HARVARD UNIVERSITY
CENTER FOR AFRICAN STUDIES

HARVARD Global Health Institute

Workshop Report

7-8 MAY 2018

RADCLIFFE ACCELERATOR WORKSHOP REPORT

CLIMATE CHANGE, AGRICULTURE & HEALTH IN AFRICA

Ongoing changes in global climate, caused by human use of fossil fuels, threaten agriculture across the globe, with associated impacts on human nutrition. Nowhere is this threat more acute than in Africa, which already struggles with chronic food insecurity, widespread malnutrition, and vulnerability to drought and other climate extremes.

The Harvard University Center for African Studies (CAS) and Global Health Institute (HGHI), in collaboration with the Radcliffe Institute for Advanced Studies, convened an Accelerator Workshop in May 2018 to bring together scholars from across Africa and Harvard University to evaluate current data and policy interventions, to propose innovative collaborative research projects, and to form a multidisciplinary Working Group that will convene on an annual basis.

The Radcliffe Accelerator Workshop was opened by CAS Oppenheimer Faculty Director Emmanuel Akyeampong, who welcomed participants – particularly those who had traveled from Africa – and observed that the Workshop built on an earlier workshop in November 2017, convened by the Harvard T. H. Chan School of Public Health, the Harvard Kennedy School, and the Center for African Studies, and noted crucial support from the Harvard University Center for the Environment (HUCE) and the Harvard T. H. Chan School of Public Health.

THE NEW NORMAL?

The Workshop opened with a presentation on the ongoing water crisis in Cape Town. Water use in Cape Town has held remarkably constant since 2000 due to interventions including tiered pricing and leak management. However, 2015-2017 were the three driest years on record in the Western Cape, progressively depleting dams and other water storage facilities. In response, Cape Town sought to further restrict water use in the city, with considerable success – average daily water use per capita fell from 200 liters to 50 liters – but still not enough to reconcile with the available supply. Interestingly, the greatest

conservation savings were seen in those users that initially fell in the highest quintile of use, whose usage eventually moved below that of the lowest quintile. This new usage pattern, while commendable, has regressive consequences including increasing the cost of water to poorer, low-use households.

By using different climate models to simulate the likelihood of Cape Town's drought with and without anthropogenic climate change, it can be demonstrated that the recent drought was approximately ten times more likely under conditions of climate change.

Climate modeling and forecasting continues to improve, but current datasets are not adequate to effectively anticipate the full impact of climate change on agriculture. For example, temperature extremes have been increasing, generally with negative consequences for agriculture. However, intensification of agriculture is correlated with a reduction in extreme high temperature. This effect, while largely beneficial currently, could lead to even more pronounced temperature extremes if agriculture falters due to failures of soil moisture, for example.

IMPACT ON NUTRITION

Africa is currently undergoing the "nutrition transition," as more Africans consume large quantities of processed foods, leading to increasing non-communicable diseases (NCDs) such as diabetes, cancer, and heart disease. The health effects of this transition can take years or decades to fully manifest; and, due to population-level adaptations, there is evidence to suggest that if people in Africa and elsewhere adopt the "Western" diet, the health consequences may be even worse than the observed impacts in the US and Europe. Targeting single dietary components such as fat or sugar cannot adequately address these health effects; rather, attention to "Diet Quality" more broadly is essential. US policymakers still associate Africa with undernutrition and struggle to appreciate the "triple burden" presented by obesity and micronutrient deficiency in African populations, in addition to undernutrition.

In Madagascar, bushmeat forms a nutritionally essential component of the diet of rural Malagasies. However, hunting bushmeat is not sustainable, as Malagasy fauna evolved in the absence of human hunting, and bushmeat and fisheries are further threatened by climate change and changes in land use across the island. For example, scientists expect a 50% decline in fish catch in equatorial areas, exactly where climate change will produce other nutritional challenges. It is therefore imperative to foster and support sustainable livestock practices to support nutritional needs in Madagascar and elsewhere.

PEDAGOGY

Concerns about the gaps in relevant pedagogical offerings on climate change, agriculture, and health at African insti-

tutions of higher learning were balanced by acknowledgments that few institutions anywhere in the world have adequate offerings in this complex, interdisciplinary area. Massive open online courses (MOOCs) offer the possibility of reaching Africans across the continent and potentially "leapfrogging" current gaps in educational offerings. African institutions are also increasingly focusing on these issues through interdisciplinary centers such as the Center for Climate Change and Sustainable Development founded at the University of Ghana in 2014.

SOLUTIONS & TENSIONS

Reducing greenhouse gas emissions in order to mitigate climate change in the future may be in tension with development broadly and with the challenges of adapting to the impacts of climate change, raising important questions of equity. Africa has contributed little to historical global greenhouse gas emissions; should Africa be permitted to expend the global "carbon budget" in order to "catch up" to developed, fully industrialized nations?

Use of neglected crops such as castor, together with innovative refinement processes, to produce biofuels may be economically and environmentally preferable to current patterns of fossil fuel usage in Africa.

So-called underutilized crop species (UCS) have the potential to play a significant role in the adaptation of African agriculture to the impacts of climate change, particularly on smallholder farms. 80% of African farms are smallholdings, with 80% of these farming two hectares or less. Yet smallholder farms produce 80% of the food supply in Africa. These farms mostly use rain-fed agricultural techniques and often suffer from poor soils and low yields. Climate change is expected to shorten the crop season and narrow the area of suitability for common crop species. Diversifying crops cultivated by smallholder farmers to include indigenous UCS varieties – many of which are already in limited cultivation – has potential to increase food security. In addition, many UCS are rich in micronutrients and are better adapted to poor soils and drought than conventional crop species. New research at the University of Ghana seeks to identify obstacles to UCS cultivation and to foster market demand and extension support for crops such as the frafra potato.

Climate change heightens and underlines the urgency of increased investment in African agriculture. Africa has failed to keep pace with the immense growth in crop yields achieved elsewhere in the world during the so-called Green Revolution, in part due to policy failures to adequately support fertilizer use and appropriate irrigation. There is widespread undernutrition on the continent. As a result, Africa must import cereals to feed its growing population, at considerable cost – reaching $110 billion by 2025.

Supporting fertilizer use requires improved availability of credit, particularly to women farmers, as well as greatly improved rural road infrastructure. Currently the cost of transporting fertilizer on poor roads to rural Africa drives up the price to three to five times the price at the farm gate than in Asia.

Supporting improvements in irrigation requires immense investment in infrastructure – providing adequate irrigation to just 16% of African farmland would cost $35 billion (though this is what is currently being spent on food imports annually). Crucially, however, the benefit to cost ratio for irrigation projects over time is 2:1.

Drawing on findings like these, the International Food Policy Research Institute (IFPRI) has calculated that offsetting the burden of climate change between now and 2050 would cost $3bn annually, to expand irrigation, improve irrigation efficiency and rural roads, and conduct agricultural research. An example of such a program to increase agricultural production through increased investment is the Southern Agricultural Growth Corridor of Tanzania (SAGCOT), which intended to mobilize $2.1 billion in private sector investments, backed by $1.3 billion in public sector investments in infrastructure and other public goods. However, the project has foundered due to unreliable electricity and difficulties with import licenses, underlining the need for effective policy and leadership.

DATA SOURCES

A key challenge in studying and responding to the health consequences of climate change lies in gathering rigorous and appropriate data. Health impacts are typically assessed through time series analysis. The "holy grail" is to identify a dose-response function, identifying the relationship between the health and the environmental variable.

To do so, the perfect health data set would be retrospective, longitudinal, population-based, representative, time and location stamped, and quality controlled and standardized across sites. It would also cover a range of climate-sensitive adverse health outcomes and be linkable to other relevant data sets, including socio-economic data, meteorological data, remotely-sensed data, agricultural data, and market data.

A key example of such crucial health datasets is produced by the INDEPTH Network in Africa and Asia, which has observed over 81 million person-years through surveys conducted three times per year, including in many of the geographic areas in which the impact of climate change is greatest. It is a network of autonomous study sites or "public health observatories"; the function of the network is to standardize best practices and to promote collaboration. The data is shared online for use by researchers.

Weather Information Management in East

Africa through Information & Communication Technology (WIMEA-ICT) – a collaborative project hosted at Makerere University in Uganda – aims to increase access to reliable, actionable weather information by designing and producing autonomous weather stations. A prototyping process has yielded a relatively cheap and durable but accurate design. Thirty stations have been deployed so far, allowing for extensive field testing and several design improvements. An ongoing challenge is policymakers' lack of appreciation for the value of meteorological information, including for health outcomes such as weather-sensitive diseases.

Responding to a similar shortage of empirical, downscaled data on air quality in Africa, another project based at Makerere is designing and deploying portable air monitors in Kampala. Researchers will use the monitors to establish baseline air quality data and then consider the health impacts of air quality. Eventually, analysis of such data will allow air quality forecasting, permitting advisories to residents on appropriate behaviors to minimize harmful exposures. Major sources of particulate matter include trash burning, older vehicles, and unpaved roads.

New research led by the Harvard School of Engineering and Applied Sciences (SEAS) deploys drones to "smell the forest" – using drone-mounted sensors to detect a range of volatile organic compounds (VOCs) to gather data about stress in the forest, including stresses associated with climate change. Drones permit data-gathering at a previously impossible degree of granularity, elevation, and time frame.

The Soil Moisture Active Passive (SMAP) satellite, launched in 2015, provides an unprecedented dataset on soil moisture across the globe, at nine kilometers spatial resolution. Prior research on crop yield prediction has focused on the role of temperature and precipitation, modeling "heat stress" and "moisture stress." The impact of soil moisture has not been well described due to the absence of data, but evidence of irrigation improving yield under extreme heat suggests that soil moisture plays a key role. Analysis of two years of SMAP data in the US indicates that soil moisture predicts approximately 16% of variability in yield, surpassing the predictive significance of either temperature or precipitation.

NEXT STEPS

The impact of climate change on African agriculture and consequences for public health is an area of interest for a wide range of organizations, including the African Development Bank, the African Academy of Sciences, and the African Export-Import Bank.

Harvard University

Key priorities for CAS and HGHI include

developing pedagogy and teaching on this subject at Harvard, including developing an undergraduate course and visiting scholar programs, as well as directing existing programs such as post-doctoral programs and endowed lectures to engage the broad interest in the impact of climate change on livelihoods and health in Africa. In December 2017, a CAS board member facilitated a study visit by nine scientists (including four from Harvard) to explore joint research projects with African partners in Uganda, Kenya and Ghana. A similar visit – to Nigeria, Rwanda, South Africa and Mauritius – is planned for the near future.

HGHI is developing a MOOC on Climate Change & Health, to launch in the near future. This MOOC will complement existing online courses on the topic developed in Europe, as well as a new set of courses developed by the World Bank and partners.

The HUCE Fellows program supports five post-doctoral fellows in working with Harvard faculty. HUCE also awards small faculty grants specifically designed to motivate interdisciplinary work, typically involving faculty from at least two different Harvard schools.

SEAS has a broad international education program, focused on key technologies in each geographic area; there are synergies with existing SEAS projects in Latin America, including around environmental health. SEAS is also launching a joint terminal Masters of Design and Engineering together with the Graduate School of Design.

The Harvard Planetary Health Scholars program trains undergraduates in the discipline of Planetary Health and supports them in developing a capstone research project in Madagascar. A key goal is to leave tangible products and a lasting legacy with local communities, including policy briefs and decision support tools.

The Planetary Health Alliance, headquartered at Harvard University, is creating a global "community of practice" around the new discipline of planetary health, including creating relevant educational materials and tailoring them to the situations in individual countries.

The Walker Study Group on Systems Change in Nutrition and Agriculture brought together students from the Harvard Kennedy School and the Harvard T. H. Chan School of Public Health to investigate domestic and global health systems change at the intersection of nutrition and agriculture. A "Juma Study Group" on this topic – in honor of Professor Calestous Juma – was proposed in order to sustain and foster student engagement.

African Institutions

There is a wide range of relevant research and policy work taking place in Africa. The University of Cape Town's African Centre for Cities has a program in Urban Food

Security, focusing on the vulnerability to food insecurity of Africans in informal settlements transitioning from subsistence farming. In addition, the University of Cape Town Department of Public Health is launching a course on climate change and health through the Centre for Environmental and Occupational Health.

The African Climate and Development Initiative (ACDI) is a cross-university entity that aims to coordinate and facilitate problem-based research at the intersection of climate and policy, brokering cooperation between faculty that span a wide range of academic sectors and coordinating large, multi-country proposals.

Similarly, the African Climate Change Adaptation Initiative, headquartered at the University of Ghana and including the University of Stellenbosch in South Africa, Mekelle University in Ethiopia, and the University of Dar es Salaam in Tanzaniabrings together a network of African scientists to study the impact of climate change on food systems in order to support adaptation to climate change, including through guiding policy.

The African Research Universities Alliance (ARUA) brings together research-intensive universities across Africa, including the University of Cape Town, the University of Ghana, and Makerere University. ARUA is in the process of establishing Centers of Excellence, including one on Climate and Development, bringing together ACDI at the University of Cape Town, the Institute for Climate Change Adaptation at the University of Nairobi, and the Institute for Environment and Sanitation Studies (IESS) at the University of Ghana. The IESS is also launching a new Masters program in Sustainability Science and Environmental Sanitation.

The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) is a consortium of 85 universities in 35 African countries, with a secretariat at Makerere University, focused on supporting smallholder farmers through grants, training and, ICT support.

The workshop concluded with participants from Harvard, European, and African academic institutions pledging to work together to develop a multi-year research project examining the nexus of climate change, agriculture, and health in Africa with annual workshops held in rotation on the three continents; work closely with policy institutions to ensure research is translated into practical reforms and interventions; co-create courses to be taught in our different institutions with online versions wherever possible; facilitate faculty and student exchanges between our various universities; and support through our publications scientific journals based in Africa, such as the newly-launched, open access Scientific African.

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