Development and Opportunities in the Maize Sector in Eastern and Southern Africa

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By

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Dedicated to my dearest daughter Aadya

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PREFACE

Maize is the main staple crop in sub-Saharan Africa (SSA) and hence, the continent's food security crucially hinges on the crop's growth in production. Considering the importance of maize for the economies in sub-Saharan Africa, several national governments have subsidized agricultural inputs. Ever since the subsidies came into play, the debate on their effectiveness refuses to die and even the research findings on the subject are far from conclusive. There are also recent studies that have raised concerns about the stagnation in maize production in several African countries, Kenya being a particular case.

Given this backdrop, this book is an attempt to synthesize the production scenarios of maize over the years, the outlook of its production, and the investment opportunities in maize in eastern and southern Africa involving four countries (Kenya, Ethiopia, Malawi and Zimbabwe). It fills a major research gap as it synthesizes a large amount of data and literature and provides insightful conclusions. The specific objectives of the study are to: (i) establish the current maize situation in terms of production and consumption during 2005-15, (ii) predict the outlook for maize in the medium and longer-term perspectives, and (iii) determine the investment opportunities for research and development (R&D priorities for public and private sector R&D), in terms of technological, economic, social/equity and environmental considerations. The study has considered all dimensions of maize production and consumption in the countries such as geographical zone, agro-ecological regions, farming sectors, and the rural and urban populations, among others. Perusal of the existing literature revealed gaps in information that were filled through secondary data collection and key informant interviews.

By analysing long time series data on agricultural production, trade, and investment, the book offers insightful recommendations for the sub-Saharan African region. The timing of the book could not have been more apt given that maize production in the region is experiencing myriad challenges including increased costs of production, low market prices, decline in household's cultivatable land due to increase in human population, prevalence of poor government policies along the entire production to marketing chain, and crop pests and diseases. Climate change has

exacerbated these challenges and made the agricultural reliant rural communities in SSA vulnerable to poverty. To adapt to climate change effects in agricultural sector, climate-smart agricultural practices (CSA) has been proposed by the scientific community as a possible solution. Several studies have examined the suitability and profitability of the CSA practices in SSA countries. This book also touches upon briefly the opportunities and constraints of CSA in the studied countries.

Pradyot Ranjan Jena

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ABBREVIATIONS AND ACRONYMS

ADD	The Agricultural Development Division
ADMARC	Agricultural Development and Marketing Corporation
AFC	Agricultural Finance Corporation
AGRITEX	Technical and Extension Services (Department of MAMID)
AISE	Agricultural Input Supply Enterprise
ARDA	Agricultural and Rural Development Authority
ASPEF	Agricultural Sector Productive Enhancement Facility
ATCC	Agricultural Technology Clearing Committee
BAU	business-as-usual
BFAP	Bureau for Food and Agricultural Policy
CAN	Calcium ammonium nitrate
CIMMYT	International Maize and Wheat Improvement Center
COMESA	Common Market for Eastern and Southern Africa
CSA	Central Statistical Authority
DAES	Department of Agricultural Extension Services
DAESS	District Agricultural Extension Services System
DAP	Di-ammonium Phosphate
DARS	The Department of Agricultural Research Services
DDF	District Development Fund
DFID	The Department for International Development
DIVA	Diffusion of Improved Varieties in Africa Project
DRSS	Department of Research and Specialist Services
DTMA	Drought Tolerant Maize for Africa
EAC	Kenya's Extra East African Community
EARS	The Ethiopian Agricultural Research System
EGTE	Ethiopian Grain Trade Enterprise
EIAR	Ethiopian Institute of Agricultural Research
EPWG	Economic Policy Working Group
EPZA	Export Processing Zone Authority
ESAP	Economic Structural Adjustment Programme
ESC	Ethiopian Seed Corporation
ESE	Ethiopian Seed Enterprise
FAO	Food and Agricultural Organization
FEWSNet	Famine Early Warning Systems Network
FISP	Farm Input Subsidy Programme

GDP	Gross Domestic Product
GIS	Government Input Scheme
GMB	The Grain Marketing Board
GMO	Genetically modified organism
GoE	Government of Ethiopia
GOM	Government of Malawi
Ha	Hectare
HIV	Human Immunodeficiency Virus
HLIs	Higher Learning Institutions
IAR	Institute of Agricultural Research
IECAMA	Imperial Ethiopian College of Agriculture and Mechanical Arts
IFPRI	International Food Policy Research Institute
JAICAF	Japan Association for International Collaboration of Agriculture and Forestry
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspectorate Society
Kg	Kilogramme
Km	Kilometre
KFA	Kenya Farmers' Association
KNBS	Kenya National Bureau of Statistics
KSC	Kenya Seed Company
LSC	Land Soil and Crop
MLN	Maize lethal necrosis
MoA	Ministry of Agriculture
MoAFS	Ministry of Agriculture and Food Security
MOAMID	Ministry of Agriculture Mechanization and Irrigation Development
MAMID	Ministry of Agriculture Mechanization and Irrigation Development
MoARD	Ministry of Agriculture and Rural Development
MoTI	Ministry of Trade and Industry
Mt	Metric tonne
MRFC	Malawi Rural Finance Company
NARS	National Agricultural Research System
NCPB	National Cereals and Produce Board
NGO	Non-Governmental Organization
NPK	Nitrogen (N), Phosphorus (P) And Potassium (K)
NR	Natural Region
NRZ	National Railways of Zimbabwe
NSCM	National Seed Company of Malawi

NSO	National Statistics Office
OPV	open-pollinated variety
OR	Old Resettlement
PADETES	Participatory demonstration and training extension system
PHL	Post-Harvest Losses
PRP	Protracted Relief Program
PSF	Productive Sector Facility
RARIs	Regional Agricultural Research Institutes
CRATES	Center for Regional Agricultural Trade Expansion Support
SACA	Smallholder Agricultural Credit Administration
SADC	Southern African Development Community
SARI	South Agricultural Research Institute
SG2000	Sasakawa Global
SAP	Structural Adjustment Programme
SEEDCO	Seed company
SFFRFM	Smallholder Farmers Fertilizer Revolving Fund of Malawi
SIMLESA	Sustainable Intensification of Maize - Legume in Eastern and Southern Africa Project
SNNP	Southern Nations, Nationalities, and People's Region
SNNPR	Southern Nations and Nationalities People's Region
SSA	Sub-Saharan Africa
STAM	Seed Traders Association of Malawi
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TEGEMEO	TEGEMEO Institute of Agricultural Policy Development
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
US$	United States Dollar
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VOCA	Volunteers in Overseas Cooperative Assistance
WRS	Warehouse Receipt System
WFP	World Food Program
ZAIP	Zimbabwe Agriculture Investment Plan
ZIM-STAT	The Zimbabwe National Statistics Agency

CHAPTER 1

INTRODUCTION

1.1 Significance of Agriculture to Sub-Saharan African Economy

The population in sub-Saharan Africa (SSA) is rising fast. The global population is expected to grow by 50% by 2050 compared to its present level. For food production to maintain pace with population expansion, there must be a significant rise in the output of food (Gregory and George 2011; Godfray et al. 2010; Tilman et al. 2002). Another concerning issue is that malnutrition is increasing in SSA (Food and Agricultural Organization (FAO) 2014; FAO 2009). Agriculture is the driver of both eastern and southern Africa's regional economies. Agriculture contributes over 40% to the GDP except for Zimbabwe, where it is 18%. Further, agriculture employs a majority of the population, which is above 70% (International Food Policy Research Institute (IFPRI) 2012; Kenya National Bureau of Statistics (KNBS) 2013; Government of Malawi (GoM) 2002; Rukuni et al. 2006; Chibwana et al. 2010; Cromwell and Kyegombe 2005; Ministry of Agriculture Mechanization and Irrigation Development (MAMID) 2010).

Agriculture has risen to become a major concern in Africa's development agenda during the last decade. Despite the fact that there is some fresh potential for large-scale farming on the continent, particularly in the land-rich countries of the continent (Deininger and Byerlee 2012), a major role for smallholder farming systems in agricultural growth in Africa will be to ensure that the continent's food security is met (Birner and Resnick 2010; Davis et al. 2017; World Bank 2007). Farms in Sub-Saharan Africa typically operate under two hectares in size, with almost 70% of them being smaller (Deininger and Byerlee 2011: xxviii) and often they do not achieve more than 25% of their projected returns (Deininger and Byerlee 2011: xxxviii). During 2005-15, significant efforts have been made to narrow the yield gap, but it is becoming clearer that improving labour productivity in African agriculture is equally critical to alleviating poverty (Diao et al. 2018).

There is little debate on the importance of agriculture in reducing poverty in Sub-Saharan Africa on historical, theoretical and empirical grounds. A large-scale reduction in poverty is unlikely in the absence of agricultural growth as more than two-thirds of the labour force in most African countries (sometimes up to 70%) is employed in agriculture and the importance of contributions of agricultural production to the consumption baskets of the poor are important. In Africa's agricultural sector, where smallholders make for the vast majority of the farming population, one of the most difficult challenges—and, perhaps unsurprisingly, a subject of dispute—is how to change the sector. Agricultural transformation necessitates not just the growth of unconventional (and often export-oriented) agriculture but also the transformation of traditional agriculture, where farmers have produced the same goods for centuries. The proliferation of success stories involving non-traditional and export-oriented agriculture in African nations (Reardon et al. 2009) is encouraging, but the scaling up and replication of these stories to include conventional smallholder domestic-oriented agriculture continue to be a problem.

It is the relationship between agricultural development and economic expansion that is at the heart of the argument. Albert Hirschman developed the idea of links, demonstrating that investment in a number of contemporary industrial areas may lead to entire economies emerging via retro- and reverse connections between upstream and downstream businesses (Hirschman 1958). Because agriculture was considered to be a traditional industry at the time, it was believed that contemporary industries would be required to provide the essential economic drivers. As a result of its dependence on a limited number of modern inputs provided by non-agricultural businesses, one would expect subsistence agriculture to have few connections to the rest of the economy.

In the late 1960s and 1970s, however, Asia's green revolution overlooked agriculture as a conventional industry with a passive role in development. It showed the possibility for agricultural change via the application of scientific-based technology adapted to the environmental needs of a given nation. Agricultural development is highlighted by the ‘induced innovation model’ advocated by Hayami and Ruttan (1985), which emphasizes both the significance of technological change for agricultural expansion and the fact that technical change is frequently endogenous to a country's economic structure. Growing agricultural production necessitates assistance for the connections between the agricultural and non-agricultural sectors, as the green revolution and the induced innovation model are shown. Johnston and

Mellor (1961) made history by bringing the idea of consumer connections into the wider economy, which includes agriculture as a significant component.

The major points of difference between agricultural optimists and pessimists are mostly based on their different views on the transformation of smallholder agriculture. Using historical literature as a starting point, Barrett et al. (2010) examined the role of agriculture in development and concluded that the views of the 1960s are still valid today. For nations with large interior populations and limited access to foreign markets, Gollin (2010) demonstrated that agricultural expansion is important for economic growth since the significance of agriculture-led growth is dependent on the feasibility and expense of importing food. Dercon (2009) claimed that agriculture is critical to the development of African economies in landlocked and resource-poor nations but that agriculture is not important in resource-rich, coastal or well-located countries. As De Janvry (2010) pointed out, developing nations incurred enormous expenses in the 1980s and 1990s as a result of their neglect of agriculture. He also drew a connection between increased focus on agriculture and the current economic, social and environmental problems. In his view, the role of agriculture in development should be rethought since its functions are now many, and the settings in which it is implemented have changed significantly. In spite of the fact that a new paradigm of agriculture for development is still in its early stages, the effective application of this paradigm in Africa is essential and urgent. The availability and utilization of agricultural technology, including better varieties and fertilizers, to enhance food production continue to emphasize agricultural policy in these nations (Jena et al. 2021; Jena and Odendo 2014).

1.2 Maize Production in Eastern and Southern Africa

Within agriculture, maize is the most important cereal crop in all the countries of SSA, both in terms of the level of production and area coverage (Richardson 2007; Central Statistical Authority (CSA) 2012; World Bank 2013). Also, maize provides the greatest per capita consumption among all the cereals, contributing significantly to food security.

Maize is grown by over 90% of the farmers in the region, although productivity varies widely amongst these farmers. Over time, maize production has been shifting from larger operations to small-scale cultivation due to a decline in landholdings and increased input costs. Except for use as raw grain, maize is processed into maize meal or used to produce a number of different goods and by-products, such as flour and oil,

as well as animal feed for cattle and sheep (United States Agency for International Development (USAID) 2012; Rosegrant et al. 2007). The average annual per capita consumption of maize and maize products in the area is now more than 120 kg (Kapuya et al. 2010; Kirimi et al. 2011).

Many advances have been made in research and have led to the development of improved hybrid varieties that are high-yielding and drought-tolerant. However, farmers have not been able to realize the full potential of the sector. These could be attributed to low fertilizer adoption (Jena et al. 2021) as well as other technologies due to either lack of information or inadequate funds to purchase the inputs or adopt the new technologies that, in most cases, are costly.

In developing countries, several challenges to maize production have been identified. These include inadequate funds to purchase inputs, lack of favourable government policies, political instability, climate change, low technological adoption, poor marketing systems and issues relating to land tenure systems.

1.3 Scope and the Objectives of the Book

Although maize is an important crop in the eastern and southern African regions, not many studies cover the different aspects of the maize value chain comprehensively. However, this information is required for understanding the status of and identifying the investment opportunities in the maize sub-sector. A regional evaluation of maize production, outlook and investment possibilities in eastern and southern Africa has been used to pen this publication. The countries involved are Kenya, Ethiopia, Malawi and Zimbabwe. The regional project aimed at collecting data that will assist in generating information on the maize situation, outlook and investment opportunities. The information was documented in order to be used as a guide/tool for research intervention and policy choices that meet the target requirements for technological development.

The study is expected to inform all maize stakeholders on the current status of maize production and trends, markets, available opportunities for investment along the maize value chain (e.g., seed, green maize, food and feed industries). Constraints relating to maize production and markets will be analysed in terms of opportunities and trade-offs and their effects. The book contributes to the agricultural policy planning in SSA by providing a clear statement and understanding of conditions under which maize is produced, traded and consumed in eastern and southern Africa.

The following are the particular goals of the research that have been documented:

(i) To establish the current maize situation in terms of production and consumption at present and during 2005-15.
(ii) To predict the outlook for maize in the medium and longer-term perspectives.
(iii) To determine the investment opportunities for research and development (R&D priorities for public and private sector R&D), in terms of technological, economic, social/equity and environmental considerations.

1.4 Organization of the Book

The remainder of the book is arranged in the following ways. The concept and methods of the research are discussed in detail in Chapter 2. Maize production trends are presented in Chapter 3, with emphasis on current maize production and the importance of maize in SSA. Chapter 4 describes maize inputs use and research and development. Maize output value chains and consumption are presented in Chapter 5. Chapter 6 provides the forecasts of the future maize production in the four SSA countries. Chapter 7 presents investment opportunities as well as the conclusion and policy recommendations.

CHAPTER 2

FRAMEWORK AND METHOD

Among the four countries studied, Zimbabwe and Malawi have been chosen to represent the southern African sub-region while Kenya and Ethiopia represent the eastern African sub-region. Outcomes from these country case studies are combined to provide a bigger picture detailing the maize situation, outlook and investment opportunities in the eastern and southern African region. The study considers numerous dimensions of maize production and consumption in the countries such as geographical zones, agro-ecological regions, farming sectors, and the rural and urban populations, among others. Analysis of both secondary and primary data as well as the review of literature is the main research approach used in the study and it involves research on grey literature (policy documents, newspaper articles, periodic reports, unpublished research outputs) and published peer-reviewed literature (journal articles, working papers, discussion papers and books). The perusal of literature enabled the identification of gaps and suggested the methodology for the study. Primary data was collected through structured and key informant interviews to complement the existing secondary data. This study focuses on the key areas of maize production and consumption such as the geographical distribution of maize farming in eastern and southern Africa, technology use, and the maize value chain among others.

A broad range of issues including the inventory of improved maize technologies, maize technology adoption, and analysis of the adoption decision behaviour of maize farmers are considered in the assessment. The future outlook of maize production and consumption considers projections for the period from 2015 and 2030, based on the data obtained for each case, over the years from 1980 to 2015. Furthermore, the assessment considers maize input/output supply and demand, analysis of major maize-related constraints, and investment opportunities.

2.1 Methodology of the Study

2.1.1 Ethiopia

Primary and secondary data were utilized in the research, which was gathered from a variety of sources. Primary data was generated from previous baseline surveys, focus group discussions with key informants and communities in major maize growing areas. Secondary data was collected from various governmental and non-governmental sources. However, the data from the Ethiopian Central Statistical Authority (CSA) was the basis for estimating maize area and production. In Ethiopia, CSA collects data throughout the country using a network of 25 branch offices, 2290 enumeration areas, and about 3000 enumerators and field supervisors. Although similar data sets could be obtained from other sources such as line ministries of the Government of Ethiopia (GoE), the United States Department of Agriculture (USDA), and the Food and Agricultural Organization (FAO), most official studies in the country depend on the official data from the CSA.

The data was analysed and synthesized using a variety of statistical techniques. Descriptive statistics were largely used to summarize and present maize facts and figures while graphs were employed to project trends related to maize production and consumption. A regression analysis (exponential function) employed to project future development of the maize sub-sector as defined below:

$$y = a \times e^{bx}$$

Where, **x** is the value of the independent variable (in this case, the year),
y is the value of the dependent variable (in this case, maize production and consumption), and
e (approximately 2.7182) is the base of natural logarithms.

The analysis of the future maize outlook considered three scenarios. The first scenario (also referred to as the base scenario) considers historical trends of production and maize area based on historical average growth rates, adoption rates and average productivity levels. The second scenario assumes a progressive improvement in the share of maize area under improved varieties due to intensified efforts in scaling up of proven

improved maize technologies. The third scenario, on the other hand, combines both increased adoption (higher share of maize area under improved maize technologies) and improvements in productivity of the crop.

2.1.2 Kenya

The main sources of information used for the Kenya case study are the household survey and the secondary sources. The secondary sources included the literature reviews which were used to develop the background information on the maize sector as well as the methodology for the study on the maize situation, outlook and investment opportunities in Kenya. The literature used for this purpose includes the annual reports of the Ministry of Agriculture, theses, peer-reviewed journal articles, working papers, and books. This exercise has helped in compiling a comprehensive maize sector literature review for Kenya. The main sources of information in this study included the following reports:

1. Kenya National Bureau of Statistics (KNBS): economic surveys
2. Ministry of Agriculture (Crop Division)
3. CountrySTAT Kenya
4. TEGEMEO Institute: panel data and household surveys
5. United States Agency for International Development (USAID) and World Bank: annual reports

Maize production from 2013 to 2030 was projected using the linear model as follows:

A linear growth model was assumed where $Mt_{+1} = M_t\ (1+n)$, M_{t+1} = Maize output in year t+1, M_t = Maize output in year t, and n is the growth rate in maize output. In this case, the assumptions made included:

- The area of production remains constant, climatic conditions also remain constant.
- The current use of improved seed is maintained.
- Maize supply response to the coefficient of fertilizer use of 0.37.

Having that in mind, four fertilizer scenarios were assumed. The first scenario was if the current adoption rates of inorganic fertilizers were maintained; second was if the adoption of the fertilizers increased by 10%; the third was if the fertilizer adoption rates increased by 20%; and lastly, if the adoption dipped by 20%.

2.1.3 Zimbabwe

The literature review was the first step in developing the background and foundation for this study and it assisted in identifying existing relevant evidence, knowledge gaps and developing research methodology for further inquiry on maize situation, outlook and investment opportunities in Zimbabwe. The main research methods used were literature review, secondary data and primary data. Unpublished reports, working papers, journal articles, discussion papers, books, theses and consultancy reports were reviewed from various sources to develop a comprehensive maize sector literature review for Zimbabwe. This study derived a lot of knowledge from recent and abundant literature sources on the maize sector in Zimbabwe such as relevant ministries and departments; academic institutions; research institutions such as CIMMYT, agencies of the United Nations such as Food and Agriculture Organization (FAO), World Bank and World Food Programme (WFP); international donor agencies such as United States Agency for International Development (USAID); various developmental and non-governmental organizations. The main documents reviewed in this literature were:

- Ministry of Agriculture Mechanization and Irrigation Development reports (various years).
- *Zimbabwe Agricultural Revolution Revisited*, edited by Rukuni et al. (2006). Published by the University of Zimbabwe.
- International Maize and Wheat Improvement Center (CIMMYT) research outputs on technology adoption in Zimbabwe.
- USAID research outputs over the years on the maize sector.
- *FAO/WFP Crop and Food Security Assessment Mission to Zimbabwe Report* by FAO/WFP (2010). Published by Food and Agriculture Organization of the United Nations and World Food Programme.
- *Zimbabwe: Agricultural Sector Assessment Study, Final Report* by Zimbabwe Multi-Donor Trust Fund (World Bank 2010).

The literature review provided an overview of the Zimbabwean economy, agricultural sector and overview of Zimbabwe's maize sector. Details of the maize sector obtained from the literature included the context of the maize sector in Zimbabwe, its value chain, the economics of production, government and donor-supported developmental programmes supporting the provision of basic inputs to farmers, among others. This provided important background information about the sector in Zimbabwe on which further inquiry was based. The literature review ends by deriving insights from the

presented literature, identifying gaps in maize research addressed in this study such as maize technology use, research and development, demand, future outlook and investment opportunities. The contributions from this study were derived through secondary information and primary data collected after the literature review.

To project the future outlook in maize production, four scenarios were envisaged: a business-as-usual (BAU) situation (Scenario 1), an improved macro-economic situation in which fertilizer use will increase by 20% (Scenario 2), a much better macro-economic situation in which fertilizer use will increase by 50% (Scenario 3) and lastly, a worse off scenario in which the macro-economic situation becomes worse and fertilizer use decreases by 20% (Scenario 4).

In this study, the outlook of maize consumption was based on population. Using the trends in population increase over the past decade as given by ZIM-STAT, the population was found to be increasing by 1.1% while statistics on maize consumption revealed an average annual increase of 1.6%. Using a linear growth model, consumption is simulated based on two anticipated scenarios. The first scenario (Scenario A) is a situation where the current population growth rate of 1.1% is maintained and the second (Scenario B) is with an increased population growth of 5%.

2.1.4 Malawi

The study was conducted based on an examination of existing literature—both published and unpublished materials—as well as secondary data obtained from national crop estimates statistics provided by the Ministry of Agriculture and Food Security (MoAFS), the Ministry of Trade and Industry (MoTI), and the National Statistics Office (NSO). In the secondary dataset, there included aggregate information on national production, export and import quantities of maize as well as input supply and national maize price patterns across time. Field observations and discussions with a variety of stakeholders contributed to the improvement of the literature review.

Data analysis employed a diversity of statistical approaches to analyse historical trends over the years and to estimate the growth rates over time. Historical trends of maize production, consumption, imports and exports were analysed using descriptive approaches.

The projection of future outlooks for maize was done for both production and consumption. The projections were done in three scenarios with