Breeding for Resilience for Different Food Systems in Tanzania & Implications for the East African region.

By

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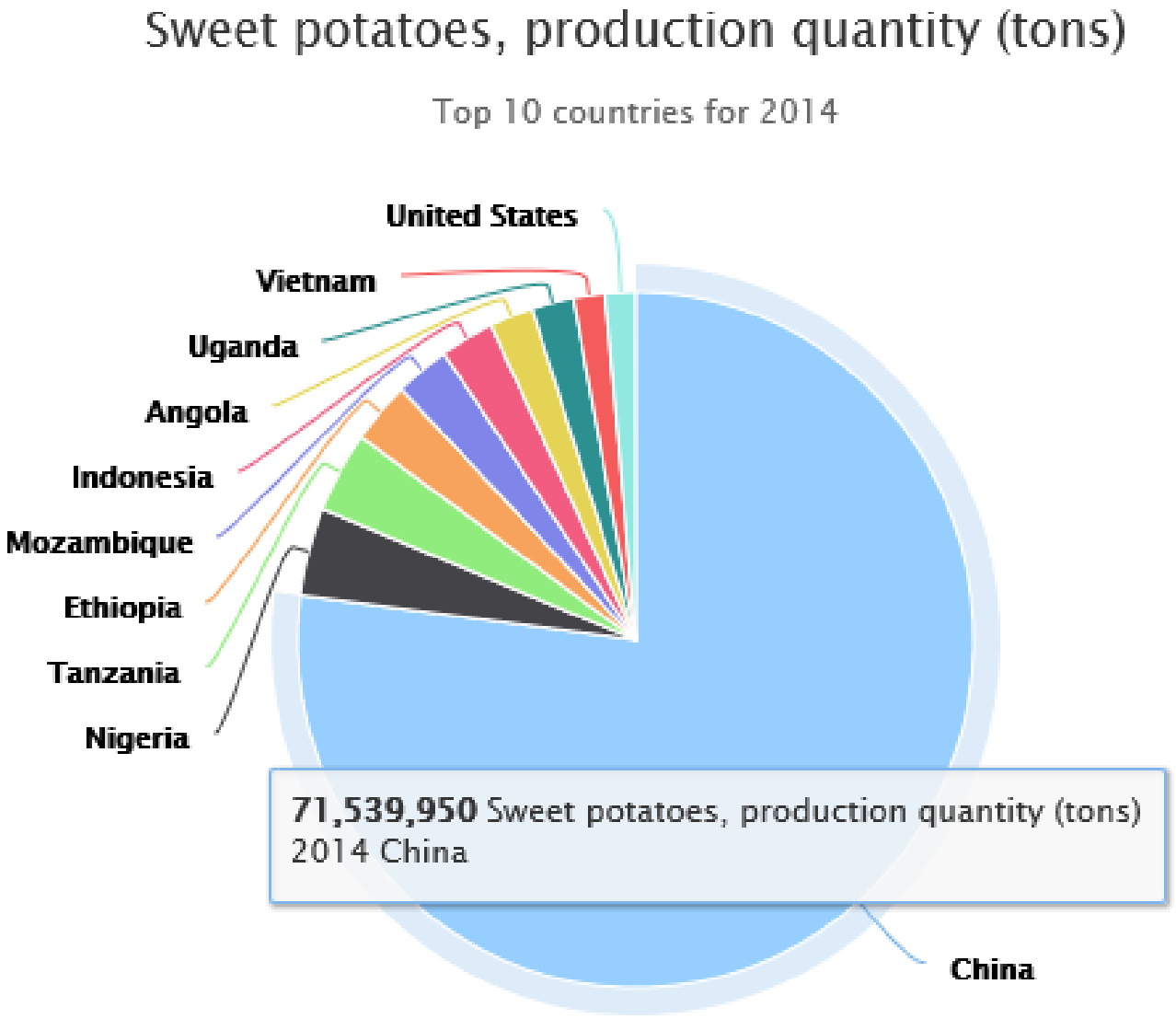
Outline

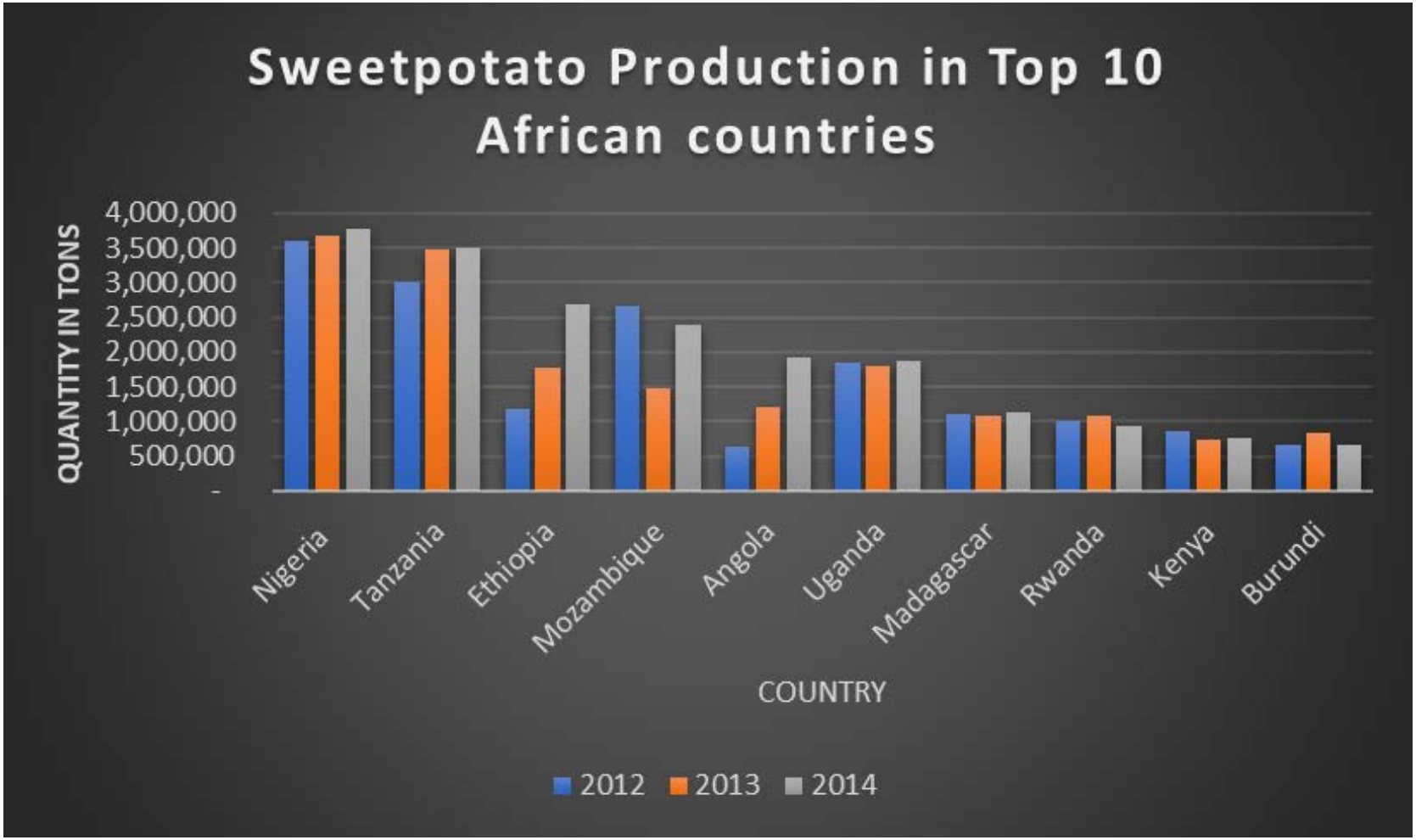
- Introduction:
  - Importance and Crop Use
- Crop improvement
- Product target
- Research focus
- Breeding approaches
- Objectives
- Seed systems
- Examples in seed systems and collaborations

Food systems

- A food system includes all processes and infrastructure involved in feeding a population: growing, harvesting, processing, packaging, transporting, marketing, consumption, and disposal of food and food-related items. It also includes the inputs needed and outputs generated at each of these steps.



Source: FAOSTAT 2014


Sweetpotato Production in Top 10 African countries
QUANTITY IN TONS
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
-
Nigeria
Tanzania
Ethiopia
Mozambique
Angola
Uganda
Madagascar
Rwanda
Kenya
Burundi
COUNTRY
2012
2013
2014

Importance and crop uses

- Sweetpotato is grown for its storage roots and leaves:
  - for food and nutrition security
  - income generation
  - for feed in many developing countries.
- It remains an attractive crop in the rural communities in developing countries.
- In Tanzania, sweetpotato is an important crop grown by subsistence farmers mostly women for food security
- Sweet potato leaves are grown widely in the peri-urbans and in rural areas as a source of income for women and youths

Crop uses

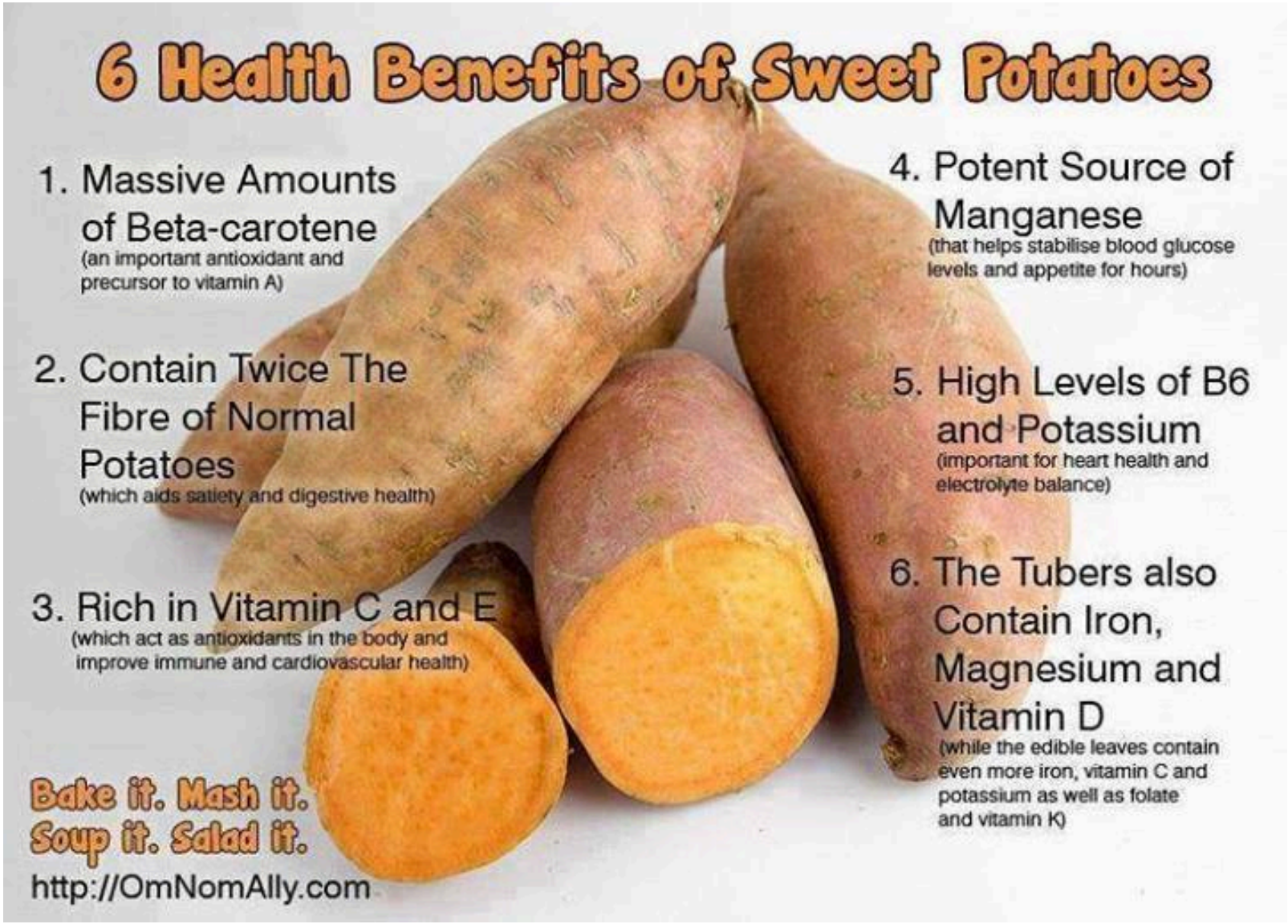
- Sweet potato leaves are consumed as a leafy vegetable by the majority of the people in Tanzania,
- It is a good source of micro-nutrients: Vit A, B, C, K, calcium, iron, magnesium, phosphorus, Potassium
- Roots are nutrient dense especially the orange fleshed- rich in beta carotene content

Narrow leaf varieties

Broad leaf varieties

Roots can be processed into products : cakes, noodles, Jam, Juice, crisps, sliced-dried chips

Health benefits of sweetpotatoes



Raw Sweet Potato

Nutritional value per 100 g (3.5 oz)	
Energy	359 kJ (86 kcal)
Carbohydrates	20.1 g
- **Starch**	12.7 g
- **Sugars**	4.2 g
- **Dietary fibre**	3 g
Fat	0.1 g
Protein	1.6 g
Vitamin A equiv.	709 µg (89%)
- beta-carotene	8509 µg (79%)
Thiamine (vit. B_1)	0.078 mg (7%)
Riboflavin (vit. B_2)	0.061 mg (5%)
Niacin (vit. B_3)	0.557 mg (4%)
Pantothenic acid (B_5)	0.8 mg (16%)
Vitamin B_6	0.209 mg (16%)
Folate (vit. B_9)	11 µg (3%)
Vitamin C	2.4 mg (3%)
Vitamin E	0.26 mg (2%)
Calcium	30 mg (3%)
Iron	0.61 mg (5%)
Magnesium	25 mg (7%)
Manganese	0.258 mg (12%)
Phosphorus	47 mg (7%)
Potassium	337 mg (7%)
Sodium	55 mg (4%)
Zinc	0.3 mg (3%)

Link to USDA Database entry
Percentages are relative to US recommendations for adults.
Source: USDA Nutrient Database

Sweet potato leaves, raw

Nutritional value per 100 g (3.5 oz)	
Energy	175 kJ (42 kcal)
Carbohydrates	8.82 g
- **Dietary fiber**	5.3 g
Fat	0.51 g
Protein	2.49 g
Vitamin A equiv.	189 µg (24%)
- beta-carotene	2217 µg (21%)
- lutein and zeaxanthin	14720 µg
Thiamine (vit. B_1)	0.156 mg (14%)
Riboflavin (vit. B_2)	0.345 mg (29%)
Niacin (vit. B_3)	1.13 mg (8%)
Pantothenic acid (B_5)	0.225 mg (5%)
Vitamin B_6	0.19 mg (15%)
Vitamin C	11 mg (13%)
Vitamin K	302.2 µg (288%)
Calcium	78 mg (8%)
Iron	0.97 mg (7%)
Magnesium	70 mg (20%)
Phosphorus	81 mg (12%)
Potassium	508 mg (11%)

Direct link to database entry [4]
Percentages are relative to US recommendations for adults.
Source: USDA Nutrient Database

Sweetpotato used as Ornamental plants


SUDAN
ETHIOPIA
UGANDA
KENYA
RWANDA
BURUNDI
CONGO
TANZANIA
ZAMBIA
MALAWI
MOZAMBIQUE
Kampala
Gulu
Jinja
Masaka
Kabale
Kigali
Bukavu
Bujumbura
Kigoma
Kisumu
Nakuru
Nairobi
Garissa
Mandera
Malindi
Mombasa
Mwanza
Arusha
Tabora
Tanga
Zanzibar
Dodoma
Dar es Salaam
Morogoro
Iringa
Mbeya
Mtwara
Tunduru
Lotikipi Plain
Lake Turkana
Chalbi Desert
Mt. Elgon 14,178 ft.
Mt. Kenya 17,058 ft.
Mt. Kilimanjaro 19,340 ft.
Lake Albert
Lake Edward
Lake Kivu
Lake Victoria
Serengeti Plain
Masai Steppe
Great Rift Valley
Lake Tanganyika
Lake Rukwa
Lake Nyasa
Pemba I.
Zanzibar I.
Mafia I.
Uele River
Congo River
Lualaba River
Ugalla River
Rufiji River
Ruvuma River
Tana River
EQUATOR
East Africa
International boundary
Kampala National capital
Nairobi Over 1 million people
Dodoma 100,000 to 1 million people
Kigoma Under 100,000 people
0 75 150 225 300 miles
0 75 150 225 300 kilometers
©NYSTROM

Important constraints in E.A. Region

- **Tanzania:** Low yield, SP weevils and SPVD, drought, and low DM of OFSP
- **Uganda:** SPVD, Alternaria, weevils
- **Ethiopia:** SPVD, SP weevil, low yield and low dry matter content of OFSP
- **Kenya:** SPVD, Alternaria and weevils, Drought, low yield, low dry matter in OFSP, in-adequate research funds, and few breeders.
- **Rwanda:** Low yield, dual purpose varieties, low DM, low ß-carotene, SPVD, Weevil

Crop improvement

- Yield (10-25%)
- Dry matter content (20-38%)
  - Low, medium, high
- Virus resistance/tolerance
  - Select 2 in (1-5 scale)
- Pest tolerance
- Increased micronutrients (beta carotene positive correlated with zinc, iron)
- Mealyness for fresh use
- Drought tolerance-
- Good storability
- Seed systems-virus free

Crop Improvement

- To develop improved varieties, plant breeders require:
  - a diverse pool of genetic resources, not entirely available in the case of sweetpotato.
- Crop wild relatives: the undomesticated “cousins” - can be used to introduce greater tolerance to heat and other stresses to the crop.
- Collection and conservation: CIP Lima, Peru maintain >6,500 wild, traditional and improved varieties

Product target:

- Root yield: >15t/ha
- Maturity: 4 month after planting
- Tolerate important virus diseases (SPVD) score 2 (1-5 scale)
- High beta carotene content-roots and leaves
- High iron and zinc content-leaves
- Sugar content: low, moderate and high
- Dry matter content : 20-38%
- Dual purpose sweetpotato-leaf and root production

Breeding approaches

- Germplasm collection, introduction, conservation and utilization
- Morphologic characterization-IBPGR-1980, CIP descriptors
  - Agronomic characterization
  - Micronutrient determination (beta carotene, iron and zinc)-HPLC in advanced laboratory
- Genetic characterization- use of Markers
- Hybrization, evaluation and selection

Markers in sweetpotato

- Simple sequence repeat markers are of particularly interest to study: (Ngailo et al., 2016; Yada et al., 2010; Rodriguez-Bonilla et al., 2014)
  - because they are abundant in plants,
  - have high level of polymorphism and the codominance nature and high numbers of alleles per locus
  - are adaptable to automation (Donini and Stephenson, 1998).
- Efficiency of SSR markers has been demonstrated in identifying and characterizing the genetic diversity and relationships
- These markers are powerful and have the ability to discriminate genotypes including those related by pedigree

Hybridization, Evaluation and Selection :

- About 10 parental lines selected- based on genetic backround, performance
- Crossing block – made at SRI-Kibaha and LZARDI ukiriguru
- F_1 - about 2000 botanical seeds (a seed is a potential genotype)
  - Unreplicated trial – local check plots
- Preliminary evaluation -200 genotype selected, planted in 2 sites;
- Advanced evaluation: 20 or more
- On-farm Trials- farmers assessment
- National Performance Trials and DUS
- Apply for official release

Nutritional analysis for micronutrients

- Root and leaf samples collected and prepared for micronutrients determination using HPLC
- Other nutrients: Proximate analysis -water, ash and fibre according to AOAC, 1984

Research focus

- To improve root yield of SP varieties adapted to broad and specific Agro ecological zones
- To increase SP resistance to SPVD and weevil
- To screen for drought resistance
- To improve beta carotene and dry matter content of OFSP
- To promote technical and training support to CBOs, NGOs, and farmers seed producers
- To improve sweetpotato quality planting material production and seed system in the country
- To promote diversified utilization, i.e. food/ processing

To promote linkages, and distribution of breeder seed to seed entrepreneurs

Sweetpotato seed systems

- Use of virus free planting materials - Collaborate with different laboratories: both public-MARI, KEPHIS and private- CBS-Arusha and KILIMORGANO-Dar
- Research: Responsible with **Pre-basic seed production** and Basic seed category:
  - Inspection and Certification by Tanzania Seed Certification Institute (TOSCI)
- **Basic seed, Certified (C1&C2)- Private sector and Seed enterpreneurs-** Seed regulations of 2017 in place -January 2017
  - Inspection and Certification by Tanzania Seed Certification Institute (TOSCI)
- **Quality Declared Planting Materials** (QDPM)- seed enterpreneurs and farmers groups- We continue advocating for sweetpotato seed systems
  - Quality Declared planting materials- Legislation tabled to the Ministry for endorsement

SP Action for Security and Health (SASHA II)- Pre-Basic seed

- **Objectives**

➢ Strengthen tech. & institutional capacity to produce pre-basic seeds

- To create awareness of clean planting materials, and coordinate demand for increased sustainability

❖ Achievements

❖ 8500 cutting of 9 varieties (Kabode, mlezi, Naspot-13, Naspot-12, Naspot-11, Kakamega, Ejumula, Kiegeya and Mataya) procured from Crop Bioscience Solution - Arusha

❖ Workshops: Two workshops were conducted

❖ 96 multipliers trained by the three team: SRI-Kibaha, ARI-Ukiriguru and ARI-Uyole

❖ 787,647 cuttings produced and 80% were sold between to date

❖ to compare vine and root yield btn seed sourced from farmers fields versus seed sourced from screen house.

Achievements…

✓ **Table 2: The comparison of 3 demo plots using planting material from (screen house and farmers fields in Misungwi district.**

	Farmer Source			Screen House Source		
Varieties	**Root yield (t/ha)**	**Foliage yield**	**Virus symptoms 1 month before harvesting (1-9)**	**Root yield (t/ha)**	**Foliage yield**	**Virus symptoms 1 month before harvesting (1-9)**
Polista	13.01	23.93	3.0	16.75	25.71	1.0
Kabode	9.00	21.08	2.7	16.17	21.56	1.0
Naspot 11	14.44	22.35	2.0	19.35	25.31	1.0
Umeme	13.51	17.86	2.7	15.54	19.22	1.7
Mean	**12.49**	**21.31**	**2.6**	**16.95**	**22.95**	**1.2**
LSD	**3.804**	**8.419**	**0.881**	**2.884**	**8.952**	**0.577**
CV	**15.24**	**19.78**	**17.1**	**8.52**	**19.52**	**24.7**

Fast Track Project on SP variety dissemination

-*More than 7,000,000 cuttings disseminated -Primary schools*
- 153 primary schools piloted in Tanzania and Uganda
-15 districts intervened
- More than 200 extension officers trained on SP technologies
-OFSP incorporated in Primary school curicullum in Uganda with 4 exemplar books to be tested
- Nutrition education book approved by the Tanzania Institute of Education
-

Dr Everina Lukonge with farmers and district leaders

JUMANNE FEBRUARI 16, 2016 Nipashe25

Ukiliguru kunufaisha shule 32 kwa mbegu viazi vitamu

Na Daniel Mkate, Sengerema

SHULE 32 za msingi katika wilaya za Sengerema na Misungwi mkoani Mwanza na Shinyanga, zinatarajiwa kunufaika kwa mbegu za kisasa za viazi kupitia mradi wa 'Sambaza mbegu za viazi fasta' unaosimamiwa na chuo cha kilimo cha Ukiliguru kilichopo wilayani Misungwi.

Akizungumza wakati wa ugawaji wa mbegu hizo kwa wananchi wa kijiji cha Nyasenga wilayani Sengerema mwishoni mwa wiki, meneja wa mradi huo, Dk. Evelyne Lukonge, alisema wilayani humo jumla ya shule 13 zitasambaziwa mbegu hizo, mpaka sasa shule saba zimenufaika.

"Kwanza tulianza na shule ya msingi Nyasenga kwa kutoa mbegu kwa wanafunzi 200 kwa kila mmoja kupewa miche 120, hivyo baada ya kuzalisha nao wanatoa mara mbili zaidi kwa wananchi ili ziweze kusambazwa," alisema Dk. Lukonge.

Dk. Lukonge alisema mbegu ambazo zipo katika mradi huo ni aina saba ambazo ni kabode, mazao, polista, ukg-sp, new dimbuka, kakamega na naspoti II.

Hata hivyo, alisema lengo la mradi huo ni kuhakikisha mbegu za viazi zinasambazwa kwa kasi ili baadaye ziweze kutoa faida kwa wakulima na kuwanufaisha kimaisha.

Alisema wakulima wanapewa elimu ya kutosha kupitia mradi huo kwa kusambaza kwa mbegu 'fasta' huku wakitarajiwa kusambaza aina 12 ya mbegu hizo.

Naye Katimu Mkurugenzi wa Halmashauri ya Wilaya ya Sengerema, Lameck Nyaruga, alisema viazi ni zao la biashara, hivyo hakuna sababu kwa wakulima wa kijiji cha Nyasenga kuendelea kuishi na umaskini.

"Lazima wakulima tukitumie vizuri chuo cha utafiti Ukiliguru ili kuleta mabadiliko ya kiuchumi na kifikra...pia tuboreshe afya za akinamama na watoto kwa kutumia lishe ya viazi," alisema Nyaruga.

Aidha, aliwaasa kusambaza mbegu hizo kwa wengine kutokana na kuwapo na mahitaji mengi wilayani Sengerema.

Awali mwalimu mkuu wa shule ya msingi Nyasenga, Esther Kisinza, ambaye mradi huo ulianza shuleni kwake, alikishukuru chuo cha Ukiliguru kwa kuichagua shule hiyo kuweka shamba la viazi la mfano na pia kusambaza kwa wananchi.

Lazima wakulima tukitumie vizuri chuo cha utafiti Ukiliguru ili kuleta mabadiliko ya kiuchumi na kifikra

SHAMBA MFA

Dk. Evelyne Lukonge ambaye ni mkuu wa mradi wa sambaza mbegu za viazi fasta kutoka chuo cha Ukiliguru wilayani M wa Mwanza, akiwaonyesha wananchi jinsi mbegu za viazi za kisasa zinavyotoa mazao kwa muda mfupi kwenye shamba la Shule ya Msingi Nyasenga wilayani Sengerema juzi. **PICHA: DANIEL MKATE**

Bukoba watakiwa kuimarisha ulinzi shiri

Na Lilian Lugakingira, Bukoba

VIONGOZI wa mitaa, vijiji na kata katika Wilaya ya Bukoba mkoani Kag

bayo yanasimamiwa na kamati ya ulinzi na usalama yatafanyika katika kata zote za wilaya ya Bukoba yenye halmashauri mbili (wilaya na manis

haya yasijitokeze tena sisha wananchi kushir mali katika ulinzi na u marisha doria za vik

Ndugu zangu fed

VISTA and BNFB Projects

- Trained 24 vine multipliers in the Central zone of Tanzania: Dodoma ad Singida BNFB
- Training of extension staff on 'Everything you ever wanted to Know about Sweetpotato'- SUA for VISTA and BNFB
- Pre-basic seeds for VISTA and BNFB projects
  - SRI-Kibaha, ARI-Hombolo, ARI-Uyole
- Evaluated 16 OFSP varieties in 10 districts in Central and Southen Highlands zones-
- Conducted Mother Baby Trials-17 mother trials and 152 baby trials to determine the performance and adaptability of varieties
  - Identified about 3 superior OFSP varieties for release in 2 years.

Basic seed production at SUGECO-SUA, Morogoro

Training in Dodoma 2016-BNFB

IFPRI-HarvestPlus- World vision

- Conducted 3 training session to 131 lead farmers/seed multipliers and extension staff from 5 districts in Central and Lake zones: Topics: Agronomy, Postharvest and values addition

SRI-KIBAHA AND LZARDI UKIRIGURU-TRAINING FARMERS AND EXTENSION OFFICERS

Achievements

- National Program –officially released 17 SP varieties among those 6 are OFSP
- Seed Regulations of 2017-(G.N. 37-2007) includes Cassava, Sweetpotato and Potato
- Provision of pre-basic seed-inspected and certified by TOSCI
- Nutrition enhanced through OFSP– reached 48 districts out of 169 in Tanzania (29%)
- Promotion of OFSP: Good collaboration with the Media houses-Radio, TV, Newspapers, etc
- Noted Increased demand for OFSP planting materials

Achievements

- Established strong Collaboration with different partners in the region: CIP, IFPRI-HarvestPlus, World Vision, AGRA,
- Locally: Commission for Science and Technology, Sokoine University of Agriculture-SUGECO, UDSM, LGA, Seed Multipliers and farmers, CBOs, Private sector-processors, TAHA, etc
- Supporting District programs- dissemination of OFSP varieties and awareness creation: Ilindi ward, Bahi district, Dodoma, Tanzania- BNFB

- Harmonized seed Regulations in East African Countries and Now SADC countries (May 2017)

Collaboration with Private sector

- Matoborwa company in Dodoma Tanzania
- AFCO company in Dar es salaam
- TAHA, CBS

Challenges

- Drought-climate change
- Inadequate funding for breeding
- Succession plan of scientist
- Inadequate clean planting materials – more efforts needed
- Lack of equipment in the National program for micronutrient analysis-NIRS,HPLC

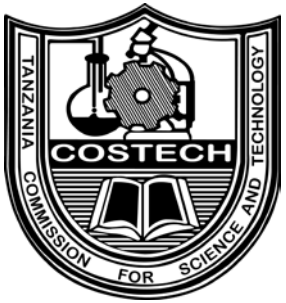
Future plans

- Continue with the conventional breeding- incorporating end-users preferences around market segments
  - Sugar levels for processing and value addition (high vs. Low)
  - Dry matter content (low, medium and high)
- Maintanance of breeder seeds
- Use of molecular markers- complement breeding
- Nutritional analysis-NIRS technology or HPLC (out source)
- Genomic selection- need for capacity building
- Try GBS -high throughput, next generation sequencing- in collaboration with Beca

Acknowledgement

FARMERS, SEED MULTIPLIERS, PROCESSORS

BILL & MELINDA GATES foundation



Asanteni sana; Thank you for listening