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Editorial

Towards transforming agricultural food systems in Africa: Seed and production systems, pest control and farmer empowerment

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ABSTRACT
The question whether the higher potential of agricultural food systems in Africa would be achieved in the next two decades is increasingly being debated, especially in the context of exponentially increasing human population and the continued low agricultural productivity compared to the rest of the world. Although significant progress has been made, more needs to be done in terms of investment and research to boost crop yields, especially cereals such as maize, which is the most demanded and produced staple on the continent, and other traditional cereals such as finger millet. The African Journal of Rural Development (AFJRD), like many other scientific peer-reviewed journals, contributes to facilitate dissemination of research outputs to promote development. In this second issue of its fifth volume, scientists sought to address specific questions along the cereal crops value chains, in particular, seed and production systems, pest control and farmer empowerment, and discussed how these findings can inform interventions towards transforming agricultural food systems on the continent.

Keywords: agricultural productivity; land use management; Sub-Saharan Africa; honeybee; cereals; climate

RÉSUMÉ
Il est de plus en plus débattu si nous pouvons réaliser, dans les deux prochaines décennies, un potentiel plus élevé de production dans nos systèmes alimentaires agricoles en Afrique, en particulier dans un contexte d'explosion démographique, et de la faible productivité agricole comparée au reste du monde. Bien que des progrès significatifs aient été accomplis, beaucoup reste encore à faire en termes d'investissements dans la recherche pour accroitre les rendements des cultures, en particulier les céréales comme le maïs, qui constitue l'aliment de base le plus sollicité et le plus produit sur le continent, et d'autres céréales traditionnelles telles que l'éleusine. Le Journal Africain pour le Développent Rural (AFJRD), comme beaucoup d'autres revues scientifiques à comité de lecture, contribue à disséminer les résultats de recherche et promouvoir leur application pour développement. Dans ce deuxième numéro de son cinquième volume, les auteurs ont abordé des questions spécifiques sur les chaînes de valeur des cultures céréalières, en particulier les systèmes de semences et de production, la lutte antiparasitaire et l'autonomisation des agriculteurs, et ont discuté l'application de ces résultats pour mieux informer les interventions visant à transformer les systèmes alimentaires agricoles sur le continent.

Mots clés: productivité agricole; gestion de l'utilisation des terres; Afrique sub-saharienne; abeille; céréales; climat

INTRODUCTION

It is prominently claimed that the African continent is blessed with a staggering space of arable land that can substantially contribute to change the course of food systems in the near future. About 60% of the world's arable land is in Africa, with a potential to lift its populations from poverty, to feed them and the rest of the world. However, in most African countries, food import volumes meet more than 50% of food demands, and this coupled with the increasing human population has been exceedingly challenging. For instance, in 2013, over 18% of maize and almost 60% of wheat supplies were imported by many African countries (FAO, 2019). By 2050, the African population would have reached 2 billion people, and it remains unclear if the continent can meet this increase in foods demand without greater reliance on imports or expansion of agricultural area at the expense biodiversity loss and greenhouse gas emissions (van Ittersum *et al.,* 2016).

Although significant progress has been made in recent years, more still needs to be done in terms of investment and research to boost crop yields, especially cereals such as maize, which is the most demanded and produced staple on the continent, and other traditional cereals such as finger millet and sorghum. For instance, cereal yields in 2016 averaged 1.5 tons per ha in Sub-Saharan Africa, which are much lower than the 4.1 tons in Asia, the 4.8 tons in South America and the 7.2 tons in North America. At the same time, across the continent, cereal and legume production have mainly relied on micro and small and medium-sized farms (<3 ha), which provide over 85% of total cereal and legumes production (Demmler, 2020). These figures show that there is still much more potential for increased cereal production on the continent.

1. Foundation seed quality and yield

The benefit of sowing quality seed is tremendous for productive agricultural systems, as the use of quality seed of a variety having high genetic potential can increase yield by 20 – 25% (AgriQuest, 2020). Despite this importance, the seed industry is barely taking off in many West African countries, mainly due to insufficient quantity of early generation seed, especially foundation seed. As pointed out in Dagnoko *et al*. (2020), increasing the supply of foundation seed and enhancing their accessibility will ensure the take-off of the seed industry in Mali and West Africa. In this issue, Dagnoko *et al*. (2020) compared three models of foundation seed production in Mali, namely: Research Institutions Model, Seed Companies Model, and Smallholder Farmers Model, for their performance in terms of seed quantity, quality and model efficacy in realizing the yield potential of single varieties of rice, millet, sorghum, groundnut, and cowpea. The authors found that Foundation seed of millet, sorghum, and cowpea can be produced under the formal seed system by the Smallholder Farmers Model with high yields and good quality while Seed Companies Model can produce foundation seed of sorghum and millet with good yield and high quality. The authors recommend that policy makers consider involving seed companies and smallholder farmers together with research institutions in the production of foundation seed to achieve quality requirements.

2. Cereals yields and pest control

Cereal yields per hectare in most Sub-Saharan Africa countries are currently low, limiting opportunities for smallholder farmers to increase their agricultural incomes. In the current African agri-food systems, traditional cereals such as pearl millet, finger millet, and teff are still being grown, but maize, rice, sorghum, and wheat dominate cereal production (Demmler, 2020; FAO, 2020). Among these cereals, maize remains the major staple at continental level, accounting for 45% of total major crop production by volume in 2017 (FAO, 2020). Despite different national and international interventions, there is still widespread low productivity of maize across the continent. In Kenya and Uganda, maize productivity remains low with an average yield from 1.6 to 1.8 t/ha, against a potential yield of 7 t/ ha (Okoboi *et al.,* 2012). Efforts towards increasing maize yield have not only focused on variety improvement (e.g. KS-DH13, KS-H6217 and KH 600-23A see Kang'ethe, 2011), but also on exploring different agricultural land use management systems such as upland-rainfed, upland-irrigated, and wetland only systems (Turyahabwe *et al*., 2013).

In this issue, two papers addressed maize production in East Africa (Kamau *et al*., 2020; Tugeineyo, 2020). Kamau *et al*. (2020) assessed the technical efficiency of maize farming under different systems in the wetland zones of Kenya and Uganda. The authors observed that while upland-irrigated system was associated with the highest technical efficiency, land, seeds, manure, basal fertilizers, pesticides, and labor were among the major determinants of maize yield. They suggested that government policies should consider different wetland regimes and encourage maize farmers to grow maize under the upland-irrigated system using subsidized alternative sources of water to reduce pressure on wetland resources (Kamau *et al*., 2020). Farmer associations should also support maize farmers to produce under this system especially with subsidized alternative sources of water such as government-owned dams.

Parasites, pathogens and pests are often cited among drivers of productivity in agricultural farms, either by directly affecting crops systems, or by affecting pollinators within agricultural systems. Striga are root-parasitic plants constraining major agricultural cereal crops, including maize and finger millet production in tropical and semi-arid regions of Africa. Efforts to reduce Striga densities have been shown to substantially increase crop growth and yield in many agricultural fields (Kountche *et al*., 2016). In this issue, two papers addressed striga as parasite affecting maize and finger millet (Makani *et al*., 2020; Tugeineyo *et al*., 2020). Makani *et al*. (2020) determined the resistance of finger millet genotypes to Striga asiatica infection. The authors evaluated three finger millet genotypes (KNE624, KNE814 and SDMF1702) under laboratory and glasshouse conditions for pre-attachment resistance and germination percentage, and growth performances, respectively. They found that the genotypes that were screened showed varying degrees of tolerance and susceptibility to Striga infection, with finger millet genotype SDMF1702 appearing to be tolerant (Makani *et al*., 2020).

Tugeineyo *et al*. (2020) analysed the economic effects of adopting IRM varieties under Striga control project in Eastern Uganda, based on a sample size of 60 farmer households and using two commercially imazapyr resistant maize varieties (Longe 5H-IR and Victoria 3H-IR) in comparison with local maize. As expected, the yield of local maize decreased with an increasing Striga counts in the fields (Tugeineyo *et al*., 2020). More importantly, their gross margin analysis showed considerable difference in profit between IRM (Ug.sh 6,107,500) and local (Ug.sh 3,672,800) in Striga infested area, mainly due to low losses on IRM and high sales of maize grains, maize fresh cobs and maize flour. The authors also recommended that that farmers with land infested with Striga should be equipped with more information about IRM technology in order to reap higher yields and profits.

Parasites, pathogens and pests are also drivers of productivity in agricultural farms, as they affect pollinators within agricultural systems. In this issue, Kugonza (2020) reviewed several peer-reviewed publications to map out the status of bacterial, fungal, and viral pathogens, mites, as well as pests and predators of honeybees in Africa. Taking into account the geographical spread of these pathogens and parasites, the study predicted that the entire African continent is under a massive attack. For instance, the American foulbrood has spread from three countries in 1980 to 12 to date. On the other hand, fungal pathogens are reported in countries along the eastern African coast and their western neighbours. The author also found that nine out of the 23 viruses that afflict honeybees globally are present in ten African countries, whereas the Varroa mite currently known as a pan-global pest, is found across all geographical regions of Africa. The author suggested proactive measures to counterattack these invaders using integrated approaches if the African continent is to continue having its rich biodiversity, crop production and food.

3. Farmers' livelihoods and production systems

Climate information services have been shown to guide decision making for better outcomes. In this issue, Manpaje *et al*. (2020) investigated the impact of access to climate information services on smallholder farmers' livelihood outcome variables such as yield of pearl millet, livestock value and household incomes. The authors found that tailored climate information services have the capacity to enhance farmers' livelihood outcomes such as incomes, but have non-significant impact on pearl-millet yield, and weak impact on livestock value.

Cirimwami *et al*. (2020) determined the socioeconomic factors for widespread adoption of bean, cassava, maize and potato intensification technologies in Eastern DRC. The authors identified the use of organic fertilizers, tractor, integrated management of the soil fertilization, erosion control, agroforestry and alley cropping, improved seeds, in-line sowing, agricultural finance and pest control as drivers of intensification of these crops production.

Freshwater input from a river is a major factor controlling the productivity of the riverine ecosystems and the livelihoods they support. However for better resource management, long time series of streamflow data are required to understand the water flow characteristics. In this issue, Tesfamariam *et al*. (2020) developed a rainfall-runoff model using the Hydrologic Engineering Center - Hydrologic Modelling System. The authors simulated the model to generate a continuous time series of daily streamflow for the last 30 years, and compiled the missing records thereby extending the flow data of the river. It is expected that the data provided will inform management decisions for efficient water resource allocation in the basin (Tesfamariam *et al*., 2020).

CONCLUSION

The African continent faces a wide range of challenges in the production of major staple cereals crops. By publishing this issue, we showcased recent research efforts to improve crops production systems from seed quality and yield, agricultural production and economic perspectives with specific focus on rice, millet, sorghum, groundnut, cowpea and maize. The issue also provided insights into pathogens, parasites and predators affecting cereal crops such as maize and millet, and crops pollinators such as honeybee Apis mellifera, well known for its vital role in the pollination of flowers in many agricultural systems. Finally, the issue presents information on how access to vital information and data (e.g. climate information services and hydrological simulation of watershed) can contribute to improve farmers' livelihood or guide better management decision. Our hope in reviewing and publishing these information is to promote visibility of research outputs to help in advancing scientific debate and research application for transformative food systems on the continent.

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STATEMENT OF NO-CONFLICT OF INTEREST

The authors declare that there have been no involvements that might raise the question of bias in the work reported or in the conclusions, implications, or opinions stated.

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