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Modernizing Technologies for African Agricultural Transformation:

A call to action and partnerships

A brief developed for the upcoming Virtual High-Level Dialogue on Feeding Africa: Leadership to Scale Up Successful Innovations, 29–30 April 2021

The challenge for Africa to feed itself and become a major food supplier for the world is compounded by climate change and the need to produce healthier, safer, and more nutritious food, while producing less waste and fewer greenhouse gases. Yet after more than a decade of progress in reducing hunger in Africa, the number of undernourished is on the rise again. FAO recently reports that 256 million Africans go hungry every day; 93% are in sub-Saharan Africa. As the continent's population is expected to reach 2 billion by 2050, and considering continued urbanization and climate change, Africa's ability to feed itself is at great risk unless significant transformations occur across its economy and agricultural sector.

Apart from the insufficient food supply, Africa also faces unprecedented nutrition challenges, environmental degradation, and frequent climatic shocks. The disruptions in the global supply chains and the movement restrictions at local and regional levels due to COVID-19 and the associated economic downturn have worsened food and nutrition security in several countries. According to the World Health Organization, 91 million people in Africa fall ill and 137,000 die each year due to foodborne diseases. This scenario is simply unacceptable. As a result, food safety has become an essential precondition for access to regional and global food trade and increasingly high-value domestic markets in developing countries. Therefore, assuring food safety and security is a significant indicator of success for the African Continental Free Trade Area, which came into force in January 2021.

The latest review by the African Union Commission of progress towards the attainment of food and agriculture targets set by Heads of State and Government under the framework of the African Union's Comprehensive Africa Agriculture Program revealed that by 2019 only four out of the 49 countries remain on track to achieving their goals. Africa's food systems must transform to achieve food security, deliver better nutrition, reduce poverty, and address the environmental challenges of the 21st century.

The picture is not, however, all doom and gloom. Numerous successes demonstrate successful movement toward agricultural and food system transformation in Africa. These successes result from a complementary convergence of science and technology, favorable policies, strong support institutions and services, and access to finance and markets. When scaled upward, these achievements promise to form the nucleus of the heralded transformation of Africa's food systems. Scaling is possible by investments in proven processes and materials. In Africa, scaling for food and agricultural transformation is hampered by underinvestment in the sector. This stems from a lack of conviction by policy makers about the returns (economic, strategic, and political) accruing from investment in food and agriculture versus other sectors. The fact that Africa can afford to pay US$50 billion per year to import food that it could otherwise grow for itself shows that the resources to invest in scaling food and agriculture exist. What is needed is a concerted commitment at the highest level to make the necessary investments and complement them with technical backstopping and policy regimes that support sustainable scaling of needed innovations and technologies.

Current thinking recognizes a winning progression that extends from the downstream reaches of the research-and-development continuum well into the development efforts focused upon transforming African agriculture.

In the last few decades, various research outputs have been developed with the potential to transform Africa's agriculture. However, for these to be useful, they must be translated into technologies that can be readily used by the private sector, extension agents, and other intermediate stakeholders. These technologies are proven to increase the productivity and resilience of agriculture, but they must also represent profitable investments for the private sector critical in driving larger scale application. Means must be found to make Regional Public Goods more attractive to private sector investors. Large national investment programs are a crucial vehicle for scaling these technologies. The inclusion of technologies in these programs requires close collaboration between the researchers that develop them and the national governments that propel growing investment programs. These technologies do not stand alone but work in conjunction with other products and guidance, and expertise is required to bundle these related components into solutions that can be understood and acted upon by those who design, award, conduct, and absorb rural development projects.

The most promising of these projects are those supported through sovereign country loans nested into regional programs receiving strong technical support that strategically bundles and adjusts these modernizing technologies. It is incumbent that those who design and award these loans ensure that the technologies that support their efforts are well considered, and that those who implement their activities interact with how these technologies are packaged, delivered, and assessed. Technologies alone are only part of the equation. They must be matched with supportive policies, complementary services (e.g., good governance, credit, business development, and insurance), and the market pull that creates demand for them. These include progressive policies toward vibrant seed and input delivery systems, reform of extension systems that influence smallholder farmers, and timely monitoring and evaluation of interventions in a manner that effectively guides decision making and further investment. This integrative approach offers a new paradigm to the formulation, advancement, delivery, and uptake of transformational technologies across Africa.

> One effort that seeks to advance agriculture through this paradigm is the Technologies for African Agricultural Transformation Program (TAAT).

TAAT is pioneering new approaches to the deployment of proven technologies to African farmers as part of the African Development Bank's Feed Africa Strategy, operating through a partnership with 28 of its Regional Member Countries as well as nine CGIAR Centers, the Forum for Agricultural Research in Africa, Sub-regional Agricultural Research Organizations, and other institutions that together

constitute the regional technology delivery infrastructure (RTDI). TAAT is organized around 15 "Compacts" that represent priorities and partnerships to achieve Africa's potential in attaining food security, creating jobs, and advancing its role in global agricultural trade. Together these Compacts design interventions in collaboration with national programs to introduce technologies and management innovations that respond to country priorities for agricultural development. In many cases, these targets are addressed by implementing projects resulting from sovereign country loans awarded by development banks; and TAAT's role in the planning and execution of these loan projects is becoming a vital element of their success.

A substantial portion of TAAT's bundled agricultural solutions occurs by promoting improved crop varieties and animal breeds and their introduction alongside accompanying technologies and complementary interventions such as supportive policies, human and institutional capacity development, and agribusiness incubation. For the most part, these improved varieties and breeds are the products of extended efforts targeting greater productive capacity, resilience toward pests, disease, and environmental stress, and, more recently, improvement in nutritive value. The role of accompanying technologies, both production inputs and management guidance, and the complementary interventions must not be overlooked or regarded as secondary. Without the larger package, greater genetic potential, scaling, and sustained uptake of the technologies cannot be realized. Some examples of genetic innovations advanced by TAAT and their early gains follow:

Rice

Rice varieties available through TAAT include long grain and aromatic varieties developed by AfricaRice as well as its well-known New Rice for Africa (NERICA) lines. Strategic interventions have occurred in 12 countries involving over 2.2 million households on 1,354,780 ha through 41 partnerships and accelerated distribution of 67,739 tons (t) of improved seed. This effort has led to the production of an additional 285,000 t of rice per year worth $108 million; ultimately intended to eliminate massive importation of rice into Africa while providing consumers with the quality they expect.

Wheat

Wheat varieties available through TAAT have two very important traits: heat tolerance and stem rust tolerance. The first trait effectively expands the areas where wheat can be grown, including the Sahel, and the second lessens dependence upon chemical fungicides for smallholder production. Strategic interventions have occurred in seven countries involving over 1.8 million households on 1.8 million ha through 129 partnerships and accelerated the delivery of 131,211 t of certified seed. This effort has led to an additional 1.44 million t of wheat worth $291 million. The adoption of the TAAT wheat technology toolkit has resulted in record production levels in Sudan, and this approach is well positioned for wider application. The prospect of self-sufficient wheat production in Africa is, for the first time, an achievable vision.

Maize

All 35 maize varieties available through TAAT possess drought tolerance that is important within climate-smart agricultural practice. These are mostly hybrid maize varieties that are adopted into the product lines of commercial seed companies through the TEGO licensing mechanism. Strategic interventions have occurred in 11 countries involving over 5.2 million households on 841,000 ha through 60 partnerships and accelerated distribution of 21,000 t of improved seed. This effort has led to the production of an additional 631,000 t of maize worth $107 million. Increased maize production not only assures greater food security across much of Africa but also boosts animal enterprises through better and less expensive feeds. TAAT's technical package also prompted a timely response to the biological invasion of Africa by Fall Armyworm, a model readily applicable to future invasive threats.

Cassava

Cassava varieties available through TAAT have several important characteristics, particularly tolerance to widespread virus diseases, higher dry matter and starch content, and in some cases, greatly elevated concentrations of pro-vitamin A (golden cassava). Because the crop is vegetatively propagated, accompanying technologies address accelerated multiplication of plantlets and cuttings. Strategic interventions have occurred in 12 countries involving over 817,000 households on 344,000 ha through the accelerated distribution of over 20 million cuttings. This effort has led to an additional 9.4 million t of cassava worth $217 million. Africa's increased cassava production is ultimately intended for industrial processing and sales in world markets as has occurred elsewhere.

Substantial achievements were made in advancing other crops, particularly sorghum, millet, sweet potato, and beans. Sorghum and millet varieties available through TAAT are high yielding and drought tolerant; and 1,400 t of improved seed has reached over 82,000 households in the Sahel. The Orange Fleshed Sweet Potato varieties available through TAAT all contain high levels of pro-vitamin A and over 33 million cuttings have reached 55,000 households in 15 countries. Bean varieties available through TAAT all contain high levels of iron, a micronutrient important in human nutrition; and over 5,000 t of improved seed has reached about 450,000 households across eight countries. These latter two commodities, sweet potato and beans, signal the importance and acceptance of biofortified crops in achieving nutritional security.

Fish and animal enterprises are also priorities within TAAT, and improved breeds are critical to that effort. In terms of fish, catfish and tilapia are the most important ones and improved breeds of both are being reared in hatcheries operating at various scales. Technical approaches resulted in productivity increases by 475 g per harvested fish over similar production intervals. Over 127 million fingerlings were raised and released to 37,355 producers, resulting in production gains of over 60,000 t worth about $188 million. One productivity enhancing technology involves rearing only male fish within ponds that in turn increases reliance upon nearby commercial hatcheries. Animal enterprises are separated between poultry and small ruminants. Poultry breeds are either layers for eggs, broilers for meat, or dual purpose for free-range settings. Disease resistance is an important trait for all poultry breeds. Small livestock are either sheep or goats. The emphasis for both poultry and small livestock is placed upon improved feeding systems, veterinary care, and sheltering; all placed within the context of community-based breeding and marketing operations, with 3,144,133 persons trained in improved animal enterprise. Goat and sheep fattening operations are an enterprise opportunity particularly attractive to youth. In retrospect, TAAT could have included cattle within its mandate, but gains in this area were considered beyond its initial three-year time frame. Protein security is an important nutritional goal in Africa, and increased consumption of both domestic and commercial animal products is closely aligned with Africa's economic growth.

As a result of the TAAT Program, a strong case may be made for technology-driven approaches within agricultural transformation efforts.

Within only three years of inception, TAAT Crop Compacts operated across 28 African countries to advance 76 proven technologies bundled into technology toolkits by national partners through 88 monitored interventions. These efforts reached 10,616,372 households that accepted and co-invested in these innovations across a total 4,542,605 ha. This represents an average investment of $1,245,060 per country and $3.28 per adopter. The increased agricultural production that resulted was 12,148,519 t on a harvest weight basis worth an approximate $814 million based upon February 2021 prices. In this way, the Program offered a Benefit-to-Cost Ratio of 24:1, suggesting a high return to donor investment. These gains are those that were reported during the three-year Phase 1 Program cycle only, and do not consider longer term adoption and impacts beyond that interval or co-investment by other projects and partners.

If one assumes that Africa's food imports have grown to greater than $50 billion per year and that the sum of TAAT's efforts is only $814 million, then the extent of the imbalance is about 60-fold greater than the solution that the TAAT Program alone offers. This then raises the question of how can a successful Program such as TAAT be amplified to such a large extent, at what cost, and how can the required resources be raised? Alongside these technologies focused on varieties and breeds, other important technologies include those that address climate change, such as crop insurance, irrigation infrastructure, mechanization services, and digital information support. Equally important and revealing are the overall benefits enjoyed by TAAT's individual technology adopters. The average adopter committed an area of 0.43 ha to TAAT toolkits resulting in an average increased

dry weight productivity of 1.17 t/ha; an increase of 51% over initial baseline yields. This performance resulted in an increased household food supply of 670 kg (DW) per year or increased revenues of $120 depending upon how these harvests were utilized. Clearly, these gains are substantial from a household perspective but must be scaled upwards for impacts to become reflected strongly within country statistics or as documented movement toward Sustainable Development Goals.

A technology-based model able to modernize African agriculture is now available.

It is based upon bundled solutions that may be adjusted for different conditions and clients but with a proven capacity to be taken to scale through innovative partnership and finance mechanisms. At the same time, it is recognized that modernizing technologies alone are not able to evoke transformation unless the human and institutional capacity bottlenecks as well as policy and market weaknesses are addressed because their adoption is dependent on a "demand pull" and capacities to utilize them. Within the same projects that mobilize technologies, there must also be institutional and market innovations that anticipate and utilize increased production. TAAT provides for an enabler Compact dedicated to addressing capacity needs for scaling technologies, focus on priority commodities that are specifically intended to replace food import imbalances or that substitute for those imports is one means to ensure this market. In addition, the suite of technologies includes value addition to resulting

food surpluses that processes them into products suited to higher-end markets and export. When these advantages are combined with household-level benefits of increased food supply and better nutrition, a winning combination is achieved. The targeting of these technologies is also critical. Evidence suggests that women have lower access to technologies and extension services and are thus unfairly disadvantaged. The technology-based model must therefore consider the different constraints and opportunities that exist to engage, reach, benefit, and empower women.

How this model is extended and amplified is obviously a matter of further deliberation. Ultimately this model must be demand-driven at the regional program and national project levels, particularly as a component within sovereign country loans. While it is important to understand which technologies are most appropriate where, it is more important that these solutions be packaged in an understandable and accessible manner and disseminated for ready adoption within country- and community-level interventions. A prescriptive formula that determines which technology is best suited for where is likely less effective than offering a well-presented catalog of options to all, and then assisting in the design of solution packages and the brokerage of their component technologies on a demand basis. This strategy must also consider policy and institutional bottlenecks to expansion and scale as well as the market incentives that create demand for steadily increased production.

When applying this model, it is important to recognize the critical role of rural youth because they are the inheritors of Africa's farming systems. Transformative technologies and business models must include those that appeal to these youth and the characteristics they seek are becoming better known. Youth seek to

produce higher value crops or add value to produce in ways that offer guaranteed markets and reasonable profits. They embrace mechanization and automation to avoid the drudgery associated with traditional farming. They are adept at digital agriculture applications that allow for better planning and targeting, real-time diagnostics, and reliable market intelligence. These same youth better understand environmental protection and are prepared to undertake green and blue enterprises that support climate action and foster biodiversity. These youth are not homogeneous in that their career paths toward modern farming are influenced through a variety of mechanisms, including social media, secondary and vocational education, and agribusiness incubation. The concentrated efforts of the recent past to empower youth, including young women, have resulted in a new generation of champions and it is critical that those engaged in agricultural transformation listen to them.

> Now is the time to offer this model and mechanism to Africa's wider agriculture development community.

The way this is done is of critical importance. This offer is thereby extended to all existing regional organizations with consideration to how well TAAT and similar programs align to their strategies, and what roles they may play in future technology scaling. Alliances can signal huge opportunities, as with the Africa Union Commission-FAO task force effort in response to the impact of COVID-19 on food and nutrition security, the CAADP-World Bank climate resilience effort, and the EC/DeSIRA-IFAD-CAADP-XP4 institutions' regional effort on supporting

the implementation of a science-led, climate-relevant agricultural transformation across the continent. Indeed, modernizing technologies must be extended in COVID-safe and climate-smart manners. Other smaller partnerships are equally important, particularly with private enterprises interested in commercializing improved crop varieties and their accompanying technologies, or to community-based organizations seeking solutions to persistent production and marketing constraints. The table is open for free-ranging High-Level Dialogue on these opportunities. What is also understood is that to do nothing or nothing new is simply unacceptable. The threats of continued food and nutritional insecurity across Africa are too great. Humanitarian justice demands action. The necessity of agriculture as the most available engine for economic growth across Africa cannot be ignored and it is through this momentum that many targeted development and economic goals shall be achieved.

Much has been done to prepare for this High-Level Dialogue. An assortment of recent success stories has been documented. TAAT's approaches and impacts were compiled to sharpen its use as a model and mechanism. The widest possible assortment of African organizations and governments were invited to participate within it. What is expected from its participants are commitments to this process and contributions to our joint operations. Indeed, partners are now expected to buy into the "next-TAAT" with more than well-meaning words and can expect for these commitments to be authenticated into the future. New partnerships that enable mainstreaming of technologies into country strategies and market mechanisms will result. Expanding the scope of technologies to include digital access, COVID-safe, and climate-smart action will follow.

In return, we will form a developmental framework that describes what exactly shall be achieved and over what time frame. The targets will be in line with Sustainable Development Goal 2 (zero hunger) and should inform the

commitments to be made at the 2021 United Nations Food Systems Summit. From the AfDB perspective, commitments are now expected from its Regional Member Countries with the understanding that future loans will be shaped around this process. Similarly, from the IFAD perspective, commitments are now expected from African Governments and development partners to strengthen the effectiveness of delivery infrastructures in supporting the generation and scaling of technologies with the understanding that future financing will consider this dimension. From research partners, it is expected that technology bundling and demand-led scaling be prioritized in the near term while a stream of useful research products will continue to flow into the future. It is important that a Research-for-Development fund be developed for this purpose. National partners need to replicate and greatly expand successes and the means to do so shall be incorporated into country projects. This includes the full participation of relevant Ministries, notably Agriculture, Finance, Science and Technology, and Trade. Means to innovative inclusion of the private sector and capacity builders are also recognized. Ultimately, we expect solid commitments from senior government officials, including Heads of State, so that we can pursue the vision of a modern and vibrant agricultural sector across Africa. History will expect no less from us.

Advancing Modernizing Technologies within Africa's Agricultural Transformation Agenda: A Call for Unity and Action

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