A new economic vision for Africa’s agricultural transformation—articulated at the highest level of government through Africa’s Regional Economic Communities (RECs)—should be guided by new conceptual frameworks that define the continent as a learning society. This shift will entail placing policy emphasis on emerging opportunities such as renewing infrastructure, building human capabilities, stimulating agribusiness development, and increasing participation in the global economy. It also requires an appreciation of emerging challenges such as climate change and how they might influence current and future economic strategies.

Climate Change, Agriculture, and Economy

As Africa prepares to address its agricultural challenges, it is now confronted with new threats arising from climate change. Agricultural innovation will now have to be done in the context of a more uncertain world in which activities such as plant and animal breeding will need to be anticipatory. According to the World Bank, warming “of 2°C could result in a 4 to 5 percent permanent reduction in annual income per capita in Africa and South Asia, as opposed to minimal losses
in high-income countries and a global average GDP loss of about 1 percent. These losses would be driven by impacts in agriculture, a sector important to the economies of both Africa and South Asia. Sub-Saharan Africa is dominated by fragile ecosystems. Nearly 75% of its surface area is dry land or desert. This makes the continent highly vulnerable to droughts and floods. Traditional cultures cope with such fragility through migration. But such migration has now become a source of insecurity in parts of Africa. Long-term responses will require changes in agricultural production systems.

The continent’s economies are also highly dependent on natural resources. Nearly 80% of Africa’s energy comes from biomass and over 30% of its GDP comes from rain-fed agriculture, which supports 70% of the population. Stress is already being felt in critical resources such as water supply. Today, 20 African countries experience severe water scarcity and another 12 will be added in the next 25 years. Economic growth in regional hubs is now being curtailed by water shortages.

The drying up of Lake Chad (shared by Nigeria, Chad, Cameroon, and Niger) is a grim reminder that rapid ecological change can undermine the pursuit for prosperity. The lake’s area has decreased by 80% over the last 30 years, with catastrophic impacts to local communities. Uncertainty over water supply affects decisions in other areas such as hydropower, agriculture, urban development, and overall land-use planning. This is happening at a time when Africa needs to switch to low-carbon energy sources.

Technological innovation will be essential for enabling agriculture to adapt to a different climate. Meeting the dual challenges of expanding prosperity and adapting to climate change will require greater investment in the generation and diffusion of new technologies. Basic inputs such as provision of meteorological data could help farmers to adapt to climate change by choosing optimal planting dates. The task ahead for policy makers will be to design climate-smart innovation
systems that shift economies toward low-carbon pathways. Economic development is an evolutionary process that involves adaptation to changing economic environments.

Technological innovation is implicitly recognized as a key aspect of adaptation to climate change. For example, the Intergovernmental Panel on Climate Change (IPCC) defines adaptation as “Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.” It views the requisite adaptive capacity as the ability “to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.” Technological innovation is used in society in a congruent way to respond to economic uncertainties. What is therefore needed is to develop analytical and operational frameworks that would make it easier to incorporate adaptation to climate change in innovation strategies used to expand prosperity.

Innovation systems are understood to mean the interactive process involving key actors in government, academia, industry, and civil society to produce and diffuse economically useful knowledge into the economy. The key elements of innovation include the generation of a variety of avenues, their selection by the market environment, and the emergence of robust socioeconomic systems. This concept can be applied to adaptation to climate change in five critical areas: managing natural resources; designing physical infrastructure; building human capital, especially in the technical fields; fostering entrepreneurial activities; and governing adaptation as a process of innovation.

Economic development is largely a process by which knowledge is applied to convert natural resources into goods and services. The conservation of nature’s variety is therefore a critical aspect of leaving options open for future development. Ideas such as “sustainable development” have captured the importance of incorporating the needs of future generations
into our actions. Adaptive strategies will therefore need to start with improved understanding of the natural resource base. Recent advances in earth observation and related geospatial science and technology have considerably increased the capacity of society to improve its capabilities for natural resource management. But improved understanding is only the first step.

The anticipated disruptive nature of climate change will demand increased access to diverse natural assets such as genetic resources for use in agriculture, forestry, aquaculture, and other productive activities. For example, the anticipated changes in the growing season of various crops will require intensified crop breeding. But such breeding programs will presuppose not only knowledge of existing practices but also the conservation of a wider pool of genetic resources of existing crops and breeds and their wild relatives to cope with shifts in agricultural production potential. This can be done through measures such as seed banks, zoos, and protected areas. Large parts of Africa may have to switch from crop production to livestock breeding. Others may also have to change from cultivating cereals to growing fruits and vegetables as projected in other regions of the world. Other measures will include developing migration corridors to facilitate ecosystem integrity and protect human health—through surveillance and early warning systems.

Such conservation efforts will also require innovation in regional institutional coordination, expanded perspectives of space and time, and the incorporation of climate change scenarios in economic development strategies. Building robust economies requires the conservation of nature’s variety. These efforts will need to be accompanied by greater investment in the generation of knowledge associated with natural resources. Advances in information and communication capabilities will help the international community to collect, store, and exchange local knowledge in ways that were not possible.
in the past. The sequencing of genomes provides added capacity for selective breeding of crops and livestock suited to diverse ecologies. Technological advancement is therefore helping to augment nature’s diversity and expand adaptive capabilities.

Climate change is likely to affect existing infrastructure in ways that are not easy to predict. For example, road networks and energy sources in low-lying areas are likely to be affected by sea level rise. A recent study of Tangier Bay in Morocco projects that sea level rise will have significant impact on the region’s infrastructure facilities such as coastline protection, the port, railway lines, and the industrial base in general.12

Studies of future disruptions in transportation systems reveal great uncertainties in impact depending on geographical location.13 These uncertainties are likely to influence not only investment decisions but also the design of transportation systems. Similarly, uncertainty over water supply is emerging as a major concern demanding not only integrated management strategies but also improved use of water-related technologies.

Other measures include the need to enhance water supply—such as linking reservoirs, building new holding capacity in reservoirs, and injecting early snowmelt into groundwater reservoirs. Similarly, coastal areas need to be protected with natural vegetation or seawalls. In effect, greater technical knowledge and engineering capabilities will need to be marshaled to design future infrastructure in light of climate change.14 This includes the use of new materials arising from advances in fields such as nanotechnology.

Protecting human populations from the risks of climate change should be one of the first steps in seeking to adapt to climate change. Concern over human health can compound the sense of uncertainty and undermine other adaptive capabilities. Indeed, the first step in building resilience is to protect human populations against disease.15 Many of the responses
needed to adapt health systems to climate change will involve practical options that rely on existing knowledge.\textsuperscript{16}

Others, however, will require the generation of new knowledge. Advances in fields such as genomics are making it possible to design new diagnostic tools that can be used to detect the emergence of new infectious diseases. These tools, combined with advances in communications technologies, can be used to detect emerging trends in health and provide health workers with early opportunities to intervene. Furthermore, convergence in technological systems is transforming the medical field. For example, the advent of hand-held diagnostic devices and video-mediated consultation are expanding the prospects of telemedicine and making it easier for isolated communities to be connected to the global health infrastructure.\textsuperscript{17} Personalized diagnostics is also becoming a reality.\textsuperscript{18}

Adapting to climate change will require significant upgrading of the knowledge base of society. Past failure to adapt from incidences of drought is partly explained by the lack of the necessary technical knowledge needed to identify trends and design responses.\textsuperscript{19} The role of technical education in economic development is becoming increasingly obvious. Similarly, responding to the challenges of climate will require considerable investment in the use of technical knowledge at all levels in society.

One of the most interesting trends is the recognition of the role of universities as agents of regional economic renewal.\textsuperscript{20} Knowledge generated in centralized urban universities is not readily transferred to regions within countries. As a result, there is growing interest in decentralizing the university system itself.\textsuperscript{21} The decentralization of technical knowledge to a variety of local institutions will play a key role in enhancing local innovation systems that can help to spread prosperity through climate-smart strategies.

The ability to adapt to climate change will not come without expertise. But expertise is not sufficient unless it is used to
identify, assess, and take advantage of emerging opportunities through the creation of new institutions or the upgrading of existing ones. Such entrepreneurial acts are essential both for economic development and adaptation to climate change. Economic diversification is critical in strengthening the capacity of local communities to adapt to climate change.

For example, research on artisan fisheries has shown that the poorest people are not usually the ones who find it hardest to adapt to environmental shocks. It is often those who have become locked in overly specialized fishery practices. Technological innovation aimed at promoting diversification of entrepreneurial activities would not only help to improve economic welfare, but it would also help enhance the adaptive capabilities of local communities. But such diversification will need to be complemented by other measures such as flexibility, reciprocity, redundancy, and buffer stocks.

Promoting prosperity and creating robust economies that can adapt to climate change should be a central concern of leaders around the world. Political turmoil in parts of Africa is linked to recent climate events. The implications of climate change for governance, especially in fragile states, has yet to receive attention. Governments will need to give priority to adaption to climate change as part of their economic development strategies. But they will also need to adopt approaches that empower local communities to strengthen their adaptive capabilities. Traditional governance practices such as participation will need to be complemented by additional measures that enhance social capital.

The importance of technological innovation in adaptation strategies needs to be reflected in economic governance strategies at all levels. It appears easier to reflect these considerations in national economic policies. However, similar approaches also need to be integrated into global climate governance strategies, especially through the adoption of technology-oriented agreements.
On the whole, an innovation-oriented approach to climate change adaptation will need to focus largely on expanding the adaptive capacity of society though the conservation of nature’s variety, construction of robust infrastructure, enhancement of human capabilities, and promotion of entrepreneurship. Fundamentally, the ability to adapt to climate change will possibly be the greatest test of our capacity for social learning. Regional integration will provide greater flexibility and geographical space for such learning. Furthermore, promoting local innovation as part of regional strategies will contribute to the emergence of more integrated farming systems.

Throughout, this book has highlighted the role that RECs can have as a collective framework for harnessing national initiatives and sharing best practices drawn from the region and beyond. Africa’s RECs, as well as the African Union at the continental level, have programs for food security, and for science, technology, and engineering. The challenge, as highlighted, relates to putting existing knowledge within the region and beyond to the service of the people of Africa on the ground, through clear political and intellectual leadership and an effective role for innovators. Further, there is a challenge of how best to utilize the existing regional policy making and monitoring and evaluation structures in promoting innovation and tackling the challenges of food security.

The current global economic crisis and rising food prices are forcing the international community to review their outlook for human welfare and prosperity. Much of the current concern on how to foster development and prosperity in Africa reflects the consequences of recent neglect of sustainable agriculture and infrastructure as drivers of development. Sustainable agriculture has, through the ages, served as the driving force behind national development. In fact, it has been a historical practice to use returns from investment in sustainable agriculture to stimulate industrial development. Restoring it to its right place
in the development process will require world leaders to take a number of bold steps.

Science and innovation have always been the key forces behind agricultural growth in particular and economic transformation in general. More specifically, the ability to add value to agricultural produce via the application of scientific knowledge to entrepreneurial activities stands out as one of the most important lessons of economic history. Reshaping sustainable agriculture as a dynamic, innovative, and rewarding sector in Africa will require world leaders to launch new initiatives that include the following strategic elements.

Bold leadership driven by heads of state in Africa, supported by those of developed and emerging economies, is needed to recognize the real value of sustainable agriculture in the economy of Africa. High-level leadership is essential for establishing national visions for sustainable agriculture and rural development, championing of specific missions for lifting productivity and nutritional levels with quantifiable targets, and the engagement of cross-sectoral ministries in what is a multi-sector process.

Sustainable agriculture needs to be recognized as a knowledge-intensive productive sector that is mainly carried out in the informal private economy. The agricultural innovation system has to link the public and private sectors and create close interactions between government, academia, business, and civil society. Reforms will need to be introduced in knowledge-based institutions to integrate research, university teaching, farmers’ extension, and professional training, and bring them into direct involvement with the production and commercialization of products.

Policies have to urgently address affordable access to communication services for people to use in their everyday lives, as well as broadband Internet connectivity for centers of learning such as universities and technical colleges. This is vital to access knowledge and trigger local innovations, boosting
rural development beyond sustainable agriculture. It is an investment with high returns. Improving rural productivity also requires significant investments in basic infrastructure including transportation, rural energy, and irrigation. There will be little progress without such foundational investments.

Fostering entrepreneurship and facilitating private sector development has to be highest on the agenda to promote the autonomy and support needed to translate opportunity into prosperity. This has to be seen as an investment in itself, with carefully tailored incentives and risk-sharing approaches supported by government.

**Entrepreneurial Leadership**

It is not enough for governments to simply reduce the cost of doing business. Fostering agricultural renewal will require governments to function as active facilitators of technological learning. Government actions will need to reflect the entrepreneurial character of the farming community; they too will need to be entrepreneurial. Leadership will also need to be entrepreneurial in character. Moreover, addressing the challenge will require governments to adopt a mission-oriented approach, setting key targets and providing support to farmers to help them meet quantifiable goals. A mission-oriented approach will require greater reliance on executive coordination of diverse departmental activities.

Fostering economic renewal and prosperity in Africa will entail adjustments in the structure and functions of government. More fundamentally, issues related to agricultural innovation must be addressed in an integrated way at the highest possible levels in government. There is therefore a need to strengthen the capacity of presidential offices to integrate science, technology, and innovation in all sustainable agriculture-related aspects of government. Moreover, such offices will
also need to play a greater role in fostering interactions between government, business, academia, and civil society. This task requires champions.

One of the key aspects of executive direction is the extent to which leaders are informed about the role of science and innovation in agricultural development. Systematic advice on science and innovation must be included routinely in policy making. Such advisers must have access to credible scientific or technical information drawing from a diversity of sources including scientific and engineering academies. In fact, the magnitude of the challenge for regions like Africa is so great that a case could be made for new academies dedicated to agricultural science, technology, and innovation.

Science, technology, and engineering diplomacy has become a critical aspect of international relations. Ministries of foreign affairs in African countries have a responsibility to promote international technology cooperation and forge strategic alliances on issues related to sustainable agriculture. To effectively carry out this task, foreign ministries need to strengthen their internal capability in science and innovation.

**Toward a New Regional Economic Vision**

Contemporary history informs us that the main explanation for the success of the industrialized countries lies in their ability to learn how to improve performance in a diversity of social, economic, and political fields. In other words, the key to their success was their focus on practical knowledge and the associated improvements in skills needed to solve problems. They put a premium on learning based on historical experiences.

One of the most reassuring aspects of a learner’s strategy is that every generation receives a legacy of knowledge that it can harness for its own use. Every generation blends the new and the old and thereby charts its own development path, making
debates about innovation and tradition irrelevant. Furthermore, discussions on the impact of intellectual property rights take on a new meaning if one considers the fact that the further away you are from the frontier of research, the larger is your legacy of technical knowledge. The challenge therefore is for Africa to think of research in adaptive terms, and not simply focus on how to reach parity with the technological front-runners. Understanding the factors that help countries to harness available knowledge is critical to economic transformation.

The advancement of information technology and its rapid diffusion in recent years could not have happened without basic telecommunication infrastructure. In addition, electronic information systems, which rely on telecommunications infrastructure, account for a substantial proportion of production and distribution activities in the secondary and tertiary sectors of the economy. It should also be noted that the poor state of Africa’s telecommunications infrastructure has hindered the capacity of the region to make use of advances in fields such as geographical information sciences in sustainable development.

The emphasis on knowledge is guided by the view that economic transformation is a process of continuous improvement in productive activities. In other words, government policy should be aimed at enhancing performance, starting with critical fields such as agriculture, while recognizing interdisciplinary linkages.

This type of improvement indicates a society’s capacity to adapt to change through learning. It is through continuous improvement that nations transform their economies and achieve higher levels of performance. Using this framework, with government functioning as a facilitator for economic learning, agribusiness enterprises will become the locus of learning, and knowledge will be the currency of change.

Some African countries already possess the key institutional components they need to become players in the knowledge economy. The emphasis, therefore, should be on realigning the
existing structures and creating necessary new ones where they do not exist and promoting interactions between key players in the economy. More specifically, the separation between government, industry, and academia stands out as one of the main sources of inertia and waste in Africa’s knowledge-based institutions. The challenge is not simply creating institutions, but creating systems of innovation in which emphasis is placed on economic learning through interactions between actors in the society.

A key role of Africa’s RECs is to provide the regional framework for all stakeholders to act in a coordinated manner, share best practices, encourage peer review of achievements and setbacks by key players, and pool resources for the greater good of the region and Africa at large. The policy organs of the RECs, including the presidents and sectoral ministers, provide appropriate frameworks for the public and private sector to formulate innovative policies; and given the multidisciplinary and multi-sectoral nature of the initiatives, the higher policy organs at the level of heads of state and government, and at the level of joint ministerial meetings, provide a unique role for the RECs as vehicles for promoting regional collaboration and for the elaboration and implementation of key policy initiatives.

Africa has visions for socioeconomic development at the national, regional, and continental level. Science, technology, engineering, and innovation are critical pillars of any socioeconomic development vision in our time. At the three levels, the visions do not coherently interact because the continental policies are not necessarily coordinated with the policies the member states adopt and implement in the context of the RECs, and national policy making is at times totally divorced from the regional and continental processes and frameworks.

However, there are case studies of how some RECs have tried to address this dilemma, which could constitute best practices for implementation of regional policies at the national level and for elaboration of regional policies on the basis of
practical realities in the member states. In the East African
Community (EAC), each member state has agreed to establish
a dedicated full-scale ministry responsible for EAC affairs. This
means that EAC affairs are organically integrated into the
national government structure of the member states. There is
need for a coherent approach to formulation and implementa-
tion of regional policies at the national level, drawing on the
collective wisdom and clout that RECs provide in tackling key
national and regional challenges, particularly those related to
the rapid socioeconomic transformation of Africa.