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POLICY BRIEF

ENHANCED WATER SECURITY AND ENERGY ACCESS: KEY INVESTMENTS FOR SUB-SAHARAN AFRICA

Task Force 10

SUSTAINABLE ENERGY, WATER, AND FOOD SYSTEMS

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موجز السياسة

تحسين الوصول إلى الأمن المائي والطاقة: الاستثمارات الرئيسية لمنطقة أفريقيا جنوب الصحراء الكبرى

فريق العمل العاشر

نُظم الطاقة المستدامة والمياه والغذاء

المؤلفون

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ABSTRACT

Investments in energy are urgently needed in Sub-Saharan Africa. Such investments can unlock access to water resources, increase food security, accelerate rural employment, and increase income. To achieve clean energy access and associated water and food security sustainably and equitably, we recommend that the Group of Twenty (G20): (1) develop an understanding of accessible water resources and optimal rural energy system sizing; (2) strengthen the enabling policy and financial environment for renewable energy systems; (3) increase investment in rural renewable energy systems that support productive use; (4) ensure that energy, water, and food policies and investments are gender sensitive; and (5) overcome siloed thinking to improve governance across the water, energy, and food sectors.

هناك حاجة ماسة للاستثمار في الطاقة في منطقة أفريقيا جنوب الصحراء الكبرى. ويمكن لمثل هذه الاستثمارات أن تتيح الوصول إلى موارد المياه، وتزيد من مستويات الأمن الغذائي والدخل بالاضافة إلى تسريع العمالة الريفية. لتحقيق الوصول إلى الطاقة النظيفة والأمن المائي والغذائي بشكل مستدام ومنصف، نوصي في هذا الموجز مجموعة العشرين (G٢٠) بما يأتي: (١) تطوير فهم لموارد المياه التي يمكن الوصول إليها وتحديد الحجم الأمثل لنظام في المناطق الريفية. (٢) تعزيز السياسة المواتية والبيئة المالية لأنظمة الطاقة المتجددة. (٣) زيادة الاستثمار في أنظمة الطاقة المتجددة في المناطق الريفية التي تدعم الاستخدام الإنتاجي. (٤) ضمان أن سياسات واستثمارات الطاقة والمياه والغذاء تراعي الاعتبارات الجنسانية. (٥) التغلب على التفكير بطرق منعزلة لتحسين نظام الحوكمة عبر قطاعات المياه والطاقة والغذاء.

CHALLENGE

The lack of reliable access to energy, water, and food is slowing down agricultural and economic growth and well-being in Sub-Saharan Africa (SSA). Globally, the region has the lowest access to energy, safe water, and sanitation (Figure 1). Water security for productive use is also extremely low; at 5% of the cultivated area, the region has the world's lowest share of irrigation development (Ringler 2017). The high dependence on rainfed agriculture makes farmers particularly vulnerable to seasonal climate variability and climate extremes, especially droughts. Food insecurity levels are also extremely high in SSA and have been growing in the last several years because of conflict and climate change (FAO et al. 2019; Figure 1). Rapid projected population growth is imposing further pressure on inadequate energy, water, and agricultural infrastructure. Climate change and extremes are also straining existing challenges in the water, energy, and food sectors, thereby heightening the urgent need for action.

Investments in decentralized rural energy systems can unlock billions of dollars in value from improved food production and increased water security. Accelerated investments are also crucial for the achievement of important Sustainable Development Goals (SDGs), particularly SDGs 2 (Zero Hunger), 6 (Clean Water and Sanitation), and 7 (Affordable and Clean Energy).

The COVID-19 pandemic has further highlighted the inequity in access to water, energy, and food in SSA and has strengthened calls for accelerated investment in handwashing facilities, cold storage for vaccines, and nutrient-dense food, as well as improved facilities in SSA's many refugee camps, where water supply and sanitation facilities are shared.

Access to energy

Africa accounts for only 6% of the global energy demand and just over 3% of the global electricity demand. Bioenergy is the largest energy source in Africa, accounting for more than half the final energy use; this has devastating impacts on the continent's health, environmental sustainability, and economy (IEA 2019). Today, an estimated 600 million people in SSA live without electricity (IEA 2019), while existing access is often unreliable. This has severely limited economic activity. The lack of investment in infrastructure has stymied the development of a vibrant manufacturing sector in SSA and has prevented the absorption of labor from rural areas (Mueller and Thurlow 2019). The lack of investment in electricity has also hindered the development of irrigation infrastructure, rural agro-processing centers, and cold storage. This, in turn, has reduced the availability of nutrient-dense crops such as fruits and vegetables and animal source foods such as milk and eggs. Over 900 million people lack access to

modern energy services for cooking and heating, and suffer from indoor air pollution and associated adverse health impacts, particularly respiratory illnesses (IEA 2019).

Access to water

The following statistics highlight the severe challenges in access to water in SSA and the linkages to poor energy access and reduced food supply. Access to safe water of sufficient quality near the homestead can reduce the time spent collecting water for domestic use, a task that is still performed by approximately 206 million people in SSA, primarily women and girls (UNICEF and WHO 2019). The lack of domestic water for handwashing and sanitation affects health and nutrition, as highlighted by the recent COVID-19 pandemic. Periodic droughts that lead to the drying up of watering holes for animals affect the availability of animal source foods in various parts of SSA, and leads to severe income shocks for pastoralist households; for example, during the 2015/2016 El Niño event in Ethiopia, cattle herds declined by 23% in the drought-prone lowlands, where most pastoralists reside (Koo et al. 2019). These statistics are compounded by the low surface storage capacity per capita in SSA, as well as the underdevelopment of groundwater resources, which reduce water access for productive purposes, particularly for agriculture, but also for the manufacturing and service sectors (HLPE 2015).

Access to food

SSA is the only region where undernutrition is projected to increase in the coming decades (Mason-D'Croz et al. 2019). This projection is based on low agricultural production levels resulting from, among other things, a dependence on low-input rain-fed agriculture, the intensification of the impacts of climate change, and continued conflict and civil strife. Increased use of irrigation can dramatically reduce the region's growing dependency on net food imports (Xie et al. 2018), while improved energy access can fuel agricultural intensification and help develop larger rural agro-processing centers.

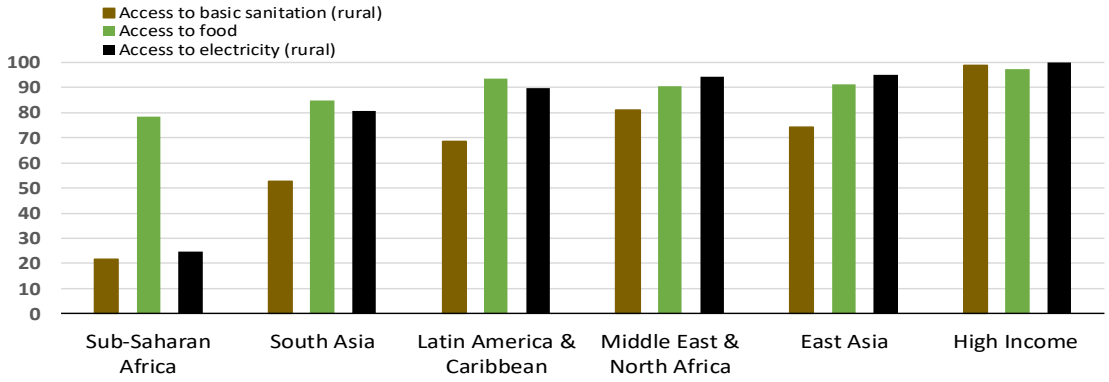

Figure 1. **Access to water, energy, and food, by region**

Note: **Access to water is proxied by rural access to basic sanitation services that are not shared with other households (2017 data). Access to food is proxied by the share of population that is not undernourished (2017 data). Access to energy is proxied by access to electricity in rural areas (2016 data).**

Source: **Authors, based on data from the World Bank (2019).**

PROPOSAL

We recommend five actions for the Group of Twenty (G20) to undertake in order to achieve sustainable and equitable clean energy access and associated water and food security. These actions are: (1) to develop an understanding of accessible water resources and optimal rural energy system sizing, (2) to strengthen the enabling policy and financial environment for renewable energy systems, (3) to increase investment in rural renewable energy systems that support productive use, (4) to ensure that energy, water, and food policies and investments are gender sensitive, and (5) to overcome siloed thinking to improve governance across the water, energy, and food sectors.

Implementation of this policy proposal supports the G20 Sustainable Energy for All (SE4ALL) Action Agenda, which was initiated in 2015 under the Turkish presidency.[1] The Action Agenda encourages G20 countries to support processes led by African countries to develop the SE4ALL agenda as an umbrella framework for national-level energy sector development; it also supports the G20 sustainable agricultural water use recommendations of 2017[2] and overall food security in this region.

Action 1: The G20 should support the development and accessibility of data on accessible water resources and optimal rural energy system sizing

Although much of SSA is resource rich in terms of solar energy and water, information on these resources is often poor and inaccessible for decision-makers and investors (MacDonald et al. 2012; Wu et al. 2017). We propose focusing on the following areas:

1.1. Assessment of the availability of renewable groundwater and surface water resources for sustainable development under climate change and extreme weather

Water resources vary widely across regions. While parts of southern Africa are classified as hyper-arid and arid, areas around the equator are generally tropical or subtropical with high rainfall. Much of SSA experiences economic water scarcity, which refers to a situation in which the sometimes plentiful and available water resources remain undeveloped because of the lack of investment in surface and groundwater development. For sustainable development, it is important to limit water use to renewable resources from runoff and groundwater recharge. SSA has the lowest per capita surface reservoir storage capacity, which increases the region's vulnerability to the adverse impacts of climate change and weather extremes. At the same time, groundwater storage is estimated to be 0.66 million cubic kilometers (km3), which is more than 100 times the level of annual renewable freshwater resources in the region

1. https://www.se4all-africa.org/seforall-in-africa/regional-initiatives/g20-energy-access-action-plan.
2. http://www.g20.utoronto.ca/2017/170122-agriculture-action-en.html.

(MacDonald et al. 2012). Many African countries that are designated as water scarce based on surface water have large groundwater reserves that can provide a buffer for climate change and weather extremes.

Although there are various sources of data on water resources, there are large discrepancies among these sources, often because of the paucity of measurement stations. Existing data sources can provide regional reconnaissance information. However, far more detailed information is necessary at the local level to assess sustainable-use potential in light of various climate futures. We call upon the International Groundwater Resources Assessment Centre (IGRAC) and on other entities that collect such data to make them publicly available and to provide them in an accessible form to African water ministers, citizens, and private investors. This will help accelerate investment in sustainable water resources. While Big Data methods allow crowdsourcing of data from citizens, including water data, the onus for the collection and monitoring of such data remains with the public sector.

1.2. Assessment of the optimal sizing of sustainable, cost-effective, and affordable clean energy systems to best support a host of rural development goals

Africa has only 50 gigawatts (GW) of renewable energy capacity, which is mostly hydropower (36 GW). Therefore, the potential for renewables is large, including solar, wind, hydropower, and bioenergy (IEA 2019).

Maps of the existing and planned electricity grids are available for Africa. These maps underscore the limited access to grid electricity in SSA (World Bank n.d.). Most transmission is in South Africa and there is a heavy reliance on fossil fuels. Owing to limited grid interconnectivity, increasing emphasis is being placed on off-grid solutions for much of rural SSA; however, optimal system sizing is lacking for key productive uses.

The Government of Ghana has considered co-location and co-optimization of its water infrastructure with rural electrification. Such joint strategies should be undertaken by all public planning entities to ensure that agricultural intensification and the associated increase in processing and cold storage facilities are optimized.

Action 2: The G20 should support the enabling environment and develop capacity and incentives for localized renewable energy systems

An improved enabling environment for energy investment can unlock follow-on investment in food production and water security. We propose three activities to support this action:

2.1. Improve the enabling environment for private sector investment in renewable energy systems

Africa currently accounts for only 4% of global power supply investment (IEA 2019); this is partly because of an unattractive enabling environment for private sector investment. Fiscal and regulatory frameworks are challenging, to the point where only larger companies can bear investment risks. The acceleration of investment in renewable energy systems would require governments to develop sound investment frameworks (IEA 2019).

2.2. Support cross-country learning on ways to accelerate market access and competition for renewable energy systems

The enabling and investment frameworks for energy differ dramatically across SSA. They range from highly developed markets in South Africa to limited experience in the Democratic Republic of the Congo. Cross-country learning can help countries that are in greatest need of increasing market access and competition to acquire important knowledge with regard to improvements in national processes. Such exchanges can be organized by countries within or across regional power pools.

2.3. Provide credit, capacity building, and other incentives for renewable energy markets to take off in more remote rural areas

Financing is needed for both, solution providers and consumers, to support the growth of renewable energy systems. Financing solutions have to be targeted to the specific energy solution; for example, while solar photovoltaic systems need larger upfront capital costs relative to diesel powered systems, their life cycle costs are lower (World Bank 2018, 30). Microlenders, such as Kenya's Juhudi Kilimo are piloting loans for solar irrigation infrastructure (Tobiko and Sokolova 2018). Other operators have introduced pay-as-you-go systems, such as CoolCap, which acquires equipment from vendors in bulk and sells it to smallholder farmers at 10% interest, repayable at harvest time (CoolCap n.d.). To repay the provider, farmers deliver their harvest to buyers, who then deduct the repayment amount from the harvest proceeds and remit it to CoolCap.

Action 3: Promote investment in rural renewable energy systems that directly support productive use

Renewable energy system investments can be recouped if end users are able to increase their income through access to electricity. Key areas where profits can be generated include irrigation, cold storage, agro-processing, and transportation. Increased income, in turn, can unlock further investments in agriculture and water security.

Localized power generation, or distributed renewable energy (DRE) systems, can simultaneously increase crop production, provide clean drinking water, and facilitate rural electrification in SSA. An example of a localized solution that has potential is the microgrid, which is defined by the US Department of Energy as "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid" (Ton and Smith 2012, 84). A microgrid can be transformational on several levels:

1) It can enable the provision of better medical services by allowing critical vaccines and medication to be stored in chilled form (for a full list of the many vaccines that are needed to address infections that are common in SSA and which require refrigeration, see Iannelli 2017).

2) It can enable farmers to access cold storage for their harvest, allowing them to sell it at a more controlled rate and, ideally, at better prices (IFC 2019)

3) Local microgrids can also help farmers process crops into higher value-added products. For instance, staple grains can be ground into flour, which can enable farmers to realize higher economic returns.

4) Better electricity access can reduce indoor air pollution by enabling people to cook with electric stoves and light their homes with LED bulbs, instead of using kerosene, cow dung (whose removal from cropland can also reduce agricultural productivity), wood, and other polluting fuels. This can especially improve the well-being of women and girls.

5) Homes can be supplied with water from solar-powered wells, which can reduce the number of hours spent fetching water every day by women and girls.

Microgrids can integrate electricity inputs from multiple sources, including solar PV panels and diesel generators. If solar-powered irrigation is widely adopted, the aggregate power-generation potential will become significant. With the proper integration of storage and load management, systems operating at such a scale can power economic activities beyond the farm, substantially benefiting local economies (Figure 2).

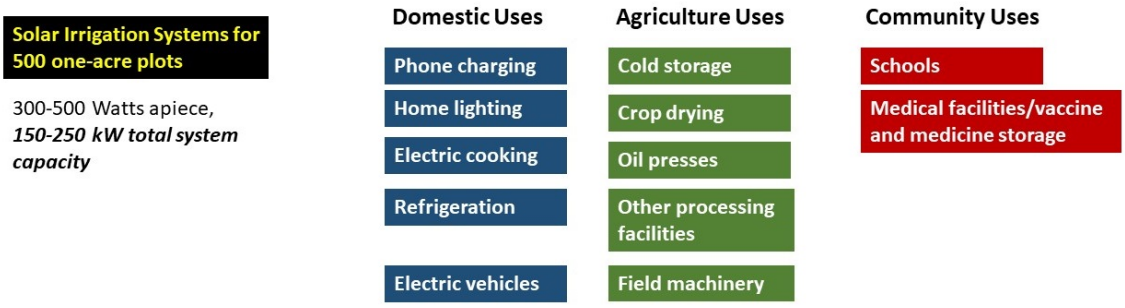

Figure 2. **Farms as anchors for local microgrids**
Source: **IFC (2019); Authors' analysis.**

Leveraging the decline in the cost of solar technologies, smallholder farmers in emerging markets are increasingly adopting solar irrigation pumps. This has improved crop yield, reduced vulnerability to rainfall variability, and enabled multiple cropping cycles. Although the upfront costs are about three to four times those of their diesel pump equivalent, the total lifetime costs of solar irrigation are already competitive. The industry is now at an inflection point where the technology is mature enough for scale. This can continue to put downward pressure on cost. The need for solar irrigation is immense, given that there were only about 5,000 pumps in use in the second half of 2018. The IFC estimates that the serviceable market for solar water pumps in SSA will more than triple from its current USD 456 million to USD 1.63 billion by 2030, supporting 2.8 million farmers. We propose the following activities as an approach to accelerate investment in rural renewable energy systems and thus expedite the process of scaling-up:

3.1. Establish investment initiatives to develop distributed renewable energy systems by drawing on digital technologies

In Africa, around 15 million people have access to mini-grids or DRE systems and approximately 5 million people have access to solar home systems (IFC 2019). Ethiopia, Kenya, and Tanzania account for most of the recent growth and systems are very small, generally below 50 watts. The market for such systems is, however, much larger and requires important investment, and is often facilitated by mobile phone or other e-payment options to link sellers and buyers (IFC 2019).

3.2. Support associated agro-processing and cold chains to ensure that high-value produce reaches consumers

Increasing yield through the introduction of solar irrigation does not in itself address the question of how the value of that additional yield can be converted into improved livelihoods. Irrigation is the critical first step, but it should be considered within an overall agriculture and food-value chain. This requires renewable energy solutions to also reliably and affordably power various agro-processing and cold storage investments. Several providers have piloted and expanded solar-powered processing and cold storage systems across various African countries, but the scale of operations remains small and needs more support.

Action 4: Ensure that energy, water, and food policies are gender sensitive

Ensuring access to energy, water, and food requires a suitable approach that not only considers the inextricable relationship among these crucial resources, but also takes the principles of gender equality into account. Women and men experience energy and water poverty differently because of their different assets and culturally and socially determined divisions of labor. Women are most often responsible for securing both water and energy sources for domestic use and this affects their time availability for care work, income generation, and leisure (Wickramasinghe 2015; Clancy et al. 2015). Another obstacle that poor rural households face is the lack of access to water and energy for productive use such as agriculture and livestock rearing. Research suggests that most technologies to facilitate these processes are aimed at male farmers and can, as a result, reduce women's control over important assets. For example, most solar and other mechanized irrigation pumps are managed by men; this can contribute to women's disempowerment and to a reduction in crop and livestock yields on women's plots and farms (Theis et al. 2018a). Depending on how energy, water, and irrigation systems are designed, implemented, and managed, women and men will benefit differently, with the burden on women potentially increasing rather than decreasing. Youth employment and productivity can also be improved with interventions geared toward their skills and expertise. We propose the following activities to this end:

4.1. Ensure that women and men are consulted during the design of rural energy and water supply systems, and the introduction of irrigation and other agricultural technologies

Research shows that women are generally excluded from accessing advanced irrigation technologies and tend to lose out in the course of the commercialization of agriculture (see, for example, Lefore et al. 2019; Theis et al. 2018a). To address this challenge, governments and private sector actors should undertake proactive measures

to ensure that women, men, and youth are all consulted in the process of designing rural energy, water supply, irrigation, processing, and cold chain systems. The under-performance of many clean energy cooking solutions in Africa is due to the lack of consultation with end users—chiefly women—in the design stage (Stanistreet et al. 2015).

4.2. Ensure that women and men receive equal information and training on policies, technologies, and institutions in the water–energy–food nexus that affects their rural livelihoods and the well-being of their families

Even when women are consulted on the design of modern irrigation technologies, they tend not to receive the same quantity and quality of information once technologies are in the market. They are also often excluded from credit and sales opportunities associated with advanced water, energy, and agricultural technologies. Several guidance documents and training materials have been developed to guide governments, NGOs, and the private sector in supporting gender equity and inclusion during intensification and commercialization processes (e.g., Theis et al. 2018b).

Similarly, the SE4ALL initiative promotes a more gender-aware approach for sustainable energy access. It incorporates the provision of financial means for affordable energy and water-access solutions, as well as improvements in the enabling environment for women so that they can participate in sustainable energy solutions at all levels (e.g., SE4ALL 2017).

4.3. Identify job opportunities for youth that are linked to energy–water investments such as in rural food processing

Rural youth in Africa and elsewhere generally face more challenges in obtaining credit than their elders and are less likely to own land and other agricultural assets. They also tend to be more educated and better linked to information and communication technologies. Rural youth in Africa are more likely to engage in rural non-farm activities than their elders. However, rural non-farm employment opportunities are limited because of poor energy access in rural areas. Youth absorption in both agricultural and non-agricultural job opportunities should be supported by the actions proposed in this policy brief, that is, by actions to improve irrigation technologies and the associated agro-processing and cold chain development in rural SSA as well as actions that improve energy and water access for non-agricultural employment opportunities.

4.4. Monitor to ensure that both women and men are reached, benefit from, and are empowered by sustainable water, energy, and food systems

It is challenging to fully grasp the gender- and youth-differentiated impacts of interventions in the energy, water, and food security space, as gender- and youth-disaggregated data are generally not collected. We therefore recommend that all countries, civil society organizations, and private sector entities collect data in order to monitor the degree to which women, men, and youth are not only reached by new technologies in the water and energy sectors, but also benefit from these technologies and use them to transform their lives. Such data collection is already enshrined in the SDGs and basic indicators have been adopted by national statistical agencies. These efforts need to be enriched through subnational data collection and through standard project investment assessments that include an ex-post evaluation and learning component focused on impacts of enhanced energy and water access on rural dwellers disaggregated by gender and age.

Action 5: Overcome siloed thinking and improve governance across the water, energy, and food sectors

Enhanced water security and energy access and the associated food security and nutrition goals can only be achieved if siloed thinking across disparate divisions and departments in government and the private sector is overcome. While water and energy security can advance rural and overall growth in SSA and dramatically improve the livelihoods of the poor, such interventions need to be accompanied by strong governance systems to reduce inequity in access and avoid environmental degradation and water depletion. We propose the following two focal areas for Action 5:

5.1. Develop institutions and plans that jointly consider water, energy, and food security goals

Energy ministries in many countries across the world continue to develop energy strategies without considering the quantity of water resources available and without making sure that ministries of agriculture are consulted to ensure that grids are connected in such a way as to encourage productive use that can pay for electricity access. Single-sector strategies incur unnecessary costs, miss important synergies, and often lead to avoidable environmental damage. We recommend that integrated, cross-sectoral water, energy, and food security strategies be jointly developed by relevant government agencies in consultation with the end users of these services, both women and men.

5.2. Develop governance systems to ensure that progress on water, energy, and food security does not increase inequity in access and degrade natural resources

The widespread concern that solar pump irrigation will rapidly deplete groundwater resources—because it does not entail variable costs, such as fuel—has limited the support for, and investment in, solar pump irrigation and is based on the lessons of quasi-free groundwater irrigation in India (Shah et al. 2018). To reduce this risk, monitoring pumping and groundwater levels should be an integral part of procedures to assess the sustainability of irrigation. Social learning interventions have shown promise in improving groundwater governance in India (Meinzen-Dick et al. 2018) and are now being piloted in Africa under the Feed the Future Innovation Laboratory for Small-Scale Irrigation.[3]

3. https://ilssi.tamu.edu.

Disclaimer

This policy brief was developed and written by the authors and has undergone a peer review process. The views and opinions expressed in this policy brief are those of the authors and do not necessarily reflect the official policy or position of the authors' organizations or the T20 Secretariat.

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