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Closing yield gap for sustainable food security in sub-Saharan Africa – progress, challenges, and opportunities

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Sub-Saharan Africa (SSA) remains food insecure despite having a climatic and biophysical potential to grow the crops to meet its growing food demand. Closing yield gap presents an opportunity to increase agricultural productivity in SSA for food security and economic stability in line with SDG 2 and 1. This work looks into the three main drivers of yield gap in SSA: water, fertilizer, and management practices, pointing out the challenges and opportunities for closing the gap. Rainwater is a good source of water, especially in tropical areas, and there is a need for its harvesting and conservation. Fertilizer use is still low (~20 kg/ha), and has to be increased while managing fertilizer nutrients effectively supported by locally developed computer-based decision support systems, for high crop yields. Latest commitments by African Union to increase local production, and supply, and reduce fertilizer costs is commendable. Adopting new crop varieties that are adapted to local conditions and resistant to drought and diseases, as well as improving good management practices backed by extension services are essential to maximizing crop yield and strengthening resilience in the face of environmental challenges. This calls for good leadership, backed up with good policies and political goodwill.

KEYWORDS

food security, agriculture, sustainable development, climate change, Africa

1 Introduction

Africa's population is growing relatively fast, increasing the continent's food demand which is expected to triple by 2050 (Searchinger et al., 2015). Despite having a lot of natural resources, and high agricultural potential, the continent remains food insecure, with an average crop yield of 1–250 kg/ha of cereal equivalencies compared to the global average of 4–100 kg/ha (OECD/FAO, 2024).

In connection with food insecurity, the continent is experiencing rising undernourishment from 17.6% of the population in 2014 to 19.1% in 2019 (FAO et al., 2020). The situation deteriorated further between 2019 and 2022, after a decade (2000 – 2010) of improvement (FAO et al., 2023; Wudil et al., 2022) (Figure 1). According to FAO et al. (2023) and Mohajan (2022), this could be attributed to the outbreak of the COVID-19 pandemic that pushed an additional 57 million people in Africa into hunger.

The SSA is a net food importer, which is approximately 15% of total African imports (African Union, 2020). This is adversely disrupted by global instabilities such as Russia-Ukraine conflict (UNICEF, 2021). This situation is likely to worsen on the backdrop of climate change if effective coping mechanisms are not put in place (Beltran-Peña and D'Odorico, 2022). Unfortunately, the continent is the most vulnerable to climate change effects owing to its over-dependence on rainfed agriculture, and limited resources (Trisos et al., 2022). Giller (2020) acknowledges that solving food insecurity challenge in Africa calls for major transformations of the smallholder farming systems in addition to the creation of alternative employment.

Overall, the SSA must urgently address its food insecurity. Failure to realize food security is not only a threat to the actualization of the United Nations Sustainable Development Goal, SDG2 – Zero Hunger, but it also affects other SDGs such as SDG1 – No Poverty, and SDG16 – Peace, Justice and Strong Institutions (Brooks, 2016). In the worst-case scenario, this threatens to wipe out the gains made under Millennium Development Goals, adversely affecting the growth and development of the continent. On the other hand, sustainable agricultural practices are important in achievement of other SDGs such SDG6 – Water, SDG12 – Sustainable consumption and production, SDG13 - Climate change adaptation and mitigation, and SDG15 on land use and ecosystems. Unfortunately, Africa is off track to meet the food security and nutrition targets of the SDGs, and poverty reduction by half over Africa by 2025, in line with Malabo Commitments (African Union, 2024) will not be realized (FAO et al., 2023). The latter was to happen through inclusive agriculture and transformation. This underscores the importance of increasing food productivity to meet the demands of the continent's population, and where possible export the extra produce to earn the continent a foreign income and cement foreign ties with other countries. However, this should be executed well to minimize biodiversity loss and carbon dioxide emissions that are associated with expansion of agricultural land (van Loon et al., 2019). As early as 2002, Sanchez (2002) reported a little increase in yield across Africa, observing that that was mainly due to intensification, rather than maximizing yield productivity. The same observation was made by Omondi et al. (2023).

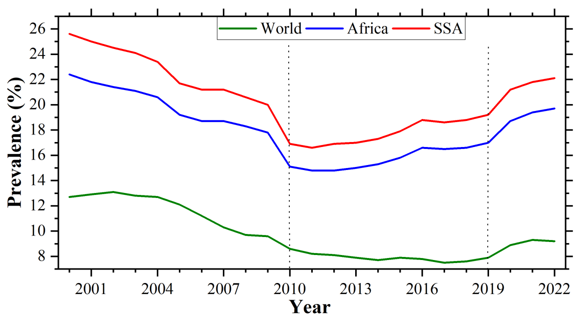

FIGURE 1
Prevalence of undernourishment in the world, Africa, and SSA (Data Source: FAO et al., 2023). The prevalence of undernourishment is a fraction of population that has a daily food intake that is insufficient to provide, on average, the amount of dietary energy required to maintain a normal, active and healthy life.

Agriculture in Africa is dominated by small-scale farmers with limited technology and capital (Adenle et al., 2019). Despite many efforts to increase food productivity, there yield gap across the continent remains high. According to the African Union (2020) report, SSA's present yield level is less than 25% of the potential yield. This is likely to worsen in the future due to climate change, where an increase in the frequency and intensity of extreme events such as drought, flood, and heat waves is projected (IPCC, 2021). Notably, precipitation and temperature have been projected to decrease and increase, respectively, over most places across the continent. This calls for effective co-benefit measures that help to not only sustain agriculture but also reduce the existing yield gaps. Filling the gap in yield production presents an avenue for increasing food security in Africa for socio-economic development since the agricultural sector is the leading source of income for the majority of its rural population (van Ittersum et al., 2016; Beltran-Peña et al., 2020). A good number of the ongoing efforts to increase yield production in Africa focus on intensification and extensification of agro-climatically suitable land (Djoumessi, 2022), posing a threat to environmental sustainability.

With the understanding that the population is growing relatively fast, yet the food insecurity is increasing calls for more attention on how to sustainably increase agricultural productivity. One of the avenues is putting measures in place to close the existing crop yield gaps as much as possible. This work focuses on three main drivers of the yield gap across Africa, namely water, fertilizer, and farm practices. Emphasis is given to how these factors affect yield gap, the challenges, and available opportunities for providing optimal conditions. The findings of this work adds voice to continent's food situation, and offers possible solutions on closing yield gap to increase food security in line with Malabo Declaration on Accelerated Agricultural Growth (African Union, 2014).

2 Overview and progress for closing yield gap in Africa

Despite having expansive land (about 60% of the world's unexploited arable land), and favorable climatic and biophysical potential conditions especially in the tropics to meet the food demand for its population, Africa's agricultural sector still records a big yield gap.

According to the Global Yield Gap Atlas (GYGA), maize crop which is the primary cereal grown in SSA countries has a yield gap that varies from 70% to 90% of their potential yield (GYGA, 2024). The yield gap is a result of many factors, among them being economic resources that limit the acquisition of tools and other necessary farm inputs. Other factors include a lack of necessary knowledge of farming and seed variety. In the future, climate change stands out as the major driver since it will likely affect temperature and water availability. In this work, we argue how water, fertilizer and good agricultural practices are the major factors that determine the yield gap across Africa. This was reported by Nhamo et al. (2014) and Senthilkumar (2022), who investigated the reduction of rice yield gap in East and Southern Africa, and the whole of Africa, respectively. Other studies include Sanchez and Swaminathan (2005), and Gashu et al. (2019). According to the United Nations Economic Commission for Africa et al. (2021) the application of limited fertilizer is a critical factor that impedes agricultural productivity gains and increases in farm incomes in Africa since many places have poor soils. Overall, low soil fertility may be attributed to intensive exploitation of agricultural land with limited or no fallowing of the land that has exhausted the soil nutrients. This emphasizes the need for mineral fertilizers to increase yield production (Buresh et al., 1997). Despite the Abuja Declaration by African Union Heads of State on Fertilizer for an African Green Revolution in 2006 to increase fertilizer use from 8 to 50 kilograms kg/hectare by 2015 (African Union, 2006), nearly a decade passed the deadline, the target is positive but slow with an average fertilizer still at about 20 kilograms kg/hectare, way below the average global use of 140 kg/ha. The low uptake of fertilizer is mostly attributed to the associated relatively high financial cost (Hillocks, 2014). A study in Kenya on nitrogen use efficiency to reduce yield gaps in maize production noted that application of Abuja Declaration Scenario (50 kg N/ha) recorded the highest grain yield increase (103.25% - 167.39%) compared to the business as usual scenario (0 kg N/ha) (Winnie et al., 2022). A look at East Africa's most dominant crop, maize, shows that increasing fertilization could increase overall maize supply by 20% in food insecure maize growing households (35% in Tanzania and 42% in Uganda) (Falconnier et al., 2023). According to Omondi et al. (2023) who focused on soybean production in SSA, application of 21–30 kg/ha of phosphorous (P) to soybean could increase yields by about 48.2%.

The gap is in the range of 50% to >90% for rainfed rice, and 60% to 80% for rainfed wheat. Notably, the gap reduces to less than 70% in all crops under irrigated conditions (GYGA, 2024). This points out the important role of water in closing the gap. For instance, in Zambia, the average farmer produces only 1–2 t/ha of maize, yet potential maize yields are 9 t/ha at profit-maximization level, and 6.75 t/ha without increasing environmental risk (Gatti et al., 2023). Assefa et al. (2020) studied smallholder maize yield gaps in Ethiopia and reported that technology yield gap constituted the largest portion of the total yield gap [54% (4.8 t/ha) to 73% (7.8 t/ha)], partly explained by limited use of fertilizer and improved seeds. Sosibo et al. (2017) while exploring opportunities for improving yields in intensive irrigated wheat production systems of South Africa, reported yield gaps in the range of 1.58–3.13 t/ha. The study noted that closing yield gaps could increase the yields by 26–38%. Over West Africa, Guo (2020) focusing on cassava yield gap, observed that the cassava yield gaps in SSA may be larger than previously thought. Noting the resilience of cassava to environmental risks, the study called for further investigation of agronomic practices and optimized fertilizer usage that are required to close the yield gap as much as possible. Others (Van Rooyen et al., 2021; Bonilla-Cedrez et al., 2021) stressed the need for strengthening agricultural intensification by complementary practices that will improve soil health over and above fertilizer application.

According to Nhamo et al. (2014), the yields realized through improved rice cultivars can be improved further through the application of good management practices, and improving nutrient, water, and weed management technologies. In a related study focusing on rice yield gap across Africa, Senthilkumar (2022) found that the application of inorganic fertilizers and/or organic amendments increased the yield by 0.8–1.2 t/ha. The study also reported that factoring of good practices increased the yield by 2.1 and 1.5 t/ha in irrigated and rainfed systems, respectively. The study emphasized the importance of water in crop yield in Africa, noting that yield gaps in rainfed rice systems are higher in the rainfed upland and rainfed lowland environments than in irrigated lowland.

The good management practices are wide, encompassing crop varieties, land preparation, sowing methods, irrigation, weed and nutrient management, crop protection, and harvesting methods. In the investigation of closing yield gap in Africa, Senthilkumar (2022) emphasized that effective practices for weed control, as well as improved water productivity and nutrient use efficiencies, are very important in closing the yield gap. Silva et al. (2023) while examining maize yield gaps in Zambia, noted that narrowing efficiency and resource yield gaps by improving crop management had the potential to more than double the current yields.

Water is an important driver of agricultural production. Hence, it is an important factor in closing the yield gap in SSA. Most SSA countries, especially those that lie in the tropics record high levels of rainfall annually. The cessation of rainfall renders some places dry to support agricultural activities, especially leading to yield loss. However, a good portion (43%) of SSA is dryland which includes 75% of the arable land. Water harvesting presents a good avenue for storing and making good utility of rainwater to maximize crop productivity. According to Hillocks (2014) in an exploration of closing yield gap in SSA, the study noted that it is challenging to close the gap in rainfed agriculture systems as compared to irrigated ones where low soil fertility constrains the response to inorganic fertilizer.

Irrigation is thus key, as it minimizes that reliance on extreme rainfall that is characterized by extreme events, mainly droughts. Other than supporting crop diversification, water provides stable conditions for fertilizer application. Irrigation is key to enhance harvest consistency in arid and semi-arid areas; it also helps in anticipating the more and more frequent dry spells and drought episodes during the growing season. Irrigation in SSA can also contribute to developing food value chains and agribusiness by securing predictable minimum yields. Currently, only 6% of arable land in Africa is irrigated and on average the area equipped for irrigation grew by just 1.5% between 1990 and 2015. Although irrigation development is low, irrigated agriculture accounts for nearly 38% of the value of total agricultural production in Africa (You et al., 2011). The potential for increasing irrigation is high, in particular in countries in SSA, where irrigated land could be expanded to 38 million hectares, up from the current 7.7 million hectares. Furthermore, You et al. (2011) highlighted that irrigation in Africa has the potential to significantly increase crop productivity by up to 50%.

Most existing irrigation schemes in Africa rely on surface water, despite a remarkable potential for using renewable groundwater resources for irrigation. Roughly 78% of large- and small-scale irrigation schemes use surface water, while 20% make use of groundwater resources. It is estimated that in 13 African countries — Nigeria, Tanzania, Ghana, Zambia, Burkina Faso, Ethiopia, Niger, Kenya, Mali, Mozambique, Rwanda, Uganda, and Malawi—tapping into groundwater could offer a potential 120-fold increase, equivalent to 13.5 million hectares, in the total area under irrigation.

Following nearly 30 years of public irrigation development in SSA, countries across the region are now entering a renewed era of investment in large-scale irrigation infrastructure. In SSA, state-scale irrigation development has historically occurred through the construction of dams and associated surface water canal irrigation infrastructure. These projects, ranging from 400ha to 100000 ha, were first initiated by colonial administrations in the early 1960s due to support from multilateral donors such as the World Bank and Africa Development Bank.

Across the continent, and more specifically in the SSA, there is a high potential to increase the area of land under irrigation. For the sake of comparison, and whereas only 4% of area cultivated in SSA is equipped for irrigation, 28% of northern African agriculture is irrigated. Northern Africa's irrigation potential is close to exhaustion, while the potential for expansion is significant in SSA. Estimations state that out of the 47 million ha potential for irrigation expansion in all Africa, 38 million ha are in SSA.

3 Challenges and opportunities

Since agricultural productivity is driven by many factors, there are equally many institutional stakeholders in the field. The institutions operating at different geographical scales offer goods and services in various aspects of farming, such as capacity building, and finances. This is indeed commendable, however, the roles of some institutions overlap, are non-existent in some areas, or are for their benefit. In the effort to promote agricultural productivity across the continent, there is a need for harmonizing the priorities of international institutions focusing on agriculture. This will promote complementariness in the sector.

3.1 Water and irrigation

Sustainable agricultural intensification only will not be enough to meet the future food demand in African countries under the current and projected climatic conditions, stressing the need for water storage to irrigate during dry periods. In the era of reducing rainfall amounts, shifts in rainfall patterns, and increasing droughts, irrigation helps in reducing the dependence on climate by constantly availing water. According to You et al. (2011), irrigation can increase agricultural productivity in SSA by at least 50%. In addition to supporting crops, irrigation provides stable conditions for applying other yield-increasing avenues such as fertilizers. Advancements in technology also make it possible to combine fertilization and irrigation and regulate the timing and the amounts of irrigation.

Following the end of colonialism, the focus of large-scale irrigation management shifted towards its social aspects rather than productivity, leading to stagnation and decline in many situations. Despite the continued construction and management of irrigation schemes by local governance systems with foreign aid, postcolonial efforts to transfer management to local communities yielded mixed results. Factors such as poor operation and maintenance, lack of institutional reform, bureaucratic inefficiency, poor service delivery, and low demand for irrigation contributed to the severe deterioration of both public and community-managed irrigation systems in SSA and other developing regions (Shah et al., 2020).

3.2 Investment and leadership

The uptake of modern irrigation remains low in SSA. According to Wudil et al. (2022), the limited irrigation in SSA can be attributed to low investment in irrigated agriculture and research. Inadequate rural electricity supply for pumping and distributing water limits uptake of modern irrigation technologies. This together with other limitations among small-scale farmers stresses the need for innovative, affordable, and easy-to-implement technologies for effective irrigation. Solar-based irrigation, a case study of Mali reported that vegetable production was the dominant water usage, giving the farmers over 40% of extra household income during the dry season (Birhanu et al., 2023). This shows how solar-based irrigation is likely to shape farming in drylands that have abundant solar energy potential, yet other forms of electricity are inaccessible or remain expensive to support irrigation. In support, Falchetta et al. (2023) found it economically feasible to run solar irrigation in SSA to spur development. Overall, the cost of installing and running irrigation systems is limiting especially for the majority of African farmers who are small-scale farmers. Such circumstances are ideal for initiation of public-private partnership projects in irrigation especially for the benefit rural communities, investors and the public, upon meeting each stakeholders conditions (German Development Institute, 2017).

According to the Africa chapter of UN-Water, water sector in Africa is facing many issues that can be categorized as natural and human issues. The natural challenges are related to the complications around shared waters (transboundary), spatial and temporal variability of climate and rainfall, desertification and degradation of water-associated ecosystems. The human factors can be summarized around: inadequate water governance and institutional systems, increasing depletion and quality stress on freshwater resources (pollution), and absence or weak water quantity and quality (and its associated ecosystems) preservation interventions.

3.3 Fertilizer management

Fertilizer usage across SSA is still low. Thus, higher use of fertilizer must be implemented to increase yields in an effort to close the yield gap. This is also beneficial in the sense that it slows extensification which minimizes deforestation (Wallace and Knausenberger, 1997). However, increasing nitrogen (N) fertilizer use required to achieve household and national food security through yield gap closure will likely increase N leaching losses and gaseous emissions (Leitner et al., 2020). Since fertilizer application is unavoidable, there is a need for strategies for nutrient management to increase nutrient use efficiency as well as profitability. According to UNDP (2022), increasing fertilizer use from the current 20 kg/ha to the 50 kg/ha target as per the 2006 Abuja Declaration could increase food production thrice in the near term. Notably, extreme weather events, mainly drought and floods, have a negative impact on the efficiency of fertilizer, hence, area based analysis employing process-based crop models is necessary to assess the impact of drought or flooding on fertilizer use efficiency to not only maximize profitability but also conserve the environment (Ricome et al., 2017).

Fertilizer supply and use across SSA has remained low for a long time, supported by the observation of Larson and Frisvold (1996) that the physical availability of fertilizers to farmers, in the appropriate quantity, packages, and at the appropriate timing, remains a main challenge to increased fertilizer uptake. Noting the shortage of fertilizers in Africa following the COVID-19 pandemic and the Russia – Ukraine War (that started on 24th February 2022), UNDP (2022) recommends for upping capacity utilization in Africa's existing fertilizer manufacturing plants. This will give the African agricultural sector all the fertilizer they need. This calls for more investment in the fertilizer production sector, given that an increase of fertilizer production to 100% of existing capacity could meet Africa's fertilizer demand (UNDP, 2022; Guèdègbé and Doukkali, 2018). In addition, Guèdègbé and Doukkali (2018) emphasizes the need for strategies to accelerate the process of interconnecting Africa's economies with transport infrastructure, so as to create a truly intra-African fertilizer market. This is challenge to most African countries to enhance trade and co-operation with others, and formulate policy in how they make subsidized fertilizer available to their farmers on time.

The application of fertilizers (NPK) is essential to restore the soil nutrients and to close the yield gap (Salim and Raza, 2020). Nutrient use efficiency (NUE) is crucial for increasing crop yield and quality while reducing fertilizer inputs and minimizing environmental damage (Rawal et al., 2022). Phosphorus (P) is a vital element for plant growth and production, and its presence in the soil is essential to maximize crop production and improve harvest quality (Ding et al., 2020). Global demand for phosphorus fertilizers is expected to increase by 50-100% by 2050 to ensure sustainable food production for a growing world population (Godfray et al., 2010). In arid and semi-arid regions soils contain much less available P, as compared to humid regions, due to low total P and high fixation of P in soils (Feng et al., 2016). In arid regions, low water inputs limit salt leaching, resulting in the accumulation of calcium (Ca) minerals that affect crop production (Feng et al., 2016). Application of right amount of P fertilizers mitigated soil salinity, increased organic matter content, available water, hydraulic conductivity and available macronutrients, especially under salinity or drought stress (Ding et al., 2020). Thus, fertilizer application rates for optimal economic and environmental yield should be considered considering the individual needs of the crop as well as their actual uptake rates depending on growth stage, water salinity, soil and weather conditions (Berger et al., 2020). Furthermore, considering spatial variability within the field in fertilizer management strategies is essential to optimize the amount of fertilizer applied. Agriculture fields are by nature heterogeneous, with parameters such as soil properties, nutrient availability and topography exhibiting high variability within the field (Bouras et al., 2023).

Current fertilizer management strategies that neglect spatio-temporal variability within the field can simultaneously result in nutrient deficiency or excess in the same field. In recent years, advances in the availability of free remote sensing data have made it possible to improve estimates of the spatial variability of crop growth conditions and soil properties (Weiss et al., 2020). In addition, the development of crop growth models has made it possible to simulate crop growth under different irrigation and fertilization conditions. A variety of models, such as CERES, APSIM, and AquaCrop have been widely used to simulate crop growth, crop yield, water use efficiency (WUE), and NUE under different irrigation and fertilization application conditions (Pelak et al., 2017). The combination of crop growth models, remote sensing data, and ground measurements will enable the development of an operational system for optimizing irrigation and fertilizer application within fields, across fields, and at regional scales. The importance of formulation and delivery of site-specific fertilizer recommendations remains important for increased crop yield and environmental protection. A good progress is an example of a Nutrient Expert (NE), a computer-based decision support system developed by Rurinda et al. (2020) that enables extension advisers to generate field- or area-specific fertilizer recommendations based on yield response to fertilizer and NUE in SSA.

There are a number of factors that limit the use of fertilizer in SSA. Since most farming is small-scale and highly inefficient, the cost and access to fertilizer are a hindrance to its usage. This is more common in areas with limited or no incentive for subsistence farmers to invest in relatively expensive crop inputs. The African Union (2024) endorsed the Fertilizer and Soil Health Action Plan and the Soil Initiative for Africa Framework, guiding the harnessing of multi-stakeholder partnerships and investments to drive policies, finance, research and development, markets, and capacity building for fertilizer and sustainable soil health management in Africa. The targets set to be realized by 2034, aims to increase access, quality and reduce the cost of fertilizer across the continent.

In the backdrop of limited resources, efforts to improve NUE are important. Studies have shown that micro-dosing and localized nutrient application methods increase the agronomic and economic efficiency of nutrient and water use for smallholder farmers who are the majority in Africa. This was demonstrated by Ibrahim et al. (2015), who reported that hill placement of manure and fertilizer micro-dosing improves yield and water use efficiency in the Sahelian low input millet-based cropping system. Similar findings were observed in different crops and various parts (e.g., Tovihoudji et al., 2017; Sebnie et al., 2020). In Benin, Tovihoudji et al. (2017) found that fertilizer micro-dosing increases NUE up to two times than for the recommended broadcast rate, and raises maize productivity by more than 50%. This practice presents an opportunity for smallholder farmers to optimize fertilizer use and increase crop productivity.

3.4 Good agricultural practices

Good agricultural practices are key in determining yield productivity. In an investigation on closing rice yield gap in Africa, Senthilkumar (2022) reported that practices that can effectively control weeds, and increase both water productivity and nutrient use efficiencies, are very critical. Aramburu-Merlos et al. (2024) and Hall et al. (2024) noted that agronomic practices related to cultivar selection, and nutrient, pest, and crop management could double on-farm yields of maize in SSA without cropland expansion.

Despite the fact that the agriculture sector across Africa is threatened by many socioeconomic and environmental factors, there are mostly traditional farm practices that have proven to be resilient to socio-environmental shocks. These present learning opportunities on best farm practices that can be adopted in effort to close the yield gap as much as possible. For instance, the learning opportunities are presented by the existing Globally Important Agricultural Heritage Sites (GIAHS), designated by FAO. The GIAHS program aims to identify and preserve sites characterized by agricultural systems created and maintained over time by local communities. The present local adaptation and mitigation of global challenges contribute to food security and sustainable development of rural communities. A good example is the MedAgriFood Resilience project (https://www.medagrifood.eu/), which focuses on studying three GIAHS sites (in Italy, Morocco and Algeria), applying a multidisciplinary approach to identify the possible social and environmental shocks impacting agroforestry and agri-food heritage systems in the Mediterranean area. This project identifies the best practices such as the design of dry-stone terraces in hilly topographies, mixed cropping, underground water storage and conservation agriculture practices. These practices can be replicated in other traditional agroforestry and agri-food systems to increase the adaptation and resilience to social and/or environmental systems shocks.

Other than the identification of best practices, the other important and involving aspect is extension services. This role, on a positive note, is being made relatively cheaper and more efficient courtesy of development of ICT technologies, the common ones adopted in Africa being text and voice-based services targeting mobile phones (Ayim et al., 2022). Timely access to right type of information could help farmers to improve the effectiveness of various practices.

4 Conclusion

There is a growing food demand to meet the demand of the Africa's fast-growing population, calling for adoption of climate-smart agriculture practices. One of the possible solutions to boost food production is the closure of the existing yield gap. The gap can be reduced to a large extent by making good use of the available surface and ground water resources, application of the right type and quantity of fertilizer, and proper farm management practices.

Increasing fertilizer usage is important for boosting food productivity across Africa. However, there is need for proper strategies for fertilizer nutrient management to increase nutrient use efficiency. This can be actualized through the provision of effective extension services that can educate farmers on best farm practices and introduce them to modern farming techniques. Proper harvesting and storage of rain water is key in support irrigation. In rural communities where the cost of electricity is high for pumping and supply of water irrigation water, solar-pumps presents a sustainable option to support irrigation. Hopefully, addressing the three main drivers of crop yield gap in Africa will help to not only close the yield gap as much as possible but will also spur the much needed economic development in Africa. This can be fully actualized through good policies and leadership, and supported by political goodwill.

Author contributions

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