

In situ conservation and use of crop wild relatives in three ACP countries of the SADC Region



OPTIONS FOR CWR PRIORITIZATION

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Regional training workshop

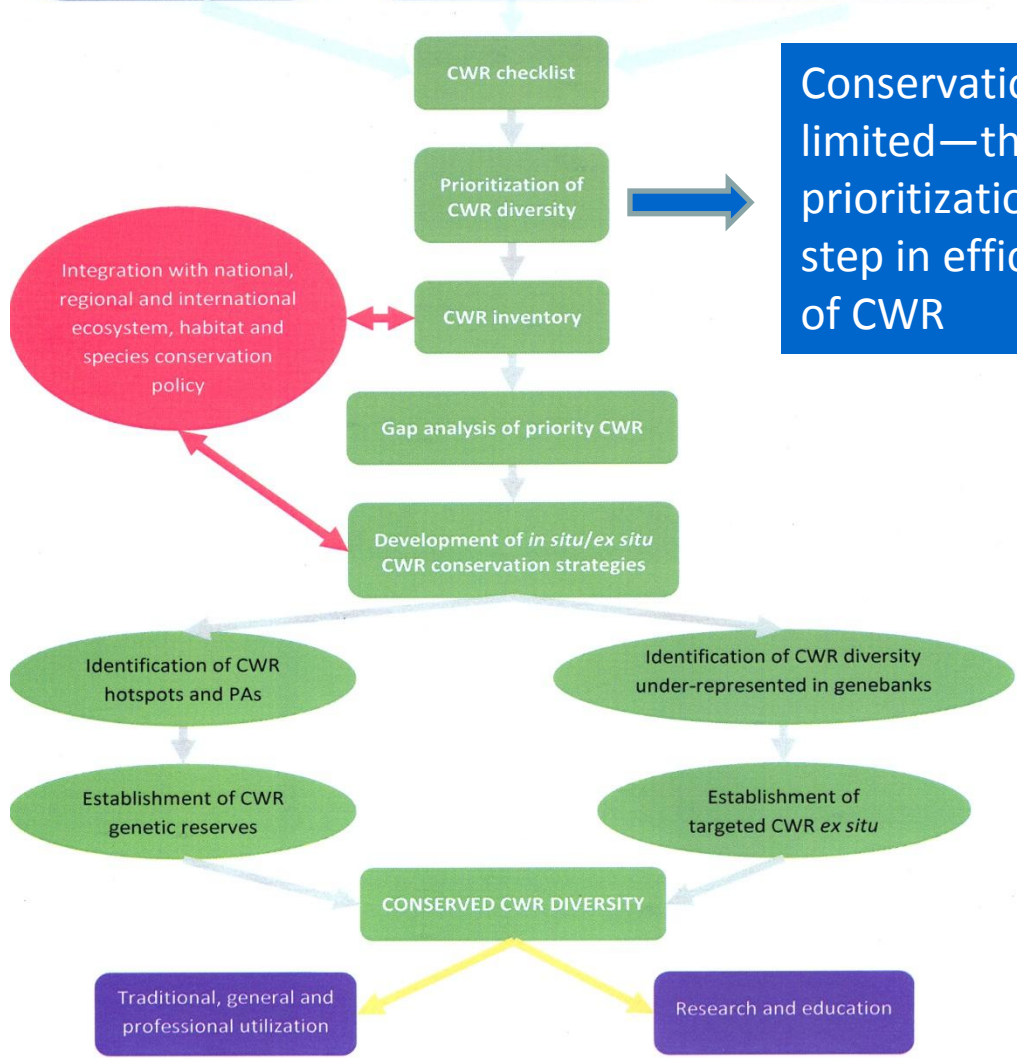
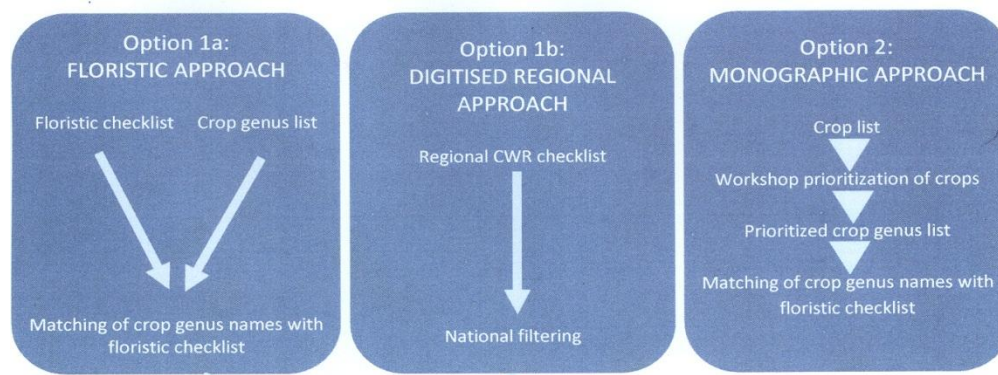
In situ conservation of CWR including diversity assessment techniques

Le Meridien Ile Maurice, 10–13 November 2014



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Conservation resources are limited—therefore, prioritization is a fundamental step in efficient conservation of CWR

SPECIES PRIORITIZATION CRITERIA

- Many criteria used, including:
 - Current conservation status, socio-economic use, threat of genetic erosion, genetic distinctiveness, ecogeographic distribution, biological importance, cultural values, cost, feasibility and sustainability, legislation, ethical and aesthetic considerations, priorities of the conservation agency (Maxted *et al.* 1997)
 - Endemicity, rarity, population decline, quality of habitat, intrinsic biological vulnerability, human impact, abundance in relation to geographical range, taxonomic uniqueness, ability of taxon to speciate into new environments



CWR PRIORITIZATION



A pragmatic and systematic approach for prioritizing CWR can be applied globally, regionally and nationally, based on three main criteria:

1. Priority crops
2. Utilization potential
3. Level of threat

CWR PRIORITIZATION

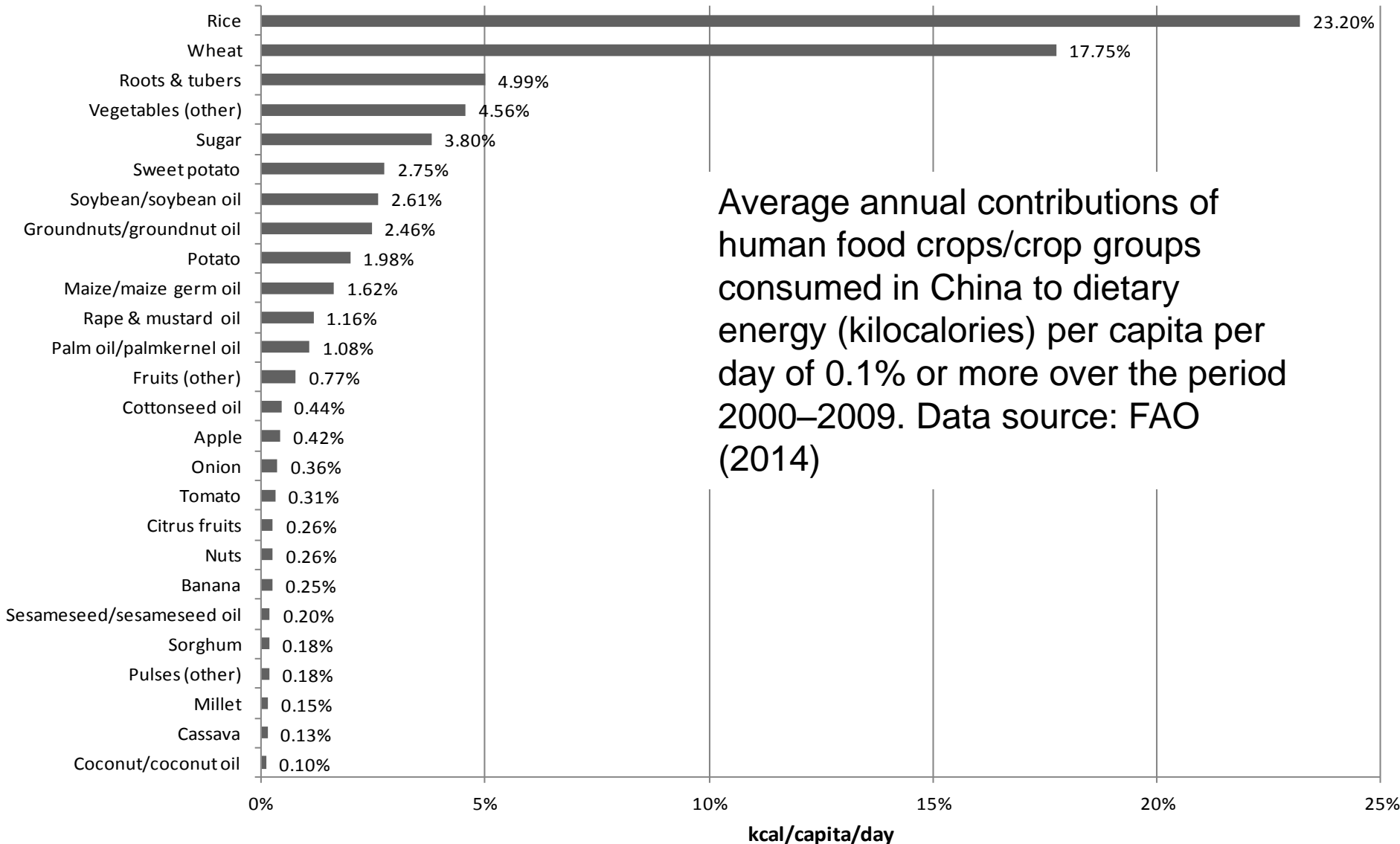
1. PRIORITY CROPS

- Priorities will vary according to scale of prioritization (i.e., global, regional, national or local) and may even vary according to the implementing agency
- Highest priority are likely to be:
 - **Food crops (important for nutrition and food security)**
 - **Crops of high economic value**
 - **Crops with multiple use values**



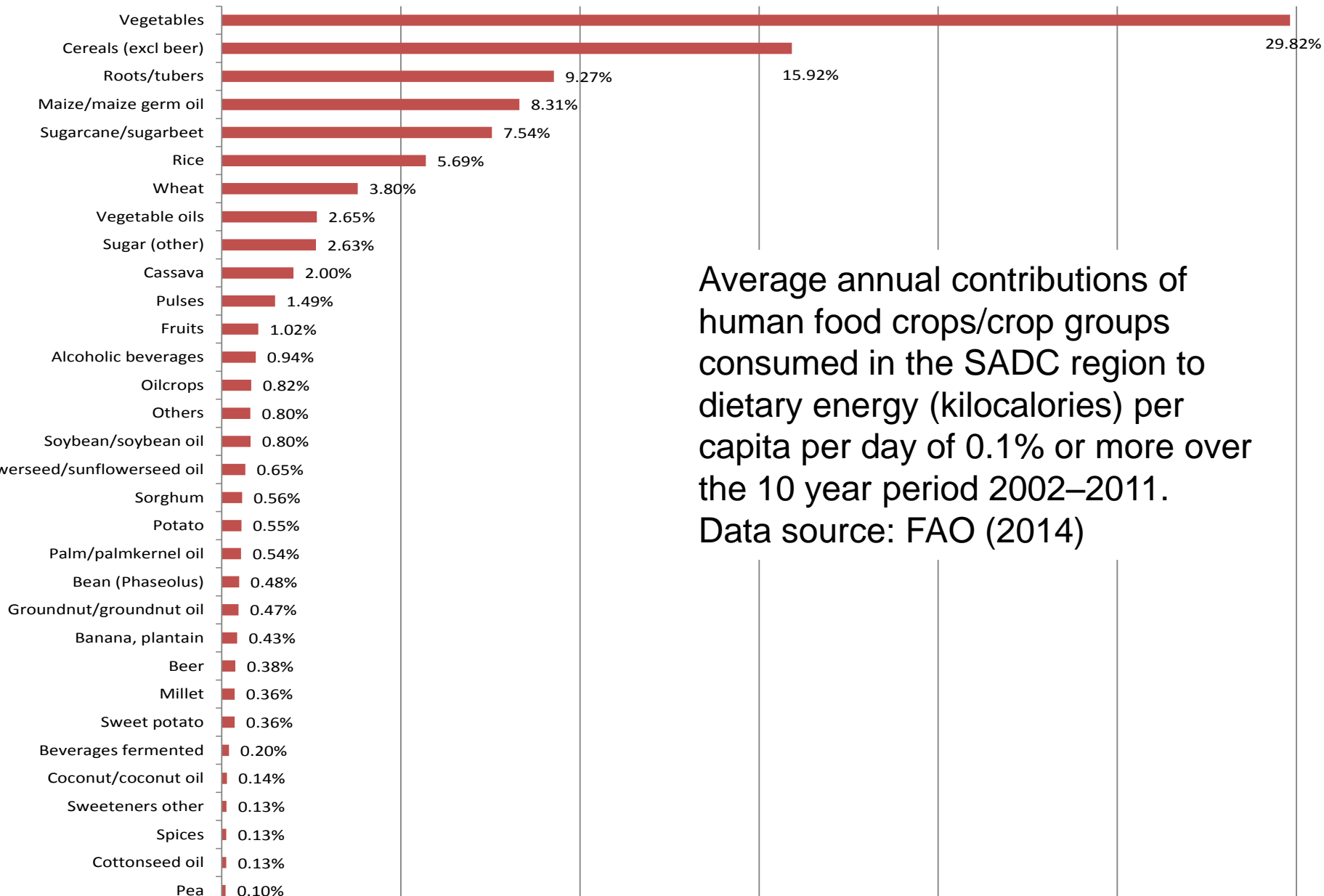
EXAMPLE: CRITERION 1 – PRIORITY CROPS

NUTRITIONALLY IMPORTANT CROPS IN CHINA



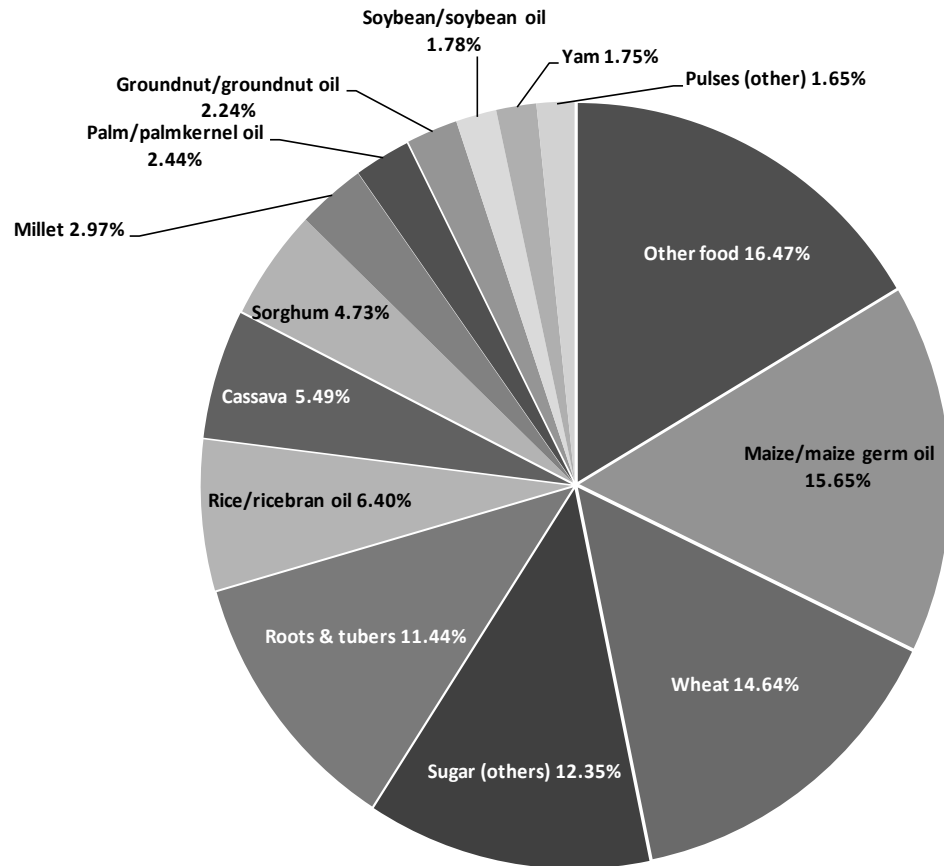
EXAMPLE: CRITERION 1 – PRIORITY CROPS

NUTRITIONALLY IMPORTANT CROPS IN THE SADC REGION



EXAMPLE: CRITERION 1 – PRIORITY CROPS

NUTRITIONALLY IMPORTANT CROPS IN THE AFRICAS



Average annual contributions of human food crops/crop groups to dietary energy (kilocalories) per capita per day of 1.5% or more over the period 2000–2009 in the Africa region.

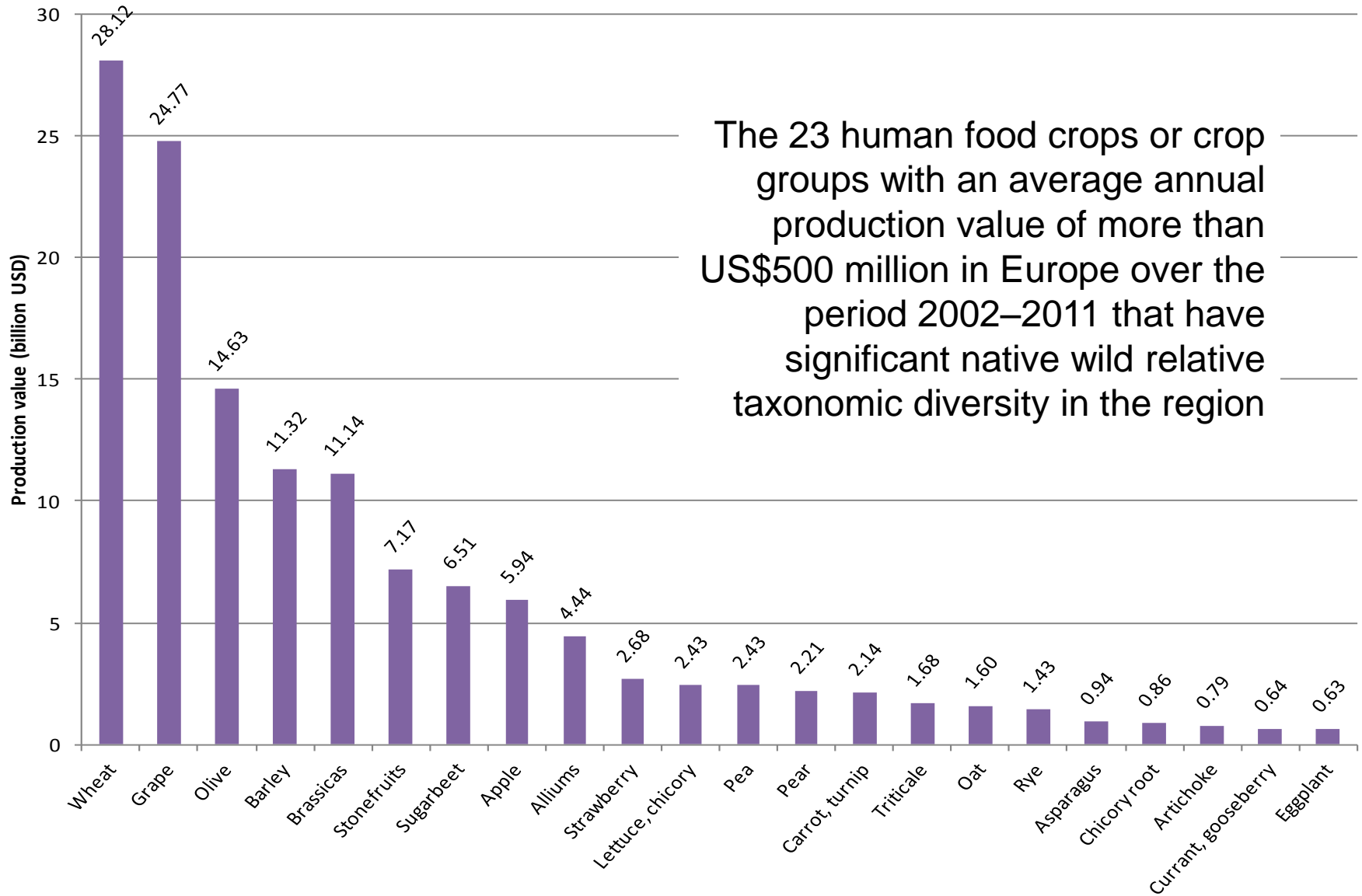
Data source: FAO (2014)

Figure 5a: Africa

The category 'other food' is an aggregation of crop commodities that each supply less than 1.5% of dietary energy. Categories such as 'rice/rice bran oil' and 'soybean/soybean oil' are grouped because they are derived from the same crop. One or other, or both forms may be consumed in any given region. The category 'sugar (others)' may include sugar sourced from sugarcane, sugar beet and a number of other crop species.

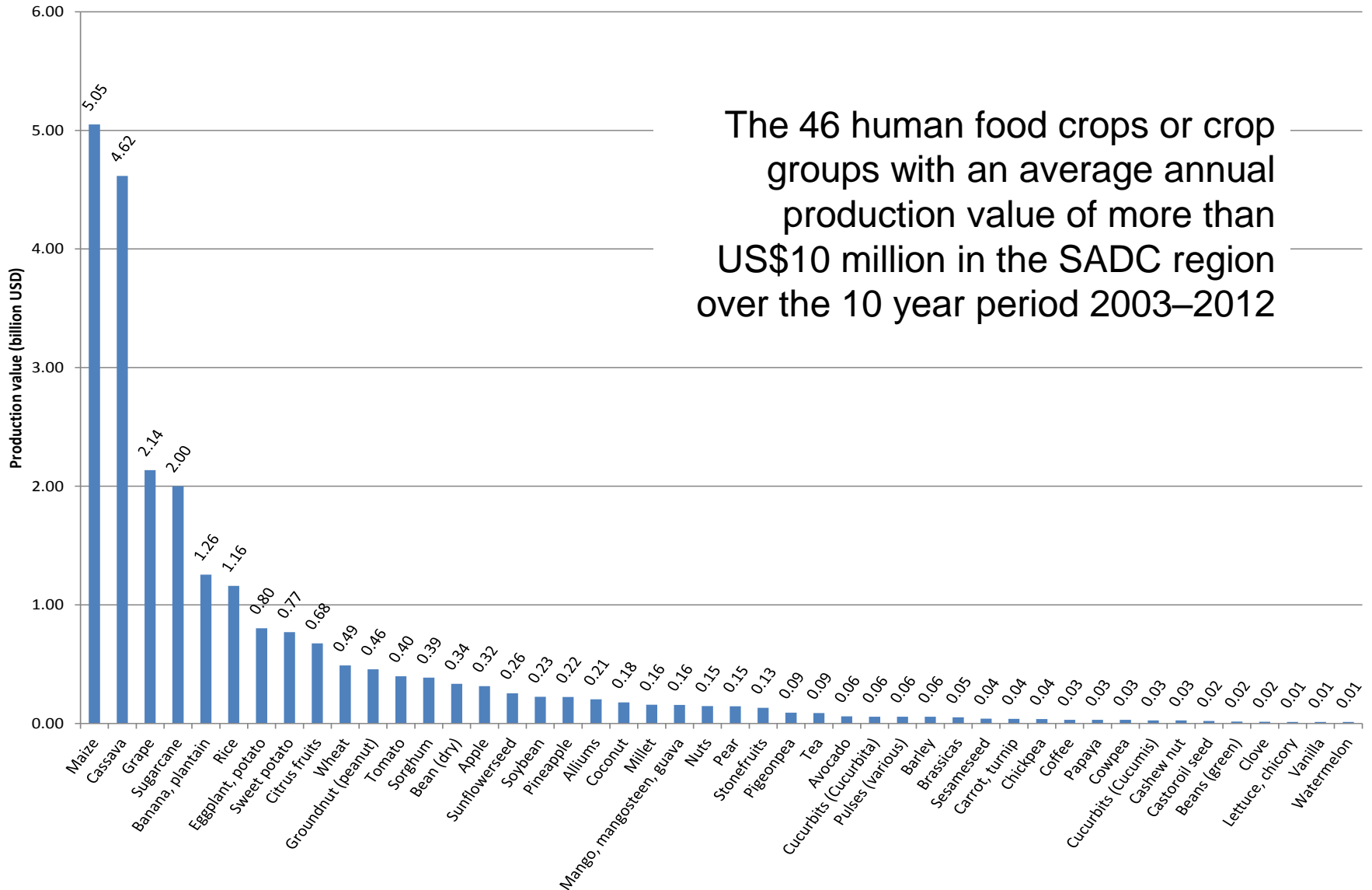
EXAMPLE: CRITERION 1 – PRIORITY CROPS

ECONOMICALLY IMPORTANT CROPS IN EUROPE



EXAMPLE: CRITERION 1 – PRIORITY CROPS

ECONOMICALLY IMPORTANT CROPS IN THE SADC REGION



CWR PRIORITIZATION

2. UTILIZATION POTENTIAL

The Gene Pool concept (Harlan and de Wet, 1971)

GP1A: cultivated forms of the crop

GP1B: wild or weedy forms of the crop

GP2: less closely related species from which gene transfer to the crop is possible but may be difficult

Prioritize the closest relatives (GP1B, GP2) + notable examples of tertiary relatives that have known use or potential use for crop improvement

GP3: species from which gene transfer to the crop is impossible, or requires sophisticated techniques (e.g., embryo rescue, somatic fusion or genetic engineering)

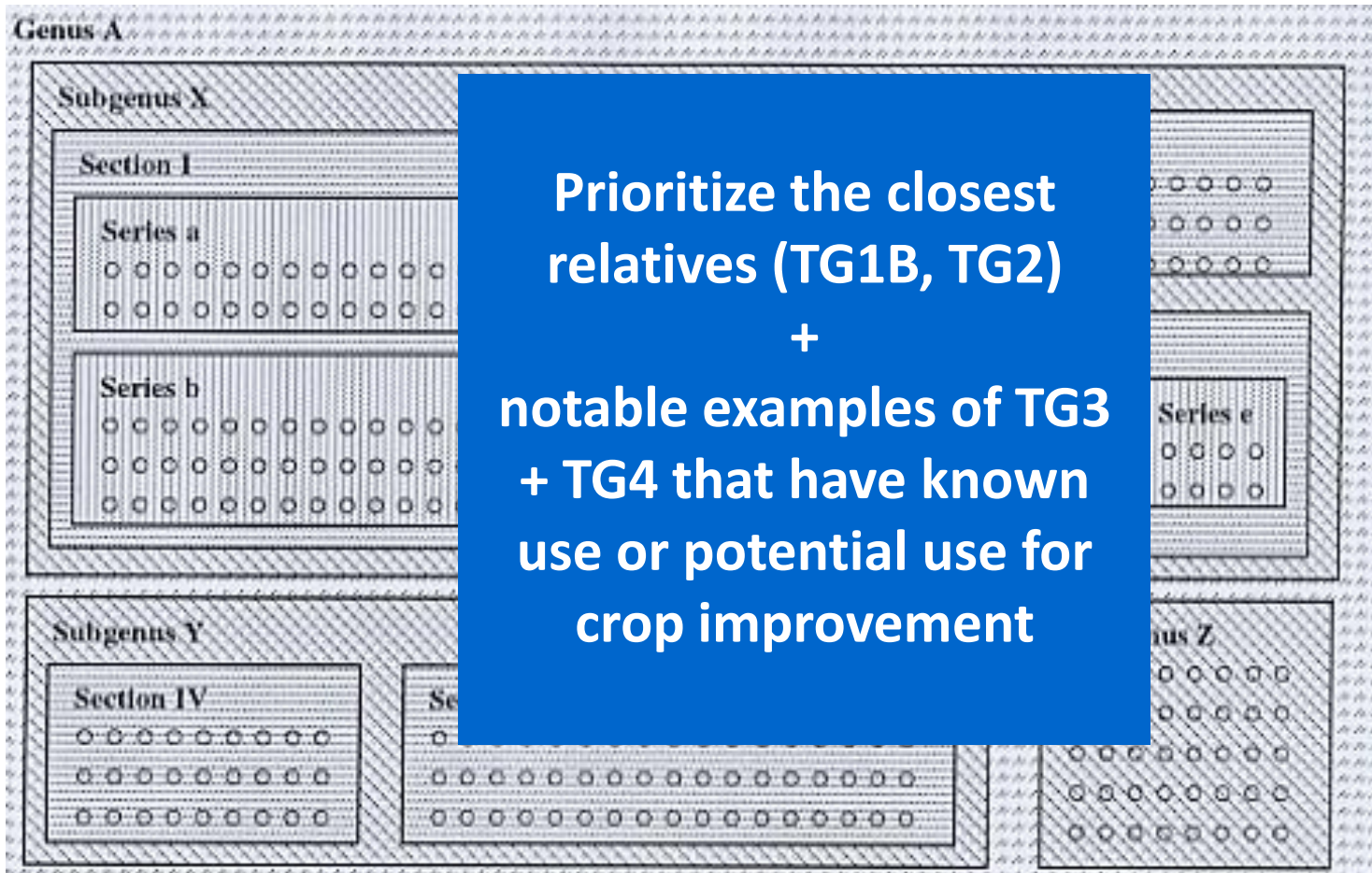
GP-

P-3

CWR PRIORITIZATION

2. UTILIZATION POTENTIAL

The Taxon Group concept (Maxted *et al.*, 2006)



TG1a: crop

TG1b: same species as crop

TG2: same series or section as crop

TG3: same subgenus as crop

TG4: same genus as crop

TG5: same tribe but different genus to crop

EXAMPLE: CRITERION 2 – UTILIZATION POTENTIAL

BEET GENE POOL (*Beta vulgaris* subsp. *vulgaris*)

Gene pool	Genus <i>Beta</i> L.
Primary	Section <i>Beta</i> Transhel <i>B. vulgaris</i> L. subsp. <i>vulgaris</i> (cultivated beets) subsp. <i>maritima</i> (L.) Arcang. subsp. <i>adanensis</i> (Pamuk.) Ford-Lloyd & Will. <i>B. macrocarpa</i> Guss. <i>B. patula</i> Ait.
Secondary	Section <i>Corollinae</i> Ulbrich <u>Base species</u> <i>B. corolliflora</i> Zosimovich <i>B. macrorhiza</i> Steven <i>B. lomatogona</i> Fisch & Meyer <i>B. nana</i> Boiss. & Heldr. <u>Hybrid species</u> <i>B. intermedia</i> Bunge <i>B. trigyna</i> Wald. & Kid.
	Genus <i>Patellifolia</i> Williams, Scott & Ford-Lloyd (syn. <i>Beta</i> Section <i>Procumbentes</i>)
Tertiary	<i>P. procumbens</i> (Smith) A.J.Scott, Ford-Lloyd & J.T.Williams <i>P. webbiana</i> (Moq.) A.J.Scott, Ford-Lloyd & J.T.Williams <i>P. patellaris</i> (Moq.) A.J.Scott, Ford-Lloyd & J.T.Williams

Primary and secondary wild relatives

Tertiary wild relatives

EXAMPLE: CRITERION 2 – UTILIZATION POTENTIAL

FINGER MILLET GENE POOL (*Eleusine coracana*)

Primary wild relatives

- *E. africana* K.-O'Byrne
- *E. indica* (L.) Gaertn.
- *E. kigeziensis* S.M. Phillips

Secondary wild relatives

- *E. tristachya* (Lam.) Lam.
- *E. floccifolia* (Forssk.) Spreng.
- *E. intermedia* (Chiov.) S.M. Phillips

Tertiary wild relatives

- *E. jaegeri* Pilger
- *E. multiflora* Hochst. ex A. Rich
- *Octochloa compressa* (Forssk.) Hilu (syn. *E. compressa* Forssk.)



EXAMPLE: CRITERION 2 – UTILIZATION POTENTIAL

DISTANT WILD RELATIVES

- **However**, in some cases, more distantly related taxa (GP3) have been highlighted as gene donors (or potential gene donors)
- These taxa are also of conservation priority

Example: Barley, *Hordeum vulgare*

- **High priority taxon:** *H. chilense* (GP3)
- **Why?** It has a number of characteristics of interest for breeding (in particular, resistance to barley leaf rust) and has potential for use in wheat and triticale improvement (Martín and Cabrera, 2005)

EXAMPLE: CRITERION 2 – UTILIZATION POTENTIAL

DISTANT WILD RELATIVES

Example: Beet, *Beta vulgaris* subsp. *vulgaris*

- **High priority taxa:** *Patellifolia* species (GP3) (*P. procumbens*, *P. webbiana* and *P. patellaris*)
- **Why?** Donors of beet cyst nematode resistance (now successfully used in sugar beet production worldwide) and other resistance traits



Patellifolia procumbens on La Gomera, Canary Islands

Lothar Frese

EXAMPLE: CRITERION 2 – UTILIZATION POTENTIAL

DISTANT WILD RELATIVES

The GP/TG concept is not a primary criterion for all crop gene pools. For example:

- **Cassava (*Manihot esculenta*):** hybridizes naturally with many of the wild species and a number of species in GP2 and GP3 have already been used in breeding programmes
- **Potato (*Solanum tuberosum*):** Ploidy manipulation or somatic fusion can be used to overcome crossing barriers in potato breeding—therefore, virtually any potato wild relative can be utilized in improvement of the crop
- **Sorghum (*Sorghum bicolor*):** close wild relatives widely distributed and not in immediate need of *in situ* conservation. Tertiary wild relatives have some useful traits but crossing is difficult. However, some rarer ones should be conserved *in situ* (eg, in Australia)

CRITERION 2 – UTILIZATION POTENTIAL

DISTANT WILD RELATIVES

- Other distantly related taxa may also be important as gene donors and should not be ignored in conservation planning!
- Many of these taxa could become more restricted and threatened in the future, particularly in response to climate change!



CWR PRIORITIZATION

3. LEVEL OF THREAT

- Threat status
 - IUCN Red List of Threatened Species
 - Regional Red Lists (e.g., European Red List of Vascular Plants)
 - National Red Lists
 - Inferred from habitat/land use type
 - Based on local knowledge
- National/regional/global legislative instruments
- Endemism/relative distribution



EXAMPLE: CRITERION 3 – LEVEL OF THREAT

BEET GENE POOL

- **High priority taxa:** *Beta patula* and *Patellifolia webbiana* (Critically Endangered), *B. macrocarpa* (Endangered), *B. vulgaris* subsp. *adanensis* and *B. nana* (Vulnerable)
- **Other taxa:** *B. vulgaris* subsp. *maritima*, *P. patellaris* and *P. procumbens* (Least Concern); *B. trigyna* (Data Deficient)



Beta nana—known from 7 localities in Greece

EXAMPLE: CRITERION 2 + 3

(Utilization potential + level of threat)

BEET GENE POOL



Lothar Frese

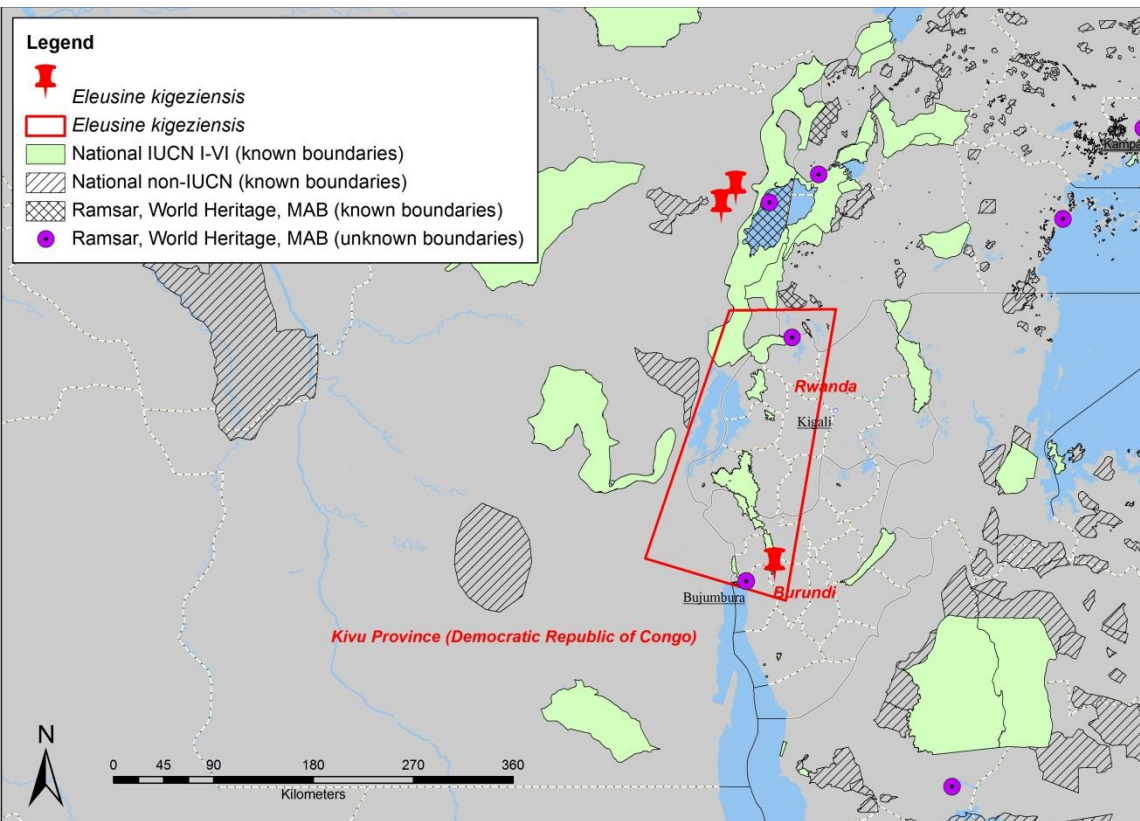
Beta macrocarpa

- **High priority taxa:** *B. patula*, *B. macrocarpa*, *B. vulgaris* subsp. *adanensis*, *B. nana*
- **Why?** Because they are threatened primary and secondary CWR

Taxon prioritization based on level of threat depends on geographic scope of strategy. (E.g., *P. patallaris* and *P. procumbens* not immediate priorities at European scale as relatively widespread, but in Portugal only a few subpopulations occur so they may be considered a priority at national level)

EXAMPLE: CRITERION 2 + 3 (Utilization potential + level of threat)

FINGER MILLET GENE POOL



- **High priority taxa:**
E. kigeziensis, *E. intermedia*
- **Why?** Because they are primary and secondary CWR with limited distributions

CWR PRIORITIZATION

APPLYING THE CRITERIA TO A NATIONAL CWR CHECKLIST

- Choice and application of prioritization criteria varies between countries; for example:
 - Apply all three criteria to complete CWR checklist, then rank to prioritize
 - Identify priority crops and then apply criterion 2, followed by criterion 3
 - Identify priority crops and then apply criterion 3
 - Apply criterion 3 to entire CWR checklist (i.e., prioritize all threatened/endemic/rare taxa), then apply criteria 1 and 2 to remaining taxa
- Approach depends on CWR diversity present, CWR taxon richness, stakeholder priorities, available time and resources, researchers' preferences

CWR PRIORITIZATION

HOW MANY PRIORITY TAXA?

Country	National CWR checklist	No. of priority CWR taxa
China	>24000	126 (871)
Cyprus	1722	178
Finland	1905	209
Germany	2874	84 (300)
Norway	2535	204
Spain	941 (>6500)	580
England	1471	148

CWR PRIORITIZATION RESOURCES



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- ▶ Forestry
- ▶ ASTI R&D Indicators

Filters / Prices / Producer Prices - Annual

BULK DOWNLOADS

Countries Regions Special Groups

Afghanistan
Albania
Algeria
Angola
Antigua and Barbuda

SELECT ALL CLEAR ALL

Elements

Producer Price (LCU/tonne)
Producer Price (SLC/tonne)
Producer Price (USD/tonne)

SELECT ALL CLEAR ALL

Items Items Aggregated

Agave fibres nes
Almonds, with shell
Anise, badian, fennel, coriander
Apples
Apricots

SELECT ALL CLEAR ALL

Years

2012
2011
2010
2009
2008

SELECT ALL CLEAR ALL

Summary

Please use the selectors above to filter your query. Your selection will be displayed in the area below and it can be edited at any time.

DISPLAY OUTPUT AS TABLE PIVOT

PREVIEW

CSV

EXCEL

<http://faostat3.fao.org/download/P/PP/E>

CWR PRIORITIZATION RESOURCES



The header features the 'crop wild relatives' logo on the left, a central title 'Crop Wild Relatives & Climate Change', and a navigation menu with links for Home, News, Why CWR, CWR Inventory (highlighted), Conservation Gaps, and Interactive Map. On the right, there is a photograph of a woman carrying a large bundle of harvested crops on her back, with a vertical credit line '© FAO / Giuseppe Bizziari'.

The Harlan and de Wet Crop Wild Relative Inventory

Classic Search **Advanced Search**

Search by crop gene pool

Enter a genus (eg. *Zea*), taxon (eg. *Zea mays*) or crop name (eg. maize).

Enter a genus, taxon or crop name **Search**

Search by crop wild relative

Enter a genus (eg. *Zea*) or taxon (eg. *Zea diploperennis*).

Enter a genus or taxon **Search**

Search by native distribution

Select your search parameter

Search by country Search by region

Select a country from the list.

Search **Search**

Search by breeding use

Select a use from the list.

Search **Search**

Crop wild relative species may be prioritised on the basis of the economic importance of the associated crop, the level of threat to CWR populations, or perhaps most importantly, the potential for CWR utilisation. Utilisation potential is determined by the ease of trait transfer between the CWR and the crop, and CWR may be assigned to different gene pools based upon these characteristics.

The Harlan and de Wet (1971) gene pool concept proposes that members of crop gene pool GP1b (primary) and 2 (secondary) are most likely to be crossable with the crop and so these become the obvious conservation priorities. However, gene pool concepts have not yet been established for all crops, and where they are not available the taxon group concept (Maxted et al. 2006), which uses taxonomic classifications of the crop genus as a proxy for relative crossability, can be applied. Taxon group TG1b (same species as crop), TG2 (same series or section as crop) and TG3 (same subgenus as crop) are given priority. Other CWR that are also given priority are species that have previously been successfully used in breeding, regardless of relative close relation to the crop. As such the Inventory presents a priority list of CWR species (members of GP1b/GP2 or TG1b-3, or previously used in breeding). The Inventory contains over 1400 taxa divided between 36 families and 92 genera, and is annotated with key ancillary data, including their regional and national occurrence, seed storage behaviour and herbaria housing major collections of the CWR.

Harlan, J.R. and de Wet, J.M.J., (1971). Towards a rational classification of cultivated plants. *Taxon*, 20, 500-517.

www.cwrdiversity.org

CWR PRIORITIZATION RESOURCES

GRIN Taxonomy for Plants

Crop Relatives in [GRIN](#) Taxonomy

(for the query: **family** = 'all families' & **native country** = 'Zambia' & **crops** = 'sorghum' & **genetic relative status** = 'GR1, GR2, GR3, & GS' & **repositories** = 'all')

Follow links for a) **GRIN taxon reports** or b) **to view literature supporting this gene pool classification** (Place cursor over highlighted items for explanation.)

Crop: SORGHUM

(compiled by Dr. Blanca León; reviewed by Dr. Gary A. Pederson, Research Leader & Acting Sorghum Curator, USDA/ARS, Plant Genetic Resources Conservation Unit, Griffin, Georgia and Dr. Jeff Dahlberg, Sorghum CGC Chair, United Sorghum Checkoff Program, Lubbock, Texas on 28 September 2010)

Crop taxa:

1. [Sorghum bicolor \(L.\) Moench subsp. bicolor](#) – sorghum
2. [Sorghum bicolor \(L.\) Moench nothosubsp. drummondii \(Steud.\) de Wet ex Davidse](#) – Sudan grass

Crop wild relatives:

Primary

1. [Sorghum bicolor \(L.\) Moench subsp. verticilliflorum \(Steud.\) de Wet ex Wiersema & J. Dahlb.](#) — [\[References\]](#)

Tertiary

1. [Sorghum versicolor Andersson](#) — [\[References\]](#)

| [USDA](#) | [ARS](#) | [GRIN](#) | [NPGS](#) | [New Search](#) |

Cite as:

USDA, ARS, National Genetic Resources Program.

Germplasm Resources Information Network - (GRIN) [Online Database].

National Germplasm Resources Laboratory, Beltsville, Maryland.

www.ars-grin.gov/~sbmljw/cgi-bin/cwrelative.pl

CWR PRIORITIZATION RESOURCES



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MARCH'S PALM PIT VIPER
Bothriechis marchi

© Dr. Silviu Petrovan



+
National and
regional Red Lists



Celebrating 50 Years of The IUCN Red List

30 January 2014 - Throughout 2014 we are celebrating the significant contribution of The IUCN Red List of Threatened Species in guiding conservation action and policy decisions over the past 50 years. The IUCN... [more](#)



Bangladesh creates new Marine Protected Area for Dolphins, Whales, Sharks and Turtles

07 November 2014 - On November 3rd 2014, the Government of Bangladesh declared the country's first Marine Protected Area, Swatch of No Ground, to safeguard whales, dolphins, sea turtles, sharks, and other... [more](#)



A royal gift for the 'Asian unicorn'

07 November 2014 - In honour of His Royal Highness the Prince Consort of Denmark's 80th birthday this year, [Copenhagen Zoo](#) recently made a... [more](#)



British zoos and aquariums celebrate Red November

07 November 2014 - This year, IUCN is celebrating 50 years of the IUCN Red List of Threatened Species™, and to mark the anniversary, the [British and...](#) [more](#)



Trade and Emerging Infectious Diseases in Amphibians

07 November 2014 - According to the IUCN Red List of Threatened Species™, amphibians are the most threatened vertebrate group on earth. The following joint statement by the [more](#)



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www.iucnredlist.org/

CWR PRIORITIZATION RESOURCES



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PGR Secure helpdesk: CWR resources

On this page you will find a number of resources to aid and inform the national CWR conservation strategy planning process. For one-to-one guidance on any aspect of national CWR conservation strategy planning, or for access to the digitized data sets mentioned under 'CWR data' below, please contact the CWR helpdesk manager, Shelagh Kell: s.kell@bham.ac.uk.

CWR conservation planning aids

▶ **The CWR *In Situ* Strategy Helpdesk:** A product of the AEGRO project, the 'CWR *In Situ* Strategy Helpdesk' is a guide and information facility for national programmes, research institutes, NGOs, protected area managers or individuals involved in the development of a CWR *in situ* conservation strategy. There are three main components of this facility:

1. A step-wise methodology for the identification of genetic reserve sites for a target crop gene pool.
2. A step-wise methodology for the identification of genetic reserve sites for a national CWR flora.
3. A list of data sources that can be consulted to aid the development of a CWR *in situ* conservation strategy.

▶ **PGRFA Conservation Toolkit:** 'Resource Book for the Preparation of National Plans for Conservation of Crop Wild Relatives and Landraces' aims to help nations to systematically formulate national strategies for the conservation of CWR and LR by leading the user through the various steps of the process and providing supporting reference material.

▶ ***In situ* Conservation of CWR eLearning Modules:** Complementing the *In situ* Conservation Manual of CWR, these modules have been developed to help conservationists gain preliminary insight into the tools and methods involved in the effective conservation of CWR.

CWR data

Below is a selection of resources with a specific focus on CWR data. For a comprehensive guide to searching for CWR data, please consult the CWR *In Situ* Strategy Helpdesk data sources pages. The CWR helpdesk manager can provide some data sets in digital format, such as the list of species included in the Habitats Directive, species included in the European Red List of Vascular Plants and the associated data (e.g., countries of occurrence, Red List Categories, major threats, habitat types), as well as a list of major and minor food crops. Other data sets can be obtained via the helpdesk through external contacts, such as *ex situ* accessions data from EURISCO and GRIN; these will be provided on an individual request basis to the relevant database managers.

▶ **National CWR checklists:** The national CWR checklists have been extracted from the CWR Catalogue for Europe and the Mediterranean, which was a product of the PGR Forum project. The checklists can be used as the basis for the creation of CWR national inventories (NIs). The CWR helpdesk manager can provide these data on request. (Click here to learn more about these data).

▶ **CWRIS:** The Crop Wild Relative Information System was a product of the PGR Forum project and comprises: a) an information management model for data associated with *in situ* conservation of CWR,

Back to main helpdesk

LR resources

Also see the publications page for additional products (deliverables) of the PGR Secure project

Concept for *in situ* conservation of CWR in Europe

Preserving diversity: a concept for *in situ* conservation of crop wild relatives in Europe



Nigel Martin, Alina Angeli, Lether Fries, and Wanda, Elena Velago Marini, Alex Lager and Stenag Kell

National CWR conservation strategy for Spain



National Strategy for the Conservation of Crop Wild Relatives of Spain

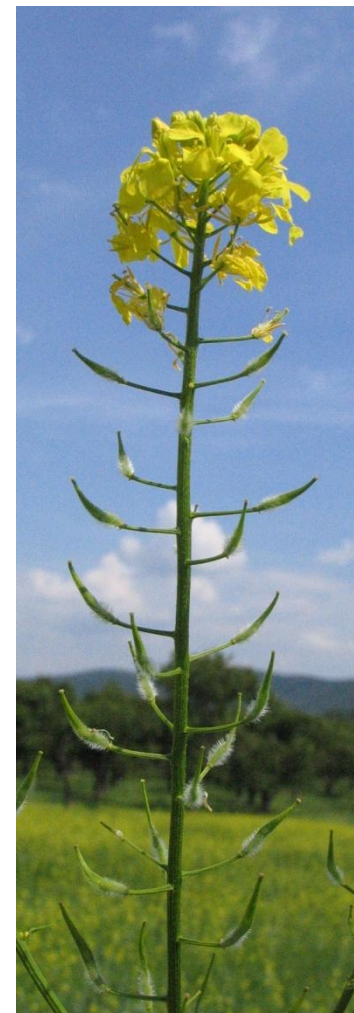
Nigel Martin, Alina Angeli, Lether Fries, and Wanda, Elena Velago Marini, Alex Lager and Stenag Kell

PGR Secure: Novel characterization of crop wild relative and landrace resources as a basis for improved crop breeding



SUMMARY

- Prioritization is a fundamental step in the national CWR conservation strategy planning process
- The three main CWR prioritization criteria are:
 1. Priority crops
 2. Utilization potential
 3. Level of threat
- Application of the criteria varies between countries
- Resources and case studies are available to inform the development of NSAPs in the SADC region



In situ conservation and use of crop wild relatives in three ACP countries of the SADC Region



OPTIONS FOR CWR PRIORITIZATION

THANK YOU FOR YOUR ATTENTION!

Shelagh Kell, Joana Magos Brehm and Nigel Maxted
University of Birmingham, UK

Regional training workshop

In situ conservation of CWR including diversity assessment techniques

Le Meridien Ile Maurice, 10–13 November 2014



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