Expanding arable land under irrigation is cardinal in the quest to attain Africa’s aspiration of transforming agriculture and realizing its true value and positive impact on wealth creation, economic growth, food security and nutrition for all. Over the last three to four decades, many initiatives have been designed to harness both small- and large-scale irrigation technologies towards increasing agricultural production and productivity. The EAU4Food (European Union and African Union cooperative research to increase food production in irrigated farming systems in Africa) project was a collaborative project under the EU–African Union Scientific Partnership aimed at enabling the successful adoption and upscaling of appropriate irrigation support innovations. The project applied a transdisciplinary approach to design, test and disseminate innovations across the continent. The project was designed to gain better insights vis-à-vis how the innovation process can be enhanced, and to share insights for supporting the implementation of national agricultural development programmes and strategies conceived within the context of the Comprehensive Africa Agriculture Development Programme (CAADP) framework. This note highlights linkages between the CAADP framework and the EAU4Food project and suggests some future areas of attention on Africa’s agenda for enhanced agricultural production, facilitated under the auspices of CAADP. © 2019 John Wiley & Sons, Ltd.

KEY WORDS: agricultural development; irrigation; innovation; CAADP

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Étendre l’expansion des terres cultivables irriguées est essentiel pour concrétiser l’aspiration de l’Afrique à transformer l’agriculture et à réaliser sa véritable valeur et son impact positif sur la création de richesses, la croissance économique, la sécurité alimentaire et la nutrition pour tous. Au cours des trois ou quatre dernières décennies, de nombreuses initiatives ont été conçues pour exploiter les technologies d’irrigation à petite et grande échelle afin d’accroître la production et la productivité agricoles. Le projet EAU4Food (recherche en coopération entre l’Union européenne et l’Union africaine visant à accroître la production alimentaire dans les systèmes de culture irrigués en Afrique) était un projet de collaboration mené dans le cadre du partenariat scientifique UE–Union africaine visant à permettre l’adoption et la valorisation à grande échelle des innovations appropriées en matière de soutien à l’irrigation. Le projet a appliqué une approche transdisciplinaire pour concevoir, tester et diffuser des innovations sur tout le continent. Le projet a été conçu pour mieux comprendre comment le processus d’innovation peut être amélioré et pour partager des idées permettant de soutenir la mise en œuvre de programmes et de stratégies de développement agricole nationaux conçus dans le cadre du Programme détaillé pour le développement de l’agriculture en Afrique (CAADP). Cette note met en évidence les liens

**Correspondence to:** Dr E. Phiri, University of Zambia, School of Agricultural Sciences, Department of Soil Science, P.O. Box 32379, Lusaka, Zambia. E-mail: ephi@unza.zm

**Développement transdisciplinaire et adoption des innovations en irrigation en Afrique: liens avec les principes du PDDAA. Un commentaire**

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INTRODUCTION

About 630 million ha of land in Africa (60% of the world’s arable land) is considered suitable for cultivation, directly supporting livelihoods for over 70% of the continent’s population (Biteye, 2016) through subsistence and commercial agriculture. Much of Africa’s natural resources are barely harnessed due to low investment.

Overall, Africa was moderately rebounding in 2017, registering an average of just below 3% gross domestic product (GDP) growth per annum, after recording 2.2% in 2016 (African Development Bank (AfDB), 2017). This recovery is, however, weak and is challenged by rapid population growth. Therefore, land being under human pressure, it is part of the solution and cannot be ignored hence far-reaching actions are required across several areas of interventions. Land use change and rapid land use intensification have supported the increasing production of food, feed and fibre (IPCC, 2019).

Notwithstanding difficulties in acquiring reliable quantitative information, there is evidence to assume that close to 350–400 million people still live on less than US$1.25 a day (AfDB, 2017; United Nations Statistical Commission, 2016).

This discrepancy in the pace of economic growth against population growth threatens the demographic dividend, including efforts to enhance employment creation and poverty reduction. African agriculture is critical to building and strengthening social and economic resilience and prosperity, as well as supporting household, national and global food and nutrition security, while still ensuring environmental resilience. For most countries in sub-Saharan Africa, agriculture is an important economic driver, whereas regional differences are reflected by a share in the GDP of more than 60% in Western Africa and 22% in Southern Africa correspondingly (Organization for Economic Cooperation and Development (OECD), Food and Agriculture Organization of the United Nations (FAO), 2016).

Especially in semi-arid areas, irrigation on smallholder farms is increasingly gaining attention (Burney et al., 2013), including the demand for water security, improved water productivity and a reliable water supply (Mofya-Mukuka and Hichaambwa, 2016).

The potential of agricultural productivity is closely linked to environmental factors, particularly water and soil quality. Especially given increasing climate extremes, there is a need to adapt food systems (Thornton et al., 2014). With more frequent occurrence of droughts and dry spells, innovation in irrigated agriculture will become increasingly important and the Comprehensive Africa Agriculture Development Programme (CAADP) clearly recognizes the need to increase the resilience of livelihoods and production systems to climate variability and change and other shocks (African Union, 2014). At the same time, Africa’s soils vary substantially by region and spread across arid and semi-arid subregions characterized by inherently low soil fertility to support agricultural production. The heterogeneity of African soils, agro-ecological conditions and crop production systems requires the use of targeted productivity-enhancing products and services. For the past four to five decades, Africa has mainly expanded the area cultivated to enhance production. However, together with poor crop husbandry, the extensive use of land has resulted in extensive environmental problems, such as nutrient mining; desertification; degraded soils; massive erosion; and loss of forests, wetlands and pastures. Consequently, to some extent, this has posed challenges to Africa’s long-term agricultural productivity and the sustainability of its agricultural production.

While still being a marginalized group with considerably low production, smallholder farmers represent a particularly relevant socio-economic component in respect of food security, family health, gender balance and social cohesion (Baiphethi and Jacobs, 2009). To improve the quality of life and the economic perspectives for African people in rural areas, it is therefore important to include smallholder farmers in the target group for expanded irrigated agriculture.

Overall, irrigation development is among the key potential investment areas requiring attention and advancement if Africa is to attain its intended long-term African Union (AU) Agenda 2063 (https://au.int/en/agenda2063) and an explicit request within the Implementation Strategy and Roadmap (IS&R) to achieve the 2025 Vision on CAADP (African Union, 2014) (Box 1).

Box Main Components of the CAADP Framework (NEPAD, 2014)

| Components of the CAADP framework: |
|-----------------------------------|
| 1 the pursuit of agricultural-led growth as the main strategy to achieve targets on food and nutrition security; |
| 2 exploitation of regional complementarity and cooperation to boost growth, |
| 3 the application of principles of evidence-based planning, policy efficiency, dialogue and inclusiveness, transparency and accountability; |
| 4 fostering mutual partnerships and alliances, and |

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5 commitment to results and to strengthening and aligning systemic capacity for effective and efficient implementation.

Africa’s common policy and investment framework for agricultural transformation, wealth creation, food security and nutrition, economic growth and prosperity, are enshrined in the Comprehensive Africa Agriculture Development Programme (CAADP)—an integral part of the New Partnership for Africa’s Development (NEPAD). CAADP was conceived by African Union Heads of State and Government in 2003 as a driver for accelerated economic growth and poverty reduction in the continent (www.nepad.org). African leaders upheld this commitment in the ambitious Malabo Declaration (June 2014). It is essential to note that CAADP (Box 1) is the most comprehensive agricultural reform effort ever undertaken in Africa and represents a fundamental shift towards development that is wholly owned and led by African governments. Malabo was designed to sustain the momentum gained during the first decade of CAADP implementation. It ushers in a more elaborate agenda and emphasizes a need to focus on enhancing the role of agriculture in wealth creation and in expanding economic opportunities for the continent’s population, particularly women, the youth and rural populations. Malabo has also transformed the initial two overarching CAADP targets (i.e. allocation of 10% of national budgets to the agricultural sector in pursuit of a 6% average annual agricultural sector growth rate) into seven key areas including the need to sustain the momentum gained during the first decade of CAADP implementation (Box 2).

Box Overview of the Malabo Declaration (NEPAD, 2014).

1 Recommitment to the principles and values of the CAADP process;
2 Recommitment to enhance investment finance in agriculture:
   • uphold 10% public spending target;
   • operationalization of the Africa Investment Bank;
3 Commitment to ending hunger by 2025:
   • at least double productivity (focusing on inputs, irrigation, mechanization);
   • reduce Post Harvest Losses (PHL) at least by half, and improve nutrition - reduce stunting to 10%
4 Commitment to halving poverty by 2025, through inclusive agricultural growth and transformation:
   • sustain annual sector growth in agricultural GDP of at least 6%;
5 Commitment to boosting intra-African trade in agricultural commodities and services:
   • establish and/or strengthen inclusive public–private partnerships for at least five (5) agricultural commodity value chains with strong linkage to smallholder agriculture;
   • create job opportunities for at least 30% of the youth in agricultural value chains;
   • preferential entry for, and participation by, women and the youth in gainful and attractive priority agribusiness;
6 Commitment to enhancing resilience in livelihoods and production systems to climate variability and other shocks:
   • ensure that by 2025, at least 30% of farm/pastoral households are resilient to shocks;
7 Commitment to mutual accountability for actions and results:
   • through the CAADP results framework—conduct a biennial agricultural review process.

The key areas in Malabo also provide the front-line indicators for transformation and performance of the agricultural sector.

With over 95% of African agriculture dependent on rainfed techniques, irrigation has been noted as one critical area to advance sustainable land and water management, considering that its share of Africa’s cropland is about one-third of the world average (World Bank, 2007; Svendsen, 2009).

Under Pillar I of CAADP, the issue of sustainable land and water management was identified as a key priority investment area, crucial for enhanced production and productivity, environmental resilience and climate-smart agriculture. In this regard, the focus has been on advancing innovation in technological development, as well as human and organizational development. This entails development related to structural and institutional arrangements at national, regional and sector level or any other level of development, which has been spearheaded through the CAADP process.
CAADP National Agriculture and Food Security Investment Plans (NAIPs)

At the end of 2014, 45 countries had finalized their CAADP National Agriculture and Food Security Investment Plans (NAIPs). NAIPs are detailed financial plans drafted from evidence-based analyses and multi-stakeholder consultations. A quick analysis indicates that all 45 countries had identified and selected irrigation among their top five priority programme areas. Specific programmatic areas range from irrigation equipment/technologies to skills and management training. In all the cases, there is a greater appreciation of the role and value of private-sector participation/investment in advancing irrigation development. Necessary elements that would enable the success of the industry in this space include an enabling policy and regulatory environment; multi-stakeholder conversations and participation; financing; as well as participation in technology development and supply, including management of after-sales facilities. It is also important to emphasize that an irrigation development system, which is integrated into viable agricultural commodity value chains, is needed to ensure the success of the NAIPs.

All these advances are gaining momentum within the context of CAADP, with countries paying more attention to evidence-based planning and prioritization, social responsibility, and inclusiveness. These issues have advanced the collective responsibility for agricultural development across public- and private-sector players, as well as civil society and other key stakeholders.

CAADP, which is reinforced by the Malabo Declaration, has also emphasized the need to nurture and strengthen smallholders in commodity value chains—from subsistence to partial and full commercial units and practitioners/farmers. This will create a direct linkage between increased agricultural productivity and the opening of increased economic and job opportunities for rural and, generally, poorer communities. Through the multisectoral and multidisciplinary principle of CAADP, agricultural players and stakeholders, as well as agricultural policies and subsequent regulations, are interacting more openly and coherently in advancing agricultural development. In matters of irrigation development, for instance, this is essential when it comes to rallying necessary capital infrastructure investments such as water harvesting and storage dams.

The intensity and extent of poverty, food insecurity and malnutrition in Africa encourage CAADP member states to recognize the significance of CAADP and to appreciate the necessity for accelerated reform of national policies and effective design of programmes aimed at contributing to eliminating hunger and malnutrition on the continent.

Biennial reporting to AU

It is essential to note, further, that AU member states are required to report biennially to the AU Heads of State and Governments Summit, through a well-designed scorecard that was developed to highlight progress made in achieving the Malabo Declaration targets. Under this process, some common indicators have been developed to enable countries to track similar issues and to influence a sort of peer-learning agenda in the continent. Among areas that are measured under the biennial review reporting (BRR) processes is the issue of progress made in irrigation development. The first report/scorecard, which serves as a baseline for future reporting, was presented to the AU Summit in January 2018. This signifies the importance that African leaders have placed on the Malabo Declaration and the need to ensure progress is made to attain targets that have been spelled out in specific priority areas including reliable water systems.

Viewing EAU4Food from the perspective of the CAADP principles

The European Union and African Union cooperative research to increase food production in irrigated farming systems in Africa (EAU4Food) was a collaborative research project that focused on enhancing and sustaining agricultural productivity in irrigated farming systems (Dolinska et al., 2018; Froebrich et al., 2019). It was funded by the European Commission under the 7th Research Framework Programme and the particular FP7-Africa 2010 Call, as part of the EU–African Union Scientific Partnership, with additional financial contributions from participating partner countries.

EAU4Food was executed in four irrigated zones of Africa. These zones were purposefully selected to stretch over the entire continent and to represent Southern Africa (Mozambique and South Africa), Northern Africa (Tunisia), West Africa (Mali) and East Africa (Ethiopia).

By implementing a transdisciplinary approach, the project had put smallholder farmers in the lead position of defining and testing innovative approaches. Results were shared and reflected in two distinct stakeholder platforms, namely Community of Practices (CoP), with a focus on the practitioners, and the Learning Practice Alliance (LPA), where they could interact with more stakeholders at higher decision-making levels.

Though EAU4Food was not formally linked to the CAADP implementation process, it is worth identifying apparent linkages.

CAADP recognizes the importance of irrigation, alongside inputs and mechanization, as a means to double productivity and to end hunger by 2025 (key area 3). In
general, the Malabo Declaration does not differentiate large-scale irrigation systems and irrigated smallholder farms. With its focus on smallholder irrigation, experiences of EAU4Food are critical to understanding how this important group of farmers can be supported in future.

Results of the project throughout the different agro-ecological zones and related agronomic systems (as reflected in this special issue) made it clear that innovation of irrigated smallholder agriculture is by far not just a technical issue. Any progress towards doubling productivity depends on realizing innovation. As this is intrinsically linked to increasing the basic ability of smallholder farmers to innovate and create an enabling framework to facilitate such a transition, measures to double productivity should not be restricted to technical training and the provision of technology and inputs. Farmers from all case studies also highlighted the need for enhanced market access. Likewise, institutional and organizational barriers, particularly when it comes to the operation and maintenance of centralized irrigation infrastructure, must be overcome.

Necessary strategies to improve the enabling framework for innovation as postulated above are directly linked to CAADP’s agribusiness perspective (key area 4), fostering inclusive agricultural growth and transformation resulting in Halving Poverty by 2025. To improve access to markets and to adapt agribusiness to include smallholder farmers, CAADP foresees the strategic role of inclusive public–private partnerships, also as one key principle to realize the Strategic Action Areas within the Implementation Strategy and Roadmap (IS&R) (African Union, 2014). Even though EAU4Food did not have the resources to initiate public–private partnerships at the case study sites, important insights were gained into understanding their relevance. Without partnering with relevant actors in the value chains, innovation in agribusiness often remains wishful thinking. Without strong public-sector engagement, the necessary additional measures to foster inclusiveness, capacity building and improved sustainable use of natural resources will most likely remain absent. At the same time, the project experiences in EAU4Food exposed how difficult it is to realize public–private partnerships in practice. Future measures to enable innovation in smallholder agriculture should strengthen the networking and marketing capacities of individual smallholder farmers and farmer associations. Likewise, the project revealed an equal need for decision makers, extension staff and local and international agronomic experts to internalize the understanding of agribusiness perspectives. Overall, EAU4Food showed how difficult it is to manage the transition from being just a producer, towards understanding farming as an agribusiness with the intention of entering into new partnerships and the change of the entire value chain.

Within key area 4, CAADP pledges to improve job opportunities for the youth and women as well. Initially, EAU4Food did not have a priority focus on these target groups. The South African and Mozambique case studies highlighted their relevance. Individual success stories as inspiring examples should be captured and disseminated to convince people that farming is not just a traditional burden, but an exciting and promising opportunity to generate income and gain societal recognition.

Key area 5, boosting the Intra-African trade, had not been a specific component of the EAU4Food project. However, the case studies executed revealed the need to improve the access of smallholder farmers to markets. Next to individual interventions at local scale, the boosting of intra-African trade can be seen as a relevant accompanying measure to create more and different marketing opportunities under the condition that it is accompanied by other measures that enable smallholder farmers to serve this market.

Irrigated smallholder farming within the EAU4Food case studies in Mali, Tunisia and Ethiopia highlighted the possibility of securing harvests under extreme climatic conditions. Naturally, irrigation can largely contribute to key area 6, Enhancing resilience in livelihoods and production systems to climate variability and other shocks. However, the project also revealed the dependence on well-functioning infrastructure, be it local pumps, dam gates or the maintenance of canals. This again showed that individual farmers’ simple investment in local technology would not lead to their success without them having the necessary enabling environment.

Irrigation is simple when there are abundant water resources. It becomes more difficult when many need to share the little. Under certain circumstances, optimization of existing usage can lead to a secured water supply for all users. This is particularly relevant for head- and tail-enders of a given irrigation scheme when over-irrigation causes waterlogging problems, and there is additional value added when head-enders irrigate with less water (Habtu et al., 2018).

Irrigation in Africa is not only challenged by water scarcity; floods also pose a significant threat to farm households. The 2012 flood of the Limpopo River severely damaged infrastructure within the EAU4Food case study in Mozambique, interrupting the water supply for a long period. Flexible systems, which can quickly be reinstalled, could be of additional value to increase resilience instead of relying on concrete canals and distribution works alone.

**CONCLUSIONS**

This paper outlined the linkages between the EAU4Food project and CAADP. The EAU4Food project investigated fundamental issues underlying challenges and opportunities...
for increasing and sustaining agricultural performance across the continent of Africa, focusing on five countries representing four different regions of Africa (Southern, East, West and Northern Africa). This project was one of only a few that combined sub-Saharan Africa and Northern Africa to seek means of addressing a common and major challenge to agricultural productivity.

The forming of CoPs and LPAs under the EAU4Food project was in strong conformity with CAADP principles. It encourages the use of partnerships and alliances that include farmers, agribusinesses and civil society in the implementation of agricultural development programmes. The project EAU4Food to a great extent matched several CAADP key areas, agreed upon in the Malabo Declaration. The project’s focus on irrigation and innovation in smallholder farming is in line with CAADP’s striving to end hunger, halving poverty and advancing resilience in livelihood against climatic shocks.

Implementing the EAU4Food project demonstrated ways in which true innovation in irrigated smallholder agriculture can be achieved through a transdisciplinary approach. The project gained additional ownership from the smallholder farmers and higher-level stakeholders involved. It also provided insights into the diversity of barriers to innovation across the African continent. In addition, the project revealed how much effort is required in terms of financial costs and investment of time to build such a wide ownership. As a consequence, key messages on lessons learned were only available at the end of the project. It would still be worth establishing a structural exchange on the EAU4Food key messages within CAADP and the CAADP member states.

This is of particular interest, as innovation in smallholder agriculture cannot be achieved without improving the enabling environment that addresses responsibilities in maintenance and operation, further capacity building in the view of agribusiness innovation, and ways to enhance farmers’ access to markets.

Being implemented by the individual member states, CAADP has no direct way to improve the enabling environment. However, the IS&R to operationalize the Malabo Declaration clearly aspires to ‘review and implement policy and institutional reforms that strengthen leadership, management and technical capacity in agriculture’, striving for improved leadership capacity to strengthen also broader and deeper multisectoral partnerships as well as agricultural policies that support the entire agricultural value chain (African Union, 2014).

CAADP will play an instrumental role in further supporting the already ongoing shift in mindset within the AU—creating an understanding that smallholder farmers are not just a vulnerable group, but one of the important players for vibrant innovation in agribusiness.

The role of public–private partnership and investment are fundamental in the CAADP process (and in irrigation development) and will help to widen the solution space in rural innovation.

Repeatedly advocating that agribusiness innovation must integrally address the optimization of irrigated production, pointing out additional perspectives for the youth and female farmers, strengthening the importance of climate resilience and intra-African trade, CAADP will stimulate AU member states to realize agribusiness innovation of smallholder farmers in a more holistic approach and to improve the enabling framework conditions accordingly.

Above all, linking EAU4Food to CAADP through the NAIPs at country level further enriches the mandatory Biennial Review Reporting activity by member states of the AU as required by African leaders towards achieving Malabo Declaration including the AU Vision 2025 of Zero Hunger.

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