SCIENCE AND EDUCATION
FOR SUSTAINABLE LIFE

Sorghum and Pearl Millet Improvement in Sudan

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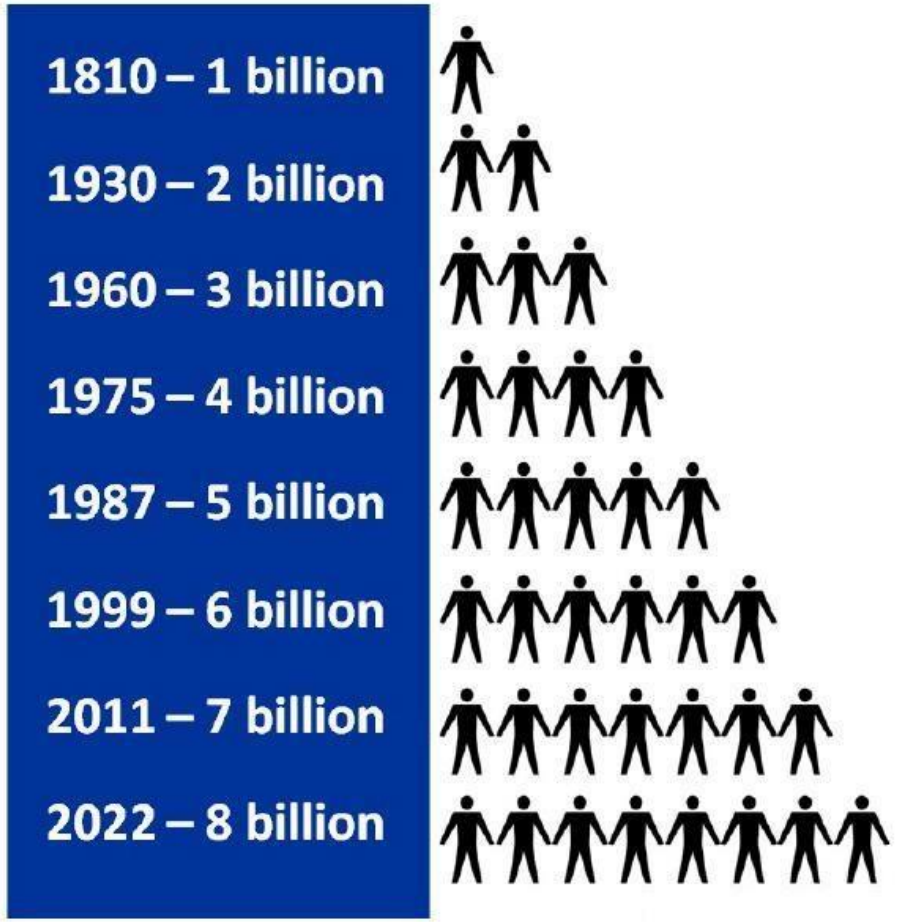
September 5, 2023

Alnarp, SLU

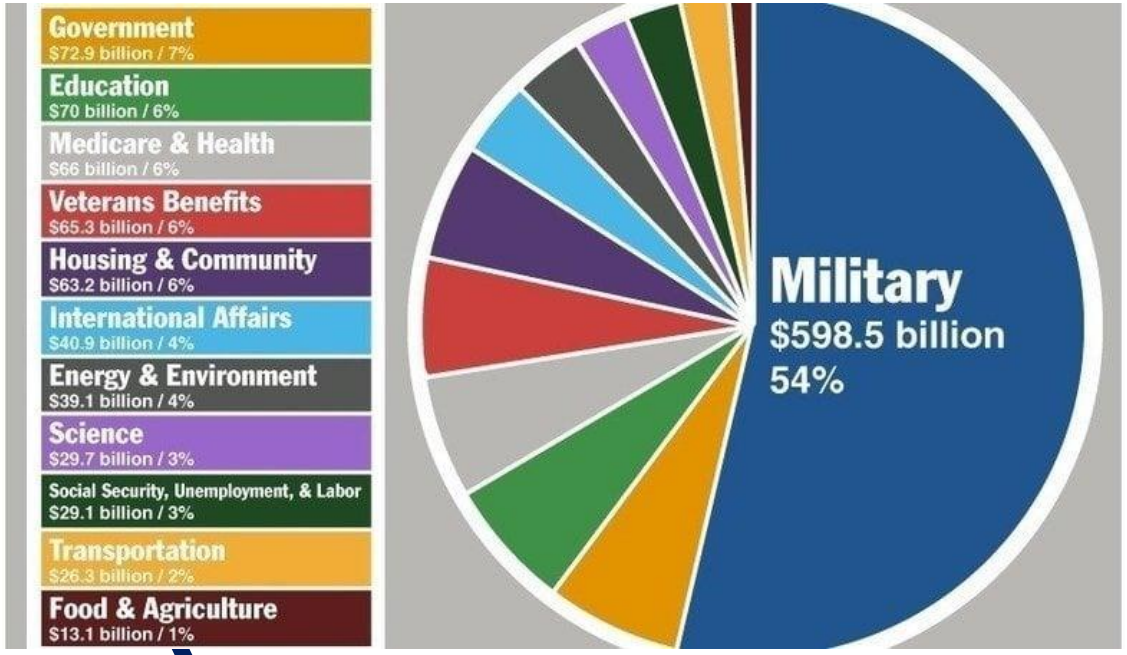
INTERNATIONAL YEAR OF MILLETS 2023

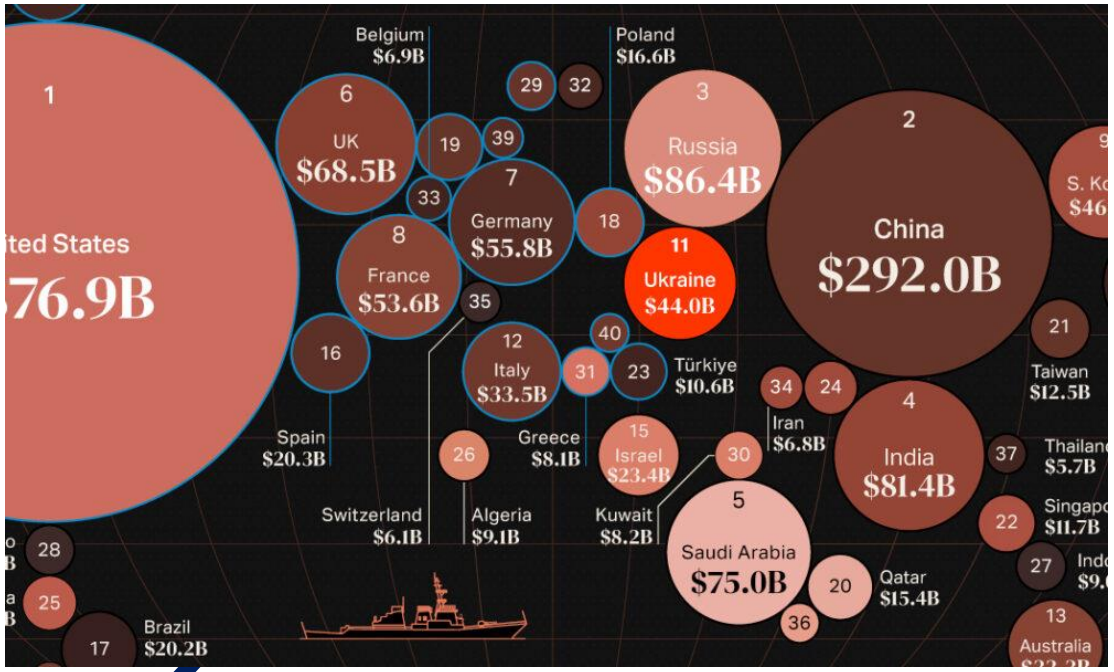
Today's challenges on sustainable and resilient food production

- ✓ Changing climate
- ✓ Water scarcity
- ✓ Emergence of biotic and abiotic stresses
- ✓ Soil degradation
- ✓ Biodiversity loss
- ✓ Nutritional Challenges
- ✓ Pesticide and fertilizer reliance
- ✓ Knowledge and technology gap
- ✓ Policy and regulatory hurdles
- ✓ Food loss and waste



Military budget vs food and agriculture in the world





1% Food and Agriculture

1 + 1 = 2%

Research agenda

Importance of Sorghum

- ✓Staple food security crop in Africa and Asia
- ✓Thrives in arid conditions with high water-use efficiency
- ✓Used for food, fodder, and bioenergy
- ✓Resilient to climate changes and efficient C4 photosynthesis
- ✓The Sudan is the origin of sorghum

2n = 2x =20

Importance of Pearl Millet

- ✓Essential source of dietary energy, protein, and micronutrients
- ✓Nutrient-dense food crop in Africa and Asia
- ✓Climate-resilient and C4 crop
- ✓Used for food, fodder, and bioenergy

2n = 2x =14

Nutrition Facts in 100 g

100 gr in whole grain wheat

Nutrition Facts

Serving Size	**100 g**
Amount Per Serving	
Calories	**339**
	% Daily Values*
Total Fat 1.87g	**2%**
Saturated Fat 0.322g	**2%**
Trans Fat -	
Polyunsaturated Fat 0.779g	
Monounsaturated Fat 0.232g	
Cholesterol 0mg	**0%**
Sodium 5mg	**0%**
Total Carbohydrate 72.57g	**26%**
Dietary Fiber 12.2g	**44%**
Sugars 0.41g	
Protein 13.7g	
Vitamin D -	
Calcium 34mg	3%
Iron 3.88mg	22%
Potassium 405mg	9%
Vitamin A 0mcg	0%
Vitamin C 0mg	0%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

100 gr in rice

Nutrition Facts

Serving Size	**100 g**
Amount Per Serving	
Calories	**129**
	% Daily Values*
Total Fat 0.28g	**0%**
Saturated Fat 0.076g	**0%**
Trans Fat -	
Polyunsaturated Fat 0.075g	
Monounsaturated Fat 0.087g	
Cholesterol 0mg	**0%**
Sodium 365mg	**16%**
Total Carbohydrate 27.9g	**10%**
Dietary Fiber 0.4g	**1%**
Sugars 0.05g	
Protein 2.66g	
Vitamin D -	
Calcium 10mg	1%
Iron 1.19mg	7%
Potassium 35mg	1%
Vitamin A 0mcg	0%
Vitamin C 0mg	0%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

100 gr in maize

Nutrition Facts

Serving Size	**100 g**
Amount Per Serving	
Calories	**86**
	% Daily Values*
Total Fat 1.18g	**2%**
Saturated Fat 0.182g	**1%**
Trans Fat -	
Polyunsaturated Fat 0.559g	
Monounsaturated Fat 0.347g	
Cholesterol 0mg	**0%**
Sodium 15mg	**1%**
Total Carbohydrate 19.02g	**7%**
Dietary Fiber 2.7g	**10%**
Sugars 3.22g	
Protein 3.22g	
Vitamin D -	
Calcium 2mg	0%
Iron 0.52mg	3%
Potassium 270mg	6%
Vitamin A 10mcg	1%
Vitamin C 6.8mg	8%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

100 gr in potato

Nutrition Facts

Serving Size	**100 g**
Amount Per Serving	
Calories	**77**
	% Daily Values*
Total Fat 0.09g	**0%**
Saturated Fat 0.026g	**0%**
Trans Fat -	
Polyunsaturated Fat 0.043g	
Monounsaturated Fat 0.002g	
Cholesterol 0mg	**0%**
Sodium 6mg	**0%**
Total Carbohydrate 17.47g	**6%**
Dietary Fiber 2.2g	**8%**
Sugars 0.78g	
Protein 2.02g	
Vitamin D -	
Calcium 12mg	1%
Iron 0.78mg	4%
Potassium 421mg	9%
Vitamin A 0mcg	0%
Vitamin C 19.7mg	22%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

✓ The four most important food security crops

100gr in Sorghum

Nutrition Facts

Serving Size	**100 g**
Amount Per Serving	
Calories	**339**
	% Daily Values*
Total Fat 3.3g	**4%**
Saturated Fat 0.457g	**2%**
Trans Fat -	
Polyunsaturated Fat 1.37g	
Monounsaturated Fat 0.993g	
Cholesterol 0mg	**0%**
Sodium 6mg	**0%**
Total Carbohydrate 74.63g	**27%**
Dietary Fiber 6.3g	**23%**
Sugars -	
Protein 11.3g	
Vitamin D -	
Calcium 28mg	2%
Iron 4.4mg	24%
Potassium 350mg	7%
Vitamin A 0mcg	0%
Vitamin C 0mg	0%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

100gr in Millet

Nutrition Facts

Serving Size	**100 g**
Amount Per Serving	
Calories	**378**
	% Daily Values*
Total Fat 4.22g	**5%**
Saturated Fat 0.723g	**4%**
Trans Fat -	
Polyunsaturated Fat 2.134g	
Monounsaturated Fat 0.773g	
Cholesterol 0mg	**0%**
Sodium 5mg	**0%**
Total Carbohydrate 72.85g	**26%**
Dietary Fiber 8.5g	**30%**
Sugars -	
Protein 11.02g	
Vitamin D -	
Calcium 8mg	1%
Iron 3.01mg	17%
Potassium 195mg	4%
Vitamin A 0mcg	0%
Vitamin C 0mg	0%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

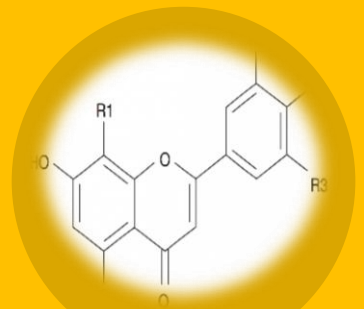
Source: https://www.fatsecret.com/calories-nutrition/generic/flour-whole-wheat?portionid=52100&portionamount=100.000

Health benefits of

SORGHUM and MILLET

1

Vital source of vitamins and minerals



2

Rich source of antioxidants

3

Naturally gluten free crop

4

Lowers blood cholesterol

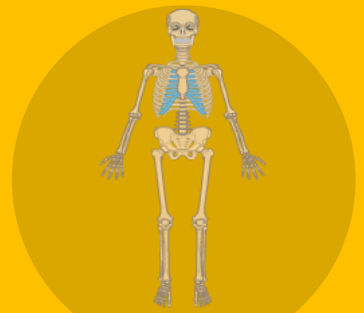
Suitable for sensitive patients with allergies

5

Staple food for celiac and inflammatory bowel disease patients

6

Contains a high level of dietary fiber and protein



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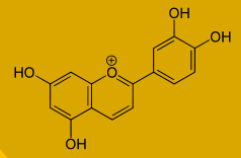
Good for the health of the bones

3-deoxyanthocyanins



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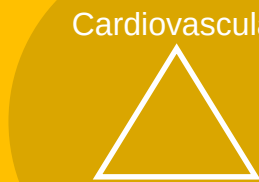
Compounds containing 3-DXA inhibit human colon cancer cells

9

Promote blood circulation

10

Maintaining a healthy weight



11

Prevent cardiovascular diseases, cancer, and type 2 diabetes

Sorghum Improvement to Striga, 2022-2024

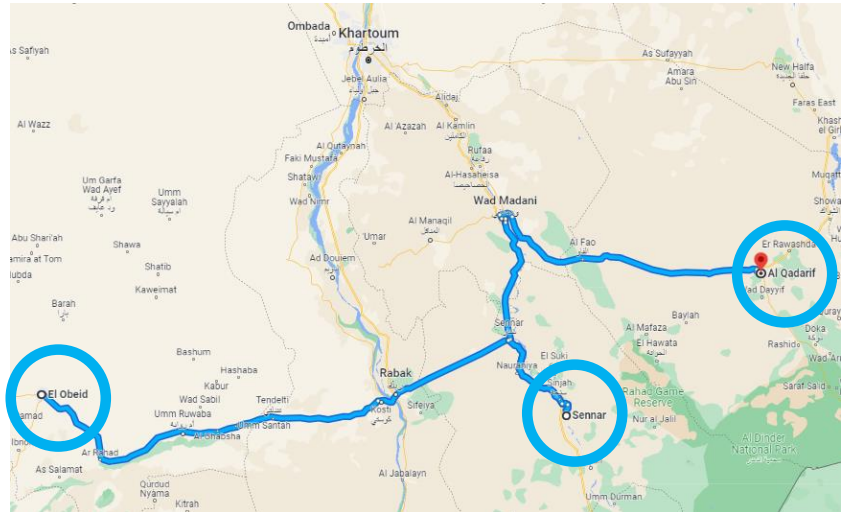
- ✓Striga (*Striga hermonthica*) is a predominant species in sorghum
- ✓Striga binds to sorghum roots, extracts water and nutrients, and hinders plant growth and development
- ✓This parasitism can lead to devastating yield losses in sorghum fields
- ✓Host breeding resistance is the primary solution to Striga infestations in sorghum
- ✓Not much chemical option, and its not sustainable
- ✓**Aim:** Identifying sorghum accessions that are resistant to Striga

Vetenskapsrådet

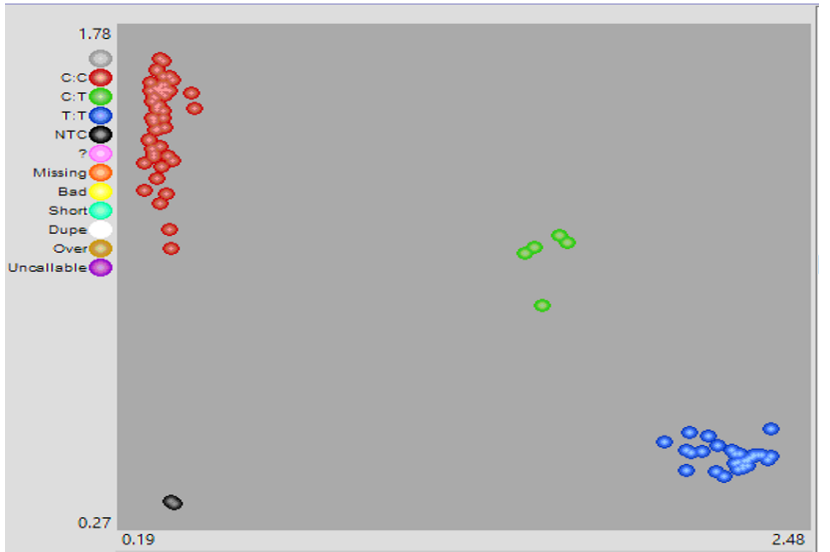
Striga Sick-Plot

✓Sick-plot in three locations (Sennar, El-Obeid, and Elgaderif)

✓Planted ~700 accessions (wild sorghum) in 2022 and 2023



- ✓In 2022, ~150 accessions demonstrated resistance to Striga in three locations
- ✓Several accessions have been identified as possessing the stay-green trait
- ✓Screened with known KASP markers for Striga and stay-green at the Excellence in Plant Breeding, one CGIAR
- ✓The 2022 field phenotyping and KASP markers indicate that these wild sorghum accessions possess unique and novel traits for Striga resistance and stay-green.



Ongoing activities

- ✓Genotyping-by-sequencing (GBS) ongoing
- ✓Field phenotyping 2023
- ✓GWAS and KASP validation in 700 wild sorghum
- ✓Recombinant Inbred Lines [PQ-434i (♀) and Butana (♂)] in the field in four loactions GBS for linkage and QTL mapping

Pearl Millet Biofortification, 2022-2024

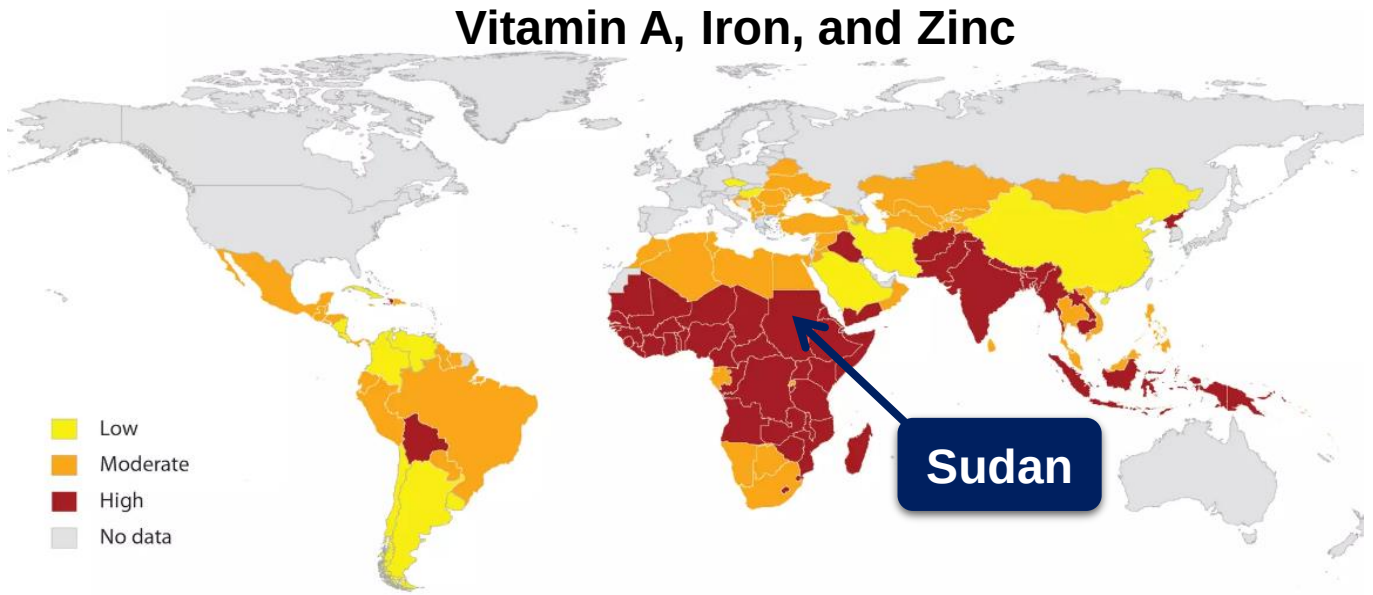
- ✓Pearl Millet (*Pennisetum glaucum*) is an essential food security crop in western Sudan
- ✓Sudan is one of the centers of origin of Pearl Millet
- ✓Micronutrient deficiencies, a major public health concern in Sudan (WHO, UNICEF, etc.)
- ✓**Aim:** Identifying pearl millet accessions with high Fe and Zn content

Vetenskapsrådet

Global Micronutrient Deficiencies

✓1 in 3 People are Malnourished (WHO)

✓Major public health issue in low and middle-income countries

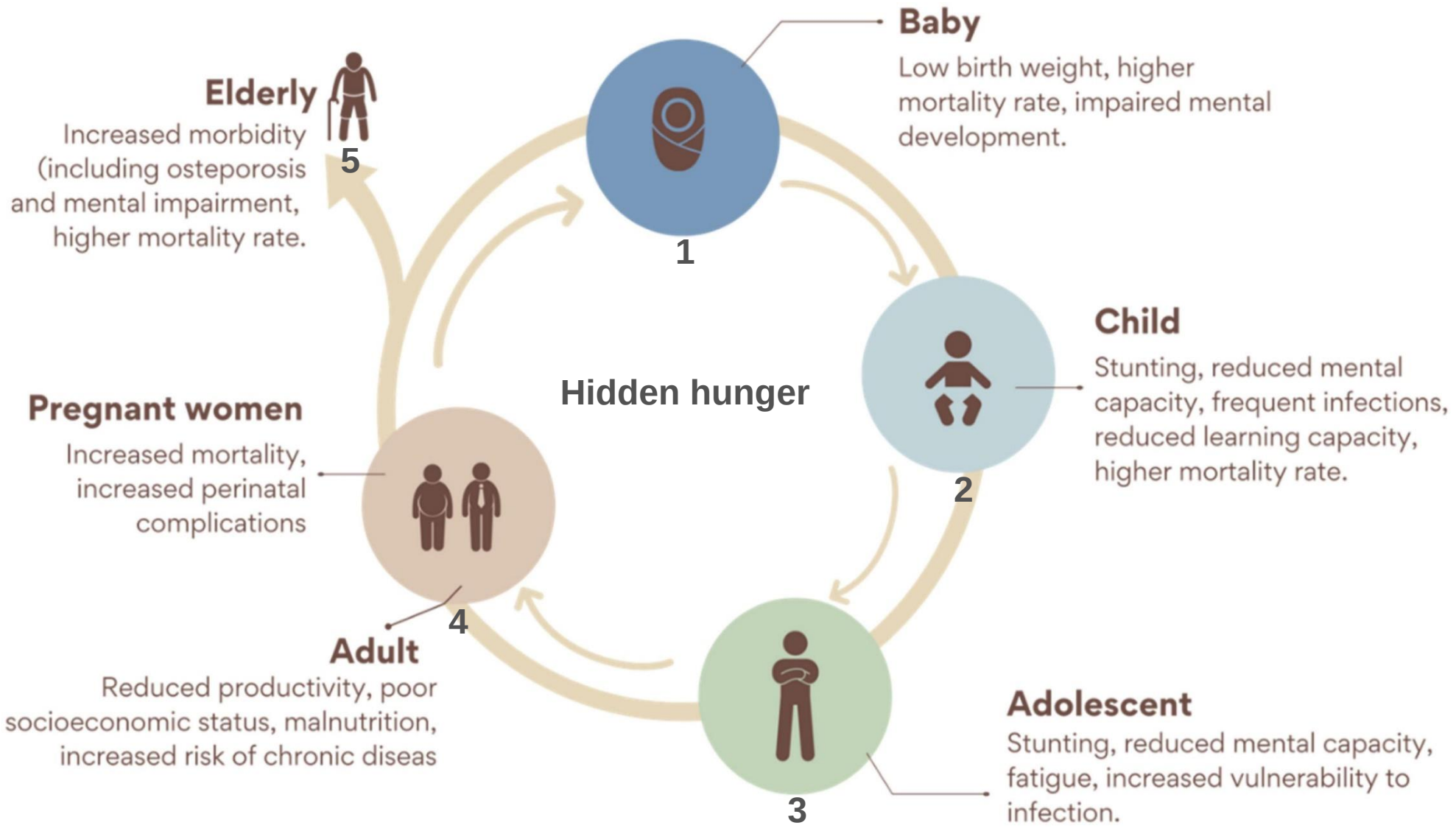


HarvestPlus
Better Crops • Better Nutrition

Preliminary results

- ✓Planted ~400 accessions in 2022 (seed increase) and in two locations in 2023
- ✓Screened with known KASP markers for Fe and Zn at the Excellence in Plant Breeding, one CGIAR
- ✓High variation among the samples based on KASP markers

Micronutrient deficiencies across the life cycle



Ongoing activities

- ✓Phenotyping for Fe and Zn
- ✓GWAS and KASP validation in 400 accessions
- ✓ Total Phenolic contents
- ✓Carotenoids profiling
- ✓Use traditional knowledge to decrease anti-nutritional compounds and boost bioavailability

Capacity Building

✓Six Ph.D. students involved from Sudan

✓They come to SLU for training, and other lab experiments

✓In 2023 January-April, six of them were at SLU, Alnarp

Acknowledgement

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