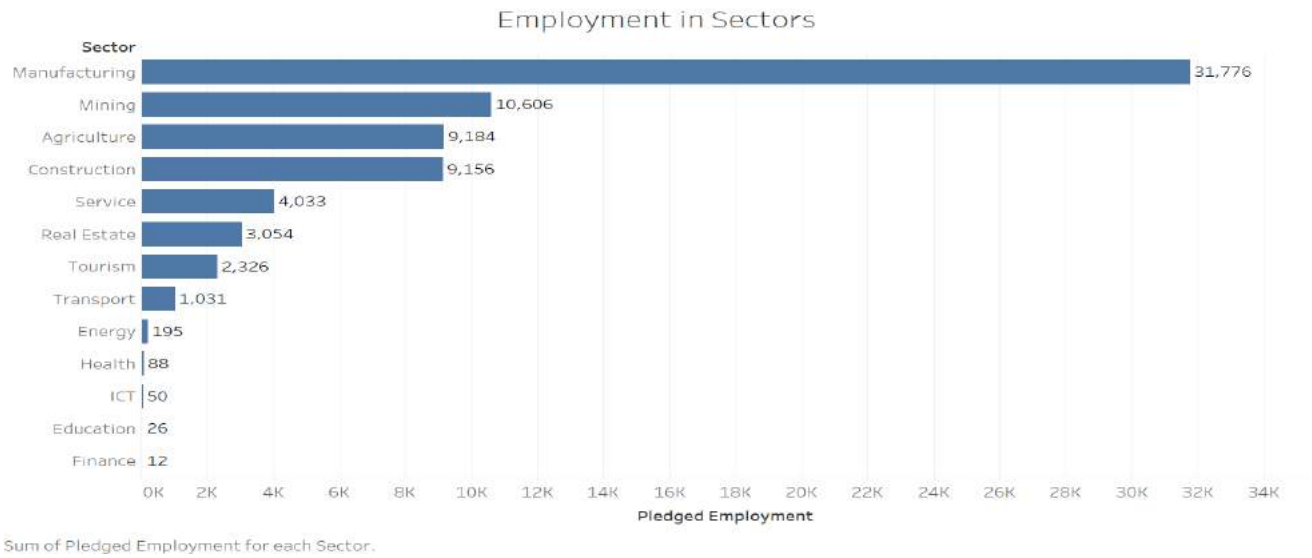
Manufacturing is by far the leading sector in job creation and has created 4.35 jobs for every 100 units of currency spent. This is followed by the Construction, Service and the Mining sectors as the major contributors, mainly due to the labor-intensive processes.

Figure 2.11: Sum of Pledged Employment and sum of Pledged Investment (2000-2019)



Source: Created with data from Zambia Development Agency (ZDA)

Figure 2.12: Sum of Pledged Employment for each sector in Zambia



Source: Created with data from Zambia Development Agency (ZDA)

Zambia has high rate of informal employment and low Union density due to provisions of Industrial and Labour Relations Act that provides exemption from formation of trade unions in establishments that employ less than 25 workers.

Trade unions have the ability to influence and negotiate a fairer pay settlement. Although the domestic worker's gross salary increased from K522.40 (Approx. 26. 29 USD) to K993.60 (Approx. 50 USD) and that of Grade 1 shop worker and general worker from K1132 (Approx. 56. 97 USD) to K1968.60 (Approx. 99 USD), the gap between the salaries of workers and senior management is wide. This has been attributed to low bargaining power of employees given the low density of Unions (A. Kasoma, PMRC).

SELECT HIGH PROFILE INVESTMENTS

Majority of the investments were made in the Manufacturing, Mining and Infrastructure sector, barring one major investment each in the Energy and Service sector in late 2018 and early 2019.

> ***Majority of the investments were made in the Manufacturing, Mining and Infrastructure sector***

A sudden jump in the employment generated was observed in the year 2008. This can be attributed to the creation of the Zambia-China Economic and Trade Cooperation Zone (ZCCZ) under the Multi Facility Economic Zone (MFEZs) established under the ZDA Act No. 11 of 2006 (ZDA, 2006). Several important projects were approved under this scheme and the investments and employment generated were spread over a couple of years. The scope and outcome of MFEZs have been discussed in greater detail in the section below.

Central African Cement Limited, a joint venture project between the ZCCM-Investment Holdings (49 per cent holding) and the China Machinery Construction Group Ltd, also known as SinoConst (51 per cent holding) (News Diggers, 2018) signed at the end of 2018, to construct 5000t/day clinker production plant faces the challenge of national overcapacity due to market saturation (Global Cement, 2018).

Kaidi Biomass Zambia Limited, a firm engaged in biodiesel production using Jatropha initially planned to invest US$450 million in 2011. But the project never saw the light of day primarily due to failed land acquisition (Paul C. Samboko, Mitelo Subakanya and Cliff Dlamini, 2017).

MINING SECTOR IN ZAMBIA

Zambia is the world's eighth largest producer of copper and holds six percent of the world's known copper reserves. Zambia also produces 20 per cent of the world's emeralds. This means that the mining sector is not only vital to the economy but is an important source of government revenue (generating almost 70 per cent of total export receipts) and employment generation (accounting for 25 per cent of private sector employment and 10 per cent of the total formal sector) (PwC, 2019). However, there are several challenges facing the industry that have lead to reduced production (in 2019 Copper fell 12.5 per cent from 2018 levels) and a reduction of approximately 80 per cent in exploration activities over the past ten years according to the Zambia Chamber of Mines. This includes uncertainty in the mining tax regime and sales tax implementation, rising energy costs due to poor rainfall, lower copper ore grades and falling global market demand. Susceptible to shocks from the global economy, the US-China trade dispute and the uncertainty it caused also attributed to the fall in copper prices.

> ***Zambia is the world's eighth largest producer of copper and holds six percent of the world's known copper reserves.***

Moreover, the capital-intensive sector also faces challenges from the invention and proliferation of cognitive technologies as several tasks performed by humans have now become automated. This gradually led to a reduction in the requirement of workers in mining and certain other sectors. However, the lack of national-level supplier development policy hindered the development of forward and backward linkages, and nearly 95 per cent of goods and services used by the mining industry were imported (World Bank, 2016).

This gradually led to a reduction in the requirement of workers in mining and certain other sectors.

According to interviewees working in the mining sector, the licenses to explore most local mines have already been applied for, so foreign investors need to enter into Joint Ventures with local actors or purchase it from them. “This shouldn’t be too difficult because most locals don’t have the capacity to explore these mines” (Personal Interview, Chinese Manager, 2019). While western mining companies have traditionally dominated copper production in Zambia, Chinese companies are stepping up their presence. According to a senior official in the Mining Department, of the seven original mines owned by Zambia Consolidated Copper Mines (ZCCM- IH) – Konkola Mine in Chililabombwe Town, Nchanga Mine in Chingola Town, Chambishi Mine in Chambishi Town, Nkaana Mine in Kitwe, ZTCM Chibuluma in Kalulushi, Mopani mine in Mufulira, and Roan mine in Luyansha – Chinese companies are directly or indirectly involved. While some are wholly Chinese owned, in some others Chinese companies have bought majority shares while in the rest they have already indicated interest. According to him “Within the next 3-5 years, at least 5 of the original copper-belt mines will be Chinese owned.”

The Chinese presence in the Zambian mining landscape also includes actors who buy low-grade copper material from SME’s that have small scale mining licenses or collects copper from local dumping sites and processes it to make high-grade copper. The equipment, technology and machinery used in processing this copper is from China while the markets for their products are China and India. Such entities employ around 50 locals and around 10 Chinese employees. Two such actors interviewed listed out several challenges of operating out of Zambia including limited access to good copper, high corruption, excessive political interference, high taxes, power shortages, lack of skilled workers and issues regarding land ownership. But when asked why they didn’t return to China in the face of challenges, the response was that “competition in China is very high, it’s easier to survive in business here” (Personal Interview, Chinese Manager, 2019).

The Chinese presence in the Zambian mining landscape also includes actors who buy low-grade copper material from SME’s that have small scale mining licenses or collects copper from local dumping sites and processes it to make high-grade copper.

CHALLENGES

The electricity mix in Zambia is dominated by hydro-generation and accounts for 85 percent (2380 MW) and non-hydro accounts for 15 percent (405 MW) of the total power generation capacity (USAID, 2020). Zambia recorded an average real GDP growth rate of 6 per cent the past decade while the power generation capacity grew at a mere 3 per cent each year (ZDA).

Zambia experienced low rainfalls, and the country's annual rainfall dropped from 1200 mm to 600 mm during 2014 -2015 (D. Kaunda, 2015). Zesco, the country's sole power utility faced serious challenges in the said period. The below average rainfall left insufficient water in dams for electricity supply.

Several mining companies, including the Anglo-Swiss mining and commodity trading giant Glencore that owned Mopani Copper Mines in Zambia and Luanshya Copper Mines cited power shortages as one of the reasons for layoff alongside dropping copper prices (D. Kaunda, 2015).

The load shedding also impacted the small-scale enterprises. Among the several issues related to load shedding, the irregularity of sticking to the load shedding time cost the enterprises labour overtime, damage to the equipment and delays due to restart of machinery (Alfred Mwila, Goodson Sinyenga, et al, 2017).

The load shedding also impacted the small-scale enterprises

Among the other sectors severely impacted due to rainfall shortages was the agricultural sector. It contributed 12.6 per cent to Zambia's economy and employed two-third of the labour force. Shortage of electricity increased the reliance on back-up generators, which in turn escalated the cost of commodity production and processing. The farmers produced lesser surplus and passed higher cost to consumers, increasing the cost of living. Excess labour was laid off to reduce production cost (Paul Samboko, Antony Chapoto, et al, 2016).

The reliance of electricity from hydro-power was slowly reduced and new investment licenses were granted between 2008 and 2013. The prominent among them (non – hydro) were the Maamba Thermal Project and EMCO Energy Coal Power Project. The 300 MW Maamba Collieries Limited commissioned in July 2016 and now accounts for nearly 10 per cent of generation capacity. The EMCO Energy Coal project signed in September 2012 have been continuously delayed, and now appears to be shelved (EMCO). Furthermore, the Government of Zambia put in place policy and regulatory reforms that boosted private sector investment in the electricity sector, increased access to electricity (1 million customers connected to national grid in 2019) and promoted alternative renewable energy sources including solar projects in Chinsali, Samfya, Kitwe districts and Lusaka (Government of Zambia, 2019).

DEPRECIATION OF KWACHA AGAINST DOLLAR

Figure 2.13: ZMK/USD Chart

Source: XE Currency Chart

The combination of tightening of money by the Federal Reserve and the Chinese economic slowdown caused sharp selloffs in the majority of currencies across the world, especially the countries exporting commodities. The devaluation of the Chinese Yuan (The Guardian, 2015) had a profound effect on Zambian Kwacha and it lost 16 per cent of its value in August 2015 alone. The Zambian economy's high dependence on demand from China (half of the total exports) caused the Kwacha to fall to record lows, and it became the worst-performing African currency in 2015.

> ***The devaluation of the Chinese Yuan (The Guardian, 2015) had a profound effect on Zambian Kwacha and it lost 16 per cent of its value in August 2015 alone.***

While a depreciating Kwacha may have been good for Zambia given over 70 per cent of export coming from copper, the lower copper prices did not help realize the gains. Further, outside the minerals sector, the exported output was low and imported inputs high. Thus, it was ultimately a disincentive for agricultural and manufacturing producers in Zambia (K. Shula, 2015). The decline in export volumes (7.8 per cent contraction in copper earning) and lower average copper prices negatively impacted the country's external performance leading to currency depreciation and widening the overall payment deficit.

DEVELOPMENT OF MULTI-FACILITY ECONOMIC ZONES

Zambia had generally performed below par in three decades due to low or lack of investment in advanced technologies and innovations needed to add value to raw materials (World Bank,

2009), prior to establishment of the MFEZs. At the Forum on China-Africa Cooperation (FOCAC) held in 2006, the Chinese government pledged to support the establishment of the Special Economic Zone in Zambia.

At the Forum on China-Africa Cooperation (FOCAC) held in 2006, the Chinese government pledged to support the establishment of the Special Economic Zone in Zambia.

The Special Economic Zones (SEZs) are defined as "larger estates that could be considered cities on their own. They usually cover all industrial and service sectors and target both foreign and domestic markets. They provide an array of inducements ranging from tax to regulatory incentives. In addition, they permit on-site residence." While a MFEZ is a specific geographic area with quality physical and special infrastructure, where economic policies are more liberal than in the rest of the country in order to attract and facilitate the establishment of world-class enterprises within the zones (Deborah and Tang, 2011) (Kazwala E. Sikozi, Levi Siaminwe, et al, 2016).

In Zambia, MFEZs are established under the ZDA Act No. 11 of 2006 (ZDA, 2006), and are structured in two parts, namely the Production MFEZs (for manufacturing related entity) and Export Trade MFEZs (for commercial trading, warehousing, etc. to exploit export markets). They were established with the aim to make it competitive and integrate with the local economy. The integration would help in the transfer of knowledge and technology, a prerequisite to modern industrialisation. It would further have a positive spillover effect on sectors like utilities, transport, agriculture and services would witness (ZDA).

Intervention such as Multi Facility Economic Zone (MFEZs) provided the much-needed stimulus to industrial infrastructure and helped in facilitating foreign investments and expansion of production capacities in the manufacturing sector. Zambia-China Economic & Trade Cooperation Zone (ZCCZ) became the first Multi Facility Economic Zone to be declared by the Republic of Zambia according to the ZDA Act. It was also the first Chinese Overseas economic & trade cooperation zone to be established in Africa. The Production MFEZs in Zambia were Chambeshi MFEZ, Lusaka East MFEZ, Lusaka South MFEZ, Lumwana MFEZ, Sub-Sahara Gemstone Industrial Park.

Zambia-China Economic & Trade Cooperation Zone (ZCCZ) became the first Multi Facility Economic Zone to be declared by the Republic of Zambia according to the ZDA Act.

However, there were several shortcomings due to non-existence of forward and backward linkages. Some of the local industries still used the machinery of the 1960s and experienced constant breakdowns. The technological gap between the Chinese counterpart and local

industries was extremely high. The implementation of MFEZs was a big challenge due to lack of clearly defined frameworks and resources. Further, policies like investment threshold requirement equivalent of US$500,000 to take benefits of the priority sector in MFEZ created additional barriers as it was beyond the capacity of most of the local investors (World Bank 2019). Under these circumstances, it was difficult to achieve some major objectives of establishing a MFEZ i.e. promoting the growth of Micro, Small and Medium Enterprises (MSME) sector.

CONCLUSION

As Zambia's biggest investor, Chinese investment inflows into the country across sectors has been crucial to its growth. While the diversification into manufacturing and construction is comparatively recent as compared to mining, it has led to an increase in employment generated. However, most of the jobs created seems to be for the unskilled workers, limited knowledge transfer that opens up opportunity in management positions. The high-profile investments also don't seem to have created many forward and backward linkages as initially expected. Similarly, the creation of ZCCZ as part of the MFEZ has also failed to realize its full potential partially due to lack of skills, technology and the absence of state-of-art infrastructure. Although Zambia's investment climate is fairly business friendly and the country has incredible business potential, the myriad of issues including power and rainfall shortages, currency depreciation among others are serious challenges. Most importantly, the country's excessive dependence on China has meant that the quantum, nature and type investment inflows from Beijing has a direct and severe impact on Lusaka's economy, which poses a significant risk both for the short and long term.

Although Zambia's investment climate is fairly business friendly and the country has incredible business potential, the myriad of issues including power and rainfall shortages, currency depreciation among others are serious challenges.

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Chapter

3

Enhancing Zambia's Human Capacity? The Dynamics of China-Zambia Agriculture Skills and Knowledge Transfer

Musadabwe Chulu, Nkumbu Nalwimba and George T. Mudimu

INTRODUCTION

Zambia's agriculture sector contributes about 9 per cent to the country's economy but 59 per cent of the population lives in the countryside and is agriculture-dependent (CIAT-World Bank, 2017). In the Seventh National Development Plan, the Zambian government recognizes that skill development is one of the major mechanisms through which agricultural production and productivity can be improved (Government of Zambia, 2017). For instance, in the period between 2014 and 2018, the Zambian government sought to train 3,500 extension workers in good agricultural practices in various disciplines of agriculture (Ministry of Agriculture and Livestock, 2013). This thrust on the urgent need for skill development in the agriculture sector is largely driven by the realization that there is a deficiency of expertise or agricultural experts with higher-level qualifications. It is this challenge that has prompted the Zambian government through the Ministry of Agriculture (MoA) to seek out partners in the development of agriculture skills.

Of the many available options for the development of much-needed skills, particularly in research and technology, China is considered a reliable partner largely because it has had remarkable success with lifting 50 million people out of poverty annually (China Daily, 20 December 2019). Moreover, Chinese experts indicate that they are ready to share their success stories through various forms of agriculture support, under its Official Development Assistance (ODA) with other developing countries including Zambia (Personal Interview, Beijing 2019). The support provided includes donations, storage infrastructure, equipment, training, technical assistance and scholarships and is rendered under the Forum on China- Africa Cooperation (FOCAC) (FOCAC, 2001). The Zambian government is thus, leveraging on this opportunity to meet its agricultural agenda as set in the Seventh National Development Plan but does not influence the training offered by China in agriculture. The skills transfer is mostly conducted through workshops and seminars that are held in China and is regarded as filling the necessary skills

gaps. For instance, existing studies point out that annually around 10,000 African professionals are trained in various subjects with the majority being trained in agriculture in China (Tugenhadt and Alemu, 2016). The agrarian nature of many African states necessitates the dominance of agriculture in the training programs.

Although many factors effect agricultural production, this study focuses on one of the critical components of agricultural development, that is, human capacity. The central argument of this chapter is that China - Zambia skills and knowledge transfer is a key component in Zambia's human capacity enhancement and the achievement of a skilled agriculture workforce faces some hurdles. This chapter highlights how the agricultural skills transfer occurs, what factors influence the training programs, who gets trained and what challenges are experienced. Additionally, it highlights the relevance of the skills and knowledge that is transferred to Zambia while analyzing whether China also gains new agricultural skills from Zambia.

Therefore, this chapter is guided by the following questions; How does China - Zambia agricultural skills and knowledge transfer occur; What challenges are encountered in the skills transfer and what implications does the China - Zambia agricultural skills transfer have on Zambia's policy terrain? The data for this chapter was obtained through a review of existing literature as well as empirical data collection. The primary data collection was conducted from October 2019 to December 2019. The primary data draws from ten in-depth interviews with Zambian Ministry of Agriculture (MoA) staff members trained in China, five key informant interviews with MoA officials and the Chinese consulate in Zambia and one key informant interview with a Chinese Development and Aid expert in Beijing. Five of the in-depth interviews were conducted when the MoA officials were undergoing training in Beijing, China in 2019.

SETTING THE SCENE: CHINA-ZAMBIA AGRICULTURE AID

Zambia's strong relation with China is underlined by the fact that China accounts for 28 per cent of Zambia's external debt (Ayinla and Folarin, 2019). However, some argue that the level of cooperation is determined by Zambia's economic size (Haggai, 2017). Nonetheless, if one was to follow the economic size theorizing in terms of China- Africa cooperation levels, then Nigeria and South Africa, the largest economies in Africa, would have the largest amount of foreign aid. For example, as of 2018, Zambia received about 45.7 per cent of China's total foreign aid to Africa (Ayinla and Folarin, 2019; AATF, 2010) and has been the biggest aid recipient in Africa since Chairman Mao's time (Hairong and Sautman, 2010). Hence, China-Zambia aid cooperation is stronger, concerning China's total engagements in Africa. However, it is important to note in terms of monetary volume much of the aid is targeted towards the mining and industrial sector (Mwanawina, 2008; Hairong and Sautman, 2010).

This notwithstanding, several studies point out that China's agricultural cooperation can be traced back to imperial China (c.f Moyo, 2016) and in more modern history to the 1960s and continues to the present day, although the mode and methods have changed with time (Brautigam and Xiaoyang, 2009). For one, in the 1960s China sent agriculture experts to Africa and post-2000,

China brings African officials to China to 'see for themselves' China's success story in the agriculture sector (Li et al., 2012). Moreover, having achieved rapid agriculture success with limited land per capita, it is clear that China has centered agriculture in its development model (Li et al. 2012).

In Zambia, China's official representatives acknowledge that China-Zambia agriculture cooperation has entered the 'Fast development stage' (Zambia Daily Mail, 2017) indicating the two governments' strong support for agriculture growth. However, one of the many criticisms leveled against China is that of land grabbing. This argument of China pursuing an agro-imperialistic agenda in Zambia - which would essentially involve displacing locals from benefitting from the agriculture value chains - has been refuted although it has been established that China is seeking markets for its technologies and products in Zambia (Hairong and Sautman, 2010). The huge Chinese investments in Zambia's agriculture could also be explained by Zambia's liberalized agriculture sector, for instance, foreigners can own land in Zambia, particularly through the current farm block models. Thus, a liberalized land tenure system acts as driver that attracts Chinese engagement in agriculture. At the same time, it's prudent to note that China is 'not a newcomer to overseas farming' (Brautigam, 2009: 254). Although, studies indicate that the cooperation between China and Zambia has been largely progressive, Ngoma (2016) provides a more plausible explanation that the relations have transcended from warm to lukewarm. For instance, during the late President's Sata's election campaign there was huge resentment against the Chinese, though this later evolved into warmer relations after President Sata ascended to power. Thus, these broader state relations also determine the number of MoA staff members that are trained. As the current government has good relations with China, the number of MoA officials trained in China has also increased.

SKILLS AND KNOWLEDGE TRANSFER

There is no doubt that Zambia like several other developing states lacks adequate skills. For instance, in 2014 Zambia had 14 per cent Ph. D level staff among its agriculture researchers (CIAG, 2016). The agriculture sector is rapidly globalizing therefore, upgrading skills have become imperative to meet the changing environment (van Rensburg, 2014). Some skills gained in school are not adequate for the workplace, which requires 'hard' technical expertise (Robinson, 2006) including competence in resource management, information, human and technology (Gisselquist and Marie Grether, 2000; Robinson, 2006). China as previously indicated provides training under the ambit of FOCAC through different programs, focused investments and demonstration centers (Amanor and Chichava, 2016). Details are spelt out in paragraph 3.1 for Agriculture, Food Security, and Food Safety as follows (FOCAC, 2018):

- Organic farming.
- Training young leaders in agriculture development.
- Scientific research.

- Technical training.
- Technology transfer.
- Processing and marketing.
- Planning and designing agriculture policy.
- Supporting implementation of CAADP.
- Scientists' exchanges.
- Development of new research.
- Human resources cooperation.

Tugenhadt and Alemu (2016) provide a more detailed description of the training provided to Africa by China. The programs are short term policy courses, that run from two weeks up to three months and ministerial courses - conducted in the form of face to face arrangements - that are usually completed in 10 days. In 2014, 494 courses were offered, of these 233 targeted African professionals and most of the initiatives are run and coordinated by the Academy of International Business Officials (AIBO) (Tugenhadt and Alemu, 2016) where the age of participants ranged between 20 and 50 years. The new technologies introduced encompasses improved crop varieties, irrigation projects and the use of pesticides.

THE ZAMBIAN STATE AND SKILLS TRANSFER

Zambia's Extension and Advisory Service Strategy notes that:

"*The current extension service delivery system does not adequately cater for extension staff in-service and refresher training. This could result in most field extension workers confronting farmers with obsolete extension messages leading to a possible loss of confidence in public extension services delivery and eventually to poor adoption and adaption of innovation hence low production and productivity*".

Hence, considering this gap, the Chinese government is complementing the Zambian government since refresher courses in the current extension service delivery system are almost non - existent (GRZ, 2016). The Zambian state has been encouraging farmers to attend courses, form cooperatives, widening the chances of better adoption of newly disseminated knowledge and skills and addressing Zambia's agricultural productivity. This is a serious issue as the high rate of poverty in rural areas (was 78 per cent in 2015) has been attributed to low yields (CIAT, 2017) which in turn are largely a result of the failure to adopt improved methods of farming or production. Alternatively, for a form of the Green Revolution to boost yields, the prevailing political, economic and cultural regulations that the government makes would also be vital (Sun, 2011).

FINDINGS

Training and Participant Selection

Since the establishment of FOCAC in 2000, China has trained over 5,400 Zambia government officials from various sectors of the economy, of this 984 were drawn from the MoA. In 2018 and 2019, 98 officials from the Ministry of Agriculture and Ministry of Fisheries and Livestock have attended short-term training courses in China. The training that is conducted under Chinese aid can be dissected into two platforms; one that is conducted in Zambia and the other, conducted in China, from the months of April to early December. This chapter focuses on the training that is provided in China.

First, it is important to note that it was difficult to ascertain the exact number of Zambian MoA officials that are trained in China per year due to the unavailability of the information at the Chinese Economic Consular in Zambia and MoA. However, key informants from the MoA indicated that around 80 personnel are trained annually and of this about 40 per cent are female. The training courses the MoA members attend have a duration of 2 to 3 weeks or 45 days and these are conducted in various cities of China. The training participants move from one city to another as they infuse theoretical learning and practical lessons. Some of the interviewees indicated that on an average, training participant visited 3 cities during a two-week training period. Table 3.1 below highlights the training programs that were conducted in 2019 for the agriculture sector.

Table 3.1: Training Courses for the Year 2019

No	Course Title
1	Seminar on Agricultural Development Planning for BRI Countries
2	Training Course on Hybrid Maize Technology Extension for Zambia
3	Seminar on Agricultural Production Technology in Zambia
4	Seminar on Development & Management of Exhibition Industry for Developing Countries
5	Seminar on Agricultural Products Distribution and Trade for African Countries
6	Seminar on Soil and Fertilizer Comprehensive Management and Utilization for Developing Countries
7	Training Course on the Operation and Maintenance of Small-scale Agricultural Machinery for Developing Countries
8	Seminar on Climate Change and Agricultural Sustainable Development
9	Seminar for African Countries and African Union on Agricultural Modernization Cooperation and Food Security
10	Training Course on the Integrated Technology of Dairy and Beef Cattle Production for Developing Countries
11	Seminar on Agricultural Management and Practical Techniques for BRI Countries
12	Training Course on the Integrated Pest Management Technology of Tropical Crops for Developing Countries.

Source: Field Data (2019)

SELECTION

Information obtained from the interviews indicated that some of the participants were selected by the headquarters of the MoA and the selection process is conducted in various ways. One of

the interviewees indicated that he was selected to attend the training in 2014 and was chosen because his portfolio was concerned with agricultural trade and marketing. In terms of the nature of the participants, the group that was in China stated that the training was specifically for the technical services department and they were selected by the Head Office of the MoA in Zambia. Furthermore, they said the MoA made the selection on a rotational basis among the provinces to allow equal access to the training programs. In terms of the designation/ level of employees trained, the course trained both junior and senior technicians. One of the respondents indicated that he had attended two training programs in China in 2014 and 2016. These training programs were on Agricultural Mechanisation Training for Developing countries (2014) and Grain storage and Processing in developing countries (2016). The training courses were conducted for 21 days and 28 respectively. The majority (80 per cent) of the respondents in Zambia remarked that the training met their expectations. However, interestingly, the participants were not assessed on their skills needs before attending and not all of them were part of the manpower development plan. MoA's manpower development plan spells out the ministry's training needs on an annual basis. The training courses that participants attended covered subjects such as:

- Manufacturing of the different agricultural machinery and equipment.
- Conditions suitable for efficient output.
- Adjustments and maintenance of the different machinery and equipment.
- Introduction of grain storage structures.
- Type of grain to be stored versus the type of structure.
- Maintenance of Grain storage structures.
- Rice processing and polishing machines.

One of the respondents highlighted that "*So much knowledge was gained especially on the regulation of different conditions in the storage structure and manufacturing of the different agricultural equipment and machinery"*. About 40 per cent of the respondents noted that the training they received on farm mechanisation and grain storage is very much applicable to the Zambian condition. The current campaign by the government to mechanise is in sync with the new technology that was demonstrated during the training in China. Furthermore, one of the informants highlighted that "*Most farming equipment and machinery I was exposed to is also common here in Zambia".* The evidence from the interviews indicates that the technology on grain storage equipment was very important though some of it was not yet in use in Zambia.

NATURE OF TRAINING

The training conducted in China consists of participants drawn from several countries. For instance, evidence from a training on Agricultural Trade and Marketing program indicates that the participants were from African and South-East Asian countries that are mainly English speaking.

The training combined presentations by Chinese experts and field visits to Chinese farms. Key aspects of the training relied heavily on the Chinese experience in terms of technology and infrastructure. There were also interactions with Chinese farmers though this was limited due to the language barrier and the loss in translation of the messages. Some interviewees from a training course on Mechanisation remarked that technically, the training met the expectations of the participant. Besides, the trainees shared the experience and knowledge with colleagues when they arrived in Zambia.

APPLICABILITY OF THE SKILLS AND KNOWLEDGE

As for the agricultural machinery and equipment that was demonstrated in China some of it was being localised in Zambia by Chinese companies such as Camco Equipment Zambia Limited. However, there were lags in that the same machinery was not manufactured in Zambia. Besides, the respondents noted that in terms of grain storage structures, China made high use of technology such as software as a way of improving the storage processes. This was however not yet in use in Zambia. A Zambian informant remarked that "*The software that they are using are well advanced and as a country, it will be good to reach those levels".* For technology and knowledge to be useful it must have widespread application by the intended beneficiaries. In this regard, evidence from the interviews in Zambia indicates that the application of the learned technologies has not been done to the required level due to the different levels of technological advancements here in Zambia.

Mostly, the respondents used the principles they learned in China to teach the local farmers but this process suffered a drawback in that some of the technology was not yet available locally, worse still in some remote areas. One of the respondents noted that "*For example, manufacturing of the tractors may not happen in our country, but the maintenance, adjustment, calibration, and storage principles are the same. Also, rice production is slowly growing in Zambia hence the need for knowledge on the equipment used for processing".* An interesting perspective is that the Zambian extension officers noted that, they were not aware of the technology utilization levels of commercial farmers. They highlighted that commercial farmers are independent as they employ farm managers to handle such issues.

Thus, this study argues that Chinese technology and knowledge dissemination are mainly aimed at benefitting smallholder farmers who are largely serviced by agricultural extension officers (c.f Nalwimba, Qi and Mudimu, 2017). However, this has not been achieved, as indicated by remarks made by one respondent that he was unable to implement any of the lessons learned due to a lack of supportive resources from the Zambian government. **Case 1** below presents some perspectives drawn from Zambian personnel during their training in China between October 2019 and November 2019.

CASE 1: TECHNICAL SERVICES DEPARTMENT (TRAINING IN CHINA)

This group stayed in China for 45 days. They all hailed from one province in Zambia. The training the group attended was conducted by Chinese academicians and various representatives of companies that manufacture agriculture equipment. In terms of the latest technology, the group rated 40 per cent of the equipment as new technology. Over the course of 45 days in China, they moved around 3 cities, however, they stayed longer in Beijing. Part of their stay in China also included visits to key historical sites such as the Great Wall, Temple of Heaven and the National Museum among other numerous places. The Zambian group was also combined with other participants from Egypt, Gambia, and Ethiopia. In terms of gender, 70 per cent of the participants from Zambia were male and 30 per cent females. The participants' age ranged from 32 to 46 years. The participants all alluded that they had taken contacts of the companies and the professors they met. Some suggested that they will keep in touch with the professors so that could get access to scholarships in the future for their postgraduate studies. Overall, they rated the training to have met 80 per cent of their expectations. The participants expressed their keenness to learn new skills and technology and share this with their compatriots upon their return to Zambia. However, they raised reservations mostly on the language barrier which resulted due some of the younger translators hired by the facilitators failing to adequately present the technical information and other related information. Furthermore, they also mentioned some of the firms restricted entry to some areas of the production sites or ignored some of the questions, which, however, were critical to the participants. Besides, the participants also bemoaned the need to visit more companies with technologies that are more appropriate for the smallholder farmers in Zambia. Other administrative issues cited by the trainees included the frequent change of the training schedules and canceling of some planned demonstrations. The technologies and machinery companies they visited were related to crop, livestock, and pest machinery.

DISCUSSION

As demonstrated by evidence from the interviews the training is aid funded. Therefore, the training is extensively based upon resourcefulness of aid experts (Buckley et al. 2017). An over-reliance on aid experts/ foreign trainers' results in issues such as language barriers and failure to engage better translators decimates the efficacy of the training process. Hence, under such a condition, local training has more potential to solve the language problem. However, the challenge is that the Chinese experts in Zambia are limited and only available at the Chinese Aid Technology Demonstration Centre (ATDC) in Lusaka. Therefore, training in China still presents a wider chance to learn from an array of experts. As much as the training provided in China is appreciated by the trainees, the efficacy of training is largely determined by the ability of the participants to learn, motivation to transfer the technology after training, attitude to the skills development, culture and organisational strategy (van Rensburg, 2014). Thus, in as much effort can be made on training the officials, how these skills are utilised also largely depends on the post-training period.

The other broader challenge is that the training provided by China is mostly in the form of aid, therefore, Zambia has limited input on the form of training and the courses' contents (Xu et al., 2016; Scoones, Amanor, Favareto and Qi., 2015). Hence, there is a high chance for the dissemination of knowledge and skills that may not be very appropriate to the Zambian local conditions. Furthermore, needs assessments of the participants is not conducted before attending the courses, therefore, there is a tendency of sending participants to China even for training that is not critical to their current work responsibilities. At times, the non-coordination between the training providers and the manpower development planners leads to the rise of a mismatch between the nation's goals and the training. Further, due to limited post - training support by the donor, it means that the host government has to use more of its resources to scale up, that is, to use the newly gained knowledge, to roll out the training to other members of staff and to embark on further research. However, such scaling up has been largely hindered by low resource allocation to research in Zambia. The state usually allocates 0.051 per cent of the National Budget to agriculture research less than the 1 per cent mandated by the African Union (CIAG, 2018). The situation is also further complicated by weak collaborations between the private sector and the public sector in research (Salami et al, 2010; Nalwimba, Qi and Mudimu, 2017). Thus, as much as the state has been pushing for the inclusion of the private sector in agriculture via platforms such as the Farmer Input Support Program there is still limited inclusion of private sector in the licensing of new seeds and technology (Nalwimba, Qi and Mudimu, 2018).

This study also noted that the training (in China), largely encompassed Chinese training Zambians, according to the interview data no Zambian agriculture experts have for the period this study is based on, visited China to train Chinese officials. This study argues that Zambia can train the Chinese on understanding the local conditions so that the training provided by the Chinese is tailored to Zambia's needs. This is necessary since the adaption of various types of technology is supposed to take into account Zambia's different environments, crops, and ecological zones. Based on the observations of largely a one-way skills and knowledge transfer, assertions by Xinhua (2018) that China and Africa are complimentary in agriculture do not fully capture the China- Zambia Africa agriculture training dynamics that is largely dominated by Chinese training Zambians.

However, this does not rule out the occurrence of knowledge transfer from Zambia to China. Knowledge is transferred through publications, discussion, licensing and sales (Gisselquist and Marie Grether, 2000). Therefore, Zambia's knowledge transfer to China is more on the side of discussions, publications and conferences. However, in other contexts, Zimbabwean officials have visited China to train Chinese on tobacco farming (Gu et al, 2016). Hence, on this instance, Gisselquist and Marie Grether (2000) arguments that there is a lack of inclusion of indigenous knowledge that captures the realities of the current skills training and knowledge transfer. Studies cautiously and consistently remind us that agriculture demands context-based strategies (Li et al., 2012). This is a pertinent issue given the backdrop that a gap exists between training provided in China and Africa (Buckley et al., 2017). However, by and large China's demonstration and sharing of the latest technology is in tandem with Zambia's Vision 2030 of moving from "hoes to combine harvesters" (Winter, 2016).

CONCLUDING REMARKS AND POLICY IMPLICATIONS

This chapter has outlined and discussed how China transfers skills and knowledge to Zambia. The skills and knowledge transfer is conducted in the form of aid to Zambia under the ambit of FOCAC. For the past years, China has trained many agriculture personnel in various skills. The skills have been beneficial by introducing Zambians to new technology as well as how to maintain existing technology. The training has been very beneficial to a nation that has limited resources to carry out a wide-scale human capacity building program. At the same time, the donor-driven nature of the program has often resulted in limited government input into the training and at times not so appropriate knowledge and skills are disseminated. But by and large, the training and skills are in line with Zambia's Vision 2030 of a mechanised agriculture sector, poverty and hunger-free nation. In terms of policy implications, the study notes the following:

- The training should also focus on what is readily available in the Zambian context. For example, Ox-drawn technology must also be included in the training programs offered as most small and emerging farmers still utilize it.

- For the machinery and equipment not available in Zambia, a deliberate policy to establish mechanisation centers equipped with the necessary equipment where farmers can learn from and also access hire services will be appropriate. In addition, farmers who can afford to buy, a soft and affordable arrangement to allow them to acquire such machinery must be devised. If the manufacturing of agricultural equipment and machinery is done locally, then there can be a likelihood of many farmers accessing and owning them due to reduced production and related costs and eventually lower prices.

- The training programs must be more aligned with the country's agriculture policies and visions. For instance, skills assessment must be conducted before the staff members embark on the training.

- This study argues that Zambia can train the Chinese on understanding the local conditions so that the training provided by the Chinese is tailored to Zambia's needs.

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Chapter

4

Artificial Intelligence in Zambian Agriculture: Case Study of a Chinese firm-Guangzhou Jifie Technology Co., Ltd. (XAG, 广州极飞科技有限公司)

Muyobozi Sikalubya

INTRODUCTION

The Zambian agriculture system is composed of small-scale and commercial farmers, nonetheless, small-scale farmers who produce crops for home consumption and surplus for sale accounts for the bigger percentage of production. These farmers face daunting tasks in combating crop diseases, pests, and climate variability such as droughts which have dwindled output and threatened food security in the country. Therefore, in combating the aforementioned challenges the Zambian government has been engaging with the Chinese firms to boost output through the adoption of Artificial Intelligence (AI), precisely the use of drones in ensuring pests management control. Consequently, Zambian agriculture has witnessed rapid adoption of AI and Machine Learning (ML) both in terms of in-field farming and output production techniques. Cognitive computing, in particular, is all set to become the most eruptive technology in agriculture services as it can understand, learn, and respond to different situations to increase efficiency. Similarly, on the global scale, agriculture productivity has been growing steadily owing to technological advancement aimed at increasing yield and output without increasing the cultivation area share. Therefore, the adoption and application of Artificial Intelligence such as drones, crop data processing and precision farming help farmers to keep pace with technological advancements as well as reap the benefits of this service. Currently, in Zambia, a Chinese firm known as XAG headquartered in Guangzhou with subsidiaries across China, Korea and Zambia is working with farmers to provide advisory services for sowing, land preparation, application of fertilizer and pest control using drones. In 2016 the firm established its research subsidiary branch in Zambia which marked the firm's first launch in Africa. This initiative has already resulted in 30 per cent higher yield per hectare on an average in 2017-2018 farming season compared to the previous farming season (Ministry of Agriculture, 2018). Therefore, with the application of AI in the Zambian agriculture system, there is a high prospect that there will be efficient pest control management and less costly growth.

Currently, in Zambia, a Chinese firm known as XAG headquartered in Guangzhou with subsidiaries across China, Korea and Zambia is working with farmers to provide advisory services for sowing, land preparation, application of fertilizer and pest control using drones.

THE FALL ARMYWORM

The fall armyworm is a distractive and highly intrusive pest that mainly targets corn. At the larval stage, the aforementioned caterpillar, eminent with a white inverted-Y spot on its crown and four black dots arranged in a rectangular shape on the tail surface of the body section, causes the utmost destruction to the maize plant (Prasanna et al., 2018: 2). If left unrestrained, the pest can consume all parts of the plant leaving only a bare field. The fall armyworm as they grow, they even turn out to be cannibalistic and feast on their family members up until only 1 or 2 young insects remain on each foliage. Additionally, it can feast on the crop all the way through the year regardless of the temperature variation, and can easily move from one region to another. The pest can hover more than 100 kilometers within a single night when they turn into a fully-fledged moth, they can lay over 1000 eggs during its lifespan, making it a highly populated an invasive pest on maize yield (F.A.O., 2018a)

In general, this small restless pest has been causing devastation over the main grain-producing regions. Although, mainly found in the tropics and sub-tropics of the Americas, in the beginning of 2016, the pest traversed the Atlantics and invaded China and Zambia. With its presence first spotted in India in July 2015, these pests have now destructively trooped into both Africa and Asia and spread eastward to Southeast and Northeast Asian countries such as Myanmar, Thailand, Sri Lanka, China, South Korea and Japan. As alluded earlier, the widespread invasion of fall armyworm has resulted in an enormous yield loss, threatening food security and the livelihood of smallholders. According to the assessments of Food and Agriculture Organisation (FAO), in Africa, fall armyworm has invaded and destroyed more than 1.5 million hectares of maize fields, and the annual financial losses borne by the highly devastated 12 corn-producing countries including Zambia ranges between US$1 and US$ 4.6 Billion. Additionally, the FAO projections indicate that crop losses due to the fall armyworm attack in different Asian countries range from 1.2 per cent to 20 per cent (F.A.O, 2018b).

In general, this small restless pest has been causing devastation over the main grain-producing regions.

CHINA- ZAMBIA INTENSIFY PARTNERSHIP IN PROTECTING CROPS AGAINST FALL ARMYWORM USING DRONES

In China, the counter battle to the threatening trooping fall armyworm is obstinate. Ever since the validation of its manifestation in January 2016, the pest has spread to over 21 provinces

and projected to raid the northeast maize producing region. Having been equipped with huge expertise in preclusion and treatment of similar armyworm species, in China the Ministry of Agriculture stood extremely vigilant to this new crop aggressor. For instance, in Yunnan province, situated in the Southwest regions of China, the farmers first encountered the fall armyworm which originated from the neighbouring regions of Myanmar. It is also the most plagued area, with approximately over 86,000 hectares of crop fields infested within 6 months of the pests' invasion (China agricultural outlook 2018). Wenshan, a separate region of Southeast Yunnan province faced a similar tragedy. The local farmers first spotted the fall armyworm in Wenshan at the end of March 2017 and were not aware of what it was or misidentified it for other similar kind of vermin.

Having been equipped with huge expertise in preclusion and treatment of similar armyworm species, in China the Ministry of Agriculture stood extremely vigilant to this new crop aggressor.

The villagers' sluggish reaction to the ensnarement of fall armyworm and their initial failure to recognize this species has given rise to a widespread infestation amongst maize and sugarcane fields. Therefore, under such a situation, there are proofs of effective use of biochemical mechanisms to curb the spread of fall armyworm. Nonetheless, the labor-intensive hand spraying method extensively used by Chinese farmers is neither effective nor ecological. Thus, when a farmer spends the entire day hand spraying a single pest-ridden area, by the time they finish, the pests would have already annexed other parts of the field that were initially unharmed (Prasanna et al., 2018:65). In addition, farming in china mostly takes place in highlands, where big ground-based machinery finds it difficult to access the infected crops.

Thus, combating pests in such regions demands a swift, in effect large-scale operation supported by drones, which are dexterous enough to maneuver in dense and lofty plants on mountainous regions. It was for this reason that the XAG firm industrialized a modern technology to substitute the traditional practices against insecticide and started vigorously engaging in the fight against fall armyworm using AI techniques in most of the affected areas. In June 2016, under the authority of the municipal council, the XAG team conducted a three-week rigorous operation with their mechanized drones to spray pest-ridden crops. Consequently, the firm deployed a team of professionals to offer cost-effective Unmanned Aircraft Systems (UAS) spraying facilities to smallholders. The team testified that it was the first time that they witnessed such an aggressive pest in that region.The fall armyworm is a very destructive pest and once it invades a field it can encroach all parts of the maize crop including foliage, whorl, stalk and cob. Particularly, if the vermin invade the crop at its premature whorl phase, the corn can develop a disorder known as 'dead heart' a condition that makes a crop fail to reach its full maturity. Therefore, crop catastrophes had put a lot of agronomists' source of revenue at risk and forced them to shift to other crops that are insusceptible to this vermin infection.

> ***The fall armyworm is a very destructive pest and once it invades a field it can encroach all parts of the maize crop including foliage, whorl, stalk and cob.***

However, in Wenshan, drones remained uncommon among the majority of small-scale farmers, this is due to farmer's reluctance to accept new technologies for agricultural production. Nevertheless, the fight against fall armyworm using drone's technology has transformed the attitude of many small-scale farmers who were previously skeptical concerning agriculture application of aerial monitoring system. Approximately 270 hectares of croplands that XAG drones had sprayed over, managed to control pest mutilation to the least possible level (Rwomushana et al, 2018:21). This was mainly due to the fact that XAG's drone facilitates an exceptional spraying application that makes pesticides more consistently adhere to an expansive yield surface. Additionally, such innovative AI is highly efficient, ecologically friendly and cost-effective, which enables farmers to save their infected fields and boost crop production.

> ***Approximately 270 hectares of croplands that XAG drones had sprayed over, managed to control pest mutilation to the least possible level***

The fight against the invasive fall armyworm was not only confined to the Chinese soil, but Zambia has also taken a decisive role in combating these agricultural epidemic causing vermin. Thus, Zambia was among the first country in Sub-Saharan Africa to suffer armyworm infestation, a pest which left many fields naked, dwindled crop output and threatened food security in the country. Since then, the country has encountered a number of challenges in combating pests, currently, the fall armyworm has a preference to feast on maize which is a key food crop for the majority of Zambian residents. According to the national household survey under the central statics of Zambia, in 2016, up to 99 per cent of farmers recounted that their cornfields had been pest-ridden by hazardous fall armyworm, with approximated yield loss of over 35 per cent, which when evaluated in monetary form is correspondent to a virtual economic worth of US $16 Million (MoA, 2017). In Zambia, Maize is a labour and costs-intensive crop, moreover, most of the small-scale growers lack supplementary biochemical management. Therefore, the epidemic caused by fall armyworm worsened the already cost-intensive crop production. Agronomists had to hand-spray insecticides to exterminate the pests, if not, they would be left impoverished with devastated fields. The pest has been petrifying farmers and triggered a widespread yield loss, it is a cancerous virus for crop production. Devoid of well-validated regular antagonist or hereditarily altered maize varieties, local farmers precisely in Zambia, ordinarily resort to traditional pesticide spraying, but in certain cases the results were unsatisfactory.

In Zambia, Maize is a labour and costs-intensive crop, moreover, most of the small-scale growers lack supplementary biochemical management.

It was at this point that the Ministry of Agriculture and Livestock had to look to the East precisely to China for help in curbing this disastrous pest which had engulfed the whole country and threatened to turn it into an empty food basket. They realized that the fight against fall armyworm demands to go aerial. So, it reached out to XAG known for its precision UAS spraying mechanism. The decision to look east (China) despite the fact that the pest originates from the west (Americas) was deliberated upon the fact that China had faced the same challenge of the fall armyworm and that the country quickly adopted successful measures to eradicate the pest. To that effect, XAG took a lead in aiding to eradicate the pest. The main reason why the Zambian government approached XAG was that the firm had vast experience in piloting UAS drones that would efficiently combat the pests. Thus, the whole crop protection team of XAG led by Fraser Zhang was prominent in engaging with local farmers for spraying experiments using drones to thwart the identical kind of pests at twilight in Chibombo area of Central province of Zambia. The XAG firm and Zambian pest control team under the Ministry of Agriculture observed how Zambia has been in misery from the outbreak of pest disease from Land's End to John O'Groats (SECI, 2017:38).

The decision to look east (China) despite the fact that the pest originates from the west (Americas) was deliberated upon the fact that China had faced the same challenge of the fall armyworm and that the country quickly adopted successful measures to eradicate the pest.

The Ministry of Agriculture Livestock and Fisheries in partnership with XAG and Sungari Investment Zambia Limited, acquainted with drones to fight against fall armyworm. Since 2018, as an agricultural technology service provider, XAG has been engaging with local farmers in ensuring proper crop management through the use of drones. Previously, in Zambia, the usage of insecticide control involving hand spraying method remained as the most extensively used technique in combating fall armyworm. Nonetheless, based on evidence from farmers, this method is toxic to the users and less effective in eradicating crop pests. Therefore, conducting labour-intensive hand spraying method in big farmlands proved to be unfeasible, let alone a vast wastage of pesticides and the danger of biochemical poisoning (Xinhua, 2019). Furthermore, farmers frequently get more irritated when they have sprayed pesticides many times but are devoid of any positive outcome. In addition, hand spraying method poses a problem in accurate measurement of insecticide, which to a larger extent is the reason why fall armyworm proved to be difficult to eradicate.

Therefore, after witnessing how the fall armyworm devastated crop fields in Zambia, XAG described the pest as a 'crop-killing monster'. As a matter of fact, it does not only attack cornfield

but also attacks over 80 extra crop species, including soybeans, sugarcane, wheat, ginger, cassava, and sorghum. During the day, the fall armyworm young insect frequently hides inside the essential part of maize and occasionally tunnel into the topsoil. As they mature, they breed enormous amounts of Fras to protect the spirals[1], making it hard for pesticides to contact the vermin. This is one of the reasons why hand spraying of pesticides on the fall armyworm proved futile, thus, when confronting such hard-hitting state of affairs, XAG's drones were the only option. To that effect, during the 2017 farming season, the XAG team piloted a sequence of field research and hands-on operations on three commercial farms, covering approximately 200 hectares of crop fields (CSO, 2018).

> ***As a matter of fact, it does not only attack cornfield but also attacks over 80 extra crop species, including soybeans, sugarcane, wheat, ginger, cassava, and sorghum.***

Consequently, the project which was launched in early 2016 and went into effect in 2017-2018 farming season, effectively managed to eradicate fall armyworms on approximately 30 hectares of severely pest-ridden maize field at Kalele smallholding, situated in Kabwe in the central province of Zambia. Previously, due to the severity of fall armyworms infestation on the aforementioned farm, the farm supervisor assumed that his cornfields could not survive against the vermin and opted to adopt new technology. As a result, the outcome was to a certain extent substantial as the yield loss rapidly decreased.

Currently, with years of amassed technical know-how on UAS crop fortification, XAG and Sungari firm have launched drone-based spraying facilities for the majority of domestic farmers, agro-dealer firms as well as commercial and multinational farms such as York farm, Seed.co., Zambia Sugar Plantation, Butter Mere farm, Kafue Sugar and Kasama Sugar Plantations, to mention a few. During the operation, the first drones piloted for the task after twilight, when the nocturnal pests stop masking themselves. Subsequently, with the intelligent atomisation drenching technique, the drones, consistently, target insecticides onto the plants, spirals and stalks of the maize. No doubt, low-toxicity systemic pesticides would be supplementary in effect to intensify pest mortality and safeguard the foliage, which eventually increases crop yield and output. Thus, in the coming farming seasons, the Zambian Ministry of Agriculture and Livestock in collaboration with all stakeholders such as XAG and Sungari firm intends to magnify the application of artificial intelligence provide it to all farmers for ensuring food security in the country. Further, XAG and Sungari firms anticipate to grow agro-industry and supply smart agronomy tools to other nearby African countries, such as Kenya, Zimbabwe, Malawi, Uganda and Rwanda, which are similarly subjected to the torment of fall armyworm caterpillars (SP, 2017:23).

[1] ***Fras is a thick protective outer layer the fall armyworm develops, which acts as a shield from hazard.***

> ***No doubt, low-toxicity systemic pesticides would be supplementary in effect to intensify pest mortality and safeguard the foliage, which eventually increases crop yield and output.***

APPLICATIONS OF ARTIFICIAL INTELLIGENCE

As alluded earlier, multiple challenges emanating from pest infection, low income as well as droughts have hit the agriculture system in Zambia. Thus, in attempting to address these challenges the government of Zambia adopted AI in the agriculture sector and crop data processing has tremendously improved. Due to the fact that if the exercise is conducted without the aid of supercomputer systems, assembling and breeding data is time-consuming and costly. Nonetheless, through the application of Chinese aided AI, there is a prompt completion of all this procedure at an inexpensive rate, making crop supervision much more accurate. Thus, Chinese engagement in facilitating the application of AI in the Zambian agriculture sector correlates to the decrease in the effect of crop pests and diseases, which is considered as one of the major problems in field management. As a result, with a comprehensive span of data and information acquired from AI devices brought by Chinese firms, the Zambian small-scale farmers are able to detect the inception of diseases in the initial phase, enabling farmers to adopt safety measures in advance and evade yield fatalities.

> ***Thus, in attempting to address these challenges the government of Zambia adopted AI in the agriculture sector and crop data processing has tremendously improved.***

The influence of Chinese firms in facilitating the application of AI in the Zambian agriculture sector is an indispensable tool that avails accurate information from the analysis of soil, planting and harvesting; enabling the farmer to make a rapid resolution in the face of teething troubles, thereby boosting total output. The adopted technological devices offer inordinate precision in the identification of climate occurrences impelling the crop yield, such as high temperature, precipitation, bearing and blustery weather velocity essentially in real-time, making data analysis interesting. Comprehensive understanding of the environmental mismanagement such as deforestation, misuse of insecticides and pests helps famers to select the best input to use, at what time and in what amount in order to reap a concentrated yield per hectare.

> ***The adopted technological devices offer inordinate precision in the identification of climate occurrences impelling the crop yield, such as high temperature, precipitation, bearing and blustery weather velocity essentially in real-time, making data analysis interesting.***

Since the inception of involvement of XAG in Zambia, there has been a rapid use of AI in the agricultural sector which ultimately drives growth by availing enormous amount of data produced on daily basis in both regulated and amorphous format. The technological devices avail information on chronological-meteorological conditions pattern, topsoil grades, innovative investigation on breeding, precipitation, pest infiltration and descriptions from Drones and remote sensing. Therefore, the availability of cognitive computing technologies through Chinese firms offers necessary and robust agriculture information which increases yield in the Zambian agriculture sector. To that effect, XAG firm offers Proximity Sensing and Remote Sensing which are two vital technologies mostly applied for intelligent data synthesis at Nakambala Sugar Plantation located in Mazabuka district of Zambia. These technological tools are applied for a wide range of analyses among which is soil testing. Despite the fact that remote sensing demands sensors to be erected into aerial or satellite coordination, proximity sensing enables sensors to interact close to the soil and get accurate data (Ricciardi et al., 2018: 64). This aids the depiction of soil quality and plant growth information per specific hectare. Additionally, the firm offers both hardware and software crop processing solutions such as the mechanical devices used in measuring the accurate amount of fertilizer per crop, harvesting, collecting and pairing crop irrigation and growth information necessary in boosting precision agriculture business.

The technological devices avail information on chronological-meteorological conditions pattern, topsoil grades, innovative investigation on breeding, precipitation, pest infiltration and descriptions from Drones and remote sensing.

Nonetheless, the involvement of Chinese firms in the Zambian agri-business has sparked numerous discussions, for instance, precision agri-business is one of the highly debated topics in contemporary agri-business forums, precisely among commercial growers in Zambia. The debates rest on whether mechanization of the agri-business by Chinese firms has emerged as a blessing in disguise and whether technological advancement will help to revamp green and sustainable growth deteriorated by the climate change in the sector. Many analysts in the field of agricultural economics have deliberated on such discussion with some testifying that Chinese (XAG) drone-based descriptions can aid in-depth field exploration, yield monitoring, scanning of fields without harming local industries, which is very essential in agriculture management and consequently ensuring stable growth in the sector. Farmers in the face of rapid climate change share digitalized vision technology on prominent meteorological information which ensures sustainable and green growth. Drones image information on remote sensing and pests ridden yields gives alerts in real-time to hasten precision agri-business. Different yield images in white/ UV-A light regulate whether the yield is ready for harvest (Rwomushana et al., 2018:22). As a result of such technological advancement propelled by Chinese firms, Zambian farmers are now able to assess various intensities of readiness for crop harvest and dispatch their produce to the market on time, this enormously aids resource optimization and production efficiency.

Drones image information on remote sensing and pests ridden yields gives alerts in real-time to hasten precision agri-business.

Consequently, based on numerous agricultural estimates carried out with the aid of AI such as assessment of topsoil condition, prediction of meteorological conditions, seed varieties, and pest incursion in the specific agricultural zone of Zambia, farmers are able to preeminently select the best type of crops to grow and suitable crossbred seeds for specific ecological zones. Further, farmers can predict and improve their output centered around the previous information about efficient productivity. Similarly, with the help of AI, external dynamics such as marketplace tendencies, availability of agricultural technological devices tends to empower farmers' efficiency in production.

To that effect, the availability of remote sensing systems and hyper-spectral imaging devices offers indispensable technical know-how in increasing yield among Zambian farmers. Thus, such an application of AI revolutionised the Zambia agriculture management of farmlands for both small-scale and commercial farmers. Correspondingly, farmers apply such expertise in monitoring crop growth and offer information in cases of abillionormalities during the growth period. Therefore, it is a fact that usage of drone-based systems in Zambian agriculture propelled by Chinese firms is exceedingly significant in terms of handling adversative weather situations, efficiency expansions, precision farming as well as crop management.

Correspondingly, farmers apply such expertise in monitoring crop growth and offer information in cases of abillionormalities during the growth period.

Thus, the usage of these technical devices such as drones frequently occurs prior to yield rotation in order to capture an accurate three-dimensional field plot's topography, drainage, topsoil assessment feasibility and irrigation. Likewise, drone solutions enable farmers to conduct Chemical content assessments of the soil such as Nitrogen-level controlling. Apart from that, at Nakambala Sugar cane plantation, automated drones spray fluids by moderating distance from the ground contingent to the topography. Thus, the prospects of Artificial Intelligence in the Zambian agriculture sector precisely on yield monitoring and healthiness valuation driven by Chinese firms proves to be one of the most significant elements in agricultural science to offer drone-based alternatives in association with digitalized vision expertise (USAID et al., 2018). High-resolution cameras input in drones' systems capture and assembles precision field descriptions which can be computed to ascertain zones with unwanted plants, it can also detect which crops requires watering, assess crop pressure level during growth phases, and the amount of precipitation. In terms of infested foliage, by flicking through crops in both near-infrared light, it is conceivable to engender multi-spectral descriptions by means of drone devices. Consequently, this enables farmers to accurately postulate an infested area of the field or specific crop including

their position in an immense farm to promptly monitor treatments. The multispectral pictures conglomerate spectral images by means of a spatial scanning system to define the three-dimensional information technique applied for huge acreages. The aforementioned time-based component of AI offers accurate crop management to Zambian farmers, thereby increasing output and ensuring food security in the country.

> ***In terms of infested foliage, by flicking through crops in both near-infrared light, it is conceivable to engender multi-spectral descriptions by means of drone devices.***

DRONE AS NEW TECH TO BATTLE THE CROP-DEVOURING FALL ARMYWORM

Given the situation, smart agriculture devices such as drones would come in handy for fixing these problems, possibly with minimal environmental impacts. In China, professional farmers and agricultural service providers have already harnessed the existing drone technology to conduct appropriate chemical sprays and safeguard the country's crop production. The drone, with centimeter-level navigation, can operate fully autonomously over complex terrains and easily adapt itself to different spraying conditions of various crop species, including maize. Hence farmers can free themselves from much physical toil while no longer risking their health in the battle against fall armyworm.

> ***The drone, with centimeter-level navigation, can operate fully autonomously over complex terrains and easily adapt itself to different spraying conditions of various crop species, including maize.***

An effective large-scale usage of drones spraying suppresses the encroachment of pests efficiently. For example, the newly developed plant protection drone has an efficient spraying capacity reaching up to 14 hectares per hour. Therefore, drone swarm operation can besiege the infested croplands and kill the pests en masse within a large area, thus reducing the extent of moth migration. This drone can even safely operate to crash down the pests at night when the caterpillars tend to reveal themselves and actively feed on the plants. In addition, the aforementioned device can also achieve uniform applications of ultralow-volume pesticides. Specifically, the drone atomizes the pesticides into micron-level droplets, so the chemicals can evenly adhere to the surface of maize plants with a higher coverage rate. The strong downdraft generated by the propellers can significantly reduce liquid drifting and increase pesticide deposition, which means that both sides of the leaves and the central part of crops is more precisely targeted. Such a mechanism can not only increase fall armyworm's exposure to chemicals but also cut down a large amount of pesticide use and better conserve the beneficial insects.

Specifically, the drone atomizes the pesticides into micron-level droplets, so the chemicals can evenly adhere to the surface of maize plants with a higher coverage rate.

Agriculture drones with such precision spraying technology are available in China and have started to travel across Zambia and some other countries to help curb the spread of pests. Since April 2019, in China's Guangxi Province, XAG and Bayer Crop Science have initiated their first-ever emergency control to help local smallholders' ward-off fall armyworm on their maize fields. The plant protection drones' coordination with Chlorantraniliprole, a low-toxicity synthetic insecticide approved for use, have effectively killed the pests and achieved larval mortality rate of as high as 98 per cent (Ricciardi, 2018: 65). Therefore, drones could be one of the safe and effective tools to increase framer's efficiency, but it needs some time for the farming community to fully accept and adopt such advanced technology.

INTEGRATED PEST MANAGEMENT TO FIGHT THE ENEMY

Although, it is more or less impossible to completely exterminate these hazardous pests in the country, with the application of AI, there is a significant decrease in the spread and crop damage. Based on the concrete application of AI, a science-driven Integrated Pest Management method has been established and incorporated to specifically fight against fall armyworm. An operational integrated pest management approach incorporates an assortment of complementary procedures, including insecticide spraying, biotic regulator, host crop resistance and agro-ecological land management, which maximizes efficiency and at the same time decrease the adverse effects on the environment and human life. All these approaches plummet into two core classifications and selectively implemented in combination, centered on the exploration of invasion concentration and yield growth phases.

Based on the concrete application of AI, a science-driven Integrated Pest Management method has been established and incorporated to specifically fight against fall armyworm.

To that effect, the Zambian Ministry of Agriculture has embraced a number of strategies to combat yield loss in the agriculture sector. Some of the strategies employed to reduce yield loss include increasing crop species which are genetically impervious to fall armyworm as well as consolidating the pliability of the farming ecosystem such as early planting, crop alternation, inter-cropping or companion harvesting, which reduces the prospect of pest's infiltration. Additionally, during the period of pests attack certain tactics have been applied; for instance, spraying eco-friendly artificial pesticides or bio-insecticides and hosting natural pests' antagonists, such as organisms, predators and pathogens, that target fall armyworm (MoA, 2018). Such measures have proved successful in containing the pests' population and condense yield mutilation.

Another intervention that the Ministry of Agriculture, through Chinese high-tech firms has embraced in ensuring field management, is the assimilation of Chinese chemical control using diverse technological tools. This has remained as one of the core approaches, particularly when the pest population in the field reaches a certain exploitative threshold. The Ministry of Agriculture in Zambia through field experience and Chinese research teams has approved that the appropriate use of insecticides in line with the national and international field management criteria can efficiently upsurge pest larvae mortality and decrease yield mutilation through a non-toxic method. Nonetheless, the solicitation and effectiveness of these Chinese chemical control procedures show a discrepancy between diverse regions and plant varieties. As some pest strains have progressively developed resistance to such insecticides. Nonetheless, in China, the genetically modified corn variety appears to be efficiently resistant to fall armyworms and other pests that threaten maize yield in Zambia. Thus, there is a need to integrate such maize varieties in Zambia, in order to ensure food security.

On the contrary, since fall armyworm is a new-fangled intrusive pest in Zambia, there is still a lack of naturally stirring genetic agents to offer fortifications against the pests. As the majority of farmers still lack technical know-how, they entirely resort to organic spraying instantly after identifying pests' mutilation. Consequently, the effectiveness of such manual pest control techniques tends to be unsatisfying. This is mainly due to misguided application of chemicals or insecticide mismanagement, such as inappropriate application rate, erroneous prescription, irregular spraying in addition to the application of counterfeit or extremely unsafe insecticides. Thus, the Ministry of agriculture in collaboration with XAG offer training programs to enlighten agronomists with the technical know-how on Integrated Pest Management using AI techniques.

Additionally, with the ever-increasing urbanization, Zambia has long been faced with critical degree of labour shortage in the agriculture sector. The majority of the youthful and able-bodied populace has been on a rampant exodus to the metropolitan areas in search of off-farm jobs, leaving the old aged population and women to practice farming. However, the advent of smart, automated technologies such as drones and other AI devices encourages urbanites, especially the young generation, to start agribusiness. XAG, through its drone-based precision spraying technology, has been part of this wave to bring vigor back to the rural economy through agriculture investments. To that effect, the application of AI, such as drones is very intriguing and fascinating to a number of youths which has cultivated an enormous potential to make agriculture a viable and attractive business. Using borrowed AI, from China a number of youth farmers are able to efficiently collect field data, spray insecticides, effectively plant seeds and monitor yield growth shorn of injuring the plants (MoA, 2018). XAG's field atomisation spraying method is of utmost significance in fortifying micron-level precision farming obligation. Therefore, with the assimilation of such kind of technology, Zambia's agriculture industry gets a rapid transformation and commercialization, precisely, farmers situated in highlands. Nonetheless, managing a smallholding is still regarded as an unskilled job, demanding an irresistible and enormous capacity of manual labor.

To that effect, the application of AI, such as drones is very intriguing and fascinating to a number of youths which has cultivated an enormous potential to make agriculture a viable and attractive business.

The application of AI such as operating an agriculture drone for insecticide spraying is an absolutely different experience from engaging a consumer drone for above ground cinematography. Thus, in spite of enhanced experience in UAS operation, the evolution of an agriculture drone aviator is substantially and conceptually challenging for many farmers in Zambia and even in China. For instance, it took XAG's workers more time and energy to absorb an innovative technology that demands mastery, concentration, specialization and agility. However, through relentless, rough training and practice on the field many farmers manage to assimilate and familiarised themselves with every single phase of the technological application in the field, including field surveying, Real-Time Kinematic (RTK) sensor set-up, and mounting aerial spraying parameter. Although perplexing, the application of AI proved to be interesting to many agronomists. Since the assimilation of drones in field management, XAG has witnessed an enormous increase in the number of buyers from nearby farmers such as Miller estates, Zambeef farm and smallholding around the Chibombo area. This has not only boosted the market of XAG but also revitalized the agriculture industry with intelligent management in both Zambia and China.

Although perplexing, the application of AI proved to be interesting to many agronomists.

CHALLENGES AND RECOMMENDATIONS

As alluded earlier, although AI o□ers massive prospects in the rejuvenation of the agriculture sector in Zambia, there is still a deficiency of expertise in using high-tech machinery among small-scale farmers in Zambia. An acquaintance with external factors such as meteorological conditions, soil analysis and the manifestation of pests, for precision farming, is relatively a massive task which demands time and energy. Therefore, what currently appears to be the best solution, may not be ideal for many small-scale farmers in the long-run due to variations in external constraints such as high cost of equipment, the invalidity of technical know-how, and lack of access to credit facilities. To that effect, the future of farming fundamentally hinges on the adoption of cognitive solutions. Despite the fact that in Zambia innovative research in agriculture is still in evolution, infant stage and more or fewer applications of AI techniques are now accessible in the market, the industry is still decidedly underserved. Thus, when it comes to the management of genuine challenges confronted by agronomists, using self-directed verdict, and extrapolative elucidations to solve such emanating challenges, Zambian agri-business is still at an embryonic phase.

> ***To that effect, the future of farming fundamentally hinges on the adoption of cognitive solutions.***

Therefore, in order to exploit the enormous opportunities of AI in the Zambian agriculture sector, applications ought to be stouter. Thus, the government ought to intensify assimilation of modern technology and high investment in the sector, in order to handle rapid variations in external conditions, the Ministry of Agriculture in collaboration with agro-firms ought to facilitate simultaneous decision making and adopt a feasible policy for amassing and managing appropriate data in an efficient manner to ensure precision farming.

Another imperative aspect is the overpriced cost of various high -tech devices existing in the market for agri-business. The devices need to be more affordable to make sure the available technology in the sector spreads across the country catering to all farmers. Therefore, an open-source policy through subsidizing the implements would make the solutions cost-effective, resulting in a swift adoption and developed infiltration among the agronomists.

> ***The devices need to be more affordable to make sure the available technology in the sector spreads across the country catering to all farmers.***

The aforementioned challenges tend to limit the effectiveness of biochemical regulators piloted with the traditional spraying method. In addition to putting the workers in comparatively high harming hazard, hand-spraying, precisely on maize stalks approaching maturity stage is highly unproductive such that it cannot meet the demand for a rapidly evolving control over the insatiable fall armyworm. Furthermore, in order to shield a bigger yield, agronomists tend to spray insecticides several times, which would lead to biochemical overdose and immense waste of water. Nonetheless, in various circumstances, the insecticides fail to penetrate through the veiled young insects owing to irregular manual spraying method.

> ***In addition to putting the workers in comparatively high harming hazard, hand-spraying, precisely on maize stalks approaching maturity stage is highly unproductive such that it cannot meet the demand for a rapidly evolving control over the insatiable fall armyworm***

CONCLUSION

The engagement of the Zambian government through the Ministry of Agriculture and Livestock with Chinese firms such as XAG has facilitated the assimilation of smart, efficient and sustainable agriculture among Zambian farmers. As a result of such collaboration, farmers are now able to

mitigate some of the threatening challenges encountered during crop production such as those during pest control and management practices precisely the fight against the fall armyworm. Farmers are now able to access a wide assortment of AI devices such as drones in their local market. The sector has also witnessed high investment channeled towards the application of AI. Thus, such an application of AI by Chinese firms revolutionized the Zambia agriculture management of farmlands for both small-scale and commercial farmers. Correspondingly, farmers apply such expertise in monitoring crop growth and offer information in cases of abillionormalities during the growth period. Therefore, it is a fact that usage of drone-based systems in Zambian agriculture propelled by Chinese firms is exceedingly significant in terms of handling adversative weather situations, efficiency expansions, precision farming as well as crop management. Furthermore, the partnership of the Zambian government with the Chinese firms in agriculture has led to an increase in yield and high efficiency in production, thereby ensuring food security in the country.

Overall, the adoption and application of AI in the Zambian agriculture sector have enabled farmers to mitigate factors deterring agri-business growth. Therefore, AI such as the use of drones from XAG has safeguarded maize yield by combating hazardous pests and ensured precision farming for both small-scale and commercial farmers in the country. Nonetheless, there is still a need to intensify the assimilation of modern technology and high investment in the sector precisely among small-scale farmers. Thus, a robust emphasis must be put into developing an inclusive technical know-how approach reinforced by smart devices and adapted for the indigenous agronomic ecology.

Overall, the adoption and application of AI in the Zambian agriculture sector have enabled farmers to mitigate factors deterring agri-business growth.

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Chapter

5

Diversity in China-Zambia Agricultural Co-operation: Case Studies of the Agriculture Technology Demonstration Center (ATDC), Zhongken Farm and Zhongyang Eco-Agriculture Park

Tong Wu and Veda Vaidyanathan

Based on fieldwork conducted, the case studies discussed in this chapter provide a unique perspective into the scale, type and nature of Chinese investments in Zambia's agriculture. From the traditional State-owned farm model, an Agriculture Technology Demonstration Centre to real estate majors entering the agricultural domain, bringing in their strengths and experience of large-scale infrastructure building to tap into the potential for agro-business in the country, the patterns of engagement are diverse.

THE AGRICULTURE TECHNOLOGY DEMONSTRATION CENTRE (ATDC)

The Agriculture Technology Demonstration Centre (ATDC) is a flagship project of the Chinese contemporary agricultural aid programme in Africa (Lu, 2016). The ATDC project was first proposed at the Beijing Summit of the 3rd FOCAC in 2006 when the Chinese government pledged to build 10 ATDCs in different African countries. The number was then increased to 20 at the 4th FOCAC of 2009 and by 2012, over 23 Chinese-aided ATDCs were operational (Lu, 2016). According to the official document which guides the practice of these Centre's, their primary aim is to improve the food security of the recipient countries through the transfer of advanced agro-technologies from China. The Chinese central-level government actors are involved in the macro planning, facilitating and supervising the ATDC project. In most cases, each of the ATDC-recipient countries is twinned with one specific province (or provincial-level city) in China.

Each ATDC has three operational stages: Project Construction Stage, Technical Cooperation Stage and Business Operation Stage. In the project construction stage, the Chinese government provides construction of infrastructure and agro-equipment while the host government provides

operation support such as land, electricity and water. Once the construction is completed, the ATDC is transferred to the host government and becomes a state asset of the host country. During the business operation stage, which usually takes up to three years, a Chinese technical team will be assigned to the Centre for scientific research, technique demonstration, technique training and extension of technology.

> ***In the project construction stage, the Chinese government provides construction of infrastructure and agro-equipment while the host government provides operation support such as land, electricity and water.***

After a three-years technical cooperation stage, the Center is expected to be able to establish a market-oriented and sustainable cooperation model. Financially, the Chinese government only covers the operational fees of the ATDCs for the first three years of technical cooperation; afterward, the Center needs to fund itself through income from the business operation.

> ***Financially, the Chinese government only covers the operational fees of the ATDCs for the first three years of technical cooperation; afterward, the Center needs to fund itself through income from the business operation.***

ZAMBIA'S ATDC

The China-aid China-Zambia Agricultural Technology Demonstration Center is one of the first 14 ATDC's in Africa. It was approved by the Ministry of Commerce, supervised by the Government of Jilin Province and operated by Jilin Agricultural University under the framework of the "Chinese province-Africa country cooperation" program and so the technical team members are from the University (Personal Interview, 2019). Founded in 1948, Jilin Agricultural University specializes in breeding of new species of crops, processing of agricultural products and developing fungi resources (JLAU, 2019) and they bring this expertise to the ATDC.

The Centre covers a total area of 120 hectares with facilities for administration and training, accommodation, experiment and demonstration, extension blocks, a water reservoir with a capacity of 600 cubic meters, 13 boreholes for production and domestic water supply. The Chinese government provided financial support for constructing this infrastructure and also provided funds for operational machinery including tractors, trailers, harvester, sprayer and planters. At a cost of US$10 Million, the construction of the ATDC was completed in 2011 and it was handed over to the Government of Zambia the same year (JLAU, 2019). However, between 2012-2015, the ATDC was operated by Jilin Agricultural University and it provided the salary for staff working in the ATDC.

also provided funds for operational machinery including tractors, trailers, harvester, sprayer and planters.

Image 3: ATDC in Zambia

Source: Photographs taken by the authors at the ATDC in Lusaka, 2019

Since the ATDC was expected to become financially independent, after three years of government support in 2015, Zambia's ATDC stopped receiving any funds from the Chinese government. The ATDC's income has relied on the revenue generated by production and sale of maize, soybeans, wheat, cultivation of spawns of mushroom, renting machines to local farming communities and lending technical services to small holder farms.

Another source of income for ATDC is the funding from different projects. In addition to financial support from agriculture cooperation programmes established by the governments of China and Zambia, it is also backed by stakeholders such as the Bill and Melinda Gates Foundation and programmes such as the "10+10 China-Africa agriculture scientific research project" by the China Association for the Promotion of International Agriculture Cooperation (CAPIAC) (Personal Interview, Director, Lusaka, 2019).

Currently the ATDC has five Zambian and six Chinese staff. Among the Chinese experts, all of whom are from Jilin Agricultural University, one is in charge of poultry, another of mushroom and the others are responsible for managing the purchases, handling the finances of the farm and ensuring that all the machinery is operational. The Centre's work is based on four pillars: scientific research, technique demonstration, technique training and extension of technology.

The ATDC has thus far examined 460 local varieties of crops, introduced and tested the seeds of maize, wheat and soybeans from Jilin, Sichuan, Yunnan, Guangdong, Hebei and Inner Mongolia. Eventually, ATDC successfully cultivated two wheat varieties and one corn variety which have been approved by the Zambian National Variety Registration Commission for commercial cultivation within the country. Until 2019, the ATDC had organized 59 training workshops. The themes included edible mushroom cultivation, vegetable farming and pest control, soil management, agriculture machinery management, livestock production, and agricultural product storage and processing technology. The subjects, usually, were decided by the Ministry of Agriculture of Zambia or the University of Zambia. The majority of training teachers were Chinese and some courses were held by Zambians from the University of Zambia and the Ministry of Agriculture.

Eventually, ATDC successfully cultivated two wheat varieties and one corn variety which have been approved by the Zambian National Variety Registration Commission for commercial cultivation within the country.

A total of 1305 people took the training, which included an officer from the Ministry of Agriculture, farmers, women entrepreneurs and students. In order to ensure participation, the ATDC advertises details of the various training programs online and then farmers apply to the training program of their interest. The Centre also allows students from the University of Zambia, Copperbelt University and the Natural Resources Development College (NRDC) - Zambia's leading agriculture college - to utilize the lab and provides them with internship opportunities.

Furthermore, the ATDC has demonstration plots, for wheat, soybeans, maize and mushroom where experts lead various training programs on how to use new technologies, introduce tools and farming techniques. The edible mushroom research team of Jilin Agriculture University, led by Professor Li Yu, has built mushroom demonstration farms and keeps tracking their performance, benefiting more than 500 small and medium farmers in Lusaka, Copperbelt and Luapula.

The edible mushroom research team of Jilin Agriculture University, led by Professor Li Yu, has built mushroom demonstration farms and keeps tracking their performance, benefiting more than 500 small and medium farmers in Lusaka, Copperbelt and Luapula.

Image 4 & 5: Mushroom demonstration rooms and their signs

Source: Photographs taken by the authors at the ATDC in Lusaka, 2019

According to the director, most Zambian farmers come to the programme to learn new techniques that they later use in their businesses and its effects are already visible people selling different types of mushrooms in markets. According to him the new technology learned at the Demonstration Center has led to a diversification of products sold and has possibly contributed to new sources of income for participating farmers.

A Zambian expert working in the ATDC as a translator acknowledged its social impact and stated that the ATDC contributed to the local farms in increasing incomes and provides a platform for learning from each other. However, he also admitted that language and culture differences are major challenge during the technology transfer. Chinese teachers, sometimes, are unable to explain technique issues precisely in English. He also argued that there was a difference in the Chinese and Zambian work ethic which sometimes caused friction. There also seemed to be a lack of integration with the Chinese and Zambian teams working separately.

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ZHONGKEN ESTATES

Johnken Farm (Zhongken Farm) is a State-Owned Enterprise, that was established by the China State Farm Agribusiness Corporation (CSFAC) in 1993 after acquiring 3,573 hectares of land in Chisamba on a long-term lease basis with the low-interest loan from former Ministry of Foreign Trade and Economic Cooperation (renamed to Ministry of Commerce) (Personal Interview, Director Zhongken, Lusaka).

The China Africa Agriculture Investment Corporation (CAAIC), 55 per cent of which is owned by China National Agricultural Development Corporation and 45 per cent by the China-Africa Development Fund, purchased Zhongken Farm in 2010 from CSFAC (Personal Interview, Lusaka) and is the largest, most profitable Chinese farm in Zambia today (Y.Hairong, B. Sautman, 2010). The Chinese manager in-charge of this farm is directly appointed by Beijing with an initial term of three-years which is extendable (Y.Hairong, B. Sautman,2010, Personal Interview, Director Zhongken, Lusaka).

Image 6: Johnken / Zhongken Estates

Source: Photograph taken by the authors, 2019

When the first director Chi Wang and his wife Li Li came to manage this farm in 1994, there was nothing on the farm but one house. There was no electricity, clean water or cultivated land (SinaNews, 2003, Deborah, 2015). Over the course of the decade, Zhongken Estate Ltd was gradually developed into a medium-scale farm that engages in feeding chicken, cows and pigs as well as planting wheat. Unfortunately, however, Chi Wang died in a car accident in 2005 and his

wife Li Li, a nurse in her 40's, took over the management of the farm. Her success with Zhongken farm was noticed, widely written about and she won a plethora of awards including the 1st China-Africa Friendship Award in 2006 and the Economy Women of the Year award in 2011. Mr. Huang took over the leadership of the farm as Director, from 2015 since Li Li had been appointed to another position at the China-Africa Agriculture Investment Corporation Limited (CAAIC).

The farm plants wheat in the dry season and plants maize, soybeans and sunflowers in the rainy season. The total amount of crop production is around 3000-4000 tons each year, most of which is sold to the local market. According to the Director, there is no plan to export to China as there is sufficient demand in the local market. Zhongken Farm used to depend highly on chicken farming, accounting for 20 per cent market share in the Zambian market. However, the income from chicken raising has been decreasing due to local competition. "Local individuals and Small and Medium Enterprises (SME's) can easily make money by raising a chick for 45 days and it does not require a big farmhouse or special equipment. They learn the techniques, enter the market and are Zhongken's fiercest competition."

"Local individuals and Small and Medium Enterprises (SME's) can easily make money by raising a chick for 45 days and it does not require a big farmhouse or special equipment.

This was one of the main drivers that pushed Zhongken farm to shift its focus from chicken breeding to crop planting which requires more land, irrigation and equipment. For now, 70 per cent income is generated through crops, 30 per cent from chicken breeding and the farm uses the chicken manure to fertilize crops. Zhongken has also invested in cost-saving modern tools including semi-automated machines to increase efficiency. According to the Director, almost half of the land has not been used for cultivating because of capital shortage as it would cost US$ 2000-3000 per hectare for land development.

The farm currently employs 4 Chinese citizens, 12 Zambian managers and 150 formal employees. While the Chinese managers take on supervision and general management positions, Zambian managers oversee various departments or sub-farms, such as food processing, agricultural machinery and poultry feeding. The Farm provides free accommodation, low-cost power supply and free water to formal workers. The employees usually take the whole family (average 5 members) to the house provided by the farm and their children go to a school on the estate.

The director claims local managers are very important to the farm and they have sent nine managers to China for training that spans over a period of 1-2 months. The farm provides the salary, but the flight and accommodation are provided by the Chinese government. Additionally, there are four different types of capacity building on the farm. 1) The training provided by the Chinese government each year 2) Management training from Zambia Agriculture University 3) Training on company regulations that include internal rules and labor law 4) Weekly technique training including planting, irrigation and safety training.

According to Mr. Huang, “We don’t only teach local farmers how to plant crops and breed the chicken but also share our Chinese principles and work ethic. We are efficient and plan ahead”. While several local employees who have received their training, have started their own farms, the director believes that there are definitely differences in work cultures. “We tell them that we encourage hard-work, self-discipline and efficiency and tell them that laziness and stealing will cost them their jobs.”

On labour unions, Mr. Huang stated that they are active and were crucial to local management. The labour union plays a coordinator’s role and communicates the labour’s needs to the manager, such as accommodation allocation, uniform hand out and so on. The labour union also deals with stealing and penalty. The union committee will decide how to punish the labourers for stealing, or any other misbehaviour on the farm. “We work very well together, no problems with Unions”, he said.

The labour union plays a coordinator’s role and communicates the labour’s needs to the manager, such as accommodation allocation, uniform hand out and so on.

He did however stress on the many challenges facing the farms operations in Zambia. “Agriculture is not an easy business. It requires highly investment but gets low profit.” The farm Director keeps looking for new ways to continue Zhongken Farm’s sustainable growth. He proposes building an agro-processing plant so that it can process wheat and maize to powder and soybeans to soybean cake and developing a fertilizer manufacturing plant to recycle chicken and cattle manure. However, all these plans need investment and all decisions will be made by the headquarters. The farm also suffers from the impact caused by climate change. When the hot and dry season gets longer, the production decreases. Besides, dry season also affects the power supply since Zambia relies highly on hydropower.

The managers on the farm pointed out that Zambia’s unstable Kwacha also impacts the agriculture business. The local currency depreciated by 5.6 per cent in November 2019 and has been depreciating by 17 per cent on a year-on-year basis (Lusaka times, 2019). All products of Zhongken Farm are sold locally and the income is earned in local currency however, the farm has to import machinery and spare parts, in US dollars. “The business environment is not very good for foreign investors with no incentives for agriculture, high tax rates and increasing operational costs including, employees’ salaries and social benefits. If the company owners cannot make money, the business won’t last long”, he concluded.

All products of Zhongken Farm are sold locally and the income is earned in local currency

ZHONGYANG ECO-AGRICULTURE PARK

Background

Zhongyang Eco-Agriculture (Industry) Park was founded by Zhongyang Construction Group Co. Ltd. It is a private Chinese company with five business divisions: Zhongyang Engineering, Zhongyang Capital, Zhongyang Industry, Zhongyang Real Estate and Zhongyang Agriculture.

Zhongyang Group specializes in construction and it is a relatively new entrant in the Agriculture sector. However, the group acquired a 3000-hectare farm in Zambia and recruited Dr. Hu Huojin, a Chinese agriculture expert who has over eight years of operational experience in Africa, to be its Director.

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Image 7: Zhongyang Eco-Agriculture Park

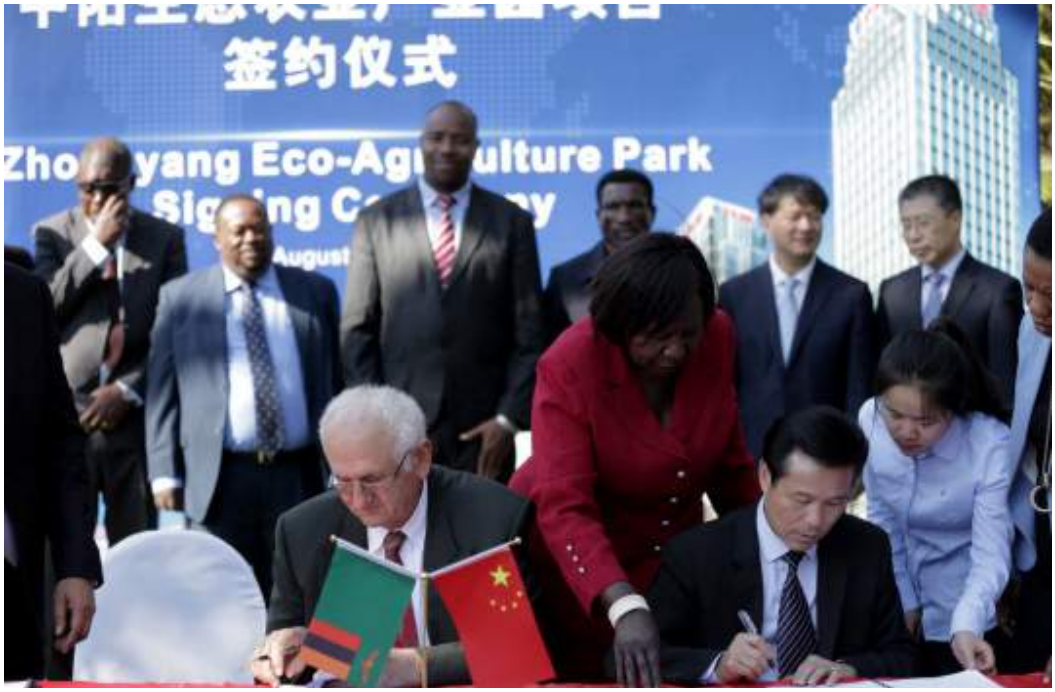
Source: Photograph taken by the authors, 2019

The farm, now called 'Zhongyang Eco-agricultural Industrial Park', located on the Great East road, near Chongwe town has a long history of planting and has been through four owners. The first owner established this farm by purchasing 4 small farms and focused on planting soybeans in the 1960s. In 2003, a Danish national bought this farm, planted potatoes and named it "water in the hill". In 2013, he sold it to another individual who in turn sold it to Zhongyang Group in 2018.

According to the Group's website, the project contract signing ceremony was attended by the Minister of Zambia Ministry of Agriculture, Central Governor, Governor of Muchinga, Chairman of the State-owned Enterprise Committee, Ambassador of Zambia in China, Commercial Counsellor, member of Standing Committee of Jiangxi Provincial Party Committee and other leaders form China and Zambia who spoke highly of the project's significance and placed great hopes on the future development of the park.

Zhongyang Group has an ambitious plan to build an Eco-agricultural Industrial Park as a modern, advanced demonstration center with ten zones and two centers. The ten zones include crop, food processing, seed R&D, digital agriculture, Science and education, livestock, forest and animal, fruit, Aquatic products, and recreation zones. Two centers are an administration center and employees' residential center. It plans to build more boreholes, solar pumps and pivots to ensure water supply.

Image 8: Contract Signing Ceremony of Zhongyang Eco-agricultural Industrial Park



Source: Zhongyang Construction Group

The director and other Chinese experts working on the farm gave the authors of this chapter a tour of the land, shared plans of construction and discussed in detail the potential of the agriculture sector in Zambia. The authors also accompanied the managers in their meetings with local suppliers who were helping construct parts of the farm. However, since the interviews and

field visit in late 2019, the COVID-19 pandemic has slowed down the progress of the park and pushed back the ambitious plan by a few months or even possibly years and therefore the future of the plans described to us remains uncertain.

Table 5.1 List of Chinese Farms in Zambia

Year	Project Name	Pledged Investment	Pledged Employment	Industry
1994	Zhonghua Farms Corporation Ltd	129,200.00	30	
1994	Zambezi Ranching & Cropping Ltd	372,000.00	200	Commercial Farming
1994	China Zambia Friendship Farm	317,500.00	5	Commercial Farming
1996	Ronghe Company Limited - Mixed Farming	150,000.00	31	Commercial Farming
1997	Zamchin Company Limited	270,000.00	30	
1997	Le Yun Investments Limited	259,391.00	20	
1997	Hua Xing Company Limited - Livestock Production	205,000.00	20	Agro-Processing
1997	Hongxiang Company Ltd	388,000.00	26	
1998	Danhui Investments Limited	300,000.00	30	
1998	China Jiangsu Prospect (Z) Limited - Mixed Farming	930,000.00	30	Commercial Farming
1998	Qiuwha Investment International Limited - Commercial Farming	500,000.00	50	Commercial Farming
1998	Hong Fa Company Limited	328,000.00	35	
1999	Fur Da Investments Limited – Poutry	190,000.00	20	Commercial Farming
2000	Wang Merriman Limited	97,600.00	31	
2000	Zhongken Friendship Farm	1,840,000.00	208	Commercial Farming
2001	Wei Ma Company Limited	318,737.00	38	
2001	Pokel International Ltd	107,400.00	29	
2004	Inter Chain Farm Investment Ltd	52,000.00	13	
2006	Kaifeng Agriculture Investment	391,500.00	39	
2006	Wei Yu Co. Ltd	150,000.00	22	
2006	China Harvest Investment Limited	1,800,000.00	25	
2008	D.L. Investments Ltd - Poultry and Piggery Farming	700,000.00	45	Commercial Farming
2008	Shunxin Investment Ltd - Horticultural Products	500,000.00	37	
2008	Wu Company Ltd - Horticultural Products	1,100,000.00	13	Horticulture
2009	Zhonghua Farms Corporation Ltd	129,200.00	27	
2009	Hua Fei Livestock Company Ltd - Mixed Farming	500,000.00	8	Commercial Farming
2009	Xing Hua Investments Ltd	510,000.00	1	
2011	Yang Yang Company Ltd - Poultry Production	500,000.00	24	
2011	Grand Prospects Ltd - Mixed Farming (Maize, Horticultural Products)	1,100,000.00	100	
2011	Agriculture Science & Technology Co. Ltd - Agro-Processing	10,001,042.00	104	Agro-Processing
2011	Xing Da Investments Ltd - Agro-Processing	600,000.00	14	Agro-Processing
2011	Canaan Farm Limited-Mixed Farming Activities	864,651.00	10	Commercial Farming
2012	Agriyana Investments Limited	1,040,000.00	15	

Year	Project Name	Pledged Investment	Pledged Employment	Industry
2012	Green Home Farm Limited	2,300,000.00	80	
2012	Soft Silver Investment Co. Ltd	1,095,000.00	37	
2012	Deck Investments Limited	510,000.00	43	Commercial Farming
2012	Tongda General Dealers - Meat processing	939,030.00	16	Agro-Processing
2012	Topace Agriculture Development Company Limited	9,400,000.00	20	
2012	Jin Shan Investment Company Limited	488,000.00	15	Agro-Processing
2012	Long Ping West Hing Farm Limited	1,100,000.00	40	
2013	Kulima Tobacco Company Limited	50,000,000.00	2000	
2013	Syno Agricultural Development Company Limited	600,000.00	12	
2013	Auspicious Investments Zambia Limited	1,000,000.00	80	
2015	PURE GREEN AGRICULTURE INVESTMENTS LIMITED	257,000.00	103	
2015	Mpundu Wild Honey Limited	500,000.00	200	Agro-Processing
2016	Huayu Investment Ltd	1,114,433.50	24	

Source: Zambia Development Agency

CONCLUSION

The ATDC provides an example of how Chinese and Zambian strengths have been leveraged to find and create agro-business opportunities. The fact that state support ends after the initial few years means that it shifts from an aid project and is forced to be entrepreneurial in order to function. While, in theory, it could seem as if Zambian and Chinese agriculturists work in tandem, in reality, they seem to be operating in their own silos. Although they seem to be working closely with small holder farmers, training them in technologies, equipping them with information and even leasing farm equipment, an impact assessment of the effect it has had on local communities can be conducted only after a few years or decades. Nonetheless, the framework of the ATDC is definitely replicable and could provide other actors engaged in Zambia ideas on how to approach aid/ investment paradigm in agriculture. Zhongken, being one of the oldest Chinese farms in the country seems to have established ties with local workers although their biggest competition are entrepreneurs who used to work in their farms. While they seemed to have a variety of crops and animals on the farm, they also seemed keen on diversifying their activities.

Although they seem to be working closely with small holder farmers, training them in technologies, equipping them with information and even leasing farm equipment, an impact assessment of the effect it has had on local communities can be conducted only after a few years or decades.

Zhongyang on the other hand represents the ambition of the Chinese private sector, with no knowledge or experience in agriculture, relying on the experience and vision of an agronomist and manager who had previous experience of working in other parts of Africa including Mali.

They claimed the project touted to be Africa's most modern farm was part of the BRI, but on further questioning seemed to broadly place it in the wider ambit of President Xi's vision and seemed to be keen to receiving support from the Chinese state as well as other Chinese firms.

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Chapter

6

Perspectives from the Grassroots

Veda Vaidyanathan

As the chapters in this monograph attest, the current China - Zambia relationship is defined by a lop-sided trade relationship, where Zambia imports a diverse range of products from China that drive its economy while its biggest export to China is still a primary commodity, Copper, making it vulnerable to market shocks. Similarly, investments from China haven't created significant forward or backward linkages with the local communities in Zambia. There are not many successful Joint Ventures largely owing to the technological gaps between Chinese enterprises and local companies. Similarly, skills and knowledge transfer from Chinese managers to local employees haven't been standardized with a lot of the on-site training relying on 'sign language' and 'learning from observation'. While some Chinese companies, especially in the Copperbelt region, have begun to contribute to the local vocational training institutes, stakeholders agree that more emphasis needs to be placed on the quality of capacity building. In the same vein, it was pointed out that local suppliers aren't able to compete with the price of Chinese imports and have been calling for legislation that protects the interests of local manufacturers.

While some Chinese companies, especially in the Copperbelt region, have begun to contribute to the local vocational training institutes, stakeholders agree that more emphasis needs to be placed on the quality of capacity building

Challenges notwithstanding, the Government of Zambia and the Zambia Development Agency are encouraging foreign direct investments into the country and have in place several fiscal and non-fiscal incentives for potential investors. For instance, if the investment is below US$250,000, they help with facilitation and investments above US$500,000, qualify for tax deductions and permissions to import machinery for 5 years duty free (Personal Interview, Zambia Development Association, Lusaka, 2019). However, the Zambian government's focus on attracting Chinese enterprises in particular is so strong that the ZDA has even hired a Chinese citizen as an employee to help liaison with Chinese firms (Personal Interview, Zambia Development Association, Lusaka, 2019).

Furthermore, officials from different departments travel to China on 'road shows', facilitated by Ministry of Agriculture, Commerce, ZDA and others where officials meet between 100-200 potential investors. According to officials who went on these trips, while they do have access to several exhibitors looking to invest in Africa and particularly Zambia, the challenge is with follow up; while there is a translator at the event, it is difficult to communicate effectively afterwards which renders a slow progress (Personal Interview, Official, Ministry of Agriculture, Lusaka, 2019). Zambian officials also pointed to the fact that terms agreed upon at the beginning, often change without notice and this has also pushed them to cancel agreements or step back from deals.

Another initiative aimed at incentivizing investments into Zambia is Partnership for Investment and Growth in Africa (PIGA), which aims among other things, to build the capacity of the ZDA by training officials across departments on how to prepare feasible proposals and add value to the country's dialogue on policy formulation. Initially, PIGA wanted to match foreign investors with local SME's to enter into Joint Venture's. But the mismatch in size and scale of local operators with Chinese led to scrapping of that idea, instead focusing on bringing in free field investments. PIGA has been operational for over three years, they have interacted with over 200 Chinese firms and hosted a delegation from China Council for Promotion of International Trade in Zambia. However, after significant time and effort, they signed the first deal with a Chinese agro-processing company at the time of interview (Personal Interview, Zambian Coordinator for PIGA, Lusaka, 2019).

CHINESE INVESTMENTS AND BUILDING CAPACITY

While the chapter authored by Musadabwe Chulu, Nkumbu Nalwimba and George T. Mudimu points out that the donor-driven nature of Chinese training programs in agriculture often result in not-so-appropriate skills and knowledge disseminated, they also argue that skill building programs have largely been in line with Zambia's Vision 2030 of a mechanized agriculture sector. However, as the issue of lack of skilled workers in Zambia was mentioned by stakeholders interviewed across other sectors, the author interviewed Zambian officials from the Technical Education, Vocational and Entrepreneurship Training Authority Zambia (TEVETA), representatives of workers unions and Zambian employees who worked at Chinese companies for alternate perspectives.

Approximately 1000-1500 skilled workers in Zambia graduate with a technical diploma from one of the 5-6 technical institutes in Zambia of which 2-3 in the Copperbelt. Skills training in Zambian technical institutes train craftsmen, technicians, technologists, artisans with a year of theoretical training accompanied by three months attachment where they are ideally supposed to be working in the industry and return to the institute after to finish their training (Personal Interview, Director General, TEVETA, Lusaka, 2019).

However, most Chinese industries did not employ Zambian graduates in top jobs and this was attributed to their lack of management skills. When asked why skilled technicians from Zambia

- a traditional mining country – weren't occupying senior positions, interviewees said that while some had the requisite qualifications, they did not have the experience in handling projects of a huge scale. Regarding methods of technology transfer where language constraints were often cited as a challenge, interviewees claimed that skills and knowledge transfer wasn't effective due to language issues and learning based only on observation had its limitations.

> ***However, most Chinese industries did not employ Zambian graduates in top jobs and this was attributed to their lack of management skills.***

However, it was also pointed out that there is a gap in the skill level of technical graduates from Zambian institutes and what the industry requires. "We even have people to train, but no equipment" stated one official. Most training centers are largely disconnected with the courses provided not in sync with industry requirements or driven by needs of the industry therefore most institutions are functioning "for the sake of it". The capacity of the trainers or enhancement of their skills has not happened and up gradation of equipment has also not taken place. So even if curriculum was revised, colleges don't have the right tools. Most training programmes also have no apprenticeship or practical training, when they do, they aren't linked to industry, so most graduates don't have any hands-on experience upon graduation. Moreover, the skills development programs are expensive and there isn't sufficient financing. Due to these challenges and also because of the poor infrastructure in most of these institutes, companies have adopted a few institutes or have started their own.

> ***The capacity of the trainers or enhancement of their skills has not happened and up gradation of equipment has also not taken place.***

For instance, a Chinese mining company operating in Luanshya, has taken over the local training college and is training lecturers, updating curriculum and providing new equipment. An MoU was signed under the auspices of the FOCAC, whereby eight polytechnic institutes in China are developing one course each in an area of their specialization (e.g., mechatronics). They send one expert or lecturer from this institute to China for an eight-week training (where the accommodation and tuition is paid by Ministry of Education, GoC and flight and tickets paid by GoZ). The aim is to rehabilitate the college, upgrade equipment (some donated by GoC, some bought by GoZ) and train teachers in China. Currently courses are taught by two Chinese experts working with Zambian teachers. According to a manager, Chinese companies require a different set of skills and new technology in their mines, and their interest in Luanshya is so that the Chinese mines there will not have an issue hiring highly skilled Zambians with the requisite skills in the future.

An MoU was signed under the auspices of the FOCAC, whereby eight polytechnic institutes in China are developing one course each in an area of their specialization (e.g., mechatronics).

Furthermore, Chinese companies seem to prefer hiring people with no background or training and then train them from the start. "Even Zambian graduates prefer to first work in Chinese mining companies, receive their training and then they move to Mopani or Kalumbila mines" (Personal Interview, Official, Zambia Union of Technical Education Lecturers and Allied Workers, Lusaka, 2019). Even though working in Chinese mines long term is not desired due to the long working hours, low wages (Western companies may pay its engineers US $2000 while Chinese pay US $500), bare minimum health and safety standards, Chinese organizations have still become the training ground for these graduates (Personal Interview, Chinese Manager, Chingola, 2019). Government institutions therefore cannot even compete with these institutes and graduates from these institutions are considered more employable than even those graduating with degrees from universities. According to one stakeholder, "the Chinese understand that no business can rely only on expats and in a short time are already contributing to enhancing skills, this must be appreciated".

"Even Zambian graduates prefer to first work in Chinese mining companies, receive their training and then they move to Mopani or Kalumbila mines"

On the domestic front, the Zambian government has introduced plans to build local skills. One of the measures to upgrade technical institutes has been introducing a "Skills Development Levy", a financing strategy introduced in 2017 to help infuse capital into Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA) with the idea to strengthen linkages between training and industry. According to this plan, companies have to give 0.05 per cent of their gross pay roll which will be utilized towards improving infrastructure and staff capacity. Representatives from private companies are part of the 'Fund managers Committee' and oversee how the capital is disbursed. With the private sector now involved monetarily in improving skills, they are more invested in the outcome, which will have long term benefits. With the funds collected in 2018, the GoZ has ordered equipment for TEVETA, has trained teachers and sponsored vulnerable students. This is widely seen as a sustainable financing system, although it is the result of discussions that took place in the late 90's and has taken a few decades to take shape.

As private sector is now involved monetarily in improving skills, they are more invested in the outcome, which will have long term benefits.

CHINESE DIASPORA IN ZAMBIA

An increase in the diversity of investments with over a thousand Chinese companies operating in Zambia, the consequent opportunities has resulted in a significant Chinese diaspora. The Zambia - China Association has 200 members, both institutional and individual, 100 from the Copperbelt region - all of them from the private sector as the SOE's have their own association. The Association provides classes to sensitize Chinese investors to Zambian laws, labour, immigration, traffic, firearms and so on. They also have a WeChat group in which local Zambian news (information about fuel hike etc.) is translated and posted to keep citizens abreast of new policies and changes. Members also approach the office bearers of the association when they are in trouble who in turn offer help with administrative issues, navigate government offices or help with immigration bottlenecks. Sometimes when disputes arise between Chinese managers and workers, these are brought to the association as well (Personal Interview, Senior Office Bearer, China-Zambia Association, Kitwe, 2019).

They also have a WeChat group in which local Zambian news (information about fuel hike etc.) is translated and posted to keep citizens abreast of new policies and changes.

Small scale entrepreneurs like Mr. Li, who had first tried his hand at selling textiles in South Africa, later began acquiring copper in Congo and finally set up an industry in Zambia, where he takes copper from dump sites and processes sheets which were later exported. Mr. Wang on the other hand is from a mining family in China, did not have much of a choice but accompany his father to Chingola, where the family - his parents, sister and brother-in-law - live in a bare cement and brick house - employ around 50 locals to mine for copper.

Image 9: Zambia's new Chinese police officers removed after outcry

Source: The Standard, 2018

The Chinese Diaspora in Zambia was strong enough that eight Chinese nationals were recruited into the Zambian Police force, with the special role of liaising with Zambia's Chinese community, but this idea caused widespread furore and the officers were quickly decommissioned (BBC, 2017).

CHINESE RESPONSE TO NEGATIVE PERCEPTION

What complicates the China-Zambia narrative is the tangible negative perception of the Chinese in the country. While the Chinese stakeholders interviewed attributed the negativity to skewed coverage by western media, stories are often taken out of context and unnecessary hyperbole by local media houses, most Zambian stakeholders suggested that that the lack of integration with local communities, low incentives for employees and communities, low safety, equipment standards were some common causes of concern. However, this pessimism against Chinese run companies in Zambia is not a recent phenomenon. In 2011 for instance, Human Rights Watch (HRW) issued a communique reporting ill treatment of workers and poor remuneration in companies such as China Non-Ferrous Metal Mining Company (CNMC). In 2010, there were also reports of two managers of a Chinese mine that were convicted of shooting 11 Zambian workers.

While the Chinese stakeholders interviewed attributed the negativity to skewed coverage by western media, stories are often taken out of context and unnecessary hyperbole by local media houses, most Zambian stakeholders suggested that that the lack of integration with local communities, low incentives for employees and communities, low safety, equipment standards were some common causes of concern.

Regarding the visceral push back the Chinese have continued to face in age country, the response of Chinese stakeholders engaged in the mining sector was that a lot of the misunderstanding stemmed from ignorance as "there is low awareness of local labour laws and safety and equipment among Chinese firms - as they were introduced in China only in the 80's". When prodded further about the low pay and long working hours in Chinese mines, an accusation that stems often in media reports, the manager agreed that "the claim that Chinese companies don't pay well compared to western companies is true but western companies have been around for 5-6 decades, have access to the best ores, have been recipients of state support and incentives from the Zambian government and have therefore benefitted for decades. Comparing new Chinese firms to these old firms, is unfair." He added that "when prices fall, other companies lay off workers but Chinese companies take responsibility and do not let go of workers". This claim however was found to be false as there are several reports that detail how companies had laid off employees during uncertain times including CCM which fired 200 miners in 2015 (New York Times, 2015).

On why the oversight was lax and stronger regulations didn't exist to protect workers, experts pointed out that Ministry of Labour was probably one of the lowest funded, employs only a handful of inspectors and prevalence of corruption means that regular, efficient checking of project sites isn't feasible. So clearly, while the promise of the China-Zambia engagement is opening up new avenues of cooperation and deepening existing ones, the pushback also seems to be layered and complex.

CHALLENGES OF OPERATING IN ZAMBIA: THE CHINESE PERSPECTIVE

One of the major challenges identified by Chinese entrepreneurs was interrupted power supply. Two of the smaller mining operations the author visited did not have power supply during the visit and all the employees sat under the shade of the building or under trees, waiting for the power to come back on. Some days, the power would be available only for a few hours, which had a severe impact on business, according to the Chinese managers. While bigger companies like CCM have a dedicated power line, the consumption levels are still pre-decided and controlled, and going over these levels requires them to pay extra. The issue of power shortage was also brought up by managers of construction firms stating that on some days, factories can sometimes only run half a day. Some of the other challenges of operating in Zambian mines included hike in fuel prices, non-receipt of tax returns, lack of a skilled workforce, the fact that mineral royalties to be paid to the government was higher than other countries and the fact that it increased if the global price of copper went up.

While bigger companies like CCM have a dedicated power line, the consumption levels are still pre-decided and controlled, and going over these levels requires them to pay extra.

One of the other challenges of operating in Zambia, that was consistently brought up, was the issuance of work permits. However, Zambia Development Authority officials stated that those companies that registered with the ZDA, received help in applying for work permits. According to one official, ZDA often takes up cases on behalf of registered companies with the Immigration office, the issue however is that not all enterprises register with the ZDA. Zambian officials insist that getting work permits are not difficult for experts or technicians with unique skills but if "they want to bring in workers in which local Zambians can work", it is discouraged. "We want FDI, but also want to promote local employment" (Personal Interview, Zambia Development Association, Lusaka, 2019).

One of the other challenges of operating in Zambia, that was consistently brought up, was the issuance of work permits.

One of the other difficulties faced by builders seem to be that "there is a shortage of availability of building material as only quarry dust, sand, cement is sourced locally and rest is imported but

due to fluctuating currency, advance payments are sometimes delayed with the shortest delivery time from China is eight weeks; South Africa is two weeks. For big accounts, special orders need be custom made" (Personal Interview, Chinese Contractor, Lusaka, 2019). However, they also stated that there are more local manufacturers active in the market than there was in the past. To put this in perspective, an interviewee stated that "1 bag of 50 kg cement used to be 52 Kwacha but now it's become 13 Kwacha".

According to them, the slowdown of the Zambian economy from 2015 has had an enormous impact on their business, as China Exim, AFDB, World Bank, have signed contracts to build an array of projects, but those partially funded by the Government of Zambia have stopped and there is "no activity on site". The Ndola-Carriageway project for instance has been insured by Sinosure for US$1 billion but the guarantee of 10 per cent needs to be paid by the GoZ - which hasn't been paid yet - so the project has been stalled. Similarly, in other road projects, contractors were paid only the first few advance installments, so most contractors have stopped work (Personal Interview, Chinese Contractor, Lusaka, 2019). "While the incentives provided by the host government in the form of cheap land and tax deductions at the beginning were beneficial, the cost advantage is negated with time".

According to them, the slowdown of the Zambian economy from 2015 has had an enormous impact on their business, as China Exim, AFDB, World Bank, have signed contracts to build an array of projects, but those partially funded by the Government of Zambia have stopped and there is "no activity on site".

CHALLENGE OF WORKING WITH THE CHINESE: THE ZAMBIAN PERSPECTIVES

Zambian officials pointed out that one of the main challenges of working with Chinese firms was the fact that they are insular by nature. According to them, it is difficult even for the Zambia Mining Association to get information regarding the production and output of Chinese mines. They also stressed the fact that local content policy was not adhered to by Chinese companies. While this was largely because specialized equipment and technology was not locally available, even if they were, there wasn't any legally binding rule to ensure purchase from Zambian manufacturers. They also highlighted that there was almost no technology or skills transfer to employees working in the mines, the working conditions were grave with even safety equipment not provided, which has led to a largely negative perception.

Local Zambian manufacturers who worked on the big mines had differing responses to their experience of working with Chinese stakeholders. While one commented that "doing business with Chinese mining companies has been straightforward and fair", others claimed that "Chinese (and Indian) companies need to find ways of working with local companies and not "stifle small operators" (Personal Interview, Office Bearer, Chingola Chamber of Commerce, 2019). According

to them, local contractors cannot compete with Chinese distributors on price and they are hopeful that the government regulates SME's to protect smaller Zambian businesses. Several Zambian entrepreneurs gave examples on how local manufacturing capabilities were not at all tapped into - "the Chinese could set up local manufacturing plants to make products like clay, which can be easily sourced. They could also set up auxiliary industries in Copper like manufacturing electrical cables or could also set up units to process copper." Several entrepreneurs also alluded to incredible work ethic of the Chinese and the exceptionally high efficiency. In one instance a local business owner recounted that they were hired to work on a smelter and after they completed 70 per cent of the job, the Chinese did the 30 per cent themselves but paid them for 100 per cent "They want to do most of the work themselves, in their own standards" (Personal Interview, Member, Chingola Chamber of Commerce, 2019).

Several entrepreneurs also alluded to incredible work ethic of the Chinese and the exceptionally high efficiency.

Additionally, interviewees admitted that Chinese workers were paid significantly more than local Zambian employees (with one pointing out that Chinese are paid US $60 a day, while the local workers are paid US $5), however the government increasing minimum wage has pushed them to pay better wages which in turn has pushed up management costs. Interestingly, Chinese workers admitted to making more money working in Africa than they do in China - bricklayers and carpenters are paid US $2000 - and more importantly there is usually a continuous stream of work in most African cities, so they often times move from one project to another. This is however not always the case with some workers heading back to China in case they cannot find alternate work or their visa expires.

Interestingly, Chinese workers admitted to making more money working in Africa than they do in China - bricklayers and carpenters are paid US $2000 - and more importantly there is usually a continuous stream of work in most African cities, so they often times move from one project to another.

This also led to the discussion of Chinese laborers brought in to do menial work, which has caused significant tension among workers especially as unemployment rates in Zambia are high, officially around 30 per cent, but could even amount to 70 per cent according to some. This means that not only are there are very few opportunities for daily wage workers but those who graduated from technical institutes cannot find employment either. Some students enrolled in technical institutes don't even have the opportunity to work for three-month attachment with a company during training. "There needs to be a law that compels companies to hire local graduates or provide incentives for the same" stated a representative of a worker's union.

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Conclusion

Veda Vaidyanathan

The China-Zambia relationship that has been rooted in the historicity of their interactions and the longstanding political ties were for long driven by China's demand for Zambian Copper. However, in the last two decades since setting up the Forum for China Africa Cooperation (FOCAC), there has been considerable diversification of Chinese engagement with the country. Increasing investments, a growing diaspora, lop sided trade, a looming debt issue, a visceral negative perception accompanied by greater political and socio-economic interlinkages suggests growing complexity of Zambia-China relations.

Analyzing the trends of Chinese engagement in Zambia, highlights three main ideas for India: to incentivize Indian industries, especially SME's to tap into African markets, to strengthen existing engagement and include more industry specific and technical courses in the capacity building initiatives that exist. The aim should be to build on New Delhi's own strengths, leverage the considerable goodwill she enjoys to reimagine frameworks of cooperation, focus more on connecting sub-national actors than overarching state centric initiatives.

For instance, while Muyobozi Sikalubya's chapter with case studies of Chinese firms using Artificial Intelligence, drone technologies to improve agricultural productivity and yield to empower small holder and commercial farmers and has revolutionized the agriculture management in the country, it also speaks to the new innovate ways in which the Government of Zambia is seeking collaborations. This case study was also an interesting example of how China has succeeded in bringing new ideas and solutions to an old crippling challenge. To put this in context, the Fall Army Worm is one of the key pests that affect crop yield in Zambia, and an FAW outbreak that started in Nigeria in 2016 had swept across Africa in 2017 and affected over 44 countries (PARM, 2019). This could provide Indian technological and fin-tech startups to work with Zambian actors and collaborate on projects which address similar challenges.

Additionally, a closer examination of one sector alone points to the different drivers, manner of resource allocation, the intention and approach of various actors involved and the outcomes. For instance, as the chapter authored by Musadabwe Chulu, Nkumbu Nalwimba and George T. Mudimu explains, one of the most important contributions of China's investments into this Zambian agriculture has been the several training programs in place to build individual and institutional capacities. To ensure the sustainability of investments, it is imperative to train local professionals. The interventions they mention will not only help improve the quality, relevance of training but it also points toward an area where India has considerable opportunity to contribute.

Given that India's strength has traditionally been in capacity building and already has several existing frameworks in place, it would be beneficial to assess the impact of the existing initiatives and introduce more industry specific training.

The three case studies picked by the author and Tong Wu represent samples from different clusters - one of the oldest Chinese state-owned farms, a farm recently purchased by a private construction company looking to enter the agriculture markets and the Agricultural Technology Demonstration Center that works directly with local universities and communities - all point toward the sheer diversity of investments even within one sector. While the ecological park is still very much in the ideational phase with the ambition of turning it into Africa's first modern farm, it has slowed down its operations and the Chief scientist and agronomist has returned to China stating that he will not be going back to Zambia in light of the ongoing COVID-19 pandemic.

Similarly, the ATDC, had plans to expand into setting up granaries and factories to process its farm outputs but will slow down its activities in light of the global health crisis which has severely affected the Zambian economy. The manager at Zhongken farm also said that his farm's income has hit an all-time low this year and while none of the workers have yet tested positive for COVID-19, they are being very careful in their operations. Nevertheless, while the case study of Zhongken provides a perspective on the traditional agriculture cooperation milieu, the ATDC highlights novel ways of engaging local communities, and Zhongyang Farms indicates the long-sighted, futuristic potential of investments. They could suggest that Indian firms, which have until now been active in traditional domains, could branch out and seek opportunities in other unexplored vistas.

While examining these interactions do provide cues to how New Delhi could craft its own policies, it also provides examples of what not to do.

While examining these interactions do provide cues to how New Delhi could craft its own policies, it also provides examples of what not to do. For instance, it was pointed out that although Zambia needs China for the big investments that promise to generate jobs and growth, the presence of Chinese farmers selling chicken in the local market or that of a Chinese laborer in a construction site has raised concerns. In addition to taking up unskilled jobs, accusations of the market being flooded by Chinese products and driving out competition by local manufacturers is rife. It was also pointed out that local communities are not able to benefit from the spillover effects of bigger Chinese investments. The fact that construction sites are littered with red banners with Chinese characters, managers who cannot speak local languages, building facades with Chinese art and the fact that Chinese teams tend to be insular also point to socio-cultural stresses that exist.

It was also pointed out that local communities are not able to benefit from the spillover effects of bigger Chinese investments.

Image 10: A Chinese built shopping Centre in Lusaka

Source: Photograph taken by the author in Zambia, 2019.

Regardless, what these chapters essentially do is point toward the heterogeneity of possibilities and makes a case for reimagining existing cooperation in sectors including agriculture and finding spaces for private and government entities to work together to find innovate solutions to traditional challenges.

Some other pointed takeaways for India could include:

- Facilitation of India Inc. and incentivizing investments into Zambia, setting up a desk or consultant at the ZDA who could connect Indian industries to local agencies and actors;
- Harnessing Indian strength and experience in Power and Gas Sectors and our massive Railway establishments;
- Stronger art/ literature/ culture related institutional presence;
- Liberalizing and encouraging states to directly invest as sub national entities;

- Skill development could be best treated as a spin off from an established industry or skill up-gradation of employed local labour, this would add the critical skill-industry linkage which would be crucial to the success of the program;
- Enhancing language and administrative capacity building exercises could help leverage Indian strength with Zambian requirements;
- Indian higher education institutions could consider a technical/ medical/ law/ management/ finance/ economics/ higher degree education exchange programs/ slots after assessment of existing initiatives;
- Encourage actors working in Information technology and financial services;
- English language compatibility can be leveraged very well;
- Diaspora institutions can be strengthened and organized to create avenues of cooperation.

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PROFILE OF RESEARCH TEAM

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About ICS

The Institute of Chinese Studies, Delhi (ICS) is one of the oldest research institutions on China and East Asia in India. With support from the Ministry of External Affairs, Government of India, it is the mandate of the ICS to develop a strategic vision for India's dealings with China and to help adapt India's priorities quickly and appropriately to address the research and educational demands arising from China's emergence. The ICS seeks to promote interdisciplinary study and research on China and the rest of East Asia with a focus on expertise in China's domestic politics, international relations, economy, history, health, education, border studies, language and culture, and on India-China comparative studies. It also looks to fostering active links with business, media, government and non-governmental organizations in India through applied research, executive training programmes, and seminars and conferences, and to serve as a repository of knowledge and data grounded in first-hand research on Chinese politics, economy, international relations, society and culture.

The ICS has its origin in the China Study Group, which began its activities in 1969. In 2010, the ICS took on an independent existence with MEA support as a research think-tank on China and East Asia. It conducts programmes on China's economy, politics, border studies, comparative development studies and relations with China and East Asia. It trains and connects scholars, provides policy inputs, and works with academic community and policy-makers. With strong collaborations in China, Taiwan, Vietnam, the US, and Russia, it organises conferences, delegations, and scholar exchanges. Its publications range from the prestigious journal China Report and issue briefs to academic papers and an active social media outreach.

Currently, ICS is the only multi-disciplinary think-tank in India for the study of China from a uniquely Indian angle. Ambassador Ashok K. Kantha, who was Ambassador of India to China until January 2016 and had served earlier as Secretary (East), MEA and High Commissioner to Sri Lanka and Malaysia, is Director of ICS since April 2017. Its Governing Council is chaired by Prof. Patricia Uberoi, and its Advisory Board by Ambassador Shivshankar Menon, former National Security Advisor, Foreign Secretary and Ambassador to China.

ABOUT
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