

Research Article

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Omission in Adoption: Whole of Systems Approach Applied to Case Study Analysis of Genetically Modified (GM) Maize Adoption in Eastern Cape Province South Africa

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Abstract

This article critically explores the political economy of genetically modified (GM) maize adoption in South Africa, focusing on its impact on smallholder farmers using the whole-of-systems approach. While South Africa has become a leader in GM maize production, the benefits have been unevenly distributed, particularly disadvantaging smallholders. Government efforts to integrate smallholders into the GM maize value chain have faced significant challenges, including structural inequalities, high input costs, inadequate infrastructure, and limited access to education and resources. The article analyzes the broader political, economic, and environmental contexts, revealing how global trade policies, foreign investments, and domestic regulatory frameworks influence smallholder integration into the global maize value chain. A case study of the Eastern Cape province underscores the additional challenges smallholders face, such as climate change, labor shortages, and barriers to market access. Despite GM maize's potential to improve food security and smallholder incomes, the article argues that current policies and institutional frameworks need substantial reforms to ensure equitable benefits. The research highlights the need for a multidimensional approach that addresses the socio-economic, political, and environmental factors constraining smallholder participation in the GM maize sector, calling for targeted interventions to bridge the gap between large-scale commercial farms and smallholders.

Purpose

This article examines the whole systems approach of genetically modified (GM) maize adoption in South Africa, focusing on the impacts on smallholder farmers. It aims to explore how structural inequalities, global trade policies, and domestic regulations influence the integration of smallholders into the GM maize value chain, and to assess whether current initiatives effectively support food security and income growth for these farmers.

Design/methodology/approach

The research employs a comparative political-economic analysis, combining an extensive literature review with empirical data from fieldwork between 2014 and 2015. The study examines the South African government's efforts to promote GM maize adoption and smallholder integration into the global maize value chain, with a specific case study of the Eastern Cape province. This approach provides a comprehensive understanding of the socio-economic, political, and environmental contexts affecting smallholder participation.

Findings

The study finds that despite South Africa's leadership in GM maize production, the benefits remain unevenly distributed, particularly disadvantaging smallholders. High input costs, inadequate infrastructure, and limited access to education hinder their participation in the value chain. Moreover,

global trade policies and foreign investments often exacerbate these challenges, rather than alleviate them. The case study of the Eastern Cape highlights additional barriers such as climate change and labor shortages. The research concludes that current policies and institutional frameworks require substantial reform to ensure equitable benefits for smallholders.

Originality

This article provides a nuanced analysis of the intersection between GM maize adoption and smallholder agriculture in South Africa by applying a whole-of-systems approach to the case study analysis. The study is emphasizing the need for a multidimensional approach to address persistent inequalities. It contributes original insights into the broader debate on the role of modern agricultural technologies in enhancing food security and economic inclusion for smallholder farmers in developing countries.

Keywords: Genetically Modified Maize; Smallholder Farmers Political Economy; Food Security; Agricultural Policy; South Africa; Value Chain Integration

Introduction

Since the commercialization of genetically modified (GM) crops in 1996 in the United States, their adoption has expanded globally. By 2019, 190.4 million hectares of GM crops were cultivated worldwide, with over half of this growth occurring in developing countries (ISAAA, 2021; Khush, 2012). This widespread adoption has been driven by coordinated efforts from research institutions, the public and private sectors, and civil society (Brookes & Barfoot, 2017). However, despite these advancements, the long-term implications of GM crops—ranging from environmental and health concerns to economic impacts—remain contentious. Regions such as Europe and Japan strongly resist GM crop integration in their food systems, creating significant trade barriers and influencing global perceptions of GM technology (Paarlberg, 2002, 2010; Smyth, 2017).

In contrast, in many developing regions, particularly Africa, policymakers face the dual challenge of addressing chronic food insecurity while weighing the benefits and risks of GM crops. South Africa, the first African nation to commercialize GM crops, offers valuable insights into the broader implications of GM crop adoption on the continent. This paper argues that while GM technology holds the potential for improving food security and economic growth, its integration into South Africa's agricultural sector has perpetuated deep-seated inequalities, particularly disadvantaging smallholder farmers.

The South African government has embraced GM technology as part of a broader strategy to improve food security and boost smallholder incomes. Policies like the Accelerated and Shared Growth Initiative of South Africa (ASGISA) and the Strategic Plan for South African Agriculture have placed smallholder agriculture at the forefront of efforts to address the dualism within the agricultural sector (NDA, 2001, 2012b). These strategies aim to bridge the gap between smallholders and commercial farmers, ensuring that smallholders benefit from modern agricultural technologies, including GM crops (NDA, 2001).

Despite these policy ambitions, the reality on the ground reveals that the benefits of GM crop adoption have been unevenly distributed. Large-scale commercial farms have captured most gains, while smallholders, especially black smallholders, remain marginalized. This paper contends that the integration of GM crops has failed to address the structural inequalities that have long plagued the sector, often exacerbating them. Rather than leveling the playing field, GM crop adoption has deepened the divide between commercial and smallholder farmers.

A central argument of this paper is that the institutional, environmental, political, economic, and sociocultural contexts within which GM technology is adopted significantly shape its outcomes. We apply a whole of systems approach to conduct the case study. In other words, A Whole of Systems Approach (WoSA) to genetically modified (GM) crop analysis is a comprehensive framework that examines the complex interactions between GM crops and various dimensions of the agricultural ecosystem. This approach considers ecological impacts, such as biodiversity and sustainability, while also addressing economic implications, including market dynamics and cost-benefit analyses. Social and cultural factors, such as equity for smallholder farmers and cultural acceptance, are integrated with political, regulatory, and ethical considerations. By emphasizing interdisciplinary collaboration and stakeholder engagement, WoSA ensures that GM crop policies and practices are evaluated holistically, promoting balanced and sustainable agricultural development.

In South Africa, the legacy of apartheid has left a deeply divided agricultural sector, where large-scale commercial farms, predominantly owned by white farmers, dominate, and black smallholders struggle to compete. This structural inequality has profound implications for the adoption and impact of GM crops. While commercial farmers can access the resources and infrastructure necessary for adopting GM technology, smallholders face numerous barriers, including limited access to credit, land, and markets and a lack of education and training on GM technology (Aliber & Hall, 2012).

The liberalization of South Africa's agricultural market in the 1990s, following the country's transition to democracy, further disadvantaged smallholders. The Marketing Act of 1996, which abolished marketing boards for staple and cash crops, including maize, left smallholders without the institutional support necessary to compete in the market. The Maize Board, restructured as the Maize Trust, remains largely controlled by large commercial farmers, further marginalizing smallholders (Aliber & Hall, 2012). Consequently, the benefits of GM maize have predominantly accrued to commercial farmers, while smallholders have struggled to integrate into the GM value chain.

Fieldwork conducted for this paper provides empirical evidence of the challenges faced by smallholders in adopting GM crops. Interviews with smallholder farmers in the Eastern Cape, one of South Africa's poorest provinces, revealed a range of obstacles to GM crop adoption. High input costs, especially for GM seeds, fertilizers, and pesticides, and a lack of access to credit and markets were common themes. Many smallholders also expressed concerns about the environmental and health risks associated with GM crops, reflecting the broader global debate on the technology. Moreover, the lack of education and training on GM technology has left many smallholders with little understanding of how to grow GM crops or the potential benefits and risks involved.

The broader geopolitical and economic context also shapes GM crop integration in South Africa. The global maize value chain, in which South Africa is a key player, is influenced by complex trade dynamics and political pressures. Domestic policies and international trade agreements have often prioritized the interests of large commercial farmers over those of smallholders. As a result, smallholders have struggled to compete in both domestic and international markets, further limiting their ability to benefit from GM technology.

Considering these challenges, this paper argues for a more nuanced, context-specific approach to GM crop adoption in South Africa. Rather than promoting GM technology as a one-size-fits-all solution to food insecurity, policymakers need to address the specific needs and constraints of smallholder farmers. This includes tackling the structural inequalities that have long characterized the agricultural sector and providing the necessary support and infrastructure for smallholders to adopt and benefit from GM technology.

Moreover, the decision-making processes related to GM crop adoption must be more transparent and inclusive. Many smallholders reported feeling excluded from these processes, with decisions often made by government officials and commercial farmers without adequate

consultation with smallholder communities. This lack of trust in both the technology and the institutions responsible for regulating it further hinders GM crop adoption among smallholders.

In conclusion, this paper argues that while GM technology has the potential to contribute to food security and economic growth in South Africa, its integration into the agricultural sector has been marked by deep-seated inequalities and uneven benefits. The experience of smallholder farmers, particularly in the Eastern Cape, highlights the need for a more context-specific and inclusive approach to GM crop adoption. By addressing the structural barriers that limit smallholders' ability to benefit from GM technology and ensuring their inclusion in decision-making processes, policymakers can help create a more equitable and sustainable agricultural sector in South Africa. This paper will contribute to the ongoing debate on the value of GM crops in developing economies by providing a detailed analysis of the political, economic, and sociocultural dimensions of GM crop adoption in South Africa.

Literature Review and Context Analysis

The literature review methodology for this study adopts a Whole of Systems Approach (WoSA) along with a systematic and integrative approach to comprehensively analyze the multifaceted impacts of genetically modified (GM) crops on South African smallholder agriculture. The objective was to contextualize the historical, political, and economic challenges facing smallholder farmers while exploring the role of institutional innovations and policy frameworks in shaping their agricultural practices. This process aimed to provide a comprehensive understanding of the factors influencing the adoption of modern agricultural technologies, particularly GM crops, within the South African context.

To ensure a thorough and well-rounded review, multiple academic databases were used, including Google Scholar, JSTOR, Scopus, and Web of Science. These databases were selected for their extensive coverage of peer-reviewed articles and scholarly works across various disciplines. The search strategy involved the use of specific keywords and phrases relevant to the topic, such as "empirical research", "fieldwork", "case study", "political economy"; "Agri* systems", "smallholder farmers in South Africa", "GM crops value chain", "perception in adoption in South Africa", "agricultural policy in South Africa", "maize value chain," "leadership" and "institutional support for smallholders." Boolean operators, such as AND and OR, were employed to refine the search results from over 150,000 to a manageable 200 articles that were peer-reviewed, published within the last two decades, and focused on the South African context or provided relevant insights applicable to the region.

In addition to keyword searches, backward and forward citation tracking was used to identify influential papers that may not have appeared in the initial search results but were cited frequently in other works. Studies that lacked empirical evidence or were primarily speculative were excluded from the review. Articles that focused on regions outside of South Africa without providing applicable insights or comparative analysis were also excluded to maintain the geographical relevance of the study. Furthermore, older studies that had been superseded by more recent research were omitted unless they provided foundational theories or historical context necessary for understanding the evolution of smallholder agriculture in South Africa. This method allowed for a more comprehensive examination of the literature and ensured that the most relevant and impactful studies were included in the review. The inclusion and exclusion criteria for selecting articles were carefully designed to maintain the relevance and quality of the literature reviewed. Studies that offered empirical data, policy analysis, or theoretical frameworks related to smallholder agriculture, GM crop adoption, and the broader political-economic environment were prioritized. Additionally, articles that examined the socio-political challenges, institutional support mechanisms, and market dynamics influencing smallholder farmers in South Africa were considered essential for this review.

As part of the review process, the selected articles were critically analyzed to identify recurring themes, gaps in the literature, and areas where further research is needed. The review process applied CASP Checklist: Systematic Reviews with Meta-Analysis of Observational Studies (BETA)¹. We sought to understand the broader historical, political, and economic contexts that have shaped smallholder agriculture in South Africa. This contextual understanding is essential for comprehending the structural and institutional challenges that smallholders face, particularly in the adoption of GM crops.

Smallholder farmers in South Africa

The historical analysis reveals that the legacy of apartheid and the structural inequalities it created have had long-lasting impacts on the agricultural sector in South Africa. Smallholder farmers, particularly black smallholders, have historically been marginalized and excluded from the benefits of modern agricultural technologies and institutional support. This exclusion has been perpetuated by policies that favored large-scale commercial agriculture and failed to address the specific needs of smallholders.

¹You can download the CASP checklist from here <https://casp-uk.net/casp-tools-checklists/systematic-reviews-meta-analysis-observational-studies/>

Moreover, the political economy of agriculture in South Africa has been shaped by the interplay of global and domestic forces. The liberalization of agricultural markets in the post-apartheid era, coupled with the pressures of globalization, has created a highly competitive environment that often disadvantages smallholders. The integration of GM crops into the agricultural system has been positioned as a potential solution to improve productivity and food security. However, the adoption of GM technology by smallholders has been limited due to high input costs, lack of access to credit, and inadequate infrastructure.

Institutional innovations, such as the introduction of commodity exchanges and crop biotechnology, have been implemented to support the agricultural sector. However, these innovations have often been more beneficial to large-scale commercial farmers than to smallholders. The review highlights the need for more targeted policies and support mechanisms that address the unique challenges faced by smallholder farmers. These include improving access to education and training, providing financial support, and creating market opportunities that are accessible to smallholders.

The definition of smallholder farmers is based on the basic characteristics of their production systems, such as the simple and outdated technologies that they use, low inputs, and dependence on a local and seasonal labor force. Smallholder farmers differ in individual characteristics, farm size, resource distribution between food and cash crops, being male and female, having diversified and undiversified income, and motivations to plant crops (Aliber & Hall, 2012; Böhringer & Ayuk, 2003; DAFF, 2012). In South Africa, although there is a paucity of data, it is estimated that while there are about 2.5 million black households in smallholder agriculture who are producing for subsistence purposes, about 100,000 farmers are smallholders producing for commercial purposes, and less than 5% have adopted technology (Aliber & Hall, 2012; Cousins, 2013; Gouse, 2012). As the national economy globalized and modernized, gradually agricultural production declined by about 5%, mainly caused by reduced production of maize, wheat, and sugarcane. In particular, maize is an important crop since it is the source of the staple food (pap) for millions, the source of export income, and a major driver of gender empowerment (Abidoye & Mabaya, 2013; Gouse, 2012; Metro, 2012), as women are the main producers and users of maize. However, the domestic terms of trade for these crops are declining, which is leading to 624,000 jobs lost in the agriculture sector at a time when the cost of the food basket is on the rise² (NDA, 2012b). During the last quarter of 2022, 120,000 agriculture jobs were lost (IOL, 2023). Although time passed, smallholder numbers shrank in South Africa, no change in the level of poverty, or the ability to adopt new technologies or enter the agribusiness easily.

In the consideration of the Strategic Plan of South Africa and elsewhere globally within the discourse on smallholder development, smallholder farmers are referred to as “emerging” farmers. This implies that they are bona fide farmers only insofar as they begin to resemble and are recognized as commercial farmers and market integration happens automatically. In other words, the neoliberal argument is that the trickle-down effect of commercialization of the agricultural sector will lead smallholder farmers to connect with the value chain and over time they will become successful commercial farmers³. This is an inherent dualism, which seems to have been in the agriculture development discourse for decades. This masks the structural and institutional limitations within which the smallholder farmers are embedded and constrains their capability to be productive participants in their society, their sector, and the economy.

Why smallholder agriculture is key to developing, transforming, and reforming developing countries' economies is no longer new knowledge. In 2021, it was estimated that 21% of the South African population was involved in agricultural employment (World Bank, 2021). To improve the economic condition of smallholders, science, technology, financial, and institutional mechanisms need to be understood and improved. Whereas a developed commercial sector co-exists with many communal farms, the smallholder agricultural sector is much less cooperative. Despite the recent trend of government expenditure and institutional reforms (e.g. Land reform, AgriBEE), more institutional innovations are needed to “address rural and economic growth, food security, and inequality through increased productivity and job creation in the sector,” according to Agriculture Minister Tina Joemat-Pettersson (NDA, 2012b).

In the case of South Africa, smallholder agriculture has been largely untouched by government interventions to strengthen the commercial agriculture sector for decades. In contrast, during the last three decades, considerable institutional efforts were made to generate well-developed infrastructure for storage and logistics to support large-scale farms. For instance, welfare services such as education, health, and access to transportation systems discriminate between black provinces like Limpopo, Eastern Cape, KwaZulu-Natal, and non-black provinces like Northern Cape and Western Cape (Hoogeveen & Ozler, 2004; StatSSA, 2011, BusinessTech, 2016).

²The cost of this food basket, expressed as a share of the average monthly income of the poorest 30% of the population, increased from 32.4% in October 2010 to 36.4% in October 2011 (NDA, 2012b).

³Interviews with national experts and academics at the University of Pretoria in June 2014, but no clear evidence was presented to justify the argument based on the observed growth in commercial farming and transition of smallholder farmers into the commercial supply chain.

Table 1: AgriBEE scorecard.

No	Empowerment Indicator	AgriBEE Indicative Scorecard (points)
1	Ownership (Land and Equity)	20
2	Management Control	10
3	Employment Equity	10
4	Skills Development	20
5	Preferential Procurement	20
6	Enterprise Development	10
7	Rural Development and Poverty Alleviation	10

Source: (Purchase, 2013).

Over subsequent years, South Africa has managed to introduce multiple institutional innovations. For example, South Africa became the first African country to establish Commodity Exchanges and introduce crop biotechnology in the agricultural sector. These developments built South Africa's reputation on the continent and elsewhere in terms of institutional innovation. Yet these changes also seemed to introduce other unintended policy outcomes. Roxburg, Dorr, Leke, & et al. (2010) suggest that the sudden removal of price controls, export orientation, and a volatile currency, coupled with changing natural and climatic conditions, made the agricultural sector particularly unfavorable for smallholders.

A major challenge to this is the inherent inability of the smallholders to compete in the value chain and take advantage of any marketing support offered by the public sector for emerging farmers and entrepreneurs due to poor education and a weak knowledge foundation. EEAS (2007) suggests that “Bantu” education was designed for the black population to meet the unskilled Labour needs of the whites and is devoid of mathematics and science. “Bantu” education consisted of poor educational and knowledge foundations that converged with other institutional restrictions such as land and business ownership.

In the past, the black African population was restricted from owning land and businesses, mainly in the food and fuel sector. Because of Bantu Education and its legacy in South Africa, many black South Africans have historically and continue to be denied access to quality education, depriving them of employment and other socioeconomic opportunities (Gallo, 2020). Agriculture marketing is critical as it dictates the level of incentives farmers can realize from selling their surplus produce and acquiring a supplier position in the value chain. Before 1996, a variety of marketing boards existed to support commercial farmers to remain competitive in the value chain. As mentioned already, marketing boards were abolished through the Marketing of Agricultural Product Act of 1996 and opened the agricultural value chain to every size of the producer

which leads to more marginalization of smallholder farmers.

Genetically Modified (GM) Maize for smallholders

Agricultural biotechnology, especially genetically modified crops, has played a very important economic and productivity-enhancing role in South Africa. South Africa is a net exporter of maize, and the overall economic gains from GM crop adoption are estimated to be USD 809 million (Brookes & Barfoot, 2012). Maize has a strong global value chain and commercial GM maize⁴ has about 17 years of history in the country. GM maize adoption was rapid among commercial farmers, and by 2012/13, it was estimated that about 72% of planted white and yellow maize were GM (Abidoye & Mabaya, 2013). In 2017, South Africa commercially produced approximately 1.1 million hectares of GM varieties for direct human consumption, representing an 85% adoption rate (Alliance for Science). Whereas white maize is the staple food for 80 percent of the South African population, yellow maize is used for animal feed and as input in the food industry. As a result, GM maize has been identified as a strategic crop for linking smallholder agriculture development since 2003. In 2003, the Massive Food Production Programme (MFPP) and, in 2009, the Accelerated and Shared Growth Initiative of South Africa (AsgiSA) were initiated by South African provinces to link black smallholders in the Eastern Cape with the maize value chain. Both programs were discontinued after a few years of operation due to high input costs (seeds, fertilizers, pesticides, and machinery) and open market price fluctuations.

Other factors such as climatic variability, labor shortages, water crises, land tenure problems, and weak transportation infrastructure contributed to the demise of these programs. Some commentators have suggested that the main beneficiaries of the projects were “the private sector, particularly the seed and agro-chemical companies, as the government was practically subsidizing the introduction of their expensive products to a new market of smallholder farmers who would otherwise not afford them” (GRAIN, 2008). Another study found that, despite preferential policies implemented by the South African government such as the Black Economic Empowerment for Agricultural Sector (AgriBEE) Act, agribusinesses may have been reluctant participants in absorbing the smallholder surplus, which is not an inspiring condition

⁴Bt maize was approved for commercial production in 1998/99, and Bt yellow maize was planted in that same season. The first plantings of Bt white maize two years later in 2001/02 established South Africa as the first GM subsistence-crop producer in the world. Commercialization of herbicide-tolerant (HT) maize followed in 2003/04, and “stacked” traits Bt+HT (BR) maize was released for the 2007/08 production season (Gouse, 2012).

for smallholders (Metro, 2012). This is the dynamic nature of institutional support and pest population pressures due to climate change leading to reduced value for money from farming GM maize. The profitability of adopting GM maize can thus vary between seasons, locations, and producers as many studies discovered.

For South African farmers and farmers in other countries, adoption of GM crops can be considered an insurance policy against economically important pests such as bollworms and stalk borers, as the argument can be made that it can help reduce the risk and cost associated with an expensive labor force, but this was not true to South African small farmers as literature review suggested. Although there is no database of GM farmers in South Africa, based on seed company information, seed sales, and assumptions regarding seed quantity, bag sizes, and seeding rates, Gouse, Kirsten, & Van Der Walt (2008) estimated that approximately 23% of the estimated 46,500 smallholder farmers who regularly buy hybrid seed from the three largest maize seed companies – Monsanto, Du Pont, and Paneeer – planted GM maize seed since 2007/08. GM smallholder adopters appear to be relatively nominal given that there are an estimated 240,000 small-scale small-surplus farmers and more than 2 million subsistence farmers in South Africa (Gouse, 2012). Nevertheless, agricultural development schemes focusing on smallholder production and productivity intensification as well as commercialization with modern technology to reduce inequality and poverty is a way to look into the future. Agricultural technology continues to be a way to capture benefits and engage capital for growth accumulation.

Whole of Systems view of the Maize Global Value Chain

One of the objectives of this paper is to understand the maize market value chain and understand how information about price and power (rules, laws, contracts) flow through various agents or nodes to create opportunities or barriers for smallholders to receive benefits from expanding GM maize production. As mentioned, South Africa has a highly developed maize value chain. Historically, it served the commercial large farmers, but recently there has been significant political and economic attention both from the public and private sector to make the value chain pro-smallholders. Below is a representation of the South African maize value chain. An important value chain development is that in years when imports constitute a major share of the marketed supplies, the structure of the maize value chain can change considerably as demands decline in the domestic market. So, any institutional innovation to smallholders in the value chain needs to be of this fact, as such debates are ongoing on the import tariff of maize.

Input suppliers' industry

There are formal and alternate sources to get access to improved seeds. Alternate sources include household

exchanges, NGOs, and government projects' distribution of inputs. Formal inputs are accessed through markets. Seed, fertilizer, and agrochemicals, important intermediate inputs for agriculture production, are big businesses in South Africa. Over the years total expenditure on agriculture intermediate inputs and services has increased from approximately Rand 36 billion in 2003 to Rand 67 billion in 2008 (Esterhuizen, 2006: 193). However, much of the observed increase was derived from the cost of fuel which is about 20% of the country's total agricultural input expenditure.

Over the years, annual fertilizer consumption grew in South Africa to compensate for the aridity of the land (FSSA, 2008). The two major fertilizer manufacturing companies are Omnia and Sasol; each company has a market share of more than 20%. Fertilizer manufacturing uses both locally produced materials (ammonia and phosphates) and imported components such as potash since it is not locally

found (Kirsten and House, 2002:3). The South African fertilizer market is very competitive, and the competition is driven by price incentives, product differentiation and specialized services such as individual agronomic advice, custom blending, and application. Smallholders are increasingly being pulled into the fertilizer supply chain with marketing and promotional advocacies to use fertilizer (FAO 2005). At the same time, the country is increasingly dependent on imported fertilizer⁵ (Grain SA Fertilizer Report 2011).

The seed companies in South Africa typically distribute their seeds directly to the farmers through their network of field agents. The seed companies (mainly Monsanto⁶ Pioneer and Pannar) are the major sources of GM seed. Any new products developed need to abide by national biosafety and other seed-related regulations before release to the local market. This may include confined field trials, food/feed safety, and socioeconomic assessments as well

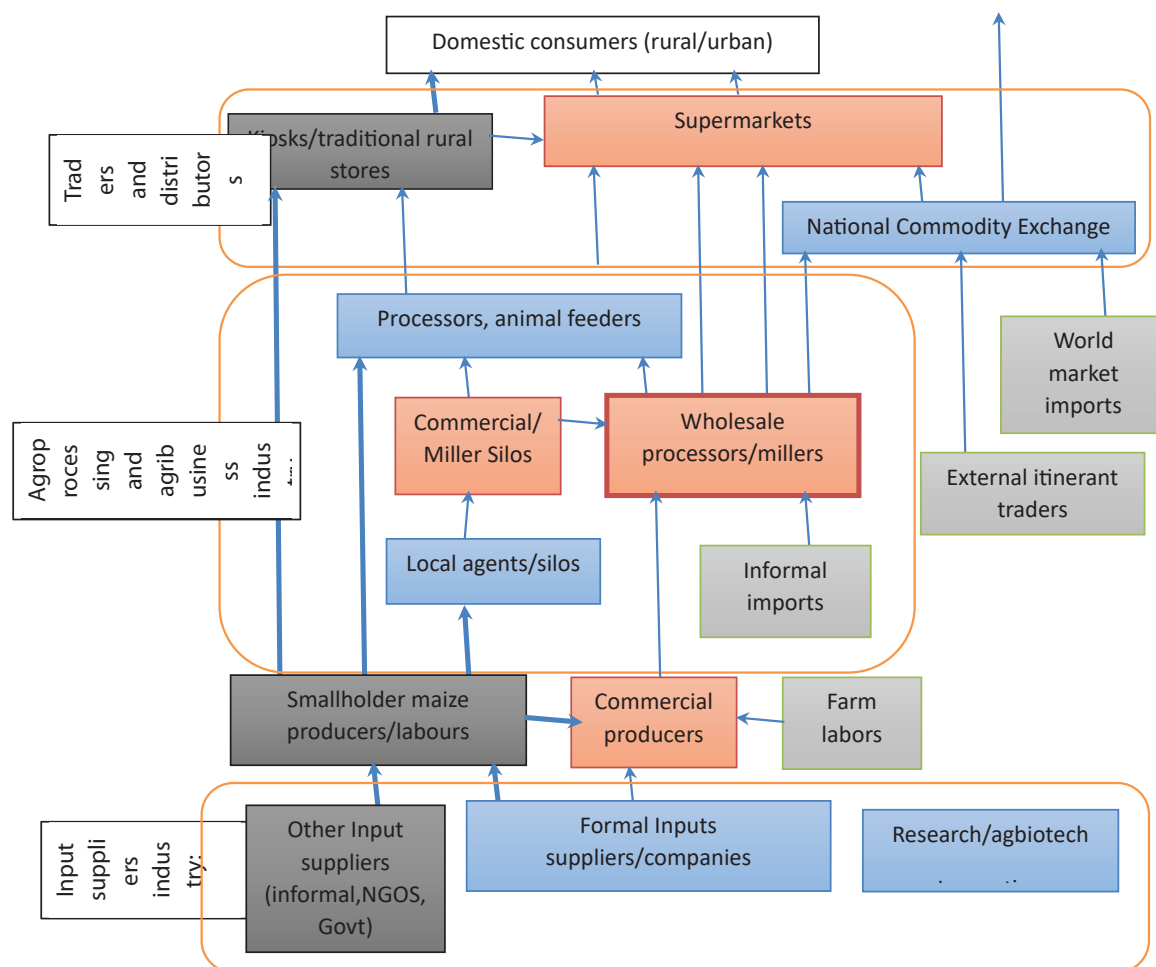


Figure 1: Gray: institutions directly involved with smallholders value chain
 Blue: institutions involved with both smallholders and commercial value chain
 Red: institutions directly involved with commercial value chain
 Thick blue lines: direct touch points of the smallholder agriculture sector
 Orange boxes: three major influencers input providers, agro-processing companies and distributors
 Note: Smallholders and commercial farmers are distinctive in character as explained in the earlier sub section, hence not covered here.

as meeting conventional seed registration and certification procedures before being released on the market.

Agro-processing and agribusiness industry

With deregulation, the traditional ways to collect maize from farmers were largely dismantled and some of them were converted into private companies, such that 100% of the marketing boards and 90% of the cooperatives were covered under this policy change. Currently, the maize agro-processing industry depends on the collection capacity, efficiency, and reliability of the storage companies. There are about 432 silos of which 172 are on-farm and 260 are commercial. The commercial silos are owned by only three owners namely AFGRI, NWK, and SENWES group (NDA, 2012a, 2021). The combined storage capacity of the three companies occupies 73% of the total available storage capacity of the country and remains unchanged. The commercial storage facilities are geographically specific and most of them are situated in the northern part of the country. The Northern part is not only a key maize-producing region but also one of the developed and connected regions of the country.

The wholesale maize processors receive the maize from the silos and add value to them. There are two types of processors – Wet and Dry milling industries. Dry milling processors produce maize meal, and products derived from this are, maize grits, maize rice, unshifted, sifted, coarse, super, and special maize meal. The wet milling process uses water to produce pure starch. Since deregulation, the number of informal millers increased from 111 in 1996 to 296 in 2015 (ACB, 2017, p. 17). Although, there are both public and private millers. Yet, four major millers have overall market power control. The four large companies include Premier Foods, Tiger Milling Company, Pioneer, FoodCorps, and the South African Breweries. Each with over 12 billion Rand annual turnover (Kirsten, Stander, & Haankuku, 2010). These companies are operating through a highly integrated value chain.

While processing and distributing maize products, they also develop new products and improve existing products to satisfy the diversity of needs of consumers. These companies compete and strive to enhance their product appeal to diverse consumers. In fact, since the mid-1990s, they expanded their branded value chain in remote parts of the country, changing subsistence farming households into consumer households. They add value to maize by converting it into a sale of a range of fortified and unfortified maize meals, bread, processed foods, and alcoholic and non-alcoholic beverages. A significant development is that most of these firms are South African and have a significant presence in other African countries. This institutional arrangement opens opportunities for smallholders to be part of a growing industry that is capable of exporting

abroad. According to the National Chamber of Milling statistics⁷. There is a perception that consumer preference changes and the growth in substitute products, mainly imported for human consumption, has caused a decline in demand for domestic maize meal (Louw, Geysers, et al 2010). After the maize market deregulation, the number of millers increased, although most of them were underperforming and underutilized.

Traders and distributors industry

Agriculture traders perform a critical role in the free market economy within which the maize sector operates. During times of surplus traders export maize and in times of shortage, they facilitate imports. Several grain traders take positions (forward buying and selling), assume risks, establish value, and generate real exchange and cash in the market. In SAFEX, there are national, international, financial, and hedge firms trading for and against South African maize. With the conversion of cooperatives into public companies, many entities have expanded their operations into trading and based on the market conditions they operate their credit and financing services for producers. The large traders are Rand Merchant Bank, Senwes, Afgri, Cargill, Louis Dreyfus and Verus Farms. The smaller competitors are Brisen, Bester Feed Exchange, CTH, FFarmWise, Unigrain, and Freestate grain (NDA, 2012a). Historically railroads were the main sources of trading physical grain. However, since the mid-1990s, there has been some expansion of road systems to complement the railroad system. Transportation is an important factor in operating an efficient commodity market. Participants not only need to account for distribution, but they are also liable for the quality of the product, which means safe and reliable transportation. In general, the ratio of rail and road transportation used within the maize value chains has changed from 80% rail and 20% road to 50% rail and 50% road. With the growing competition from private road transportation companies, the single national rail company is reinventing its service provisions and tariff structure.

⁵According to the Department of Agriculture, Forestry and Fisheries data published in 2020 compared with the International Fertiliser Association (2010) report on South Africa is becoming more and more dependent on imports to satisfy the local fertiliser demand. In 1990, less than 20 % of fertiliser needs was imported; in 1999, 40 % of the demand was imported; and in 2020, over 65 % to 70% of South Africa's nutritional fertiliser needs was imported.

⁶Sensako en Carnia, a major local seed company was bought by Monsanto in the mid-90s and no longer exists.

⁷Industry Statistics page of the National Chamber of Milling (NCM) states "following the Competition Commission concerns regarding information sharing, the Chamber has discontinued the dissemination and distribution of industry statistics until such time when the Commission has given clear guidelines regarding information sharing on an industry basis." (<http://www.grainmilling.org.za/>)

In addition, it is important to underscore that there are formal and informal distributors in South Africa. In urban areas, a number are supermarkets and retail chains offer maize-derived products to domestic consumers, while the rural population depends mostly on the local kiosks and shops. There are seven major retail players, namely Pick n' Pay, Shoprite, Metcash, Spar, Massmart, Fruit & Veg City, and Woolworths (NDA, 2012a). In rural areas, maize meal prices are not driven by factors such as affordability, habit, taste, hygiene, and convenience, but rather by opportunist pricing. There is a growing demand for maize meal in SA. The National Grain Milling Association study found that although none of the local millers offered any value addition or fortification to the maize meal, the retail price was comparable to value-added maize meal (Louw, and Geyser 2010). The price differentiation between rural and urban areas is a critical public policy issue, as rural food security is linked with the accessibility and affordability of maize.

To establish an effective maize value chain that connects rural producers with global trading, processing, and distribution industries, both short- and long-term issues need to be considered. Using the IFS framework to analyze this sector in South Africa, may open the possibility of performing a broad-based political, economic, and social perspective using short and long-term lenses on the smallholder agriculture sector in the country.

Political Economic System Influence Global GM Maize Value Chain of South African

Agricultural market reforms may have aimed to lift most barriers to facilitate market participation by smallholders, and yet have had limited outcomes, often because of inadequate support and understanding about the trade-offs, and bottlenecks for non-participation in agricultural markets and global value chains. The lack of understanding is further complicated by multiple intricacies of structural and process factors defining markets and value chains such as lack of information, price shocks, fear of losing and being cheated, social and cultural interaction issues, and so forth. Whether smallholders can withstand shocks or seize global market opportunities such as high prices, is perhaps the simplest and most important determinant of success in South Africa, both for the public and private sectors facilitating the GVC integration. In this section, we aim to break down some of the common structural changes, namely global trade policies, information issues related to foreign direct investment, and perceptions related to GM crops that influence the extent to which smallholders are going to link or delink from the global or national value chain.

Global trade and price transmission condition

The South African Futures Exchange (SAFEX)⁸ grew out

of an informal market in 1988 after South Africa's financial liberalization in the 1980s (Adelegan, 2009). Following agricultural market liberalization, the Agricultural Markets Division (AMD) was established in 1995 as a separate division of SAFEX. SAFEX is a major commodity futures market, not just in South Africa but in the entire African continent. It was developed by the government and supported by donors to reduce transaction costs that lie at each node of the value chain and scale it up, especially, with the country's main staple crop (white maize) as its flagship contract (AFDB 2013). Small-scale farmers are not expected to participate directly in futures markets – at least, not until they build up the necessary knowledge, resources, and capacity. Instead, dissemination of pricing and other market information – coupled with training small-scale farmers in its use – is one way of increasing these farmers' capacity and resilience. Rather, the intermediary organizations within the value chain that offer services to smallholder farmers such as cooperatives, input suppliers, purchasers, transporters, and financiers (including microfinance organizations) benefit from participating in the exchange market. According to UNCTAD's report on South Africa's agriculture exchange market, it is estimated that 20% of commercial farmers are directly involved and 70% of the maize value chain uses SAFEX in some capacity to reduce price risks, discover prices, market physical commodities, and invest in new farms (UNCTAD, 2009). Given the importance of SAFEX in transmitting market information and purchasing power throughout the value chain, it is an important institution, influencing successful smallholders' integration into the value chain. According to UNCTAD, the "utility of a commodity exchange . . . lies in its institutional capacity to remove or reduce the high transaction costs faced by entities along commodity supply chains in developing countries" (UNCTAD, 2007, p. 4).

The foreign exchange rate is one of the indicators of monetary policy and the national institutional capacity to reduce transaction costs. Since market liberalization, the US/Rand exchange rate has fluctuated widely. Combined with significant dependency on rain-fed agriculture, along with other political considerations, SAFEX trades can be characterized by high levels of volatility in price, output, and export. Furthermore, world maize prices had little to no significant effect on South African maize prices

⁸A commodity exchange is a market governing institution that sets up exchange rules, based on which multiple buyers and sellers trade a commodity and commodity-linked contracts. Such contracts are for future delivery. Such exchange are done based on a cash or "spot" trade for immediate delivery, forward contracts on the basis of warehouse receipts, or the trade of farmers' repurchase agreements for financing (known as "repos"). Aside from facilitating trade, an exchange can serve as a center for registering transactions for tax purposes, such as in Turkey.

(Minot, 2011). There are two reasons to offer: first, several southern and eastern African countries import maize from South Africa rather than from markets outside of Africa. Second, yellow maize dominates world markets for maize, but white maize is strongly preferred among African consumers. South Africa is one of the few countries that exports white maize in significant volumes (Minot, 2011). The global price transmission through SAFEX is low in the case of maize in South Africa, although food prices for imported crops like rice and processed food are exported at market parity.

As a participant in the global market, there is no doubt that the global price flows through the global value chain, which is not always favorable to smallholders. In the recent years, GrainSA⁹ has raised concerns over limited grain collection locations, weak infrastructures for crop delivery, price volatility, and aggressive price speculation, which is increasing the wholesale price of domestic production and risks leading to the importation of cheaper grains (NAMC, 2009). This is relevant for emerging subsistence-to-commercial maize farmers in Limpopo, KwaZulu Natal, and the Eastern Cape who have faced—and still face—various production and marketing constraints (e.g. silo capacity and placement) to enter the value chain with their seasonal surplus (Gouse, 2012).

Foreign direct investments and foreign relationships

In the past two decades, as the market has been liberalized, the South African commercial farmers (still almost exclusively white) have had mixed experiences. On the one hand, they experienced pressure from the dismantling of an elaborate architecture of policy and institutions to support commercial farming: a diminishing marketing board, price floors, cheap credit, subsidies, and tax breaks, redistribution of land, and the introduction of labor rights. On the other hand, the source of the same pressure offers the opportunity for the farmers to respond by adopting one of the three strategies: a) exit, b) diversify, or c) relocate. Indeed, the total number of commercial farming units declined from approximately 60,000 in 1996 to about 40,000 in 2011 (Hall, 2011). During the same time, another group of commercial farmers diversified their agribusinesses by expanding activities upstream and downstream in the value chain and benefited from foreign direct investment and joint ventures offered to South Africa (Esterhuizen, Rooyen, & Doyer, 2005). South Africa is the first African country to be among the top 50 countries in the world according to the Doing Business Index for the

past decade and still holds the 41st position out of 189 countries, based on ease of doing business (World Bank, 2014). The expansion of retail chains (or supermarkets) is proof of this ease, which created a mass consumer culture even in remote parts of the country (Baipethi & Jacobs, 2009).

The third group of farmers relocated their agribusiness interests to other countries. In fact, in 2010, the Commercial Farmers Association (AgriSA) and the Agricultural Business Chamber (AgBiz) were engaged in negotiation with 22 African countries' governments for land acquisition to maintain SA's competitiveness in the global agricultural market (Esterhuizen et al., 2005; Hall, 2011). While land-grabbing discourse largely focused on "foreign" actors, for South Africa, it meant the loss of "expert commercial farmers [accustomed to operating] under tough African conditions" to countries like Zambia, Mozambique, Mali, and Madagascar, offering favorable business and investment conditions.

Nevertheless, AgriSA plays an important diplomatic role and organizes missions for agricultural elites to establish political and economic leadership in the African continent to scale up their value chain¹⁰ which will also link national smallholders to satisfy growing demands overseas. Private companies are also addressing commodity production finance issues for smallholders. For example, in 2016, the total U.S. foreign assistance to South Africa was USD 459.7 million. In 2007 the First National Bank received USD 300 million from the US Agency for International Development (USAID) to develop a finance package for commercial smallholders. The package covered crop production costs, insurance, hedging, selling the crops, management, and so on. There is a need for careful research to determine the extent to which this is going to offer any solution to linking smallholders into the value chain¹¹. The percentage of smallholders who are linked with processing and marketing in the global value chain needs to be measured to validate this research.

Global GM debate and effects on the domestic value chain

South Africa has a long history with GM technology, from the medical sector to the agricultural sector. There are a significant number of contrasting positions within

⁹GSA is a voluntary association of grain farmers established to represent the interests of its members. It was formed out of NAMPO (maize), NOPO (soybeans, sunflower, and groundnuts), WPO (wheat, barley, and oats), and the SPO (grain sorghum) (<http://www.grainsa.co.za/>).

¹⁰South African farmers conduct a wide range of activities and services, aside from farming in the countries where they received or are receiving land, including engineering, building, consulting, and startup-fundraising.

¹¹Multistage sampling and a stratified random interview method will be used within distinct categories for the population to confirm or disconfirm the insights mentioned in the preliminary analysis.

the maize value chain in SA since the introduction of the GM version. Contrasting positions have in many cases introduced confusion into the value chain which can be traced to a distinct set of developments.

First, although there is relatively weak opposition to adopting GM crops, a small but vocal and well-organized group, funded by European non-profits like Greenpeace and the Gaia Foundation, has campaigned around the legislative capital, Cape Town. Information flows from the campaigners to the public through the mass media, unlike in other African countries, and much of the reporting on GMOs has become more neutral over time¹².

Second, the debate on the topic may be divided by racial lines. For example, the proponents namely, AgriSA, GrainSA, commercial farmers, and agribusiness associations, who tend to be white South Africans, are accused by the opponent non-profit organizations of being out-of-touch with the lives of their regular customers, who tend to be black South Africans. Typically, black South Africans are those who eat milled GM white maize three times a day, tend to be poor and even if GM products were labeled, they are unlikely to have other options as most of the entire supply chain of the maize meal is GM maize¹³.

Third, there are conflicting views on the role and effectiveness of the regulatory agency in South Africa, the Executive Council of Biotechnology. As described by Cooke & Downie (2013), proponent stakeholders view the Council as unnecessarily precautionary, slow, and inconsistent in its decision-making. In the opinion of these stakeholders, the Council has unnecessarily slowed down applications and/or decreased the applications, especially by South African researchers. In turn, other stakeholders view the Council as a weak organization and it has been accused of being in the pocket of the scientists who are foreign-educated, funded, and carrying out research for the benefit of foreign companies (Cooke & Downie, 2013; Gilliam, 2013).

Fourth, seed industry developments may have an impact on innovation for food security in South Africa. According to Bio Watch of South Africa, due to recent decisions by several South African Courts, smallholders' and consumers' rights were overlooked when the South African courts approved the merger between the multinational company Pioneer Hi-Bred Inc. (a subsidiary company of Dupont) and South Africa's largest seed company, Pannar Seed (Pty) Ltd. Pannar has a strong rural consumer network and specializes in maize seed and skill distribution. In 2013, Dupont Pioneer acquired a majority share in Pannar. In the view of critics of the merger, this decision effectively placed a foreign corporation in control of the South African food-crop-seed supply chain and offered an excessive level of control in the South African seed industry. The influence of foreign companies raises concern about broader national

interests of food security and the conservation of crop diversity for small-holder farmers¹⁴ (Gilliam, 2013).

Finally, within the South African government, a complex inter-agency dynamic exists. While the South African Agriculture and the Science and Technology Departments are seen as proponents of GM crops, other departments such as the Environmental Affairs and the Trade and Industry departments, are perceived to play a more precautionary role in decision-making. The more precautionary approach may be due to the latter two department's mandates of considering environmental and trade relationships. Europe is a major export destination of South Africa, especially for fruits and vegetables which may introduce some European buyer preferences into the decision making. Conflicting interactions may lead to regulatory and technological decision-making conflicts. In 2013, after a much-heated debate, a GM potato application was rejected, which was USAID funded and was developed by an international consortium led by the South African Agricultural Research Council over eight years apparently due to potential trade implications but also due to estimated smallholder impact in terms of pest damage reductions (Cooke & Downie, 2013).

National Governance and Institutional

The intractable problems of promoting the growth of smallholder agriculture income have inspired researchers from a variety of backgrounds. The two emerging approaches from the nascent consensus from scholars about how to promote growth in smallholder agriculture in Africa include although these are not necessarily mutually exclusive: (i) it is not easy, and such development will need to overcome several structural constraints arising from history and geography and requires a proactive policy stance accommodating state and market interests (Delgado, 2005; Jaffee & Morton, 1995); and (ii) smallholder producers should be vertically linked with the global value chain by incentivizing processing and marketing firms to include them in their growth strategies (Little & Watt 1994; Niewoudt & Grenewald (eds), 2003). Building on the existing consensus, this section uses the IFS framework to identify key factors that constitute the Governance and Institution segments of South Africa influencing the

¹²See Biowatch South Africa (BWSA) position paper on GMO on <http://www.biowatch.org.za>

¹³Many South Africans have been eating GM maize as their staple food for over a decade, a technology that has been approved for human consumption after undergoing regulatory approval in South Africa. Furthermore, this is the same technology that has been used and/or consumed in several other countries such as the USA, Canada, Argentina, and others.

¹⁴<http://www.ngopulse.org/organisation/biowatch-south-africa>

smallholder integration in the value chain to help with food security.

Land distribution and land tax

SA agriculture is polarized, with a well-developed commercial sector consisting of 32,000 commercial farmers who have political and economic capital occupying 80 percent of the agricultural land on the one side and the underdeveloped and underproductive small-scale farming sector supporting over a million households, utilizing rain-fed agriculture to cultivate 14 percent of the arable land (NDA, 2012)¹⁵ on the other hand. Redistribution of agricultural farmland is a government restitution program that aims to transfer ownership of 30% of commercial agricultural land to previously disadvantaged people by 2014. To ensure successful access to land, additional programs¹⁶ are being introduced. According to Edward Lahiff of the Programme for Land and Agrarian Studies (Report no. 30, published by University of the Western Cape) states that “the experience of South Africa, in particular, suggests that market-based approaches are incapable of effecting a large-scale redistribution of land or restructuring of the agrarian economy, and are likely to be met with growing popular opposition as the crisis of rural livelihoods grows and the limitations of ‘willing seller, willing buyer’ become apparent” (2007: ii). Others have suggested that smallholder farming became a means to access land under the revised Land Rights Act, which in turn allows farmers to rent or sell land (Philip & Hassen, 2008).

To improve land reform under the Local Government Municipal Property Rates, Act No 6 of 2004, a Local Government Municipal Property Rates Act is being proposed to discourage idle land or speculation in the land market, thereby speeding up the rate of land transfer. This has been a contentious topic for almost a decade, with no clarity. This has resulted in further difficulty, as poor people fear further costs, as is evident from Land Reform Minister Gugile Nkwinti’s speech, as he notes, “the government had brought about 6,000,000 hectares to date, of which nearly 2,000,000 hectares has been resold” (Editorial, 2011). In 2013, the Financial Times ran a report on South Africa’s land distribution, stating that, “with the country approaching the 20-year anniversary of the end of white minority rule, black and white farmers alike say the programme has failed to produce the desired results” (England, 2013).

¹⁵<http://www.nda.agric.za/docs/statsinfo/Ab2012.pdf>

¹⁶The Settlement and Land Acquisition Grant (SLAG) and Land Redistribution for Agriculture Development (LRAD). For a detailed analysis, see (Lyne & Darroch, 2003).

The idea for land redistribution was equality and integration of black farmers into the domestic commodity value chain, namely maize. This policy objective was based on the possibility that integrating more smallholder farmers into the agricultural production system, in turn as an outcome, redistribution will contribute to food affordability by increasing production. The proposed outcome contrasts to the dramatic food price rise that has taken place since 2008.

However, this logic may not apply in South Africa, where 94% of the smallholder are mainly producing GM maize and the existing evidence seems to show that in local markets smallholder producers often do not benefit from the global price hike because the local maize supply chain is not strongly linked with the domestic maize value chain, which is dominated by the large producers (FAO 2009). This is a public policy issue, and more research is needed, especially following statements by the Competition Commission which acknowledge that “The existence of the surplus may well result in lower-than-expected returns to farmers and financial difficulties for some. Ultimately, this may negatively affect the country’s productive capacity of maize in the long run” (Press Release, 2011)¹⁷.

Agri BEE and Governance

Another driver that seems to focus on smallholder integration into the value chain is targeted foreign aid in the agriculture sector. Several studies found that because of conservative farm planning models, based on unsubstantiated economic viability and entrenched antipathy, failed to ensure political and economic benefits to the black majority (and yet minority) in South Africa (Zimmerman 2000, Lahiff 2007). Since 2004, the country has attracted the national landmark lending initiative, which was institutionalized as the Black Economic Empowerment (BEE) Act in 2004 (Ponte, Roberts, & Sittert, 2007).

The Ministry of Agriculture and Land Affairs developed the provisions for BEE for the agriculture sector, known as Agri BEE. The critical objectives of the provision were to have 30% of commercial agriculture land being owned by black farmers, and an additional 20% being leased by black farmers by 2014. As of 2019, black people own 4% of the total of South African land (Africa Check, 2019). In addition, the provisions set a target of 10% of farmland being set aside for farm laborers’ production, along with sharing ownership stakes in all farm enterprises by 2008 and pushing to eliminate farmworkers’ illiteracy by 2010 (Hlengani, 2005). After a decade since the

¹⁷For a full report see <https://groups.google.com/forum/#!msg/cosatu-press/qzigg7RaUTc/v8pHDvM--11J>

provision was enacted, the BEE has been most successful in mining, fishing, and state-owned enterprises, where the government can impose regulatory power, and not in the agriculture sector (Ponte et al., 2007). Interestingly, the last census of agriculture indicated around 1,100,000 emerging and commercial farming enterprises (Purchase, 2013). In terms of black empowerment in the milling industry, two companies – FoodCorps and Premier Food have majority black shareholders (NDA, 2012a). The number of households engaged in agriculture was 2,3 million in 2016 (Community Survey, 2016).

However, the BEE is a major compliance matter for companies that wish to do business in South Africa. There are seven elements that any farm and agribusiness should comply with ownership management control, skills development, preferential procurement, employment equity, enterprise development, and socio-economic development practices (Cargill, 2010). The Agri BEE provision, which is a charter that was based on Section 12 of the BBEE act, basically says that compliance with the charter is not compulsory. There is no penalty, even in cases of non-compliance. The Ministry of Agriculture in 2012 converted the Agri BEE charter into the sector code¹⁸, which is based on Section 9 of the BBEE Act and is legally binding. The new Preferential Procurement Regulations, 2022, came into effect on 16 January 2023. The 2022 regulations are similar and repeat the wording found in the Preferential Procurement Policy Framework Act (PPPFA). With these new regulations, the B-BBEE Act is still applicable. However, a change that has been made with the 2022 Regulations is that “while under the 2017 Regulations, the 10 or 20 Preference Points could only be allocated based on the B-BBEE Contribution Level or score of the tenderer under the B-BBEE Codes, the 2022 Regulations require each organ of state to set the ‘specific goals’ for which points will be awarded in a preferential procurement policy and apply this to each tender”(BusinessTech,2022).

Problematically, the Parliamentary Monitoring Group (2019) found that the “Land Bank was not only ineffective in distributing the funding to apply to the Agri BEE programme it also put the overarching principles of the Agri BEE programme. Agri Bee was one of South Africa’s most important development finance institutions and had a pertinent role to play in the achievement of transformation and development of the agricultural sector. In 2019 Agri BEE was sitting with R251 million while poverty and income inequality were on the rise among large-scale farmers and smallholders. The Department reported that since 2012, 178 proposals had been received for consideration by the Department, and 18 had gone through the due diligence process of the Land Bank. The report published by the Parliamentary Monitoring Group stated that the Agricultural Department was not doing enough to market the Agri BEE programme, and that the Land Bank

needed to increase its reach into the deep rural areas. They said that “considering the urgent need for transformation, the fact that only 18 proposals had been accepted in the past eight years was unacceptable.” (PMG 2019).

With the sector code, the Ministry of Agriculture obtains the power to force business entities to comply with Agri BEE to get and retain access to public goods, like water, electricity, trade licensees, and other provisions controlled by the government (Sato, 2013). Following this, the sector received an improved scorecard, which applies to every entity, except exempted Micro Enterprises (EMEs) and Qualifying Small Enterprises (QSEs), in all provinces:

A survey¹⁹ conducted by AgriBiz, which is the agriculture business chamber, noted that it is very difficult to measure the BEE compliance of the agricultural sector, as so few enterprises have determined their score or obtained accredited scorecards. The reason for non-compliance seems to be that most enterprises falling under the Agri BEE sector codes are farmers and smaller enterprises and do not have adequate knowledge and incentives to participate in the BEE scheme (Agbiz, 2014). This could mean that despite the inclusive approach observed in the changing regulatory environment, smallholders’ reality has not changed, and innovative policy instruments are failing to address the underlying conditions that have been limiting the progress of black farmers and black enterprises in the agricultural value chain. More research is needed in this area of policy focused on overcoming the limiting conditions that black farmers face in South Africa.

Labor Policies and Domestic Trends

There is a paucity of reliable data on small-scale agriculture, and the labor force, who are also part-term farmers. Due to the lack of clarity on the meaning of terms such as “smallholder,” “farm laborer,” “emerging farmer,” and “small-scale farmer,” it also appears to be challenging to find reliable labor statistics to develop necessary structural changes (Aliber & Hall, 2012; Cousins, 2013). However, according to the Labour Force Survey (LFS) of Statistics South Africa (LFS, 2013-2022), there are about 4 million black individuals engaged in the agriculture sector, belonging to about one million households. According to the LFS data, 61% of black farmers are women and most of

¹⁸Government Gazette as Gazette Number 36035 (Notice 1065 of 2012)

¹⁹The survey was relatively small. A total of 21 agribusinesses responded to the survey, of which 5 were below R1 billion turnover (the smallest with R25 million turnover), 9 were between R1 billion and R4 billion turnover and the remaining 7 over R4 billion turnover. For the purpose of analyzing differences, the smaller 5 were labeled as category 1, the middle group as Category 2, and the largest agribusinesses as Category 3.

the women farmers are subsistence farmers. Therefore, it is estimated that the remaining 39% of farmers engaged in commercial farming are men (Cousins, 2013). Commercial farming is mainly done by men, and about one-third of them are emerging black farmers who are between 20 to 48 years old (ibid). A large proportion of this productive labor force is affected by HIV/AIDS, causing loss of agricultural productivity, high labor turnover rates, and high production costs. Commercial farms are adversely affected by the deaths and ill-health of workers, which is subsequently felt in the SA agricultural value chain (Ortmann, 2005).

It appears that because genetically modified crops are less labor-demanding, the technology is conducive to the labor market trend observed in South Africa. Moreover, with the Agri BEE in place, agribusinesses are prioritizing skill-development opportunities and new job creation for the underprivileged black population, mainly by introducing and influencing them to adopt modern technologies such as GM. Many SA commercial farmers are serving as mentors for emerging farmers. As mentioned already, commercial farmers are proponents of GM technology, they are undertaking innovative solutions to ensure labor productivity and maximize crop production by establishing farmworker equity-sharing schemes. This is a scheme where the financial equity is shared between the previous landowner and his/her farmworkers. The objective of such a scheme is to create a strong backward supply chain of maize and connect with the global value chain that is well-established by the commercial farmers. To what extent such institutional innovation will have a considerable impact on the GVC and transaction costs to internalize the policy chain needs to be observed.

Analysis of Systems of Influence Through Local Political Economy

A full study within the locality is needed to fully describe the local context. Here we are using available information to provide some initial indications of the type of analysis to be done in a full-blown study by linking a small section of localized smallholders in the value chain which is a part of the GVC strengthening strategy. This implies obtaining a clear understanding of the different socioeconomic and political conditions which differ from one locality to another.

For example, within the maize value chain, the context in which Eastern Cape Province maize producers operate is likely to be different than the Northern Cape Province farmers. Therefore, it is important to identify the key variables that influence local production, value creation and distribution conditions, and localized transaction costs. These are known as backward linkages in the global value chain literature. Backward linkage approaches transfer positive spillover effects to the respective local

communities within which a sector is concentrated. This allows the restructuring of dysfunctional segments of the value chain. Backward linkage also allows for localized governance system development, as opposed to using national regulations alone, to capture more benefits from the market by local sectors.

For preliminary review purposes, we will focus on the Eastern Cape to identify the key constraints that challenge scaling up value chain activities to link smallholders producing GM maize with the global value chain. In terms of its relative position within the national economy, the Eastern Cape is home to 11.5% of South Africa's population, but accounts for only 7.6% of its GDP (South Africa Gateway, 2016) It is characterized as one of the poorest smallholder agricultural zones occupied by the black African population. In terms of geographical conditions, it is dry and arid, projected to become dryer in the next 10 to 20 years (Johnston, Hachigonta, Sibanda, & Thomas, 2012). Concomitantly, widespread poverty and a high Gini coefficient, which was higher by 0.02 points than the national Gini coefficient of 0.67 in 2010 have not changed over the last decade and the projects are rather grim (ECSECC, 2011). According to the latest data available from the World Bank analysis of the Gini coefficient in 2014, South Africa has the world's highest Gini coefficient, 63.0. Likewise, the human development index for the Eastern Cape region is 0.51 and shows a depressing trend over the past five years, largely because of low life expectancy resulting from HIV/Aids, which is weakening the productive labor force, subsequently minimizing the local economic productivity (ECSECC, 2011). Also, unchanged in the recent available macroeconomic database maintained by the World Bank.

Climate change and local crop productivity

The Eastern Cape is one of the disadvantaged provinces of South Africa. Climate change variability has a considerable impact on the agricultural system there, which is primarily rain-fed. The CSIRO model predicts that annual rainfall will decrease by about 100 mm in much of the Eastern Cape. Similarly, the MIROC model predicts that the entire country will experience a decline in rainfall by about 100mm. In either case, there will be a shortage of rainfall in the Eastern Cape. A study was conducted by an IFPRI team on climate change's impact on food and agriculture in South Africa using the IMPACT global model²⁰. Using three types of GDP-per-capita scenarios, the model found that at first

²⁰IMPACT global model for food and agriculture estimates the impact of future GDP and population scenarios on crop production and staple consumption, which can be used to derive commodity prices, agricultural trade patterns, food prices, calories consumption and child malnutrition. Three GDP-per-capita scenarios were used to derive different alternatives. They are an optimistic, pessimistic, and baseline scenario.

total maize yield will rise, but the gains will be offset by loss in area after 2035, and by 2050, the level of maize production will be around the same level as 2010. In other words, maize-exporting South Africa will become a net importer by 2050 (Johnston et al., 2012). However, South Africa will struggle to sell maize in Africa after increased rainfall boosted crops in Malawi and Zambia which have lifted export bans on their non-genetically modified (GM) crops that are preferred on the continent (Reuters, 2017).

Decision Support System for Agrotechnology Transfer (DSSAT) crop modeling software, projecting the impact of rainfall change on maize yield for 2050, using 2000 climate change data as the baseline. The most significant change is noticeable in the current maize-producing areas, while some colder areas in the Northwest province, including the Eastern Cape, will warm up and produce less maize (Nelson, Rosegrant, et al 2010). This may shift the production location and may introduce new types of vulnerabilities in the crop-loss regions. Smallholder farmers in these locations are most vulnerable. This may then further exacerbate the economic and ecological sensitivity faced by the smallholders. Adding to this, the relatively undeveloped Eastern Cape province's water catchment system would add further challenges to the overall local agricultural system (Blignaut, Heckerman, & Aronson, 2009). Additionally, most rural residents in the Eastern Cape still access water from dams, rivers, and streams for domestic and agricultural purposes (Apraku, 2023). Such pre-existing context often missed the evidence-based policy design processes in the country. How big are these challenges, who will be most affected, and what could policymakers do to facilitate adaptation? Providing answers to these questions is not the task of this report but the idea is to introduce the IFS framework that could help in examining a wider range of linkages—economic, demographic, and climate—than has previously been analyzed.

Transportation and Connectivity

Transportation is a critical feature of making trade work. Also, the cost of transportation of a commodity dictates the transaction costs. The maize price in the exchange market includes transportation costs and estimates the change in the Rand/Exchange plus the price of fuels. The pricing structures are complex within some of the levels of the value chain, and this is partially because of the high transaction cost of transporting maize (Rakhudu, 2006). For example, it is easier for traders to import maize from Argentina than collect it from the Eastern Cape. Transnet Freight Rail, formally known as Spoornet, has a monopoly over the rail transportation system and controls commodity transport tariffs, which typically do not favor the agriculture sector (Rakhudu, 2006). In 2013, Transnet decided to increase tariffs on the mining sector, arguing that it would allow

them to offset the cost of favoring the agriculture sector and facilitating more domestic food and grain distribution. However, to what extent this is truly going to make a difference remains to be seen. As the map below will reveal, rail connection is non-existent in the region. There will be limited benefits to this policy transferable to the local maize farmers in the Eastern Cape Province.

Moreover, despite being a coastal province and having an active port like Port Elizabeth harbor, the value of export maize has dropped significantly over the last decade. A part of it can be attributed to the change of focus of the port. Since 2006, the port has increasingly been used to handle imports and exports of vehicle parts which displaced the agricultural products transfer from the harbor over time. Limitations to export further caused declines in relevant incentives distribution and maize production dropped to at about 1% of the total South African maize production. Whereas in other provinces maize prices saw some positive trends, in the Eastern Cape, market prices are consistently downward trending (NDA, 2012a). There needs to be more research to understand what factors are causing the decline of local maize prices. A study finds that institutional innovations like AsgiSA are little known by the smallholders (Aliber & Hall, 2012). AsgiSA Eastern Cape is a government initiative that assists smallholders in storing and marketing crops (Mtero, 2012). It connects milling plants to community-owned silos for processing local maize for the local market. This is a step forward for the region but not a complete solution to link smallholders producing surpluses in the Eastern Cape with the global market. It is because there is little information available about small-scale silos that are dotted all over the region. While it is known that they are directly connected with the smallholders to transport their crops for procurement, it is unknown how prices are set and at what margins. To target smallholder maize farmers in rural areas with any policy instruments, more clarity is needed on the number, nature, and practice of the local agents as they are the conductors of backward and forward linkages in the local value chain.

Labor costs and productivity

Agriculture is the most important source of output in the primary sector, accounting for over two-thirds in 2002. Looking at the census, it appears that the sector's importance has not changed in 2012 (NDA 2012). The Eastern Cape has the highest level of poverty and inequality among South Africa's 9 provinces and has one of the highest unemployment rates (52.8% in 2020) compared to the national average of 42%, in terms of broad definition. Even though agriculture is the major sector of employment, the income earned from the sector is 60% to 80% lower than the wages received in other sectors. Households need multiple sources of income. Along with agriculture, farm laborer's

informal income (domestic work and construction) and pension are key sources of income. Moreover, more than two-thirds (69%) of the employed have less than a grade 12 education (EEPR, 2004). As a result, the labor market suffers from both seasonal shortages of labor and skilled labor to modernize the farming system. Subsequently, staple foods were scarce, including maize, in most households during the August to February period.

Moreover, labor availability and productivity are also harmed by the HIV/AIDS epidemic in the Eastern Cape. Although HIV prevalence among adults in the Eastern Cape is among the lowest of the 9 provinces, the impact is severe, as those aged 15–49 years constitute most of the economically active population and the core of the Eastern Cape economy (EEPR, 2004). Losses of adult agricultural labor and the increased losses of urban remittances to rural households further exacerbate poverty and limit future growth (FAO, 2000). To scale up smallholders, the Eastern Cape region needs to consider such cultural and structural problems and productivity issues.

While cultural and structural problems are long-term issues, in the short-term GM maize crops tend to save labor in the production system. Research shows that Bt maize has an output advantage that declines as pest pressure decreases and that net returns to Bt maize are often higher, although they do not always outweigh the higher cost of Bt seed (Gouse et al. 2009, 2012). Also, some studies found that Bt maize leads to a reduction in the use of insecticides and minimizes plant exposure to fumonisin, a toxin associated with esophageal cancer and birth defects in humans and that is potentially fatal to livestock (Piesse & Thirtle 2008; Pray et al. 2009). Moreover, with the spread of no-till practices, Herbicide-tolerant Roundup Ready® (RR) maize, appears to increase output while reducing labor demand (Gouse et al. 2006; Piesse & Thirtle 2008), and thus offer higher gross margins despite higher seed costs in most regions (Gouse et al. 2009). A combination of benefits that GM technology offers has the potential to reduce smallholder net returns risk (Regier et al. 2012, Gouse 2012). Considering the optimism in the studies available, it is a puzzle why smallholder farmers are not seeing the benefits and the returns that are promoted. An alternative research framework is needed to combine multiple threads of opportunities and challenges that are faced by smallholders. The IFS framework, which is a combination framework, might offer an integrated approach that could help researchers and policymakers to contextualize overlapping factors and develop better conditions for the smallholders.

Conclusion and Recommendations

The political, economic, and socio-cultural analysis presented in this paper over the past decade highlights

significant challenges in South Africa's integration of genetically modified (GM) crops to support smallholders. Despite the potential of GM crops to enhance food security, increase productivity, and integrate smallholders into the maize value chain, the reality remains starkly different. The gap between smallholders and commercial farmers persists, income inequality continues to grow, and debates over the adoption of GM crops are far from resolved. The case study of South Africa reveals that GM crop production has not successfully alleviated the challenges faced by predominantly black smallholders. Although GM maize could have played a critical role in addressing food insecurity and boosting productivity, the benefits have largely been confined to large commercial farms. Smallholders, on the other hand, remain marginalized, struggling to move beyond subsistence farming. This failure can be attributed to the inadequacy of reforms and policies aimed at supporting smallholders, including land redistribution, education, and infrastructure improvements. These initiatives, though well-intentioned, have not fully achieved their goals.

The liberalization of the agricultural market in 1995, which allowed large commercial farmers to dominate the Maize Board, further exacerbated the inequalities faced by smallholders. The discriminatory practices that ensued led to reduced agricultural productivity among black smallholders, leaving them unable to compete. Despite several policies and institutional efforts to create shared prosperity between smallholders and commercial farmers, long-term improvements have been elusive. The analysis of the global value chain of maize highlights how smallholders have been disadvantaged in accessing the benefits of modern technology, such as GM crops. Institutional innovations aimed at empowering smallholders have often fallen short due to a lack of adequate education and market access. High input costs, including seeds, fertilizers, and machinery, have made it difficult for smallholders to adopt GM crops, while additional factors like climate variability, labor shortages, water crises, and weak infrastructure have further hindered their progress. The geopolitical context also plays a significant role in shaping the adoption of GM crops in South Africa. Global trade policies, foreign direct investment, and perceptions related to GM crops influence whether smallholders can effectively participate in the global and national value chains. Small-scale farmers are often excluded from market participation until they acquire the necessary knowledge, resources, and capacity, leaving them vulnerable to market volatility and unfavorable global prices.

Furthermore, the introduction of GM maize has sparked ongoing debates. While opposition to GM crops remains relatively weak, concerns persist about the control of the South African food-crop-seed chain by foreign corporations and the potential threat to crop diversity. These issues,

coupled with fears of rejection by European markets, add complexity to the adoption of GM crops. In conclusion, this paper underscores the need for a multidimensional approach to policy-making that addresses the structural and institutional barriers hindering smallholders. To bridge the gap between smallholders and commercial farmers, targeted policies must focus on improving access to education, infrastructure, and markets. Additionally, addressing land restitution, reducing input costs, and enhancing smallholders' resilience to climate change and market fluctuations are critical to ensuring that the benefits of GM crops and other modern technologies are equitably distributed across the agricultural sector. Without such comprehensive efforts, the disparities in South Africa's agricultural landscape are likely to persist, leaving smallholders marginalized and the promise of GM crops unfulfilled.

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