Can African Yam Bean fight be an answer for food security and sustainable agriculture?

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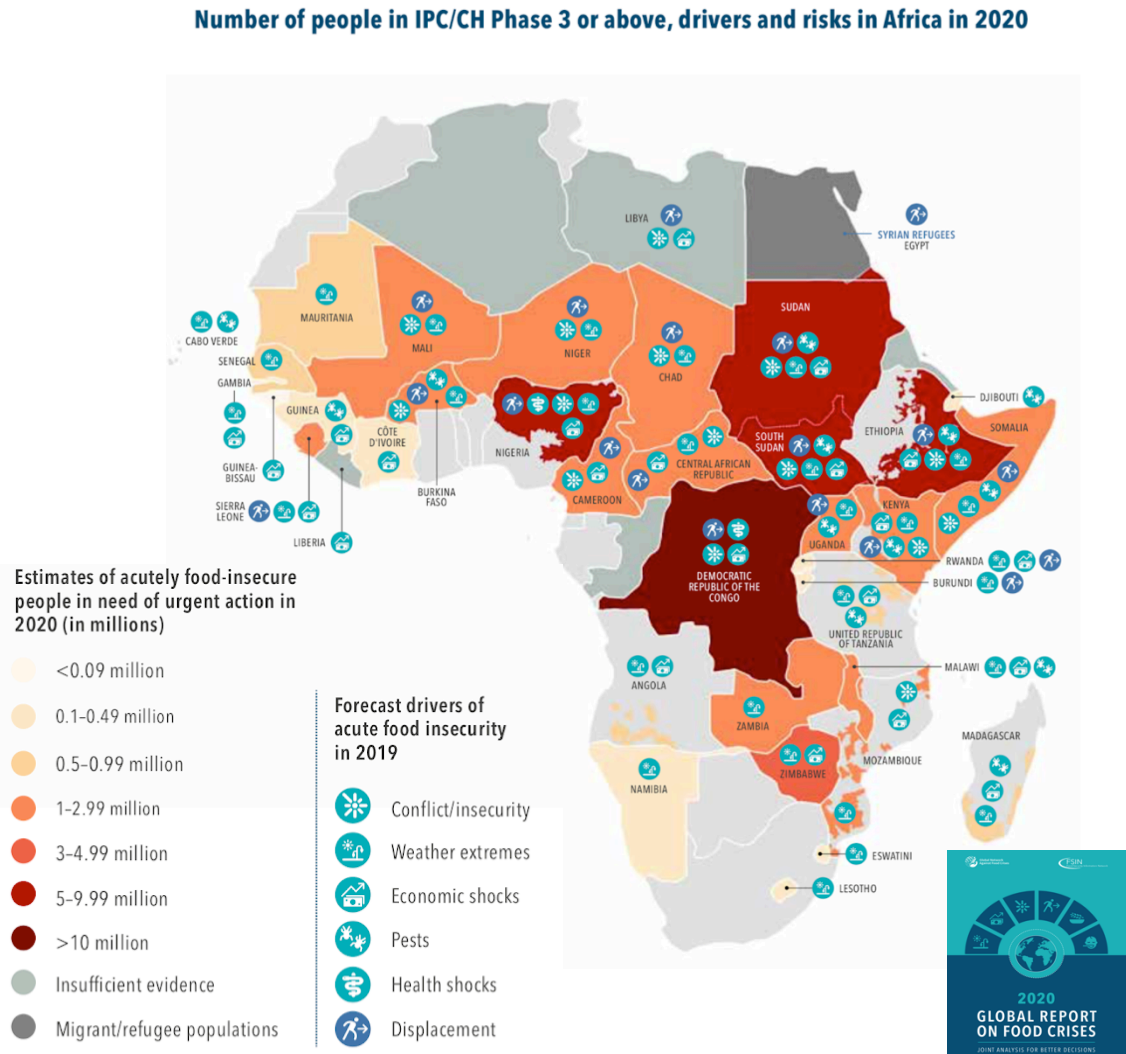
Agenda

- Food security & forgotten crops
- What are tuberous legumes?
- African Yam Bean as alternative crop in Nigeria
- Challenges
- Promising results and future work

Food security
Multidimensional

- Hunger/ malnutrition alongside overweight/ obesity - distribution problem?
- Extreme climate makes it worse
- 10 billion in 2050: how do we sustain this?



UN World Food Programme, 2020, Global Report on Food Crises

Legumes as sustainable and nutritious crops

WORLD PULSES DAY
10 FEBRUARY

CELEBRATING
#WorldPulsesDay

Food and Agriculture Organization of the United Nations
SUSTAINABLE DEVELOPMENT GOALS

Food and Agriculture Organization of the United Nations

10 February
World Pulses Day

PULSES CONTRIBUTE TO FOOD SECURITY

AFFORDABLE SOURCE OF PROTEIN AND MINERALS

In many countries meat, dairy and fish are expensive and thus out of the reach of many, especially the poor. These populations therefore depend on plant foods to cover their protein needs. Protein and energy deficiencies, in both quantity and quality, are often the culprit for widespread malnutrition, which is manifest in the form of stunting or wasting. In addition, iron

FOOD SECURITY IS DEFINED AS: "A SITUATION THAT EXISTS WHEN ALL PEOPLE, AT ALL TIMES, HAVE **PHYSICAL, SOCIAL** AND **ECONOMIC ACCESS** TO **SUFFICIENT, SAFE** AND **NUTRITIOUS FOOD** THAT MEETS THEIR DIETARY NEEDS AND FOOD PREFERENCES FOR AN ACTIVE AND HEALTHY LIFE".[1]

LOW FOOD WASTAGE FOOTPRINT

Food waste is one of the main problems related to food security. It is estimated that one-third of the food produced for human consumption worldwide is lost or wasted.[4] Through the entire agricultural supply-chain, losses and wastage occur. In developing countries, most losses occur during production or transportation while in developed countries, a large proportion of food is wasted at the consumption stage.[5] Since pulses are shelf stable,

FAO publication for World Pulses Day 2021

Nitrogen-fixing nodules: special structures on legume roots

- Symbiotic association with specific soil bacteria
- Can generate own nitrogen “fertilisers”

Soybean nodule picture from ManitobaPlus

Medicago nodule picture from Wikimedia

But not all legumes are good

Soyfields in Amazon rainforest (Shutterstock)

- Soybean is not a sustainable crop!

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Science & Environment

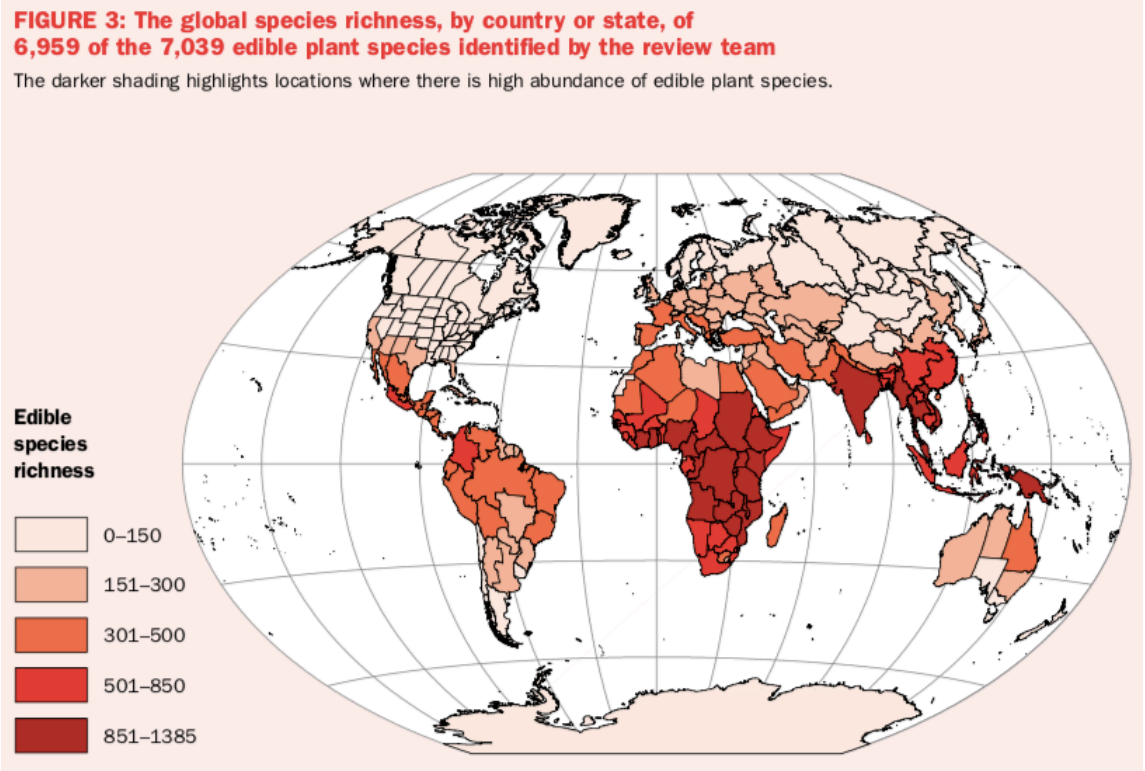
Amazon soya and beef exports 'linked to deforestation'

By Helen Briggs
BBC Environment correspondent

17 July 2020

Forgotten, neglected, underutilised orphan crops

- **90%** of calories from **15 species**
- **95%** of calories from **30 crop species** (Lenser & Theiben, 2013, *Trends in Plant Sci*)
- **80%** calories of human & livestock from **four crop species: wheat, rice, corn, soybean** (Gressel, 2008, *Genetic Glass Ceilings*)



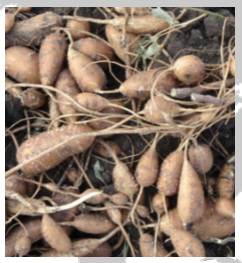
Kew State of the World's Plants and Fungi 2020

Tuberous legumes

- Traditional food of native people
- Both beans (above ground) and tubers (underground) can be consumed

Tuberous legumes around the world

Hopniss
Apios americana

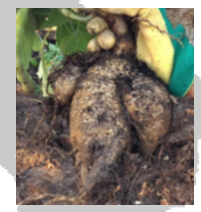


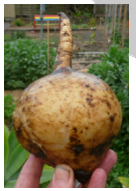
Earthnut pea
Lathyrus tuberosus

Kudzu
Pueraria sp.

Winged beans
Psophocarpus tetragonolobus

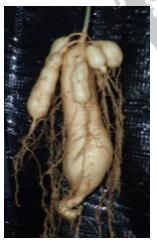
Ahipa
Pachyrhizus ahipa





Jicama
Pachyrhizus erosus

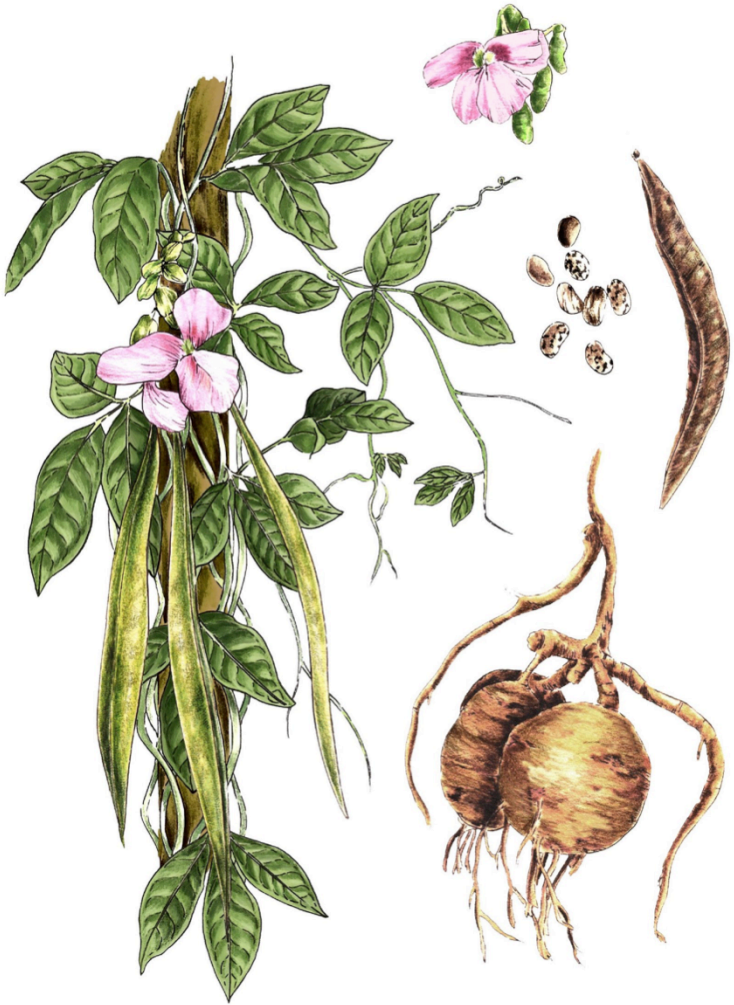
African Yam Bean
Sphenostylis stenocarpa



Zombi pea
Vigna vexillata

Bush carrot
Vigna lanceolata

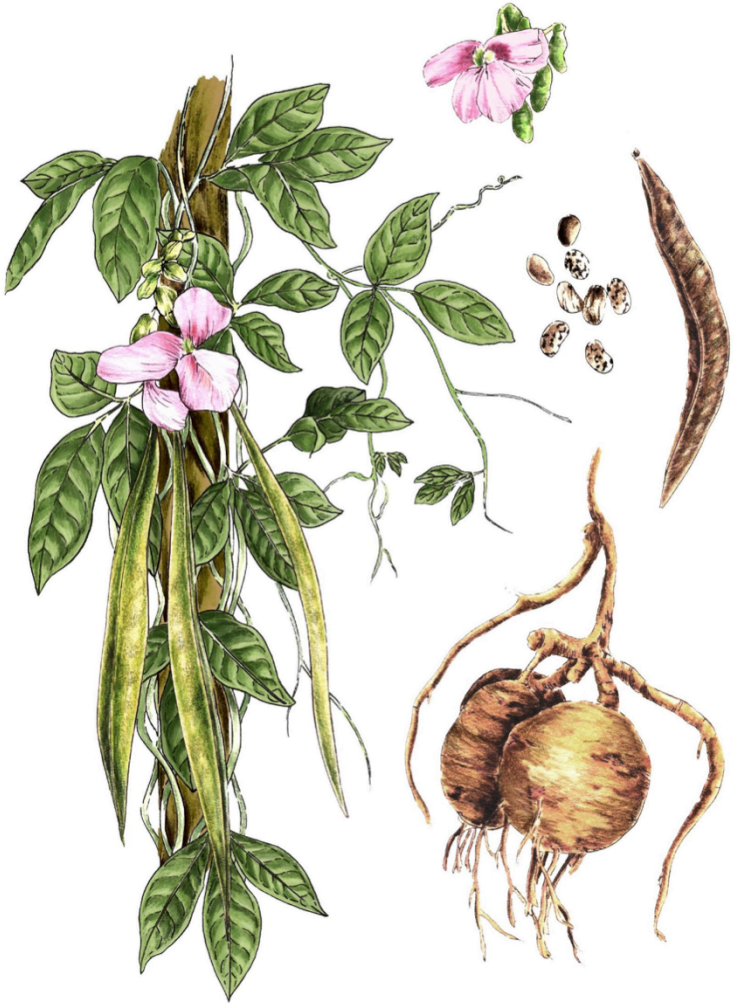
Pictures from *Legume Perspectives* (Issue 9, 2020)



African Yam Bean

Sphenostylis stenocarpa

- Originates from Ethiopia and used to be grown all over Africa
- Both beans and tubers are edible: eaten for beans (West Africa) or tubers (East and Central Africa)
- High protein in beans and tubers - alleviate malnourishment in Nigerian Civil War (1967-1970)

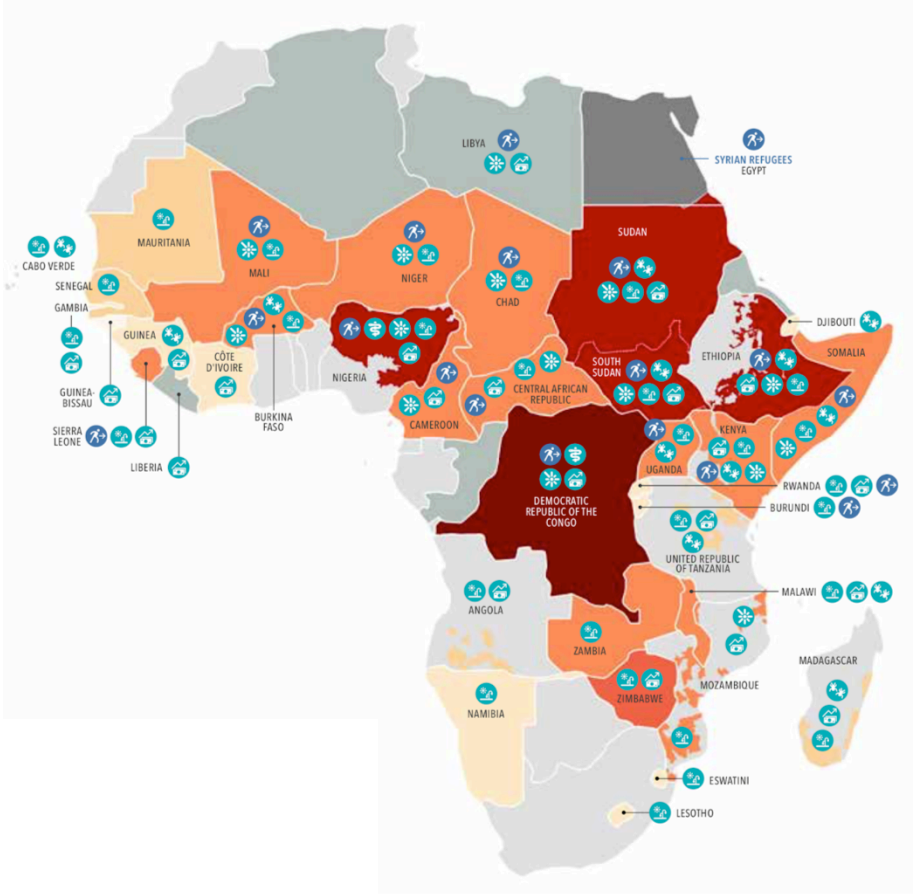


African Yam Bean

Sphenostylis stenocarpa

- Higher seed yield per unit land with up to 3000 kg/ha
- Drought-resistant
- Nitrogen-fixing nodules – enrich soil with nitrogen, good for intercropping
- Grown by old farmers – acreage is declining

AYB across Africa



New approach from the lab to the field

- Lab → field → farmers
- **Farmers** → lab → field → farmers
- Interviews with farmers in Nigeria:
  - Bigger tubers
  - Reduced cooking time for beans

More challenges

- Inconsistent tuber formation
- Tuber deteriorates quickly

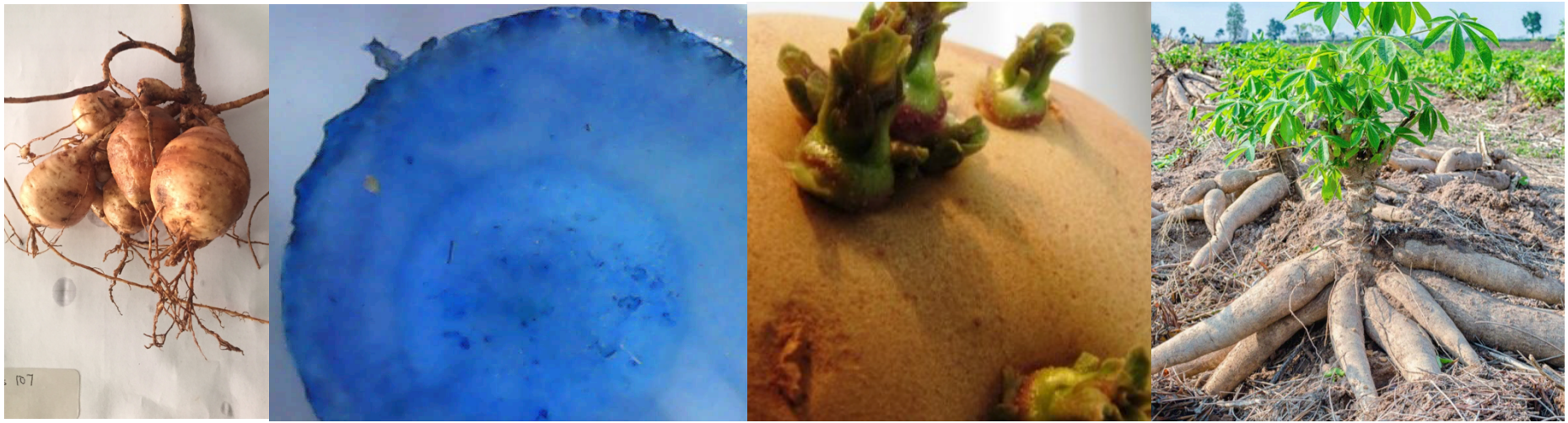
Even more challenges (biology)

- Barely any studies on tuber development in legumes
- Nothing is known about AYB tuber development
- No published AYB genome for breeding

Promising results

- AYB has stem-hypocotyl tuber (different to potato and cassava)

AYB **Potato** **Cassava**



Pictures from Ademola Aina (IITA) https://www.bestfoodfacts.orgg https://www.gardeningknowhow.com

Unique feature of the tuber

Microtuber from the eye of another tuber

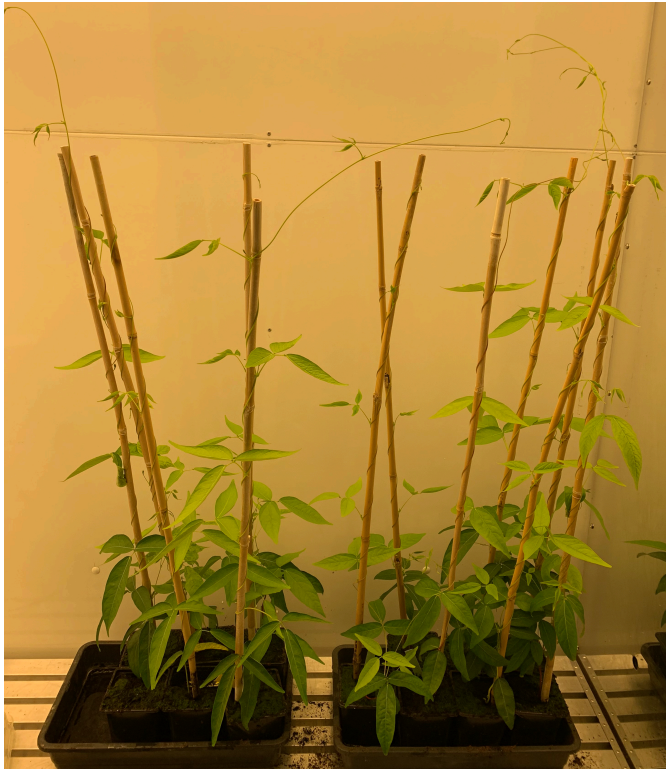
Pictures from Ademola Aina (IITA)

Promising results

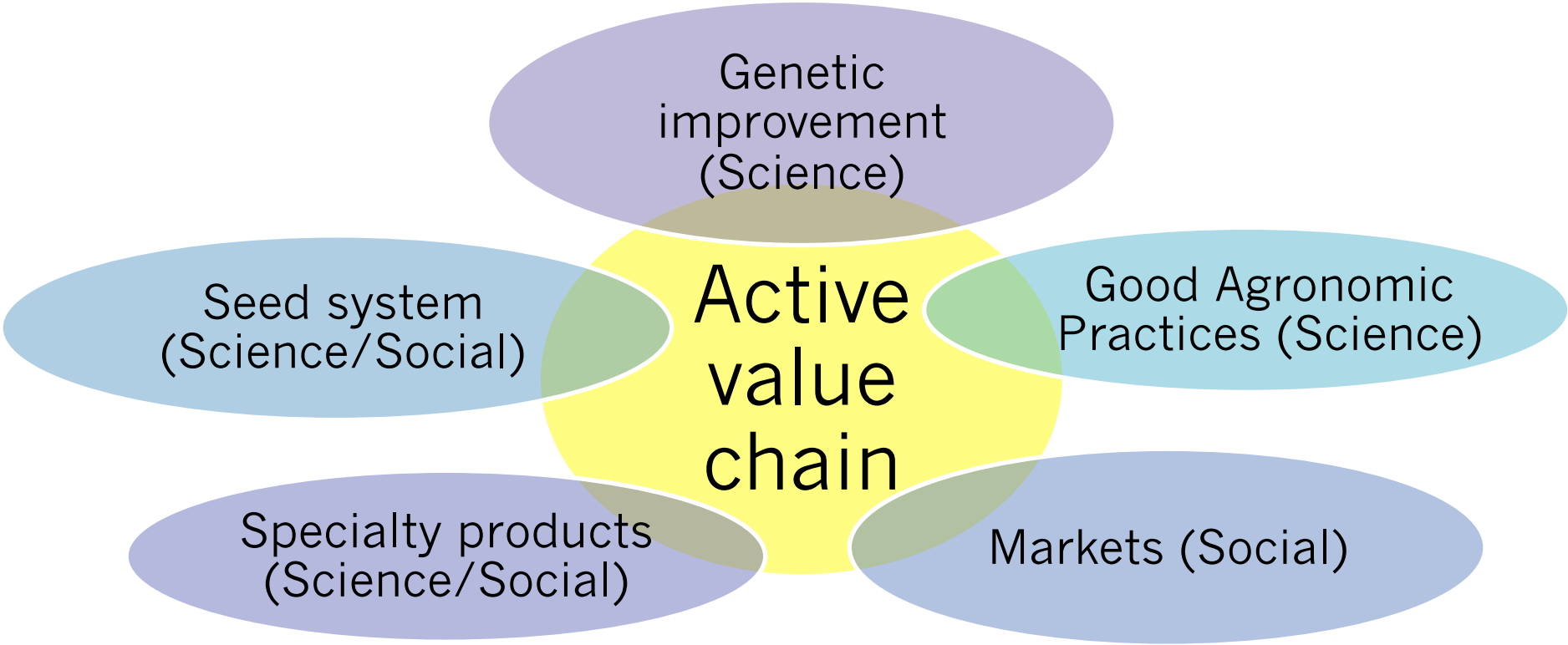
- Increased in nitrogen-fixing nodules leads to increased tuber productivity
- AYB genome has been sequenced by a group in BeCA, Kenya

Future work

- Detailed study of the tuber development (alongside beans and nodule formation) – source-sink relationship
- Breeding programs
- Stakeholder meeting to identify challenges and how to move forward



The big picture



From Dr Morufat Balogun (IITA)

Thank you

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