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Assessing Capacity Needs for Strengthening Agricultural Innovation Systems in Africa

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Abstract
The paper discusses the capacity-building needs that need to be streamlined to boost agriculture innovation systems (AIS) in Africa. It researches the impacts of institutional, technical and human potentials on the efficiency and sustainability of innovation within the agricultural development. The paper assesses the challenges and barriers to current knowledge sharing, collaboration of stakeholders and policy frameworks, and research infrastructures to find areas of most urgency of intervention. The results indicate that dedicated investment in training, institutional change, and cross-sectoral collaboration are key to induce farm development, elevate efficiency and encourage inclusive growth in the farm. The paper also focuses on the relevance of the context-based approaches that can enhance local capabilities of innovation and provide the sustainability of impact.
Keywords: ***Agricultural innovation systems, capacity building, institutional development, knowledge transfer, stakeholder collaboration, agricultural productivity, Africa, rural development, policy frameworks, innovation capacity.***

1.Introduction
Many African economies still rely on agriculture as their mainstay but its challenges (including food insecurity and poverty, climate change and poor technological diffusion, among others) indicate that change is dire. At the heart of such a change is the reorganization of both knowledge application and management of science and innovation. The notion of innovation systems has, in the recent past, ceased as a promising perspective on improving the process of agricultural development in Africa by connecting scientific knowledge with the wider landscape of actors, in the form of policymakers, farmers, non-governmental organisations, the business sector and regional organisations(1). This paper aims at discussing the critical capacity building needs that are required to support the transformation of African agricultural systems towards more innovative, inclusive, sustainable agricultural systems. This is by re-casting the discourse of agricultural research and its socio-economic consequences, its connection with institutional change, science policy and stakeholder involvement.
Since ancient times, due to its Green Revolution heritage, Africa has been the centre of agricultural research that has been geared toward enhancing the productivity of crops using technology-oriented intervention. In as much as this resulted in some positive increases in food output, they alluded little to the social, political and economic environments within which innovation is undertaken. Moreover, the conventional so-called linear approach to technology transfer, i.e., transfer out of research institution to extension agencies and, finally, to farmers, has been shown to be irrelevant to the realities of African agriculture, which have been progressively complicated and complex. The introduction of biotechnology, digital agriculture, and the other disruptive technologies has created new opportunities, including new governance issues associated with equity, ethics, risk and regulatory systems. This involves the need of scientists, as well as research managers and development practitioners, to ascend complex terrain as the technological change needs to be accompanied by public accountability, policy coherence as well as her social legitimacy.
Among the most urgent reasons to consider the renewed interest in capacity development is the increased contribution of the private sector in the area of agricultural research and development (R&D). The focus of innovation has moved out of the purely public institutions due to globalization, trade liberalization and commercialization of agricultural inputs. This has brought opportunities as well as tensions. On the left hand, the private sector will come in with financial resources, high efficiency and market accessibility. Conversely, it tends to appraise profitability over and above inclusivity and sustainability(2). The growing call to redefine the role of public agricultural R&D systems is occurring as public systems find themselves in budget-constrained environments with low relevance of their work, and at a time when the industrial environment is already being

transformed into triple helix comprising industry, civil society and smallholder producers. Policymakers and scientific leaders now find themselves in a situation where they have to make sure that the innovation pathways become receptive to the demands of marginalized groups, and responsive in terms of global value chains as well.
The issue is not only about funding and collaborations. African public agricultural research organizations are becoming more and more questioned about its accountability, performance and capacity to deliver. The findings of the research are not always translated to reach rural poor even after decades of the input, because of the poor connections between the results of the researches and the demands of the end users. It has contributed to the request that the model of innovation is more on the integrated model, which is demand driven and also socially engaged. Such a model can be found in the innovation systems approach which focuses more on networks, feedback loops, co-evolution between actors instead of only the creating of scientific knowledge(3). Notably, the method implies the appearance of new kinds of competencies in the sphere of African agricultural institutions: systems thinking, policy literacy, interdisciplinary cooperation, and adaptive management.
Being aware of these deficiencies, a vision by the New Partnership for Africa Development, also known as NEPAD, was presented so as to improve the abilities of African scientists and research managers in the context of science-policy priorities related to agricultural development. It is based on the realization that good innovative does not just require good technology but building mechanisms that can enable innovation, institutions, policies and legal framework as well as cultural practices that can enable learning, experimentation and responsiveness. Having entered the stage of operationalization of this agenda, NEPAD requires answering the following question: What capacities should be built, and how may it be done in a co-ordinated and effective manner?
In order to start finding an answer to this question, this paper utilizes a site of research variants, namely, literature reviews, institutional surveys, expert interviews, and case studies performed in a variety of African countries. Such a mixed-methods design enables to have a refined insight into what the barriers and opportunities of agricultural innovation in the system are. It unveils, to take one example, that most actors in research realize theoretically the significance of stakeholder involvement and interdisciplinarity, yet in practice they usually lack the instruments and institutional requirements to put them into practice. In addition to that, training programs and curriculums are not up-to-date, too technical and not oriented to the changing socio-economic and environmental conditions under which agriculture practices take place.
Also, the involvement of international partners and donors has to be questioned. Although foreign aid has played a central role towards the development of agricultural research in Africa, it has at some point shifted national priorities, increased dependency, and lack of institutional coherence. The essence of capacity building, therefore, entails enhancing African institutions to establish their agendas, negotiate funding relations and making substantial contributions into the global discussions on research(4). It requires capacity building in the form of human resource development as well as strengthening of organizations - building capacity should not be limited to individuals alone, but to structures, incentives, cultures driving institutional behavior as well.
It is the contention of this paper that the re-conceptualizing of agricultural development as an innovation systems would entail quite a significant change of mind-set-that the central figure in understanding something as a system should not be science as an entity unto itself but as a sub-system which is embedded in a greater socio-technical system. It not only entails investment in labs and technologies, but also into dialogue, networks and capacities to mediate across different knowledge systems. It demands the need to harmonize the world between policy and practice, scientific excellence, and development pertinence. Most importantly, it requires the establishment of learning organizations, research institutions that can apply some rethinking towards their task, experiment the new types of interaction and respond to changes.

2.Building Collaborative Agricultural Innovation Ecosystems in Africa

Over the past years, Africa has witnessed major conceptual shift in the paradigm of agricultural development. Conventional strategies based on the principles of isolated research, centralized extension systems and dissemination of technology in a top-down approach are getting over to acknowledgement that innovation is a social, dynamic process. With this shift has come into focus the idea of agricultural innovation ecosystems, dynamic multi-actor ecosystems in which knowledge, technology, finance, and policy interact to produce sustainable agricultural transformation. Experts, scientists and research facilities are not the only actors in such ecosystems, as farmers, agribusinesses, civil society, development agencies, and the private sector are also involved in co-creation of solutions that may suit the individuals of a specific place. In this section, the author

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discusses how African countries can develop such collaborating ecosystems through the operational redefinition approach of institutional roles, disciplinary silos, and stakeholder connections that lead to inclusive agricultural innovation(5).

The flaws of previous concepts of development, especially the linearized transfer-of-technology one, are currently recognized pretty well. The obsolete model considered research institutions to be the only source and origin of agricultural information that would be passed to other passive agents, usually farmers, via extension allowance. This mechanistic approach did not only ignore and marginalize indigenous knowledge system, but also could not capture the intricacy of local working farming systems based on economic, cultural and environmental factors. Otherwise, the innovation ecosystem model is more about feedback loops, social learning, and adaptation. It understands that innovation does not only happen because of breakthroughs in the form of technological novelty but because of prolonged interactions between actors that are situated within specific institutional and socio-political environments.

One feature of a strong agricultural innovation ecosystem is its focus on the aspect of interconnectivity that is establishing connections and channels of relationships as well as information among a variety of actors. These systems have been typified by the intensification of coordination, trust and iterative problem-solving in countries where agricultural innovation has been successful. Effective ecosystems encourage free flow of information between scientists and farmers, provide avenues of participatory research and encourage joint ventures between government and commercial companies. Notably, they move the gauge beyond the mere scientific measures (e.g. the number of peer-reviewed publications), and onto the more development-based indicators, i.e. the adoption rates, farmer income and environmental sustainability.

Such focus on teamwork does not overshadow the value of quality research in the scientific field. It does the opposite though; it increases the scope of relevance by making sure that research is agitated by problems in the field and can be verified as a result in the field (6). New capacities have to be developed by African scientists and institutions, not only in some advanced technologies, such as genomics or precision agriculture, but also facilitation, communication, and stakeholder engagement. To give an example, scientists will have to acquire skills of explaining the complicated scientific results to farmers and incorporate the farmer feedback to make changes in their research plans. The same applies to agricultural universities and think tanks, which have to revise their curriculum to comply with the interdisciplinarity of innovation, and its relationship with socio economic structures.

Institutional transformation is a significant facilitator of innovation ecosystems. Most of the public agricultural research organizations in Africa were configured in an earlier period, they have inflexible mandates, bureaucracies and little stimulation to inter-sectoral activities. To achieve effectiveness in an ecosystemic model, such institutions need to become more nimble, decentralized and responsive. This can also include redesigning organizational structures to accommodate cross-functional teams, integrating social scientists and innovation brokers within research and constructing policy spaces to experiment and learn. Besides that, innovation ecosystems will require more coherence between national policy, funding models, and ground realities, in order to make innovation approaches more top-down supportive and bottom-up operational.

The role of the private sector in these ecosystems is hard to overestimate. With increasing commercialization and input intensity in agriculture, the use of technology is being accelerated more by privately owned companies through seed systems and digital platforms as well as value chain integration. But the private sector frequently does not have the capabilities or interest in contacting marginalized farmers, at least not in the remote regions. Therefore, governments and research institutions can contribute to the development of business models that are inclusive, they can provide incentives to innovation that is pro-poor, and they can be able to participate in the development of public-private partnerships where risks and gains are shared. Meanwhile, non governmental organizations, cooperatives and farmer associations play a key role linking the voices in the countryside to innovation agendas in the national and global levels.

One of the most significant obstacles to the practical implementation of agricultural innovation ecosystems is the absence of the common understanding of what these systems are(7). There is general support by a large number of stakeholders to the concept of collaboration and systems thinking but in many cases, they do not have the institutional cultures, tools, or resources to pursue the concept. Indicatively, a large proportion of agricultural scientists are still educated in strictly-defined fields of study and are measured using traditional scholarly standards that fail to favor ecosystem interactions. There is also tendency on the part of policy makers to treat R&D as a separate entity instead of a cutting-across tool of development. The solution lies in capacity building initiatives in

which stakeholders will be exposed to systems thinking, and management innovation, and collaborative governance.

New projects offer grounds of hope. To give an example, certain research organizations throughout Africa are embracing the concept of so-called innovation platforms a multi-stakeholder arena in which producers, processors, researchers, as well as service providers jointly design interventions on common difficulties. Another group is experimenting by piloting integrated research themes integrating crop improvement with climate resilience, gender equity and market access. These initiatives prove that, well supported by correct institution, even the least favored systems with resources may produce effective outcomes. But replicating or scaling the best of these innovations across nations and contexts does not depend on a few individual success stories, but on a transformational change in the way agricultural innovation is theorized and funded and managed.

To sum up, Africa needs innovation ecosystems inclusive of interactiveness to transform the agricultural landscape by shaking off individualistic innovation strategies. These systems utilize the various capabilities of actors throughout the value chain and they are supported by mutual accountability, continuous learning and context related solutions (8). In order to make this transformation reality, African governments, research institutions and development partners need to invest not only in technology but also in the relationship, structure and norms which make innovation really work. Africa can only fulfill its food security, economic inclusion and environmental sustainability ambitions by placing agricultural R&D at the centre of a larger ecosystem of transformation.

3.Strategic Capacity Development for Inclusive Agricultural Innovation in Africa

Within the context of an impossible acceleration of environmental, technological and economic discontinuities in African agricultural systems, the effective and inclusive capacity to innovate has become a burning necessity. The African countries should not only invest in agricultural technologies to overcome this challenge but also evaluate and solve the institutional and human capacity gaps which delay innovation. The section includes systematic reconsideration of capacity development requirements in the frames of the inclusive agricultural innovation with focus on the significance of system readiness, interdisciplinary competency and alignment of stakeholders.

One of the basic findings is that technological progress in agriculture can no longer be observed as the only form of innovation. It is becoming imminent that it needs to be integrated with the wider policy, economic and social systems. Therefore, the political, institutional and partnership dimensions ought to be mainstreamed in capacity building as well as technical expertise. The presence of stakeholders within all the areas of research, government and civil society is the key issue at hand that needs to be empowered not only to create new knowledge, but also to understand the intricate interactions within which it finds application. The ability to negotiate, broker the competing interests, build trust in heterogeneous networks has become as important as scientific skills.

A. Reconceptualizing Science Policy in agricultural development

Among the most notable conclusions of the recent evaluations, one should mention the fact that the current science policy as applied to the field of agriculture lacks the resources to administer the scope of innovations in African realities. Even though, technological progress based on speed like biotechnology, precision farming, and digital agriculture have enormous potentials, the challenges that come with its application are equally as regulated, ethical, and social issues. African scientists in the agricultural field and policymakers usually receive inadequate training on how to go around these problems, which encompass intellectual property rights (IPRs), biosafety rules, and or fair sharing of benefits(9). This is a gap that hinders effective translation of research into developmental outcomes especially among the marginalized communities.

In addition, science policy is commonly handled as a distinct entity as opposed to being part of the research and development. Consequently there is a regular mismatch between policies on agricultural research and the actual constraints and opportunities an end user of the research- farming, processor, and local entrepreneur has to work with in the real world. There is, accordingly, an essential capacity requirement to integrate policy analysis into the scientific research systems with a vision that innovation must be steered by strong knowledge base of governing institutions and systems, the realities of marketplaces and the values of societies.

B. Construction of Interdisciplinary and Transdisciplinary Skills

Conventional education on agricultural sciences has tended to focus on disciplinary specialization resulting in a strong expertise that hinders the researcher in complex real-life problem-solving. The innovative world requires systems thinking i.e. ability to develop the understandings gained in the sectors of the agronomy, economics,

sociology, ecology, and political science. This requires reform of curriculas on agricultural universities and training centers in order to facilitate interdisciplinary education and project-based learning.

Specifically, the researchers have to be educated how to work intersectorally and interorganizationally. It is not only the technical skills that are needed to comprehend how to communicate with farmer cooperatives, engage with private agribusinesses, negotiate with NGOs and government officials but emotional intelligence, ability to communicate and negotiate approaches. The absence of training in these so-called soft skills has long been a drawback of many good-hearted initiatives which often fail to create a long-term impact because of poor alignment with their stakeholders.

C. Increasing the level of institutional partnership and innovation platforms

The other fundamental gap in capacity is the development and maintenance of effective partnership. Innovation is not built in a vacuum but is rather in an environment where the public and the private institutions, research organizations, and the local communities interact. Nevertheless, most African agricultural research organizations do not have well-developed systems that can deepen and maintain such partnerships. The common ones are weak networks, lack of coordination, and distrust among stakeholders.

The remedy to this is capacity building, which is geared towards supporting institutions to be facilitators of innovation platforms; multi-stakeholder forums, where there is co-definition and co-production of solutions to the challenges affecting them. This is done through the training of participatory techniques, inclusive governance, and conflict resolution, and accountability structures. It needs resources, too, to run these platforms on the ground exercise infrastructure, meeting spaces, flexible funding mechanisms that can permit experimentation, and iteration.

D. Finding their Way Through the Ever-Shifting Relationship of the State and Donors

The role of governments in agricultural innovation and the donors are transforming. Although historically the state has been in the centre of directing and funding research, monetary crunch and emergence of the private sector has opened up the stage of innovation. Governments should today be seen as enablers- establishing favorable environment by using policy incentives, regulatory changes, and promoting knowledge trade. Although a lot of policymakers do not posses technical foundation to make a decision on complicated issues of science and policy.

Similarly, donor agencies are moving towards the results-based funding model, which necessitates recipient institutions to define precise theories of change, prove the effects and comply with international standards. African scientists and administrators are not usually trained on how to develop proposals, approach donors and manage the projects which decreases their chances of competing in foreign funds. These areas require capacity building in order to have local ownership of innovation agenda and a associated decrease in reliance of outside consultants or intermediaries.

E. Reactions to Emerging Contexts

The agricultural research and innovation systems should be flexible. High speed of climatic change, a dynamic business environment, pandemic, and geopolitics require that institutions are agile in terms of learning, and adaptation. However, most African research organizations are bureaucratic and change slowly as well as being averse to risk(10).

The creation of learning organizations will involve an investment in the development of adaptive management capabilities, knowledge management strategies and monitoring and evaluation mechanisms beyond accountability facilitating reflection and the taking of strategic course-corrective action. Leadership development is also essential; it is enabling managers and mid-level personnel to become change leaders, new model testers, and scaled whatever proves effective.

F. Novelty and Knowledge Translation

More than contents of what is taught, the issue of the capacity development delivery is very crucial. Conventional workshop applications, which mostly lack relevance to the work environment of the workshop participants, are not effective. Best practices emerging today lay stress on experiential learning, case based teaching, peer to peer exchange, and action research. Participants are not supposed to gain new knowledge only but use it in real-time to apply to real problems.

An example of possible links would be biosafety training would be combined with the institutional policy reform project and communication training would be undertaken by co-producing innovation briefs with farmer groups. Moreover, the learning should be inclusive- it should focus not only on the researchers but also on the policy actors and the extension agents, the head of the civil societies, as well as the young entrepreneurs.

In this respect, the growing interest to create a cadre of so called specialists in the training-of-trainers who are to spread skills within their institutions. Capacity-building materials should also be universal, culturally oriented and in various languages and forms through off- line and on-line means.

4.Conclusion

Isolated technological progress, as well as the piecemeal institutional changes, cannot lead to agricultural transformation in Africa. Rather, it dictates a totality of reorganization of the entire notion of realizing, categorizing and maintaining innovation all around the continent. As presented in this paper, and as supported by the strategic capacity building in the form of inclusive, responsive, and integrated agricultural innovation ecosystems, this is the best prescription to the chronic problem of food insecurity, poverty, and underutilized scientific potential in African agriculture.

Following decades of good intentioned yet in most instances disjointed efforts, it has recently become more evident that the relative inability of agricultural research in Africa to have a significant impact has more to do with failure to integrate and coordinate systems and align capacities than with science. No matter how sound technically the research institutions are, it will never flourish and bring any significant change when they are isolated out the social, political and economic twists within which the innovation is to germinate. The only way to open up the agricultural potential of Africa is, therefore, to provide its institutions and actors with the policy expertise, coordination systems and adaptability they require to live with complexity.

A favourable development lies in the increased awareness of an innovation systems thinking, in which the role of networks, interactions, feedback loops, et cetera that bring ideas into application is also an indicator of success. It requires capacity on many levels: of grassroots actors taking part in co-design processes, of mid-level scientists enabling interdisciplinary research, and senior policymakers making scientific evidence accessible in inclusive national strategies. An innovation ecosystem approach restores the concept of capacity building to multi-stakeholder, cross-sectoral, learning-intensive process and does not exclude individuals in need of a technical upgrade.

Most importantly, capacity development should change its role towards systematic learning and institutional change instead of ad hoc training. This entails entrenching policy analysis in research activities, enhancing science society communications, assisting in reforming leadership and governance within farming institutions and synchronizing the investment of donors to meet the priorities of the land. Also, development of rigorous curricula, policy-relevant case studies, and inclusive training models that could be used to support the process, as well as institutional learning and innovation preparedness monitoring tools should be part of the capacity building.

NEPAD and its partners have a golden chance to undertake a coordinated continental effort to take economic growth, heading towards the next generation by focusing on capacity development as a strategic baseline of agricultural innovation. In this bid, national and regional institutions must not be the only ones that are assisted, but also create a pan-African structure that can facilitate cross learning, harmonised policy advice as well as resilience overtime to the emerging global challenges.

Simply put, developing capacity in innovation is not only concerned with enhancing what will be possible in African institutions, but how they think, how they work together and how they evolve. It is a matter of making space, new voices, new formations, new problem-solving not based on foreign facts and aspirations, but on African realities and aspirations. Proper investments, vision and political determination will help Africa to restructure its food systems into a source of inclusive growth, ecological integrity and financial independence.

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Conflicts of interest

The authors have no conflicts of interest to declare

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