CWR conservation in the SADC region

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Plant Genetic Resources: Our challenges, our food, our future
2 June 2016, University of Birmingham
CONTENTS

• Introduction to project

• Capacity building in the SADC region

• National Strategic Action Plans for CWR conservation and sustainable use in Mauritius, South Africa and Zambia

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SADC CROP WILD RELATIVES PROJECT

• In situ Conservation and Use of Crop Wild Relatives in three ACP countries of SADC Region
• 2014-2016
• Led by Bioversity International
• Co-funded by the European Union and implemented through the ACP-EU Co-operation Programme in Science and Technology (S&T II) by the ACP Group of States. Grant agreement no. FED/2013/330-210.
SADC CROP WILD RELATIVES PROJECT

• CWR are an important source of trait diversity for crop improvement
• Food and economic security
• Their importance is not well recognised
• Threatened in the wild
• In situ and ex situ conservation inadequate
• Partnership between environment and agriculture sectors

Important diversity of wild relatives of: coffee, cucurbits (cucumber, gherkin, melon), eggplant, lettuce, millets, okra, pulses (cowpea, pigeon pea, sword bean), rice, sorghum and watermelon
SADC CROP WILD RELATIVES PROJECT

Overall objective
• Enhance the link **between conservation and use of CWR** in three ACP countries within the SADC region, as a means of underpinning regional food security and mitigating the predicted adverse impact of climate change.

Specific objectives
• **Enhance the scientific capacities** within the partner countries to conserve CWR and identify useful potential traits for use to adapt to climate change.
• **Develop exemplar National Strategic Action Plans** for the conservation and use of CWR in the face of the challenges of climate change across the SADC region.
CAPACITY BUILDING IN THE SADC REGION
CAPACITY BUILDING

To assess and improve capacities on *in situ* conservation and use of CWR in the SADC region

Training needs assessment

Training workshops

Skype and face-to-face meetings

Templates

Online toolkit
CAPACITY BUILDING
TRAINING NEEDS ASSESSMENT

Surveys in Mauritius, South Africa and Zambia
Survey in the SADC region

Key findings:

• Expertise on CWR is limited

• Lack of capacity in taxonomy, ecogeographic survey, seed handling, climate change modelling, data management and analysis

• CWR data quantity and quality are poor and accessing data within the SADC region is difficult

• Lack of policies on CWR
CAPACITY BUILDING TRAINING WORKSHOPS

Regional training workshop on in situ conservation of CWR – Mauritius, November 2014

26 participants from 14 SADC countries

• Creating CWR checklists and inventories
• Prioritization of CWR for conservation
• Conservation status assessment of priority CWR
• Plans for implementation of conservation priorities
• Relevant policy for the conservation of CWR

Regional training workshop on predictive characterization and pre-breeding – South Africa, April 2015

23 participants from 9 SADC countries

• Application of ecogeography to PGR
• Predictive characterization of selected CWR for a specific traits
• CAPFITOGEN tools
• Definition and application of pre-breeding
• Genebank operations critical to pre-breeding programmes
• Principles for parental selection and the generation and management of variation
• Outline of actions that promote the use of CWR diversity for inclusion into NSAP for the conservation and use of CWR

Provide training on CWR in situ conservation and utilization
CAPACITY BUILDING TEMPLATES

Support CWR conservation planning and development of NSAP

TEMPLATE FOR THE PREPARATION OF A NATIONAL STRATEGIC ACTION PLAN FOR THE CONSERVATION AND SUSTAINABLE USE OF CROP WILD RELATIVES

Ehsan Dulloo, Joana Magos Brehm, Shelagh Kell, Imke Thormann and Nigel Maxted

Biodiversity International
and
University of Birmingham

Joana Magos Brehm, Shelagh Kell, Imke Thormann, Nigel Maxted and Ehsan Dulloo

University of Birmingham
and
Biodiversity International
INTERACTIVE TOOLKIT FOR CROP WILD RELATIVE CONSERVATION

The Toolkit

- Generation of a CWR Checklist
- Prioritizing the CWR Checklist
- Compilation of the CWR Inventory
- Genetic Data Analysis of Priority CWR
- Diversity Data Analyses of Priority CWR
- Novel Threat Assessment of Priority CWR
- Gap Analysis of Priority CWR
- Climate Change Analysis
- Establishment of In situ Conservation Goals
- Implementation of In situ Conservation Priorities
- Establishment and Implementation of Ex situ Conservation
- Monitoring CWR Diversity

NATIONAL CWR CONSERVATION PLANNING

Involves the planning for systematic in situ and ex situ conservation of CWR diversity at national level. It results in the systematic representation of the nation's CWR diversity in an in situ network of genetic reserves (within existing protected areas or by establishing novel conservation areas) with back-up ex situ collections of genetically representative population samples in national gene banks (i.e. seeds, tissue, DNA, living plants). The conservation recommendations that result from this national CWR conservation planning process can and should be used to feed the National Strategic Action Plan for the conservation and utilization of CWR.
CAPACITY BUILDING
INTERACTIVE TOOLKIT FOR CWR CONSERVATION

Resource Book for the Preparation of National Plans for Conservation of Crop Wild Relatives and Landraces

Nigel Maxted, Joanna Magos-Behn and Steilgh Kell
University of Birmingham
United Kingdom

Can use existing data to establish which global crops are cultivated in-country

NO

Expert-based approach + national and international crop production statistics + germplasm collections

Regional (multicountry) inventory of CWR available?

NO

National Flora/checklist?

YES

Extract national species from regional inventory

Harmonise taxonomy with national flora

DIGITISED LIST OF NATIONAL CROPS

DIGITISED FLORISTIC CHECKLIST

DIGITIZED MATCHING (FLORA AGAINST CROPS)

YES

Can use existing data to establish which global crops are cultivated in-country

DIGITISED LIST OF NATIONAL CROPS

Determine the target crop gene pool / taxon group concepts to be used

Harmonise taxonomy with national flora

Prioritise CWR checklist

National CWR checklist

Validation by experts

Draft national CWR checklist

Add extra information to each CWR

National CWR inventory

Make the CWR inventory available to users

Capacity building

Interactive toolkit for CWR conservation – innovation

Interactive flowcharts
NATIONAL STRATEGIC ACTION PLANS FOR CWR
CONSERVATION AND SUSTAINABLE USE
MAURITIUS, SOUTH AFRICA AND ZAMBIA
NATIONAL STRATEGIC ACTION PLANS FOR CWR CONSERVATION AND SUSTAINABLE USE

Compile baseline information on CWR diversity of CWR in the 3 countries (checklist, prioritization, ecogeographic survey)

Identify CWR hotspots and priority sites for in situ conservation and ex situ collection (diversity analysis)

Predict which CWR in situ populations and materials from ex situ collections have traits adapted to extreme climate conditions (predictive characterization)

Develop exemplar National Strategic Action Plans (NSAP) for the conservation and sustainable use of priority CWR in the 3 countries
### CWR CONSERVATION PLANNING

### Mauritius
- Global crops, endemic taxa with cultivated species.
- Human food, forestry, medicinal, ornamental crops + wild harvested plants.
- Only native.
- 527 taxa (Mauritius) (75% of flora)
- 142 taxa (Rodrigues) (96.2% of flora)

### South Africa
- Global crops, minor crops potentially important for South Africa and regionally.
- Human food (incl. beverages), fodder crops.
- 1609 taxa

### Zambia
- Global approach (global crops).
- National approach (national crops) – 59 crops’ prioritization.
- Cereal, food legumes, vegetable, root and tuber, oil, fibre, pasture and forage and green manure national (native and introduced) crops.
- Only native.
- 3671 and 464 taxa
<table>
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<th>Country</th>
<th>Criteria</th>
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<tr>
<td>Mauritius</td>
<td>Economic value (10 year average production value at national, regional, global levels)</td>
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<td>Utilization potential for crop improvement</td>
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<td>Relative distribution</td>
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<td>Occurrence status</td>
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<td>IUCN Red List categories</td>
</tr>
<tr>
<td>South Africa</td>
<td>Economic value (10 year average production value in SADC)</td>
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<td></td>
<td>Socio-economic value (average annual contribution to dietary energy per capita per day for Africa + globally important crops for food security)</td>
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<td>Utilization potential for crop improvement</td>
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<td>Relative distribution</td>
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<td>Occurrence status</td>
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<td>IUCN Red List + national categories</td>
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<td>Zambia</td>
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<td></td>
<td>Utilization potential for crop improvement</td>
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<td>Relative distribution</td>
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<td>IUCN Red List categories</td>
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</tbody>
</table>
CWR CONSERVATION PLANNING
PRIORITIZATION

PRIORITIZATION METHOD

PRIORITY CWR

PRIORITY CWR RELATED CROPS

MAURITIUS

Mauritius: coffee (Coffea), olive (Olea), fig (Ficus), Indian olive (Elaeocarpus), fonio (Digitaria), palm, (Dictyosperma, Acanthophoenix)

Rodrigues: Aloe, Asparagus, fig (Ficus), fonio (Digitaria), olive (Olea), sweet potato (Ipomoea)

13 in Mauritius
9 in Rodrigues

CWR related to food crops prioritized.
Scoring and sum of scores used to further prioritize CWR related to food crops.
Top 10 in each Mauritius and Rodrigues.

SOUTH AFRICA

Scoring and sum of scores.
Score ≥11 (out of 26) + all GP1-GP3 taxa that didn’t score ≥11

292 taxa

Cucumber/gherkin and melon (Cucumis), eggplant (Solanum), millets (Digitaria, Echinochloa, Eleusine, Panicum, Paspalum, Setaria), rooibos tea (Aspalathus), sweet potato (Ipomoea), yam (Dioscorea), etc

ZAMBIA

Scoring and sum of scores.
CWR grouped according to range of scores (high, medium, low)

32 taxa

Cowpea (Vigna), cucumber/melon (Cucumis), eggplant (Solanum), millets (Eleusine, Pennisetum), rice (Oryza), Sorghum, sweet potato (Ipomoea), yam (Dioscorea)
**Priorities CWR Mauritius**

- **6 families**
- **7 genera**
- **13 taxa**
- 13 native
- 4 endemic
  - MU
  - 6 endemic Mascarenses
- 1 EW?
- 6 CR
- 1 EN
- 1 VU

**Priority CWR Rodrigues**

- **6 families**
- **6 genera**
- **8 taxa**
- 8 native
- 1 endemic ROD
- 1 EN

**Species**

- **3 CWR of coffee**
- **2 CWR of Indian olive**
- **2 CWR of fig**
- **2 CWR of fonio**
- **2 CWR of sweet potato**
PRIORITY CWR
SOUTH AFRICA

15 families
33 genera
292 taxa
253 native
93 endemic to ZA
25 CR
26 EN
16 VU

49 CWR of sweet potato
32 CWR of millets
48 CWR of eggplant
41 CWR of rooibos tea
PRIORITY CWR
ZAMBIA

34 taxa

3% endemic to ZM (1)

23% endemic to SADC (8)

83% GP1b/GP2/TG1b/TG2/confirmed (29)

17% threatened (6)

All human food related

5 CWR of cowpea

9 CWR of cowpea

5 CWR of rice

7 CWR of cucumber/melon

5 CWR of yam
CWR CONSERVATION PLANNING

MAURITIUS

- 7 sources
- MU: 118 populations (12 priority CWR)
- ROD: 84 populations (10 priority CWR)

Species distribution analysis
Richness
Complementarity analysis
% of populations within PAs

SOUTH AFRICA

- 3 sources
- Ongoing

Systematic conservation planning
In situ gap analysis
Identification of genetic reserves that conserves both species and ecogeographic diversity and takes into consideration climate change
Ex situ gap analysis

ZAMBIA

- ??? Sources
- 590 populations (21 priority CWR)

Species distribution
Richness
Complementarity analysis
In situ gap analysis
Ex situ gap analysis
CWR DIVERSITY ANALYSIS
MAURITIUS

Coffea myrtifolia
Ficus laterifolia
Ficus densifolia
Elaeocarpus integrifolius
Pandanus utilis
Elaeocarpus bojeri
Digitaria didactyla
Digitaria ciliaris
Dictyosperma album var
Coffea mauritiana
Coffea macrocarpa
Acanthophoenix rubra

Scale 1: 594475
CWR DIVERSITY ANALYSIS
MAURITIUS

• 12 priority CWR occur within existing PAs – genetic reserves
• Need to identify additional site for 1 priority CWR (outside PAs)
CWR DIVERSITY ANALYSIS
ZAMBIA

Taxa distribution

Observed taxa richness
CWR DIVERSITY ANALYSIS
ZAMBIA

- 13 5x5 Km grids - 21 CWR

- 10 PAs - 18 CWR
- Need to identify additional sites for 3 priority CWR (outside PAs)
PREDICTIVE CHARACTERIZATION

MAURITIUS

COFFEE
- Drought tolerance
- Low caffeine content
- Resistance to pests and diseases

SOUTH AFRICA

COWPEA
- ???

ZAMBIA

RICE
- Flood tolerance
- Drought tolerance

CAPFITOGEN TOOLS (http://www.capfitogen.net)

Select populations of target CWR with target traits – pre-breeding
NATIONAL STRATEGIC ACTION PLANS FOR CWR CONSERVATION AND SUSTAINABLE USE

- Raise awareness of the value of national CWR diversity for food and economic security, particularly for adapting crops to the impacts of climate change
- Define the specific actions and resources required to effectively conserve and sustainably utilize national CWR diversity
- Provide a framework and roadmap for long-term conservation and sustainable use of CWR
- Contribute to regional and global efforts in CWR conservation and sustainable use
NATIONAL STRATEGIC ACTION PLANS FOR CWR CONSERVATION AND SUSTAINABLE USE

ELEMENTS

- National, regional and global policy framework
- National agricultural and floristic diversity
- National CWR diversity
- Utilization potential and conservation status

STRAATEGIC ACTIONS for conservation & sustainable use of CWR

CONCRETE ACTIONS for conservation & sustainable use of CWR

- Stakeholder collaboration
- Resource mobilization
- Monitoring and review

Ex situ conservation programme

Communities, public awareness
Strategic actions

- Policy interventions to enable concrete actions
- Provide the enabling conditions and necessary incentives to achieve NSAP objectives
Enabling environment

- Review existing policy
- Integrate CWR conservation into existing national, regional and global conservation and sustainable use initiatives
- Define lead agencies and stakeholder responsibilities
- Identify capacity building needs
- Develop communication strategy
- Sustainability: endorsement, financial support, stakeholder commitment
NATIONAL STRATEGIC ACTION PLANS FOR CWR CONSERVATION AND SUSTAINABLE USE

MAURITIUS

• Involvement of the Deputy Permanent Secretary from the beginning
• National stakeholders’ workshops in Mauritius and Rodrigues
• NSAP to be adopted by the Ministry of Agroindustry
• Extension of existing network of PAs (based on CWR conservation planning)
CWR DIVERSITY ANALYSIS
SADC REGION
TWO CORE LEVELS OF CONSERVATION PLANNING

Maxted et al. 2015

CWR DIVERSITY ANALYSIS IN THE SADC REGION

Develop of food and beverage CWR checklist for the SADC region

Prioritize of CWR for conservation action

Identify hotspots and priority sites for in situ conservation and ex situ collection (diversity analysis)

Develop SADC CWR conservation strategy planning and integration of NSAP from 3 countries
CWR DIVERSITY ANALYSIS IN THE SADC REGION
DEVELOPMENT OF CWR PARTIAL CHECKLIST - DATA SOURCES

- Harlan and de Wet Inventory [cwrdiversity.org – Vincent et al. 2013]
- GRIN Taxonomy for Plants [www.ars-grin.gov/cgi-bin/npgs/html/index.pl – USDA Agricultural Research Service]
- SPGRC species lists, including taxa in the base collection
- Various other online resources
The SADC region contains a wealth of CWR diversity with > 1900 spp.

Food and beverage crops with native CWR diversity in the region include rice, millet, eggplant, cucurbits (cucumber, gherkin, melon), sorghum, sugarcane, sweet potato, pulses (e.g., cowpea, pigeon pea, sword bean), sesame seed, coffee, lettuce, watermelon, okra and asparagus.

Many other crops of socio-economic importance have wild relatives in the region, including several minor food crops and species related to non-food crops (e.g., herbs, spices, environmental, industrial, ornamental, medicinal, forestry).
CWR DIVERSITY ANALYSIS IN THE SADC REGION
PRIORITIZATION OF CWR FOR REGIONAL CONSERVATION ACTION

 More than 1900 CWR species occur in the region
 Which species are the highest priorities for conservation action?
  ➢ Species related to crops important for food and economic security
  ➢ Species with greatest potential for utilization in crop improvement programmes
CWR DIVERSITY ANALYSIS IN THE SADC REGION
PRIORITIZATION OF CWR FOR REGIONAL CONSERVATION ACTION

60 food/beverage crops/crop groups reported by FAO in the SADC region

34 food/beverage crops in the SPGRC base collection

27 other cultivated food or beverage species in the SPGRC database

In total, 91 food/beverage crops/crop groups cultivated in the region

731 CWR species related to 75 of these crops/crop groups occur in the SADC region

GP1b-GP3 + CWR with potential or confirmed uses in crop improvement

115 CWR
CWR DIVERSITY ANALYSIS IN THE SADC REGION
PRIORITY CWR FOR REGIONAL CONSERVATION ACTION
CWR DIVERSITY ANALYSIS IN THE SADC REGION

Diversity analysis (complementarity, ecogeographic, combination of both)

*In situ* and *ex situ* gap analyses

Climate change analysis

Conservation recommendations
Total of 13076 georeferenced and good quality records (GEOQUAL tool, CAPFITOGEN)
CWR DIVERSITY ANALYSIS IN THE SADC REGION

Observed taxon richness [circular buffer of 50 km (CA50) around each occurrence point for all priority CWR]

Predicted taxon richness [estimated by potential distribution models (for 77 taxa) combined with CA50 (for 36 taxa)]
TO FINALIZE...
KEY OUTPUTS

• Capacity of over 50 participants from SADC Member States in *in situ* conservation and use of CWR has been strengthened.

• Templates (checklis and inventory, occurrence data collation, NSAP and technical background document) will be published.

• An interactive toolkit for conservation of CWR will be made available online.

• CWR checklists and inventories in each of the three partner countries have been developed.

• Hotspots of priority CWR sites have been identified in each country and in the SADC region for active in situ conservation and ex situ collections, based on diversity analyses.

• National Strategic Actions plans (NSAP) for CWR conservation and use in Mauritius, South Africa and Zambia will be developed and implemented.

• The foundations of a SADC Strategic Action Plan for the conservation of priority CWR will be established.
CWR conservation in the SADC region

Thank you!

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