H3Africa and the African life sciences ecosystem: building sustainable innovation

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H3Africa and the African Life Sciences Ecosystem: Building Sustainable Innovation

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Abstract

Interest in genomics research in African populations is experiencing exponential growth. This enthusiasm stems in part from the recognition that the genomic diversity of African populations is a window of opportunity for innovations in postgenomics medicine, ecology, and evolutionary biology. The recently launched H3Africa initiative, for example, captures the energy and momentum of this interest. This interdisciplinary socio-technical analysis highlights the challenges that have beset previous genomics research activities in Africa, and looking ahead, suggests constructive ways H3Africa and similar large scale science efforts could usefully chart a new era of genomics and life sciences research in Africa that is locally productive and globally competitive. As independent African scholars and social scientists, we propose that any serious global omics science effort, including H3Africa, aiming to build genomics research capacity and capability in Africa, needs to fund the establishment of biobanks and the genomic analyses platforms within Africa. Equally they need to prioritize community engagement and bioinformatics capability and the training of African scientists on these platforms. Historically, the financial, technological, and skills imbalance between Africa and developed countries has created exploitative frameworks of collaboration where African researchers have become merely facilitators of Western funded and conceived research agendas involving offshore expatriation of samples. Not surprisingly, very little funding was allocated to infrastructure and human capital development in the past. Moving forward, capacity building should materialize throughout the entire knowledge co-production trajectory: idea generation (e.g., brainstorming workshops for innovative hypotheses development by African scientists), data generation (e.g., genome sequencing), and high-throughput data analysis and contextualization. Additionally, building skills for political science scholarship that questions the unchecked assumptions of the innovation performers be they funders, scientists, and social scientists, would enable collective innovation that is truly sustainable, ethical, and robust.

Situating OMICS in a Global World

Checking on the premises and delivering on the promises

TAKING A PROACTIVE ROLE IN THE GLOBALIZATION of life sciences, not to mention global omics systems science and integrative biology, has been on the strategic development agenda of various nations for the past several years. The development of the life sciences is seen as a way to realize and deliver innovation in genomics leading to improved health outcomes. The associated development of a national or international bioeconomy is also promoted as a way of generating jobs, employment, and wider economic growth. An agenda that pushes a developing country towards contribution to an international bioeconomy may be problematic if we do not examine the challenges to fair benefit distribution which arise from being more integrated in the global economic system.

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The leaders of prominent science and engineering research funding agencies from some 50 countries primarily belonging to G-20 and the Organisation for Economic Co-operation and Development (OECD) recently convened at the U.S. National Science Foundation in Virginia for the first Global Merit Review Summit in 2012 (Suresh, 2012). In part, this reflected efforts to ensure that science can deliver on its promises in both developed and developing countries, though the latter binary is increasingly blurred owing to substantial interdependency between nations, whether classified as developed or developing. Perhaps it is such pragmatic interdependency and in part motivation to contribute to global welfare of resource-limited countries through building science infrastructure that have led to a number of large-scale consortia science around the world, the African continent included. Such scientific consortia often articulate an ethos to foster open collective innovation (Bessant and Möslein, 2011) and capacity building in advanced technology driven sciences such as genomics.

Under this overarching context, one of the flagship genomics research projects currently underway in Africa is the Human Heredity and Health in Africa initiative (H3Africa). The project was underlined by promissory discourse on how this and similar global initiatives are going to change the face of genomics research and more importantly, the health of Africans (Bishop et al., 2014; H3Africa consortium, 2014). There is no doubt genomics research on African samples has the potential to contribute substantially to the improvement of health and health systems across the world. Human-kind originated from Africa nearly 200,000 years ago (Hayden, 2013; Ingman et al., 2000) and Africans exhibit the greatest genetic diversity (Masimirembwa et al., 2014). The H3Africa project is expected to collect in excess of 50,000 genomics samples (H3Africa consortium, 2014), representing substantial progress if we compare to smaller scale projects that have sequenced 2000 African genomes to date. There is then, a real and positive potential for massive genomics data generation.

Thus, funding from the USA NIH (National Institute of Health) and the UK Wellcome Trust is greatly appreciated. As independent African researchers in the field, we are also compelled to articulate the potential caveats and unchecked assumptions so as to ensure large-scale consortia stay clear of risks and pitfalls that may potentially fall in blind spots of decision-makers who conceived them in the field of omics sciences systems (Dove, 2013). Indeed, such panoptic engagement between H3Africa and other science consortia and independent field scientists is essential since the findings from these programs are not only going to benefit Africans but also the rest of the world, since African genomes are thought to harbor many clues to disease susceptibility as well as treatment response (Dandara et al., 2014; H3Africa consortium, 2014; Masimirembwa et al., 2014).

The stated aims of H3Africa go beyond the need to collect and secure African samples because of their known significance, towards building clinical research capabilities in the African context and fostering collaborations within the African scientific community. Delivering on the promissory discourse, however, depends first on ensuring that benefits accrue to Africans. This means examining the innovation and emerging biotechnology governance frameworks in place. It also requires asking the right questions in global omics and life sciences and ensuring that African stakeholders are empowered to shape the research agenda and also to be able to continue long after such projects have concluded. To this end, it is noteworthy that most opinions and reports have been by persons from *within* (i.e., beneficiaries to the funding), and the angle has often been to look at the benefits with lesser attention to challenges ahead. There is a need for independent voices working in the genomics field in Africa so both benefits and potential or unintended negatives can be examined for a truly symmetrical discourse. Second, the promise that H3Africa will facilitate sustainable science development in Africa needs to be understood in terms of its contribution to building capacity (physical resources) as well as capabilities (human resources). It is hoped that capacity building might lead to new and extended research programs in other important areas that are currently lacking on the African continent. For example, because of population continuity in many parts of Africa, genomics research on archaeological populations might assist our understanding of past, present, and future population dynamics. Other important domains, such as agricultural and ecological research, nutri-metabolomics, traditional medicine, and Big Data biology will also benefit from enhanced ''omics'' and bioinformatics capacity on the continent (Bondia-Pons et al., 2013; Misra and Panda, 2013; Vivar et al., 2013; Wang and Chen, 2013).

In the sections that follow, we outline three important and interrelated factors impacting delivery of the promise of the H3Africa project; the expansion of governance frameworks, the improvement of capacities and attendant trust issues, and the development of human capabilities. Building capacities and capabilities in the life sciences can lay the foundations of a bioeconomy, and we discuss in this article the inherent contradictions in economic systems that strive for sustainability, while at the same time edging towards specialization.

Governance of Knowledge-Based Innovation and Public Benefit

Governance implies a move away from a governmental top-down approach towards a more democratic and distributed approach, a *steering* role, for ordered rule and collective action (Dove, 2013). The outputs are no different from those of government, though the processes essentially vary with an increased role for nongovernment actors in the policy making process (Lyall and Tait, 2005). It may be argued that a governance approach to the delivery of promise in H3Africa is important because of the wide range of stakeholders involved and the range of aims and goals that must be achieved. The governance approach allows for a more complex set of relationships between these actors to surface, be articulated, and negotiated. These may be relationships which in the past have been complicated by issues of trust and power.

It is our contention that the success of H3Africa is important to all African researchers, those currently holding H3Africa-funded grants, as well as those who do not have such grants, because success of this program is likely to lead to the improvement of our understanding of the role of genetics in disease, and past and present population dynamics. Importantly, H3Africa aims to establish infrastructure such as biorepositories to facilitate studies on biodiversity, disease, and pharmacogenomics of African populations into the future. The current governance framework, recognizing the

limited and depletable nature of samples, states that consideration should be given as to when and how these samples are used and shared and that samples should be used in a manner that ensures the greatest benefit to the public (H3Africa high level principles on ethics, governance, and resource sharing). Importantly, the formation of a biorepository, is the creation of a commodity which has an implied ''bio-value'' (Birch and Tyfield, 2012). Similar to all biorepositories, achieving benefit to the public with a scarce resource can be problematic especially when considering non-use, secondary uses of data, patentability of discoveries made on the basis of H3Africa data, and the criteria used for granting access to samples (Huzair and Papioannou, 2012; Winickoff, 2007).

Despite substantial scholarship, legislative and regulatory efforts by national and supra-national bodies, there remain concerns around informed consent. Informed consent is complicated in societies who have limited knowledge about genomics and its applications (Graboyes, 2010). Concern extends to the validity of individual consent in the face of increasing knowledge that an individual's genomics information can contribute to information about a community, tribe, or other subpopulation. Hence the demands by some African and other developing communities for both individual and community consent is also valid (Buseh et al., 2013; Graboyes, 2010; Mello and Wolf, 2010; Wright et al., 2013).

Innovation and technology governance frameworks to steer the conduct of genomics research in most African countries therefore currently falls short. It should be part of the remit of H3Africa to lobby governments in and outside Africa for statutory governance instrument developments to ensure that democracy in research can be upheld. Without the input of African stakeholders into the research agenda, there is a potential risk that the stated aims and goals of Western funders take priority. Instruments for democratic governance and regulation are important not only at national level, but also at the 'local' or organizational level to prevent power differences that could unduly influence the control of resources and enforce inequitable distribution of benefit from the research. Thus far, the contributions of African governance initiatives in H3Africa have been mostly eloquent appeals for funding from the USA and the EU to strengthen genomics research in Africa. This does not, however, automatically make them equals in the emerging H3Africa initiative, but mere convincing beneficiaries of the idea. Arguably, African researchers' demands for tangible contribution from African organizations and governments could give the African stakeholders strength of voice in the consortium and in the implementation of the program. What we argue for is not impossible; indeed, recently, a clinical trial was successfully completed by a group of mostly African researchers (Mayosi et al., 2014) working on an identified African-specific problem under the auspices of IMPI, yet with very minimal funding.

Building Capacity and Mutual Trust

Fulfilling the promissory rhetoric depends on the capacity to collect, store, organize, and utilize samples, data, and information within Africa. Genomics data generation is associated with infrastructural requirements such as sustainable biobanks, genomic characterization platforms, and appropriate expertise and training. The establishment of a biorepository, if well curated and funded, can be the reservoir of future projects for training African scientists using emerging or improved technologies. Alongside enormous potential to contribute to the improvement of human health, exists a troubled history of genomics research in Africa and other resource limited regions around the world (Dandara et al., 2012; 2014; Gotch and Gilmour, 2007; Graboyes, 2010; Mello and Wolf, 2010; Wonkam et al., 2011).

With the infusion of research funds to the continent, the urgency in the collection of biological samples, and anticipated quick generation of data, it is inevitable that most if not all the initial data-generation will be undertaken outside Africa. However, this should not dampen the enthusiasm to establish relevant infrastructure in Africa, in the medium to long-term lifetime of the project.

Continuing to send samples to collaborators outside Africa without improving capacity to characterize them locally, is likely to galvanize the existing views of many local ethic review committees, making them averse to the concept of global sharing of biological specimens and data, which many still view as exploitation (Mduluza et al., 2013; Mello and Wolf, 2010). It is a difficult proposition but this may be precisely where the H3Africa can show that it is transformative in its stated vision and objectives. The attempt to harmonize standards for biobanking is encouraging (Staunton and Moodley, 2013) and hopefully when the time is right, samples from different collections could be useful in answering pertinent genomic questions that may require much larger sample sizes.

With the granting of large funds, there is the potential for mis-management in regions that lack adequate oversight or are laden with power differences between local and global researchers and funders. In the last 40 years, we have witnessed around the world multiple cases where large funds have been mis-managed, which in turn have heavily undermined the much needed humanitarian endeavours (Butterfield, 2004; Halonen et al., 2003; Mosse, 2005). Expenditure on meetings is often high at initial stages of projects. Meetings for and by consortium members hopefully establish confidence and trust relationships. Most of the researchers lack a history of working together and so there should be a balance between funds used for meetings and funds allocated to supporting the setting up of infrastructure for genetic data generation, analysis, and the training of young scientists.

One of the potential problems is the duration of funding for biobanks. Since they are a special and veritable research resource, funding should be assured for the full duration of H3Africa and beyond. There should already be conversation at higher levels such as the Africa Union (AU) through their NEPAD (the New Partnership for Africa's Development) program, or at individual country level, to start setting aside future funding commitments to ensure sustainability of H3Africa-sponsored biobank funding. Individual governments particularly those of leading economies such as South Africa and Nigeria may also avail some funding for this strategic resource.

In the early days of setting up H3Africa, one of the needs frequently articulated has been the collection of African genetic/genomic samples, to be characterized by African-based researchers, with the characterization to be done in Africa. This is one of the most challenging visions to put into action.

There seems to be rather little infrastructural development focus, especially for genetic and genomic data generation (i.e., genotyping platforms that include sequencing facilities). If no concrete genetic or genomic characterization platforms are developed, after the H3Africa funding, African researchers risk returning to the period before this initiative had commenced, where there was a reliance on the use of Western collaborator platforms. Within a bioeconomy, there is a pressure to specialize in resource or service provision to reduce cost and maintain a competitive advantage in a specific area. This would provide only limited local benefit and work against sustainable science development. It is therefore in the interest of African scientists in H3Africa, to push forward a core inclusive agenda so that such infrastructure spending on such platforms is realized.

The formation of H3Africa brought excitement and justified hope especially with respect to the involvement of Africa-based researchers on decisions concerning how the samples collected from Africa are going to be utilized (including secondary and tertiary usage). However, considering the troubled collaboration history summarized above, there has always been an underlying trepidation among African researchers, both within and outside the H3Africa consortium, that this could be another potential way to sanitize the removal of African biological samples in a well-coordinated manner with the complicity of African-based researchers, for the benefit of those outside the African continent.

Indeed, taking into account the history of biological sample movement in Africa and elsewhere in the developing world, where there was unregulated and unauthorised recruitment and sampling of populations (Graboyes, 2010), the H3Africa Communicable and Noncommunicable Diseases Working Groups produced a White Paper in January 2011 titled ''Harnessing Genomic Technologies Toward Improving Health in Africa: Opportunities and Challenges''. The White Paper boldly stated:

> …. the establishment of a viable, productive clinical and research infrastructure, through combined leveraging of capacity, expertise, and infrastructure within existing institutions and investing in new centers of excellence. This new infrastructure will require investment in capacity development… (H3Africa White paper, 2011).

In effect, the vision broadly encapsulates resource development, infrastructure development and Education and training (www.h3africa.org).

The White Paper outlined the challenges as well as possible solutions. Prominent infrastructural resource developments proposed included setting up of biobanking facilities (possibly to stem the tide of parachute science where biological samples were removed from Africa for studies abroad) and notably:

> … provision of technological infrastructure (units/centers of excellence) for genetic and genomic data generation and analysis that enables investigators to accomplish clinical research in the African context and to foster collaborations within the African scientific community (H3Africa White paper, 2011).

Being on the African continent and experienced in the social studies of the global life sciences R&D, we are not fully convinced that there is sufficient buy-in by H3Africa researchers to keep their biological samples at the H3Africa sponsored biobanks. This could partly be due to the difficulty experienced where ingrained and troubled historical practices with researchers who have become a conduit for sample provision to offshore collaborators, are expected to change overnight in their thinking and personal ethos, and suddenly start to share and keep samples together. Efforts to build systems of open innovation or collaborative innovation are therefore premised on trust relationships. Of note, mutual trust is built slowly over time rather than overnight. Moreover, collaborations involving North–South partners bring to this relationship a particular historical dimension that has been underexplored in studies of innovation.

Generally, capacity building efforts should be considered throughout the knowledge production chain, from idea generation, to data generation, to data analysis, interpretation and knowledge-based innovation and ultimately science-driven societal development and prosperity. A more integrated capacity building approach that takes into account the development of people (as we discuss in the next section) alongside the development of physical resources, may help prevent brain drain and unsustainable capacity building (Table 1).

Development of Human Capabilities

Underlying both the establishment of a more effective ethics and governance framework and the unlocking of potential in physical infrastructure is a need to develop human 'capability' (which we borrow from Sen's (1985) people centered approach in economic development). Since the release of the White Paper, and the awarding of research grants totalling nearly $80 million over 5 years via the H3Africa initiative, the tone of the rhetoric and sentiments among involved researchers seems to have changed. It could be early days because the immediate issues facing the researchers are around training African researchers on issues around sample collection (e.g., administering consent, taking care of ethical and legal issues, temporary storage, and shipping of samples). This is already an investment in scientific capability, a form of brain-gain.

In other words, African researchers should not establish their role in the bioeconomy merely as sample providers (providing the raw material for the beginning of a value chain that ends in the West or richer countries) for which their epidemiological studies were a reward. The PhDs and Postdocs arising from H3Africa associated training, should be recognized as experts in their own right and be encouraged to make novel and original contributions to the field.

As discussed in the previous section, genomics research dealing with African populations was happening but mostly through large exports of biological samples to western countries that often was lamented by African researchers and has since created a negative perception for Africans within the continent and those in the diaspora (Buseh et al., 2013; Graboyes, 2010), which endures to this date. Any analysis of large consortia including H3Africa must take into account the historical legacy and scholarship on globalization in a context of ''Big Biology'' and the ways in which historical and global socio-technical forces might shape innovation trajectories in data-intensive omics sciences in Africa (Dove, 2013; Rajan, 2006; 2013).

Table 1. Topline Executive Points to Rethink for Sustainable Scientific Capacity Building in Africa and Sustainable Innovation for All

- H3Africa and other infrastructure capacity building efforts for 21st century science and knowledge-based innovation around the world are valuable initiatives that can potentially benefit many. Yet the dynamic 21st century science initiatives demand real-time calibration including of the efforts for capacity building such as H3Africa and beyond. Voices and scientific expertise in Africa ''from the ground up'' are crucial to build a sustainable future for Africa and by Africans in the course of H3Africa and well beyond.
- Any capacity building effort in Africa cannot afford to overlook the long and painful historical context of biosample shipments from the continent by researchers situated elsewhere offshore; this history has to be born in mind for any biomedical and life sciences consortia to succeed now and in the future.
- Capacity-building should materialize in the *entire* knowledge co-production trajectory from idea generation (e.g., brainstorming workshops for innovative idea generation by African scientists) to data generation (e.g., genome sequencing) to data analysis, interpretation and knowledge-based innovation and ultimately science-driven societal development and prosperity. In the course of capacity building, subcontracting out or outsourcing any component of the above scientific knowledge trajectory would lead to many adverse potentials such as brain drain, unsustainable capacity building that does not stand the test of time and the local context and the 21st century science, among others. An *integrated* capacity building in the course of H3Africa and other capacity building initiatives are essential.
- For sustainable capacity building, what is needed, in addition to ethics and policy, is a critical lens on discourse and promissory rhetoric that questions the unchecked assumptions of science, scientists and social scientists alike; this can be achieved by incorporating a political science and discourse analysis pillar to collective innovation and capacity building efforts such as H3Africa that will – at a truly independent arms length – question-the-questions and the embedded assumptions in science and knowledge based innovation (De Vries, 2004; Jasanoff, 2003; 2013; Wynne, 2010).
- Finally, it is important to bear in mind opportunity costs as well: That the end-game in scientific infrastructure capacity building is *not* limited to genomics but should also consider other omics technologies including technologies that are simple (e.g., frugal innovation) and importantly, consider innovative ways to link (translate) discovery science and technology to knowledge-based innovation and prosperity for all.

For example, in the past, prior to H3Africa, the sending of samples out of the continent was mostly to African researchers based in diaspora or on quasi-collaborations between African-based researchers and their well-resourced Western counterparts where power differences in research resources made such collaborations not equitable. Western counterparts characterized and analyzed data from these samples training their own researchers who then often became ''experts'' on African problems. This bias and inequity largely side-lined the training of researchers situated in Africa, in part leading to the dearth of research capability observed on the African continent. An additional avenue of sample export from Africa has been and still includes activities through clinical trials by the pharmaceutical industry, something that needs due consideration but is beyond the scope of this commentary and is mentioned for the sake of completeness (Nienaber, 2011; Pang 2011; Warner et al., 2011). Thus, consortia such as H3Africa can assist in reducing the brain-drain and possibly turn it into a brain-gain.

Also mentioned previously is the need for a core inclusive agenda for genomic characterization platforms to be realized in Africa. The establishment of these platforms will lead to the training of individuals on the respective techniques for using and maintaining such infrastructure. There is commendable training in bioinformatics that has been put in place (Adoga et al., 2014; Bishop et al., 2014). Indeed, this is one of the current success stories of H3Africa which, as a potential to revolutionalize genomics research, however, we hope for more. If the coordination observed in H3Africa in these early days is anything to go by, this may in some way lead to improved brain-gain. However, this training will be in vain if it is only focused on data-analysis without also promoting training in data generation. The impressive focus on bioinformatics training prepares African scientists to manage and handle huge amounts of data that are foreseen to be generated either abroad or from centers to be set-up locally. If genomics data are not going to be generated in Africa, all the training that is happening in bioinformatics will not be sustainable, in our personal view, as trainees will most likely follow where data are being generated, leaving Africa in a worse-off position.

From the original intention to have samples analyzed in Africa, which in itself would be the right catalyst for infrastructural development, the emphasis seems to now being placed on data generation from anywhere where there are functioning facilities. As previously mentioned, this is the scenario that existed before the launch of H3Africa, where African researchers were mostly collectors of samples (Gotch and Gilmour, 2007). We cannot afford to return to where we existed before H3Africa and certainly should not end worse off as African scientists and society, when the H3Africa funding stream runs out. Genomics research, if well-established, could also place ''omics'' research at the center of understanding other important fields such as physical anthropology and archaeology.

The Way Forward and Concluding Remarks

Africa has been and will remain an important resource for genetics research as confirmed by the following statement taken from the H3Africa White Paper under the title *The Future of H3Africa:*

> The model proposed for H3Africa seeks to position Africa not only as a vital resource for genetic and genomic data collection but also as the recognized scientific hub for the initiation and full implementation of modern genetic and genomics research in African populations. The success of H3Africa depends largely on the provision of adequate resources and infrastructure for African scientists (H3Africa White Paper, 2011)

We are hopeful that H3Africa concretely transforms the previous status of Africa as a resource for sample collection and instead stimulates the evolution of Africa into a veritable

''global innovation hub'' that attracts new scholars internationally to its institutions (brain-gain). Building capacity for genomics data generation *and* analysis, as espoused in the H3Africa White Paper vision under infrastructure, is consistent with this forward progressive vision. It is essential that technology is seen to be transferred and shared in an altruistic way, especially through long-term commitments to capacity building and training.

Returning to our view that the right questions need to be asked, before finding the right answers, we have highlighted a number of unchecked assumptions (summarized in Table 1), which if taken into account, might well strategically position H3Africa and other large-scale life sciences consortia to deliver on the promises to improve the health, welfare, and research capacity and capability of Africans. In the absence of such consideration, we put the current exhaustive investments in global omics science and otherwise well-argued initiatives at significant risk. This is a historical responsibility and the time to act is now while the futures are still in the making.

There is no doubt genomics research on African samples has the potential to contribute substantially to the improvement of human health throughout the world (Dandara et al., 2012). In this vein, African researchers must be stake holders, they must be empowered in the process so that long after H3Africa has ended, good scientific research continues on the basis of the infrastructure set-up during this well-intended and robust funding period. Buy-in and ''financial-adoption'' by African governments is necessary for sustainability and to ensure continued strengthening of genomics research on the African continent.

In a recent Science article (H3Africa consortium, 2014), the consortium lists some of their measures of future success and we would like to add another to this list: *catalysis of long-term funding to ensure long-term sustainability of established infrastructure including bio-banks, genomic platforms, and data analysis training programs.* This could be achieved through funding from international bodies such as NEPAD and any other international body that can support long-term sustainability. As we describe above, funding programs should be accompanied by governance mechanisms to allow participation of all stakeholders in funding decisions and with long-term strategies that could ensure the self-funding sustainability. This is not only with regard to decisions over infrastructure investment but also with respect to setting the research agenda and asking the right questions and ensuring research projects build African scientific capability. For H3Africa to be sustainable, it should serve as a reference point for future engagements within Africa as well as between Africa and the rest of the world.

Within continent capacity building gradients, for example, North–South or East–West Africa, could deter progress and some mixer function to equitably distribute capacity building efforts in Africa would be helpful. Interfacing with additional governance instruments such as Science Peace Corps or micro-grants or other types of instruments for governance of capacity building might catalyze the much needed infrastructural capacity development.

As African life scientists and social science scholars experienced in the field of science and technology studies (STS), we write this piece with much hope that in 5–10 years' time, we will see genuine capacity built in omics science systems and begin to see the signs that Africa is becoming an international innovation hub attracting scholars offshore to the continent. Yet this vision is not ''automatic'' and requires us to be reflexive and consider hitherto unchecked assumptions some of which are noted in Table 1. In the absence of such consideration, we might instead see a potential movement of African researchers to offshore or Western labs in the future unless the H3Africa and similar large scale life sciences efforts ensure both training *and* retention of the current and the next generation of scientists skilled in the entire knowledge co-production trajectory from data generation to analysis to innovation analysis. We believe H3Africa is an opportunity to change the past—old sanitized ways of simply sourcing genomics samples from Africa—and move to a future built by African scientists and Africans for science that is locally productive, embedded in the local norms and priorities of the citizens while being globally competitive. This embodies an opportunity for building mutual trust, and importantly, the promises and actions on the ground to overlap in the course of H3Africa and large-scale life sciences initiatives.

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