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THE NEW HARVEST

Agricultural Innovation in Africa

Calestous Juma



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THE NEW HARVEST

To Hon. Mohamed Najib bin Abdul Razak
With my best wishes
Galekwa Rama
January 11, 2011

"This book presents a timely analysis of the importance of infrastructure in improving Africa's agriculture. Leaders at national and state levels will benefit immensely from its evidence-based recommendations."

— *Goodluck Jonathan*
President of the Federal Republic of Nigeria

"This book is a forceful reminder of the important role that African women play in agriculture on the continent. It is critical that they are provided with equal educational opportunity as a starting point for building a new economic future for the continent."

— *Ellen Johnson Sirleaf*
President of the Republic of Liberia

"New technologies, especially biotechnology, provide African countries with additional tools for improving the welfare of farmers. I commend this book for the emphasis it places on the critical role that technological innovation plays in agriculture. The study is a timely handbook for those seeking new ways of harnessing new technologies for development, including poor farmers, many of whom are women."

— *Blaise Compaoré*
President of Burkina Faso

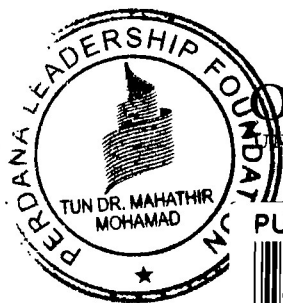
"*The New Harvest* underscores the importance of global learning in Africa's agricultural development. It offers new ideas for international cooperation on sustainable agriculture in the tropics. It will pave the way for improved collaboration between Africa and South America."

— *Laura Chincilla*
President of Costa Rica

THE NEW HARVEST

AGRICULTURAL INNOVATION IN AFRICA

GALESTOUS JUMA



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*In memory of Christopher Freeman
Father of the field of science policy and innovation studies*





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Agricultural Innovation in Africa Project

Project Director and Lead Author

Calestous Juma, Harvard Kennedy School, Harvard University,
Cambridge, USA

International Advisory Panel and Contributing Authors

John Adeoti, Nigerian Institute of Social and Economic Research,
Ibadan, Nigeria

Aggrey Ambali, NEPAD Planning and Coordinating Agency,
Tshwane, South Africa

N'Dri Assié-Lumumba, Cornell University, Ithaca, USA

Zhangliang Chen, Guangxi Zhuang Autonomous Region,
Nanning, People's Republic of China

Mateja Dermastia, Anteja ECG, Ljubljana, Slovenia

Anil Gupta, Society for Research and Initiatives for Sustainable
Technologies and Institutions, and Indian Institute of Man-
agement, Ahmedabad, India

Daniel Kammen, University of California, Berkeley, USA

Margaret Kilo, African Development Bank, Tunis, Tunisia

Hiroyuki Kubota, Japan International Cooperation Agency, Tokyo

Francis Mangeni, Common Market for Eastern and Southern
Africa, Lusaka, Zambia

Magdy Madkour, Ain Shams University, Cairo, Egypt

Venkatesh Narayanamurti, School of Engineering and Applied
Sciences, Harvard University, USA

Robert Paarlberg, Wellesley College and Harvard University, USA

Maria Jose Sampaio, Brazilian Agricultural Research Corporation,
Brasilia, Brazil

Lindiwe Majele Sibanda, Food, Agriculture and Natural Resources
Policy Analysis Network, Tshwane, South Africa

Greet Smets, Biotechnology and Regulatory Specialist, Essen, Belgium

Botlhale Tema, African Creative Connections, Johannesburg,
South Africa

Jeff Waage, London International Development Centre, London

Judi Wakhungu, African Centre for Technology Studies, Nairobi,
Kenya

Project Coordinator

Greg Durham, Harvard Kennedy School, Harvard University,
Cambridge, USA

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INTRODUCTION

In his acceptance speech as Chairman of the Assembly of the African Union (AU) in February 2010, President Bingu wa Mutharika of Malawi said:

One challenge we all face is poverty, hunger and malnutrition of large populations. Therefore achieving food security at the African level should be able to address these problems. I would therefore request the AU Assembly to share the dream that five years from now no child in Africa should die of hunger and malnutrition. No child should go to bed hungry. I realize that this is an ambitious dream but one that can be realized. We all know that Africa is endowed with vast fertile soils, favourable climates, vast water basins and perennial rivers that could be utilized for irrigation farming and lead to the Green Revolution, and mitigate the adverse effects of climate change. We can therefore grow enough food to feed everyone in Africa. I am, therefore, proposing that our agenda for Africa should focus on agriculture and food security. I propose that our slogan should be: "Feeding Africa through New Technologies: Let Us Act Now."¹



This statement lays out a clear vision of how to approach Africa's agricultural challenge. This book builds on this optimistic outlook against a general background of gloom that fails to account for a wide range of success stories across the continent.² African agriculture is at the crossroads. Persistent food shortages are now being compounded by new threats arising from climate change. But Africa faces three major opportunities that can help transform its agriculture to be a force for economic growth. First, advances in science, technology, and engineering worldwide offer Africa new tools needed to promote sustainable agriculture. Second, efforts to create regional markets will provide new incentives for agricultural production and trade. Third, a new generation of African leaders is helping the continent to focus on long-term economic transformation. This book provides policy-relevant information on how to align science, technology, and engineering missions with regional agricultural development goals.³

This book argues that sustaining African economic prosperity will require significant efforts to modernize the continent's economy through the application of science and technology in agriculture. In other words, agriculture needs to be viewed as a knowledge-based entrepreneurial activity.⁴ The argument is based on the premise that smart investments in agriculture will have multiplier effects in many sectors of the economy and help spread prosperity. More specifically, the book focuses on the importance of boosting support for agricultural research as part of a larger agenda to promote innovation, invest in enabling infrastructure, build human capacity, stimulate entrepreneurship and improve the governance of innovation.

The emergence of Africa's Regional Economic Communities (RECs) provides a unique opportunity to promote innovation in African agriculture in a more systematic and coordinated way.⁵ The launching of the East African Common Market in July 2010 represented a significant milestone in the steady

process of deepening Africa's economic integration. It is a trend that complements similar efforts in other parts of Africa. It also underscores the determination among African leaders to expand prospects for prosperity by creating space for economic growth and technological innovation.

One of the challenges facing Africa's RECs has been their perceived overlap and duplication of effort. Part of this concern has been overstated. The RECs evolved based on local priorities. For example, the Economic Community of West African States (ECOWAS) is by far the most advanced in peace-keeping while the Common Market for Eastern and Southern Africa (COMESA) has made significant strides in trade matters. In the meantime, the East African Community (EAC)—one of the oldest regional integration bodies in the world—has made significant advances on the social, cultural, and political fronts. It has judicial and legislative organs and aspires to create a federated state with a single president in the future.

Probably the most creative response to concerns over overlap and duplication was the 2008 communiqué of October 22 by the heads of state and government of COMESA, EAC, and the Southern African Development Community (SADC), agreeing to form a tripartite free trade area covering the 26 countries in the region, and to cooperate in various areas with SADC. This move will go a long way in helping achieve the African Union's continental integration objectives. The agreement provides for free movement of businesspeople, joint implementation of inter-regional infrastructure programs, and institutional arrangements that promote cooperation among the three RECs. The agreement calls for immediate steps to merge the three trading blocs into a single REC with a focus on fast-tracking the creation of the African Economic Community.

Drawing on the experience of the EAC, the Tripartite Task Force, made up of the secretariats of the three RECs, will develop a road map for the implementation of the merger. The new trading bloc will have a combined GDP of US\$625

billion and a population of 527 million. It is estimated that exports among the 26 countries rose from US\$7 billion in 2000 to US\$27 billion in 2008, and imports jumped from US\$9 billion in 2000 to US\$32 billion in 2008. This impressive increase was attributed to the efforts of the three RECs to promote free trade.

The heads of state and government directed the three RECs to implement joint programs: a single airspace; an accelerated, seamless inter-regional broadband infrastructure network; and a harmonized policy and regulatory framework to govern information and communication technology (ICT) and infrastructure development. The RECs were also expected to effectively coordinate and harmonize their transport, energy, and investment master plans. The three secretariats were asked to prepare a joint financing and implementation mechanism for infrastructure development within a year. It was also agreed that a Tripartite Summit of heads of state and government shall meet once every two years.

There are other regional developments in Africa that project a different scenario. The Euro-Mediterranean Partnership with the Maghreb countries (Algeria, Morocco, and Tunisia) resembles hub-and-spoke bilateral networks. The agreements signaled interest in facilitating free trade and promoting foreign direct investment. They also represented innovations in international cooperation that defied classical “north-south” relations.⁶ While the arrangements have helped to safeguard access by the Maghreb countries to the European Union (EU) countries, they have yet to show strong evidence of foreign direction investment (FDI) flows.⁷ A more generous interpretation is that FDI flows are more complex to arrange outside the general domain of natural resource extraction. It may take time for such flows to occur, and some of the decisions might be linked to access critical resources such as solar energy from the Sahara Desert. This topic continues to attract attention in business and technical circles.⁸

It would appear for the time being that regional integration in eastern and southern Africa is driven more by regional trade dynamics while the Maghreb has to endure the pressures of being close to the European Union, with attendant uncertainties on the extent to which Euro-Mediterranean relations can maintain a dependable path.⁹ A series of missteps and false starts in EU integration have resulted in a more precautionary approach that is needed to foster policy learning. These dynamics are likely to influence the types of technological trajectories that the various regions of Africa pursue.

The Economic Community of West African States, for example, might end up developing new southern transatlantic trade relations with the United States and South America while eastern and southern Africa may turn east. These scenarios will influence the kinds of technologies and strategies that the regions adopt.

This book builds on the findings of the report, *Freedom to Innovate: Biotechnology in Africa's Development*, prepared by the High Level African Panel on Modern Biotechnology of the African Union (AU) and the New Partnership for Africa's Development (NEPAD).¹⁰ The panel's main recommendations include the need for individual countries in central, eastern, western, northern, and southern Africa to work together at the regional level to scale up the development of biotechnology. This book aims to provide ideas on how to position agriculture at the center of efforts to spur economic development in Africa. It outlines the policies and institutional changes needed to promote agricultural innovation in light of changing ecological, economic, and political circumstances in Africa.

This book explores the role of rapid technological innovation in fostering sustainability, with specific emphasis on sustainable agriculture. It provides illustrations from advances in information technology, biotechnology, and nanotechnology. It builds on recent advances in knowledge on the origin and evolution of technological systems. Agricultural productivity,

entrepreneurship, and value addition foster productivity in rural-based economies. In many poor countries, however, farmers, small and medium-sized enterprises, and research centers do not interact in ways that accelerate the move beyond low value-added subsistence sustainable agriculture. Strengthening rural innovation systems, developing effective clusters that can add value to unprocessed raw materials, and promoting value chains across such diverse sectors as horticulture, food processing and packaging, food storage and transportation, food safety, distribution systems, and exports are all central to moving beyond subsistence sustainable agriculture, generating growth, and moving toward prosperity.

Developed and emerging economies can do much more to identify and support policies and programs to assist Africa in taking a comprehensive approach to agricultural development to break out of poverty. This requires rethinking the agenda to create innovation systems to foster interactions among government, industry, academia, and civil society—all of which are critical actors.

The book is guided by the view that innovation is the engine of social and economic development in general and agriculture in particular. The current concerns over rising food prices have compounded concerns about the state and future of African agriculture. This sector has historically lagged behind the rest of the world. Part of the problem lies in the low level of investment in Africa's agricultural research and development. Enhancing African agricultural development will require specific efforts aimed at aligning science and technology strategies with agricultural development efforts. Furthermore, such efforts will need to be pursued as part of Africa's growing interest in regional economic integration through its Regional Economic Communities.

African leaders have in recent years been placing increasing emphasis on the role of science and innovation in economic transformation. The Eighth African Union Summit met

January 2007 and adopted decisions aimed at encouraging more African youth to take up studies in science, technology, and engineering education; promoting and supporting research and innovation activities and the related human and institutional capacities; ensuring scrupulous application of scientific ethics; revitalizing African universities and other African institutions of higher education as well as scientific research institutions; promoting and enhancing regional as well as south-south and north-south cooperation in science and technology; increasing funding for national, regional, and continental programs for science and technology; and supporting the establishment of national and regional centers of excellence in science and technology.¹¹ The decisions are part of a growing body of guidance on the role of science and innovation in Africa's economic transformation. These decisions underscore the growing importance that African leaders place on science and innovation for development.

However, the translation of these decisions into concrete action remains a key challenge for Africa. This study is guided by the view that one of the main problems facing African countries is aligning national and regional levels of governance with long-term technological considerations. This challenge is emerging at a time when African countries are seeking to deepen economic integration and expand domestic markets. These efforts are likely to affect the way agricultural policy is pursued in Africa.

The 2007 African Union Summit decisions paid particular attention to the role of science, technology, and innovation in Africa's economic transformation, and they marked the start of identifying and building constituencies for fostering science, technology, and innovation in Africa. They focused on the need to undertake the policy reforms necessary to align the missions and operations of institutions of higher learning with economic development goals in general and the improvement of human welfare in particular.



These decisions represent a clear expression of political will and interest in pursuing specific reforms that would help in making science, technology, and innovation relevant to development. However, the capacity to do so is limited by the lack of informed advice on international comparative experiences on the subject. The central focus of this book is to provide high-level decision makers in Africa with information on how to integrate science and technology into agricultural development discussions and strategies. Specific attention will be placed on identifying emerging technologies and exploring how they can be adapted to local economic conditions.

The book is divided into seven chapters. Chapter 1 examines the critical linkages between agriculture and economic growth. The current global economic crisis, rising food prices, and the threat of climate change have reinforced the urgency to find lasting solutions to Africa's agricultural challenges. The entire world needs to find ways to intensify agricultural production while protecting the environment.¹² Africa is largely an agricultural economy, with the majority of the population deriving their income from farming. Food security, agricultural development, and economic growth are intertwined. Improving Africa's agricultural performance will require deliberate policy efforts to bring higher technical education, especially in universities, to the service of agriculture and the economy. It is important to focus on how to improve the productivity of agricultural workers, most of whom are women, through technological innovation.

Chapter 2 reviews the implications of advances in science and technology for Africa's agriculture. The Green Revolution played a critical role in helping to overcome chronic food shortages in Latin America and Asia. The Green Revolution was largely a result of the creation of new institutional arrangements aimed at using existing technology to improve agricultural productivity. African countries are faced with enormous technological challenges. But they also have access to a much

larger pool of scientific and technical knowledge than was available when the Green Revolution was launched. It is important to review major advances in science, technology, and engineering and identify their potential for use in African agriculture. Such exploration should include an examination of local innovations as well as indigenous knowledge. It should cover fields such as information and communication technology, genetics, ecology, and geographical sciences. Understanding the convergence of these and other fields and their implications for African agriculture is important for effective decision making and practical action.

Chapter 3 provides a conceptual framework for defining agricultural innovation in a systemic context. The use of emerging technology and indigenous knowledge to promote sustainable agriculture will require adjustments in existing institutions. New approaches will need to be adopted to promote close interactions between government, business, farmers, academia, and civil society. It is important to identify novel agricultural innovation systems of relevance to Africa. This chapter examines the connections between agricultural innovation and wider economic policies. Agriculture is inherently a place-based activity and so the book outlines strategies that reflect local innovation clusters and other characteristics of local innovation systems. Positioning sustainable agriculture as a knowledge-intensive sector will require fundamental reforms in existing learning institutions, especially universities and research institutes. Most specifically, key functions such as research, teaching, extension, and commercialization need to be much more closely integrated.

In Chapter 4 the book outlines the critical linkages between infrastructure and agricultural innovation. Enabling infrastructure (covering public utilities, public works, transportation, and research facilities) is essential for agricultural development. Infrastructure is defined here as facilities, structures, associated equipment, services, and institutional arrangements

that facilitate the flow of agricultural goods, services, and ideas. Infrastructure represents a foundational base for applying technical knowledge in sustainable development and relies heavily on civil engineering. The importance of providing an enabling infrastructure for agricultural development cannot be overstated. Modern infrastructure facilities will also need to reflect the growing concern over climate change. In this respect, the chapter will focus on ways to design “smart infrastructure” that takes advantage of advances in the engineering sciences as well as ecologically sound systems design. Unlike other regions of the world, Africa’s poor infrastructure represents a unique opportunity to adopt new approaches in the design and implementation of infrastructure facilities.

The role of education in fostering agricultural innovation is the subject of Chapter 5. Some of Africa’s most persistent agricultural challenges lie in the educational system. Much of the focus of the educational system is training young people to seek employment in urban areas. Much of the research is carried out in institutions that do not teach, while universities have limited access to research support. But there is an urgency to identify new ways to enhance competence throughout the agricultural value chain, with emphasis on the role of women as farm workers and custodians of the environment. It is important to take a pragmatic approach that emphasizes competence building as a key way to advance social justice. Most of the strategies to strengthen the technical competence of African farmers will entail major reforms in existing universities and research institutions. In this respect, actions need to be considered in the context of agricultural innovation systems.

Chapter 6 presents the importance of entrepreneurship in agricultural innovation. The creation of agricultural enterprises represents one of the most effective ways to stimulate rural development. The chapter will review the efficacy of the policy tools used to promote agricultural enterprises. These include direct financing, matching grants, taxation policies

government or public procurement policies, and rewards to recognize creativity and innovation. It is important to learn from examples that helped to popularize modern technology in rural areas and has spread to more than 90% of the country's counties. Inspired by such examples, Africa should explore ways to create incentives that stimulate entrepreneurship in the agricultural sector. It is important to take into account new tools such as information and communication technologies and the extent to which they can be harnessed to promote entrepreneurship.

The final chapter outlines regional approaches for fostering agricultural innovation. African countries are increasingly focusing on promoting regional economic integration as a way to stimulate economic growth and expand local markets. Considerable progress has been made in expanding regional trade through regional bodies such as COMESA, SADC, and the EAC. There are eight other such RECs that have been recognized by the African Union as building blocks for pan-African economic integration. (See Appendix I for details on the Regional Economic Communities [RECs].)

So far regional cooperation in agriculture is in its infancy and major challenges lie ahead. Africa should intensify efforts to use regional bodies as agents of agricultural innovation through measures such as regional specialization. The continent should factitively explore ways to strengthen the role of the RECs in promoting common regulatory standards.

It is not possible to cover the full range of agricultural activities in one volume. This book does not address the important roles that livestock and aquaculture play in Africa. Similarly, it does not deal with innovation in agricultural machinery. But we hope that the systems approach adopted in the book will help leaders and practitioners to anticipate and accommodate other sources of agricultural innovation.¹³





SELECTED ABBREVIATIONS AND ACRONYMS

AMU	Arab Maghreb Union
AU	African Union
BecANet	Biosciences Eastern and Central Africa Network
CAADP	Comprehensive Africa Agriculture Development Programme
CEN-SAD	Community of Sahel Sahara States
CIMMYT	International Centre for the Improvement of Maize and Wheat
COMESA	Common Market for Eastern and Southern Africa
DFID	Department for International Development
EAC	East African Community
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IGAD	Intergovernmental Authority for Development
IRRI	International Rice Research Institute
NABNet	North Africa Biosciences Network
NCDC	National Cocoa Development Committee



xxvi SELECTED ABBREVIATIONS AND ACRONYMS

NEPAD	New Partnership for Africa's Development
RECs	Regional Economic Communities
SADC	Southern African Development Community
WABNet	West African Biosciences Network

THE NEW HARVEST





1

THE GROWING ECONOMY

The current global economic crisis, rising food prices, and the threat of climate change have reinforced the urgency to find lasting solutions to Africa's agricultural challenges. Africa is largely an agricultural economy with the majority of the population deriving their income from farming. Agricultural development is therefore intricately linked to overall economic development in African countries. Most policy interventions have focused on "food security," a term that is used to cover key attributes of food such as sufficiency, reliability, quality, safety, timeliness, and other aspects of food necessary for healthy and thriving populations. This chapter outlines the critical linkages between food security, agricultural development, and economic growth and explains why Africa has lagged behind other regions in agricultural productivity. Improving Africa's agricultural performance will require significant political leadership, investment, and deliberate policy efforts.

The Power of Inspirational Leadership

In a prophetic depiction of the power of inspirational models, Mark Twain famously said: "Few things are harder to put up



“Calestous Juma draws on a rich harvest of research to write a convincing analysis of the importance of innovation and entrepreneurship in the agricultural sectors of Africa. Hopefully, it will be widely read by scholars and policy analysts across Africa as well as outside. It is a great book.”

—Elinor Ostrom, Professor of Political Science, Indiana University,
and 2009 Nobel Laureate in Economic Sciences

“Calestous Juma has once again produced a book that will be an important reference for scholars, researchers and practitioners in their search for ways to break the persistent conundrum that is Africa’s failure to properly exploit its huge agricultural potential. The book reveals his exceptional ability to express ideas that will be relevant to the emerging trends in Africa’s agricultural and political economy.”

—Monty Jones, Executive Director, Forum for Agricultural Research in Africa,
and 2004 World Food Prize Laureate

AFRICAN AGRICULTURE is currently at a crossroads, at which persistent food shortages are compounded by threats from climate change. But, as this book argues, Africa faces three major opportunities that can transform its agriculture into a force for economic growth: advances in science and technology; the creation of regional markets; and the emergence of a new crop of entrepreneurial leaders dedicated to the continent’s economic improvement.

Filled with case studies from within Africa and success stories from developing nations around the world, *The New Harvest* outlines the policies and institutional changes necessary to promote agricultural innovation across the African continent. Incorporating research from academia, government, civil society, and private industry, the book suggests multiple ways that individual African countries can work together at the regional level to develop local knowledge and resources, harness technological innovation, encourage entrepreneurship, increase agricultural output, create markets, and improve infrastructure.

Calestous Juma is Professor of the Practice of International Development and Director of the Science, Technology, and Globalization Project at Harvard University. He is also a Fellow of the Royal Society, the United Kingdom’s scientific academy.

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