CLIMATE-SMART Agriculture 2015

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The potential of underutilised crops to improve food security in the face of climate change

F.J. Massawe, S. Mayes, A. Cheng, H.H. Chai, P. Cleasby, R. Symonds, W.K. Ho, A. Siise, Q.N. Wong, P. Kendabie, Y. Yanusa, R. Azman and S.N. Azam-Ali

The University of Nottingham Malaysia Campus

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Outline

Crop production - plant species diversity

- Current major crops

Crop diversification - a real opportunity

Looking beyond the major crops: underutilised/minor crops as part of the solution

- Crops For the Future

Crop production: plant species diversity

Plant species
300-500,000

Cultivated or harvested
7000

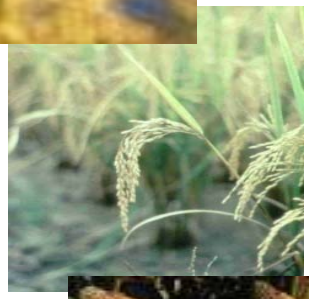
90% world food
12 plant ,
8 animal species

>60% Human diet
3 species

Underutilised/orphan /minor crop species

Wheat

Rice



Maize

Climate change will exacerbate loss of genetic diversity: crop diversity is one of the assets to adapt against the effects of climate change

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Crop production and climate change

Crop failures in several parts of the world predominantly in Africa and Asia

Climate change will cause shifts in areas suitable for the cultivation of the current crops

Crop production and plant species diversity

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Climate Smart Agriculture

Crop diversity: more crops

Increase crop productivity – matching crops to climates

Preserve agricultural biodiversity – diversification of food sources

Crop diversification – a key adaptation strategy: food and nutrition security, income generation

Underutilised/orphan/minor crop species

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Underutilised Crop Species

Species with underexploited potential: food and nutrition, income generation and adaptation …

- often subsistence crops

Grow in their natural environments often in marginal land, drought tolerant … evidence?

Receive little attention from research, extension services, policy and decision makers, donors, technology providers and consumers

Small increase in the average yield of a major species ~ global impact - area under cultivation

Significant increases in the yield of a minor crop ~ local effect

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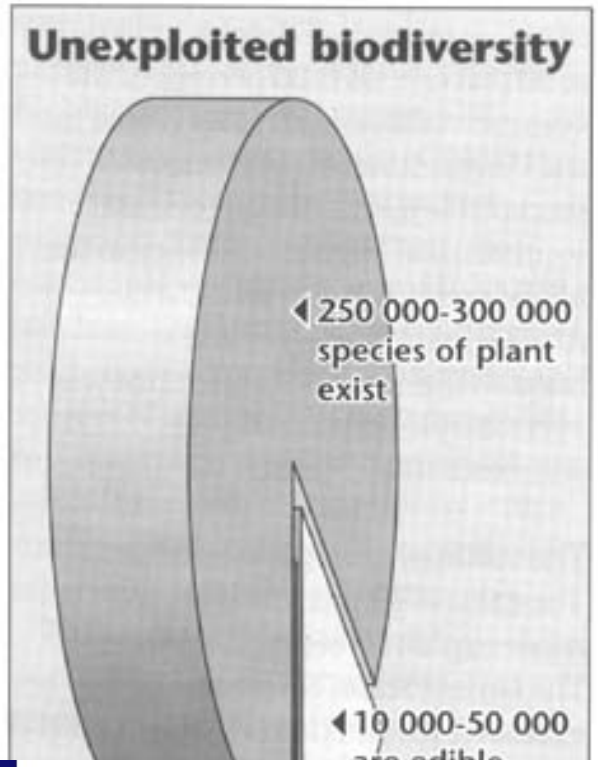

Climate Smart Agriculture – Beyond the major crops

PNAS

Increasing homogeneity in global food supplies and the implications for food security

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Promoting Underutilised Crops: Beyond the major crops

Regional specific and for Africa this means crops adapted to, for example:

- Drought and heat stress conditions

Most future climate models show a declining future maize yields in most growing regions in Africa.

What are the alternative crops?

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Some examples of crops of Africa – what do they offer?

Type of crop	Common Name	Botanical name	Desirable property	Undesirable property	Reference
Cereals	Finger millet	*Eleusine coracana*	High in iron & protein, low in glycemic index	Low productivity	[2,8]
	Fonio	*Digitaria exilis*	Fast maturing	Low productivity	[5,8]
	African rice	*Oryza glaberrima*	Resistance to diseases & pests	Lodging & shattering of seed	[5,9]
	Pearl millet	*Pennisetum glaucum*	Drought & heat tolerance	Insect pests & diseases	[10]
	Tef	*Eragrostis tef*	Abiotic stress tolerance, free of gluten	Low productivity & lodging	[11,12]
Leguminous crops	Bambara groundnut	*Vigna subterranea*	Nutritious & drought tolerance	Late maturing	[3]
	Cowpea	*Vigna unguiculata*	Drought tolerance & nutritious	Low productivity & insects	[3]
	Grass pea	*Lathyrus sativus*	Extreme drought tolerance & nutritious	Toxic seeds	[13]
	Amaranth	*Amaranthus* spp.	Fast growing & nutritious	Insect pests & diseases	[3]
	Celosia	*Celosia argentea*	High productivity	Sensitivity to nematodes & water-logging	[3,8]

Tadele and Assefa (2012). Agronomy, 2, 240-283.

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Bambara groundnut

(*Vigna subterranea* (L.) Verdc)

Grown primarily by subsistence farmers

Seeds are a reasonably balanced, nutritious food - represents an important source of protein

The crop is drought resistant, reasonably free of diseases and pest and adapted to poor soils

No improved varieties, only landraces

Yields are variable

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Bambara groundnut – a climate resilient crop?

Physiological attributes associated with yield under semi-arid conditions – drought resistance in Bambara groundnut

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Beyond the major crops: diversity of small millets

Cultivated in arid and semi-arid as rain-fed crops

Often grown under adverse soil and weather conditions

Always been crops of drought-prone areas, but give reliable harvests

http://www.minor-millets-a-cereal-grain-rich-in-diatery-fiber.htm

Finger millet [*Eleusine coracana* (L.) Gaertn.],
Foxtail millet [*Setaria italica* (L.) Beauv.],
Proso millet (*Panicum miliaceum* L.),
Fonio millet (*Digitaria exilis* Stapf. & *Digitaria iburua* Stapf.)

Teff (*Eragrostis tef*)

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Amaranth: Drought and heat tolerance?

- Early maturing - 20 to 45 days *(Ebert et al., 2011)*.
- A C4-cycle plant, amaranth can sustain high photosynthetic activity and water use efficiency under high temperatures and high radiation intensity, making it an ideal crop for abiotic stress conditions under changing climates *(Wang and Ebert et al., 2013)*.

The water requirement for growing seed amaranth is 53–58 % less than that required for wheat and 40–50 % less than maize

(Kauffman and Weber 1990)

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Climate change - implications

- A number of crops will not be able to grow in their existing climatic range

- Adaptive traits observed in crops such as Bambara groundnut enable these crops to perform well under stressful conditions.

- Climate change and its consequences call for research on climate resilient crops - determine which crop species will be fit for future climates.

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What needs to happen?

Research and development of underutilised crop species:
for food and nutrition security - will sustain smallholder farmers; provide improved livelihoods, income and health for their families.

Bioversity International

RESEARCH and AWARENESS

CFF
Crops For the Future

Crops For the Future – to enable the wider use of underutilised crops to diversify agricultural systems

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Crops For the Future (CFF)

Mission

To develop solutions for diversifying future agriculture using underutilised crops

Objectives

To secure a greater role for underutilised crops in global agriculture especially for the rural poor

CFF
Crops For the Future

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Climate Smart Food Systems …

Crop diversification - crops to match climates

- diversity of food sources and diets

Research and development of minor, underutilised crops

http://conservationmagazine.org/wordpress/wp-content/uploads/2014/03/global-grains.jpg

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