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# Widening participation would be key in enhancing bioinformatics and genomics research in Africa

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ABSTRACT

Bioinformatics and genome science (BGS) are gradually gaining roots in Africa, contributing to studies that are leading to improved understanding of health, disease, agriculture and food security. While a few African countries have established foundations for research and training in these areas, BGS appear to be limited to only a few institutions in specific African countries. However, improving the disciplines in Africa will require pragmatic efforts to expand training and research partnerships to scientists in yet-unreached institutions. Here, we discuss the need to expand BGS programmes in Africa, and propose mechanisms to do so.



## 1. Introduction

Bioinformatics and genome science (BGS) are relatively new disciplines, gaining importance across the biomedical research, healthcare and agriculture sectors due to their importance in helping to improve the timeliness and accuracy of disease diagnosis, prognosis and treatment, as well as enhancing crop yield (Machuka, 2004; McCarthy et al., 2013; Worku et al., 2005). While scientifically-advanced countries in North America and Europe have been major leaders in BGS, many developing countries (including some African countries) have made important achievements in applying genomics technologies to enhance biomedical research, healthcare and agriculture (Machuka, 2004; Mitropoulos et al., 2015). Since the mid-1990s, many African countries have been employing tools and techniques in BGS to help advance scientific research (Bishop et al., 2015; Fatumo et al., 2014; Karikari, 2015a; Lyantagaye, 2013; Masiga and Isokpehi, 2004; Ojo and Omabe, 2011). BGS research groups have been constituted and studies employing these approaches have been conducted and published by African scientists, helping to improve our understanding of the biological basis of health and disease among humans and non-human species (Bishop et al., 2015; Fatumo et al., 2014; H3Africa Consortium et al., 2014; Karikari, 2015a; Machuka, 2004). Importantly, scientists in Africa have been applying BGS techniques to address some of the continent's most debilitating challenges, including those of food insecurity, unsustainable agricultural practices and the high disease burden (Fatumo et al., 2014; Karikari, 2015a; Machuka, 2004). For example, some African scientists and their collaborators recently employed genomics technologies to sequence the genome of the tsetsefly, the vector for Human African trypanosomiasis — a devastating tropical disease (International Glossina Genome Initiative, 2014). Also, African researchers were instrumental in the epidemiological characterisation of the Ebola virus disease (EVD) (through whole-genome sequencing) during the recent outbreak in West Africa (Gire et al., 2014). A major progress in agricultural genomics in Africa was the sequencing of the sorghum genome in 2009 and the recent sequencing of the genomes of forty-four sorghum lines, which demonstrated that genomics diversity and historical domestication differences existed between the lines studied (Mace et al., 2013; Paterson et al., 2009). Sorghum is a nutrient-rich African crop, with a promise to help improve food security and reduce malnutrition and poverty on the continent (Kelemu et al., 2013). Being the first indigenous crop in Africa to have had its genome completely sequenced, the findings from these studies provide a vital resource for genetic improvement of sorghum and other cereal crops to enhance crop yield, agricultural productivity and food security (Kelemu et al., 2013). The foregoing examples show that the importance of BGS is becoming widespread and almost indispensable to advancing biological research in Africa.

## 2. BGS in Africa appear to be concentrated in a few institutions

The progress made in BGS in Africa can be attributed to investments made in building the physical and intellectual capacity to promote the

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**Table 1**
Academic, commercial and non-profit organisations in Africa that have bioinformatics and genomics resources and expertise.[a]

| Institution | Focus | Website |
|---|---|---|
| African Centre of Excellence in Bioinformatics, University of Sciences, Techniques, and Technology of Bamako, Mali | Providing infrastructure and tools for training, mentorship and research in large-scale bioinformatics and genomics data analysis. | – |
| African Centre of Excellence for Genomics of Infectious Diseases, Redeemer's University, Nigeria | To apply genomics and bioinformatics approaches to help improve research into infectious disease pathogenesis, surveillance, clinical care and control. | http://acegid.org |
| African Centre for Gene Technologies, South Africa | To develop a network of scientists with expertise in biotechnology and *omics* technologies. | http://www.acgt.co.za |
| African Collaborative Centre for Microbiome and Genomics Research, Institute of Human Virology, Nigeria | To develop a collaborative team of expert scientists who will help to accelerate the search for disease biomarkers that would increase the timeliness and accuracy of cervical cancer research, diagnosis and treatment. | http://h3accme.com |
| West African Bioethics, Nigeria | The programme is aimed at providing training and research in bioethics (delivered in English and French) to scientists in West Africa. Moreover, West African Bioethics has introduced graduate programmes (MSc, MPhil and PhD) in bioethics in partnership with the University of Ibadan, Nigeria. | http://bioethicscenter.net/web/ |
| Institut Pasteur de Côte d'Ivoire (IPCI), Côte d'Ivoire | The IPCI has expertise in the use of molecular technologies for studying pathogens of public health importance — particularly in the areas of diagnosis, genotyping and genomics. | http://www.pasteur.ci |
| Biosciences Eastern and Central Africa (BECA), International Livestock Research Institute (ILRI), Kenya | BECA is a New Partnership for African Development (NEPAD) initiative that supports the expansion of bioinformatics training and research efforts in East and Central Africa. | http://hub.africabiosciences.org; http://www.ilri.org/kenya |
| West African Bioinformatics Research Institute, Ilorin, Nigeria | This non-profit organisation is aimed at helping to promote bioinformatics teaching and research in West Africa, through the development of databases and software and the provision of training courses. | http://www.wabri.org |
| African Studies on Population and Health (ASOPAH), Nigeria | This non-profit organisation is an affiliate of the Environmental and Health of Communities of Africans international organisation. ASOPAH's research focus includes genetic factors in health and disease. | http://www.asopah.org |
| H3ABioNet nodes (these are centres of excellence in bioinformatics funded under the H3Africa scheme) | | |
| Botswana Harvard AIDS Institute Partnership, Botswana | This is a research partnership between the Government of Botswana and Harvard University in the United States to improve research and training efforts aimed at controlling the HIV/AIDS epidemic in Botswana and elsewhere in southern Africa. | http://aids.harvard.edu/reserch/bhp/ |
| Egyptian Center of Bioinformatics and Genomics/Genetics Department, Faculty of Agriculture, Zagazig University, Egypt | The Centre focuses on providing bioinformatics and genomics research and education support to members of the Zagazig University community and beyond. | http://english.zu.edu.eg/Index.aspx; http://www.agri.zu.edu.eg (in Arabic) |
| Kumasi Centre for Collaborative Research in Tropical Medicine/Kwame Nkrumah University of Science and Technology, Ghana | This H3Africa node has expertise for research and training in bioinformatics and genomics, with a focus on infectious, non-communicable and neglected tropical diseases. | http://kccr-ghana.org; https://www.knust.edu.gh |
| Noguchi Memorial Institute for Medical Research, Ghana | This node has expertise in molecular and computational research methods (including quantitative PCR, probe hybridisation techniques, and genome sequencing and data analysis). | http://www.noguchimedres.org |
| International Centre of Insect Physiology and Ecology (ICIPE) , Kenya | Bioinformatics and genomics research at ICIPE is focused on infectious diseases, anthropods and plant-parasite interactions. | http://www.icipe.org |
| International Center of Excellence in Research, University of Sciences, Techniques and Technology of Bamako, USTTB, Mali | The Centre has expertise in, and resources for, research and education in malaria, neglected tropical diseases, HIV/AIDS and tuberculosis. | http://www.usttb.edu.ml |
| Southern Africa Network for Biosciences (SANBio), University of Mauritius, Mauritius | SANBio aims to train more scientists in southern Africa in bioinformatics skills through capacity-building courses and efforts to introduce bioinformatics modules into existing university curricula. | http://www.uom.ac.mu |
| Centre de Recherche Medicale et Sanitaire, Niamey (CERMES), Niger | CERMES aims to develop a centre of excellence in bioinformatics to provide support in research and training in public health and other areas in Mali. | http://www.cermes.net/cermes/ |
| Covenant University Bioinformatics Research (CUBRe), Nigeria | CUBRe aims to help advance bioinformatics in Nigeria through research and capacity-building activities targeted at supporting academic and corporate organisations to improve biomedical research and drug discovery and development. | http://cubre.covenantuniversity.edu.ng |
| National Biotechnology Development Agency (NABDA), Nigeria | NABDA seeks to develop national competence in the development and application of bioinformatics tools and techniques to provide biotechnology-driven solutions to biological problems in Nigeria. | http://www.nabda.gov.ng |