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Bioinformatics: Its role for agricultural research and food security in Africa

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DSA_Addis2019

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Addis Ababa University, Ethiopia

Who am I

Helen Nigussie Aychegrew (Ph.D.)
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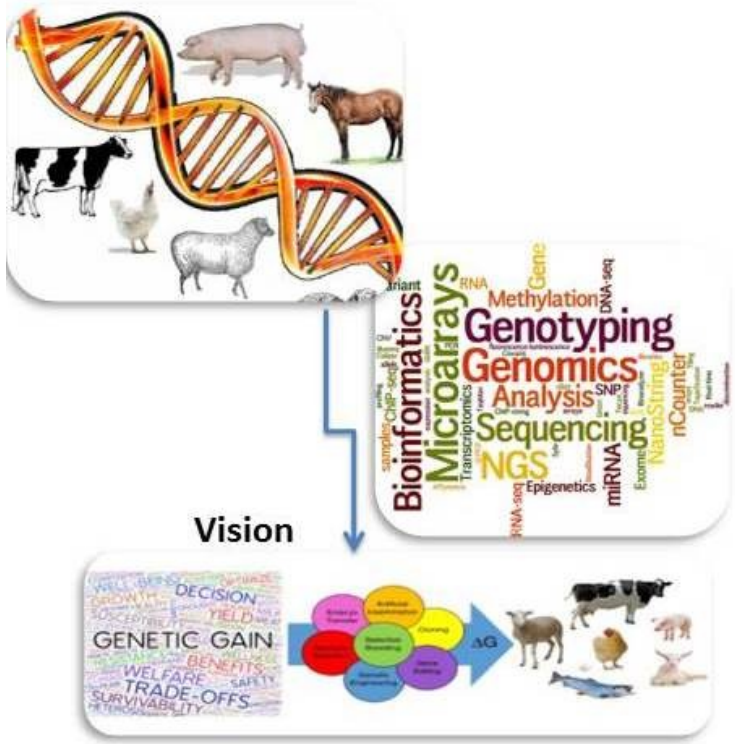
Background

Animal genetics and Breeding

(Sheep genetics /genomics)

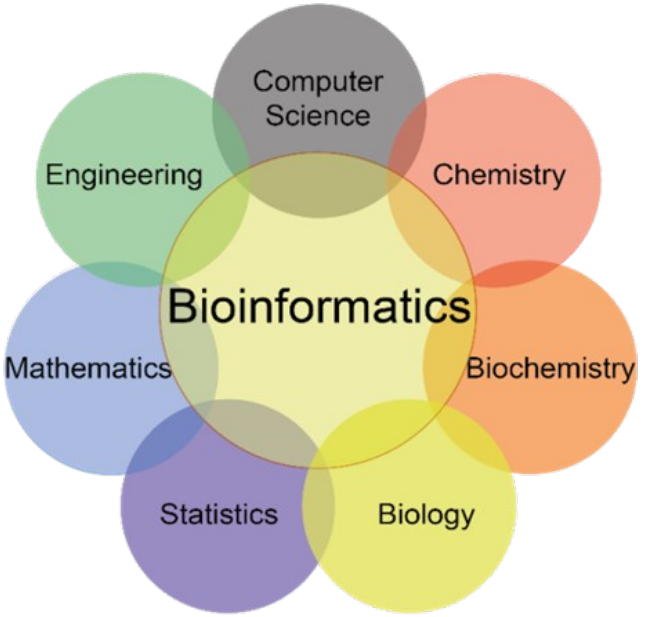
Research Interest

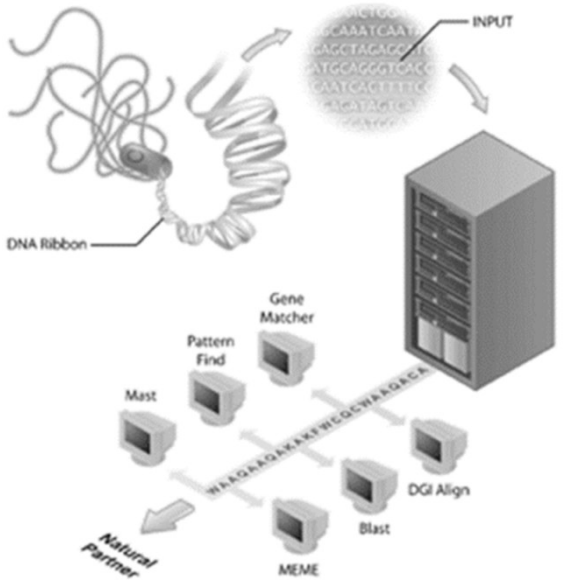


What is Bioinformatics?

- Bioinformatics is an interdisciplinary field that develops and improves methods for storing, retrieving, organising and analysing biological data.

- It also involves the integration of computers, software tools, and databases in an effort to address biological questions.

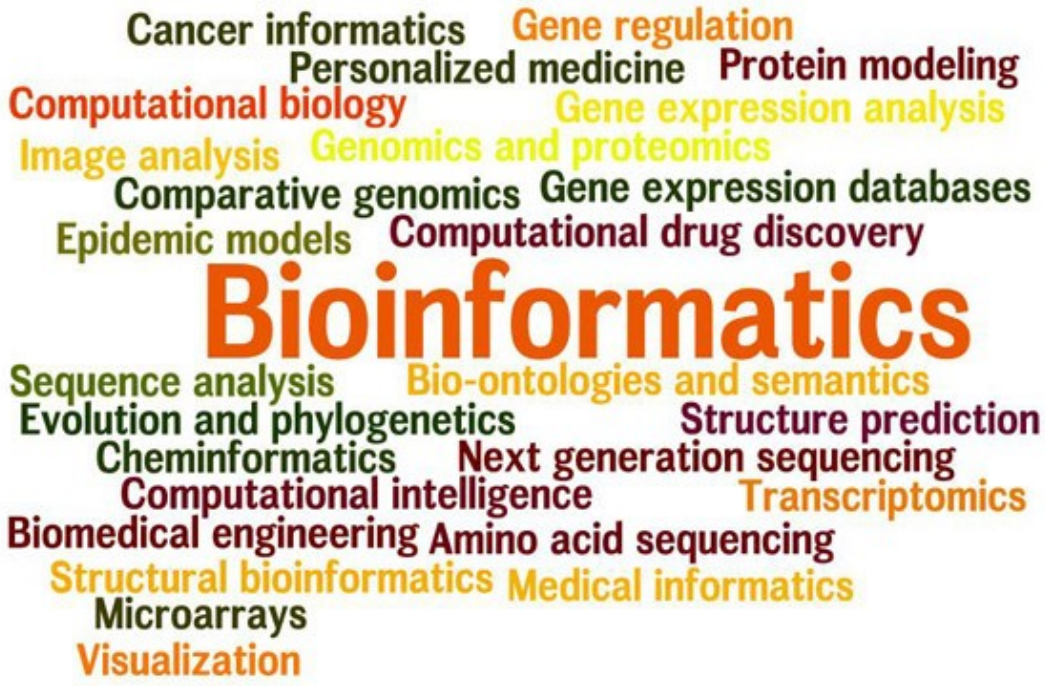




What is Bioinformatics?.....

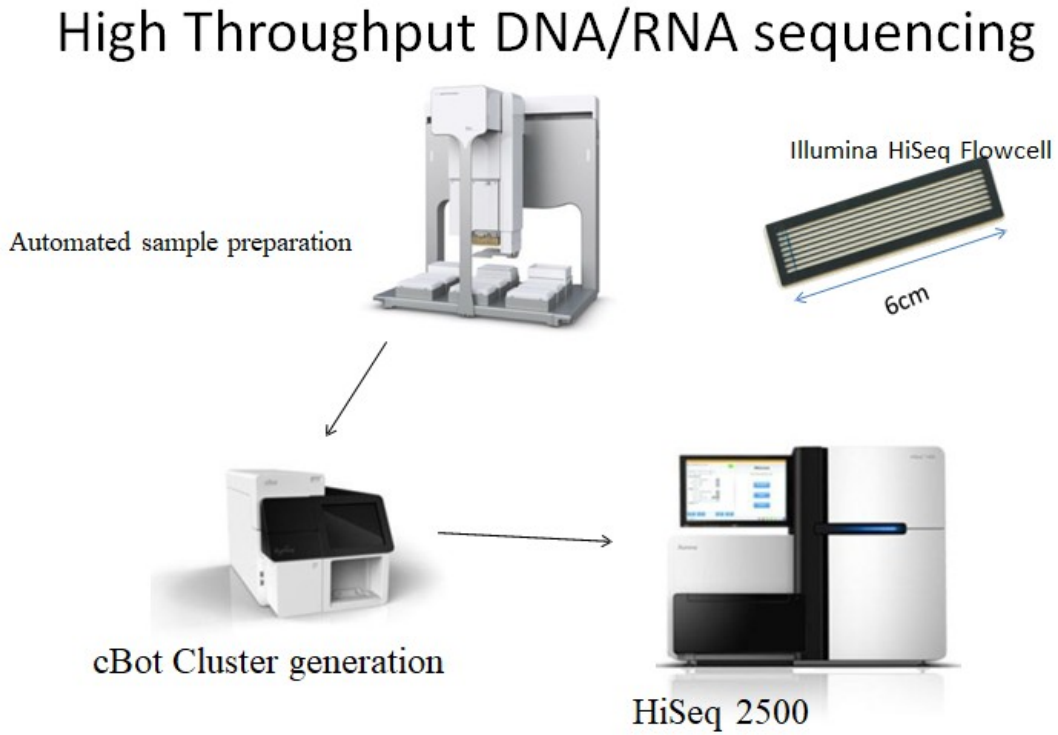
- It has come out as a tool to smoothing the ways for biological discoveries.

- It has aided in genome sequencing, and has shown its success in locating the genes, in phylogenetic comparison and in the detection of transcription factor binding sites of the genes.



What is Bioinformatics?

- ✓ Increasing interest in genomics research
- ✓ Rapid ground breaking progress of sequencing technology generate big data set
- ✓ Cost-effective that nowadays it is common for any experimental lab to use sequencing methods to study genome of interest.

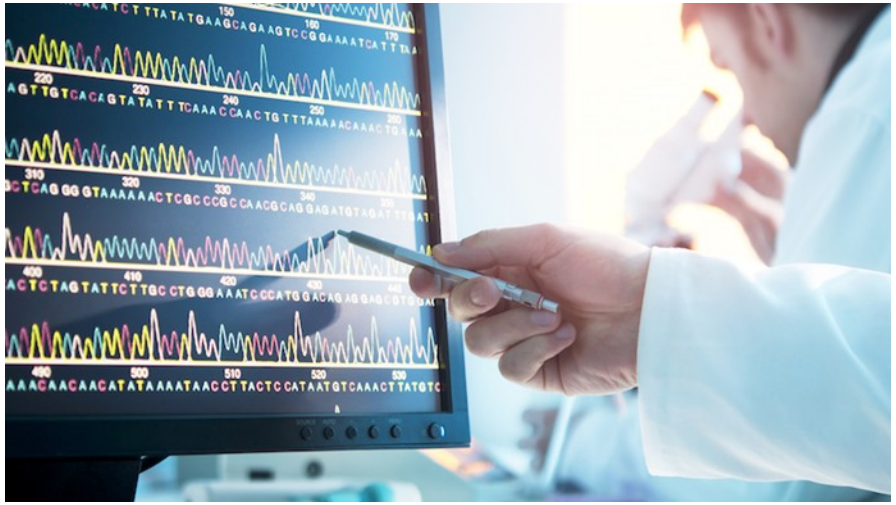


How do we use Bioinformatics?

- Store/retrieve biological information (databases) e.g NCBI, Emble ……..
- Retrieve/compare gene sequences
- Predict function of unknown genes/proteins
- Search for previously known functions of a gene
- Compare data with other researchers
- Compile/distribute data for other researchers

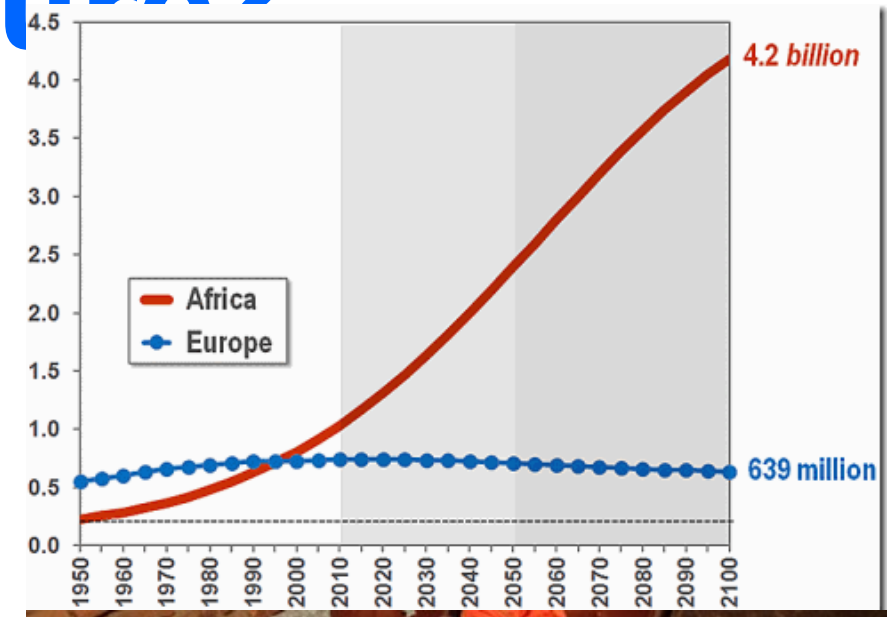
How Bioinformatics…..

- Bioinformatics deals with any type of data that is of interest to biologists
  - ✓ *DNA and protein sequences*
  - ✓ *Gene expression (microarray)*
  - ✓ *Raw data collected from fiel d or laboratory experiment*
  - ✓ *Images, virtual models, Soft ware*
  - ✓ *Articles from literature and d atabases of citations*



Why bioinformatics in Agriculture?

- Increasing population, urbanization and expected increasing income in Africa lead to strong demand for protein source foods
- Food insecurity and malnutrition
- Agricultural productivity is



Why Bioinformatics?.....

- To supply nutritional food to continuous increasing world population while considering three important limitations:-
    - less plow lands,
    - depletion of energy resources and
    - unpredictable climate change.
- we need to enlarge the pace of research so we can be capable to provide enough food for future generations.

Agenda 2063 ASPIRATION 1

- A prosperous Africa based on inclusive growth and sustainable development
  - ✓ *Modern agriculture for increased production, productivity and value addition contributes to farmer and national prosperity and Africa's collective food security.*

Significance of Bioinformatics in Agriculture

Crop

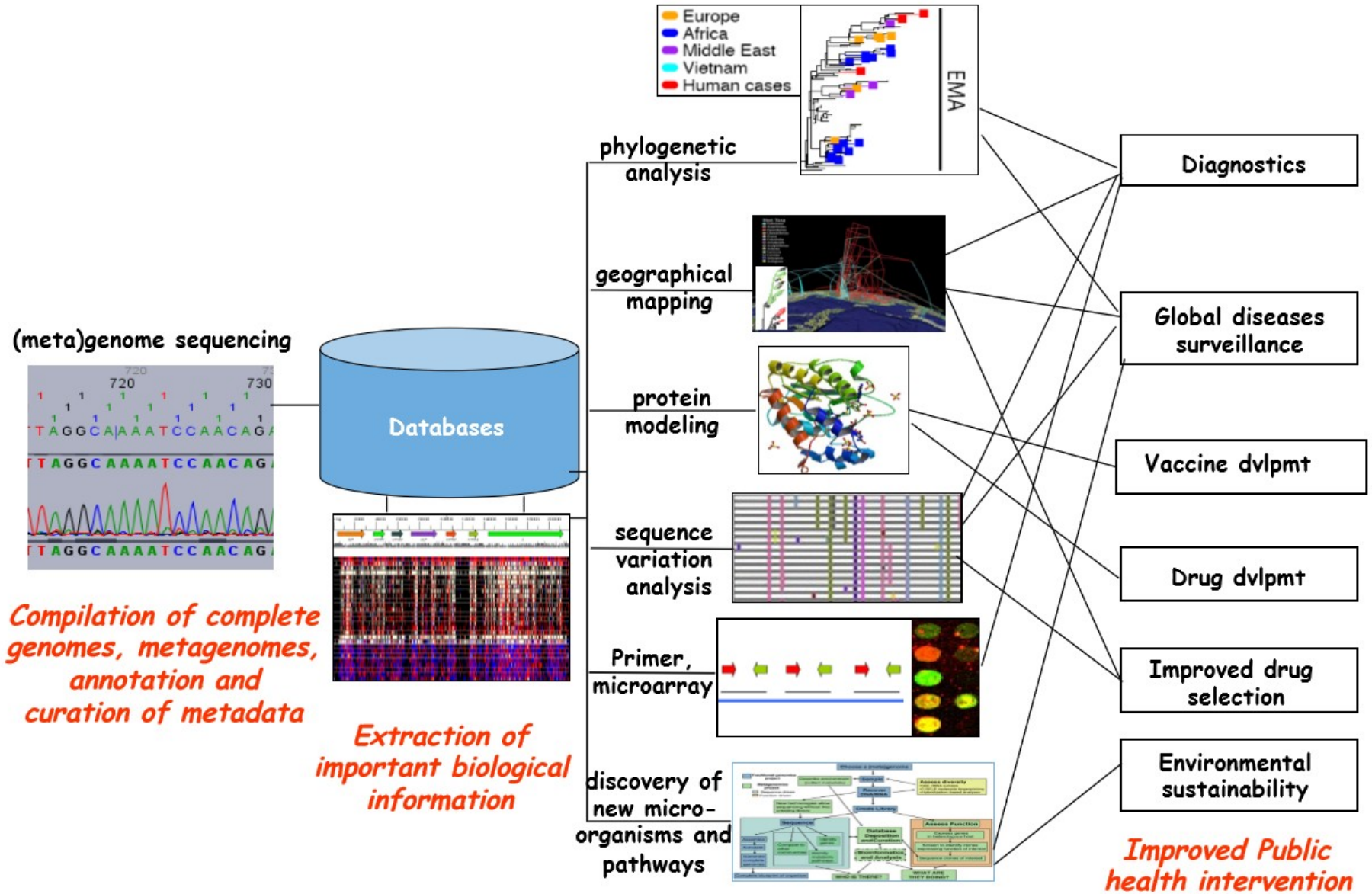
- Molecular breeding
  - ✓*Insect Resistance*
  - ✓*Poorer soils and Drought Resistant*
  - ✓*Improve productivity and nutritional Quality*

Significance….

Livestock

- ✓ Reference genome
- ✓Improve productivity
  - *Improve the efficiency and well-being of farm animals*
  - *and the quality of their useful products*
- ✓Promote efficient animal health program
  - *vaccine development*
  - *diagnosis*

From Sequence to impact



Opportunities and Challenges in Africa

Opportunity

- ✓A number of repositories for big data curation and analysis
- ✓Growing number of studies on agricultural genomics since from 2014 to 2018 (PubMed).
- ✓The same trend in Africa following the accessibility and affordability of NGS technology

Challenges

- ✓Limited access for computational facility (HPC, data storage and power and internet) in Africa.
- ✓Shortage of trained bioinformaticians
- ✓Limited Bioinformatics program in the educations systems.

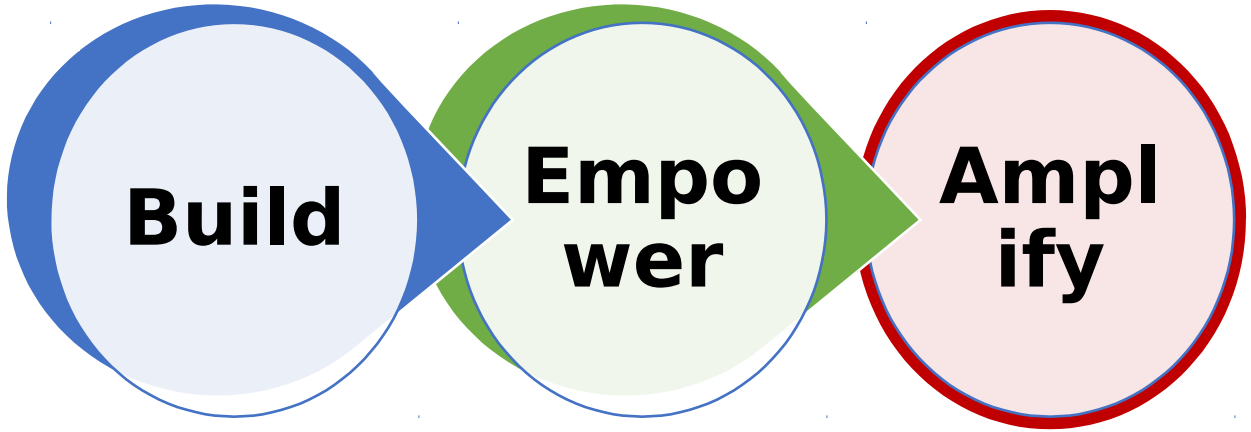
New initiatives in Agricultural Bioinformatics

Bioinformatics Community of Practice (Bix CoP)

- Jointly initiated a the John Innes Centre, Earlham Institute and the BecA-ILRI hub, Kenya,
- Designed to build a strong self-sustaining network of bioinformaticians in Africa with expertise in data analysis for agricultural biosciences
- Implemented to be completed in three phases that include: the Build phase (April to October 2018), the Empower phase (October and November 2018) and the Amplify phase (2019).

Big data – Data analysis skills = Data Overload

The Programme

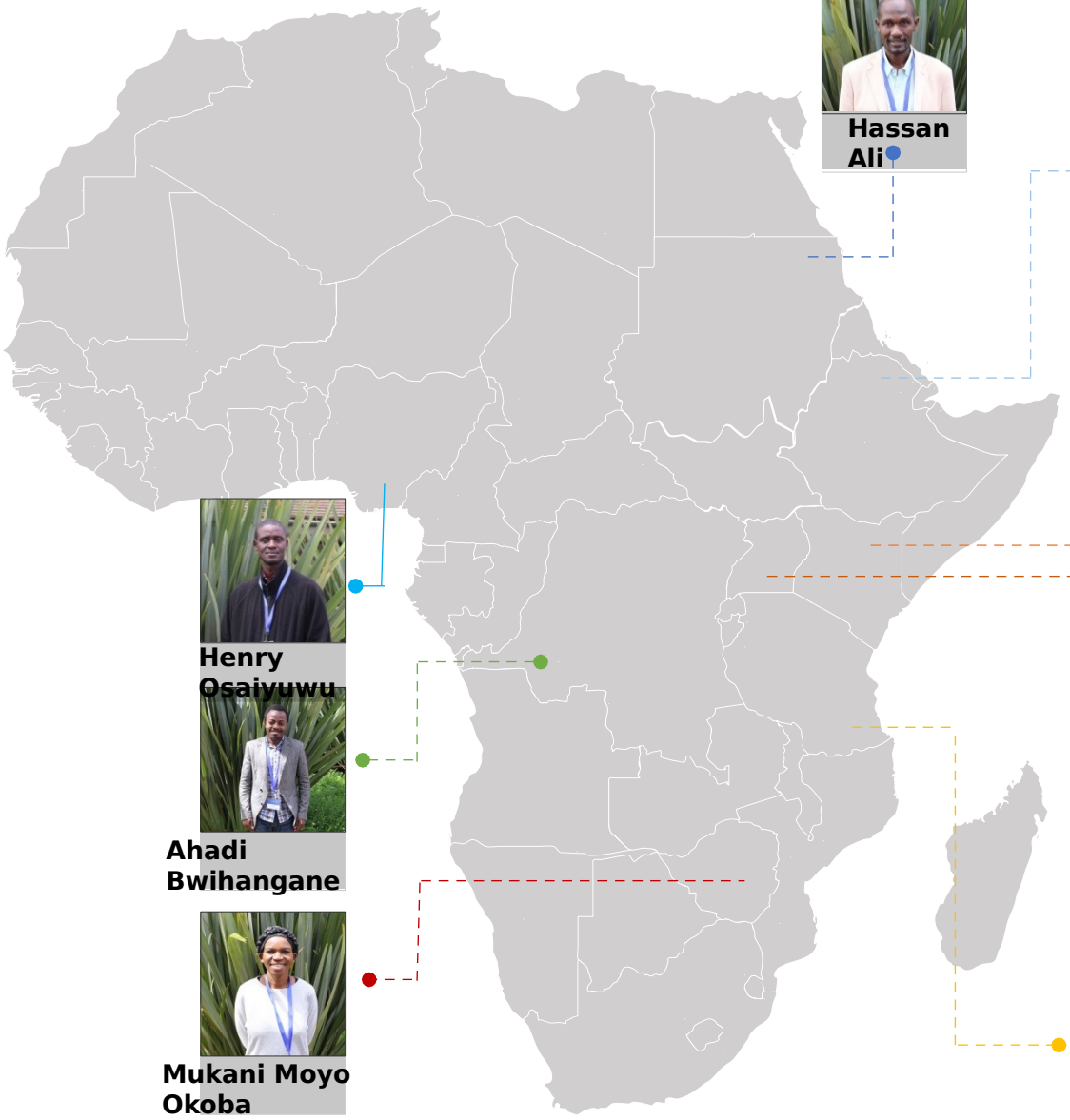


- Data carpentry, Linux, python
- R programming
- NGS, mapping, sequence databases
- RNA-Seq and Variant Calling
- GBS, GWAS, Genomic Selection
- Phylogenetics and Metagenomics
- Pipelines (Galaxy, Docker, etc)

- **Train-the-trainer**
- **Soft-skill training**

- **Two Regional Workshops**

The Fellows and Partners



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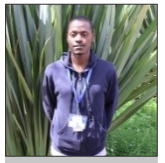
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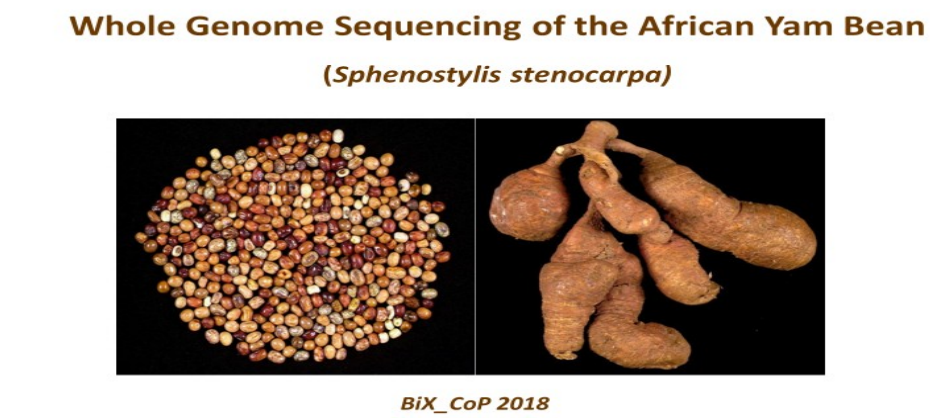
Partners

biosciences eastern and central africa

John Innes Centre
Unlocking Nature's Diversity

Earlham Institute
Decoding Living Systems

Final projects of BixCoP_2019



Objectives

- To develop a web-based visualization tool for livestock microbiome dataset.
- Enhance communication between National Agricultural Research Systems (NARs) and farmers in relation to varieties and crop management
- To Generate a draft whole genome assembly of African Yam Bean.

THANK YOU